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Annual European Union greenhouse gas inventory 1990–2010 and inventory report 2012

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Executive summary

ES.1 Background information on greenhouse gas inventories and climate change

The European Union (EU), as a party to the United Nations Framework Convention on Climate Change (UNFCCC), reports annually on greenhouse gas (GHG) inventories for the year t–2 within the area covered by its Member States (i.e. domestic emissions taking place within its territory).

The present inventory also constitutes the EU-15 submission under the Kyoto Protocol and covers information and data from Member States available until 28 March 2011. Under the Kyoto Protocol, the EU-15 took on a common commitment to reduce emissions by 8 % between 2008 and 2012 compared to emissions in the 'base year' ([1]). The EU-27 does not have a common target under the Kyoto Protocol in the same way as the EU-15.

The legal basis for compiling the EU inventory is Council Decision No 280/2004/EC concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol ([2]). The purpose of that decision is:

1. to monitor all anthropogenic GHG emissions covered by the Kyoto Protocol in the Member States;
2. to evaluate progress towards meeting GHG reduction commitments under the UNFCCC and the Kyoto Protocol;
3. to implement UNFCCC and Kyoto Protocol obligations relating to national programmes, greenhouse gas inventories, national systems and registries of the EU and its Member States, and relevant procedures under the Kyoto Protocol;
4. to ensure the timeliness, completeness, accuracy, consistency, comparability and transparency of reporting by the EU and its Member States to the UNFCCC secretariat.

The EU GHG inventory comprises the direct sum of the national inventories compiled by the EU Member States making up the EU-15 and the EU-27. Energy data from Eurostat are used for the reference approach for CO_2 emissions from fossil fuels developed by the Intergovernmental Panel on Climate Change (IPCC).

The main institutions involved in compiling the EU GHG inventory are the Member States, the European Commission Directorate-General for Climate Action (DG CLIMA), the European Environment Agency (EEA) and its European Topic Centre on Air Pollution and Climate Change Mitigation (ETC/ACM), Eurostat and the Joint Research Centre (JRC).

The process of compiling the EU GHG inventory is as follows. Member States submit their annual GHG inventories by 15 January each year to the European Commission, DG CLIMA, with a copy to the EEA. The EEA and its ETC/ACM, Eurostat and the JRC then perform initial checks on the submitted

([1]) For the EU-15, the base year for CO_2, CH_4 and N_2O is 1990; for fluorinated gases 12 Member States have selected 1995 as the base year, whereas Austria, France and Italy have chosen 1990. As the EU inventory is the sum of Member State inventories, the EU-15 base year estimates for fluorinated gas emissions are the sum of 1995 emissions for 12 Member States and 1990 emissions for Austria, France and Italy. The EU-15 base year emissions also include emissions from deforestation for the Netherlands, Portugal and the United Kingdom.

([2]) OJ L 49, 19.2.2004, p.1. Note that Council Decision No 280/2004/EC entered into force in March 2004. Therefore, the compilation of the 2004 inventory report started under the previous Council Decision 1999/296/EC.

data. The draft EU GHG inventory and inventory report are circulated to Member States for review and comments by 28 February. Member States check their national data and the information presented in the EU GHG inventory report, send updates if necessary and review the EU inventory report itself by 15 March. The EEA and its ETC/ACM prepare the final EU GHG inventory and inventory report by 15 April for submission by the European Commission to the UNFCCC Secretariat; a resubmission is prepared by 27 May, if needed.

The EU adopted the Climate and Energy Package in April 2009. The Package sets out the objective of limiting the rise in global average temperature to no more than two degrees Celsius above pre-industrial levels. To achieve this goal the EU committed to a unilateral emission reduction target of 20 % ([3]) by 2020 compared with 1990 levels, and agreed to a reduction of 30 %, provided that other major emitters agree to take on their fair share of a global reduction effort.

Both trading sectors, i.e. those operating within the EU Emissions Trading Scheme (ETS), and non-trading sectors will contribute to the 20 % objective. Minimising overall reduction costs implies that by 2020 EU ETS sectors must reduce emissions by 21 % compared to 2005 and that non-EU ETS sectors must reduce emissions by approximately 10 % compared to 2005. The non-trading sectors broadly include direct emissions from households and services, transport, waste and agriculture. The non-trading sectors currently account for about 60 % of total greenhouse gas emissions.

Information on land use, land-use change and forestry (LULUCF) activities is covered in the Kyoto Protocol under Art. 3.3 (afforestation, reforestation and deforestation) and Art. 3.4. (forest land management, cropland management, grazing land management and revegetation). Detailed information on those LULUCF activities are provided in Chapter 11 of this report.

In addition, all parties to the Kyoto Protocol must provide information on how they are implementing their greenhouse gas commitments in such a way as to minimise potential adverse social, environmental and economic impacts on developing countries. This information, required under Article 3, paragraph 14 of the Protocol, is presented in Chapter 15 of this report.

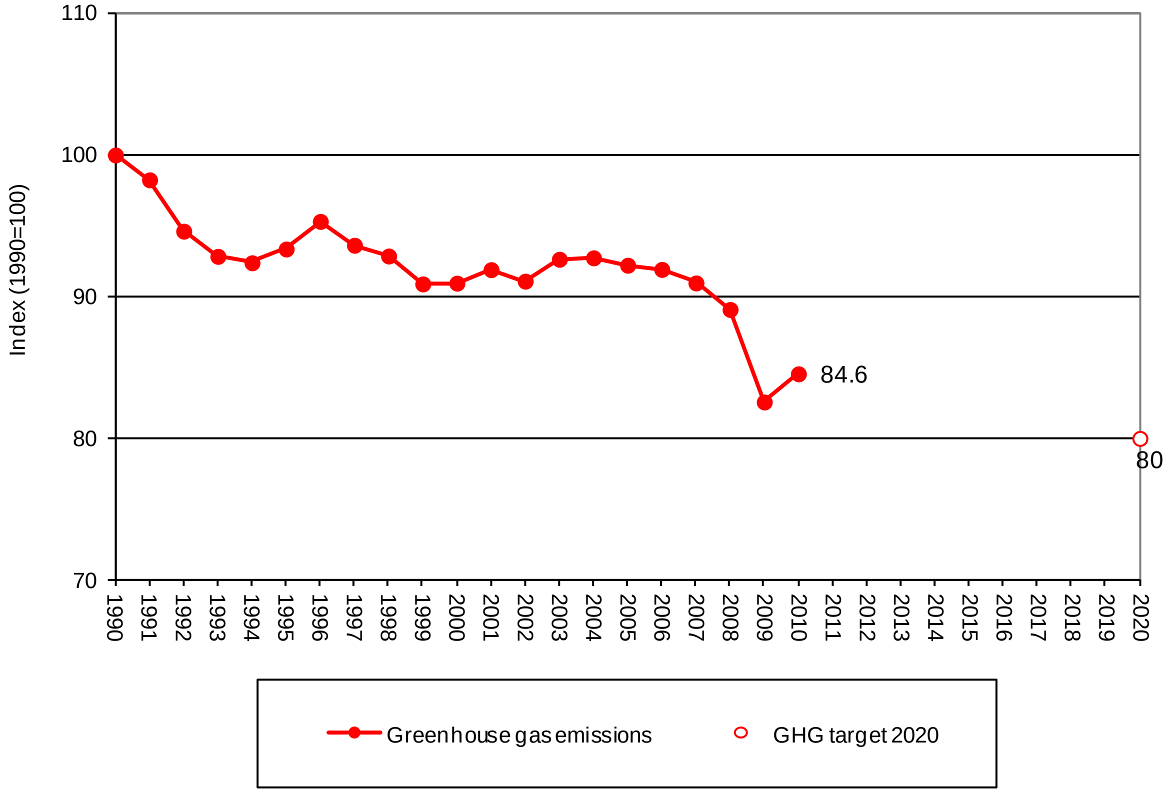
ES.2 Summary of greenhouse gas emission trends in the EU

EU-27

Total GHG emissions without LULUCF in the EU-27 decreased by 15.4 % between 1990 and 2010 (862 million tonnes CO_2-equivalents). Emissions increased by 2.4 % (111 million tonnes CO_2-equivalents) between 2009 and 2010 (Figure ES.1).

([3]) All emission information for the EU-27 in this report uses 1990 as the starting point when addressing emission reductions. The EU-27 does not have a common target under the Kyoto Protocol in the same way as the EU-15.

Figure ES.1 EU-27 GHG emissions 1990–2010 (excl. LULUCF)



Note: GHG emission data for the EU-27 as a whole refer to domestic emissions (i.e. within its territory) and do not include emissions and removals from LULUCF or emissions from international aviation and international maritime transport. CO_2 emissions from biomass with energy recovery are reported as a memorandum item according to UNFCCC guidelines and are not included in national totals. In addition, no adjustments for temperature variations or electricity trade are considered. The global warming potentials are those from the 1996 revised IPCC Guidelines for National Greenhouse Gas Inventories.

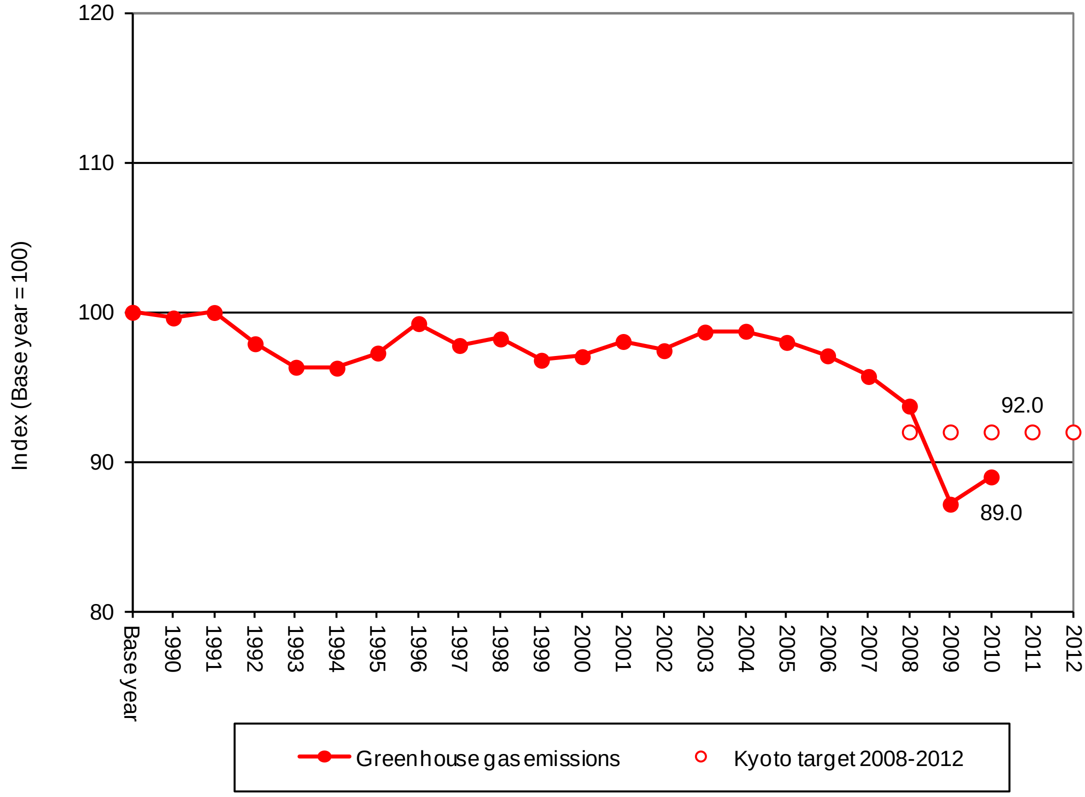
EU-15

In 2010 total GHG emissions in the EU-15 without LULUCF were 10.6 % (452 million tonnes CO_2-equivalents) below 1990, and 11.0 % (468 million tonnes CO_2-equivalents) below the EU-15 Kyoto 'base year' ([4]). Emissions increased by 2.1 % (78.5 million tonnes CO_2-equivalents) between 2009 and 2010.

Under the Kyoto Protocol, the EU agreed to reduce its GHG emissions by 8 % by 2008–12 compared to its base year. This can be achieved by a combination of existing and planned domestic policies and measures, use of carbon sinks and use of Kyoto mechanisms. Since 2009 total GHG emissions have been below the EU-15 Kyoto target (Figure ES.2).

([4]) Following the UNFCCC reviews of Member States' 'initial reports' during 2007 and 2008 and pursuant to Article 3, paragraphs 7 and 8 of the Kyoto Protocol, the base-year emissions for the EU-15 have been fixed at 4 265.5 Mt CO_2-equivalents.

Figure ES.2 EU-15 GHG emissions 1990–2010 compared with the target for 2008–12 (excluding LULUCF)



Note: GHG emissions data for the EU-15 as a whole refer to domestic emissions (i.e. within its territory) and do not include emissions and removals from LULUCF or emissions from international aviation and international maritime transport. CO_2 emissions from biomass with energy recovery are reported as a memorandum item according to UNFCCC guidelines and are not included in national totals. In addition, no adjustments for temperature variations or electricity trade are considered. The global warming potentials are those from the 1996 revised IPCC Guidelines for National Greenhouse Gas Inventories.

Following the UNFCCC reviews of Member States' 'initial reports' during 2007 and 2008 and pursuant to Article 3, Paragraphs 7 and 8 of the Kyoto Protocol, the base-year emissions for the EU-15 have been fixed at 4 265.5 Mt CO_2-equivalents. On average, EU-15 greenhouse gas emissions in the period 2008–2012 would need to be 341 Mt below that base-year figure in order to meet the 8 % Kyoto Protocol reduction target. This can be achieved by a combination of existing and planned domestic policies and measures, the use of carbon sinks and the use of Kyoto mechanisms.

Main trends by source category, 1990–2010

Table ES.1 shows the sources with the largest contribution to the change in total GHG emissions in the EU between 1990 and 2010. Over the 20-year period, EU-15 emissions decreased by 10.6 %, while EU-27 emissions decreased by 15.4 % (Table ES.3).

Table ES.1 **Overview of EU-27 and EU-15 source categories whose emissions increased or decreased by more than 20 million tonnes CO_2-equivalents in the period 1990–2010**

Source category	EU-15	EU-27
	Million tonnes (CO_2 eq.)	
Road Transportation (CO2 from 1A3b)	108.3	159.3
Consumptions of halocarbons (HFC from 2F)	70.9	82.3
Cement Production (CO2 from 2A1)		-22.2
Production of halocarbons (HFC from 2E)	-25.8	-25.8
Nitric Acid Production (N2O from 2B2)	-26.1	-36.5
Enteric fermentation (CH4 from 4A)		-41.8
Households and servicies (CO2 from 1A4)	-28.5	-77.8
Agricultural soils (N2O from 4D)	-40.1	-70.9
Iron and Steel Production (CO2 from 1A2a +2C1)	-42.9	-92.2
1B Fugitive emissions from fuels (CH4)	-49.6	-73.4
Manufacture of Solid fuels (CO2 from 1A1c)	-51.4	-53.6
Adipic Acid Production (N2O from 2B3)	-57.3	-58.3
Solid waste disposal on land (CH4 from 6A)	-59.9	-55.7
Public Electricity and Heat Production (CO2 from 1A1a)	-61.1	-208.7
Manufacturing industries (excl. Iron and steel) (Energy-related CO2 from 1A2 excl. 1A2a	-114.2	-207.9
Total	**-451.70**	**-862.3**

Note: As the table only presents sectors that have increased or decreased by more than 20 Mt CO_2-equivalents, the sum for each country grouping (EU-15 and EU-27) does not match the total change listed at the bottom of the table. CO_2 emissions from 'cement production' and CH_4 emissions from 'enteric fermentation' in the EU-15 fell by less than 20 million tones.

Main trends by source category, 2009–2010

Table ES.2 shows the sources with the largest contribution to the change in GHG emissions in the EU between 2009 and 2010. This year, EU-15 emissions increased by 2.1 %, while EU-27 emissions increased by 2.4 % (Table ES.3).

Table ES.2 **Overview of EU-27 and EU-15 source categories whose emissions increased or decreased by more than 3 million tonnes CO_2-equivalents in the period 2009–2010**

Source category	EU-15	EU-27
	Million tonnes (CO_2 eq.)	
Households and servicies (CO2 from 1A4)	32.7	43.1
Iron and Steel Production (CO2 from 1A2a +2C1)	28.0	32.9
Manufacturing industries (excl. Iron and steel) (Energy-related CO2 from 1A2 excl. 1A2a)	18.4	19.8
Public Electricity and Heat Production (CO2 from 1A1a)		14.1
Manufacture of Solid fuels (CO2 from 1A1c)	5.1	5.8
Consumptions of halocarbons (HFC from 2F)	4.4	4.4
Road Transportation (CO2 from 1A3b)	-5.2	-4.7
Adipic Acid Production (N2O from2B3)	-9.2	-9.2
Total	**78.5**	**111.0**

Note: As the table only presents sectors whose emissions have increased or decreased by at least 3 million tonnes of CO_2-equivalents, the sum for each country grouping does not match the total change listed at the bottom of the table. CO_2 emissions from 'public electricity and heat production' in EU-15 increased by less than 3 million tonnes.

Main reasons for emission changes in the EU-15, 2009–2010

The 78.5 million tonnes CO_2-equivalents increase in GHG emissions between 2009–2010 was mainly due to the following factors (Table ES.2):

- Increasing emissions in households and services (32.7 million tonnes or 5.7 %) were mainly caused by Belgium, Germany and the Netherlands. Winter temperatures in Europe in 2010 were, on average, below 2009 levels (i.e. colder).
- A substantial increase in emissions from iron and steel production (28.0 million tonnes or 24.8 %) was caused by a significant growth in crude steel production due to the recovery from the 2009 economic crisis and the strong rise in industrial output. According to the World Steel Association, crude steel production in the EU-15 declined in in all major steel producing countries in 2009 (by 30 %) and increased again in 2010 (by 25 %).
- Emissions from manufacturing industries excluding the iron and steel industry (18.4 million tonnes or 5.1 %) increased significantly, mainly in Germany and Italy.
- HFC emissions from the consumption of halocarbons (4.4 million tonnes or 6.6 %) increased, stemming from refrigeration and air conditioning. This continued the trend observed since 1990, with Finland, Italy, Spain and the United Kingdom reporting the largest increases in absolute terms.

For the EU-27, the increase in emissions in 2010 was partly driven by the economic recovery from the 2009 recession in many European countries, which had itself caused substantial emissions reductions in 2008 and 2009 in all Member States. In 2010 the winter was also colder than in the previous year, leading to increased demand for heating and higher emissions from the residential and commercial sectors.

CO_2 emissions from fossil fuel combustion increased by 2.8 % in the EU-27 in 2010. This was driven by strong growth in emissions from natural gas (7.4 % in 2010), underpinned by significantly lower gas prices, and higher emissions from solid fuels (up 4.1 %), partly offset by lower emissions from the combustion of liquid fuels (down 1.3 %). The use of nuclear power also increased in 2010. As in previous years, strong growth in the use of renewables continued in 2010, partially offsetting the increase in GHG emissions.

Emissions from iron and steel production and other manufacturing industries also increased significantly in 2010, reflecting the economic recovery and stronger growth of industrial gross valued added in many EU Member States in 2010. Indeed, the 2010 verified emissions from sectors covered by the EU Emissions Trading Scheme (EU ETS) increased overall by 2.9 %, with industrial sectors increasing by 5.1 %.

For a detailed analysis at the EU-27 level, see 'Why did greenhouse gas emissions increase in the EU in 2010? EEA analysis in brief', available from 30 May 2012 at http://www.eea.europa.eu/publications/european-union-greenhouse-gas-inventory-2012

Table ES.3 **Greenhouse gas emissions in CO_2-equivalents (excluding LULUCF) and Kyoto Protocol targets for 2008–12**

MEMBER STATE	1990 (million tonnes)	Kyoto Protocol base year [(a)] (million tonnes)	2010 (million tonnes)	2009–2010 (million tonnes)	Change 2009–2010 (%)	Change 1990-2010 (%)	Change base year–2010 (%)	Targets 2008–12 under Kyoto Protocol and "EU burden sharing" (%)
Austria	78.2	79.0	84.6	4.9	6.1%	8.2%	7.0%	-13.0%
Belgium	143.3	145.7	132.5	7.3	5.8%	-7.6%	-9.1%	-7.5%
Denmark	68.6	69.3	61.1	0.4	0.6%	-11.0%	-11.9%	-21.0%
Finland	70.4	71.0	74.6	8.4	12.8%	6.0%	5.0%	0.0%
France	559.0	563.9	522.4	7.8	1.5%	-6.6%	-7.4%	0.0%
Germany	1246.1	1232.4	936.5	24.7	2.7%	-24.8%	-24.0%	-21.0%
Greece	105.0	107.0	118.3	-6.4	-5.1%	12.6%	10.6%	25.0%
Ireland	55.2	55.6	61.3	-0.4	-0.7%	11.2%	10.3%	13.0%
Italy	519.2	516.9	501.3	9.8	2.0%	-3.5%	-3.0%	-6.5%
Luxembourg	12.8	13.2	12.1	0.56	4.9%	-5.9%	-8.3%	-28.0%
Netherlands	212.0	213.0	210.1	11.1	5.6%	-0.9%	-1.4%	-6.0%
Portugal	60.1	60.1	70.6	-3.8	-5.1%	17.5%	17.4%	27.0%
Spain	282.8	289.8	355.9	-10.4	-2.8%	25.8%	22.8%	15.0%
Sweden	72.8	72.2	66.2	6.6	11.0%	-9.0%	-8.2%	4.0%
United Kingdom	763.9	776.3	590.2	17.9	3.1%	-22.7%	-24.0%	-12.5%
EU-15	**4249.3**	**4265.5**	**3797.6**	**78.5**	**2.1%**	**-10.6%**	**-11.0%**	**-8.0%**
Bulgaria	114.3	132.6	61.4	2.5	4.3%	-46.3%	-53.7%	-8.0%
Cyprus	6.5	Not applicable	10.8	-0.3	-2.4%	67.6%	Not applicable	Not applicable
Czech Republic	195.8	194.2	139.2	4.4	3.3%	-28.9%	-28.4%	-8.0%
Estonia	40.9	42.6	20.5	4.1	25.2%	-49.8%	-51.9%	-8.0%
Hungary	97.3	115.4	67.7	0.8	1.2%	-30.4%	-41.4%	-6.0%
Latvia	26.6	25.9	12.1	1.1	10.2%	-54.5%	-53.4%	-8.0%
Lithuania	49.4	49.4	20.8	0.9	4.3%	-57.9%	-57.9%	-8.0%
Malta	2.0	Not applicable	3.0	0.02	0.6%	49.1%	Not applicable	Not applicable
Poland	457.4	563.4	400.9	19.1	5.0%	-12.4%	-28.9%	-6.0%
Romania	253.3	278.2	121.4	-2.0	-1.6%	-52.1%	-56.4%	-8.0%
Slovakia	71.8	72.1	46.0	1.8	4.1%	-35.9%	-36.2%	-8.0%
Slovenia	18.5	20.4	19.5	0.1	0.3%	5.7%	-4.1%	-8.0%
EU-27	**5583.1**	**Not applicable**	**4720.9**	**111.0**	**2.4%**	**-15.4%**	**Not applicable**	**Not applicable**

([a]) As Cyprus, Malta and the EU-27 do not have targets under the Kyoto Protocol, they do not have applicable Kyoto Protocol base years.

ES.3 Summary of emissions and removals by main greenhouse gases

EU-27

Table ES.4 gives an overview of the main trends in EU-27 GHG emissions and removals for 1990–2010. The most important GHG by far is CO_2, accounting for 82.4 % of total EU-27 emissions in 2010 excluding LULUCF. In 2010, EU-27 CO_2 emissions without LULUCF were 3 891 Tg, which was 12.0 % below 1990 levels. Compared to 2009, CO_2 emissions increased by 3.1 %. Emissions of CH_4 and N_2O decreased in 2010, while HFCs increased again in 2010.

Table ES.4 **Overview of EU-27 GHG emissions and removals from 1990 to 2010 (Tg CO_2-equivalents)**

GREENHOUSE GAS EMISSIONS	1990	1995	2000	2005	2006	2007	2008	2009	2010
Net CO_2 emissions/removals	4,126	3,839	3,810	3,946	3,926	3,897	3,779	3,423	3,572
CO_2 emissions (without LULUCF)	4,420	4,149	4,117	4,255	4,255	4,204	4,108	3,773	3,891
CH_4	595	540	486	436	429	422	417	409	405
N_2O	518	462	417	390	377	376	368	347	338
HFCs	28	42	48	63	67	73	78	80	84
PFCs	20	14	10	6	6	5	5	3	3
SF_6	11	15	10	8	7	7	7	6	7
Total (with net CO_2 emissions/removals)	**5,297**	**4,913**	**4,780**	**4,848**	**4,812**	**4,781**	**4,653**	**4,268**	**4,409**
Total (without CO2 from LULUCF)	**5,591**	**5,222**	**5,087**	**5,157**	**5,141**	**5,087**	**4,982**	**4,618**	**4,729**
Total (without LULUCF)	**5,583**	**5,213**	**5,078**	**5,149**	**5,132**	**5,079**	**4,974**	**4,610**	**4,721**

EU-15

Table ES.5 gives an overview of the main trends in EU-15 GHG emissions and removals for 1990–2010. As in the EU-27, in the EU-15 the most important GHG is CO_2, accounting for 82.9 % of total EU-15 emissions in 2010. In 2010, EU-15 CO_2 emissions without LULUCF were 3 147 Tg, which was 6.4 % below 1990 levels. Compared to 2009, CO_2 emissions increased by 2.8 %. As in the EU-27, CH_4 and N_2O emissions decreased in 2010, whereas HFC emissions increased.

Table ES.5 Overview of EU-15 GHG emissions and removals from 1990 to 2010 (Tg CO_2 equivalents)

GREENHOUSE GAS EMISSIONS	1990	1995	2000	2005	2006	2007	2008	2009	2010
Net CO_2 emissions/removals	3,191	3,100		3,302	3,261	3,227	3,137	2,859	2,964
CO_2 emissions (without LULUCF)	3,362	3,293	3,368	3,480	3,459	3,404	3,328	3,062	3,147
CH_4	437	413	373	325	319	314	311	306	304
N_2O	400	382	341	311	298	297	289	278	269
HFCs	28	41	46	57	59	62	66	69	73
PFCs	17	12	8	5	5	5	4	3	3
SF_6	11	15	10	7	7	7	6	6	6
Total (with net CO_2 emissions/removals)	**4,083**	**3,964**	**3,941**	**4,008**	**3,949**	**3,912**	**3,813**	**3,521**	**3,620**
Total (without CO2 from LULUCF)	**4,254**	**4,156**	**4,145**	**4,186**	**4,147**	**4,089**	**4,004**	**3,724**	**3,803**
Total (without LULUCF)	**4,249**	**4,149**	**4,139**	**4,180**	**4,142**	**4,083**	**3,999**	**3,719**	**3,798**

ES.4 Summary of emissions and removals by main source and sink categories

EU-27

Table ES.6 gives an overview of EU-27 GHG emissions in the main source categories for 1990–2010. The most important sector by far is energy (i.e. combustion and fugitive emissions), accounting for 79.7 % of total EU-27 emissions in 2010. The second largest sector is agriculture (9.8 %), followed by industrial processes (7.3 %).

Table ES.6 Overview of EU-27 GHG emissions in the main source and sink categories from 1990 to 2010 (Tg CO_2-equivalents)

GHG SOURCE AND SINK	1990	1995	2000	2005	2006	2007	2008	2009	2010
1. Energy	4,304	4,040	3,986	4,093	4,085	4,022	3,943	3,661	3,763
2. Industrial Processes	465	442	394	408	406	419	397	330	343
3. Solvent and Other Product Use	17	14	14	12.814	13	12	12	11	12
4. Agriculture	594	515	504	479	475	476	475	464	462
5. Land-Use, Land-Use Change and Forestry	-286	-300	-298	-300	-320	-298	-322	-342	-312
6. Waste	203	201	180	156	154	149	147	143	142
7. Other	0	0	0	0	0	0	0	0	0
Total (with net CO_2 emissions/removals)	**5,297**	**4,913**	**4,780**	**4,848**	**4,812**	**4,781**	**4,653**	**4,268**	**4,409**
Total (without LULUCF)	**5,583**	**5,213**	**5,078**	**5,149**	**5,132**	**5,079**	**4,974**	**4,610**	**4,721**

EU-15

Table ES.7 gives an overview of EU-15 GHG emissions in the main source categories for 1990–2010. More detailed trend descriptions are included in Chapters 3 to 9 of this report.

Table ES.7 **Overview of EU-15 GHG emissions in the main source and sink categories from 1990 to 2010 (Tg CO_2-equivalents)**

GHG SOURCE AND SINK	1990	1995	2000	2005	2006	2007	2008	2009	2010
1. Energy	3,278	3,205	3,258	3,348	3,324	3,264	3,198	2,969	3,042
2. Industrial Processes	353	352	311	313	306	311	296	257	265
3. Solvent and Other Product Use	13	12	12	10.483	11	10	10	9	10
4. Agriculture	434	414	414	389	384	384	383	375	374
5. Land-Use, Land-Use Change and Forestry	-166	-185	-198	-172	-193	-171	-186	-198	-178
6. Waste	171	166	145	120	118	114	112	110	108
7. Other	0	0	0	0	0	0	0	0	0
Total (with net CO_2 emissions/removals)	**4,083**	**3,964**	**3,941**	**4,008**	**3,949**	**3,912**	**3,813**	**3,521**	**3,620**
Total (without LULUCF)	**4,249**	**4,149**	**4,139**	**4,180**	**4,142**	**4,083**	**3,999**	**3,719**	**3,798**

ES.5 Summary of EU Member State emission trends

Table ES.8 gives an overview of Member State contributions to EU GHG emissions for 1990–2010. Member States show large variations in GHG emission trends.

Table ES.8 **Overview of Member State contributions to EU GHG emissions (excluding LULUCF) from 1990 to 2010 (Tg CO_2-equivalents)**

Member State	1990	1995	2000	2005	2006	2007	2008	2009	2010
Austria	78	80	80	93	90	87	87	80	85
Belgium	143	151	146	144	139	134	137	125	132
Denmark	69	76	68	64	72	67	64	61	61
Finland	70	71	69	69	80	78	70	66	75
France	559	555	565	567	552	542	537	515	522
Germany	1,246	1,117	1,039	997	999	977	976	912	937
Greece	105	110	127	136	132	135	131	125	118
Ireland	55	59	68	69	69	68	68	62	61
Italy	519	532	552	575	564	556	542	492	501
Luxembourg	13	10	10	13	13	12	12	12	12
Netherlands	212	223	213	211	207	206	205	199	210
Portugal	60	70	82	87	82	79	78	74	71
Spain	283	314	381	435	427	436	404	366	356
Sweden	73	74	69	67	67	66	64	60	66
United Kingdom	764	706	670	654	650	640	626	572	590
EU-15	**4,249**	**4,149**	**4,139**	**4,180**	**4,142**	**4,083**	**3,999**	**3,719**	**3,798**
Bulgaria	114	82	63	66	67	71	69	59	61
Cyprus	6	10	10	11	11	11	11	11	11
Czech Republic	196	150	146	146	148	149	144	135	139
Estonia	41	20	17	19	18	21	20	16	21
Hungary	97	79	77	79	78	76	73	67	68
Latvia	27	13	10	11	12	12	12	11	12
Lithuania	49	22	19	23	23	25	24	20	21
Malta	2	2	3	3	3	3	3	3	3
Poland	457	433	385	389	405	407	401	382	401
Romania	253	181	141	149	153	150	147	123	121
Slovakia	72	53	49	51	51	49	50	44	46
Slovenia	18	18	19	20	21	21	21	19	20
EU-27	**5,583**	**5,213**	**5,078**	**5,149**	**5,132**	**5,079**	**4,974**	**4,610**	**4,721**

The overall EU GHG emission trend is dominated by the two largest emitters, Germany and the United Kingdom, accounting for about one third of total EU-27 GHG emissions. These two Member States have achieved total GHG emission reductions of 483 million tonnes CO_2-equivalents compared to 1990.

The main reasons for the favourable trend in Germany were increasing efficiency in power and heating plants and the economic restructuring of the five new *Länder* after German reunification. The reduction of GHG emissions in the United Kingdom was primarily the result of liberalising energy markets and the subsequent fuel switches from oil and coal to gas in electricity production and N_2O emission reduction measures in the production of adipic acid.

France and Italy were the third and fourth largest emitters in 2010, respectively accounting for 11.1 % and 10.6 % of total EU-27 emissions. France's emissions were 6.6 % below 1990 levels in 2010. In France, large reductions were achieved in N_2O emissions from the adipic acid production, but CO_2 emissions from road transport and HFC emissions from consumption of halocarbons increased considerably between 1990 and 2010. Italy's GHG emissions were 3.5 % below 1990 levels in 2010. Emissions increased since 1990 primarily from road transport, electricity and heat production and petroleum refining but the country's total GHG emissions have decreased significantly (7.2 %) since 2008.

Poland and Spain are the fifth and sixth largest emitters in the EU-27, accounting for 8.5 % and 7.5 % of total EU-27 GHG emissions in 2010. Poland decreased GHG emissions by 12.4 % between 1990 and 2010 (and by 28.9 % since the base year, which in Poland's case is 1988). The main factors for decreasing emissions in Poland — as for other new Member States — were the decline of energy inefficient heavy industry and the overall restructuring of the economy in the late-1980s and early-1990s. The notable exception was transport (especially road transport) where emissions increased. Spain increased emissions by almost 26 % between 1990 and 2010. This was largely due to emission increases from road transport, electricity and heat production, and manufacturing industries.

ES.6 International aviation and maritime transport

Emissions of greenhouse gases from international aviation and shipping activities increased constantly between 1992 and 2007. Since 2007 emissions have decreased in the EU-27, which partly reflects the economic recession. EU greenhouse gas emissions from international aviation are lower than for international maritime transport but have been growing more rapidly until 2007. The average annual EU-27 growth rates in emissions since 1990 were 3.3 % for international aviation and 1.6 % for international maritime transport. Total GHG emissions from international transport reached 285 million tonnes CO_2-equivalents in 2010.

For detailed information on emissions from international bunkers see Section 3.7 of this report.

ES.7 Information on recalculations

The UNFCCC has permanently fixed the base-year emissions for the EU-15 (at 4 265.5 million tonnes CO_2-equivalents) based on reviews during 2007 and 2008. Recalculations of past emissions data occur every year, however, based on the inventory improvements that Member States are required to undertake for the whole time series.

Based on EU Member State GHG inventories in 2012, total EU-15 GHG emissions in 2009 were 0.1 % lower than reported in the 2011 GHG inventories. Similarly, total EU-15 emissions in 1990 reported in 2012 GHG inventories were 0.4 % lower than the 1990 emissions reported in 2011 inventories.

Table ES.9 Overview of major recalculations in the EU-15 in 1990

	Member State	1990		Main explanations
		Gg CO_2 equiv.	Percent	
1A2_Manufacturing Industries and Construction CO2	FR	1,635	2.0	1990 : report grandes installations de combustion 1992 donc prise en compte des combustibles hors bilan de l'énergie (gaz industriels notamment) 2009 : Mise à jour bilan de l'énergie
1A3_Transport CO2	FR	1,301	1.1	Mise à jour des chiffres des Comptes des Transports de la Nation (CCTN)
1A2_Manufacturing Industries and Construction CO2	UK	1,260	1.3	- Emission factors: Revision to coke emission factor due to updated GCV figures. Now reported to greater accuracy in national energy statistics - Activity data: Revisions made for some fuels from 2005 onwards in the national energy statistics. - Reallocation: Reallocations across sectors for Gas Oil. Reallocations within 1A2 to disaggregate emissions from 1A2f. More detail within the NIR.
1A1_Energy Industries CO2	UK	1,250	0.5	- Methods: A gap in reporting of OPG use in refineries has been identified and resolved. This affects 2005 onwards; also some revisions to assumptions on EU ETS data for recent years in power stations and refineries. - Emission factors: Revisions have been made to solid fuel carbon factors as GCVs are now reported to a higher level of precision. - Activity data: Offshore installation data revised following consultation with the offshore regulatory agency and site operators. Activity data revised for powerstations from 2001 for gas oil.
4D_Agricultural soils N2O	FR	-1,346	-2.4	Changement méthodo de l'estimation du N2O issu de la décomposition des résidus de cultures
1A4_Other sectors CO2	UK	-1,450	-1.3	- Revised assumptions: No domestic combustion of natural gas in Gibraltar. - Revisions to gas oil activity data based on new research. - Revisions made for some fuels in national energy statistics from 2005 onwards.
4B_Manure management CH4	FR	-1,516	-11.0	Création d'un modèle de calcul des émissions au niveau régional pour 41 catégories + Mise à jour des systèmes de gestion des déjections en batiment + Mise à jour des facteurs d'excrétion azotée
4A_Enteric fermentation CH4	FR	-1,595	-5.0	Création d'un modèle de calcul des émissions au niveau régional pour 41 catégories + Mise à jour des systèmes de gestion des déjections en batiment + Mise à jour des facteurs d'excrétion azotée
4D_Agricultural soils N2O	DE	-2,411	-4.8	Adjusted N-excretion model for 4D1.2 and 4D2; adjusted acitivity data for 4D1.4, 4D1.5, 4D3.1, 4D3.2.
6A_Solid waste disposal on land CH4	UK	-13,075	-23.3	Correction to model. Previous version included an error that over estimated DDOC landfilled.

Note: The explanations for recalculations are presented as provided by the parties in their national greenhouse gas inventory reports.

Table ES.10 Overview of major recalculations in the EU-15 in 2009

	Member State	2009 Gg CO_2 equiv.	2009 Percent	Main explanations
1A1_Energy Industries CO2	UK	4,541	2.5	- Methods: A gap in reporting of OPG use in refineries has been identified and resolved. This affects 2005 onwards; also some revisions to assumptions on EU ETS data for recent years in power stations and refineries. - Emission factors: Revisions have been made to solid fuel carbon factors as GCVs are now reported to a higher level of precision. - Activity data: Offshore installation data revised following consultation with the offshore regulatory agency and site operators. Activity data revised for powerstations from 2001 for gas oil.
2F_Consumption of halocarbons HFC	UK	3,043	28.3	The refrigeration and air conditioning model has been re built to utilise bottom up data across all categories. All parameters have been reviewed and revised.
1A4_Other sectors CO2	FR	1,844	1.9	Mise à jour activité
2C_Metal production CO2	DE	1,790	14.8	Activity data: new statistical data available
6A_Solid waste disposal on land CH4	DE	1,281	15.1	Activity data: updated statistical data
1A4_Other sectors CO2	IT	1,191	1.4	- Update of CO2 natural gas emission factor - Update of waste fuel consumption for commercial heating
4D_Agricultural soils N2O	UK	1,150	4.6	- Crop areas production and categories have been updated. The N2O-N emitted during manure management is no longer subtracted from the N available to apply to soils. - Animal numbers and categories were revised and updated. The time spent grazing for dairy and beef cattle has been changed. AWMS distribution has been updated. Crop areas
1A1_Energy Industries CO2	IT	-1,215	-0.9	- Update of CO2 emission factors for pet coke, synthesis gases and derived gases: update of CO2 natural gas emission factor - Reallocation of fuel oil and natural gas consumptions between energy production and manufacturing industries
6A_Solid waste disposal on land CH4	FR	-1,369	-8.0	- 6A1: Pour le CH4, la baisse des émissions est à imputer à une surestimation (liée à une approche simplificatrice) des émissions de la re-soumission de mai 2011 compensée en partie par une hausse des émissions due à la révision à la hausse du COD (Carbone Organique Dégradable). - 6A2: Modification du COD de 110 à 114 avant 2000 (mais ef fet de cinétique)
1A1_Energy Industries CO2	DE	-1,626	-0.5	- 1A1a, gaseous fuels, activity data: New statistical data available. - 1A1c, solid fuels, activity data: New statistical data available.
1A2_Manufacturing Industries and Construction CO2	IT	-1,782	-3.2	- Update of CO2 emission factor for residual gas from chemical processes; update of CO2 natural gas emission factor; update of CO2 emission factors for petcoke, refinery gas and derived solid gases. - Reallocation of fuel oil and natural gas consumptions between energy production and manufacturing industries
4D_Agricultural soils N2O	DE	-3,292	-7.6	Adjusted N-excretion model for 4D1.2 and 4D2; adjusted acitivity data for 4D1.4, 4D1.5, 4D3.1, 4D3.2.
1A4_Other sectors CO2	DE	-4,252	-2.9	New statistical data available.

Note: The explanations for recalculations are presented as provided by the parties in their national greenhouse gas inventory reports.

For detailed information on recalculations see Chapter 10 and the sector-specific recalculations.

ES.8 Information on indirect greenhouse gas emissions

Emissions of CO, NO_X, NMVOC and SO_2 must be reported to the UNFCCC Secretariat because they influence climate change indirectly. The first three substances are precursor substances for ground-level ozone which is itself a greenhouse gas. Sulphur dioxide emissions can contribute to forming microscopic particles (aerosols), which can reflect sunlight back out into space and also affect cloud formation.

Table ES.11 shows the total indirect GHG and SO_2 emissions in the EU-15 between 1990 and 2010. All emissions were reduced significantly from 1990 levels; the largest reduction was achieved in SO_2 (85 %), followed by CO (65 %), NMVOC (55 %) and NO_x (47 %).

Table ES.11 Overview of EU-15 indirect GHG and SO_2 emissions for 1990–2010 (Gg)

GREENHOUSE GAS EMISSIONS	1990	1995	2000	2005	2006	2007	2008	2009	2010
	(Gg)								
NOx	13,695	12,054	10,512	9,504	9,191	8,882	8,175	7,460	7,259
CO	53,271	42,107	31,816	24,029	22,710	21,735	20,569	18,191	18,745
NMVOC	15,379	12,765	10,400	8,514	8,391	7,804	7,412	7,063	6,978
SO2	16,501	9,987	6,191	4,623	4,396	4,174	3,097	2,660	2,429

In the EU-27, SO_2 emissions decreased by 78 %, followed by CO (61 %), NMVOC (53 %) and NO_X (46 %) (Table ES.12).

Table ES.12 Overview of EU-27 indirect GHG and SO_2 emissions for 1990–2010 (Gg)

GREENHOUSE GAS EMISSIONS	1990	1995	2000	2005	2006	2007	2008	2009	2010
	(Gg)								
NOx	17,173	14,769	12,723	11,663	11,354	11,042	10,226	9,382	9,285
CO	66,241	51,013	39,545	30,316	29,004	27,998	26,964	24,467	25,620
NMVOC	17,967	14,570	12,039	10,095	9,946	9,341	8,911	8,506	8,478
SO2	25,266	16,749	10,523	8,150	8,015	7,671	6,392	5,609	5,443

In addition, EU Member States annually report emissions of these substances to the United Nations Economic Commission for Europe (UNECE) Convention on Long-Range Transboundary Air Pollution (LRTAP). Emissions of NO_X, NMVOCs and SO_2 are also reported under the EU's National Emissions Ceilings Directive ([5]).

ES.9 Information on using the EU ETS for national GHG inventories in EU Member States

The present report also includes an analysis of the use of data and emissions reported under the European Union Emissions Trading System (EU ETS) for preparing national GHG inventories in the EU-15. The analysis shows that most Member States use the ETS data to improve and refine the estimation and reporting of CO_2 emissions from energy and industrial processes. All 27 Member States indicated that they used ETS data for quality assurance/quality control purposes and checked data consistency between both sources (see Sections 1.3.2 and 16.2.2).

Fourteen Member States indicated that they directly use the verified emissions reported by installations under the ETS for their national GHG inventories. Twenty-one Member States used ETS data to improve country-specific emission factors. Seventeen Member States reported that they used activity data (e.g. fuel use) provided under the ETS in the national inventory.

Using ETS data improved the quality of greenhouse gas inventory data in terms of completeness (additional emission sources can be estimated for which no data were available before the EU ETS), accuracy (e.g. due to improved country-specific emission factors), and allocation of emissions to correct common reporting format (CRF) source categories.

([5]) Directive 2001/81/EC of the European Parliament and of the Council of 23 October 2001, OJ L 309, 27.11.2001, p. 22–30.

Annexes published on CD-ROM and the EEA website only:

Annex 1: Additional information for EU-15

Annex 1.1: Key category analysis and uncertainty estimates

Annex 1.2: CRF tables

Annex 1.3: Status reports

Annex 1.4: CRF Table Summary 1A, Summary 2 and 8(a)

Annex 1.5: CRF Tables Energy

Annex 1.6: CRF Tables Industrial processes

Annex 1.7: CRF Tables Solvent use

Annex 1.8: CRF Tables Agriculture

Annex 1.9: CRF Tables LULUCF

Annex 1.10: CRF Tables Waste

Annex 1.11: CRF table 10

Annex 1.12: EU-15 MS CRF tables and National inventory reports

Annex 1.13: EU SEF tables

Annex 2: Additional information for EU-27

Annex 2.1: Key category analysis

Annex 2.2: CRF tables

Annex 2.3: Status reports

Annex 2.4: CRF Table Summary 1A, Summary 2 and 8(a)

Annex 2.5: CRF Tables Energy

Annex 2.6: CRF Tables Industrial processes

Annex 2.7: CRF Tables Solvent use

Annex 2.8: CRF Tables Agriculture

Annex 2.9: CRF Tables LULUCF

Annex 2.10: CRF Tables Waste

Annex 2.11: CRF table 10

Annex 2.12: EU-27 MS CRF tables and National inventory reports

Annex 2.13: EU SEF tables

PART 1: ANNUAL INVENTORY SUBMISSION (EU-15)

1 Introduction to the EU greenhouse gas inventory

This report is the annual submission of the European Union (EU) to the United Nations Framework Convention on Climate Change (UNFCCC). It presents the greenhouse gas (GHG) inventory of the EU, the process and the methods used for the compilation of the EU inventory as well as GHG inventory data of the individual EU Member States for 1990 to 2010. The GHG inventory data of the Member States are the basis of the EU GHG inventory. The data published in this report are also the basis of the progress evaluation report of the European Commission, required under Council Decision No 280/2004/EC concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol.

This report aims to present transparent information on the process and methods of compiling the EU GHG inventory. It addresses the relevant aspects at EU level, but does not describe detailed sectoral methodologies of the Member States' GHG inventories. Detailed information on methodologies used by the Member States is available in the national inventory reports of the Member States, which are included in Annex 1.12. Note that all Member States' submissions (common reporting format (CRF) tables and inventory reports), which are included in Annex 1.12 and made available at the European Environment Agency (EEA) website, are considered to be part of the EU submission. Several chapters in this report refer to information provided by the Member States, where additional insights can be gained. In many cases this Member State information is presented in summary overview tables.

The EU greenhouse gas inventory has been compiled under Council Decision No 280/2004/EC concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol (6). The emissions compiled in the EU GHG inventory are the sum of the respective emissions in the respective national inventories, except for the Intergovernmental Panel on Climate Change (IPCC) reference approach for CO_2 from fossil fuels. Since the data are revised and updated for all years, they replace EU data previously published, in particular, in the 2011 submission by the European Commission to the UNFCCC Secretariat of the *Annual European Community greenhouse gas inventory 1990–2009 and inventory report 2011* (EEA, 2011).

This part of the EU GHG inventory report includes data for the EU-15 Member States. The EU-15 Member States are Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and the United Kingdom. This part includes all the detailed information provided in previous reports for the EU-15.

1.1 Background information on greenhouse gas inventories and climate Change

The annual EU GHG inventory is required for two purposes.

Firstly, the EU, as the only regional economic integration organisation having joined the UNFCCC and the Kyoto Protocol as a party, has to report annually on GHG inventories within the area covered by its Member States.

(6)OJ L 49, 19.2.2004, p. 1.

Secondly, under the monitoring mechanism, the European Commission has to assess annually whether the actual and projected progress of Member States is sufficient to ensure fulfilment of the EU's commitments under the UNFCCC and the Kyoto Protocol. For this purpose, the Commission has to prepare a progress evaluation report, which has to be forwarded to the European Parliament and the Council. The annual EU inventory is the basis for the evaluation of actual progress.

The legal basis of the compilation of the EU inventory is Council Decision No 280/2004/EC concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol (7). The purpose of this decision is to: (1) monitor all anthropogenic GHG emissions covered by the Kyoto Protocol in the Member States; (2) evaluate progress towards meeting GHG reduction commitments under the UNFCCC and the Kyoto Protocol; (3) implement the UNFCCC and the Kyoto Protocol as regards national programmes, greenhouse gas inventories, national systems and registries of the EU and its Member States, and the relevant procedures under the Kyoto Protocol; (4) ensure the timeliness, completeness, accuracy, consistency, comparability and transparency of reporting by the EU and its Member States to the UNFCCC Secretariat.

Under the provisions of Article 3.1 of Council Decision No 280/2004/EC, the Member States shall determine and report to the Commission by 15 January each year (year X) inter alia:

their anthropogenic emissions of greenhouse gases listed in Annex A to the Kyoto Protocol (carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride SF_6)) during the year before last (X – 2);

provisional data on their emissions of carbon moNO_xide (CO), sulphur dioxide (SO_2), nitrogen oxides (NO_x) and volatile organic compounds (VOCs) during the year before last (year X – 2), together with final data for the year three-years previous (year X – 3);

their anthropogenic greenhouse gas emissions by sources and removals of carbon dioxide by sinks resulting from land-use, land-use change and forestry during the year before last (year X – 2);

information with regard to the accounting of emissions and removals from land-use, land-use change and forestry, in accordance with Article 3(3) and, where a Member State decides to make use of it, Article 3(4) of the Kyoto Protocol, and the relevant decisions thereunder, for the years between 1990 and the year before last (year X – 2);

any changes to the information referred to in points (1) to (4) relating to the years between 1990 and the year three-years previous (year X – 3);

the elements of the national inventory report necessary for the preparation of the EU greenhouse gas inventory report, such as information on the Member State's quality assurance/quality control plan, a general uncertainty evaluation, a general assessment of completeness, and information on recalculations performed.

The reporting requirements for the Member States under Council Decision 280/2004/EC are elaborated in the Commission Decision 2005/166/EC laying down rules implementing Decision 280/2004/EC of the European Parliament and of the Council concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol (8). According to the

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(7)OJ L 49, 19.2.2004, p. 1.
(8)OJ L 55, 1.3.2005, p. 57.

Council decision and the Commission decision the reporting requirements are exactly the same as for the UNFCCC, regarding content and format. The EU and its Member States use the '*UNFCCC guidelines on reporting and review*' (Document FCCC/CP/2002/8), and prepare inventory information in the common reporting format (CRF) and the 'national inventory report' that contains background information.

In accordance with UNFCCC guidelines, the EU and its Member States use the *IPCC Good practice guidance and uncertainty management in national greenhouse gas inventories* (IPCC, 2000), which is consistent with the *Revised 1996 IPCC guidelines for national greenhouse gas inventories* (IPCC, 1997). The use of IPCC (2000) by countries is expected to lead to higher quality inventories and more reliable estimates of the magnitude of absolute and trend uncertainties in reported GHG inventories.

1.1.1 A description of the institutional arrangements for inventory preparation

Figure 1.1 shows the inventory system of the European Union. The DG Climate Action of the European Commission is responsible for preparing the inventory of the European Union (EU) while each Member State is responsible for the preparation of its own inventory which is the basic input for the inventory of the European Union. DG Climate Action is supported in the establishment of the inventory by the following main institutions: the European Environment Agency (EEA) and its European Topic Centre on Air Pollution and Climate Change Mitigation (ETC/ACM) as well as the following other DGs of the European Commission: Eurostat, and the Joint Research Centre (JRC) (9).

(9) The Statistical Office of the European Communities (Eurostat) and the Joint Research Centre (JRC) are DGs of the European Commission. For simplicity reasons, these institutions are referred to as 'Eurostat' and the 'JRC' in this report.

Figure 1.1: **Inventory system of the European Union**

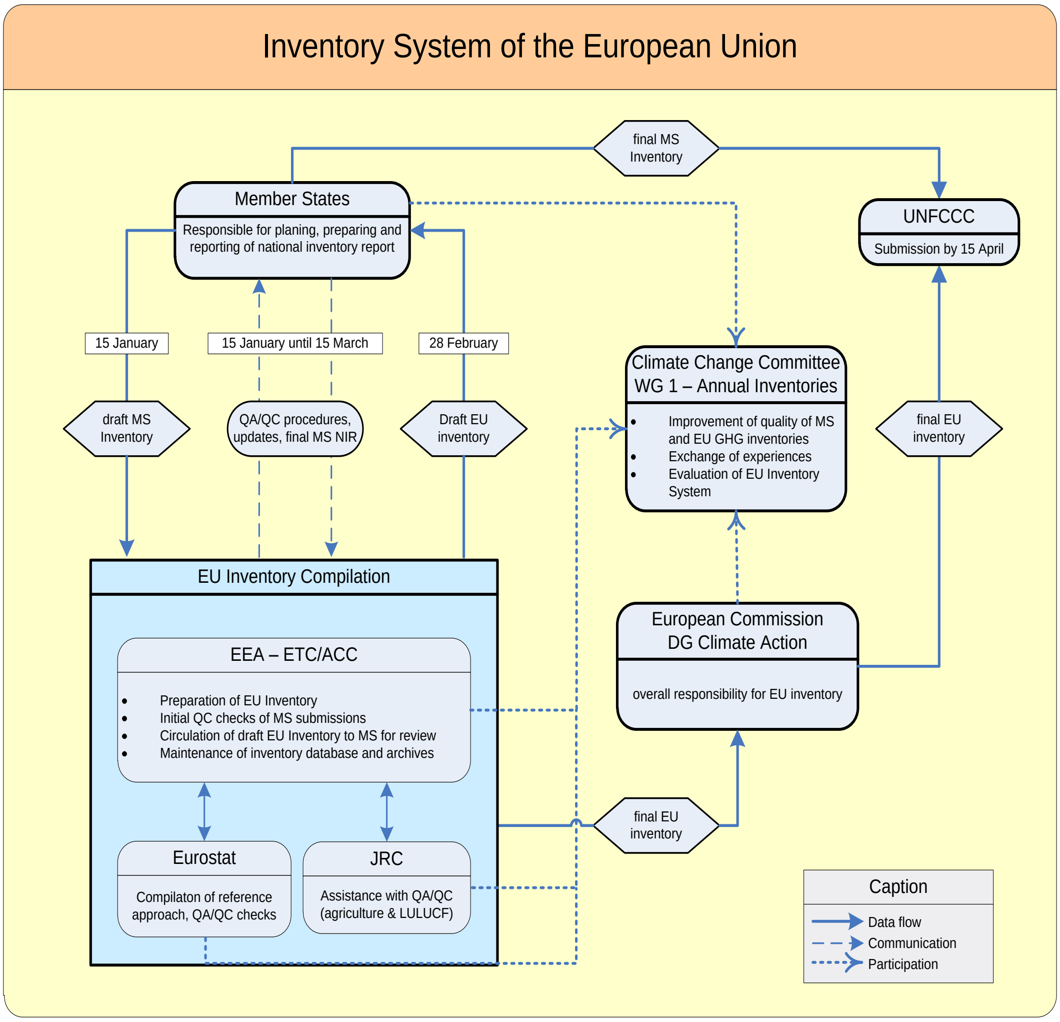

Table 1.1 shows the main institutions and persons involved in the compilation and submission of the EU-15 inventory.

Table 1.1 **List of institutions and experts responsible for the compilation of Member States' inventories and for the preparation of the EU inventory**

Member State/EU institution	Contact address
Austria	Manfred Ritter Umweltbundesamt Spittelauer Laende 5, A-1090 Vienna
Belgium	Peter Wittoeck Federal Department of the Environment Place Victor Horta 40, B-1060 Brussels
Denmark	Ole-Kenneth Nielsen Aarhus University Frederiksborgvej 399, PO Box 358, DK-4000 Roskilde
Finland	Riitta Pipatti Statistics Finland PB 6 A, FIN-00022 Statistics Finland
France	Ministère de l'Écologie, de l'Énergie,du Développement Durable et de la Mer (MEEDDM) en charge des Technologies vertes et des Négociations sur le climat Direction Générale de l'Energie et du Climat (DGEC) Arche de La Défense Paroi Nord 92055 La Défense CEDEX Frédérique Millard Centre Interprofessionel Technique d'Etudes de la Pollution Atmosphérique (CITEPA) 7 Cité Paradis, F-75010 Paris

Member State/EU institution	Contact address
	Jean-Pierre Fontelle
Germany	Michael Strogies Federal Environmental Agency Wörlitzer Platz 1, D-06844 Dessau-Roßlau
Greece	Ms Irini Nikolaou, Ministry of Environment, Energy and Climate Change Villa Kazouli, Kifisias 241 Athens, Greece
Ireland	Paul Duffy Environmental Protection Agency Richview, Clonskeagh Road, Dublin 14, Ireland
Italy	M. Contaldi, R. de Lauretis, D. Romano National Environment Protection Agency (ANPA) Via Vitaliano Brancati 48, I-00144 Rome
Luxembourg	Eric De Brabanter Département de l'Environnement Ministère du Développement durable et des Infrastructures L-2918 Luxembourg Dr Marc Schuman Administration de l'Environnement 16 rue Eugène Ruppert L-2453 Luxembourg
Netherlands	Wim van der Maas National Institute for Public Health and the Environment P.O. Box 1, 3720 BA Bilthoven, The Netherlands
Portugal	Teresa Costa Pereira Agência Portuguesa do Ambiente Rua da Murgueira — Bairro do Zambujal, P-2721-865 Amadora
Spain	Maj Britt Larka Abellán Dirección General de Calidad y Evaluación Ambiental y Medio Natural Ministerio de Agricultura, Alimentación y Medio Ambiente Plaza de San Juan de la Cruz s/n, E-28071 Madrid
Sweden	Ms. Agnes von Gersdorff Ministry of Environment Tegelbacken 2 S-103 33 Stockholm Sweden Mrs. Maria Lidén The Swedish Environmental Protection Agency S-106 48 Stockholm Sweden
United Kingdom	Joanna MacCarthy, Helen Champion Department of Energy and Climate Change 3 Whitehall Place, London SW1A 2AW, UK
European Commission	Velina Pendolovska European Commission, DG Climate Action Beaulieu, BU-5 2/119, Brussels, Belgium
European Environment Agency (EEA)	Ricardo Fernandez European Environment Agency Kongens Nytorv 6, DK-1050 Copenhagen, Denmark
European Topic Centre on Air Pollution and Climate Change Mitigation (ETC/ACM)	Nicole Mandl, Michael Gager, Manfred Ritter European Topic Centre on Air Pollution and Climate Change Mitigation Umweltbundesamt Spittelauer Laende 5, A-1090 Vienna, Austria
Eurostat	Michael Goll Statistical Office of the European Communities (Eurostat), Jean Monnet Building, L-2920 Luxembourg, Luxembourg
Joint Research Centre (JRC)	Giacomo Grassi, Adrian Leip Joint Research Centre, Institute for Environment and Sustainability, Climate Change Unit Via Enrico Fermi, I-21020 Ispra (VA), Italy

1.1.2 The Member States

All EU-15 Member States are Annex I parties to the UNFCCC. Therefore, all EU-15 Member States have committed themselves to prepare individual GHG inventories in accordance with UNFCCC reporting guidelines and to submit those inventories to the UNFCCC secretariat by 15 April. In addition, all EU Member States are required to report individual GHG inventories prepared in accordance with UNFCCC reporting guidelines to the Commission by 15 January every year under Council Decision 280/2004/EC.

The European Union's inventory is based on the inventories supplied by Member States. The total estimate of the EU greenhouse gas emissions should accurately reflect the sum of Member States' national greenhouse gas inventories. Member States are responsible for choosing activity data, emission factors and other parameters used for their national inventories as well as the correct application of methodologies provided in the IPCC 1996 Guidelines, IPCC Good Practice Guidance and IPCC Good Practice Guidance for LULUCF. Member States are also responsible for establishing quality assurance/quality control (QA/QC) programmes for their inventories. The QA/QC activities of each Member State are described in the respective national inventory reports and summarised in the European Union inventory report.

Apart from submitting their national GHG inventories and inventory reports the Member States take part in the review and comment phase of the draft EU inventory report, which is sent to the Member States by 28 February each year. The purpose of circulating the draft EU inventory report is to improve the quality of the EU inventory. The Member States check their national data and information used in the EU inventory report and send updates, if necessary. In addition, they comment on the general aspects of the EU inventory report.

The Member States also take part in the Climate Change Committee established under Council Decision No 280/2004/EC. The purpose of the Climate Change Committee is to assist the European Commission in its tasks under Council Decision No 280/2004/EC.

Under Council Decision 280/2004/EC all Member States are required to establish national systems. Table 1.2 summarises the information on national systems/institutional arrangements in the EU-15 Member States.

Table 1.2 Summaries of institutional arrangements/national systems of EU-15 Member States

MS	Institutional arrangements/national systems	Source
Austria	Austria has a centralized inventory system, with all the work related to inventory preparation being carried out at a single national entity. The most important legal arrangement is the Austrian Environmental Control Act (Umweltkontrollgesetz), which defines the main responsibility for inventory preparation and identifies the Umweltbundesamt as the single national entity with the overall responsibility for inventory preparation. Within the Umweltbundesamt the "Inspection Body for Emission Inventories" is responsible for the compilation of the greenhouse gas inventory. Within the inventory system specific responsibilities for the different emission source/sink categories ("sector experts") are defined. Sector experts collect activity data, emission factors and all relevant information needed for finally estimating emissions. The sector experts are also responsible for the choice of methods, data processing and archiving and for contracting studies, if needed. As part of the quality management system, the head of the "Inspection body for GHG inventory"approves the methodological choices. Finally, sector experts perform Quality Assurance and Quality Control (QA/QC) activities. The Austrian Inventory is based on the SNAP nomenclature and has to be transformed into the UNFCCC CRF to comply with the reporting obligations under the UNFCCC. In addition to the actual emission data, the background tables of the CRF are filled in by the sector experts, and finally QA/QC procedures as defined in the inventory planning process are carried out before the data are submitted to the UNFCCC. As part of the QMS" s documentation and archiving procedures a reliable data management system has been established to fulfil the data collecting and reporting requirements. This ensures the necessary documentation and archiving for future reconstruction of the inventory and con-sequently enables easy access to up-to-date and previously submitted data for the quantitative evaluation of recalculations. As part of the QMS (Corrective and Preventive Actions) an efficient process is established to grant transparency when collecting and analyzing findings by UNFCCC review experts or any other issues concerning the quality of activity data, emission factors, methods and other relevant technical elements of inventories. Any findings and discrepancies are documented; responsibilities, resources and a time schedule are attributed to each of these in the improvement plan. Measures, which include possible recalculations, are taken by the sector experts. The national energy balance is the most important data basis for the Austrian Air Emissions Inventory. The Austrian statistical office (Statistik Austria) is required by contract with the Federal Ministry of Agriculture, Forestry, Environment and Water Management and with the Federal Ministry of Economics and Labour to annually prepare the national energy balance. The compilation of several other relevant statistics is regulated by law. Other data sources include reporting obligations under national and European regulations and reports of companies and associations. The main data sources used for activity data were: • Energy Balance from Statistik Austria; EU-ETS; Steam boiler database (for the sector Energy) • Energy Balance from Statistik Austria (for the sector Transport) • National production statistics, import/export statistics; EU-ETS; direct information from industry or associations of industry (for the sector Industry) • Short term statistics for trade and services, Austrian foreign trade statistics, structural business statistics, surveys at companies and associations (for the sector Solvents) • National Studies, national agricultural statistics obtained from Statistik Austria (for the sector Agriculture) • National forest inventory obtained from the Austrian Federal Office and Research Centre for Forests (for the sector LULUCF) • National agricultural statistics and land use statistics obtained from Statistik Austria • Database on landfills (1998-2007) + Electronic Data Management (from 2008-2010). The main sources for emission factors are: (1) national studies for country specific emission factors, (2) plant-specific data reported by plant operators (3) IPCC GPG (4) Revised IPCC 1996 Guidelines (5) EMEP/EEA air pollutant emission inventory guidebook .	Austria's Annual Greenhouse Gas Inventory 1990–2010 Mar 2012 pp 24ff

MS	Institutional arrangements/national systems	Source
Belgium	In the Belgian federal context, major responsibilities related to environment lie with the regions. Compiling greenhouse gas emissions inventories is one of these responsibilities. Each region implements the necessary means to establish their own emission inventory in accordance with the IPCC guidelines. The emission inventories of the three regions are subsequently combined to compile the national greenhouse gas emission inventory. Since 1980, the three regions have been developing different methodologies (depending on various external factors) for compiling their atmospheric emission inventories. During the last years important efforts are made to tune these different methodologies, especially for the most important (key) sectors. Obviously, this requires some co-ordination to ensure the consistency of the data and the establishment of the national inventory. This co-ordination is one of the permanent tasks of the Working Group on « Emissions » of the Coordination Committee for International Environmental Policy (CCIEP), where the different actors decide how the regional data will be aggregated to a national total, taking into account the specific characteristics and interests of each region as well as the available means. This working group consists of representatives of the 3 regions and of the federal public services. The Interregional Environment Unit (CELINE - IRCEL) is responsible for integrating the emission data from the inventories of the three regions and for compiling the national inventory. The National inventory report is than formally submitted to the National Climate Commission, established by the Cooperation agreement of 14 November 2002, for approval, before its submission to the secretariat of the United Nations Framework Convention on Climate Change and to the European Commission, under the Council Decision 280/2004/EC concerning a Mechanism for Monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol.	Belgium's GHG Inventory (1990 – 2009) National Inventory Report Jan 2011 p 2 No major change since 2010 submission
Denmark	On behalf of the Ministry of the Environment and the Ministry of Climate,Energy and Building the Danish Centre for Environment and Energy (DCE)is responsible for the calculation and reporting of the Danish national emission inventory to the EU, the UNFCCC (United Nations Framework Convention on Climate Change) and UNECE CLRTAP (Convention on Long-Range Transboundary Air Pollution). Hence, the Danish Centre for Environment and Energy (DCE), Aarhus University, prepares and publishes the annual submission for Denmark to the EU and UNFCCC of the National Inventory Report and the GHG inventories in the Common Reporting Format, in accordance with the UNFCCC guidelines. Furthermore, DCE is responsible for reporting the national inventory for the Kingdom of Denmark to the UNFCCC. DCE is also the body designated with overall responsibility for the national inventory under the Kyoto Protocol for Greenland and Denmark. The work concerning the annual greenhouse gas emission inventory is carried out in cooperation with Danish ministries, research institutes, organisations and companies. The Government of Greenland is responsible for finalising and transferring the inventory for Greenland to DCE. The Faroe Islands Environmental Agency is responsible for finalising and transferring the inventory for the Faroe Islands to DCE. There are now data agreements in place with both Greenland and the Faroe Islands ensuring the data delivery. These agreements contain deadlines for when DCE is to receive the data and documentation. DCE has been and is engaged in work in connection to the meetings of the Conference of Parties (COP) to the UNFCCC and the meetings of the parties (COP/MOP) to the Kyoto protocol and its subsidiary bodies, where the reporting rules are negotiated and settled. Furthermore, DCE participates in the EU Monitoring Mechanism, Working Group 1 (WG1), where the guidelines, methodologies etc. on inventories to be prepared by the EU Member States are regulated.	Denmark's National Inventory Report 2012: Emission Inventories 1990-2010 Mar 2012 p 36f

MS	Institutional arrangements/national systems	Source
Finland	In accordance with the Government resolution of 30 January 2003 on the organisation of climate policy activities of Government authorities in Finland, Statistics Finland assumed the responsibilities of the National Entity for Finland´s greenhouse gas inventory from the beginning of 2005. Statistics Finland as the general authority of the official statistics of Finland is independently responsible for greenhouse gas inventory submissions under the UNFCCC, the Kyoto Protocol and the EU monitoring mechanism. Besides Statistics Finland, the Finnish Environment Institute, MTT Agrifood Research Finland and the Finnish Forest Research Institute take part in the inventory preparation. Statistics Finland acquires also parts of the inventory calculations as purchased services from VTT (Technical Research Centre of Finland) and Finavia. In Finland the national system, as intended in the Kyoto Protocol (Article 5.1), is based, besides regulations concerning Statistics Finland, on agreements on the production of emission/removal estimations and reports between the inventory unit at Statistics Finland and the expert organisations mentioned above. Statistics Finland has also agreements with the responsible ministries defining the responsibilities and collaboration in relation to the reporting requirements under the UNFCCC and Kyoto Protocol, as well as the EU monitoring mechanism. In Finland the National System is established on a permanent footing and it guides the development of emission calculation in the manner required by the agreements. The National System is designed and operated to ensure the transparency, consistency, comparability, completeness, accuracy and timeliness of greenhouse gas emission inventories. The quality requirements are fulfilled by implementing consistently the inventory quality management procedures. A detailed description of the National Greenhouse Gas Inventory System in Finland can be found from the report "National Greenhouse Gas Inventory System in Finland" which is available on the web: http://stat.fi/greenhousegases. The following changes in Finland‟ s national system have been implemented during 2010: Finavia did not renew the contract for the estimation of the emissions from aviation. The intention was that Eurocontrol would take over this task. Negotiations with Eurocontrol had been initiated earlier, but the general assembly of the Eurocontrol gave its acceptance for the provision on the data for inventory purposes only late in 2010. Eurocontrol will start developing a portal, from which its member states could retrieve the information needed to estimate the emissions for the national GHG. Finland will participate in this development work. However, the project has progressed very slowly and implementation of the portal will take place at the earliest in 2012. Finavia has agreed to provide Statistics Finland with the necessary data and support for the inventory calculations until the agreement with Eurocontrol is implemented. Finavia currently responsible for the negotiations on this issue with Eurocontrol, and will also take part in the development of the portal mentioned above. Finavia will also provide further technical assistance in this issue, depending on the details of the future agreement with Eurocontrol. For 2009 the emissions from aviation were estimated based on data provided by Finavia and calculations made by Statistics Finland. The agreement between Statistics Finland and the Energy Market Authority has been updated in 2010. The new agreement defines in more detail the collaboration as well as contents and timelines for data/other information exchange between the organisations in the reporting of the data to UNFCCC secretariat. The new agreement gives Statistics Finland also access to the more detailed data collected by the Energy Market authority.	GHG Emissions in Finland 1990-2010 Draft Jan 2012, p 20 ff.

<table>
<tr><th>MS</th><th>Institutional arrangements/national systems</th><th>Source</th></tr>
<tr><td>France</td><td>The responsibility of the definition and control of the National Air Pollutant Emissions Inventory System (Système National d'Inventaire des Emissions de Polluants dans l'Atmosphère (SNIEPA)) is pertained by the Ministère de l'Ecologie, du Développement durable, des Transports et du Logement (MEDDTL).

The MEDDTL is in charge of overseeing production of the inventories and overall coordination of the system.

Other ministries and public bodies contribute to the emission inventories by providing data and statistics used in the preparation of the inventories.

The MEDDTL has entrusted CITEPA (Interprofessional Technical Centre for Studies on Air Pollution or Centre Interprofessionnel Technique d'Etudes de la Pollution Atmosphérique) with the following tasks: preparing the emission inventories with regard to methods and preparing their updating, data collection and processing, data storage, production of the reports and various means of disseminating the information, control and quality management. CITEPA assists the MEDDTL in overall coordination of the National Air Pollutant Emissions Inventory System. Mention should be specifically made of the coordination that must be ensured between the emission inventories and emitter registers such as the E-PRTR and the greenhouse gas emission allowance register in the frame of the ETS directive, not forgetting other aspects (guides published by the MEDDTL, the annual pollutant emission reporting system, etc.).

The MEDDTL provides CITEPA with all information it has at its disposal under existing legislation and regulations, such as the annual notifications made by Classified Installations under the pollutant emission reporting system, as well as the results of different studies providing greater knowledge on emissions that it commissioned either internally (ie within its departments) or from other bodies, such as the National Institute for Industry, Environment and Risks (INERIS).

The MEEDDM steers the Emissions Inventories Consultation and Information Group (GCIIE) whose tasks are to:
• give its opinion on the results of estimates produced in the inventories,
• give its opinion on the changes made to the methodology for estimating emissions,
• give its opinion on the action plan for improving inventories for the future, issue recommendations on all subjects directly or indirectly linked to emission inventories in order to ensure consistency and smooth running of actions, and encourage synergies, etc.,
• recommend actions for improving the estimation of emissions in the context of research programmes.

The GCIIE is made up of representatives:
• of the Ministry of Ecology, Energy, Sustainable Development and Sea (MEDDTL), and specifically the General Directorate for Energy and Climate (DGEC), General Directorate for Spatial Planning, Housing and Nature (DGALN), the General Directorate for Infrastructure, Transport and Maritime Affairs (DGITM), and the General Directorate for Civil Aviation (DGAC)
• of the Ministère de l'agriculture, de l'alimentation, de la pêche, de la ruralité et de l'aménagement du territoire (MAPRAT), particularly the Statistics and Forward Studies Department (SSP) and the General Directorate for Agricultural, Agri-food and Land Policies (DGPAAT), the Ministère de l'Economie, des Finances et de l'Industrie (MINEFI), and specifically the General Directorate of the National Institute of Statistics and Economic Studies (INSEE), the General Directorate of the Treasury and Economic Policy (DGTPE) and the General Directorate of Companies (DGE),
• of the General Sustainable Development Commission (CGDD), particularly the Observation and Statistics Department.</td><td>direct communication, March 2010

Some changes in the national system with compared to 2010 submissions regarding names of Ministries</td></tr>
</table>

MS	Institutional arrangements/national systems	Source
Germany	The national Inventory System in Germany fulfils the requirements of the Guidelines for National Systems (Decision 19/CMP.1), which are also binding under the European Decision 280/2004/. The use of the IPCC-Guidelines and IPCC Good. Practice Guidance and a continuous Quality Management and continuous improvement of the inventory ensure a transparent, consistent, comparable, complete and accurate inventory. In an agreement of state secretaries representing the ministries involved in emission reporting (June 2007) the Federal Environment Agency (Umweltbundesamt) wasappointed as the National Coordination Agency for emission inventory reporting, acting as the Single National Entity.The Agreement by State Secretaries on the National System entails: • Definition of responsibilities relative to the relevant sources and sink categories among the departments • Determination of the Federal Environment Agency as the Single National Enity • Implementation of a National Co-ordinating Committee of the departments • Determination of resources for inventories and reporting Other involved institutions and agencies: • Federal Ministry of the Environment, Nature Conservation and Nuclear Safety (BMU) • Federal Ministry for Consumer Protection, Food and Agriculture (BMELV) and the Heinrich von Thünen Institut • Federal Ministry of of the Interior (BMI) together with the Federal Statistical Office • Federal Ministry of Defence (BMVg) • Federal Ministry of Finance (BMF) • Federal Ministry of Economis and Technology (BMWi) • Federal Ministry of Transport, Building and Urban Affairs (BMVBS) • Working Group on Engery Balances Tasks of the National Coordination Agency (Umweltbundesamt) are: • Serving as the central Focal Point for all inventory and reporting Issues • Assure and coordinate information and data flow • Planning of the inventories • Compilation of the inventories • Archiving of the inventories • Quality control and Quality Assurance To establish and assure data stream the National Coordination Agency has conclude agreements with other state and non-state institutions, like the economy, institutions of the federal state and other federal institutions To meet these tasks the National Coordination Agency has developed a database “Zentrale System Emissionen” (which is the main instrument for documentation and quality assurance on the level of data) and the Quality system “Emissionsinventare” (which regulates responsibilities and quality targets). The National Coordination Agency within UBA cooperates with other units within UBA. Forcoordination of the tasks within UBA a working team “Arbeitskreis Emissionsinventare” was installed. Research centres contribute to inventory compilation with research projects that are carried out within the Framework, inter alia, of the research programme “Umweltforschungsplan”.	Nationaler Inventarbericht Zum Deutschen Treibhausgasinventar 1990 - 2010 Mar 2012 pp 65 ff. (submitted in German, translation provided by Germany via direct communication)

MS	Institutional arrangements/national systems	Source
Greece	The Ministry of Environment, Energy and Climate Change, MEECC (former Ministry for the Environment, Physical Planning and Public Works) is the governmental body responsible for the development and implementation of environmental policy in Greece, as well as for the provision of information concerning the state of the environment in Greece in compliance with relevant requirements defined in international conventions, protocols and agreements. Moreover, the MEECC is responsible for the co-ordination of all involved ministries, as well as any relevant public or private organization, in relation to the implementation of the provisions of the Kyoto Protocol, according to the Law 3017/2002 with which Greece ratified the Kyoto Protocol. In this context, the MEECC has the overall responsibility for the national GHG inventory, and the official consideration and approval of the inventory prior to its submission. The entities participating in the organizational structure of the National Inventory System are: The MEECC designated as the national entity responsible for the national inventory, which keeps the overall responsibility, but also plays a more active role in the inventory planning, preparation and management. The National Technical University of Athens (NTUA) / School of Chemical Engineering, which has the technical and scientific responsibility for the compilation of the annual inventory. Governmental agencies and ministries, international associations, along with individual private industrial companies. The MEECC, as the national entity, has the overall responsibility for the national GHG inventory. Among its responsibilities are the following: • The co-ordination of all ministries and governmental agencies involved, as well as any relevant public or private organization. In this context, it oversees the operation of the National System and decides on the necessary arrangements to ensure compliance with relevant decisions of the COP and the COP/MOP. • The official consideration and approval of the inventory prior to its submission. • The response to any issues raised by the inventory review process under Article 8 of the Kyoto Protocol, in co-operation with the technical consultant (NTUA Inventory Team), who has the technical and scientific responsibility for the inventory planning, preparation and management of all sectors, as mentioned above. • The timely submission of the GHG inventory to the European Commission and to the UNFCCC Secretariat • The keeping of the Centralised Inventory File, which is delivered to the institute which has the technical responsibility for the inventory planning, preparation and management (currently NTUA) at the beginning of each inventory cycle. The Centralised Inventory File is kept at the premises of MEECC. • The administration of the National Registry. • The supervision of Quality Assurance/Quality Control Plan (QA/QC). As it appears from the above description, the role of the MEECC is not narrowed to the coordination of the entities involved in the inventory process and to facilitate the activity data transfer from the data providers to the NTUA's Inventory Team. MEECC has an active role in monitoring and overseeing the inventory process through continuous communication and frequent scheduled and / or ad-hoc meetings with the Inventory Team of NTUA and the competent ministries or other agencies involved.	Greece – Climate change emission inventory Information under Article 3(1) of the Decision 280/2004/EC, Jan 2011, pp 3-6

MS	Institutional arrangements/national systems	Source
Ireland	In 2005, UK consultants NETCEN carried out a scoping study to identify the essential elements and structure of a national inventory system for Ireland to meet the needs of Decision 280/2004/EC and to comply with obligations under Articles 5 and 7 of the Kyoto Protocol. The establishment of Ireland's national inventory system was completed by Government Decision in early 2007, building on the framework that has been applied for many years. It puts in place formal procedures for the planning, preparation and management of the national atmospheric inventory and identifies the roles and responsibilities of all the organisations involved in its compilation. All formal mechanisms together with the QA/QC procedures are fully operational in this present reporting cycle. The EPA Office of Climate, Licensing and Resource Use (OCLR) is the inventory agency and the EPA is also designated as the single national entity with overall responsibility for the annual greenhouse gas inventory. The national system is also exploited for the purpose of inventory preparation and reporting under the LRTAP Convention ensuring efficiency and consistency in the compilation of emission inventories for a wide range of substances using common datasets and inputs. As a formal management system, the national system aims for continuous improvement to increase the quality and robustness of the national atmospheric inventory over time. In addition to the primary data received from the key data providers, the inventory team obtains considerable supplementary information from other teams in OCLR and the Office of Environmental Enforcement within the EPA. These sources include Annual Environmental Reports (AER) submitted by licensed companies and the National Waste Database. The inventory team also draws on national research related to greenhouse gas emissions and special studies undertaken from time to time to acquire the information needed to improve the estimates for particular categories and gases. The approval of the completed annual inventory involves sign-off by the QA/QC manager and the inventory manager before it is transmitted to the Board of the EPA via the Programme Manager of the Climate Change Unit in OCLR. Any issues arising from the Board's examination of the estimates are communicated to the inventory experts for resolution before final adoption of the inventory. The results are released at national level in advance of their official submission to the European Commission in accordance with Decision 280/2004/EC in January of the reporting year and subsequently to the UNFCCC secretariat. For the 2008/2009 reporting cycle, the inventory agency was able to comply with a request from Government to produce preliminary greenhouse gas emissions estimates for 2007 by mid October 2008.	Ireland National Inventory Report 2009,GHG emissions 1990-2007 reported to the UNFCCC Mar 2009 pp 6-7

MS	Institutional arrangements/national systems	Source
Italy	A Legislative Decree, issued on 7th March 2008, institutes the National System for the Italian Greenhouse Gas Inventory. The Institut of Environmental Protectioen and Research (ISPRA), former Agency for Environmental Protection and Technical Services (APAT) is the single entity in charge of the development and compilation of the national greenhouse gas emission inventory. The Ministry for the Environment, Land and Sea is responsible for the endorsement of the inventory and for the communication to the Secretariat of the Framework Convention on Climate Change and the Kyoto Protocol. The inventory is also submitted to the European Commission in the framework of the Greenhouse Gas Monitoring Mechanism. The Institute annually develops a national system document which includes all updated information on institutional, legal and procedural arrangements for estimating emissions and removals of greenhouse gases and for reporting and archiving inventory information. The last year report is publicly available at: http://www.apat.gov.it/site/_files/NationalSystemItaly08.pdf. A specific unit of the Agency is responsible for the compilation of the Italian Atmospheric Emission Inventory and the Italian Greenhouse Gas Inventory in the framework of both the Convention on Climate Change and the Convention on Long Range Transboundary Air Pollution. The whole inventory is compiled by the agency; scientific and technical institutions and consultants may help in improving information both on activity data and emission factors of some specific activities. All the measures to guarantee and improve the transparency, consistency, comparability, accuracy and completeness of the inventory are undertaken. ISPRA bears the responsibility for the general administration of the inventory, co-ordinates participation in reviews, publishes and archives the inventory results. Specifically, ISPRA is responsible for all aspects of national inventory preparation, reporting and quality management. Activities include the collection and processing of data from different data sources, the selection of appropriate emissions factors and estimation methods consistent with the IPCC 1996 Revised Guidelines, the IPCC Good Practice Guidance and Uncertainty management and the IPCC Good Practice Guidance for land use, land- use change and forestry, the compilation of the inventory following the QA/QC procedures, the assessment of uncertainty, the preparation of the National Inventory Report and the reporting through the Common Reporting Format, the response to the review process, the updating and data storage. Different institutions are responsible for statistical basic data and data publication, which are primary to ISPRA for carrying out emission estimates. These institutions are part of the National Statistical System (Sistan), which provides national official statistics, and therefore are asked periodically to update statistics; moreover, the National Statistical System ensures the homogeneity of the methods used for official statistics data through a coordination plan, involving the entire public administration at central, regional and local levels. The National Statistical System is coordinated by the Italian National Institute of Statistics (ISTAT). Ministries, public agencies and other bodies are obliged to provide the data and information specified in the annual statistical plan; the same obligations regard the private entities. All the data are protected by the principles of statistical disclosure control and can be distributed and communicated only at aggregate level. The main Sistan products, which are primarily necessary for the inventory compilation, are: • National Statistical Yearbooks, Monthly Statistical Bulletins, by ISTAT (National Institute of Statistics) • Annual Report on the Energy and Environment, by ENEA (Agency for New Technologies, Energy and the Environment) • National Energy Balance (annual), Petrochemical Bulletin (quarterly publication), by MSE (Ministry of Economic Development) • Transport Statistics Yearbooks, by MINT (Ministry of Transportation) • Annual Statistics on Electrical Energy in Italy, by TERNA (National Independent System Operator) • Annual Report on Waste, by ISPRA • National Forestry Inventory, by MIPAAF (Ministry of Agriculture, Food and Forest Policies). • The national emission inventory itself is a Sistan product.	Italian Greenhouse Gas Inventory 1990-2007 National Inventory Report 2009, Apr 2009, pp 20-23

MS	Institutional arrangements/national systems	Source
Luxembourg	A Grand-Ducal Regulation designates a Single National Entity, the National Inventory Compiler and the National GHG Inventory Focal Point. It also defines and allocates specific responsibilities for the realization of the GHG Inventories both within the Single National Entity and within the other administrations and/or services that are involved in the inventory preparation in the future. The Department of the Environment of the Ministry of Sustainable Development and Infrastructures (MDDI-DEV) is acting as UNFCCC National Focal Point. Thus, the "political" responsibility lies with the MDDI-DEV and it is the Ministry that officially submits the inventories and their related reports to the UNFCCC Secretariat and the European Commission (see Article 8 of the Regulation). In addition, the regulation designates the Environment Agency (Administration de l'Environnement, AEV) as the "Single National Entity with overall responsibility for the GHG Inventory". Overall management of the Single National Entity is assigned to one staff member of the Environment Agency that is nominated GHG Inventory Focal Point. The Agency also acts as "National Inventory Compiler" compiling and checking the information and GHG emission estimates coming from sector experts working within the AEV or in other administrations or services. The Environment Agency has therefore the "technical" knowledge and responsibility for the GHG Inventories. Luxembourg has, thus, adopted an "integrated approach" to avoid redundant and overlapping activities in different administrative services. This concentration of air emission reporting in one department also allows an improved consistency between different reporting schemes (UNFCCC, EU-MMD, EU-PRTR, EU-LCPD, EU-ETS, UNECE-CLRTAP and EU-NECD).	National Inventory Report 1990-2008 Luxembourg May 2010 pp 30-35
Netherlands	The Ministry of Infrastructure and Environment (IenM) has overall responsibility for climate change policy issues including the preparation of the inventory. In August 2004, IenM assigned SenterNovem (now NL Agency) executive tasks bearing on the National Inventory Entity (NIE), the single national entity required under the Kyoto Protocol. In December 2005, NL Agency was designated by law as the NIE. In addition to co-ordinating the establishment and maintenance of a National System, the tasks of NL Agency include overall co-ordination of improved QA/QC activities as part of the National System and co-ordination of the support/response to the UNFCCC review process. The National System is described in more detail in the (Fourth and Fifth National Communication (VROM 2006b, 2009). Since 1 January 2010, RIVM has been assigned by IenM as co-ordinating institute for compiling and maintaining the pollutants emission register/inventory (PRTR system), containing about 350 pollutants including the greenhouse gases. The PRTR project system is used as basis for the NIR and for filling the CRF. After the general elections in the Netherlands in 2010, the responsibilities of the former VROM moved to the restructured Ministry of Infrastructure and Environment (IenM). The Dutch PRTR has been in operation in the Netherlands since 1974. This system encompasses data collection, data processing and registering and reporting emission data for about 350 policy-relevant compounds and compound groups that are present in air, water and soil. The emission data is produced in an annual (project) cycle (RIVM, 2011). This system is also the basis for the national greenhouse gas inventory. The overall coordination of the PRTR is outsourced by the ministry (IenM) to the RIVM. The main objective of the PRTR is to produce an annual set of unequivocal emission data that is up-to-date, complete, transparent, comparable, consistent and accurate. In addition to RIVM, various external agencies contribute to the PRTR by performing calculations or submitting activity data. These include: CBS (Statistics Netherlands), PBL (Netherlands Environmental Assessment Agency), TNO (Netherlands Organisation for Applied Scientific Research), NL Agency, Centre for Water Management, Deltares and several institutes related to the Wageningen University and Research Centre (WUR). The NIR part 1 is prepared by RIVM as part of the PRTR project. Most institutes involved in the PRTR also contribute to the NIR (including CBS and TNO). In addition, NL Agency is involved in its role as NIE. NL Agency also prepares the NIR part 2 and takes care of integration and submission to the UNFCCC in its role as NIE. Submission to the UNFCCC only takes place after approval by IenM.	Greenhouse Gas Emissions in the Netherlands 1990-2010 Mar 2012 p29 f. Comments on NIR

MS	Institutional arrangements/national systems	Source
Portugal	In order to comply with the commitments at the international and EC levels, respectively, the Article 5(1) of the Kyoto Protocol and Decision 280/2004/EC of the European Parliament and of the Council, a National Inventory System of Emissions by Sources and Removals by Sinks of Air Pollutants - (SNIERPA) was created. This system contains a set of legal, institutional and procedural arrangements that aim at ensuring the accurate estimation of emissions by sources and removals by sinks of air pollutants, as well as the communication and archiving of all relevant information. The principal objective of the national system is to prepare and ensure the transparency, consistency, comparability, completeness, accuracy and timeliness of the inventory of air pollutants (INERPA), in accordance with the directives defined at international and EC levels, in order to make easier and more cost-effective the tasks of inventory planning, implementation and management, The system was established through Council of Ministers Resolution 68/2005, of 17 March, which defines the entities relevant for its implementation, based on the principle of institutional cooperation. This clear allocation of responsibilities is essential to ensure the inventory takes place within the defined deadlines. For the sake of efficiency, the Portuguese national system has been broadened to include a wider group of air pollutants than just GHG not covered by the Montreal Protocol, allowing for improvements in information quality, as well as an optimisation of human and material resources applied to the preparation of the inventory. Three bodies are established with differentiated responsibilities. These are: 1. The Portuguese Environmental Agency (APA)/ Ministry of Ministry for the Environment and Land Use Planning, is the Responsible Body responsible for: the overall coordination and updating of the National Inventory of Emissions by Sources and Removals by Sinks of Air Pollutants (INERPA); the inventory's approval, after consulting the Focal Points and the involved entities; and its submission to EC and international bodies to which Portugal is associated, in the several communication and information formats, thus ensuring compliance with the adopted requirements and directives. 2. CAOS Sustentabilidade, was a private company contracted by APA to support the inventory unit on the development of a methodological approach and the implementation of a procedure to quantify KP-LULUCF activities. 3. The sectoral Focal Points work with APA in the preparation of INERPA, and are responsible for fostering intra and inter-sectoral cooperation to ensure a more efficient use of resources. Their main task includes coordinating the work and participation of the relevant sectoral entities over which it has jurisdiction. It is also the Focal Points duty to provide expert advice on methodological choice, emission factor determination and accuracy of the activity data used. Focal Points play a vital role in sectoral quality assurance and methodological development. The involved entities are public or private bodies which generate or hold information which is relevant to the INERPA, and which actions are subordinate to the Focal Points or directly to the Responsible Body. All governmental entities have the responsibility to ensure, at a minimum, co-funding of the investment needed to ensure the accuracy, completeness and reliability of the emissions inventory. The RCM also includes a procedure for the official consideration of the inventory. This consideration is done at the level of the designated representatives of Focal Points and Involved Entities. The SNIERPA is composed of three technical elements: 1. A Quality Control and Quality Assurance System (QA/QC System) 2. A Methodological Development Programme (MDP), and 3. An integrated IT system for the management (SIGA) of the SNIERPA (this last not yet implemented).	Short Portuguese National Inventory Report on Greenhouse Gases, 1990-2010, Jan 2012, pp 1-6

MS	Institutional arrangements/national systems	Source
Spain	The Directorate-General for Environmental Quality and Evaluation (DGCEA) at the Ministry of Environment and Rural and Marine Affairs is the National Authority for the National Air Pollutant Emissions Inventory System. The air pollutant emissions inventories are considered to be statistics for State purposes and as such, in accordance with article 149.1.31 of the Spanish Constitution, are performed on the basis of the exclusive responsibility of the State. In this sense, the regulatory frame of reference is provided by the Spanish Public Statistical Function Act (Law 12 dated May 9th, 1989) and by 2009-2012 National Statistical Plan, approved by Royal Decree 1663 dated October 17th, 2008. With regard to data collection, Law 12/1989 establishes two different regimes for the regulation of statistics depending on whether data are demanded in a compulsory manner or individuals are free to provide information voluntarily. Since they form part of the National Statistical Plan and their preparation represents an obligation for the Spanish State under European Union regulations, emissions inventories fall into the first of these two regimes, i.e. the submission of data by individuals is compulsory. The DGCEA is the national entity under the Spanish national inventory system. It is technically supported by the company Análisis Estadístico de Datos, S.A. (AED). Further, DGCEA cooperates with Research Institutes and University Departments, e.g. with Sistema y Tecnologías de la Producción Animal-Universidad Politécnica de Valencia (STEPA-UPV) for the sector agriculture or Tecnologías y Servicios Agrarios, S.A. (TRAGSATEC) for LULUCF. In addition, the DGCEA has requested Ministerial Departments for the necessary information required for the preparation of the Inventory, referring to the ACDGAE-2007 (Government's Delegated Committee for Economic Affairs, February 8th, 2007) resolution for regulatory support. The representatives of the Ministerial Departments designate those persons responsible for the Contact Points that would assume, in each Department, the responsibility for processing the information requested for the SEI. • Ministry of Industry, Tourism and Trade) • Ministry of Public Safety • Ministry of Development • Ministry of Defense • Ministry of Economy and Finance • Ministry of Health and Social Policy	Inventario de Emisiones de gases de efecto invernadero de España, años 1990-2010 March 2012. (submitted in Spanish, translated)

MS	Institutional arrangements/national systems	Source
Sweden	The Swedish Ministry of Environment is the single national entity and has overall responsibility for the inventory. The Swedish EPA is responsible for co-ordinating the activities for producing the inventory, maintaining the reporting system and also for the final quality control and quality assurance of the inventory. The Swedish EPA sends the inventory to Ministry of the Environment and – on behalf of the Ministry of Environment – submits the inventory to the EU and to the UNFCCC. Finally, the Swedish EPA is responsible for national publication of the greenhouse gas inventory. The Swedish EPA engages consultants with expert skills to conduct the inventory and reporting in the area of climate change. During the spring of 2005, the Swedish EPA completed a negotiated procurement of services under the terms of the Public Procurement Act. After procurement had been completed, a framework contract was signed with the consortium Swedish Environmental Emissions Data (SMED)2, consisting of the Swedish Meteorological and Hydrological Institute (SMHI), Sta-tistics Sweden (SCB), the Swedish University of Agricultural Sciences (SLU) and the Swedish Environmental Research Institute (IVL). The contract between the Swedish EPA and SMED runs for nine years and thus covers the whole first com-mitment period under the Kyoto Protocol. SMED receives data and documentation from responsible authorities as described above and produces most of the data and documentation in the Swedish inventory. The regular inventory work is organized as a project involving all SMED organiza-tions. The project is run by a project management team with one person from each organization. The Swedish Meteorological and Hydrological Institute is main re-sponsible for production of gridded emission data. Statistics Sweden is main re-sponsible for the energy sector, the agriculture sector and parts of the waste sector, but is also involved in industrial processes since these are closely connected to the energy sector. The Swedish University of Agricultural Sciences is responsible for the LULUCF sector. The Swedish Environmental Research Institute is main re-sponsible for the industrial process sector, the solvents and other products use sec-tor and also parts of the waste sector and energy sector. On behalf of the Swedish EPA, SMED also conducts development projects necessary for improving the inventory. The process of inventory preparation is carried out differently for the different sectors: ENERGY- STATIONARY COMBUSTION: Activity data is collected for the following subgroups: Energy industries: Data from quarterly fuel statistics, a total survey conducted by Statistics Sweden at plant level and by fuel type. For some petroleum refining plants, data from the European Union Emission Trading Scheme (ETS) is used. Manufacturing industries: Data mainly from the quarterly fuel statistics, a sample survey conducted by Statistics Sweden. In some cases data from the industrial energy statistics is used as a complement. All data is at plant level and by fuel type. Other sectors: Data from official statistical reports prepared by Statistics Sweden at national level and by fuel type. ENERGY- MOBILE COMBUSTION: Data on fuel consumption at national level and by fuel type is collected and used in combination with emissions data and fuel data from the National Road Administration, the National Rail Administration, the Civil Aviation Administration and the Swedish Military. INDUSTRIAL PROCESSES: The reported data for industrial processes is mainly based on information from environmental reports. The data in the environmental reports refer to emissions derived from plant specific measurements or estimates such as mass balances. The use of default emission factors is limited. SOLVENT AND OTHER PRODUCT USE: Data used for estimating emissions from solvent and other product use are based on emission factors and national activity data obtained from the Products register kept by the Swedish Chemicals Agency. AGRICULTURE: Data on animal numbers, crop areas, yields, sales of manure, manure management and stable periods are taken from official statistical reports published by the Swedish Board of Agriculture and Statistics Sweden. Some complementary information is collected from organisations and researchers, such as the Swedish Dairy Association, Swedish Poultry Meat Association, SLU and the Swedish Institute of Agricultural and Environmental Engineering. LAND USE, LAND USE CHANGE AND FORESTRY: Estimates presented in the LULUCF sector are mainly based on data from the SLU. The SLU is responsible for the National Forest Inventory, which focuses on living biomass, and for the Swedish Forest Soil Inventory, that focuses on dry organic matter and on soil organic carbon. The two inventories are integrated and use the same infrastructure for the field sample. WASTE: Statistics on deposited waste quantities, methane recovery and nitrogen emissions from wastewater handling, are provided by the Swedish Association of Waste Management (Avfall Sverige, former RVF), Statistics Sweden, the Swedish Forest Industries Federation and the Swedish EPA. If new data on organic content in household waste or other relevant research is published, such reports are also considered. A new system for handling emission data, entitled TPS, has been developed and used for the first time in submission 2007. It supports data input from Microsoft Excel sheets, and provides different types of quality gateways.	National Inventory Report Sweden 2012 Mar 2012 pp 36 ff.

MS	Institutional arrangements/national systems	Source
United Kingdom	The UK Greenhouse Gas Inventory is compiled and maintained by AEA of AEA Technology plc – the Inventory Agency - under contract with the Climate, Energy, Science and Analysis (CESA) Division in the UK Department of Energy and Climate Change (DECC). AEA is directly responsible for producing the emissions estimates for CRF categories Energy (CRF sector 1), Industrial Processes (CRF sector 2), Solvent and Other Product Use (CRF sector 3), and Waste (CRF Sector 6). AEA is also responsible for inventory planning, data collection, QA/QC and inventory management and archiving. Agricultural sector emissions (CRF sector 4) are produced by the Defra's Land Management Improvement Division via a contract with Rothamsted Research. Land-Use Change and Forestry emissions (CRF sector 5) are calculated by the UK Centre for Ecology and Hydrology (CEH), under separate contract to CESA (DECC). DECC is the Single National Entity responsible for submitting the UK's greenhouse gas inventory (GHGI) to the UNFCCC. AEA compiles the GHGI on behalf of DECC, and produces disaggregated estimates for the Devolved Administrations within the UK. Key Data Providers include other Government Departments such as Department for Environment, Food and Rural Affairs (Defra) and Department for Transport (DfT), Non-Departmental Public Bodies such as the Environment Agency for England and Wales (EA) and the Scottish Environmental Protection Agency (SEPA), private companies such as Corus, and business organisations such as UK Petroleum Industry Association (UKPIA). As the designated Single National Entity for the UK GHG National Inventory System (NIS), DECC has the following roles and responsibilities: • National Inventory System Management and Planning (overall control of the NIS development and function; management of contracts and delivery of GHG inventory; definition of performance criteria for NIS key organisations) • Development of Legal & Contractual Infrastructure (review of legal and organisational structure; implementation of legal instruments and contractual developments as required to meet guidelines.) • As the designated Inventory Agency for the UK GHG National Inventory System, AEA has the following roles and responsibilities: • Planning (Co-ordination with DECC to deliver the NIS, Review of current NIS performance and assessment of required development action, and Scheduling of tasks and responsibilities to deliver GHG inventory and NIS. • Preparation (drafting of agreements with key data providers; review of source data and identification of developments required to improve GHG inventory data quality. • Management (documentation and archiving; dissemination of information regarding NIS to Key Data Providers; management of inventory QA/QC plans, programmes and activities). • Inventory Compilation (data acquisition, processing and reporting; delivery of NIR)	UK Greenhouse Gas Inventory 1990-2010 Short NIR, Jan 2012 pp 4-7

1.1.3 The European Commission, Directorate-General Climate Action

The European Commission's DG Climate Action in consultation with the Member States has the overall responsibility for the EU inventory. Member States are required to submit their national inventories and inventory reports under Council Decision No 280/2004/EC to the European Commission, DG Climate Action; and the European Commission, DG Climate Action itself submits the inventory and inventory report of the EU to the UNFCCC Secretariat. In the actual compilation of the EU inventory and inventory report, the European Commission, DG Climate Action, is assisted by the EEA including its ETC/ACM and by Eurostat and the JRC.

The consultation between the DG Climate Action and the Member States takes place in the Climate Change Committee established under Article 9 of Council Decision No 280/2004/EC. The Committee is composed of the representatives of the Member States and chaired by the representative of the DG Climate Action. Procedures within the Committee for decision-making, adoption of measures and voting are outlined in the rules of procedure, adopted in November 2003. In order to facilitate decision-making in the Committee, three working groups have been established: Working Group 1 'Annual inventories', Working Group 2 'Assessment of progress (effect of policies and measures, projections)' and Working Group 3 'Emission trading'.

The objectives and tasks of Working Group 1 under the Climate Change Committee include:

- the promotion of the timely delivery of national annual GHG inventories as required under the monitoring mechanism;
- the improvement of the quality of GHG inventories on all relevant aspects (transparency, consistency, comparability, completeness, accuracy and use of good practices);
- the exchange of practical experience on inventory preparation, on all quality aspects and on the use of national methodologies for GHG estimation;
- the evaluation of the current organisational aspects of the preparation process of the EU inventory and the preparation of proposals for improvements where needed.

1.1.4 The European Environment Agency

The European Environment Agency assists the European Commission, DG Climate Action, in the compilation of the annual EU inventory through the work of the ETC/ACM. The activities of the ETC/ACM include:

- initial checks of Member States' submissions in cooperation with Eurostat, and the JRC, up to 28 February and compilation of results from initial checks (status reports, consistency and completeness reports);
- consultation with Member States in order to clarify data and other information provided;
- preparation and circulation of the draft EU inventory and inventory report by 28 February based on Member States' submissions;
- preparation of the final EU inventory and inventory report by 15 April (to be submitted by the Commission to the UNFCCC Secretariat);
- assisting Member States in their reporting of GHG inventories by means of supplying software tools.

The tasks of the EEA and the ETC/ACM are facilitated by the European environmental information and observation network (Eionet), which consists of the EEA as central node (supported by European topic centres) and national institutions in the EEA member countries that supply and/or analyse national data on the environment (see http://eionet.eea.europa.eu). The Member States are encouraged to use the central data repository under the Eionet for making available their GHG submissions to the European Commission and the ETC/ACM (see http://cdr.eionet.europa.eu/).

1.1.5 The European Topic Centre on Air Pollution and Climate Change Mitigation

The European Topic Centre on Air and Climate Change Mitigation (ETC/ACM) was established by a contract between the lead organisation Institute for Public Health and the Environment (RIVM) in the Netherlands and EEA for the years 2011-2013. The ETC/ACM involves 10 organisations and institutions in eight European countries. The technical annex for the 2011 work plan for the ETC/ACM and an implementation plan specify the specific tasks of the ETC/ACM partner organisations with regard to the preparation of the EU inventory. Umweltbundesamt Austria is the task leader for the compilation of the EU annual inventory in the ETC/ACM, including all tasks mentioned above.

The ETC/ACM provides software tools for Member States to compile national GHG inventories and to convert their national inventory from Corinair-SNAP source category codes into the required CRF source categories. The main software tools are CollectER, for compiling and updating national emission inventories, and ReportER, for reporting the emissions in the required format, e.g. CRF. In addition, separate software tools are available to prepare estimates of emissions from agriculture and road transport. These tools are being used by several Member States. The ETC/ACM adapts the tools regularly to the latest changes in reporting requirements.

1.1.6 Eurostat

Based on Eurostat energy balance data, Eurostat compiles annually by 31 March estimates of the EU CO_2 emissions from fossil fuels using the IPCC reference approach. Eurostat compares these estimates with national estimates of CO_2 emissions from fossil fuels prepared by Member States and provides information summarising and explaining these differences. In order to improve the consistency of Member State and Eurostat energy data, a project on harmonisation of energy balances has started between Eurostat and national statistical offices. In addition, Eurostat is leading an EU project aimed at improving estimates of GHG emissions from international aviation.

1.1.7 Joint Research Center

The Joint Research Centre (JRC) assists in the improvement of methodologies for the land-use, land-use change and forestry (LULUCF) sector. It does so (1) by inter-comparing methodologies used by the Member States for estimating emissions and removals with a focus on LULUCF and (2) by providing EU-wide estimates with various models/methods for emissions and removals with a focus on LULUCF. For this reason, methods using inverse modelling for CH_4 emissions are currently under development. In addition, the JRC is leading a project for improving the methodologies used for estimating GHG emissions from agriculture with a focus on the N_2O emissions of agriculture soils, the source contributing most to the overall uncertainty of the EU inventory.

1.2 A description of the process of inventory preparation

The annual process of compilation of the EU inventory is summarised in Table 1.3. The Member States should submit their annual GHG inventory by 15 January each year to the European Commission's DG Climate Action. Then, the ETC/ACM, Eurostat and the JRC perform initial checks of the submitted data up to 28 February. The ETC/ACM transfers the nationally submitted data from the xml-files into the CRF aggregator database which was developped for aggregating the EU submission from member state (MS) submissions. From the CRF aggregator the aggregated EU inventory is transferred into the CRF reporter software for preparing the official EU GHG inventory submission.

Table 1.3 Annual process of submission and review of Member States inventories and compilation of the EU inventory

Element	Who	When	What
1. Submission of annual greenhouse gas inventories (complete common reporting format (CRF) submission and elements of the national inventory report) by Member States under Council Decision No 280/2004/EC	Member States	15 January	Elements listed in Article 3(1) of Decision 280/2004/EC as elaborated in Articles 2 to7 in particular: Greenhouse gas emissions by sources and removals by sinks, for the year n –2 And updated time series 1990- year n –3, depending on recalculations; Core elements of the NIR Steps taken to improve estimates in areas that were previously adjusted under Article

Element	Who	When	What
			5.2 of the Kyoto Protocol (for reporting under the Kyoto Protocol)
2. 'Initial check' of Member States' submissions	Commission (incl. Eurostat, the JRC), assisted by the EEA	As soon as possible after receipt of Member State data, at the latest by 1 April	Initial checks and consistency checks (by EEA). Comparison of energy data provided by Member States on the basis of the IPCC Reference Approach with Eurostat energy data (by Eurostat and Member States) and check of Member States' agriculture and land use, land-use change and forestry (LULUCF) inventories by DG JRC (in consultation with Member States).
3. Compilation of draft EU inventory	Commission (incl. Eurostat, the JRC), assisted by the EEA	up to 28 February	Draft EU inventory (by EEA), based on Member States' inventories and additional information where needed.
4. Circulation of draft EU inventory	Commission (DG Climate Action) assisted by the EEA	28 February	Circulation of the draft EU inventory on 28 February to Member States. Member States check data.
5. Submission of updated or additional inventory data and complete national inventory reports by Member States	Member States	15 March	Updated or additional inventory data submitted by Member States (to remove inconsistencies or fill gaps) and complete final national inventory reports.
6. Estimates for data missing from a national inventory	Commission (DG Climate Action) assisted by EEA	31 March	The Commission prepares estimates for missing data by 31 March of the reporting year, following consultation with the Member State concerned, and communicate these to the Member States.
7. Comments from Member States regarding the Commission estimates for missing data	Member States	8 April	Member States provide comments on the Commission estimates for missing data, for consideration by the Commission.
8. Final annual EU inventory (incl. EU inventory report)	Commission (DG Climate Action) assisted by EEA	15 April	Submission to UNFCCC of the final annual EU inventory. This inventory will also be used to evaluate progress as part of the monitoring mechanism.
9. Circulation of initial check results of the EU submission to Member States	Commission (DG Climate Action) assisted by EEA	As soon as possible after receipt of initial check results	Commission circulates the initial check results of the EU submission as soon as possible after their receipt to those Member States, which are affected by the initial checks.
10. Response of relevant Member States to initial check results of the EU submission	Member States	Within one week from receipt of the findings	The Member States, for which the initial check indicated problems or inconsistencies provide their responses to the initial check to the Commission.
11. Any resubmissions by Member States in response to the UNFCCC initial checks	Member States	For each Member State, same as under the UNFCCC initial checks phase Under the Kyoto Protocol: the resubmission should be provided to the Commission within five weeks of the submission due date.	Member States provide to the Commission the resubmissions which they submit to the UNFCCC Secretariat in response to the UNFCCC initial checks. The Member States should clearly specify which parts have been revised in order to facilitate the use for the EU resubmission. As the EU resubmission also has to comply with the deadlines specified in the guidelines under Article 8 of the Kyoto Protocol, the resubmission has to be sent to the Commission earlier than the period foreseen in the guidelines under Article 8 of the Kyoto Protocol, provided that the resubmission correct data or information that is used for the compilation of the EU inventory.
12. Submission of any other resubmission after the initial check phase	Member States	When additional resubmissions occur	Member States provide to the Commission any other resubmission (CRF or national inventory report) which they provide to the UNFCCC Secretariat after the initial check phase.

On 28 February, the draft EU GHG inventory and inventory report are circulated to the Member States for review and comment. The Member States check their national data and information used in the EU inventory report and send updates, if necessary, and review the EU inventory report by 15

March. This procedure should assure the timely submission of the EU GHG inventory and inventory report to the UNFCCC Secretariat and it should guarantee that the EU submission to the UNFCCC Secretariat is consistent with the Member State UNFCCC submissions.

The final EU GHG inventory and inventory report is prepared by the ETC/ACM by 15 April for submission to the UNFCCC Secretariat. Resubmissions of the EU GHG inventory and inventory report are prepared by 27 May, if needed. By 15 May, Member States should provide to the Commission any resubmission in response to the UNFCCC initial checks which affects the EU inventory, in order to guarantee that the EU resubmission to the UNFCCC Secretariat is consistent with the Member States' resubmissions. End of May the inventory and the inventory report are published on the EEA website (http://www.eea.europa.eu) and the data are made available through the EEA data warehouse (http://dataservice.eea.europa.eu/dataservice).

1.3 General description of methodologies and data sources used

1.3.1 The compilation of the EU GHG inventory

The EU inventory is compiled in accordance with the recommendations for inventories set out in the 'UNFCCC guidelines for the preparation of national communications by parties included in Annex 1 to the Convention, Part 1: UNFCCC reporting guidelines on annual inventories' (FCCC/SBSTA/2004/8), to the extent possible. In addition, the *Revised IPCC 1996 guidelines for national greenhouse gas inventories* have been applied as well as the *IPCC Good practice guidance and uncertainty management in national greenhouse gas inventories*, where appropriate and feasible. In addition, for the compilation of the EU GHG inventory, Council Decision No 280/2004/EC and the Commission Decision 2005/166/EC.

The EU-15 GHG gas inventory is compiled on the basis of the inventories of the 15 Member States. The emissions of each source category are the sum of the emissions of the respective source and sink categories of the 15 Member States. This is also valid for the base year estimate of the EU-15 as fixed in the initial review report. Table 1.4 shows the base year emissions for EU-15 Member States and EU-15 as fixed in the respective initial review reports.

Table 1.4 Base year emissions for EU-15 Member States and EU-15

EU-15 MS	CO_2, CH_4, N_2O	HFC, PFC, SF_6	Base year emissions 1) (Tonnes CO_2 equivalents)
Austria	1990	1990	79,049,657
Belgium	1990	1995	145,728,763
Denmark 2)	1990	1995	69,323,336
Finland	1990	1995	71,003,509
France	1990	1990	563,925,328
Germany	1990	1995	1,232,429,543
Greece	1990	1995	106,987,169
Ireland	1990	1995	55,607,836
Italy	1990	1990	516,850,887
Luxembourg	1990	1995	13,167,499

EU-15 MS	CO_2, CH_4, N_2O	HFC, PFC, SF_6	Base year emissions 1) (Tonnes CO_2 equivalents)
Netherlands	1990	1995	213,034,498
Portugal	1990	1995	60,147,642
Spain	1990	1995	289,773,205
Sweden	1990	1995	72,151,646
United Kingdom 2)	1990	1995	776,337,201
EU-15	1990	1990 (AT, FR, IT) 1995 (other MS)	4,265,517,719

Source: Initial review reports of the EU-15 Member States (www.unfccc.int)
Base-year emissions exclude emissions and removals from the LULUCF sector but include emissions due to deforestation in the case of Member States for which LULUCF constituted a net source of emissions in 1990.
The base year emissions relate to the EU territory of Denmark and the UK.

Of the EU-15 Member States, 12 Member States have chosen 1995 as the base year for fluorinated gases while Austria, France and Italy have chosen 1990. Therefore, the EU-15 base year estimates for fluorinated gas emissions are the sum of 1995 emissions for 12 Member States and 1990 emissions for Austria, France and Italy. The EU-15 base year emissions also include emissions from deforestation for Ireland, the Netherlands, Portugal and the UK.

The reference approach is calculated for the EU-15 on the basis of Eurostat energy data (see Section 3.6) and the key category analysis (Section 1.5) is separately performed at EU-15 level (10).

Since Member States use different national methodologies, national activity data or country-specific emission factors in accordance with IPCC and UNFCCC guidelines, these methodologies are reflected in the EU GHG inventory data. The EU believes that it is consistent with the UNFCCC reporting guidelines and the IPCC good practice guidance to use different methodologies for one source category across the EU especially if this helps to reduce uncertainty and improve consistency of the emissions data provided that each methodology is consistent with the IPCC good practice guidance.

In general, no separate methodological information is provided at EU level except summaries of methodologies used by Member States. However, for some sectors quality improvement projects have been organised/are ongoing with the aim of further improving estimates at Member State level. These sectors include energy background data, emissions from international bunkers, emissions and removals from LULUCF, emissions from industrial processes, agriculture and waste.

The EU-15 CRF Table Summary 3 in Annex 1.2 provides information on methodologies and emission factors used by the Member States. These tables have been compiled on the basis of the information provided by the Member States in their CRF Table Summary 3. In addition, information on methods, activity data and emission factors was used which was provided by the Member States in accordance with Annex I of Commission Decision 2005/166/EC. The sector-specific chapters list the methodologies and emission factors used by the Member States for each EU key source.

Detailed information on methodologies used by the Member States is available in the Member States national inventory reports, which are included in Annex 1.12. Note that all Member States'

(10) However, the choice of the emission calculation methodology is made at Member State level and is based on the key category analysis of each individual Member State.

submissions (CRF tables and national inventory reports), which are included in Annex 1.12 and made available at the EEA website, are considered to be part of the EU submission.

1.3.1.1 Internal consistency of the EU CRF tables

In principle every single EU value is aggregated from the respective value of the EU Member States. However, sometimes there are consistency problems when compiling the EU CRF tables (i.e. the sum of sub-categories is not equal to the category total) in those categories where Member States have difficulties to allocate emissions to the sub-categories. Member States use notation keys like IE or C if they cannot provide an emission estimate for a certain sub-category. At Member State level, the use of the notation keys makes transparent the reason for not providing emission estimates. However, at EU-15 level, the sub-category emission value is the sum of Member States emission values and the information of the notation keys used by some Member States is lost in the EU-15 CRF submission. In order to make this more transparent, the CRF tables now include the values or notation keys reported by the MS as comments. In addition, Annexes 1.4-1.10 of this report include the CRF tables for the sectors for each EU-15 Member State. In order to address this problem, some source categories have been reallocated for the EU CRF tables.

A second problem is the reporting of Member States in “grey cells” which need to be included in the CRF reporter manually.

A third problem occurs where MS report potential fluorinated gas emissions but do not report actual emissions. In these cases the potential emissions are included in the national totals, but they are lost when aggregating the EU actual emissions. Therefore, the potential emissions are added manually into the CRF reporter for these Member States. Table 1.5 lists the procedures applied for the EU-15 Member States.

Table 1.5 Manual changes in the CRF Reporter

CRF Table	Member State	Year	Sector	Source category	Parameter	Manual changes/inclusion in the CRF reporter
Table1B2	SE	1990-2010	Energy	1.B.2.a.5	N2O	Include SE emissions from 1.B.2.A.5 under 1.B.2.A.6
Table1B2	GB	1990-2010	Energy	1.B.2.b.1	N2O	Add pollutant N2O under 1B2b1 and include emissions from grey cells.
Table1	DE	1990-1997	Energy	1.B.2.b	CO	Include DE emissions from 1.B.2.b under 1.B.2.d 'Other non-specified'
Table2(I)s1	DE, SE, PL	1990-2010	Ind. Processes	2.A.1	NOx, NMVOC, CO	Add new gases under 2A1 and include emissions
Table2(I)s1	DE, PT	1990-2010	Ind. Processes	2.A.2	NOx, NMVOC, SO2	Add new gases under 2A2 and include emissions
Table2(I)s1	SE	1990-2010	Ind. Processes	2.A.2	SO2	Add pollutant SO2 under 2A2 and include emissions from grey cells
Table2(I)s1	PT	1990-2010	Ind. Processes	2.A.6	CH4	Include PT CH4 emissions from grey cells
Table2(I)s1	EU	1990-2010	Ind. Processes	2.A.7	CO2, NOx, CO, NMVOC, SO2	Exclude glass production from other non-specified and delete MS comments
Table2(I)s1	HU	1990-2003	Ind. Processes	2.B.2	CO2	Add pollutant CO2 under 2B2 and include emissions from grey cells (EEA finding).
Table2(I)s1	EU	1990-2010	Ind. Processes	2.B.5	CO2, CH4	Exclude 2.B.5.1 - 2.B.5.5 from other non-specified and delete MS comments
Table2(1).A-Gs2	DE	1990-2010	Ind. Processes	2.C.1.1	N2O	Add pollutant N2O under 2C1 and include emissions from grey cells.
Table2(1).A-Gs2	ES	1990-2010	Ind. Processes	2.C.1.5	N2O	Add pollutant N2O under 2C1 and include emissions from grey cells.
Table2(1).A-Gs2	GB	1990-2010	Ind. Processes	2.C.1.5	N2O	Add pollutant N2O under 2C1 and include emissions from grey cells.
Table2(1).A-Gs2	PL	2005-2010	Ind. Processes	2.C.1.5	N2O	Add pollutant N2O under 2C1 and include emissions from grey cells.
Table2(1).A-Gs2	SE	1990-2010	Ind. Processes	2.D.1	CH4, N2O	Add pollutants CH4, N2O under 2D1 and include emissions from grey cells.
Table2(1).A-Gs2	PL	2005-2010	Ind. Processes	2.D.1	CO2	Add pollutant CO2 under 2D1 and include emissions from grey cells.
Table2(II)	FR	1990-2010	Ind. Processes	2.E.2	HFC-365mcf	Include FR emissions from HFC-365mcf in CO2 equivalents and delete MS comments
Table2(II).E	EU	1990-2010	Ind. Processes	2.E.3	PFC-A	Be sure that EUC notation keys are the sum of MS notation keys (EEA finding)
Table2(II).F	EU	1990-2010	Ind. Processes	2.F	all	CRF Reporter: Enter emissions from CRF table 2(II).F
Table2.F	FR	2003-2010	Ind. Processes	2.F.2.1	HFC-365mcf	Include FR emissions from HFC-365mcf under Unspecified mix of HFCs and delete MS comments
Table2(II)	EE	2004-2010	Ind. Processes	2.F.2	HFC-365mcf	Include EE emissions from HFC-365mcf under Unspecified mix of HFCs and delete MS comments
Table2(I)s1	BG, CY, MT	1990-2010	Ind. Processes	2.F.9	HFC-P, PFC-P	Make sure that potential emissions are accounted for (run CRF Aggregator report 'APE') and include them under 2.F.9
Table4s1	LU, NL	1990-2010	Agriculture	4.A.1	CH4	Add LU, NL mature dairy cattle under dairy cattle and delete MS comments
Table4.A	EU	1990-2010	Agriculture	4.A	all	Enter additional information from SBDT4A, JRC (not population, except for cattle)
Table 4.As2	EU	1990-2010	Agriculture	4.A	all	Enter additional information from SBDT4As2, JRC (not population)
Table4s1	LU, NL	1990-2010	Agriculture	4.B.1	CH4	Add LU, NL mature non-dairy, young cattle under non-dairy cattle and delete MS comments
Table4.B(a)	EU	1990-2010	Agriculture	4.B	all	Enter additional information from SBDT 4B(a), JRC (not population, except for cattle)
Table4.B(a)s2	EU	1990-2010	Agriculture	4.B	all	Enter additional information from SBDT 4B(a)s2, JRC (not population)
Table4.B(b)	EU	1990-2010	Agriculture	4.B	all	Enter additional information from SBDT 4B(b), JRC (not population)
Table4s2	ES	1990-2010	Agriculture	4.D	Nox	Add pollutant NOx under 4D4 and include emissions from grey cells.
Table4.D	EU	1990-2010	Agriculture	4.D	all	Enter additional information from SBDT 4D, JRC (only additional information - fraction)
Table4.E	EU	1990-2010	Agriculture	4.E.1	CH4, N2O	Be sure that EUC notation keys are the sum of MS notation keys (EEA finding)
Summary1A	ES, PT	1990-2010	Agriculture	4.F.5	SO2	Add pollutant SO2 under 4F5 and include emissions from grey cells.
Table4.F	EU	1990-2010	Agriculture	4.F	all	Enter additional information from SBDT 4F, JRC (not crop production, not biomass burned)
Table5	FI	1990-2010	LULUCF	5.G	CO2	Include additional information from 5.G
Table5	GB	1990-2010	LULUCF	5.G	CO2	Include additional information from 5.G
Table5	CY	1990-2010	LULUCF	5.G	CO2	Include additional information from 5.G
Summary1.A	FR	1990-2010	LULUCF	5.G	NMVOC, SO2	Include additional information from 5.G
Table5	FR	1994-2010	LULUCF	5.G	CO2, CH4	Include additional information from 5.G
Summary1.A	IT	1990-2010	LULUCF	5.G	SO2	Include additional information from 5.G
5(III)	DE	1990-2010	LULUCF	5.G	N2O	Include additional information from 5.G
5(III)	PT	1990-2010	LULUCF	5.G	N2O	Include additional information from 5.G
5(IV)	DE	1990-2010	LULUCF	5.G	CO2	Include additional information from 5.G
5(IV)	NL	1990-2010	LULUCF	5.G	CO2	Include additional information from 5.G
Table6	ES	1990-2010	Waste	6.A.1	N2O	Add pollutant N2O under 6A1 and include emissions from grey cells.
Table6	ES	1990-2010	Waste	6.A.3	N2O, SO2	Add pollutants N2O, SO2 under 6A3 and include emissions from grey cells.

1.3.2 Use of data from EU ETS for the purposes of the national GHG inventories in EU Member States

Overview

In January 2005 the European Union Greenhouse Gas Emission Trading System (EU ETS) commenced operation as the largest multi-country, multi-sector Greenhouse Gas Emission Trading System world-wide. The scheme is based on Directive 2003/87/EC, which entered into force on 25 October 2003.The European emissions trading system (ETS) covers around 10,500 installations across the 27 Member States of the European Union. Article 14 of the Emission Trading (ET) Directive requires Member States to ensure that emissions are monitored in accordance with specific monitoring and reporting guidelines (MRG)[11], which are legally binding. Since 1 January 2005, all installations covered by the ETS have been required to estimate and report their emissions. Data for the installations covered by the ETS are reported by plant operators to competent authorities since 2005 based on a monitoring plan elaborated by the company and agreed by the competent authority in accordance with the methodologies established in the monitoring and reporting guidelines. The monitoring plan covers the following elements:

(a) the description of the installation and activities carried out by the installation to be monitored;

(b) information on responsibilities for monitoring and reporting within the installation;

(c) a list of emissions sources and source streams to be monitored for each activity carried out within the installation;

(d) a description of the calculation based methodology or measurement based methodology to be used;

(e) a list and description of the tiers for activity data, emission factors, oxidation and conversion factors for each of the source streams to be monitored;

(f) a description of the measurement systems, and the specification and exact location of the measurement instruments to be used for each of the source streams to be monitored;

(g) evidence demonstrating compliance with the uncertainty thresholds for activity data and other parameters (where applicable) for the applied tiers for each source stream;

(h) if applicable, a description of the approach to be used for the sampling of fuel and materials for the determination of net calorific value, carbon content, emission factors, oxidation and conversion factor and biomass content for each of the source streams;

(i) a description of the intended sources or analytical approaches for the determination of the net calorific values, carbon content, emission factor, oxidation factor, conversion factor or biomass fraction for each of the source streams;

(j) if applicable, a list and description of non-accredited laboratories and relevant analytical procedures including a list of all relevant quality assurance measures, e.g. inter-laboratory comparisons;

(k) if applicable, a description of continuous emission measurement systems to be used for the monitoring of an emission source, i.e. the points of measurement, frequency of measurements, equipment used, calibration procedures, data collection and storage procedures and the approach for corroborating calculation and the reporting of activity data, emission factors and alike;

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[11] Commission Decision 2007/589/EC of 18 July 2007 establishing guidelines for the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council. OJ L 229, 31.8.2007, p.1ff

(l) if applicable, a comprehensive description of the approach and the uncertainty analysis, if not already covered by items (a) to (k) of this list;

(m) a description of the procedures for data acquisition, handling activities and control activities as well as a description of the activities (see Section 10.1-3);

(n) where applicable, information on relevant links with activities undertaken under the EU ecomanagement and audit scheme (EMAS) and other environmental management systems (e.g. ISO14001:2004), in particular on procedures and controls with relevance to greenhouse gas emissions monitoring and reporting.

Similar to the IPCC Good Practice Guidance, the ETS monitoring and reporting guidance is based on a tier system which defines a hierarchy of different ambition levels for activity data, emission factors and oxidation or conversion factors. The operator must, in principle, apply the highest tier level, unless he can demonstrate to the competent authority that this is technically not feasible or would lead to unreasonably high costs. The reported emissions of each installation are verified by independent verifiers for each plant in each reporting year.

Thus, the ETS generates an EU-27 data set on verified installation-specific CO_2 emissions for the sectors covered by the scheme. The ETS includes CO_2 emissions from energy industries and manufacturing industries, in particular combustion installations, mineral oil refineries, coke ovens, production and processing of ferrous metals, and mineral industries (cement, glass, lime, bricks and tiles, other ceramic materials) if the installations exceed certain capacity thresholds. In 2008 the scope of the EU ETS has been expanded to include petrochemical cracking installations, mineral wool production and carbon black production. At the moment, the greenhouse gases covered under the EU ETS are CO_2 (since 2005) and N_2O (since 2010). However, other greenhouse gases and activities will be included in the scope of the EU ETS from 2013 onwards. In July 2006 the Climate Change Committee adopted unanimously the revised Monitoring and Reporting Guidelines for the ETS. The new Guidelines entered into force on 1st January 2008.

The plant-specific emissions data reported by operators under the EU ETS can be used in different ways for the purposes of the national GHG inventories:

1. Reported verified emissions can be directly used in the GHG inventory to report CO_2 emissions for a specific source category. This requires a number of careful checks, e.g. whether the coverage of the respective ETS emissions is complete for the respective source category and that ETS activities and CRF source categories follow the same definitions. If ETS emissions are not complete, the emissions for the remaining part of the source category not covered by the EU ETS have to be calculated separately and added to the ETS emissions.
2. Emission factors (or other parameters such as oxidation factors) reported under the EU ETS can be compared with emission factors used in the inventory and they can be harmonised if the EU ETS provides improved information.
3. Activity data reported under the EU ETS can be used directly for the GHG inventory, in particular for source categories where energy statistics face difficulties in disaggregating fuel consumption to specific subcategories, e.g. to specific industrial sectors.
4. Data from EU ETS can be used for more general verification activities as part of national quality assurance (QA) activities without the direct use of emissions, activity data or emission factors.
5. Data from EU ETS can improve completeness of the estimation of IPCC source categories when additional data for sub-categories become available from EU ETS.

6. ETS data can improve the allocation of industrial combustion emissions to sub-categories under 1A2 Manufacturing Industries and Construction;
7. The comparison of the data sets can be used to improve the uncertainty estimation for the GHG inventories based on the ranges of data reported by installations.

Differences in technical monitoring and reporting provisions between GHG inventories and the EU ETS

There are a number of detailed technical provisions that are different in the monitoring and reporting guidelines for the EU ETS and the IPCC guidelines. These differences can lead to different reported CO_2 emissions under the EU ETS and in the GHG inventory. Some of these issues may also prevent inventory compilers from using verified emissions reported under the ETS directly for emission reporting in the national GHG inventory or may also raise concerns by the expert review teams during the inventory review if Member States directly used verified emissions reported under the ETS for the reporting in the national GHG inventory. Some of these differences have been removed after the first phase of the EU ETS when the 2004 ETS MRG were replaced by the 2007 ETS MRG, however some new differences have been introduced in the second phase.

Scope of activities and installation boundaries

The ETS includes CO_2 emissions from energy industries and manufacturing industries, in particular combustion installations, mineral oil refineries, coke ovens, production and processing of ferrous metals, and mineral industries (cement, glass, lime, bricks and tiles, other ceramic materials) if the installations exceed certain capacity thresholds. Such capacity thresholds are not used for the inventory reporting. In addition different understandings of installation boundaries (furthermore, completeness of the installations included in an industry sector group) and the interpretation as to what constitutes certain activities under the EU ETS, may be different to a source category for the inventory reporting. The scope of activities and the installation boundaries need careful consideration before ETS data are used for inventory purposes.

Determination of tiers

Both reporting guidelines are based on methodological tiers that require higher tier levels of accuracy for emission sources contributing to a significant extent to the total emissions in a country. However in the inventory reporting, the key category analysis determines which methodological tier should be used which is based on the contribution of a source category to the total emission level and the emission trend. If a source category is determined as key, all emissions from this source/sector have toshould be estimated based the same minimum tier methodology.[12]

In the ETS reporting tiers apply at installation level based on the emissions at the particular installation (thresholds are < 50 kt, ≥ 50 kt and ≤ 500 kt and > 500 kt CO_2). At sectoral level, e.g. for cement and lime production, verified emissions can result from small, medium and large emitters and are therefore based on different ETS tiers. For inventory key categories, it can happen that not all verified emissions reported (in particular those estimates that are based on default parameters) under the EU ETS fulfil the tier-level required for the GHG inventory.

[12] The general rule is that if a subcategory represents less than 25-30% of the total emissions of the category, Tier 1 may be used. However, this is not explicitly stated in the IPCC GPG for all categories.

In GHG inventories time series consistency is a mandatory requirement which has also implications on the choice of methodology. Plant-specific and measured data is often not available for the whole time series and it may be challenging . In GHG inventory reviews, the ERT has in some case recommended Parties not to use EU ETS data because challenges in producing a consistent times series back to 1990 based on the use of EU when the ETS data is used.

Fuel emission factors and net calorific values

The 2004 ETS MRG used default fuel emission factors from 1996 IPCC reporting guidelines[13] and net calorific values from 2000 IPCC Good Practice guidance which is consistent with the UNFCCC reporting guidelines under the Convention and the Kyoto Protocol. The revised 2007 ETS MRG use default fuel emission factors and net calorific values from 2006 IPCC Guidelines for national GHG inventories which have not yet been adopted for reporting under the UNFCCC and will not be made mandatory before the reporting year 2015. Thus, starting from 2008 the reporting under the ETS, emissions may have been estimated with fuel-specific default EF that are not acknowledged under the UNFCCC. However, this may not affect the reporting practice substantially as both IPCC and the ETS guidelines require countries and installations to use measured/ installation-specific or country-specific EFs and NCVs. For all fuels for which the reporting is based on installation-specific or country-specific EFs, the different default parameters have no impact (country-specific parameters are normally used for all major fuel types). As the inventory also covers small installations, average carbon contents of fuels and NCVs can vary between the inventory and the ETS data.

Oxidation factor

The Tier 1 method for combustion installations 2004 ETS MRG assumed an oxidation factor of 0.99 for conversion of C to CO_2 for all solid fuels and of 0.995 for all other fuels. IPCC 1996 Guidelines recommend 0.98 for coal, 0.99 for oil and oil products, 0.995 for gas and 0.99 for peat and electricity generation.[14] 2007 ETS MRG changed the Tier 1 requirement to use of an oxidation factor of 1.0 (i.e. default assumption of 100% oxidation).

Table 1.6 Comparison of default oxidation factors used for GHG inventories and for ETS reporting

	Fraction of carbon oxidised, default parameters for tier 1		
Fuel type	**1996 IPCC Guidelines valid for GHG inventories until 2014**	**2004 ETS MRG**	**2007 ETS MRG**
Coal	0.98	0.99	1
Oil and oil products	0.99	0.995	1
Gas	0.995	0.995	1
Peat for electricity generation	0.99	0.99	1

The impact of these differences in the default assumptions for the oxidation factors on the emission estimation depends on the extent to which Member States and installations use tier 1 and the default parameters in their reporting.

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13 With few exceptions such as shale oil for which IPCC guidelines don't provide a value

14 Table 1-6 Revised 1996 IPCC Guidelines for national GHG Inventories, Reference manual, chapter energy

Transferred CO_2

The 2004 version of the ETS MRG included a specific provision for "transferred CO_2" which allowed to subtract CO_2 which is not emitted from the installation but transferred out of the installation as a pure substance, as a component of fuels or directly used as a feedstock in the chemical or paper industry, from the calculated level of emissions for an installation.[15] CO_2 that is transferred out of the installation for the following uses could be considered as transferred CO_2:

- pure CO_2 used for the carbonation of beverages,
- pure CO_2 used as dry ice for cooling purposes,
- pure CO_2 used as fire extinguishing agent, refrigerant or as laboratory gas,
- pure CO_2 used for grains disinfestations,
- pure CO_2 used as solvent in the food or chemical industry,
- CO_2 used as feedstock in the chemical and pulp industry (e.g. for urea or carbonates).

In the reporting under the UNFCCC such subtraction is not allowed if the carbon is only stored for a short time (such as for beverages or dry ice) and consequently the intermediate binding of CO_2 in downstream manufacturing processes and products should not be subtracted from CO_2 emissions.[16]

Thus, for Member States applying the provisions for transferred CO_2 in the first phase of the ETS, this provision introduced some differences in accounting of CO_2 emissions. In quantitative terms this was not very relevant as the quantities deducted from transferred CO_2 under the EU ETS were rather small as indicated in the responses to the questionnaires provided by Member States in relation of Article 21 of the ETS Directive.

In the revised version of the ETS MRG from 2007, the application of the provision requires approval by the competent authority and is only applicable if "the subtraction is mirrored by a respective reduction for the activity and installation which the respective Member State reports in its national inventory submission to the UNFCCC." Thus, the revision of the ETS MRG made the reporting of transferred CO_2 more consistent with the GHG inventory.

With regard to carbon capture and storage, the rules for CCS are stricter under the ETS than under the UNFCCC, e.g. the EU ETS does not allow taking into account emission reductions due to CCS of biomass plants or carbon capture and storage when the CO_2 is stored in long-term products. With regard to the storage of CO_2 in products also 2006 IPCC Guidelines for GHG inventories include changes that will only enter into effect in the future.

Use of EU ETS data in 2012

Based on the information submitted in the national inventory reports (NIRs) in 2012 to the UNFCCC secretariat or the European Commission, all 27 Member States indicated that they used ETS data at least for QA/QC purposes (see Table 7). In 2011 only Lithuania did not indicate whether ETS data is used for inventory preparation or not. In 2010 a similar analysis showed that 24 Member States had used ETS data for inventory purposes. 14 Member States indicated to directly use the verified emissions reported by installations under the ETS. 21 Member States used ETS data to improve

15 Decision 2004/156/EC, p. 7ff

16 The CO_2 capture and storage limestone in the Finnish pulp and paper industry for PCC production has been accepted in the UNFCCC reviews as a long-term storage for CO_2

country-specific emission factors. 17 Member States reported that they used activity data (e.g. fuel use) provided under the ETS in the national inventory.

Table 7: **Use of ETS data for the purposes of the national GHG inventory**

Member State	Status of use of ETS data	Use of emissions	Use of Activity data	Use of emission factors	Use for quality assurance
Austria	Used	✓	✓	✓	✓
Belgium	Used	✓		✓	✓
Bulgaria	Used	✓	✓	✓	✓
Cyprus	Used	✓	✓	✓	✓
Czech Republic	Used	✓	✓	✓	✓
Denmark	Used	✓		✓	✓
Estonia	Used				✓
France	Used	✓	✓	✓	✓
Finland	Used	✓	✓	✓	✓
Germany	Used		✓	✓	✓
Greece	Used		✓	✓	✓
Hungary	Used	✓	✓	✓	✓
Ireland	Used	✓		✓	✓
Italy	Used		✓	✓	✓
Latvia	Used	✓	✓	✓	✓
Lithuania	Used		✓		✓
Luxembourg	Used	✓	✓	✓	✓
Malta	Used		✓		✓
Netherlands	Used				✓
Poland	Used	✓			✓
Portugal	Used		✓	✓	✓
Romania	Used			✓	✓
Slovakia	Used		✓	✓	✓
Slovenia	Used		✓	✓	✓
Spain	Used	✓	✓	✓	✓
Sweden	Used	✓	✓	✓	✓
United Kingdom	Used	✓		✓	✓

Source: NIR 2012 submissions

The following sections provide a detailed overview of the use of ETS data in the EU-27 Member States. The information is mainly based on the NIRs, as well as on the assessment conducted for this report.

Austria

General

About one third of total Austrian GHG emissions currently result from installations under the EU-ETS (~31 Tg CO_2 in 2010). Since 2010 N_2O is included under the ETS in Austria.

Verified emissions from EU ETS have complete coverage for

- refineries,
- iron and steel manufacturing industries,
- non metallic mineral industries (cement, glass, bricks and tiles, other ceramic materials),
- pulp and paper manufacturing industries and
- CO_2 emissions from coal combustion.

Combustion plants of other industrial branches (including power plants) are considered if their thermal plant capacity exceeds 20 MWth (excluding boilers < 3 MW, biomass-boilers and hazardous and municipal waste incineration boilers).

In Austria ETS data is submitted by means of a standard calculation sheet which includes numerical data about multiple fuels, processes and material flows. Additionally a written QA/QC report has to be submitted. For fuel combustion and industrial processes the following numerical data is reported:

- Activity data: mass or volume of fuel consumption/process input material.
- Net calorific value of fuel
- Oxidation factor of fuel/conversion factor of process material
- CO_2 emission factor of fuel or process material
- Share of non fossil CO_2 in case of "non-traded fuels"

For sites with complex material flows (e.g. refineries, iron and steel plants) carbon mass balance data is reported alternatively:

- Activity data: mass or volume of material flow
- Net calorific value of material
- Carbon content of material

Direct CO_2 measurements have not been submitted.

The ETS reports include data about "traded-fuels" (e.g. different types of coal and fuel oils, natural gas) as well as "non-traded fuels" (e.g. industrial wastes, biomass). For each of the "traded fuels" a national default NCV and a national default CO_2 emission factor may be selected for emission calculation. For "non-traded fuels" plant operators have to make their own estimate of carbon content and NCV.

The allocation of ETS emissions to CRF categories was based on NACE codes reported by installations. Furthermore the background data for the emission calculations under the ETS were used for further QA/QC checks.

Energy

ETS 'bottom up' data 2005–2010 are used for calculation of emission data in categories 1A1 Energy Industries, 1A2 Manufacturing Industries and Combustion and 1A4 a Commercial/Institutional. About 200 plants reported 800 fuel and material flows yearly which have been considered in the inventory.

Austria uses activity data (mass and NCVs) from ETS data for the categories 1A1, 1A2 and 1A4a. ETS fuel masses/volumes and NCVs are used for activity data calculation. The remaining activity data is calculated by means of remaining fuel masses/volumes and averaged NCVs from the energy balance. ETS CO_2 emissions are considered by fuel. The remaining CO_2 emissions are calculated by remaining activity data and "national default" emission factors.

- 1A1a Public Electricity and Heat: For the years 2005–2010 CO_2 emissions from plants with a total boiler capacity of >= 20 MWth are taken from ETS reports and CO_2 emissions from plants < 20 MWth are calculated by means of national default emission factors and remaining fuel consumption of the energy balance. Coal consumption is fully covered by the ETS.
- 1A1b Petroleum refining: CO_2 emissions 2002 to 2005 are reported by the Austrian Association of Mineral Oil Industries which are consistent with ETS 2005 data. For the year 2006 onwards reported ETS data is used.
- 1A1c Manufacture of Solid Fuels and Other Energy Industries: For 2005 to 2010 CO_2 emissions and activity data of natural gas storage compressors are taken from ETS data.
- 1A2c Chemicals and 1A2d Pulp, Paper and Print as well as for 1A2e and f: For the years 2005 to 2010 CO_2 ETS data are considered with plant specific emissions and energy consumption and the remaining emissions are calculated based on the energy use. For Pulp, paper and print, in general ETS data shows slightly higher energy consumption (in terms of TJ) than current energy statistics, therefore ETS data is used from 2005 onwards.

1A2f Manufacturing Industries and Construction – Cement Clinker Production: CO_2 emissions from 2004 to 2010 are taken from the ETS allocation plan survey and ETS data. Activity data is taken from the ETS for the years 2005-2010.

- 1A2f Manufacturing Industries and Construction – Other: For 2005 to 2010 ETS data is considered for glass, bricks & tiles and lime manufacturing plants.

Industrial processes

Verified CO_2 emissions reported under the EU ETS were available for the years 2005-2010. These emissions have been incorporated in the inventory as far as possible. The relevant sources are 2.A.1 Cement Production, 2.A.2 Lime Production, 2.A.3 Limestone and Dolomite Use, 2.A.7a Bricks production, 2.A.7b Magnesia Sinter Plants, 2.A.7c Glass production and 2.C.1 Iron and Steel Production. Special attention was given to time-series consistency. Furthermore the background data for the emission calculations under the ETS were used for further QA/QC checks.

- 2A1 Cement clinker production: CO_2 emissions are taken from ETS for the years 2005-2010. ETS data cover the whole cement industry in Austria.
- 2A2 Lime Production: CO_2 emissions are taken from ETS for the years 2005-2010. These data cover the whole lime producing industry in Austria. The ETS data are consistent with data from the association of the stone and ceramic industry and with statistical data.
- 2A3 Limestone and Dolomite Use: CO_2 emissions are taken from ETS for the years 2005-2010. ETS data cover limestone and dolomite use in the iron and steel and the chemical industry. Since 2005, ETS background data provided more detailed information on the actual carbon content of limestone and dolomite used. Therefore, the IEFs since 2005 are slightly different to the IPCC default values.
- 2A7 Glass production: Since 2005, ETS background data provided more detailed information on the actual carbon content of the carbonates used. Therefore, the IEFs since 2005 are slightly

different compared to the IPCC default values. For 2005–2010 verified CO_2 emissions and activity data, reported under the ETS, were considered for the inventory. These data cover small amounts of other carbonates used in glass industry that have been included from 2005 onwards.

- 2A7 Bricks and Tiles Production: For 2005-2010 verified CO_2 emissions, reported under the ETS, were used for the inventory. These data cover the whole brick industry in Austria.
- 2A7 Magnesia Sinter Production: CO_2 emissions reported under the ETS were used in the inventory. The operator reported total CO_2 emissions, which were compared with the ETS data and found to agree with the inventory estimations.
- 2C1 Iron and Steel: Verified CO_2 emissions reported under the ETS were used in the inventory. These data cover CO_2 emissions from pig iron, basic oxygen and electric arc furnace steel. For pig iron production the values for 2005-2010 correspond to the background data given in the ETS report. Since 2005 the IEF is quite stable, because background data reported under the ETS allowed accounting for reducing agents other than coke.

Belgium

General

The coverage of CO_2 emissions from ETS activities in relation to individual CRF source categories is not provided in the Belgian NIR.

ETS data are generally used for QA/QC purposes in all regions. Detailed information is provided on the detailed use of ETS data for inventory purposes for Flanders and Wallonia, but not for the Brussels region.

In the Flemish region reported sources in the ETS framework are compared with the reported sources in the greenhouse gas emission inventory and completed if necessary. Next to this, the emissions of CO_2 of the most important sources are also compared in these two datasets for the available years and tuned where possible and relevant. This means that, when major changes are detected in the reported emissions of CO_2 and/or energy data, the involved industry is contacted and data are optimized if necessary. As a result more accurate emissions and/or energy data can be obtained. Since the beginning of 2010, a study is conducted to examine the differences more in detail between energy and CO_2 data reported under the ETS and the data used in energy balances (energy use) and for emission reporting (CO_2). In the Flemish region, the emission reports under the ETS Directive are verified by a verification office, the Verification Office Benchmarking Flanders, VBBV. In Wallonia, data obtained from industrial companies concerned by the European Emission Trading process are systematically cross-checked with certified reports in the framework of that mechanism. Since 2005 ETS data are used directly in Flanders and Wallonia in several source categories.

Energy

In Wallonia, since 2004, emission trading companies (included the power plants and coke oven plants) are obliged to report their energy consumptions and CO_2 emissions via a website (Regine). These data have been checked during the emission trading verifications.

- 1A1a Public electricity and heat production: In the Walloon region some QC-tests were performed in the course of 2010. In particular in the category 1A1a, a recalculation with the emission trading data is performed. In the complete sector 1A1, a comparison of activity data is performed between the Walloon CRF reporter data and the Walloon energy balance for the complete time series.

- 1A1c Manufacture of Solid Fuels and Other Energy Industries: Since 2005, the CO_2 emissions have been giving directly by the plant under the emission trading scheme (Wallonia). It's difficult to use these ETS data (coke oven gas analyses) to make a complete recalculation as there were 5 coke plants in 1990, 4 of them are now closed and there is still only one coke plant in 2009 in Wallonia.
- 1A2 Manufacturing Industries and Construction: Wallonia uses EFs for solid fuels, blast furnace gas, coke oven gas and waste fuels from ETS reporting. Concerning natural gas, gas oil and residual fuel, the CO_2 emission factors are mainly derived from the IPCC 1996 Guidelines.
- 1A2a Iron and Steel: In the Flemish region the emissions of CO_2 for the biggest steel plant are revised for the complete time series during the 2011 submission mainly because of inconsistencies in emissions during the last years between the GHG inventory and the emissions reported under the ETS. As a consequence some missing fuels were added in the inventory (cokesgrid for the complete time series and anthracite from 2004 on).

Industrial Processes

Since 2005 EU-ETS-data are integrated in the Flemish greenhouse gas inventory in the sectors of glass and ceramic (category 2A). The emissions of these sectors were recalculated for the historical years with the same methodology as the one used for EU-ETS-purposes. Because of the small emissions of CO_2 in these sectors (below the threshold of 100 kton CO_2) no other reporting obligations than the ETS-reporting for these industries exist in the Flemish region.

- 2A7 Glass production: The production of glass takes place in the Flemish and in the Walloon regions. In the Walloon region the CO_2 emission factors are calculated by the glass plant since 2003. These data are verified under the emission trading scheme. In the Flemish region more companies revised their calculation methodology for estimating their emissions of CO_2 based on the methodology used in the framework of the EU-ETS Directive.
- 2A7 Ceramic Production: In consultation with the federations and companies involved, an estimate is given of the emissions of CO_2 in the Flemish region. This estimation is calculated in Flanders with the methodology recorded in the monitoring protocol of the companies (emission trading scheme) and is based on production information and the evolution of the gamut of products. Wallonia uses plant-specific emission factors for glass production since 2003 which were verified with the data provided under the ETS.
- 2C1 Iron and Steel Production: During the 2011 submission the emissions of CO_2 in the iron and steel sector are completely revised in the Flemish region and based on the ETS-methodology instead of C-balance-approach in previous emissions. This revision took place mainly because of inconsistencies in emissions between the GHG emission inventory and the emissions reported from the emission trading directive. As a consequence the process emissions were revised as well. In the Walloon region CO_2 emissions (process and combustion emissions) have been obtained directly by the obliged reporting of the plants under the emission trading scheme since 2005.

Denmark

General

The EU ETS data for power plants account for 55 % of the CO_2 emission from stationary combustion. EU ETS data are information on fuel consumption, heating values, carbon content of fuel, oxidation factor and CO_2 emissions. DCE receives the verified reports for all plants which utilises a detailed estimation methodology. DCE´s QC of the received data consists of comparing to calculation using standard emission factors as well as comparing reported values with those for previous years. Outliers are checked.

In the Danish inventory plant or activity based CO_2 emission factors have been derived for power plants combusting coal and oil, refinery gas and flare gas in refineries, fuel gas and flare gas at off-shore installations, cement production, production of brick and tiles and lime production. For all these sources the EU ETS reports are only used in the Danish inventory for plants using high tier methods. The EU ETS data have been applied for the years 2006 - 2010.

Energy

Fuel combustion

The CO_2 emission factors for some large power plants and for combustion in the cement industry and refineries are plant specific and based on the reporting to the EU Emission Trading Scheme (EU ETS). In addition emission factors for off-shore gas turbines and refinery gas is based on EU ETS data. The EU ETS data have been applied for the years 2006 - 2010.
The EU ETS data for power plants include plant specific emission factors for coal, residual oil and gas oil.

- Power plants, coal: EU ETS data for 2010 were available from 14 coal fired power plant units. The plant specific information accounts for 97 % of the Danish coal consumption and 49 % of the total CO_2 emission from stationary combustion plants. The plants all apply bituminous coal. In 2010, the implied emission factor (including oxidation factor) for the power plants using coal was 93.6 kg per GJ. In 2010, only 2 % of the CO_2 emission from coal consumption was based on the emission factor, whereas 98 % of the coal consumption was covered by EU ETS data.
- Power plants, residual oil: EU ETS data for 2010 based on higher tier methodologies were available from 8 units combusting residual oil. The EU ETS data accounts for 34 % of the residual oil consumption in stationary combustion.
- Power plants, gas oil: EU ETS data for 2010 based on higher tier methodologies were available from 3 plants combusting gas oil. The EU ETS data accounts for 5 % of the gas oil consumption in stationary combustion.
- Industrial plants: Plant specific CO_2 emission factors have also been applied for the cement production plants, sugar production plants and vegetable oil production plants, that are part of source category 1A2 Industry. The EU ETS data includes CO_2 emission factors for coal, petroleum coke, residual oil and waste.
- Off-shore gas turbines: Individual EU ETS data are not applied for each of the off-shore gas turbines, but EU ETS data have been applied to estimate an average CO_2 emission factor for this source category. EU ETS data for the fuel consumption and CO_2 emission for off shore gas turbines are available for the years 2006-2010. Based on data for each oilfield implied emission factors have been estimated for 2006-2009. The average value has been applied for the years 1990-2005.
- Refinery gas: The emission factor applied for refinery gas refers to EU ETS data for the two refineries in operation in Denmark. Implied emission factors for Denmark have been estimated annually based on the EU ETS data since 2006.

Fugitive emissions

Reporting to the European Emission Trading Scheme are available in the annual EU ETS reports for refineries, offshore oil and gas extraction facilities and the natural gas treatment plant, concerning fugitive emissions. EU ETS data are only included in the national emission inventory if higher tier methodologies are applied. EU ETS data adequate the requirements in the IPCC good practice guidance and are considered the best data source on CO_2 emission factors due to the legal obligation for the relevant companies to make the accounting following the specified EU decisions.

- Flaring: Emissions from flaring are estimated from the amount of gas flared offshore, in gas treatment/storage plants and in refineries and from the corresponding emission factors. Emissions calculations are based on annual reports from the Danish Energy Agency and environmental reports from gas storage and treatment plants and the refineries. Calorific values are based on the reports for the EU ETS for offshore flaring, on annual gas quality data from Energinet.dk, and on additional data from the refineries.
- Oil refining: The refineries deliver information on consumption of fuel gas and fuel oil. The calorific values are given by the refineries in the reporting for EU ETS from 2006. Before 2006 the calorific values given by the refineries were used when available. When not available standard calorific values given in the basic data tables from the Danish Energy Agency combined with the conversion factor between fuel gas and fuel oil given by the refinery were used for calculation.

Industrial Processes

- 2A1 Cement production: There is only one producer of cement in Denmark, Aalborg Portland Ltd. The activity data for the production of cement clinker is obtained from the company and the CO_2 emission is from the company report to EU ETS.
- 2A2: Limestone: Limestone is used for the refining of sugar as well as for wet flue gas cleaning at power plants and waste incineration plants. The emission factors are based on stoichiometric relations between consumption of CaCO3 and gypsum generation as well as consumption of lime for sugar refining and precipitation with CO_2. This information is supplemented with company reports to EU-ETS.
- Glass and Glass Wool: The reference for activity data for the production of glass and glass wool are obtained from the producers published in their environmental reports. Emission factors are based on stoichiometric relations between raw materials and CO_2 emissions. This information is supplemented with company reports to EU-ETS.
- 2A5: Bricks and Tiles: The production of lime and yellow bricks gives rise to CO_2 emissions. The emission factors are based on stoichiometric relations, assumption on CaCO3 content in clay as well as a default emission factor for expanded clay products. This information is supplemented with company reports to EU-ETS. For 2006-2010 emission factors have been derived from CO_2 emissions reported by the brickworks to EU-ETS (confidential reports from approximately 20 brickworks) and production statistics (Statistics Denmark, 2011).
- 2A5: Yellow bricks and expanded clay products: For 2006-2010 emission factors for clay products have been derived from CO_2 emissions reported to EU-ETS (Damolin, 2011; Maxit, 2011) and production statistics (Statistics Denmark, 2011).
- 2D: Sugar production: from the year 2006-2010 the CO_2 emission compiled by the company for EU-ETS is used in the inventory (Danisco, 2011).

Uncertainties

The EU ETS data are thereby a source of consistent data with low uncertainties. Unfortunately, corresponding data does not exist before the commencement of EU ETS in 2006 and therefore it is not possible to set up time-series based on EU ETS.

Finland

General

At sectoral level verified emissions from EU ETS have complete coverage for

- Cement Production
- Lime production
- Iron and steel production

Finland also indicates how many of the total plants are included in the ETS in other sectors:

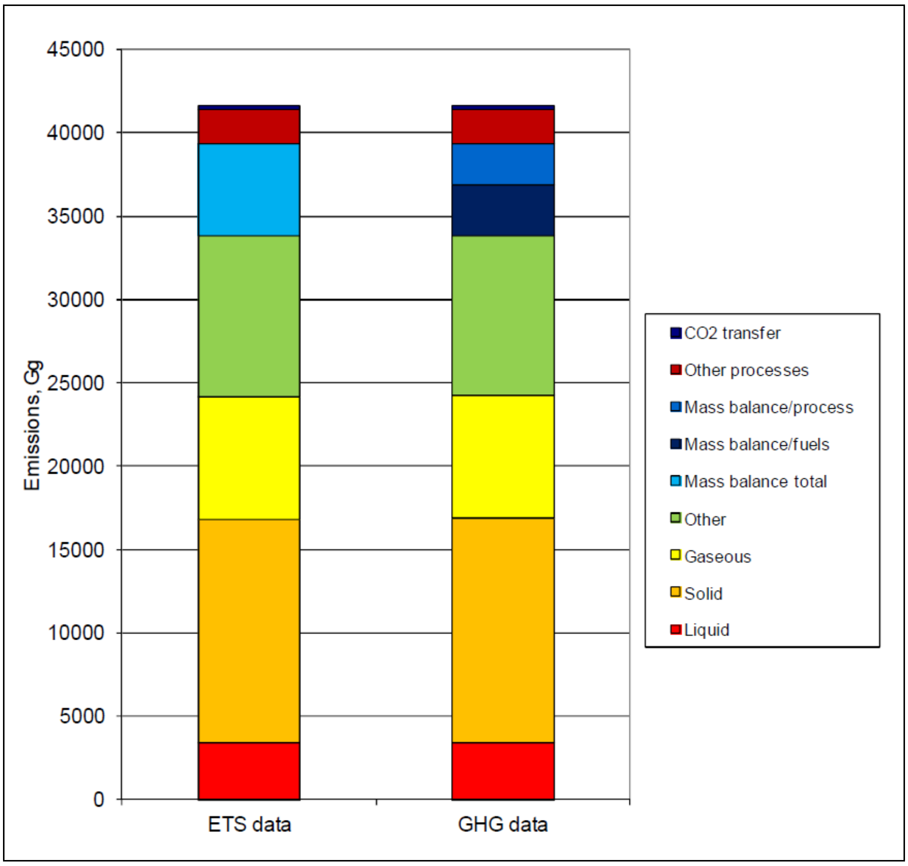
- Limestone and Dolomite Use: 19 plants out of 26 covered by ETS
- Glass Production: 4 plants out of 5
- Hydrogen Production: 2 plants out of 6

The EU ETS data obtained from the Energy Market Authority has become an increasingly important source of activity and emission data for the inventory. It has been used as prime source of activity data (especially for emissions in the Industrial process sector) and for comparison of fuel consumption and CO_2 emissions of specific installations (mainly energy emissions).

CO_2 emission data taken from the EU ETS are annually compared with the calculated emission data in the ILMARI system. Both systems include point source (bottom-up) data. In the ILMARI system the plants included in the ETS are marked. Thus summaries of total ETS and non-ETS plants can be made easily. Total CO_2 emissions taken from the ETS data were 41.5 Tg in 2010. The corresponding amount taken from the GHG inventory data was 41.5 Tg. In the ETS data 182.8 Gg of CO_2 and in the GHG data 197.5 Gg of CO_2 was transferred out of the ETS plants. The reduced amount is different because the storage factor in the inventory is based on annual data and in the ETS a predetermined average storage factor is used. The difference between the ETS and GHG data is 0.016 Tg, 0.04% of total ETS. There are more differences in the allocation of emissions to CRF categories, which can be seen in Figure 2.

The most important difference is in the Iron and steel sector, which is almost totally allocated to Industrial Processes in the ETS data. All iron and steel plants calculate and report their emissions according to the mass balance approach in the ETS. In the GHG inventory emissions are split between Energy and Industrial Processes. Another difference is the emissions of combustion of catalytic cracking coke in oil refineries, which is included in the Energy sector in the inventory and in Industrial Processes in the ETS.

Figure 2: CO_2 emissions of ETS plants compared with the corresponding emissions reported in the greenhouse gas inventory in 2010.



Source: NIR of Finland, submission 2012, p.83, Figure 3.2-2

From 2008 onwards ETS plants have been using mostly measured plant level calorific values and emission factors.

NCVs, CO_2 emission factors and fuel consumption data taken from the ETS plants were aggregated to the most detailed fuel code level and compared with the corresponding data in the ILMARI system. If there were significant differences, corrections were done in the ILMARI data (either plant-specific NCVs of emission factors or both). Concerning the most common and the most important fuels, the differences in aggregated NCVs and EFs were generally less than +-1%. For wood fuels the differences in NCVs were somewhat larger (generally +-3%). This result was expected, mainly due to difficulties of plant operators in disaggregating different types of wood residues to existing fuel code system, but also due to variations in the moisture content of wood fuels. The difference in total amount of woodfuels in TJs was 1.7% in 2010.

Energy

Emissions from fuel combustion are by far the largest source of greenhouse gas emissions in Finland, and many point sources in this category are part of the EU Emission Trading Scheme. Monitored data for CO_2 emissions from these sources have become available from the emission trading system for the inventory years 2005 - 2010. In the Energy sector ETS data have been mainly used in:

- identifying missing point sources

- checking and verifying fuel consumption data
- verifying emission data
- verifying NVCs and CO_2 emission factors by fuel type.

The work to input the data from the ETS system in the GHG database system (ILMARI) has started during 2010. At the moment the ETS plants and data are included in the ILMARI for plant level verification. In 2011 more routines were developed to flag differences in the plant level data. The actual corrections and imputations are still performed manually.

Until 2007 the national CO_2 EF for hard coal is based on a research study. In the previous inventories, long time average national CO_2 EF (94.6 t/TJ) has been used as a default EF. EU ETS started in 2005. During the first period (2005-2007) the plants were allowed to use national default EFs for solid fuels. Starting from 2008 the plants included EU ETS system have been obliged to monitor emission factors for solid fuels. In the QA/QC procedures, national default EFs of each fuel are compared to the EFs derived from the ETS data. In 2008 and 2009 the difference in the EF for hard coal was acceptable, but in 2010 the difference was 1.4%. Therefore it was decided that national annual EF for hard coal will be taken from the ETS data (which covers over 99% of total hard coal consumption. This system was put into operation starting from inventory year 2008, which is the starting year for verified EFs in the ETS system.

The PCC production data has been crosschecked with other data sources. Statistics Finland has collected plant specific data on the production amounts by PCC plant for the relevant years from the VAHTI database (national environmental permit registry) and the production statistics (plant specific data from Statistics Finland's manufacturing industry surveys). The data have also been crosschecked with the amount of captured and transferred CO_2 reported under the EU ETS. These data exist for the years 2005-2010 and include the captured and transferred amount of CO_2 by plant.

The differences in the PCC production data from the various sources have been very small. The amount calculated and reported by Statistics Finland in the greenhouse gas inventory has been approximately 97 per cent of the data reported to EU ETS 2005-2007. The difference is assumed to account for possible losses during transfer and production.

Industrial Processes

- 2A1 Cement Production: Data for Clinker production for the years 1990-2006 are received directly from the company and for years 2007-2010 from EU ETS data. All activity data for years 1990-2006 have been received directly from the company, but as a result of comparison of this data and EU ETS data, it was decided to give up inquiries because data received from the company and in EU ETS data were equal. The emissions of the most recent five years have been compared with EU ETS data. Differences between those figures have been less than 3%. For three years calculated emissions are higher than reported in EU ETS and for two years lower.
- 2A2 Lime Production: Emissions from 2005 onwards have been calculated using production data reported to the EU ETS data. The total amount of produced lime has also been checked from industrial statistics. The calculation method was slightly updated due to new information of activity data in EU ETS, as only pure lime (=CaO+MgO amounts) are used as activity data (impurities have been written off the amount of lime). All other years (1990-2004) production amount was recalculated using assumption (Emissions permit, 2010) that about 6 per cent of product is impurities. The calculated emission data for years 2005-2010 of all plants have been verified with ETS data (all plants are included in EU Emission Trading Scheme) and differences in

emissions have been found to be less than 9%. During the 2011 review it was noticed that total emissions from lime production in the inventory differed 9% from the emissions in EU-ETS and reasons for that were questioned. For the cause for the difference was noticed the purity of produced lime. The activity data used in EU-ETS is pure CaO and MgO and in the calculation of emissions of earlier years also impurities were included in amount of activity data. Due to new knowledge of activity data; the production data for years 1990-2004 were updated. The activity data for 2005-2009 were not updated because it has been received from EU ETS. As a result the emission of 2005-2009 were increased and are now closer to the verified EU ETS emission data. Emissions for years 1990- 2004 were not changed due to this recalculation, only used emission factor changed.

- 2A3 Limestone and Dolomite Use: Activity data for 2010 are collected directly from individual companies also the EU ETS data have been used. Most of the data for the earlier years have been received from individual companies, EU ETS and a small part has been estimated using industrial statistics. Also data on previously uncertain limestone and dolomite users have been checked using industrial statistics and web sites of companies and discovered that their uses do not cause CO_2 emissions.The calculated emission data of 19 plants (out of 26) have been verified with ETS data and emissions have been found to be almost equal. Higher emissions have been formed because in EU ETS companies calculate emissions using default emission factors and in the inventory emission factors are based on assumption that not all limestone and dolomite are calcinated in the process.
- 2A7 Glass Production: The consumption of limestone and dolomite has been used as activity data when calculating emissions from limestone and dolomite use. Activity data for 2010 are collected directly from individual companies and the EU ETS data. Most of the data for the earlier years have been received from individual companies, EU ETS and a smallish part have been estimated using industrial statistics.
- 2B5: Hydrogen Production: The calculated emission data of two plants (out of 6) have been verified with ETS data and emissions have been found to be equal. These two plants are biggest emitters in this category, amount of their emissions represents more than 90% of category's emissions.
- 2C1: Iron and Steel Production: From 2005 on, all four iron and steel plants in Finland report to the EU ETS. Starting from 2007 submission (2005 data), the total CO_2 emissions for GHG inventory have been taken from the ETS data, although the split between process and fuel-based emissions has been done in the same way as in the previous years' calculation.

France

General

France indicates in a general way that CO_2 emissions in the inventory are consistent with ETS emissions because they are based on the same data sources. In France plant-specific data is collected by the same entities from the same installations for both the EU-ETS and the GHG inventory and energy statistics and data is therefore consistent. The collection for the EU ETS and the inventory is therefore coordinated and coherence acorss data sources was achieved.

Small deviations occur for the following reasons:

- The CO_2 emissions from blast furnace gas are allocated to the producer. The user of these gases also declares their emissions. This could result in small differences and it is important to avoid double counting.
- Small installations with small emissions are not individually included in the estimation approach.

- The sectoral and source category definitions can be different.

Where all facilities in a given sector are covered by the ETS, consistency with the inventory is ensured by taking into account the information given by the installations that is audited by a recognized organization and by the French administration. If only some of the facilities in a sector are within the scope of the ETS, their statements under the ETS are also taken into account but the balance is accounted by other means to ensure consistency.

Energy

- 1A1 Energy industry: CO_2 emissions are determined by using emission factors for each fuel. National values are applied except when specific factors as justified by operators under the ETS are available (especially since 2005). Calculated emissions are compared with the emissions data reported under the ETS.
- 1A2f Combustion emissions from cement plants: Emissions data as reported under the ETS is used since 2004.
- 1A3a Pipeline compressors: The emission factor is determined based on data derived from the ETS since 2008.
- 1B2a Petroleum refining: CO_2 emissions are declared by the plants under the EU ETS.

Industrial Processes

- 2A1 Cement Production: France directly uses the emissions reported under the ETS since 2004. The data reported in the emission declarations are consistent with the EU ETS data and the data under E-PRTR since 2004.
- 2A2 Lime Production: ETS data are used for the inventory reporting since 2004, in particular to correct impurity of carbonate sources.
- 2A7 Glass Production: ETS data are used for the inventory reporting. They are completed with the remaining glass production not covered by the ETS. For this part of the production national emission factors are used..
- 2A7 Bricks and Tiles Production: The emissions from ETS plants are taken directly from the ETS reports. These emissions are complemented based on the remaining national production and emission factors taken from ETS reports.
- 2C1 Iron and steel: Work by FFA is in progress to harmonize CO_2 emissions from iron and steel with the verified emissions reported under the EU ETS.
- 2C3 Aluminium Production: Several meetings were conducted with FFA to improve the coherence of emission declarations of the iron and steel industry with the EU ETS data.

Germany

General

The coverage of CO_2 emissions from ETS activities in relation to individual CRF source categories is not provided in the NIR.

In 2006 a research project compared ETS emissions and inventory emissions and developed allocation rules how the ETS emissions should be allocated to inventory categories. Then a formalized procedure was developed for the annual data exchange between ETS authority and the inventory system. ETS data are generally used for verification and QA purposes but not directly in the inventory. EFs from ETS data are also used. AD from ETS data are not used because these data are confidential and would decrease the transparency of the GHG inventory.

In the CRF table 1s1 (Energy) Germany reports additional source category that include the combustion emissions from source categories covered by the ETS (glass, cement and ceramics). This additional voluntary reporting considerably enhances the comparability of ETS emissions with inventory emissions at sectoral level.

Energy

The NIR generally indicates that ETS data are used for verification purposes. Both systems, the inventory and the ETS, refer to a list of “basic” CO_2 emission factors in the energy sector.

- 1A3e: As a new data source for natural gas compressors fuel use is taken directly from the ETS since 2005.

Industrial Processes

- 2A1 Cement Production: EFs between inventory and ETS are largely consistent, deviation of 1%.
- 2A7: Glass Production: Emissions were compared with ETS emissions and found to be insignificant different, as ETS data included emissions from water glass production, which is not included in the inventory calculation.

Greece

General

Greece used AD and EF obtained from reporting under the ETS for the GHG inventory. In addition to the verified emissions provided for the period 2005-2010, data collected for the purposes of the national allocations plans for the ETS installations were collected for the period 2000-2006 and in some cases for the period 1990-2006 and this information was also used as a source for the inventory compilation. ETS data were used for 1A1, 1A2 and industrial processes.

The energy data used for the calculation of emissions derived from the national energy balance compiled by the Ministry of Development and the reports of installations under the EU ETS.

Energy

Emission factors: The determination of emission factors was based on data derived from verified ETS reports and IPCC guidelines.

- EF and AD were combined with remaining production and IPCC default EF to obtain complete emission estimates. ETS data of years 2005-2010 were used for the disaggregation of energy consumption into different activities / technologies. Average emission factors per fuel and source category / activity were estimated by combining ETS data and IPCC default emission factors per technology / activity and fuel. Emissions were calculated by multiplying the fuel consumption obtained from national energy balance per activity by the average emission factors of the respective source activity and fuel, which has been estimated as above-mentioned.
- 1A1a Public Electricity and Heat: For the public electricity and heat sector and for the years 2005-2010, a CO_2 EF of NG, based on plant specific data (ETS reports), was also calculated (plant specific EF).

- 1A1b Petroleum Refining: Tier 2 methodology was used with EFs calculated based on plant specific data (ETS reports) and IPCC default EFs for the whole time series. CO_2 and N_2O emissions from catalytic cracking are included in this sub-source category, while CH_4 emissions are supposed to be included in Fugitive emissions from fuels.
- 1A1c Manufacture of Solid Fuels and Other Energy Industries: Data collected during the formulation of the NAP for the period 2005 – 2007 and verified ETS reports (for years 2005 - 2010) were used in this inventory, particular EFs. The CO_2 EF of natural gas was estimated to comprise emissions from the processing of sour gas cleaning process among with the emissions from combustion. The EF for the processing of sour gas is based on ETS data.
- 1A2 Manufacturing Industries and Construction: Data collected (through questionnaires) during the formulation of the NAP for the period 2005 –2007 and verified installation ETS reports of 2005 - 2010 provided significant information regarding the structure of energy demand in industry per activity / technology. Energy consumption in activities not included in the EU emissions trading scheme (e.g. grey iron foundries) is estimated on the basis of the official data (national energy balance). For 2005 - 2010 activity data for steel production were available through the verified ETS reports. Also for Primary aluminium production and ferroalloys production which are included under Non ferrous metals plant specific energy consumption data which was available through the verified ETS Reports has been used for the years 2005-2010.
- Energy consumption in Non metallic minerals is disaggregated into energy consumption for cement production (SNAP 030311), lime production (SNAP 030312), ceramics production (SNAP 030319) and glass production (SNAP 030105) according to verified ETS reports of years 2005 - 2010.
- Data on the non-energy consumption of fuels derive from the national energy balance. However, plant specific data derived from verified ETS reports and information provided by specific Greek industries resulted to the improvement of reallocation of non-energy use fuels from the energy to the industrial processes sector: The non-energy use of natural gas for ammonia production and for hydrogen production has been reallocated in industrial processes sector, by using data from ETS reports and plant specific information.
- Solid fuels consumption in the ferroalloys production industry is included (in the national energy balance) in the solid fuels consumption of the non-ferrous metals sector. However, by using data from ETS reports and plant specific information, emissions from solid fuels for ferroalloys production are reallocated to the industrial processes sector, as from this submission.

Industrial Processes

CO_2 emissions from the majority of mineral and metal industries are estimated on the basis of country-specific emission factors. These emission factors derive of plant specific activity and emission data in the context of the EU ETS. Plant specific information has been collected through questionnaires for the formulation of the NAP (years 2005-2008) and verified reports under the EU ETS.

- 2A1 Cement Production: For the years 2005-2010 detailed data have been accessed via the verified ETS reports of the plants. These data refer to the quantities of carbonate raw material ($CaCO_3$, $MgCO_3$) used for the production of clinker.
- 2A2 Lime Production: The emissions are estimated making use of plant-specific data provided by the verified reports of the plants under the ETS.
- 2A3 Limestone and dolomite use: Steel production: Data are generally plant specific, deriving from the EU ETS verified reporting of the plants (for the years 2005-2010); Ceramics production: Carbonates consumption data (in the context of the ETS reports) have been used to estimate

emissions in the years 2005-2010. Activity data refer to CaCO3 and MgCO3 consumption (emission factors 0.44 and 0.522 respectively). SO_2 scrubbing: The operation of flue gas desulphurization systems in Greece started in 2000. The estimation of emissions is based on data collected during the formulation of the NAP for the period 2005 – 2007. For years 2005-2010 data from verified installation ETS reports were used. The emission factor used (0.44 t CO_2 / t limestone) derives from the stoichiometry of the reaction. Emissions have increased considerably in 2009 and 2010 as a result of the inclusion of new operation plants in the system in 2009.

- 2A4 Soda Ash Use: Since February 2006 there is only one plant operating in Greece, whereas since 2005 this plant used to have two factories. Production data have been given for both factories for years 2005- 2006 and for the only plant left for the years 2007-2010. Also for the years 2005-2010 the reports in the EU ETS context have been extensively used.
- 2A7 Glass Production: Activity data for the period 2001 – 2004 were collected (through questionnaires developed according to the guidelines described in the Commission Decision 2004/156/EC) in the framework of the formulation of the NAP for the period 2005 – 2007, according to the EU Directive 2003/87/EC. Since February 2006 there is only one plant operating in Greece, whereas since 2005 this plant used to have two factories. Production data have been given for both factories for years 2005- 2006 and for the only plant left for the years 2007-2010. Also for the years 2005-2010 the reports in the EU ETS context have been extensively used.
- 2B5 Production of other chemicals: CO_2 emissions are estimated on the basis of the natural gas consumed for the process. Data are provided by DEPA for the whole time-series and by the verified EU ETS reports of the refineries for years 2005-2010.
- 2C1 Iron and Steel: Data are generally plant specific, deriving from the EU ETS verified reporting of the plants (for the years 2005-2010) and the reporting performed for the NAP formulation in the previous years. Activity data and EF for 2005-2010 are plant specific and are based on the verified reports under the EU ETS context. According to information received by the ElStat, all the iron and steel plants of the country are included in the EU ETS.
- 2C2 Ferroalloys Production and primary aluminium production: Activity data for 2005-2010 derive of the verified reports of the industry under the EU ETS.

QA/QC

Quality control of activity data include the comparison of the same or similar data from alternative data sources (e.g. Hellenic Statistical Authority and ETS reports) as well as time-series assessment in order to identify changes that cannot be explained. It should be noted that information and data collected (through questionnaires developed according to the guidelines described in the Commission Decision 2004/156/EC) in the framework of the formulation of the National Allocation Plan (NAP) for the period 2005 – 2007, according to the EU Directive 2003/87/EC (and its transposition to the national Law, JMD 2004) along with the data from the verified reports from installations under the EU ETS for years 2005-2010 constituted a significant source of information and an additional quality control check.

- Activity data comparison: Cross-checking between energy consumption data derived from national energy balance and plant specific energy consumption data of major industrial plants derived from verified ETS reports is performed.
- Emissions comparison: Verified ETS reports were used for the computation of plant specific CO_2 EFs and NCVs. For quality control purposes emissions calculated by applying PS EFs and NCVs are compared with the emissions calculated by using IPCC defaults EFs and NCVs derived from energy balance. By this way emission estimations were verified. The most appropriate EFs and NCVs per sector are selected and applied.

Ireland

General

Emission trading covers approximately 100 installations in Ireland with combined CO_2 emissions of 17,356 Gg in 2010, accounting for 28.3 percent of total greenhouse gas emissions. The ETS data have a complete coverage for of CO_2 estimates for categories 1.A.1 Energy Industries, 2.A.1 Cement Production, 2.A.2 Lime Production, 2.A.3 Limestone and Dolomite Use, 2.A.4 Soda Ash Production and Use and 2.A.7 Bricks and Tiles.

The Emissions Trading Unit (ETU) forms part of OCLR and is a key component of the national system. Information submitted by participants in the European Union Emissions Trading Scheme (ETS) under Directive 2003/87/EC (EP and CEU, 2003) is managed by the ETU and is available to the inventory team in OCLR. The annual ETS compilation serves as an important source of activity-specific and company-specific data on CO_2 emissions, fuel use and emission factors for major combustion sources and industrial processes. The ETS returns to the Agency´s Office of Climate, Licensing and Resource Use (OCLR) provide for the complete coverage of CO_2 estimates for in a number of sub-categories under 1.A.1 Energy Industries and 2.A. Mineral Products. When the allocation to these categories from the ETS raw data is completed, the output is returned to the ETS administrator in OCLR for final checking against the source data. This ensures the efficient and consistent transfer of the verified ETS emissions estimates into the national inventory. Inventory development continues to benefit from the internal review procedures that are ongoing with regard to the EU and its Member States.

Energy

The incorporation of the ETS data in the Energy sector for the last several submissions is again considered an important step towards improved reliability and accuracy of the estimates for categories 1.A.1 and 1.A.2. Thorough checking of this input is achieved in collaboration with colleagues in the Climate Change and Environmental Research Unit (CCERU) of the EPA, which acts as the competent authority for the ETS in Ireland. Following receipt of the raw ETS data from CCERU, the inventory experts allocate the CO_2 estimates and corresponding energy amounts to the appropriate sub-categories for CRF reporting and then return the compilation to the CCERU contact person for final checking and accounting of any amendments following the ETS verification process. This ensures that where ETS emissions estimates cover a category completely, such as in 1.A.1, the verified CO_2 values are transferred directly to the national inventory and consistency of results is guaranteed. In the case where the CO_2 estimates from ETS do not completely cover the category, as for 1.A.2, the benefit is realised as better information on fuels and more representative emission factors, which improves the top-down estimates of emissions obtained using the energy balance.

As for all years since 2005, CO_2 estimates reported under the ETS for 2010 are used to achieve complete bottom-up results in respect of some important sub-categories in this sector for the 2010 inventory. This is a significant advance in terms of accuracy as the ETS estimates are verified and they represent a large proportion of the total emissions from the Energy sector.

- 1A1 Energy Industries: The Annual Installation Emissions Reports (AIER) submitted by ETS participants in respect of their CO_2 emissions and fuel combustion in 2010 under Directive 2003/87/EC were used to report the complete inventory for category 1.A.1. The emissions data from a total of 24 individual installations – 21 electricity generating stations in 1.A.1(a), one oil refinery in 1.A.1(b) and two peat briquetting plants under 1.A.1(c) – are the basis for compiling the results in this important category. In each of the three sub-categories, the verified CO_2 estimates reported by the ETS participants were used directly and the corresponding fuel use as given in the national energy balance was used to estimate CH_4 and N_2O emissions using the appropriate IPCC emission factors mentioned in the previous section.

- 1A1a Public Electricity and Heat Production: The CO_2 emissions for sub-category 1.A.1(a) obtained from AEIRs are estimated by ETS operators using tier 3 methodologies. The summarised CO_2 emissions compiled in the ETS database according to fuel type for all installations that constituted sub-category 1.A.1(a) in 2010 are aggregated to report the CO_2 emissions for this category. The CO_2 emissions estimates compiled through ETS for sub-category 1.A.1(a) are cross-checked with a separate long-standing data flow to the inventory agency covering plant-specific emissions for electricity generating stations that are used to report on the Large Combustion Plant Directive and the Convention on Long-Range Transboundary Air Pollution. The aggregated CO_2 emissions reported in the latter data-flow correspond to the compilation available under the ETS for all years since the ETS data became available.
- 1A1b Petroleum Refining: One small oil refinery accounts for the emissions reported under 1.A.1 (b) Petroleum Refining. The reported CO_2 emissions are those available from the ETS database. These emissions are estimated using tier 2 methodologies. Because high-pressure gas, low-pressure gas and residual fuel oil account for the bulk of the emissions in 1.A.1 (b) in all years and the emission factors for these fuels do not fluctuate significantly, the emissions reported using ETS data are consistent with the annual estimates for historical years.
- 1A1c Manufacture of Solid Fuels and Other Energy Industries: Emissions for 1.A.1(c) Manufacture of Solid Fuels and Other Energy Industries were reported for the first time in the 2006 submission and refer to the production of peat briquettes from milled peat in two plants. The 2010 values for CO_2 are also taken from ETS returns which are based on tier 2 methodologies.
- 1A2 Manufacturing Industry and Construction: The combustion CO_2 emissions in a variety of installations across the CRF sub-categories 1.A.2(a) through 1.A.2(f) are covered by the ETS Directive 2003/87/EC but the total CO_2 emissions in any sub-category cannot be reported for Ireland using ETS data alone, as in the case of the sub-categories under 1.A.1. The ETS data are instead used to compare fuel quantities reported under ETS with corresponding amounts given in the preliminary national energy balance and to determine improved country-specific emission factors that can be applied for particular fuels and sub-categories. Information provide from the ETS on fuel data have been used to develop an annual country-specific CO_2 emission factor for petroleum coke since 2005. Petroleum coke is used in sub-categories 1.A.2.b, e and f. The average of the most recent five years of yearly specific emission factors is applied to years prior to 2005, as ETS data is only available from 2005 onwards.

Industrial Processes

The process CO_2 emissions for the relevant source categories under *2.A Mineral Products* are largely covered by Directive 2003/87/EC (EP and CEU, 2003) on emissions trading in the EU and full use is made of this data source for the compilation of the national inventory. In general, the annual verified CO_2 emissions in respect of the installations concerned are used directly for the years covered by the ETS.

- 2A1 Cement Production: As the EU ETS subsequently became operational, plant specific CO_2 emissions and corresponding clinker production data are also available for all cement plants for the years 2004 through 2010 and these data are used directly to report emissions for category 2.A.1 in Ireland.
- 2A2 Lime Production: As in the case of cement production, lime producers provided their own estimates of CO_2 emissions from lime manufacture for the development of NAP1 under Directive

2003/87/EC on ETS. These were calculated in accordance with the methods described in the supporting Decision 2004/156/EC, thus providing detailed information on emission estimates and activity data for another important source of CO_2 emissions in *Industrial Processes*. The CO_2 estimates for lime production in 2010 have been obtained from the ETS returns to the EPA as for other recent years covered by the scheme and these have been used to confirm the estimates for previous years of the time-series.

- 2A3 Limestone and Dolomite Use: The CO_2 emissions reported under this category refer to those emissions associated with the use of limestone ($CaCO_3$) for flue gas desulphurisation and limestone used in the manufacture of bricks and tiles. Limestone has been used to capture the sulphur emitted from peat burning in one electricity generating station since 2001 and in a second such plant since 2007. The CO_2 emissions estimates are taken from ETS returns. They are estimated on the basis of limestone quantity used by the companies and an emission factor of 0.44 t CO_2/t limestone, which is the stoichiometric ratio of CO_2 to $CaCO_3$. A further minor use of limestone relevant to *2.A.3 Limestone and Dolomite Use* in Ireland is its application in the purification of sugar produced from sugar beet. However, sugar production ceased in 2006 and the only information on emissions is that obtained under ETS in respect of 2005 and 2006.
- 2A4 soda Ash Production and Use: The emissions associated with soda ash use by one company in Ireland are reported by the company under ETS for the years 2005-2010 and have been used directly in the inventory. Activity data for years prior to the ETS data were sourced by the inventory agency from the company. These data were combined with an emission factor of 0.41 t CO_2/t soda ash, indicated by the ETS data. This approach has allowed a full 1990-2010 time series of emissions to be included in the inventory.
- 2A7 Other Mineral Products: The emissions of CO_2 from glass production as well as the emissions arising from the use of clays and shale as a raw material in the manufacture of bricks and ceramics are reported under this CRF category. Similar to other categories under *2.A,* information from individual plants that are participants in the Emissions Trading Scheme is utilised to report the emissions estimates in the national inventory. In the case of bricks and ceramics, the ETS data for the four companies concerned provide estimates of emissions for the years 2005-2010 along with the corresponding quantities of carbonate input materials and the relevant emission factors. Glas production is treated as a separate sub-category under 2.A.7. In the case of crystal glass, the CO_2 emissions are based on the use of potassium carbonate and sodium carbonate use (soda ash) as reported under ETS, using the emission factors of 0.415 t CO_2/t Na_2CO_3 and 0.267 t CO_2/t K_2CO_3, provided by the ETS monitoring and reporting guidelines.

Italy

General

Data from the Italian Emissions Trading Scheme database are incorporated into the national inventory whenever the sectoral coverage is complete. Activity data collected in the framework of the EU ETS scheme do not cover the overall energy sector, whereas the official statistics available at national level, such as the National Energy Balance (BEN) and the energy production and consumption statistics supplied by Terna, provide the complete basic data needed for the emission inventory. ETS data are always used to develop country-specific emission factors and to check activity data levels.

The inventory agency ISPRA collects data from the industrial associations under the ETS and other European directives, Large Combustion Plant and EPER/E-PRTR, and makes use of these data in the preparation of the national inventory ensuring the consistency of time series.

Energy

From 2005 onwards, also the EU ETS “verifier’s reports” cover almost the entire sector, for energy consumptions, combustion emissions and process emissions.

- 1A1 Public Electricity and Heat: From year 2005 onwards a valuable source of information is given by the reports prepared for each industrial installation subject to EU ETS scheme. Those reports are prepared by independent qualified verifiers and concern the CO_2 emissions, emission factors and activity data, including fuel used. ISPRA receives copy of the reports from the competent authority (Ministry of Environment) and has been able to extract the information relative to electricity production. The information available is very useful but not fully covering the electricity production sector or the public electricity production. The EU ETS does not include all installations, only those above 20 MWe, it is made on a point source basis so the data include electricity and heat production while the corresponding data from Terna, concerning only the fuel used for electricity production, are commercially sensitive, confidential and they are not available to the inventory team. Anyway the comparison of data collected by TERNA with those submitted to the EU ETS allows identifying possible discrepancies in the different datasets and thus providing the Ministry of Economic Development experts with useful suggestions to improve the energy balance.
- 1A2 Energy Industries: From 2008, natural gas and fuel oil consumptions reported in the CRF for this sector, are those communicated by the operators of the plants included in the sector in the framework of the EU ETS scheme. Data collected by other surveys that include integrated iron and steel plants, such as EU ETS Directive, LCP and E-PRTR surveys, have been used to cross-check the energy balance data, fuels used and emission factors. Total CO_2 emissions reported in the E-PRTR by the operators are equal to those reported under the EU ETS scheme. Other sources of information are the yearly survey performed for the E-PRTR, since 2003, and EU ETS; both surveys include main industrial operators, but not all emission sources. In particular from 2005 onwards the detailed reports by operators subject to EU ETS constitute a valuable source of data. In general, in the industrial sector ETS data source is used for cross checking BEN data. Energy/emissions data from EU ETS survey of industrial sectors should be normally lower than the corresponding BEN data because only part of the installations / sources of a certain industrial sub sector are subject to EU ETS. In case of missing sources or lower figures in BEN than ETS, at fuel sector level, a verification procedure starts. Since 2007 data, ISPRA verifies actual data from both sources and communicate to MSE eventual discrepancies. This starts a verification procedure that eventually can modify BEN data. However, we underline that EU ETS data do not include all industrial installations and cannot be used directly to estimate sectoral emissions for a series of reasons that will be analyzed in the following, sector by sector.
- 1A2 Iron and Steel: For this sector, all main installations are included in EU ETS, but not all sources of emission. Only part of the processes of integrated steel making is subject to EU-ETS, in particular the manufacturing process after the production of row steel was excluded up to 2007 and only the lamination processes have been included from 2008 onwards. Moreover, the recovered coal gases used to produce electricity and steam are not included. So the EU ETS data is only of limited use for this subsector and the procedure set up starting from the total carbon input to the steel making process, is still the most comprehensive one to estimate the emissions to be reported in 1.A.2.a. Of course, data available from EU ETS are used for cross-checking the BEN data, with an aim to improve the consistency of the data set. These plants are also reported in E-PRTR, but not all sources are included.
- 1A2 Non-Ferrous Metals: Those plants are mostly excluded from EU ETS; some aluminium producing plants will be included from 2013, but only for CO_2 and PFCs emissions from the production process.
- 1A2 Chemicals: The use of EU ETS data for this subsector is rather complex because generally chemical plants are excluded from EU ETS while petrochemical plants are included.

- 1A2 Pulp and Paper and Print: Most of the operators in the paper and pulp sector are included in EU ETS, while only a few of the printing installations are included. The problem for the EU ETS data source for this subsector is that the data are reported on a point source basis, including the production of electricity. The ETS data contain info on the energy and emissions relative to electricity, but this data are not subject to verification and appear not reliable. On the other hand, the inventory team has no access to the detailed, plant by plant, database of electricity producing plants so the emissions reported in the ETS survey cannot be divided between those belonging to table 1.A.1.a and table 1.A.2.d.

- 1A2 Other: This sector comprises emissions from many different industrial subsectors, some of which are subject to EU ETS and some not. Construction material subsector is energy intensive and it is subject to EU ETS. In the national energy database (BEN), the data for construction material are reported separately and they can be cross cheeked with ETS survey. However, in the construction material subsector, there are many small and medium size enterprises, so the operators subject to ETS are only a part of the total.

- 1B Refineries: Fugitive CO_2 emissions in refineries are mainly due to catalytic cracking production processes, sulphur recovery plants, flaring and emissions by other production processes. Total fugitive emissions from refineries are calculated on the basis of the total crude oil losses reported in the National Energy Balance. These emissions are then distributed among the different processes on the basis of average emission factors agreed and verified with the association of industrial operators (UP) and yearly updated, from 2000, on the basis of data supplied by the plants in the framework of the European Emissions Trading Scheme. In particular in the EU-ETS context, refineries report CO_2 emissions for flaring and for processes separately. From 2008, the weighted average of CO_2 emission factor reported by operators in the framework of the EU ETS scheme is used for petroleum coke refinery gas and synthesis gas from heavy residual fuels. Other sources of information are the yearly surveys performed for the large combustion plants European Directive (LCP) and the EPRTR registry; both surveys include most of refineries but not all emission sources.

Industrial Processes

- 2A Mineral Products: Under the EU-ETS, operators are requested to report activity data and CO_2 emissions as information verified and certified by auditors who check for consistency to the reporting criteria. Activity data and emissions reported under EU-ETS and EPER/EPRTR are compared to the information provided by the industrial associations. The general outcome of this verification step shows consistency among the information collected under different legislative framework and the information provided by the relevant industrial associations. In particular, comparisons has been carried out for cement, lime, limestone and dolomite, and glass sectors. Additional checks regarding emissions for 2005-2009 will be carried out on account of information from new entrance installations that will be included in the ETS from 2013.

- 2A1 Cement: Emission data reported under the different obligations are in accordance for all the facilities. In the framework of the EU-ETS as well as the EPRTR registry, 52 plants out of 58 reported in 2010 their data representing more than 98% of total national clinker production. Under the EU-ETS, cement plants communicate emissions and activity data split between energy and processes phases and specifying the amount of carbonates and additives; both activity data and emissions are independently verified and certified as requested by the EU-ETS directive.

- 2A2 Lime: CO_2 emissions from lime have been estimated on the basis of production activity data supplied by ISTAT (ISTAT, several years) adding the amount of lime produced and used in the sugar and iron and steel production sectors; emission factors have been estimated on the basis of detailed information supplied by plants in the framework of the European emission trading scheme and checked with the industrial association (CAGEMA, 2005).

- 2A3 Limestone and Dolomite Use: CO_2 emissions estimates for 2010 from limestone and dolomite use are related to the use of limestone and dolomite in bricks, tiles and ceramic production, paper production and also in the treatment of flue gases from power plants. Detailed production activity data and emission factors have been supplied in the framework of the European emissions trading scheme and relevant data are annually provided by the Italian bricks and tiles industrial association and by the Italian ceramic industrial associations (ANDIL, 2000; ANDIL, several years; ASSOPIASTRELLE, several years; ASSOPIASTRELLE, 2004).
- 2B Other – Carbon black: Three facilities have been carrying out this production. CO_2 emissions from carbon black production have been estimated on the basis of information supplied directly by the Italian production plants also in the framework of the EU ETS for the last years.
- 2C1 Iron and Steel: From 2000 CO_2 emissions and production data have been supplied by all the plants in the framework of the ETS scheme, for the years 2000-2004 disaggregated for sinter, blast furnace and BOF plants, from 2005 specifying carbonates and fuels consumption and related CO_2 emissions. For 2002-2010 data have also been supplied by all the four integrated iron and steel plants in the framework of the European EPER/E-PRTR registry not distinguished for combustion and processes. The iron and steel sector emissions reported in the national EPER/E-PRTR registry and for the Emissions Trading Scheme are compared and checked.
- Ferroalloys: CO_2 emissions from ferroalloys have been estimated on the basis of activity data published in the national statistical yearbooks (ISTAT, several years) until 2001. Time series of ferroalloys activity data have been reconstructed from 2002 on the basis of statistical information (ISTAT, 2003), personal communication (Italghisa, 2011) and on the basis of production data communicated to EPRTR register and to ETS from the only plant of ferroalloys in Italy. Activity data from ferroalloys production have been updated since 2002 on the basis of new information derived from ETS and personal communication. The comparison between EPRTR and ETS data revealed some differences: further investigation led to a direct contact with the plant and to rectify the incorrect activity data.
- Aluminium Production: From 2005 certificated emission values and parameters, including anode effects, have been communicated under EU-ETS (ALCOA, 2010). CO_2 emissions from primary aluminium have been updated from 2000 on the basis of activity data derived from ETS. Emissions from primary aluminium production have been also checked with data reported under EU-ETS.

Luxembourg (NIR 2012)

General

For large point sources – and after careful assessment of data plausibility – activity data that are reported by facilities are preferably used. Indeed, these data usually reflect the actual consumptions better than aggregated national statistics data, because the facility is supposed having the best information about its own emissions. Such plant specific data have been used for CRF sectors 1 and 2. Luxembourg's planned improvement for the future foresees to considerably extent the use of consumption and emission data provided by facilities either in the framework of the EU-ETS and of the E-PRTR in its inventories. Comparison of data is possible between figures reported by industry participating to the ETS, and the distributor's figures as well as emission reports of plant operators. This is the only country specific information on uncertainty that is available.

Energy

Activity data obtained through the Emission Trading System (ETS) were used for QA/QC procedures by comparing this data to the data reported by the plant operators. Both are hosted at the Environment Agency. A list with the large energy consuming facilities along with their respective fuel consumption has been compiled and enables the Single National Entity to quickly cross-check this data with the EU-ETS data. Thus, completeness can be checked on a more systematic basis.

Industrial Processes

- 2A1 Cement Production and 2A7 Glass Production: To calculate EFs ETS Guidelines are applied.
- 2A4 Soda Ash Production and Use: Verified ETS data is used for emissions (reported under 2A7).
- 2C1 Iron and Steel Production: 2004 and 2007 ETS guidelines are applied for calculating the emissions in 2010.

The Netherlands

General

In 2011 a quantitative assessment was made of the possible (in) consistencies in CO_2 emissions between data from ETS, NIR and National Energy Statistics. The figures that were analyzed concerned about 40% of the CO_2 emissions in the Netherlands in 2010. The differences could reasonably be explained (e.g. different scope) within the given time available for this action.

Energy

In the energy sector ETS data has been used for QA/QC purposes.

Industrial Processes

- Nitric Acid Production: From 2008 onwards, the N_2O emissions of HNO3 production in the Netherlands were opted in in the European emission trading scheme (EU-ETS). For this purpose the companies developed monitoring plans that were approved by the Dutch Emissions authority (NEa), the government organization responsible for EU ETS in the Netherlands. In 2011 the companies sent the verified emission reports to NEa. The reported and verified emissions (2010) by the companies to NEa were checked against those as reported in the CRF tables (2010). No differences were found between the emission figures in the CRF and the verified emissions in the emission reports under EU ETS.

Portugal

General

According to the NIR 2012, Portugal still plans to better integrate data from ETS into the GHG inventory and to streamline the collection of data and emission estimates between the inventory and the ETS.

Energy

- Fuel consumption data for the islands Madeira and Azores were taken from reports under the ETS as well as from the Madeira and Azores Regional Environmental entities.
- Thermal electricity power plants: Since EU-ETS data is available for inventory use plant specific Carbon content was used in those cases where fuel analysis were made by the plant operator.
- Desulfurization in Large Point Source Energy Plants in Mainland Portugal*:* Since both these energy plants are included in the EU-ETS the CO_2 ratio reported under this scheme was used in the inventory – 0.44 ton CO_2/ton Ca.

- Large Point source energy plants: For the latest years (mainly 2009 onwards) the EU-ETS completely replaced the other sources of information. Plant specific CO_2 emission factors obtained in the EU-ETS have been used. Although different information sources have been used the consistency in time series is guaranteed considering that the same original source (power plant companies) is ultimately used.
- 1A1b Refining of petroleum products: The quantities of fuel consumption from 1990 to 2004 in boilers and furnaces were collected directly from individual units under the Large Combustion Plants (LCP) directive and may be observed in the next figure for fuel oil and fuel gas. Since 2005 data source was EU-ETS. Consumption expressed in energy was calculated with the following time series of Low Heating Values. This time series reflects actual information given by each refinery also under LCP directive (1990-2004) or EU-ETS (since 2005) and are weighted averages for all three plants. In a similar mode that was done for large power plants, and according to the explanations provided before, a comparison was done for total consumption in all refinery units between the data in INERPA (from EU-ETS) and the Energy Balance. There is an agreement between the two sources of information for the initial years of the period, although not so good for the last years. The differences between the two sources of information should be analysed during next year.
- 1A2 Manufacturing Industries: Data on fuel consumption for LPS were obtained since 2009 inventory from EU-ETS. It is planned to further streamline with EU-ETS data and DGEG's energy balance, mainly for sectors like Steel production and Chemical industry.
- Improvements: Better integration between activity data in the air emissions inventory and other surveys such as LCP directive, Autocontrolo program, EPER/E-PRTR, the EU-ETS and the energy surveys (co-generation) made annually by DGEG. Contacts are being made to implement it. Particular work is being done to streamline the collection of data and emission estimates between the inventory and the EU-ETS, following the promotion efforts that are being made by the European Commission.

Industrial Processes

- 2A1 Cement Production: EU-ETS method A from Annex VII of Decision 2007/589/EC is used for the period 2005-2010. Data on consumption of raw materials, was obtained for the period 2005-2010 from EU-ETS.
- 2A2 Lime Production: EU-ETS method A from Annex VIII of Decision 2007/589/EC is used for the period 2005-2010. Data on consumption of raw materials, was obtained for the period 2005-2010 from EU-ETS.
- 2A3 Limestone, Dolomite and Carbonate Use: For this industry sector, although the consumption of carbonate bearing materials is not known for the whole period, a consumption factor was developed based on the information received under the European Emission Trading Scheme (EU-ETS), and production of construction ceramics and pavement ceramics, which is available from INE's industry surveys IAIT and IAPI, was used to obtain the full time series.
- 2A7 Glass Production: Country specific emission factors were calculated using data from 10 industrial plants in Portugal under the studies for the development of the Allocation Plan for the implementation of the ETS and under the efforts to streamline both inventories. These units reported annual production quantities together with consumption of carbonate materials: limestone, dolomite, sodium, barium and potassium carbonates, from where average emission factors could be estimated.
- 2C1 Iron and Steel: The CO_2 emission factors for Electric Arc Furnace were derived from the reporting of the two iron and steel plants that are included in the ETS. Emissions were determined from consumption of carbon bearing materials in these units: limestone, calcium carbide and coke for years 2002 and 2003. It was assumed that the same carbon content exists in both scrap and

final steel produced in EAF furnaces and consequently no additional emissions are estimated apart from carbon in additives.

Spain

General

ETS data have been used for verification purposes. An agreement with the departments of the environment ministry, the industry ministry and the Autonomous Regions has been signed for this purpose. To improve further the inventory, it is planned to continue updating the inventory by including information derived from the EU ETS. The agreement for harmonization (streamlining) is still valid.

Energy

- In the 2011 submission, CO_2 emissions from power plants in the inventory were compared with the verified reports from installations under the EU ETS for QA/QC purposes.
- CO_2 emissions were also compared for refineries to detect unusual values and outliers.
- For the iron and steel industry such comparison could not yet be performed due to the access to the information. For coke oven plants not located at integrated steel plants, it has been found that data could not be used directly due to a more aggregated level of information provided under the ETS (no differentiation of processes, thus allocation of combustion and emissions to coke oven plants only is difficult).
- For the cement industry, the CO_2 EF from combustion of tyres was revised based on information provided under the EU ETS for the years 1997 to 2010.

Industrial processes

- 2A1 Cement production: Data on consumption of raw materials, emission factors and CO_2 emissions were obtained for the period 2005-2009 from EU-ETS..
- 2A2 Lime Production: Emissions between the GHG inventory and ETS reports have also been compared for lime production and to complete information provided by the industrial association ANCADE.

Sweden

General

The coverage of ETS emissions in relation to total CO_2 emissions (without LULUCF) is 31.6% in 2008, 29.2% in 2009 and 34.3% in 2010. For a number of plants in the Energy and Industrial Process sectors, data from the ETS is used in the GHG inventory. For those source categories were ETS data was applied, companies have been contacted and asked to verify and explain the estimations they have reported to the ETS. In case there has been a mismatch between ETS and previous data, the industries have been asked to provide supplementary data. Data for years before 2005 have been taken from the data collection for the preparation of the Swedish National Allocation Plans under the ETS.

Energy

- 1A1b Petroleum Refining: Data from the EU Emission Trading System (ETS) are used for four refinery plants for 2005 and later years. For the fifth plant data from environmental reports were used. In 2008 and later years, the quality of ETS data is considered to be very high for all five of the refineries, and thus this is the primary data source for the GHG inventory. For refinery gas, plant specific CO_2 emission factors reported to the ETS are used for 2008 and later, since they are considered to be more accurate then the older standard emission factor. For each of the five refineries, ETS data for the latest year are verified against the refineries' legal environmental reports.

- 1A2c Chemicals: For one of the largest facilities, including two plants, ETS data is the activity data source for 2008-2009. Before 2008, this facility was not fully covered by energy statistics or ETS data, so environmental reports and several energy surveys were used in order to get complete data for this important facility. The company also provided a time series of CO_2 emissions covering the period 2001-2010, which was used to calculate the year specific emission factors. These new emission factors were implemented in submission 2012, and thus the inconsistent time series used in submission 2011, where the "old" emission factor was used 1990-2007 and the considerably lower emission factors reported to ETS were used for 2008-2009, has now been corrected.
- 1A2f Other Industries: For 2008 and 2009, activity data for the three plants within the cement production industry is taken from the EU ETS system.
- 1B2A1 Hydrogen production plants at refineries: Both CO_2 and non-CO_2 emissions are estimated using the Tier 2 method. Activity data as consumed amount of fuels (butane gas and naphtha, respectively for the two plants) and CO_2 emissions are taken from the company´s report to the EU ETS system.
- 1B2C2 Flaring: For the years 2005 and later, data from the EU ETS system has been used when possible. Data from the EU ETS system are verified against data from environmental reports and vice versa. In submission 2010 EU ETS data was analyzed carefully. It was concluded that the notation key for flaring of natural gas (NE in earlier sub-missions) could be changed, since no such flaring could be found in the EU ETS data and all plants that might be flaring are included in the EU ETS. The coherence between environmental reports and ETS data is checked when possible, and when differences occur, the facilities are contacted for verification. For a few plants that flare small amounts of gas, activity data as amount of flared gas is shown neither in the environmental reports, nor in the ETS data.

Industrial Processes

- 2A1 Cement production: Cement production occurs at three facilities in Sweden, with one being dominant. Emission data are obtained from environmental reports, EU ETS and by direct contacts with the facilities. Emissions have been estimated based on ETS data as well as direct information from the company. From 2005, data on clinker production and total CO_2 emissions is retrieved from the ETS.
- 2A3 Limestone and Dolomite Use: Data on the use of limestone and dolomite have been acquired from environmental reports, the ETS and through direct contacts with the companies. For facilities part of the EU ETS, data on CO_2 emissions should however be used for verification of calculated CO_2 emissions using the IPCC default values. CO_2 emissions from flue gas purification in one facility have been added from 2005 due to information from the EU ETS.
- 2A4 Soda Ash Production and Use: Data on the use of soda ash have been acquired from the ETS and through direct contacts with the reporting companies.
- 2A7 Glass production: Activity data and emissions are mainly collected from the ETS or from the facilities yearly environmental reports.
- 2A7 Light expanded clay aggregates (LECA), roofing tile, brick and ceramic production: From 2005 and onwards, the equivalent data for LECA is acquired through the ETS and the Swedish LECA producer´s annual report. For roofing tile, brick and ceramics production, activity and emission

data from 2005 and onwards is acquired through the ETS. The data in the ETS does not always separate between emissions from limestone/dolomite use and CO_2 emissions from other carbon containing raw material (i.e. from the clay and other carbonates used) needed for the production. In order to as far as possible report an accurate total process-related CO_2 emission for the facilities included in this 2A7 sub-code, Sweden have chosen to report all CO_2 emissions in 2A7. As there is a lack of data before 2005, the reported emissions for 2005 are extrapolated for 1990-2004.

- 2C1 Iron and Steel Production: Secondary Steel Production: In most cases, data from the Swedish enquiry for the Swedish national allocation plan (NAP) for the EU ETS could be used for the years 1998-2002. Data for 1990-1997 and 2003-2004 has been collected directly from the plants. From 2005, the equivalent data are acquired from the ETS, from the facilities environmental re-ports and through contacts with the companies. Data in the ETS includes information concerning carbon bound in products, slag, etc, but also other sources for process related CO_2 emissions. Prior to submission 2010, these other emissions were not included for all facilities. Estimates of these missing CO_2 emissions were performed using ETS data for 2005 – 2008 and production data for years before 2005. All CO_2 emissions presented for the facilities in ETS 2005 – 2010 are included in 2C1.1 in submission 2012. Reported CO_2 emissions until year 2008 are for all facilities, except the one which closed down in 2004, based on data in the ETS.
- Primary Iron and Steel Production: From 2005, ETS data is used and 1990-2004, information has been acquired from the plant. The emissions are verified using national statistics from Statistics Sweden on amounts of coke, anthracite and out-put material. Activity data (amount of pig iron produced) on integrated pig iron and steel production along with CO_2 emissions and consumed amounts of energy gases (coke oven gas, blast furnace gas and LD-gas) and other fuels, are reported by the plants in the environmental reports since 2003. Mass-carbon balances and associated CO_2 emissions are also reported to the EU-ETS since 2005. For some years, CO_2 emissions to the EU-ETS did not include all plant stations (rolling mills), and additional information from the plants was obtained in order to ensure that no omissions occurred. Since 2008 annual CO_2 emissions reported by the plants in their environmental reports are equal to those reported to the EU ETS. For 2003 onwards, information on activity data and emissions for all plants (CRF 1A1c, 1A2a, 1B1c and 2C1.2) are taken from the environmental reports. For plants included in the EU-ETS the report data is scrutinized and compared to EU-ETS data. EU-ETS data is applied wherever it is judged to be appropriate in line with the Good Practice Guidance.
- 2C5 Other metal production: Both plants in this category report their emissions in yearly environmental reports. For the one plant included in the EU-ETS the reported activity data and emissions are analysed and compared to EU-ETS data. Where EU-ETS data is judged to be appropriate and in line with the Good Practice Guidance, it is applied.

United Kingdom

General

The data reported under the EU ETS includes quantities of fuels consumed, carbon contents, calorific values and emissions of CO_2. Data for individual installations are treated as commercially confidential by the UK regulatory authorities and so only aggregated emissions data are presented here.

From the 2008 EU ETS dataset onwards, all of the major plant opt-outs will have ceased, and a more complete picture of fuel use and emissions across heavy industry in the UK is available. Note however, that emissions from smaller combustion devices in the industrial, commercial and public sectors will not be reported, since they are outside the scope of the EU ETS. This limitation will continue to restrict how much of the EU ETS data can be used to cross-check and directly inform the

GHGI. However, from the 2008 dataset onwards, 100% of sector emissions should be covered for several major industrial sectors:

- Power stations;
- Oil refineries;
- Coke ovens;
- Integrated steelworks;
- Cement kilns; and
- Lime kilns.

In the case of coke ovens and integrated steelworks, the EU ETS reporting format does not provide a breakdown of emissions for the sectors reported within the GHGI: estimates of emissions from coke ovens, blast furnaces and sinter plants are not provided explicitly. In addition, the scope of reporting of EU ETS does not cover 100% of iron & steel sites or activities, as some secondary steel processes are excluded from the scope of EU ETS reporting. These two factors make the analysis and comparison of the EU ETS and the GHGI estimates much more uncertain for these sectors. The EU ETS data has, however, been useful as a quality check for the use of fuels within the iron and steel sector.

Energy

Carbon emission factors for coal, fuel oil, natural gas and sour gas use in power stations and fuel oil use in refineries are based on data reported to the EU Emissions Trading System (EU ETS) for the years 2005-2010. These data are of high quality, and available for all significant UK plants - some very small power stations, e.g. on remote islands, will not report to EU ETS but their fuel use will be trivial. Due to the use of site-specific data, carbon emission factors for these source categories are Tier 3. EU ETS data are not available before 2005, therefore emission factors for the earlier years must be calculated in a different way.

- 1A1b Petroleum refinery: Data from the EU ETS are also used to estimate carbon emissions from combustion of petroleum coke at refineries. This petroleum coke is in the form of carbon deposits that build up on catalysts used in cracking processes. From 2005 onwards carbon emissions from catalyst regeneration are available from the EU ETS. The emissions are quantified by site operators within EU ETS using either a mass balance approach or, increasingly, by monitoring carbon dioxide emitted in the flue gases from the catalyst regenerator. Data are available for all UK refineries. The carbon emissions available from the EU ETS are not consistent with estimates of petroleum coke consumption given in UK energy statistics, but are used because they are the best data available. This decision was agreed in close consultation with the UK energy statistics team in DECC, as it is a deviation from reported UK energy statistics on refinery petroleum coke use. Before 2005, emissions are calculated using the activity data given in UK energy statistics and the emission factor proposed in Baggott et al, 2004. Carbon factors for OPG (2005 onwards) and fuel oil (2006 to 2010) use in refineries are now also based on EU ETS data. The EU ETS emission factor for OPG is also used for OPG use in other sectors. Emissions from petroleum coke consumption in refineries are based on DUKES data and an emission factor from 1990 to 2004, and EU ETS emissions data from 2005 onwards. The EU ETS emissions data imply that the DUKES data are not consistent with the data presented in DUKES for this sector. The time series of fuel consumption presented in DUKES has been compared with the estimates derived from the EU ETS data and the UKPIA emission factor.
- 1A2: Emission factors for coal use by autogenerators for 2005 to 2010 are now based on EU ETS

data. Emission factors for lime kilns are also based on EU ETS data.

- 1B2 Oil and Natural gas: In recent years, these EU ETS data have been used by operators to update their EEMS emission estimates for combustion processes, ensuring consistency between EEMS and EU ETS, and by the Inventory Agency as a useful Quality Check on time-series consistency of carbon emission factors. Oil and Gas UK provides emission estimation guidance for all operators to assist in the completion of EEMS and EU-ETS returns to the UK environmental regulators, including the provision of appropriate default emission factors for specific activities, where installation-specific factors are not available.

Industrial Processes

The EU ETS has, for 2005 onwards, provided a source of high quality data on emissions from some industrial processes, especially cement production. In other cases, the data is limited due to opt-outs for processes that were already part of other schemes. The GHGI has made use of EU ETS data wherever possible to improve emission estimates.

- 2A1 Cement Production: As part of the data quality checking routine for the sector, we compare emissions reported by the trade association to the aggregated installation specific data from the EU ETS. The EU ETS data explicitly includes emissions from all sources including cement kiln dust. Therefore this quality check ensures that there is complete coverage of all emissions from this sector.
- 2A2 Lime Production: Analysis of EU ETS data for lime kilns suggests that the British Geological Survey data used in the GHGI significantly underestimate activity levels, however the EU ETS data are subject to some uncertainty and cover all relevant sites only from 2008 onwards. EU ETS data have cast doubt on the accuracy of the activity data currently used for this source, in particular the accuracy of data for 2008 onwards. Further research would be needed in order to verify the alternative data for 2008-2010 and also to extend the data back to earlier years. Only then could a decision be made about whether to replace the current inventory activity data with new values.

1.4 Description of key categories

A key category analysis has been carried out according to the Tier 1 method (quantitative approach) described in IPCC (2000). A key category is defined as an emission source that has a significant influence on a country's GHG inventory in terms of the absolute level of emissions, the trend in emissions, or both.

In addition to the key category analysis at EU-15 level, every Member State provides a national key category analysis which is independent from the assessment at EU-15 level17. The EU-15 key category analysis is not intended to replace the key category analysis by Member States. The key category analysis at EU-15 level is carried out to identify those categories for which overviews of Member States' methodologies, emission factors, quality estimates and emission trends are provided in this report. In addition, the EU-15 key category analysis helps identifying those categories that should receive special attention with regard to QA/QC at EU level. The Member States use their key category analysis for improving the quality of emission estimates at Member State level.

17 A comparison of the EC key category analysis with the key category analysis of the Member States (without LULUCF) in 2006 showed that most EC key categories are also key categories in the Member States. The Member States' key categories covered 92 % of the emissions of the 78 EC key categories in 2006.

To identify key categories of the EU-15, the following procedure was applied:

- Starting point for the key category identification for this report were the CRF sectoral report tables and sectoral background data tables (for energy), i.e. CRF Tables 1A(a), 2(I), 3, 4, 5, 6 of the EU-15 GHG inventory. All categories where GHG emissions/removals occur were listed, at the most disaggregated level available at EU-15 level and split by gas.
- A level assessment was carried out for the years 1990 and 2010 and a trend assessment was performed for 1990 to 2010. The assessment was carried out for emissions excluding LULUCF and including LULUCF.
- The key category analysis excluding LULUCF resulted in the identification of 76 key categories for the EU-15 and cover 96 % of total EU-15 GHG emissions in 2010. The key category analysis including LULUCF resulted in 82 key categories (see Annex 1.1).

The results of the EU-15 key category analysis excluding LULUCF is presented in Table 1.8. In addition, the table also shows for each key category the share of emissions estimated with higher tier methods. It shows that for most key categories more than 75 % of EU-15 emissions are calculated with higher methods.

More details related to the key category analysis are included in Annex 1.1. In Chapters 3 to 9 for each key category overview tables are presented which include the Member States' contributions to the EU-15 key source in terms of level and trend. Annex 1.1 also includes the results of the Tier 2 key category. It shows that source category N_2O emissions from 4D agricultural soils is by far the largest key category if uncertainties are included (both for level and trend).

Table 1.8 Key categories for the EU-15 (Gg CO_2 equivalents)

Source category gas	Gg CO_2 equ.		Trend	Level		share of higher Tier
	1990	2010		1990	2010	
1 A 1 a Public Electricity and Heat Production: Gaseous Fuels (CO_2)	60401	261344	T	L	L	95%
1 A 1 a Public Electricity and Heat Production: Liquid Fuels (CO_2)	123602	35848	T	L	L	97%
1 A 1 a Public Electricity and Heat Production: Other Fuels (CO_2)	12913	35647	T	L	L	96%
1 A 1 a Public Electricity and Heat Production: Solid Fuels (CO_2)	752876	555893	T	L	L	97%
1 A 1 b Petroleum refining: Gaseous Fuels (CO_2)	3869	15251	T		L	100%
1 A 1 b Petroleum refining: Liquid Fuels (CO_2)	96256	100541	T	L	L	99%
1 A 1 b Petroleum refining: Solid Fuels (CO_2)	3581	528	T			100%
1 A 1 c Manufacture of Solid fuels and Other Energy Industries: Gaseous Fuels (CO_2)	16985	22391	T	L	L	100%
1 A 1 c Manufacture of Solid fuels and Other Energy Industries: Solid Fuels (CO_2)	82793	27262	T	L	L	100%
1 A 2 a Iron and Steel: Gaseous Fuels (CO_2)	17440	16758		L	L	100%
1 A 2 a Iron and Steel: Liquid Fuels (CO_2)	7240	4463		L		100%
1 A 2 a Iron and Steel: Solid Fuels (CO_2)	112264	81874	T	L	L	100%
1 A 2 b Non-Ferous Metals: Solid Fuels (CO_2)	3542	500	T			76%
1 A 2 c Chemicals: Gaseous Fuels (CO_2)	33140	35088	T	L	L	91%
1 A 2 c Chemicals: Liquid Fuels (CO_2)	42830	24356	T	L	L	99%
1 A 2 c Chemicals: Other Fuels (CO_2)	2768	5731	T			100%
1 A 2 c Chemicals: Solid Fuels (CO_2)	10301	4082	T	L		98%
1 A 2 d Pulp, Paper and Print: Gaseous Fuels (CO_2)	12693	20386	T	L	L	97%
1 A 2 d Pulp, Paper and Print: Liquid Fuels (CO_2)	10323	3596	T	L		92%
1 A 2 e Food Processing, Beverages and Tobacco: Gaseous Fuels (CO_2)	16229	26850	T	L	L	96%
1 A 2 e Food Processing, Beverages and Tobacco: Liquid Fuels (CO_2)	16560	5893	T	L	L	84%

1 A 2 e Food Processing, Beverages and Tobacco: Solid Fuels (CO_2)	6021	1632	T			89%
1 A 2 f Other: Gaseous Fuels (CO_2)	91723	113609	T	L	L	96%
1 A 2 f Other: Liquid Fuels (CO_2)	116510	83616	T	L	L	96%
1 A 2 f Other: Other Fuels (CO_2)	3271	12169	T		L	96%
1 A 2 f Other: Solid Fuels (CO_2)	113525	29363	T	L	L	78%
1 A 3 a Civil Aviation: Jet Kerosene (CO_2)	13071	16385	T	L	L	96%
1 A 3 b Road Transportation: Diesel oil (CO_2)	268209	501330	T	L	L	90%
1 A 3 b Road Transportation: Diesel oil (N_2O)	1697	4998	T			98%
1 A 3 b Road Transportation: Gasoline (CH_4)	4048	847	T			99%
1 A 3 b Road Transportation: Gasoline (CO_2)	362649	235947	T	L	L	86%
1 A 3 b Road Transportation: LPG (CO_2)	7313	7182		L	L	76%
1 A 3 c Railways: Liquid Fuels (CO_2)	7752	4828		L		75%
1 A 3 d Navigation: Gas/Diesel Oil (CO_2)	8762	9186		L	L	70%
1 A 3 d Navigation: Residual Oil (CO_2)	6696	7570		L	L	71%
1 A 4 a Commercial/Institutional: Gaseous Fuels (CO_2)	60058	105089	T	L	L	95%
1 A 4 a Commercial/Institutional: Liquid Fuels (CO_2)	74142	43687	T	L	L	100%
1 A 4 a Commercial/Institutional: Solid Fuels (CO_2)	27789	2047	T	L		96%
1 A 4 b Residential: Gaseous Fuels (CO_2)	161967	252378	T	L	L	90%
1 A 4 b Residential: Liquid Fuels (CO_2)	169658	128748	T	L	L	95%
1 A 4 b Residential: Solid Fuels (CO_2)	74513	12035	T	L	L	95%
1 A 4 c Agriculture/Forestry/Fisheries: Gaseous Fuels (CO_2)	8716	11606	T	L	L	92%
1 A 4 c Agriculture/Forestry/Fisheries: Liquid Fuels (CO_2)	56845	49212		L	L	38%
1 A 4 c Agriculture/Forestry/Fisheries: Solid Fuels (CO_2)	3712	301	T			100%
1 A 5 a Stationary: Solid Fuels (CO_2)	4667	10	T			97%
1 A 5 b Mobile: Liquid Fuels (CO_2)	13672	5256	T	L	L	82%
1 B 1 a Coal Mining: (CH_4)	44014	6295	T	L	L	54%
1 B 2 a Oil: (CO_2)	7838	8768		L	L	69%
1 B 2 b Natural gas: (CH_4)	25937	18552	T	L	L	100%
2 A 1 Cement Production: (CO_2)	80174	64532	T	L	L	72%
2 A 2 Lime Production: (CO_2)	17220	15053		L	L	36%
2 A 3 Limestone and Dolomite Use: (CO_2)	7508	5731		L		72%
2 B 1 Ammonia Production: (CO_2)	19557	16485		L	L	96%
2 B 2 Nitric Acid Production: (N_2O)	35723	9632	T	L	L	100%
2 B 3 Adipic Acid Production: (N_2O)	58927	1587	T	L	L	28%
2 B 5 Other: (CO_2)	10438	15973	T	L	L	100%
2 C 1 Iron and Steel Production: (CO_2)	47059	37961	T	L	L	90%
2 C 3 Aluminium production: (PFC)	13247	697	T	L		100%
2 E 1 By-product Emissions: (HFC)	21158	977	T	L		100%
2 E 1 By-product Emissions: (SF_6)	1559	0	T			
2 E 2 Fugitive Emissions: (HFC)	6381	708	T			100%
2 F 1 Refrigeration and Air Conditioning Equipment : (HFC)	84	56476	T		L	89%
2 F 3 Fire Extinguishers: (HFC)	0	2630	T			
2 F 4 Aerosols/ Metered Dose Inhalers: (HFC)	36	9166	T		L	92%
4 A 1 Cattle: (CH_4)	115585	102332		L	L	100%
4 A 3 Sheep: (CH_4)	16608	12904		L	L	73%
4 B 1 Cattle: (CH_4)	20589	19768		L	L	78% dairy cattle, 48% non- dairy cattle
4 B 13 Solid Storage and Dry Lot: (N_2O)	19595	15885		L	L	63%
4 B 8 Swine: (CH_4)	16852	17611		L	L	65%
4 D 1 Direct Soil Emissions: (N_2O)	113326	94285	T	L	L	35%
4 D 2 Pasture, Range and Paddock Manure: (N_2O)	32985	28075		L	L	55%

4 D 3 Indirect Emissions: (N_2O)	80498	64207	T	L	L	31%
6 A 1 Managed Waste disposal on Land: (CH_4)	125218	73718	T	L	L	98%
6 A 2 Unmanaged Waste Disposal Sites: (CH_4)	13775	5776	T	L	L	100%
6 B 2 Domestic and Commercial Wastewater: (CH_4)	9001	6645		L	L	25%
6 B 2 Domestic and Commercial Wastewater: (N_2O)	9545	9501		L	L	15%

1.5 Information on the quality assurance and quality control plan

1.5.1 Quality assurance and quality control of the European Union inventory

The European Union GHG inventory is based on the annual inventories of the Member States. Therefore, the quality of the European Union inventory depends on the quality of the Member States' inventories, the QA/QC procedures of the Member States and the quality of the compilation process of the European Union inventory. The Member States and also the European Union as a whole implemented QA/QC procedures in order to comply with the IPCC good practice guidance.

The EU QA/QC programme describes the quality objectives and the inventory quality assurance and quality control plan for the EU GHG inventory including responsibilities and the time schedule for the performance of the QA/QC procedures: Definitions of quality assurance, quality control and related terms used are those provided in IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories and Guidelines for National Systems under the Kyoto Protocol. The EU QA/QC programme will be reviewed annually and modified or updated as appropriate.

The European Commission (Directorate General Climate Action) is responsible for coordinating QA/QC activities for the EU inventory and ensures that the objectives of the QA/QC programme are implemented and the QA/QC plan is developed. The European Environment Agency (EEA) is responsible for the annual implementation of QA/QC procedures for the EU inventory.

The overall objectives of the EU QA/QC programme are:

- to provide an EU inventory of greenhouse gas emissions and removals consistent with the sum of Member States' inventories of greenhouse gas emissions and removals,
- to establish appropriate QA/QC procedures at EU level in order to comply with requirements under the UNFCCC and the Kyoto Protocol,
- to contribute to the improvement of quality of Member States' inventories and
- to provide assistance for the implementation of national QA/QC programmes.

A number of specific objectives have been elaborated in order to ensure that the EU GHG inventory complies with the UNFCCC inventory principles of transparency, completeness, consistency, comparability, accuracy and timeliness.

In the QA/QC plan quality control procedures before and during the compilation of the EU GHG inventory are listed. In addition, QA procedures, procedures for documentation and archiving, the time schedules for QA/QC procedures and the provisions related to the inventory improvement plan are included.

QC procedures are performed at several different stages during the preparation of the European Union inventory. Firstly, a range of checks are used to determine the consistency and completeness of Member States' data so that they may be compiled in a transparent manner at EU level. Secondly, checks are carried out to ensure that the data are compiled correctly at EU level to meet the overall reporting requirements. Thirdly, a number of checks are conducted with regard to data archiving and documentation to meet various other data quality objectives.

Based on the EU QA/QC programme a quality management manual was developed which includes all specific details of the QA/QC procedures (in particular checklists and forms). The structure of the EU quality management manual has been developed on the basis of the Austrian quality management manual. The reason for using the Austrian manual as a template for the EU manual is that the EU GHG inventory is compiled by Umweltbundesamt Austria and the implementation of the annual QA/QC procedures are coordinated by Umweltbundesamt Austria. By using the Austrian quality manual as a template for the EU quality manual the EU can benefit from the experience made during the set-up of the Austrian quality management system which is accredited under ISO 1720; procedures and documents from the Austrian system have been taken and adapted according to the need of the EU quality management system.

The EU quality management manual is structured along three main processes (management processes, inventory compilation processes, supporting processes) of the quality management system (Table 1.9).

Table 1.9 Structure of the EU quality management manual

Chapter		Chapter description
Management processes		
ETC 01	EU inventory system	Describes the organisation and responsibilities within the EU GHG inventory system
ETC 02	QA/QC programme	Describes the preparation and evaluation of the EU QA/QC programme by the European Commission
ETC 03	Quality management system	Describes the responsibilities and the structure of the quality management system and gives an overview of the forms and checklists used
ETC 04	Quality management evaluation	Describes the evaluation of the status and effectiveness of the quality management system
ETC 05	Correction and prevention	Describes the procedures for the correction and prevention of mistakes that occur in the EU inventory
ETC 06	Information technology systems	Describes the information technology systems used such as CIRCA, Reportnet and the systems set up at Umweltbundesamt Austria
ETC 07	External communication	Describes the communication with Member States and other persons and institutions
Inventory compilation processes		
ETC 08	QC MS submissions	Describes the quality control activities performed on the GHG inventories submitted by the EU Member States
ETC 09	QC EU inventory compilation	Describes the quality control activities performed during the compilation of the EU GHG inventory including checks of database integrity
ETC 10	QC EU inventory report	Describes the checks carried out during and after the compilation of the EU GHG inventory report
Supporting processes		
ETC 11	Documents	Describes the production, change, proofreading, release and archiving of quality management documents
ETC 12	Documentation and archiving	Describes the procedure for preparing documentation and archiving

The quality checks performed during inventory compilation process are the central part of the quality manual. Quality checks are made at three levels:

1.5.1.1 Quality control MS submissions

The QC activities of MS submissions include two elements; checking the completeness of the Member States CRF tables and checking the consistency of Member States GHG data. The completeness checks of Member States' submissions are carried out by EEA/ETC-ACM by using a similar status report form as used by the UNFCCC Secretariat. The completed status reports are sent to Member States by 28 February; then Member States can check the status reports and update information, if needed. The status reports of the Member States' submissions are included in Annex 1.3 of this report.

The consistency checks of Member States data primarily aim at identifying main problems in time series of emissions and implied emissions factors, implied emissions factors across Member States and sub-category sums. For the time series checks the algorithms of the UNFCCC secretariat are used. In addition, the ETC/ACM identifies potential problems by comparison with the previous year's in-ventory submission of the Member States and checks the availability of the CRF tables needed for the compilation of the EU inventory.

In addition an action plan was implemented for the first time in 2011 aiming at improving the completeness regarding NEs of the EU greenhouse gas inventory.

1) Given the fairly wide interpretations and applications of notation keys, the identification of a "real" gap needs expert assessment which is provided by the UNFCCC review and which cannot be automated by existing EU internal procedures. Thus any action plan proposed by the EU needs to continue to be based primarily on the UNFCCC review reports. This is in particular evident in regards to the KP LULUCF, where a carbon pool can be not reported ('NR' should be used) provided that transparent and verifiable information is provided indicating that the pool is not a source, while notation keys such as NO and NA may also sometimes be linked to incomplete estimates. In this respect it needs to be stressed that the late availability of the review reports complicates the follow-up with Member States related to potential missing GHG estimates before the next EU inventory submission. In 2010, 3 Member states review reports were published by 9.4.2010, one by 13.4.2010, two by 15.4.2010, one by 19.4.2010 and one by 20.4.2010.
2) The notation key 'NE' is not in all cases an indication of a problem and neither the IPCC guidelines nor the UNFCCC review guidelines foresee an automatic procedure of gap filling when NEs are reported. For example, the notation "NE" can be used if there are no methods available in the 1996 rev. IPCC Guidelines. Overall, a fair and complete analysis of the use of "NE" including the situations highlighted in point 1 above was considered to be indispensable.

Given the above considerations the specific steps of the action plan followed since 2011 are as follows:

1. Member States are required by Decision 280/2004 to submit their national GHG inventories electronically to the European Commission by 15 January of each year. A software program was created by the EEA so that upon submission of the relevant XML/CRF files a report was generated containing a list of all non-estimated source categories per Member State, specifying which of these source categories have been flagged in the Saturday Papers and for which ones IPCC methods are available. This report was then immediately notified to each Member State. During February the experts of the EU inventory team consulted and discussed with Member States' experts inter alia:
    a) how MS have addressed and documented (or plan to address) the potential issues flagged in their Saturday Papers regarding missing estimates;
    b) the need for applying gap-filling procedures and the selection of the most appropriate methods;
    c) the need to use different notation keys.

2. The completeness of Member States' national submissions with regard to individual CRF tables was documented in the ‘status reports’ sent to the Member States on 28 February. The EEA redesigned the current ‘status reports’ to include a specific section on the provision of information relating to completeness, focusing on the latest inventory year. This new section is based on the automatic checks and the additional bilateral discussions with MS during January and February as specified above. It reflects the status of the consultation with the MS and lists the follow-up expected from the MS by 15 March. According to the procedures and time scales described in Annex VI of the Implementing Provisions, the Draft EU inventory was sent to MS by 28 February. Updated or additional inventory data submitted by MS (to remove inconsistencies or fill gaps) and complete final national inventory reports were submitted to the European Commission by 15 March.
3. In cases where, even after the two preceding steps a Member State's GHG inventory as submitted to the European Commission by 15 March still contained NEs for categories where IPCC methods exist, and/or if such reporting has been identified as a problem in previous reviews, then the EU inventory experts, in close cooperation with Member States, prepared the missing GHG source estimates in accordance with the gap-filling provisions in articles 13-16 of Commission Decision 2005/166/EC. In particular as regards the LULUCF sector, a gap-filling procedure was applied in a case where all KP tables were filled with NE, despite the previous submission (2010) was filled correctly. In this case, the same values reported in previous submission were used also in the 2011 submission. In addition, for one Member States also NEs from fugitive emissions from oil and gas were gap-filled (see section 16.5) Article 16 requires Member States to use the gap-filled estimates in their national submissions to the UNFCCC to ensure consistency between the EU inventory and Member States' inventories.
4. A general assessment of completeness is included in the EU Greenhouse Gas Inventory Report (section 1.7 of the 2011 EU NIR). For transparency reasons, the EU's 2011 inventory submission contains now an improved description of this section to reflect the additional improvements discussed above.
5. In addition to the steps detailed above the regular QA/QC procedures established to ensure the transparency, accuracy, comparability, consistency, and completeness of the EU inventory continued to be applied. The WG1 on annual inventories continues to address issues of completeness giving them priority and the EU internal reviews will further focus on identifying issues that may lead to an underestimation of emissions as we are approaching the end of the first commitment period.

In 2012 the completeness checks were extended to the use of the notation key NO and NA. All cases where less than seven Member States reported NO or NA and all other MS reported emission estimates were checked by the sector experts and clarified with Member States, if needed.

For the sectors energy, industrial processes, agriculture, LULUCF and waste sector-specific checks are performed by the sector experts. In addition, the EU sector experts receive the results of checks with the UNFCCC outlier tool before they are sent to the Member States.

The results of the consistency and completeness checks as well as the main findings of the sector specific checks are documented in the web-based QA/QC communication tool. This tool is accessible for MS inventory coordinators and inventory experts. The Member States are asked to respond to findings in this tool and if needed provide revised emission estimates or additional information.

For every updated inventory submission provided by the MS by 15 March follow-up checks are performed by the sector experts and additional findings are documented in the QA/QC communication tool and the status reports are completed. In addition it is checked if issues identified in the status reports and in the QA/QC communication tool (initial checks), which are relevant for the

EU inventory (report) have been clarified by the MS. If this is not the case MS are contacted for clarification.

1.5.1.2 Quality control EU inventory compilation

After the initial checks of the emission data, the ETC/ACM transfers the national data from the xml-files into the ETC/ACM CRF aggregator database. The version of the data received by ETC/ACM are numbered, in order to be traced back to their source. The ETC/ACM CRF aggregator database is maintained and managed by Umweltbundesamt Austria.

As the EU GHG inventory is compiled on the basis of the inventories of the EU Member States, the focus of the quality control checks performed during the compilation of the EU GHG inventory lays on checking if the correct MS data are used, if the data can be summed-up (same units are used) and that the summing-up is correct. Finally, the consistency and the completeness of the EU GHG inventory is checked. All the checks are carried out for the original submission by 15 April each year and for any resubmission. Two checklists are used for this purpose: ‘Inventory preparation/consistency’ and ‘Data file integrity’.

1.5.1.3 Quality checks EU inventory report

The checks carried out during and after the compilation of the EU GHG inventory report are specified in the checklist ‘EU inventory report’. They cover a.o. checks of data consistency between the inventory and the inventory report, data consistency between the tables and the text, but also checks of the layout.

The circulation of the draft EU inventory and inventory report on 28 February to the EU Member States for reviewing and commenting also aims to improve the quality of the EU inventory and inventory report. The Member States check their national data and information used in the EU inventory report and send updates, if necessary, and review the EU inventory report. This procedure should assure the timely submission of the EU GHG inventory and inventory report to the UNFCCC secretariat and it should guarantee that the EU submission to the UNFCCC secretariat is consistent with the Member States UNFCCC submissions.

Finally, also the detailed analysis of GHG emission trends of the EU and each EU Member State after the submission of the EU inventory to the UNFCCC also contributes to improving the quality of the EU GHG inventory. This analysis is carried out in the annual EU GHG trend and projections report (see EEA, 2011); the report identifies sectoral indicators, for socio-economic driving forces of greenhouse gas emissions, by using Member States indicator submissions under Council decision 280/2004 or data from Eurostat and from Member States’ detailed inventories. In addition, it compares and analyses Member States’ emission trends in the EU key sources and provides main explanations, either socio-economic developments or policies and measures, for these trends in some Member States.

1.5.1.4 EU internal review

A collaborative internal review mechanism is established within the European Union so that all participants (MS, EEA, Eurostat, and JRC) may contribute to the identification of shortcomings and propose amendments to existing procedures. The review activities with experts from Member States are coordinated by the ETC/ACM under Working Group I and take place during the period from April through September each year. The synthesised findings of collaborative reviews provide a basis for the planned progressive development of inventories both at Member state and at EU level.

The EU internal reviews 2010 and 2009 focussed on potential under-estimations of the MS inventories as identified in the UNFCCC review reports 2008 and on the use of EU-ETS data in the GHG inventories. In 2008, the internal review was a follow-up of the EU initial review assessed the completeness and comparability (consistent allocation) of Member States' emissions in the sector Industrial Processes. In addition, N_2O emissions from road transport were reviewed. In 2007, the internal review focused on the uncertainty estimates by identifying potential outliers of MS uncertainty estimates. In 2006 the following source categories have been reviewed by Member States experts: 1A1 'Energy industries', 1A2a 'Iron and steel production', 1.B 'Fugitive emissions from fuels', 2.A 'Mineral products', 2B 'Chemical industry', 2C 'Iron and steel production' and fluorinated gases, 2.E 'Production of halocarbons and SF_6' and 2.F 'Consumption of halocarbons and SF_6'. In 2005, the EU internal review was carried out for the first time. In this pilot exercise two Member States experts reviewed the source categories 1A2 'Manufacturing industries' and 1A3 'Transport'.

EU internal review 2012 (Review under the 'Effort Sharing Decision')

In 2012 a comprehensive EU internal review will be carried out in order to determine the emission allocations 2013-2020 for the EU internal GHG emission reduction target 2020. In the climate and energy package the European Union has committed itself to reduce greenhouse gas emissions by 20% below 1990 levels by 2020. The package comprises two pieces of legislation related to GHG emissions:

1. A revision and strengthening of the Emissions Trading System (ETS), the EU's key tool for cutting emissions cost-effectively. A single EU-wide cap on emission allowances will apply from 2013 and will be cut annually, reducing the number of allowances available to businesses to 21% below the 2005 level in 2020. The free allocation of allowances will be progressively replaced by auctioning, and the sectors and gases covered by the system will be somewhat expanded.
2. An 'Effort Sharing Decision' (ESD) governing emissions from sectors not covered by the EU ETS, such as transport, housing, agriculture and waste. Under the Decision each Member State has agreed to a binding national emissions limitation target for 2020 which reflects its relative wealth. The targets range from an emissions reduction of 20% by the richest Member States to an increase in emissions of 20% by the poorest. These national targets will cut the EU's overall emissions from the non-ETS sectors by 10% by 2020 compared with 2005 levels.

The ESD sets out the 2020 emission limit of a Member State in relation to its 2005 emissions, and its emission limits from 2013 to 2020 form a linear trajectory. In accordance with Article 3.2 of the ESD, the starting point of the linear trajectory is defined as the average annual ESD emissions during 2008, 2009 and 2010 in 2009 (for Member States with positive limits under Annex II of the ESD) or in 2013 (for Member State with negative limits). The annual emission allocations shall be determined using reviewed and verified emission data. Thus, complete emission inventories for the reference years (2005, and 2008-2010) must be available and reviewed prior to determining the annual emission allocations in 2012.

The ESD review in 2012 will be carried out by an independent review team comprising of four lead reviewers and 18 sector experts. This team will review all 27 EU Member States in a desk review (May 2012) and a centralized review (June 2012). The review will be coordinated by the EEA as the

ESD review secretariat. The ESD review will take into account both the existing quality assurance/quality control procedures for Member States' emission inventory submissions under Decision 280/2004/EC and the separate inventory review process occurring under the UNFCCC. The specific activities of the 2012 technical review will include:

1. analysis of the Member States' implementation of recommendations related to improving inventory estimates in accordance with the 1996 IPCC Guidelines and the IPCC good practice guidance as listed in the UNFCCC Annual Review Reports from the 2010 and 2011 UNFCCC review processes (8)and where UNFCCC recommendations have not been implemented, assess that the Member State has provided adequate justification for these;
2. assessment of the time series consistency of the greenhouse gas emissions estimates with a particular focus on the 2005 and 2008-2010 estimates;
3. a check whether problems identified for one Member State in UNFCCC reviews may also be a problem for other Member States (whether identified by the UNFCCC expert review team or not);
4. an assessment of any recalculations made by a Member State in their inventory since the previous submission, and assess whether these are transparently reported and in accordance with IPCC good practice guidance;
5. a follow-up on any outstanding findings from existing and extended stage 1 and 2 checks;
6. provision of an estimate for any 'technical correction' to emission estimates reported by a Member State where it is believed that emissions reported by the Member State are either under or overestimated and state the significance of these 'technical corrections' in comparison to the overall reported inventory estimates. An evidence-based justification for any such technical corrections shall be fully documented in the review reports of the relevant Member State. A record of correspondence with the Member State concerning the recommended 'technical correction' shall be retained by the review secretariat.
7. If available and appropriate, the TERT may use additional technical information in the review process, such as EU-ETS data, information from Eurostat and other international organisations.

The 2012 initial review under the ESD should also be seen as a more robust and consistent QA of MS GHG inventories that should lead to improvements in the quality of the EU and its Member States GHG inventory submissions to UNFCCC in 2013.

1.5.1.5 UNFCCC reviews

In addition, European Union QA procedures aim to build on the issues identified during the independent UNFCCC inventory review of Member States' inventories. Quality assurance procedures based on outcomes of the UNFCCC inventory review consist of the:

- Annual compilation of issues identified during the UNFCCC inventory review related to sectors, key source categories and the major inventory principles transparency, consistency, completeness, comparability and accuracy for all Member States;
- Identification of major issues from the compilation and discussion of ways to resolve them in Working Group 1 under the Climate Change Committee, including identification and documentation of follow-up actions that are considered as necessary within Working Group 1;
- Reviews of the extent to which issues identified through this procedure in previous years have been addressed by Member States;
- Ongoing investigations of ways to produce a more transparent inventory for the unique circumstances of the European Union.

1.5.1.6 Improvement plan

Based on the findings of the UNFCCC reviews, the EU internal review and other recommendations the improvement plan for the EU GHG inventory is compiled before the annual compilation process starts. After the finalisation of the annual EU GHG inventory it is evaluated if the improvements planned have been implemented.

1.5.2 Overview of quality assurance and quality control procedures in place at Member State level

As the EU GHG inventory is based on the annual inventories of the EU Member States, the quality of the EU inventory depends on the quality of the Member States' inventories and their QA/QC procedures. Table 1.10 gives an overview of QA/QC procedures in place for the EU-15 Member States. The information is taken from the Member State national inventory reports 2010, 2011 and 2012.

Table 1.10 Overview of quality assurance and quality control procedures in place for EU-15 MS at Member State level (NIR descriptions)

MS	Description of the national QA/QC activities	Source
Austria	A quality management system (QMS) has been designed to achieve to the objectives of good practice guidance, namely to improve transparency, consistency, comparability, completeness and confidence in national inventories of emissions estimates. The QMS is based on the Inter-national Standard ISO/IEC 17020 General Criteria for the operation of various types of bodies performing inspections. The QMS ensures that all requirements of a type A inspection body as stipulated in ISO/IEC 17020 are met, which include strict independence, impartiality and integrity. Since December 2005 the Umweltbundesamt has been accredited as inspection body (Id.No.241) in accordance with the Austrian Accreditation Law. The implementation of QA/QC procedures as required by the IPCC-GPG support the development of national greenhouse gas inventories that can be readily assessed in terms of quality and completeness. The QMS as implemented in the Austrian inventory includes all elements of the QA/QC system outlined in IPCC-GPG Chapter 8 "Quality Assurance and Quality Control", and goes beyond. It also comprises supporting and management processes in addition to the QA/QC procedures in inventory compilation and thus ensures agreed standards not only within (i) the inventory compilation process and (ii) supporting processes (e.g. archiving), but also for (iii) management processes (e.g. annual management reviews, internal audits, regular training of personnel, error prevention). The Austrian Quality Management System is described in detail in Austria's NIR 2011). **Changes to the QMS since the last submission** On the 13th and 14th January 2011 a comprehensive external audit by the accreditation body took place at the Umweltbundesamt. This 'Re-Accreditation' is obligatory every 5 years and aims at examining the "Inspection Body for Emission Inventories" respectively its QM-System in detail. Only minor measures were to be implemented, generally it confirmed the inspection body's commitment to high quality, and approved conformity with the standard renewing the accreditation of 2005. Following a recommendation of the accreditation audit to streamline the documentation of the management system, a completely revised quality manual was produced; in the course of this work the revision of ISO/IEC 17020 was taken into account, the new manual being more user-friendly and providing an improved presentation of requirements relating to reporting obligations in the context of emission inventories. The management processes of the QMS and the process of inventory preparation remained mostly unchanged; however the documentation and some blanks and checklists have been improved (e.g. the checklists for QA/QC that have been incorporated into the documentation files, and simplification of the management review process and report, respectively).	Austria's Annual Greenhouse Gas Inventory 1990–2010 Jan 2012-p 29
Belgium	Belgium did submit a full QA/QC plan of the Belgian national system for the estimation of anthropogenic greenhouse gas emissions by sources and removals by sinks under Article 5, paragraph 1, of the Kyoto Protocol on the 20th of October 2008 to the UNFCCC-experts as a demand of the UNFCCC-centralized review carried out from the 1st to the 6th of September 2008. In the final Annual Review Report of UNFCCC (Report of the individual review of greenhouse gas inventories of Belgium submitted in 2007 and 2008) the ERT concluded that the QA/QC plan has been prepared and implemented in accordance with the IPCC good practice guidance. This plan is revised during the 2010 submission to the UNFCCC-secretariat. The overall QA/QC responsibilities on the Belgian GHG inventory are carried out at IRCEL/CELINE the Belgian interregional environment Agency which is the national inventory agency responsible for international obligations related to air emissions reporting. As a consequence, the quality and assurance controls already carried out within the responsible regions, are supplemented by the QA/QC performed to the national Belgian inventory. After completion of the Belgian greenhouse gas emission inventory by IRCEL/CELINE, the regions and IRCEL/CELINE carry out further quality control checks of the national inventory before the official submission takes place. IRCEL/CELINE is the final responsible for the national inventory, and any change at this stage is conducted only by IRCEL/CELINE, after co-ordination with the relevant regional contacts. The QC checks are described in section 1.6.1.5. of the BE NIR. Independent audits of the greenhouse gas inventories of the regions and the national inventory have started in the course of 2002 and results became available in 2003. The purpose of these audits was to analyse the difficulties encountered while compiling the regional emission inventories into the national inventory in order to improve the quality and completeness of the Belgian national emission inventory and to evaluate the differences between the process at that time and the obligations in the framework of the UNFCCC & IPCC Guidelines and the Kyoto Protocol. The results of these audits of greenhouse gases inventories showed clearly that the Belgian national inventory is of qualitative good value. The difference between the situation in Belgium at that time and the fulfilling of the IPCC Guidelines was mainly the absence of the complete implementation of the IPCC Good Practice Guidance for the Belgian emission inventory with respect to setting up a quality system. Technical working groups are set up since the beginning of 2003 to investigate in detail the implementation of the Good Practice Guidance for the different sectors in Belgium and to harmonise the 3 regional emission inventories in Belgium as much as possible. The overall conclusion in the different technical working groups was that appropriate methods are used for all sectors and in accordance with the IPCC Good Practice Guidance. All three regions perform their own QC procedures. The Tier 1 QC checks conducted at the regional and the national level are also included in the BE NIR.	Belgium's GHG Inventory (1990-2009) Jan 2011 pp 13-15

MS	Description of the national QA/QC activities	Source
Denmark	The Quality Control (QC) and Quality Assurance (QA) plan for greenhouse gas emission inventories performed by the Danish National Environmental Research Institute is in accordance with the guidelines provided by the UNFCCC (IPCC, 1997), and the Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC, 2000). The ISO 9000 standards are also used as important input for the plan. The quality planning is based on the following definitions as outlined by the ISO 9000 standards as well as the Good Practice Guidance (IPCC, 2000): • Quality management (QM) Coordinates activity to direct and control with regard to quality. • Quality Planning (QP) Defines quality objectives including specification of necessary operational processes and resources to fulfil the quality objectives. • Quality Control (QC) Fulfils quality requirements. • Quality Assurance (QA) Provides confidence that quality requirements will be fulfilled. • Quality Improvement (QI) Increases the ability to fulfil quality requirements. The QA/QC work is supported by an inventory file system, where all data, models and QA/QC procedures and checks are stored. The QA/QC plan will continuously improve these activities in the future. The Danish Quality Concept foresees quality management, quality planning, quality control, quality assurance and quality improvement. The strategy for process-oriented QC is based on setting up a system for the process of the inventory work. In the Danish Annual EC Greenhouse Gas Report 2010: Inventories 1990-2008 it is stated that the QA/QC programme has not been changed.	Danish Annual EC GHG report 2010: Inventories 1990-2008 Jan 2010, p 2 No change since 2010 submission
Finland	The quality management system is an integrated part of the national system. It ensures that the greenhouse gas inventories and reporting are of high quality and meet the criteria of transparency, consistency, comparability, completeness, accuracy and timeliness set for the annual inventories of greenhouse gases. Statistics Finland has the overall responsibility for the GHG inventory in Finland including the responsibility for co-ordinating the quality management measures at the national level. Statistics Finland compiles and approves the inventory and submits it to the UNFCCC Secretariat and to the European Commission. As a national statistical office Statistics Finland and its Greenhouse gas inventory unit are committed to quality. The quality framework based on the European Statistics Code of Practice and Statistics Finland's Guidelines on Professional Ethics supports the GHG inventory quality management. The expert organisations contributing to the production of emission or removal estimates are responsible for the quality of their own inventory calculations. The quality coordinator steers and facilitates the quality assurance and quality control (QA/QC) process, and experts of all calculation sectors implement and document the QA/QC procedures. The inventory working group that consists of participants from all institutes involved in the inventory preparation has been established to advance communication between the inventory unit and the expert organisations in charge of the different sectors. Issues related to QA/QC are discussed in the meetings of the inventory working group and in the bilateral quality meetings between the inventory unit and the expert organisations. An electronic quality manual including e.g. guidelines, plans, templates and checklists is in place and available to all parties of the national inventory system via the Internet. Statistics Finland bears the responsibility for archiving the quality manual and for submissions of annual inventories (CRF tables and NIR). Expert organisations contributing to the sectoral calculation archive the primary data used, internal documentation of calculations and sectoral CRF tables. Statistics Finland co-ordinates the participation of the partners of the national system in the reviews, as well as responses to issues raised by the reviews of the UNFCCC Secretariat. The quality objectives and the planned QC and QA procedures are recorded as the QA/QC plan. The QA/QC plan is a checklist that specifies the QC and QA actions, the schedules for the actions and the responsibilities.The QA/QC plans are written in Finnish. The QA/QC plans are part of the electronic quality manual of the inventory and archived according to the inventory unit's archive formation plan. Quality objectives and QA/QC plans are updated yearly in the spirit of continuous improvement. The QC procedures in use in the Finland´s GHG inventory comply with the IPCC good practice guidance. General inventory QC checks (IPCC GPG 2000, table 8.1 and IPCC GPG LULUCF 2003, table 5.5.1) include routine checks of the integrity, correctness and completeness of data, identification of errors and deficiencies and documentation and archiving of inventory data and quality control actions. In addition to general QC checks, category-specific QC checks including technical reviews of the source categories, activity data, emission factors and methods are applied on a case-by-case basis focusing on key categories and on categories where significant methodological and data revisions have taken place. Results of the QC checks are recorded in internal documents for the calculation and archived in the expert organisations. The quality assurance (QA) activities recorded in the QA/QC plan are performed at the inventory evaluation stage. QA reviews are performed after the implementation of QC procedures to the finalised inventory. The inventory QA system comprises reviews and audits to assess the quality of the inventory and the inventory preparation and reporting process, to determine the conformity of the procedures taken and to identify areas where improvements could be made ISO 9001 certification of the inventory quality management system is under consideration. However, the advantages (e.g. the perspective of a third party assessment) and costs (e.g. the amount of resources required for registration) of certification have been evaluated, and it has been decided not to apply for the ISO 9001 compliance certification. Even without certification Finland continues to utilize the ISO 9001 as a benchmark for the general quality management system of the inventory.	GHG Emissions in Finland 1990-2010 Draft, Jan 2012 p 33 ff.

MS	Description of the national QA/QC activities	Source
France	The national emissions inventory system is set up, by incorporating the usual criteria applicable to Quality Management Systems (QMS). CITEPA, in charge of preparing the national emissions inventories from a technical viewpoint, has put in place a system for quality assurance and quality control based on the ISO 9001 standard . This approach has been confirmed by the fact that CITEPA was awarded a certificate issued by the French Quality Management Body (AFAQ) in 2004. This was renewed in 2007 and in 2010 and follow-up audits were conducted in between. The task of preparing the national emissions inventories is covered by the QMS via several specific processes (see Quality Manual – confidential in-house document). In this framework, several processes for quality assurance and quality control of the inventories are incorporated into the different processes and procedures implemented, corresponding to the different phases and actions. The overall objective of the quality assurance and quality control programme focuses on the production of national emissions and sinks inventories in line with requirements issued in the different national and international frameworks covered by the SNIEPA. These requirements concern the definition, implementation and application of procedures and methods aimed at meeting the criteria on traceability, exhaustiveness, consistency, comparability and punctuality required by international and EU institutions, as part of the commitments France has signed up to. Quality control is incorporated into the different phases of the processes and procedures developed by the bodies involved in the national system in order to achieve the objectives and targets set. The CITEPA, the body responsible for the technical coordination and compilation of the inventories is in charge of monitoring quality control and issues recommendations aimed at improving, completing and developing the necessary processes and procedures. These procedures can be automatic or manual, take the form of a check-list, feasibility, consistency, exhaustiveness, trend analysis and simulation tests, etc. They are implemented at several stages in the process of conducting the inventory. Quality assurance is provided through several measures designed to subject the inventories to reviews for the purpose of obtaining comments and assessments from stakeholders, generally with expert knowledge.	direct communication, March 2011
Germany	The quality system "Qualitässystem Emissionsinventare" (QSE) is built on the requirements of the IPCC Good Practice Guidance (defined in chapter 8), the national requirements in Germany and the internal Structure within Umweltbundesamt (the national Coordination Centre for GHG inventory compilation). QSE covers all steps of the inventory preparation. It was made binding within Umweltbundesamt by means of the UBA-in-house directive 11/2005 (a regulatory framework). QSE regulates responsibilities within the QA/QC system. The quality control checks for Tier 1 (pursuant paragraph 14 (g) of the Guidelines for National Systems) were carried out for 2006 reporting the first time. They were sent as QC check lists to the experts together with the request for data. The minimum requirements according to the QA/QC system for implementation, description and documentation of the QA/QC measures are carried out together with the respective contribution to the inventory. A general description of quality aims is given in the QSE-Handbook (derived from the IPCC Good Practice Guidance). According to the requirements for the IPCC GPG and Paragraph 12 (d) of the Guidelines for National Systems the necessary QA/QC activities should be summarized in a QA/QC plan. The QA/QC plan is combined with the checklist for QA/QC. For 2008, 2009 and 2010 reporting the checklists for sectoral experts were improved. Thus, both the QA/QC plans and QA/QC checklists are an instrument for the inspection of the fulfillment of the international requirements and allow for control over the quality of the inventory. In the quality improvement plan all potentials for improvement and additionally the findings from the independent inventory review are documented. Data are documented in a central archive. Either data are stored in the central archive directly or if for a given reason (e.g. confidentiality of the data) data is not stored in the central archive reference is given to place were the data is stored..	Nationaler Inventarbericht Zum Deutschen Treibhausgasinventar 1990 - 2010 Mar 2012 p 82 ff. (submitted in German, translation provided by Germany via dirct communication)

MS	Description of the national QA/QC activities	Source
Greece	A QA/QC system is being implemented since April 2004. It has been developed by the previous technical consultant (NOA) and is still being used by the National Technical University of Athens. A revision of the system was performed in May 2008, according to the experience gained from 2008 and 2009 submission, resulting in the current version 1.2. The supervision of QA/QC system is performed by the Ministry of Environment, Energy and Climate Change. The system is based on the ISO 9001:2000 standard and its quality objectives, as stated in the quality management handbook, are the following: • Compliance with the IPCC guidelines and the UNFCCC reporting guidelines while estimating and reporting emissions/removals. • Continuous improvement of GHG emissions/removals estimates. • Timely submission of necessary information in compliance with relevant requirements defined in international conventions, protocols and agreements. • The accomplishment of the above-mentioned objectives can only be ensured by the implementation of the QA/QC procedures included in the plan for: • data collection and processing • applying methods consistent with IPCC Good Practice Guidance and LULUCF Good Practice Guidance for calculating / recalculating emissions or removals, • making quantitative estimates of inventory uncertainty, • archiving information and record keeping and • compiling national inventory reports The QA/QC system developed covers the following processes: QA/QC system management, comprising all activities that are necessary for the management and control of the inventory agency in order to ensure the accomplishment of the quality objectives. Quality control that is directly related to the estimation of emissions. The process includes activities related to (a) data inquiry, collection and documentation, (b) methodological choice in accordance with IPCC Good Practice Guidance, (c) quality control checks for data from secondary sources and (d) record keeping. Archiving inventory information, comprising activities related to centralised archiving of inventory information and the compilation of the national inventory report. Quality assurance, comprising activities related to the different levels of review processes including the review of input data from experts, if necessary, and comments from the public Estimation of uncertainties, defining procedures for estimating and documenting uncertainty estimates per source / sink category and for the whole inventory Inventory improvement, that is related to the preparation and the justification of any recalculations made. The implementation of the plan started in April 2004 and the first internal review was carried out in June 2004, following procedures and manuals (available only in Greek) developed by in house staff and outside consultants. The current in use version of the QA/QC manual was revised in May 2008. All the procedures described there, are followed by both the MEECC and the NTUA staff members. Furthermore, annual internal audits take place by MEECC/NTUA between September and November of each year and audits by independent local experts are planned and implemented.	Climate Change Emissions Inventory, Information under Article 3(1) of the Decision 280/2004/EC, Jan 2011, p 10 f.
Ireland	In early 2005, the inventory agency in Ireland commissioned a project with UK consultants to establish formal QA/QC procedures in emission inventories that would meet the needs of the UNFCCC reporting requirements. The project developed a QA/QC system including a documented QA/QC plan and procedures along with a QA/QC manual. The manual provides a general overview to the QA/QC system and guidance on the application of the plan and procedures. The QA/QC plan identifies the specific data quality objectives related to the principles of transparency, consistency, completeness, comparability and accuracy required for Ireland's national inventory and provides specific guidance and documentation forms and templates for the practical implementation of QA/QC procedures. The QA/QC procedures cover such elements as data selection and acquisition, data processing and reporting so that the international requirements under the Kyoto Protocol and Decision 280/2004/EC are met. The manual provides guidance and templates for appropriate quality checking, documentation and traceability, the selection of source data and calculation methodologies and peer review and expert review of inventory data and outlines the annual requirements for continuous improvement for the inventory. The inventory agency used the 2006 reporting cycle to begin implementation of the basic elements of the new approach to QA/QC and its application was substantially completed in delivering the 2007 submission. The system facilitates record keeping related to the chain of activities from data capture, through emissions calculations and checking, to archiving and the identification of improvements. Ireland's calculation spreadsheets in all sectors have been restructured and reorganised to facilitate the QA/QC process and to facilitate more efficient analysis and to ensure ease of transfer of the outputs to the CRF Reporter Tool. This facilitates rapid year-on-year extension of the time-series and efficient updating and recalculation, where appropriate, in the annual reporting cycle. Internal aggregation to various levels corresponding to the CRF tables provides immediate and complete checks on the results. External reviews of the agriculture sector and of the entire ETS results for 2005 were conducted as important new components of quality assurance at the beginning of 2007. Inventory development continues to benefit from the internal review procedures that are ongoing with regard to the EU and its Member States.	Ireland National Inventory Report 2009,GHG emissions 1990-2007 reported to the UNFCCC Mar 2009 p 16

MS	Description of the national QA/QC activities	Source
Italy	ISPRA has elaborated an inventory QA/QC plan which describes specific QC procedures to be implemented during the inventory development process, facilitates the overall QA procedures to be conducted, to the extent possible, on the entire inventory and establishes quality objectives. Particularly, an inventory QA/QC procedures manual has been drawn up which describes QA/QC procedures and verification activities to be followed during the inventory compilation and helps in the inventory improvement. Quality control checks and quality assurance procedures together with some verification activities are applied both to the national inventory as a whole and at sectoral level. Future planned improvements are prepared for each sector, by the relevant inventory compiler. Each expert identifies areas for sectoral improvement based on his own knowledge and in response to inventory UNFCCC reviews and other kind of processes. Checklists are compiled annually by the inventory experts and collected by the QA/QC coordinator. These lists are also registered in the 'reference' database. General QC procedures also include data and documentation gathering. Specifically, the inventory analyst for a source category maintains a complete and separate project archive for that source category; the archive includes all the materials needed to develop the inventory for that year and is kept in a transparent manner. All the information used for the inventory compilation is traceable back to its source. The inventory is composed by spreadsheets to calculate emission estimates; activity data and emission factors. Particular attention is paid to the archiving and storing of all inventory data, supporting information, inventory records as well as all the reference documents. After each reporting cycle, all database files, spreadsheets and official submissions are archived as 'read-only' mode in a master computer. Quality assurance procedures regard some verification activities of the inventory as a whole and at sectoral level. The inventory is presented to a Technical Committee on Emissions (CTE), coordinated by the Ministry for the Environment, Land and Sea, where all the relevant Ministries and local authorities are represented; within this task emission figures and results are shared and discussed. Moreover, at European level, voluntary reviews of the European inventory are undertaken by experts from different Member States for critical sectoral categories. The only official review, apart from those by the UNFCCC, was performed by Ecofys, in 2000, in order to verify the effectiveness of policies and measures undertaken by Italy to reduce GHG emissions to the levels established by the Kyoto Protocol. In this framework an independent review and checks on emission levels were carried out as well as controls on the transparency and consistency of methodological approaches. Comparisons between national activity data and data from international databases are usually carried out in order to find out the main differences and to find explanations to the differences Comparisons between emission estimates from industrial sectors and those published by the industry itself in the Environmental reports are carried out annually in order to assess the quality and the uncertainty of the estimates.	Italian Greenhous e Gas Inventory 1990-2007 National Inventory Report 2009, April 2009, pp 31-35
Luxembourg	Luxembourg's Quality Management System (QMS) follows a Plan-Do-Check-Act-Cycle (PDCA-cycle), which is an accepted model for pursuing a continual improvement of performance according to international standards and is in line with procedures described in decision 19/CMP.1 and in the IPCC Good Practice Guidance. Due to Luxembourg's clear extent, its QMS deals with a manageable quantity of documents. Fol-lowing are the specifications of Luxembourg's Quality Management System: • firm build-up with a quality manual consisting of a chart with all relevant documents, handling instructions and deadlines for check; • good manageability (instead of a complex system); • usable and effective quality control procedures (user-friendly, clearly arranged). Since the QMS has been implemented in the year 2008, further developments and improvements have been implemented. The QMS ensures and continuously improves the quality (measured by transparency, accuracy consistency, comparability, completeness (TACCC) and timeliness) of Luxembourg's GHG Inventory in order to fulfil the party's obligations according to articles 3, 5 and 7 of the Kyoto Protocol. Luxembourg's Quality Management System (QMS) of the GHG Inventory is organised in three layers: a) Performance processes which directly concern the compilation of the GHG Inventory. They comprise input data, data acquisition, calculations, and generation of CRF tables and NIR as well as quality control checks and the outcomes of the NIR and CRF-tables. b) Management processes which control the system's performance by defining quality objectives, responsibilities, quality assurance procedures, improvement plans and the personnel's qualifications and obligations. c) Supporting processes which assist the system's performance by providing technical requirements and standards. Further details on Luxembourg's QMS and relating QA/QC procedures are described in detail in Luxembourg's NIR 2010.	National Inventory Report 1990-2008, May 2010 pp 51-60

MS	Description of the national QA/QC activities	Source
Netherlands	As part of its National System, the Netherlands has developed and implemented a QA/QC program (NL Agency, 2011). This program is yearly assessed and updated, if needed. The Monitoring Protocols were elaborated and implemented in order to improve the transparency of the inventory (including methodologies, procedures, tasks, roles and responsibilities with regard to inventories of greenhouse gases). Transparent descriptions and procedures of these different aspects are described in the protocols for each gas and sector and in process descriptions for other relevant tasks in the National System. The protocols are assessed annually and updated if needed. • Various QC issues: – Inconsistencies in the key category analysis between CRF and NIR were analysed and removed. The key category analysis is updated in the NIR (Annex 1) as well as the CRF files. – The Expert Review Team (ERT) recommended providing more information in the NIR report and protocols, that was until now only included in background information. The Netherlands has updated the protocols; for various sectors this implies that more information is included in the protocols, as requested by the ERT. – The ERT recommended providing more specific information on sector specific QC activities. In 2009 and early 2010, a project was performed to re-assess and update both the information on uncertainties and on sector specific QC activities [Ecofys, 2010]. The PRTR task forces continue to work on the implementation of the recommendations from this report in 2012. – The Netherlands continues its efforts to include the correct notation keys in the CRF files. General QC checks were performed. To facilitate these general QC checks, a checklist was developed and implemented. A number of general QC checks have been introduced as part of the annual work plan of the PRTR and are also mentioned in the monitoring protocols. The QC checks included in the work plan aim at covering issues such as consistency, completeness and correctness of the CRF data. The general QC for the present inventory was largely performed in the institutes involved as integrated part of their PRTR work (Wever, 2011). The PRTR task forces fill in a standard-format database with emission data for 1990–2010 (with the exception of LULUCF). After a first check of the emission files by RIVM and TNO for completeness, the (corrected) data are available to the specific task force for checking consistency checks and trend analysis (comparability, accuracy). The task forces have access to information about the relevant emissions in the database. Several weeks before the dataset was fixed, a trend verification workshop was organised by RIVM (December, 2011). The result of this workshop including actions for the task forces to resolve the identified clarification issues are documented at RIVM. Required changes to the database are then made by the task forces. Basic LULUCF data (e.g. Forest Inventories, Forests statistics and land use maps) have a different routing compared to the other basic data (see figure 1.1). QA/QC for these data are described in the description of QA/QC of the outside agencies (Wever, 2011). Quality Assurance for the current NIR includes the following activities: • A peer and public review, on the basis of the draft NIR in January/February 2012. The peer review focused on the LULUCF sector • In preparing this NIR, the results of former UNFCCC reviews, including the preliminary results of the 2011 in-country review. • NL Agency carried out an audit on the subject of confidential data of industrial process emissions. The QA/QC activities generally aim at a high-quality output of the emissions inventory and the National System; these are in line with international QA/QC requirements (IPCC Good Practice Guidance).	Greenhouse Gas Emissions in the Netherlands 1990-2010 Mar 2012 p37 ff.

MS	Description of the national QA/QC activities	Source
Portugal	The APA has the overall responsibility for the GHG inventory in Portugal, including the competence for the coordination of the Quality Assurance and Quality Control System. The conceptualization of the system has however been done under an external consultancy with Ecoprogresso. Each public organization contributing with data to the inventory is responsible for the quality of their own data. The inventory staff is responsible for the implementation of QA/QC procedures. The QA/QC system is an integral part of the SNIERPA, which was created by the March, 17th Resolution of the Council of Ministers nr. 68/2005. The QA/QC system is composed of two main elements: a Quality Control and Quality Assurance Programme and a Procedures Manual. The first schedules the application of the general (QC1) and specific (QC2) Quality Control as well as Quality Assurance (QA) procedures, described in detail in a Manual. The procedures were defined according to Good Practice and Uncertainty Management Guide (IPCC, 2000) and adapted to the specific National Inventory (INERPA) characteristics. Quality Control tier 1 (QC1) procedures defined in the QA/QC Manual include a series of checklists, which consider basic checks on the accuracy of data acquisition processes (including, e.g, transcription errors) and checks on calculation procedures, data and parameters. It includes also cross-checking among subcategories in terms of data consistency, verification of NIR and CRF tables. Documentation and archiving procedures include checks on information handling which should enable the recalculation of the inventory. QC tier 2 (QC2) procedures, on the other hand, include technical verifications of emission factors, activity data, comparison of results among different approaches. Both QC1 and QC2 procedures have been applied by the inventory team during the inventory calculation and compilation following the QA/QC plan. An important tool for data checking is the implied emissions factor (IEF) graph of the CRF Reporter. This utility enables the visual verification of time series. When inconsistent trends are detected the underlying data are analised and corrected if necessary. The results of quality control of national submissions under the EC GHG Monitoring Mechanism (e.g. completeness checks, consistency checks), and the issues raised during the annual review process of the UNFCCC, constitute additional processes of technical verification and represent valuable sources of error detection.	Short Portuguese National Inventory Report on Greenhouse Gases, 1990-2009 Jan 2010, p 15 f.
Spain	The QA/QC plan is an internal document with the aim to improve the inventory. It is revised periodically and adapted to changes in the procedures of inventory preparation. The objectives of the QA/QC plan are: Timeliness: to reach this target a time schedule for specific tasks and respective check points are established. Completeness: an exhaustive analysis is done of the Inventory's basic SNAP nomenclature (which corresponds to the nomenclatures used in the rest of the Inventory formats), all the cross-tab activities with pollutants for which references for emission estimates are provided, and with reference to these methods, an analysis is made and the basic data necessary for the application of selected estimation method is collected. Consistency: a parameter or variable is only introduced once in the data base. This assures that a parameter that is used several times in the inventory is always the same. Consistency of time series is achieved by subjecting primary data to quality control. Outliers in the time series are identified and checked. Comparability: the Spanish Inventory should be comparable with inventories from other countries. To achieve this goal definitions and nomenclature are based on SNAP and CRF. Accuracy: priority for the use of methods of higher tier is given to key categories. Transparency: the reproducibility of the inventory should be granted. For this aim processes that generate emissions, the variables of activities and their origins, the algorithms and emission factors and the estimated emissions are documented in SNAP format. Improvement of the inventory: all the preceding objectives lead to this final objective of Inventory improvement and as such contribute to the shame, with all the quality assurance and control elements mentioned. The DGCEA as single national entity of the NIS is responsible for the quality control and quality assurance system. For this task DGCEA receives technical assistance from AED.	Inventario de Emisiones de gases de efecto invernadero de España, años 1990-2010 March 2012 (submitted in Spanish, translated)

MS	Description of the national QA/QC activities	Source
Sweden	In order to fulfill the obligations of reporting to the UNFCCC and the EU, the Swedish EPA has set up a quality system as part of the national system. The struc-ture of the quality system follows the PDCA cycle (Plan, Do, Check, Act) illu-strated in figure 1.2 below. This is an adopted model for how systematic quality and environmental management activity is to be undertaken according to interna-tional standards to ensure that quality is maintained and developed. The quality system includes several procedures such as training of staff, inventory planning and preparation, QA/QC procedures, publication, data storage, and fol-low-up and improvements. All QA/QC procedures are documented in a QA/QC SWEDISH ENVIRONMENT plan3. The QA/QC plan also includes a scheduled time frame describing the differ-ent stages of the inventory from its initial development to final reporting. The qual-ity system ensures that the inventory is systematically planned, prepared and fol-lowed up in accordance with specified quality requirements so that the inventory is continuously developed and improved. **Quality control:** Quality control is the check that is made during the inventory on different types of data, emission factors and calculations that have been made. The quality control takes place according to general requirements (Tier 1) which apply to all types of data used as support material for the reporting, and specific requirements for quali-ty control (Tier 2) which are applied to certain types of data and/or emission sources. In this inventory, general Tier 1 QC measures, according to Table 8.1 in IPCC Good Practice Guidance (2000), have been carried out as follows: • Transcription errors in data input • Calculations are made correctly • Units and conversion factors are correct • Integrity of database files • Consistency in data between source categories • Correct movement of inventory data between processing steps • Recalculations, checked and documented • Completeness check • Comparison of last submission's estimates to previous estimates • Documentation of changes that may influence uncertainty estimates In addition, source specific Tier 2 QC procedures are carried out for several categories. All QC measures performed are documented by SMED in QC checklists for each CRF code or group of codes. After completion of the initial compilation of the inventory, a QC-team within SMED reviews all QC checklists. In addition, the project management team performs checks of submission data using the functional-ity of the CRF Reporter (i.e. checks of completeness, time-series consistency and recalculation explanations). **Quality assurance**: Key categories should be subject to external peer review according to the Tier 2 of the Good Practice Guidance. The Swedish QA/QC system includes national peer reviews by sectoral authorities. The peer review is defined in the Ordinance (2005:626) Concerning Climate Reporting and is, for all sectors, conducted by a person who has not taken part in the inventory preparation. The Swedish EPA is responsible for coordinating the annual peer review. This means, among other things, ensuring that the peer reviewers have received the necessary training. The peer review includes methodology and emissions factors used, as well as com-parisons of activity and emission data with other national statistics. The reviewers also identify areas for improvement, which consolidates the basis for improve-ments in coming submissions. Results from the national peer review are docu-mented in review reports. Recommendations from the review reports are collected to the list of suggested improvements described in section 1.3.8. The UNFCCC secretariat administers an international peer review of Swedish re-porting after submission. Recommendations from the review reports are collected to the list of suggested improvements described in section 1.3.8. See also section 10. The 2012 submission will also be reviewed by the EU. Recommendations from this review will be handled in the same way as recommendations from the UNFCCC review and the national peer review.	National Inventory Report 2012 Sweden Mar 2012 pp38, 45ff.

MS	Description of the national QA/QC activities	Source
United Kingdom	The National Atmospheric Emissions Inventory and the UK Greenhouse Gas Inventory are compiled and maintained by AEA, part of AEA Technology plc. The data compilation and reporting for some source sectors of the UK inventory are performed by other contractors (i.e. Rothamsted compile the agriculture sector, CEH compile the land use, land use change and forestry sector), but AEA Energy and Environment is responsible for co-ordinating inventory-wide QA/QC activities. UK emission estimates are prepared via a central database of activity data and emission factors. Numerous QA/QC procedures are built into the data processing system. These include checks before data are entered into the national database of GHG emissions, and when data are extracted from the database. The database contains activity data and emission factors for all the sources necessary to construct the UK GHG inventory. The Inventory has been subject to ISO 9000 since 1994 and is now subject to BS EN ISO 9001:2008. It is audited by Lloyds and the AEA Technology internal QA auditors. The NAEI has been audited favourably by Lloyds on three occasions in the last 12 years. The emphasis of these audits was on authorisation of personnel to work on inventories, document control, data tracking and spreadsheet checking, and project management. As part of the Inventory management structure there is a nominated officer responsible for the QA/QC system – the QA/QC Co-ordinator. . AEA is currently accredited to BS EN ISO 9001:2008. Lloyds Register Quality Assurance carried out a three yearly recertification audit of AEA in September and October 2011.. QA/QC system includes three core components. 1. The QA/QC Plan which is maintained by the GHGI's QA/QC manager and defines the specific Quality Objectives and QA/QC activities needed. The plan assigns roles, responsibilities and a timeline for completion of QA/QC activities. 2. QA/QC implementation which includes the physical undertaking of the QA/QC activities throughout the data gathering, compilation and reporting phases of the annual emission estimation cycle and in accordance with the QA/QC plan. 3. Documentation and archiving which includes a) transparent documentation of all data sources, methods, and assumptions; and b) transparent documentation of all QA/QC implementation including records of activities undertaken, findings, recommendations and any necessary actions.	UK Greenhouse gas Inventory 1990-2010: Short NIR, Jan 2012, p 21 ff.

1.5.3 Further improvement of the QA/QC procedures

One of the most important activities for improving the quality of national and EU GHG inventories is the organisation of workshops and expert meetings under the EU GHG Monitoring Mechanism. In September 2004 a 'Workshop on quality control and quality assurance of greenhouse gas inventories and the establishment of national inventory systems' was organised. The Workshop facilitated the exchange of experience of Member States in the implementation of Quality Control (QC) and – Assurance (QA) procedures and the implementation of the National Inventory System. The workshop brought together experts from 17 Member States, the European Commission (DG ENV, JRC), EEA, ETC/ACM and an observer from the UNFCCC secretariat. For details of the workshop see the workshop report available on the website of the ETC/ACM: http://air-climate.eionet.europa.eu/docs/meetings/040902_GHG_MM_QAQC_WS/meeting040902.html

A number of other workshops and expert meetings have been organised in recent years with a focus on sector-specific quality improvements. Table 1.11 lists the most important workshops.

Table 1.11 Overview of workshops and expert meetings organised under the EU GHG Monitoring Mechanism

Workshop/expert meeting	Date and venue
JRC technical workshop on LULUCF reporting under the Kyoto Protocol	21 November 2011, Brussels, Belgium
Technical workshop on projections of GHG emissions and removals in the LULUCF sector	27-28 January 2010, Ispra, Italy
JRC technical workshop on LULUCF issues under the Kyoto Protocol	9-10 November 2010, Brussels, Belgium
Reporting on supplementary information under the Kyoto Protocol starting in 2010	2 March 2009, Berlin, Germany

Technical workshop on LULUCF reporting issues under the Kyoto Protocol	13-14 November 2008, JRC, Ispra, Italy
Workshop on the implications of the implementation of the 2006 IPCC Guidelines for national GHG inventories	30 - 31 October 2008, EEA, Copenhagen, Denmark
2nd workshop on data consistency between National GHG inventories and reporting under the EU ETS	13-14 September 2007, EEA, Copenhagen, Denmark
Expert meeting on the estimation of CH_4 emissions from solid waste disposal sites with the First Order Decay method	8-9 March 2006, EEA, Copenhagen, Denmark
Workshop on data consistency between National GHG inventories and reporting under the EU ETS	9-10 February 2006, EEA, Copenhagen, Denmark
Training workshop on the use of CRF Reporter for the experts of the European Union	12-13 September 2005, EEA, Copenhagen, Denmark
EU workshop on uncertainties in greenhouse gas inventories	5-6 September 2005, Helsinki, Finland
Workshop on Inventories and projections of greenhouse gas emissions from waste	2-3 May 2005, EEA, Copenhagen, Denmark
Expert meeting on improving the quality of. greenhouse gas emission inventories for category 4D	21-22 October 2004, JRC, Ispra, Italy
Workshop on quality control and quality assurance of greenhouse gas inventories and the establishment of national inventory systems	2-3 September 2004, EEA, Copenhagen, Denmark
Workshop on emissions of greenhouse gases from aviation and navigation	17-18 May 2004, EEA, Copenhagen, Denmark
Enlargement Training Workshop on Emission Inventory Improvement and Uncertainty Assessment	27-28 November 2003, JRC, Ispra, Italy
2003/06/24 Workshop on energy balances and energy related GHG emision inventories	24-25 June 2003, EEA, Copenhagen, Denmark
Workshop on Inventories and Projections of GHG and Ammonia Emissions from Agriculture	27-28 February 2003, EEA, Copenhagen, Denmark

Most of the workshop reports are available at the website of the EEA/ETC-ACM:
http://acm.eionet.europa.eu/meetings/past_html

1.6 Uncertainty evaluation

The EU-15 uncertainty analysis was made on basis of the Tier 1 uncertainty estimates, which were submitted from the Member States in their GPG Table 6.1. The first review shows, that most MS provide uncertainty information for nearly every source category, even though two countries just submit data for their key sources. Due to this fact, the sectoral EU and EU total of emissions in the following tables might not always meet exactly the value which is reported as “true” total compare to the values in the individual trend chapters.

Uncertainties were estimated on detailed level and aggregated to six main sectors ‘Energy’, ‘Fugitive emissions’, Industrial processes’, ‘Agriculture’, ‘LULUCF’ and ‘Waste’. Within these sectors the available MS uncertainty estimates were grouped by source categories. Then for each source category a range of uncertainty estimates was calculated: the lower bound of the range was calculated by assuming that all uncertainty estimates within a source category are uncorrelated; the upper bound of estimates was calculated by assuming that all uncertainty estimates within a source category are correlated. Then a single uncertainty estimate was calculated for each source category based on the assumption that MS uncertainty estimates are correlated if they use Tier 1 methods and/or default emission factors. After having calculated the uncertainty estimates for each source category, the uncertainty estimates for the sectors and for total GHG emissions were calculated.

Estimation of trend uncertainty: The EU uncertainty estimate is rather complicated due to potential correlations between MS uncertainties. Therefore, an analytical method, which allows more flexibility than IPCC Tier 1, was compiled.

Trend in MS n category x was defined as

$$\mathbf{Trend_{n,x} = E_{n,x}(t) - E_{n,x}(0)} \qquad \mathbf{(1)}$$

Where E(t) denotes emissions in the latest inventory year and E(0) emissions in the base year.

Variance for each MS and source category was calculated by using the perceptual uncertainty estimates reported by MS, and assuming normal distributions. Uncertainties in trends of different MS and source categories were then calculated using first order approximation of error propagation.

The assumptions of correlation between years (0 and t) and between different MS are important for the estimation of trend uncertainty. However, there is not enough information about strengths of different correlations. Effect of correlation was tested both with the analytical method developed, and by using MC simulation, where Normal distribution was used in all the cases to ensure comparability with analytical estimates. Table 1.12 presents an example of such comparison made in 2006. The source category chosen for the example is 4D, N_2O emissions from agricultural soils, as this category has a major effect on inventory uncertainty in most MS. Both the effects of correlations between years and between Member States were tested.

Table 1.12 Trend uncertainty for EU-15 emissions 2006 of N_2O from agricultural soils by using different assumptions of correlation estimated using Monte Carlo simulation

Years correlate	MS correlate	Trend uncertainty
YES	YES	-27 to +26
YES	NO	±13
NO	YES	-294 to +292
NO	NO	-116 to +115

Note: "YES" denotes full correlation between years or Member States. Trend uncertainty is presented as percentage points.

The results of the comparison revealed that assumption on correlation between years has much larger effect on trend uncertainty than the assumption on correlation between MS. In the IPCC GPG 2000, it is suggested to assume that emission factors between years are fully correlated, and activity data are independent. However, in the EU uncertainty estimate, it is assumed that activity data uncertainties also correlate to some extent between years, because typically the same data collection methods are used each year. Therefore, for simplicity, in EU uncertainty estimate it was decided to assume that emissions between years are fully correlated, even though this may underestimate trend uncertainty to some extent.

In the example in Table 1.13, uncertainty decreased when correlation between MS was added to the correlation between years. However, this is not always the case; in another example considering EU-15 MS estimates for 1A1a CO_2, uncertainty was ±0.2% when it was assumed that years correlate and MS estimates are independent. When a correlation between MS was added, the uncertainty decreased to ±0.1%.

Correlation between MS is difficult to quantify, especially in case of trend uncertainty, where correlation between different MS in different years should also be quantified. Furthermore, effect of correlation on uncertainty (increasing or decreasing) depends on the direction and magnitude of trend for each MS and each source category. Therefore, a simple conservative assumption cannot be made. Therefore, for simplicity, it was assumed in trend uncertainty estimate that MS are independent18.

In general, the caveats of the method used are the same as in IPCC Tier 1, i.e. the result gives the most reliable results when uncertainties are small, and it assumes normal distributions even though this cannot actually be the case when uncertainties are >100%. However, these issues do not seem to have any major effect on the results, as can be seen from Table 1.13, where waste sector uncertainties are presented both with analytical method and Monte Carlo simulation. When uncertainty increases, also the difference between the two methods increases.

Table 1.13 Comparison of trend uncertainty estimates 2005 for EU-15 Waste Sector using the modified Tier 1 method and Monte Carlo simulation (Tier 2).

Sector	GHG	Tier 1	Tier 2
6A. Landfills	CH_4	±12	±12
6B. Wastewater	CH_4	±27	-28 to +27
6B. Wastewater	N_2O	±9	±9
6C. Waste incineration	CO_2	±7	±7
6C. Waste incineration	CH_4	±23	-23 to +24
6C. Waste incineration	N_2O	±18	±18
Waste Other	CH_4	±990	-976 to +993
Total Waste Sector		±11	±11

Note: Trend uncertainty is presented as percentage points.

Furthermore, trend uncertainty was calculated as in Equation 1, and the resulting confidence intervals were divided by base year estimate (best estimate) to obtain the relative change. The results would have been somewhat different, if trend uncertainty were calculated as in Equation 2:

$$\mathbf{Trend_{n,x} = [E_{n,x}(t)-E_{n,x}(0)]/ E_{n,x}(0)} \qquad \mathbf{(2)}$$

However, the effect of the choice between Eq 1 and 2 depends also on the direction and magnitude of trend in different MS, and without further consideration it cannot be stated whether choice of Eq 1 yielded a conservative estimate or not.

Lack of knowledge of different correlations, and many assumptions make the interpretation of EU trend uncertainty difficult, and therefore it should not be compared with uncertainty estimates of other countries. However, trend uncertainty calculations are internally consistent, and therefore the results can be used e.g. to assess which categories are the most important sources of trend uncertainty in the EU inventory.

Table 1.14 shows the main results of the uncertainty analysis for the EU-15. The lowest level uncertainty estimates are for fuel combustion activities (1.3 %), the highest estimates are for agriculture (90 %). Overall level uncertainty estimates including LULUCF of all EU-15 GHG emissions is calculated with 9.4 %and excluding LULUCF slightly lower with 9.0 %.

With regard to trend uncertainty estimates the lowest uncertainty estimates are for fuel combustion activities (+/- 0.4 percentage points), the highest estimates are for LULUCF (26.7 percentage points). Overall trend uncertainty (excluding LULUCF) of all EU-15 GHG emissions is estimated to be 1.4 percentage points.

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18 When the correlation assumptions were simplified, IPCC Tier 1 method could also have been used

More detailed uncertainty estimates for the source categories are provided in Chapters 3-8.

Table 1.14 Tier 1 uncertainty estimates of EU-15 GHG emissions for the main sectors

Source category	Gas	Emissions 1990	Emissions 2010	Emission trends 1990-2010	Level uncertainty estimates based on MS uncertainty estimates	Trend uncertainty estimates based on MS uncertainty estimates
1.A Fuel combustion activities	all	3,178,581	2,996,078	-5.7%	1.3%	0.4%
1.B Fugitive emissions	all	91,913	44,047	-52.1%	11.5%	7.1%
2. Industrial processes	all	347,115	260,061	-25.1%	8.8%	3.9%
3. Solvents and other product use	all	9,709	7,845	-19.2%	16.0%	4.4%
4. Agriculture	all	434,325	372,939	-14.1%	90.1%	8.0%
6. Waste	all	169,546	106,453	-37.2%	23.6%	10.1%
5. LULUCF	all	-130,592	-122,356	-6.3%	34.4%	26.7%
Total (incl LULUCF)	**all**	**4,100,596**	**3,665,067**	**-10.6%**	**9.4%**	**1.4%**
Total (excl LULUCF)	**all**	**4,231,188**	**3,787,423**	**-10.5%**	**9.0%**	**1.0%**

Note: Emissions are in Gg CO_2 equivalents

This was the first year an uncertainty analysis for Tier 2 (Monte-Carlo-Simulation) was conducted for each sector. The analysis includes all uncertainty data, which were reported for the member states. In detail, these are nearly 1,500 indivdual data rows for alle MS at subsector level and gas.

In all input and output parameters, uncertainty has been expressed as normal probability density function. Consistent with the IPCC requirements, the uncertainty range is presented as ragne with 95% probability of a given value being within boundaries. Thus the boundaries were given as the 2.5 and 97.5-percentiles from the mean value.

During the Monte-Carlo-Analysis the emissions and the combined uncertainty (uncertainty for emission factor and activity data) with normal distribution functions were simulated through 10.000 iterations. Therefore, for each individual level a standard dervivation of emisisons were generated. The results for this Tier 2 analysis can be found in the following tables.

Table 1.15 Tier 2 uncertainty estimates of EU-15 GHG emissions per main sector

Source category	Gas	Base year emissions 1990 (average simulation value)	Last Year 2010 emissions (average simulation value)	Level uncertainty estimates based on MS uncertainty estimates medium (2.5 - 97.5 percentile)
1.A Fuel combustion activities	all	3,179,461	2,996,084	1% (0.9 - 1)
1.B Fugitive emissions	all	91,875	44,072	10.6% (10.1 - 11.1)
2. Industrial processes	all	347,485	259,920	4.6% (4.6 - 4.6)
3. Solvents and other product use	all	9,726	7,831	13.5% (13.3 - 13.6)
4. Agriculture	all	436,089	374,947	42.7% (41 - 44.3)
6. Waste	all	-129,724	-121,344	33.6% (32 - 35.2)
5. LULUCF	all	169,620	106,418	18.1% (17.7 - 18.5)

Note: Emissions are in Gg CO_2 equivalents and are mean values of the Monte-Carlo-Analysis

Table 1.16 **Tier 2 uncertainty estimates of EU-15 GHG emissions per gases**

		CO_2	CH_4	N_2O	PFC	HFC	SF_6	total GHG
1990	Mean value	3,232.43	427.65	392.97	30.84	9.34	11.32	4,104.53
	Standard deviation	32.63	15.36	93.79	1.72	0.41	0.34	99.41
	2s	2.0%	7.2%	47.7%	11.2%	8.8%	6.0%	**4.8%**
2010	Mean value	3,028.29	297.59	263.27	72.32	1.54	4.92	3,667.93
	Standard deviation	24.38	11.92	77.77	5.55	0.09	0.14	82.28
	2s	1.6%	8.0%	59.1%	15.3%	11.3%	5.8%	**4.5%**

In September 2005 a workshop on uncertainties in greenhouse gas inventories was organised in Helsinki (Finland). The aim of the workshop was to share information and experience on uncertainty assessment, to discuss needs for further guidance, and to improve comparability of uncertainty estimates across different Member States. The main objectives were to help Member States to compile/improve uncertainty estimates and to help develop the uncertainty assessment of the EU inventory. The workshop brought together experts from 16 Member States, the European Commission (DG ENV, JRC), ETC-ACM, as well as from Norway and Russia. UNFCCC secretariat sent their statement in a written form to the workshop. The workshop produced recommendations on the following topics: a) EU Uncertainty assessment and implications on Member State uncertainty assessment and b) Uncertainty assessment at Member State level.

Table 1.17 gives an overview of information provided by EU-15 Member States on uncertainty estimates in their national inventory reports 2010 and presents summarised results of these estimates. For some Member States, either a national inventory report was available, which did not include quantitative uncertainty analysis, or no national inventory report was available at all.

Table 1.17 Overview of uncertainty estimates available from EU-15 Member States

Member State	Austria		Belgium	Denmark	Finland	France	Germany	Greece	
Citation	NIR Apr 2012, pp.43-46		NIR Apr 2012, pp. 34-36	NIR Apr 2012, p.71	NIR Apr 2012, pp. 38-39	NIR, Apr 2012, p. 44	NIR Apr 2012 , pp. 112-115	NIR, Apr 2012, pp. 40--44	
Method used	Tier 1		Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	
Documentation in NIR (according to Table 6.1/6.2 of GPG)	Yes		Yes	Yes	Yes (Annex 6)	Yes (Annex 7)	Yes (Annex 7)	Yes (Annex IV)	
Years and sectors included	emissions: 2010; trends: 1990-2010; excluding LULUCF		emissions: 2010; trends: 1990-2010; including LULUCF	emissions: 2010; trend:1990 - 2010; excluding LULUCF	emissions: 2010; trends: 1990-2010; including LULUCF	emissions: 2010; trends: 1990-2010; including LULUCF	emissions: 2010; trends: 1990-2010; including LULUCF	emissions: 2010; trends: 1990-2010; including LULUCF	
Uncertainty (%)	Tier 1 (i .L.)	Tier 1 (e. L.)	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1 (i. L.)	Tier 1 (e. L.)
CO_2				6.4%				2.7%	2.5%
CH_4				19%				42.2%	42.2%
N_2O				43%				94.1%	94.1%
F-gases				48%				168.3%	168.3%
Total	22.1%	4.2%	8.2%	4.8%	i. L.: 24% e. L.: 5%	i. L.: 17.6% e. L.: 16.2%	5.9%	9.05%	8.82%
Uncertainty in trend (%)	Tier 1 (i .L.)	Tier 1 (e. L.)	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1
CO_2				±4.0% points					
CH_4				±13.3% points					
N_2O				±12.8% points					
F-gases				±62% points					
Total	±2.95 % points	±2.34 % points	±2.97% points	±3.0% points	i. L.: ±32% points e. L.: ±6% points	i. L.: ±3.1% points e. L.: ±2.8% points	6.30%	±9.90% points	±9.63% points

Member State	Ireland	Italy	Luxembourg	Netherlands	Portugal	Spain	Sweden	United Kingdom
Citation	Uncertainty Table 2012	Uncertainty Table 2012	Uncertainty Table 2012	Uncertainty Table 2012	NIR Mar 2012, pp.17-19	Uncertainty Table 2012	NIR Mar 2012, pp. 53-56	Uncertainty Table 2012
Method used	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1
Documentation in NIR (according to Table 6.1/6.2 of GPG)	Yes	Yes	-	Yes (Annex 7)	Yes (Annex B)	Yes (Annex 7)	Yes (Annex 7)	Yes (Annex 7)
Years and sectors included	emissions: 2010; trend: 1990-2010; all categories (i.L.)	emissions: 2010; trend: 1990 -2010; all categories (i.L.)	emissions: 2010, trend: 1990-2010; all categories (e.L.)	emissions: 2010; trend: 1990-2010; all categories (e.L.)	emissions: 2010, trend: 1990-2010; all categories (e.L.)	emissions: 2010; trend: BY-2010; excluding LULUCF	emissions: 1990 and 2010; trend: 1990-2010; including LULUCF	emissions: 1990, 2010; trend: BY -2010, including LULUCF
Uncertainty (%)	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1
CO_2	2.01%			2%	4.7%	-		
CH_4	1.67%			16%	25.6%	-		
N_2O	6.65%			43%	124.7%	-		
F-gases	0.21%			35%	71.2%			
Total	7.15%	7.0%	3.44% (i.L.) 2.51% (e.L.)	3%	16.3%	13.0%	4.1%	i. L.: 19.2% e. L.: 19.1%
Uncertainty in trend (%)	Tier1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1
CO_2	±1.94% points							
CH_4	±0.84% points							
N_2O	±1.68% points							
F-gases	±0.31% points							
Total	±2.72% points	±5.5% points	i.L.: ±3.11% points e.L.: ±0.9% points		±14,4% points	±10.5% points	±2.1% points	i. L.: ±2.25% points e. L.: ±2.0% points

1.7 General assessment of the completeness

1.7.1 Completeness of Member States' submissions

The EU GHG inventory is compiled on the basis of the inventories of the EU Member States. Therefore, the completeness of the EU inventory depends on the completeness of the Member States' submissions. Table 1.18 summarises timeliness and completeness of the EU-15 Member States' submissions in 2012. It shows that GHG inventories for 2010 were submitted by all EU-15 Member States by 15 March 2012 (cut off date for the 15 April submission). The completeness of national submissions with regard to individual CRF tables can be found in the status reports in Annex 1.3.

Table 1.18 Date, mode and content of submissions of EU-15 Member States in 2012 (status 22 May 2012)

MS	Date	Submission mode	XML	SEF	CRF	KP LULUCF	NIR
AT	13.01.2012	CDR	AUT-2012-v1.1	2011	1990-2010	2008-2010	short NIR
AT	15.03.2012	CDR	AUT-2012-v1.2	2011	1990-2010	2008-2010	yes
AT	12.04.2012	CDR	AUT-2012-v1.3	2011	1990-2010	2008-2010	yes
BE	13.01.2012	CDR	BEL-2012-v1.2	2011	1990-2010	2008-2010	yes
BE	15.03.2012	CDR	BEL-2012-v1.3	2011	1990-2010	2008-2010	yes
BE	15.04.2012	CDR	BEL-2012-v1.4	2011	1990-2010	2008-2010	yes

DK	13.01.2012	CDR	DNM-2012-v1.1	-	1990-2010	1990, 2008-2010	short NIR
DK	13.01.2012	CDR	-	2011	-	-	-
DK	15.03.2012	CDR	DNM-2012-v1.2	-	1990-2010	1990, 2008-2010	yes
DK	27.03.2012	CDR	-	2011	-	-	-
DK	13.04.2012	CDR	-	-	-	-	yes
DK	02.05.2012	CDR	DNM-2012-v1.3	-	1990-2010	1990, 2008-2010	yes
DK	10.05.2012	CDR	DNM-2012-v1.3	-	1990-2010	1990, 2008-2010	
FI	12.01.2012	CDR	FIN-2012-v1.1	2011	1990-2010	2008-2010	yes
FI	15.03.2012	CDR	FIN-2012-v1.2	2011	1990-2010	2008-2010	yes
FI	24.04.2012	CDR	FIN-2012-v1.3	-	1990-2010	2008-2010	yes
FR	13.01.2012	CDR	FRK-2012-v1.1	2011	1990-2010	2008-2010	short NIR
FR	15.03.2012	CDR	FRK-2012-v1.2	2011	1990-2010	2008-2010	yes
FR	13.04.2012	CDR	-	-	-	-	yes
FR	13.04.2012	CDR	-	2011	-	-	-
DE	13.01.2012	CDR	DEU-2012-v1.1	2011	1990-2010	2008-2010	yes
DE	15.03.2012	CDR	DEU-2012-v1.2	-	1990-2010	2008-2010	yes
GR	13.01.2012	CDR	GRC-2012-v1.1	2011	1990-2010	2008-2010	-
GR	16.01.2012	CDR	-	-	-	-	short NIR
GR	15.03.2012	CDR	GRC-2012-v1.2	-	1990-2010	2008-2010	yes
GR	14.04.2012	CDR	GRC-2012-v1.4	2011	1990-2010	2008-2010	-
GR	19.04.2012	CDR	-	-	-	-	yes
IE	13.01.2012	CDR	IRL-2012-v1.1	2011	1990-2010	2008-2010	-
IE	15.03.2012	CDR	IRL-2012-v1.2	2011	1990-2010	2008-2010	yes
IE	13.04.2012	CDR	IRL-2012-v1.3		1990-2010	2008-2010	yes
IT	23.01.2012	CIRCA	ITA-2012-v1.1	2011	1990-2010	2008-2010	-
IT	15.03.2012	CIRCA	ITA-2012-v1.2	-	1990-2010	2008-2010	yes
IT	13.04.2012	CIRCA	ITA-2012-v1.3	-	1990-2010	2008-2010	yes
LU	15.01.2012	CDR	LUX-2012-v1.1	2011	1990-2010	2008-2010	-
LU	15.03.2012	CDR	LUX-2012-v1.2	2011	1990-2010	2008-2010	-
LU	23.03.2012	CDR	LUX-2012-v1.2	2011	1990-2010	2008-2010	-
LU	11.05.2012	CDR	-	-	-	-	yes
NL	13.01.2012	CDR	NLD-2012-v1.1	2011	1990-2010	2008-2010	yes
NL	15.03.2012	CDR	NLD-2012-v1.1-15March2012	-	1990-2010	2008-2010	yes
NL	14.04.2012	CDR	NLD-2012-v1.1-15Apr2012	-	1990-2010	2008-2010	yes
PT	13.01.2012	CDR	PRT-2012-v1.1	2011	1990-2010	1990, 2008-2010	short NIR
PT	15.03.2012	CDR	PRT-2012-v1.2	-	1990-2010	1990, 2008-2010	yes
PT	14.05.2012	CDR	PRT-2012-v1.3	-	1990-2010	1990, 2008-2010	yes
ES	13.01.2012	CDR	ESP-2012-v1.1	2011	1990-2010	1990, 2008-2010	short NIR
ES	15.03.2012	CDR	ESP-2012-v1.4	2011	1990-2010	1990, 2008-2010	yes
ES	12.04.2012	CDR	ESP-2012-v1.4	2011	1990-2010	1990, 2008-2010	yes
SE	13.01.2012	CDR	SWE-2012-v1.1	2011	1990-2010	2008-2010	yes
SE	14.03.2012	CDR	-	2011	-	-	yes
SE	28.03.2012	CDR	-	2011	-	-	-
GB	13.01.2012	CDR	GBE-2012-v1.1	2011	1990-2010	2008-2010	yes
GB	15.03.2012	CDR	-	-	-	-	yes

The grey xml files have been used for the EU-15 inventory

In response to the Saturday paper 2010 the EU mobilized the mechanisms of its national system to further enhance its QA/QC programme and develop an appropriate action plan, in consultation with the MS, geared in particular towards complementing the existing procedures and improving the completeness regarding NEs of the EU greenhouse gas inventory in 2011 and beyond (see description in Chapter 13). During February and March intensive consultation between the EU inventory team and the Member States took place. In some cases the EU inventory team recommended Member States to provide estimates and/or change the use of notation keys. After this consultation the number of NEs in the Member States' GHG inventories could be reduced significantly. As a result of this consultation and the improvements in response to the UNFCCC review cycle 2010 the number of NEs at EU-15 level could be reduced by about 40% in the 2011 submission compared to the 2010 submission. Annex 1.4 provides a list of all NEs and IEs and includes explanations taken from the Member States' CRF Tables 9. This information is equivalent to CRF Table 9 which cannot be filled-in automatically for the EU-15 due to the amount of information from the Member States.

The following table provides an overview of the general completeness sections of the Member States' National Inventory Reports.

Table 1.19 Description of completeness taken from EU-15 Member States submissions 2012

MS	Description of the completeness	Source
Austria	Where "NE" is used in an inventory for emissions or removals, both the NIR and the CRF completeness table indicate why emissions or removals have not been estimated. For emissions by sources and removals by sinks of greenhouse gases marked by "NE" check-ups are in progress to establish if they actually are "NO" (not occurring). As part of the improvement programme of the inventory, it is planned that these source or sink categories are either estimated or allocated to "NO".	Austria's Annual Greenhouse Gas Inventory 1990–2009 Mar 2011 p. 50
Belgium	All sources and sinks included in the IPCC Guidelines are covered with the exception of the following (very) minor sources: - CO_2 from asphalt roofing (2A5), due to missing activity data; - CO_2 from road paving (2A6), due to missing activity data; Some other 'NE' sources, mainly small missing emissions from CH_4 and N_2O from combustion activities of 'other fuels' in the Flemish region were added during the 2011 submission. No additional sources and sinks specific for Belgium have been identified for the time being. All direct and indirect greenhouse gases and SO_2 are covered in the Belgian inventory. The geographic coverage is complete. There is no part of the Belgian territory not covered by the inventory.	Belgium's Greenhouse Gas Inventory (1990–2010) Mar 2012 p. 28
Germany	If source-specific emissions and sinks are not quantified, they are quantitatively not relevant or the necessary data for an estimate are not available (NE-not estimated). The still reported "Not estimated" (NE) concern mostly not quantified emissions, which according to IPCC GPG (2003, p.1.11), do not have to be reported, as these emissions are listed in the appendices 3a.2, 3a.3 und 3a.4. Some of the emission data, which are available to UBA, cannot be published because of confidentiality. These data are complete, but can only be reported on an aggregate level.	Nationaler Inventarbericht zum deutschen Treibhausgasinventar 1990-2010 Mar. 2012 p. 113

MS	Description of the completeness	Source
Denmark	The Danish greenhouse gas emission inventories for 1990-2009 include all sources identified by the Revised 1996 IPCC Guidelines and the 2000 IPCC Good Practice Guidance. Some very minor sources have not been estimated due to lack of methodology, activity data or emission factors, i.e.: In the Solvent and other product use sector currently only N_2O emissions from anaesthesia and some other minor uses are included in CRF category 3D, Denmark will try to obtain activity data for use of N_2O in aerosol cans. N_2O emissions from anaesthesia are only included from 2005 onwards. Direct and indirect CH_4 emissions from agricultural soils are not estimated. Direct and indirect soil emissions are considered of minor importance for CH_4. No methodology is available in the IPCC Guidelines. Emissions from harvested wood products are not reported due to lack of data. Several possible sources of CH_4 in the LULUCF sector are also reported as not estimated. For more detail please see chapter 7. In the Waste sector CO_2 emissions from managed waste disposal on land are not estimated. According to the 1996 IPCC Guidelines: "Decomposition of organic material derived from biomass sources (e.g., crops, forests), which are regrown on an annual basis is the primary source of CO_2 released from waste. Hence, these CO_2 emissions are not treated as net emissions from waste in the IPCC Methodology." Emissions of N_2O from accidental fires are reported as not estimated due to lack of emission factors.	Denmark's National Inventory Report 2012 Mar 2012 Annex 5
Finland	Finland has provided estimates for all significant IPCC source and sink categories according to the detailed CRF classification. Estimates are provided for the following gases: CO_2, N_2O CH_4, F-gases (HFC, PFC and SF_6), NMVOC, NO_x, CO and SO_2. In accordance with the IPCC Guidelines, international aviation and marine bunker fuel emissions are not included in national totals. Assessment of completeness is included in Annex 5. The geographical coverage of the inventory is complete. It includes emissions from the autonomic territory of Åland (Ahvenanmaa). The emissions for the territory of Åland are not reported separately. A complete set of CRF tables are provided for all years and the estimates are calculated in a consistent manner.	Greenhouse Gas Emissions in Finland 1990 - 2010 Mar 2012 p39
France	There is only the memo item 1C2, which is not estimated, because data are not available.	Rapport National d'inventaire pour la France au titre de la convention cadre des nations unies sur les changements climatiques et du protocole de Kyoto CRF table 9 Mar 2001
Greece	In the present inventory report, which supersedes all previous ones, estimates of GHG emissions in Greece for the years 1990-2010 are presented. Emissions estimates included in the CRF tables submitted and discussed in the present report, cover the whole territory of Greece. All major sources are reported including emissions estimates for indirect greenhouse gases and SO_2. Completeness gaps in the present inventory submission that will be discussed in more details in the relevant chapters include: • CO_2 from organic chemicals production and asphalt roofing-road paving with asphalt are not estimated due to lack of emission factors in the IPCC GPG. • Potential emissions of F-gases are not estimated as, for the time being, imports/exports of the relative chemical compounds are not recorded separately by the El. Stat. It should be noted however that, during the implementation of the 2012 Improvement Plan, the inventory team has been able to come into contact and collaboration with the National Association of Refrigeration Importing & Trading Companies. In this framework the possibility of acquiring data on the imports/exports and use of the specific gases has been examined. So far the data collection process has not been concluded, but in any case the results will be used as appropriate in the next submissions. Annex VI provides in detail the sources of GHGs that are not estimated in the Greek GHG inventory, and the reasons for those sources being omitted.	Climate Change Emissions inventory Mar 2012 p43
Ireland	Table 1.10 gives an overview of the level of completeness of the 2010 GHG inventories with respect to the six greenhouse gases covered by the UNFCCC reporting guidelines, the IPCC Level 2 source-category split in operation since 2005 for reporting under the Convention and Article 3.3 activities under the Kyoto Protocol. Further detail on source/gas coverage at IPCC Level 3 is provided in the individual chapters describing the inventory methods and data for each Level 1 source-category. The work done for the current reporting cycle serves to maintain a complete and consistent emissions time-series by improving the inventories for the years 1990-2009 to bring them fully into line with that for 2010, which features important methodological changes in the Agriculture and Waste sectors. The opportunity has also been taken in this current cycle to improve, wherever possible, the estimates of emissions and removals for all years for LULUCF reported under the Convention in accordance with the requirements of Decision 13/CP.9 in order to achieve consistency with the reporting on Article 3.3 activities under the Kyoto Protocol	National Inventory Report 2012 Mar 2012 p.26 and 32

MS	Description of the completeness	Source
Italy	The inventory covers all major sources and sinks, as well as direct and indirect gases, included in the IPCC guidelines. Allocation of emissions is not consistent with the IPCC Guidelines only where there is no data available to split the information. For instance, for fugitive emissions, CO_2 and CH_4 emissions from oil and natural gas exploration and venting are included in those from oil production because no detailed information is available. CH_4 emissions from other leakage emissions are included in distribution emission estimates. N_2O emissions from oil and natural gas exploration and refining and storage activities are reported under category 1.B.2.C oil flaring. Further investigation will be carried out closely with industry about these figures. For industrial processes, emissions from soda ash use are included in glass production emissions because the use of soda is part of that specific production process.	Italian Greenhouse Gas Inventory 1990-2010 Mar 2012 p.44 f.
Luxembourg	All sources and sinks included in the IPCC Guidelines are covered. With regards to LULUCF, this submission contains new estimations for LULUCF, the three main sub-categories now being covered as well as the sub-categories wetlands, settlements and other lands, which were not estimated in the previous submission. Both direct GHGs as well as precursor gases are covered by Luxembourg's inventory. However, indirect GHG – NO_x, CO, NMVOCs – and SO_2 need to be re-evaluated in the light of the revision of the inventories Luxembourg is compiling for the UNECE CLRTAP. Generating better emission estimates for these gases are part of our planned improvements.The geographic coverage is complete. There is no part of the national territory not covered by the inventory. The sources and sinks not considered in the inventory, but included in the IPCC Guidelines, are clearly indicated. The reasons for such exclusions are explained. In addition, the notation keys presented below are used to fill in the blanks in all the CRF tables.Notation keys used in the NIR are consistent with those reported in the CRF tables. Notation keys used are those described on page 9 of document FCCC/SBSTA/2006/9 of 18 August 2006.Allocations to categories may differ from Party to Party. The main reasons for different category allocations are different allocations in national statistics, insufficient information in national statistics and/or national methods, and the impossibility to disaggregate emission declarations.	National Inventory Report 2012 Apr 2012 p.88-89
Netherlands	The Netherlands greenhouse gas emission inventory includes all sources identified by the Revised IPCC Guidelines (IPCC, 1996) – with the exception of the following (very) minor sources: · CO_2 from asphalt roofing (2A5) and CO_2 from road paving (2A6), both due to missing activity data; Information on the use of bitumen is only available for two groups: the chemical industry and all others. There is no information on the amount of asphalt roofing production and also no information on road paving with asphalt. The statistical information on sales (value) of asphalt roofing and asphalt for road paving was finalised by 2002. Based on this information it was assumed that emissions related to this two categories are very low/undetectable and that effort in generating activity data would, therefore, not be cost effective. So not only the missing activity data but also the very limited amount of emissions was the rationale of the decision to not estimate these emissions. As follow up on the 2008 review, information has been collected from the branch organisation of roofing indicating that the number of producers of asphalt roofing declined from about 15 in 1990 to less than 5 in 2008 and that the import of asphalt roofing increased. Also, information has been researched on asphalt production (for road paving) as reported in the progress of the voluntary agreements for energy efficiency. A first estimate indicates that the CO_2 emissions could be around 0.5 kton. • CH_4 from Enteric fermentation poultry (4A9), due to missing emission factors; for this source category no IPCC default emission factor is available. • N_2O from Industrial wastewater (6B1), due to negligible amounts. As presented in the NIR 2008, page 194, the annual source for activity data are yearly questionnaires which cover all urban WWTPs and all anaerobic industrial WWTPs. From this anaerobic pre-treatment, there is no N_2O emission. Precursor emissions (i.e. CO, NO_x, NMVOC and SO_2) from Memo item international bunkers (international transport) have not been included.	Greenhouse gas emissions in the Netherlands 1990-2010 Mar 2012 Annex 5
Portugal	CRF Table 9 (Completeness) gives an overview of the level of completeness of the 2012 submitted inventories to the UNFCCC and EC. Additional information on this issue is given in the subchapters. The inventory covers the 6 gaseous air pollutants included in Annex A to the Kyoto Protocol: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFC), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6), as well as estimates for indirect GHGs, including carbon moNO$_x$ide (CO), nitrogen oxides (NO_x), and non-methane volatile organic compounds (NMVOC). Data are also reported for sulphur oxides (SOx). As a general rule the inventory covers emissions realized in the whole Portuguese territory, i.e., mainland Portugal and the two autonomous regions of Madeira and Azores Islands. Despite the efforts done, it was still not possible to collect the necessary background information to quantify CO_2 emissions from agricultural lime application.	Portuguese National Inventory Report on Greenhouse Gases, 1990-2010 Mar 2012 p1-19
Spain	See CRF table 9(a)	Inventario de emisiones de gases de efecto invernadero des Espana anos 1990-2010 Mar 2012

MS	Description of the completeness	Source
Sweden	The inventory covers emissions and sinks in Sweden. All greenhouse gases are covered. The general completeness for each sector is discussed below. Detailed information is presented in Annex 5. Estimated emissions are considered to be complete for most sources. Emissions of CH_4 and N_2O from liquid bio fuels used in military transportation are however not estimated. There might also still be some lack in completeness as regards in-house generated fuels in the chemical industry and in smaller companies. INDUSTRIAL PROCESSES For most sources, and particularly for the most important ones, the estimates are in accordance with the requirements concerning completeness as laid out in the Good Practice Guidance. However, some exceptions do exist. These are primarily in sub-sectors with a large number of smaller facilities with minor emissions. Data is complete for all greenhouse gases, possibly with the exception of CH_4 for a few sources, e.g. within the chemical industry. SOLVENT AND OTHER PRODUCT USE The estimated emissions from solvent and product use are considered to be com-plete, since a new method was developed during 2005 in order to obtain all activity data concerning the sector from the Products register at the Swedish Chemicals Agency. The estimated emissions of N_2O are also considered to be complete, since na-tional data from the Products register is used in the inventory. AGRICULTURE All relevant agricultural emissions and sources are reported in the inventory. Rein-deer, which are normally not considered as a part of the agricultural sector, are included in the inventory. The majority of the country‟s horses does not belong to farms, but are included in the agricultural sector of the inventory. There are, how-ever, some marginal animal groups, which are not included, such as fur-bearing animals (minks, foxes and chinchillas). These groups are very small and there is no methodology developed for estimating their GHG emissions. All sales of fertilizers are included in the inventory, also quantities used in other sectors. N-fixing crops used in temporary grass fields, and sludge used as fertilizer is also included. This means that all anthropogenic inputs to agricultural soils are covered. LAND USE, LAND USE CHANGE AND FORESTRY All land areas are inventoried in the field except high mountains, military impedi-ments and urban land. We believe that their relative importance for the Swedish GHG inventory is small. The inventory of the LULUCF-sector is complete in the sense that all carbon pools and other sources, defined based on the IPCC GPG for LULCUF, are re-ported for land use categories that are considered managed. The reporting of woody biomass stocks refers to above and below ground parts of trees taller than 1.3 m. Other vegetation such as shrubs and herbs are not re-ported. Emissions/removals from below ground biomass of dead stump systems are from this submission included in the dead organic matter pool. WASTE The effects of possible leakage of methane and nitrous oxide from the wastewater treatment processes have not been estimated. All other data are complete. KP-LULUCF Sweden has elected the activity Forest management (FM) under Article 3.4 of the Kyoto Protocol (KP). All carbon pools as well as associated mandatory activities (such as fertilization of forest land, biomass burning and conversion to cropland) are reported for activities under article 3.3 and under FM.	National Inventory Report Sweden 2012 Mar 2012 p. 57-58
United Kingdom	The UK GHG inventory aims to include all anthropogenic sources of GHGs. Annex 5 shows sources of GHGs that are not estimated in the UK GHG inventory, and the reasons for those sources being omitted.	UK Greenhouse Gas Inventory, 1990 to 2010 Mar 2012 p.76

1.7.2 Data gaps and gap-filling

The EU GHG inventory is compiled by using the inventory submissions of the EU Member States. If a Member State does not submit all data required for the compilation of the EU inventory by 15 March of a reporting year, the Commission prepares estimates for data missing for that Member State. In the following cases gap filling is made:

- To complete specific years in the GHG inventory time-series for a specific Member State
- for the most recent inventory year(s);
- for the base year;

- for some years of the time series from 1990 to the most recent year.
- To complete individual source categories for individual Member States that did not estimate specific source categories for any year of the inventory time series and reported 'NE'. Gap filling methods are used for major gaps when it is highly certain that emissions from these source categories exist in the Member States concerned;
- To provide complete CRF background data tables for the European Union when some Member States only provided CRF sectoral and summary tables. (In this case, the gap filling methods are used to further disaggregate the emission estimates provided by Member States.)
- To enable the presentation of consistent trends for the EU.

For data gaps in Member States' inventory submissions, the following procedure is applied by the ETC/ACM in accordance with the implementing provisions under Council Decision No 280/2004/EC for missing emission data:

- If a consistent time series of reported estimates for the relevant source category is available from the Member State for previous years that has not been subject to adjustments under Article 5.2 of the Kyoto Protocol, extrapolation of this time series is used to obtain the emission estimate. As far as CO_2 emissions from the energy sector are concerned, extrapolation of emissions should be based on the percentage change of Eurostat CO_2 emission estimates if appropriate.
- If the estimate for the relevant source category was subject to adjustments under Article 5.2 of the Kyoto Protocol in previous years and the Member State has not submitted a revised estimate, the basic adjustment method used by the expert review team as provided in the 'Technical guidance on methodologies for adjustments under Article 5.2 of the Kyoto Protocol' is used without application of the conservativeness factor.
- If a consistent time series of reported estimates for the relevant source category is not available and if the source category has not been subject to adjustments under Article 5.2 of the Kyoto Protocol, the estimation should be based on the methodological guidance provided in the 'Technical guidance on methodologies for adjustments under Article 5.2 of the Kyoto Protocol' without application of the conservativeness factor.

The Commission prepares the estimates by 31 March of the reporting year, following consultation with the Member State concerned, and communicates the estimates to the other Member States. The Member State concerned shall use the estimates referred to for its national submission to the UNFCCC to ensure consistency between the EU inventory and Member States' inventories.

The methods used for gap filling include interpolation, extrapolation and clustering. These methods are consistent with the adjustment methods described in UNFCCC Adjustment Guidelines (Table 1) and in the IPCC GPG 2000.(19) On the basis of the general approaches mentioned above concrete methodologies were developed for each sector/gas (Table 1.20).

19 ETC ACC technical note on gap filling procedures , December 2006

Table 1.20 Gap filling methodologies

Estimates at the beginning or at the end of a time series
Fuel combustion related GHG emissions (CO_2, CH_4, N_2O of sector 1A):
The percentage change from Eurostat CO_2 emission estimates was used for extrapolation, where available
If there were no Eurostat CO_2 emission estimates available linear trend extrapolation was used.
Other sectors:
Linear trend extrapolation was used, where no striking dips or jumps in the time series were identified. In general the trend extrapolation was made on basis of the time series 2000-2004.
Previous year values were used where striking dips or jumps in the time series were identified.
Estimates for years within a time series
Linear interpolation between the years available was used
Estimates if no time series is available (only relevant for fluorinated gases):
HFCs:
Emissions were estimated for 2F1 'Refrigeration and air conditioning equipment' on basis of average per capita emissions of either a set of similar countries (if available) or on basis of one single country (if a set of similar countries was not available). Population data was used from Eurostat.
PFCs:
It was checked if aluminum production occurs in the relevant countries, which was not the case. For other PFC emissions no estimates were prepared because of lack of data.
SF6:
Emissions were estimated for 2F7 'Electrical equipment' on basis of average emissions per electricity consumption of either a set of similar countries (if available) or on basis of one single country (if a set of similar countries was not available). Data on electricity consumption was used from Eurostat.

1.7.2.1 Gap filling in GHG inventory submissions 2012

As for 2010 GHG inventory estimates are available for all EU Member States no gap filling was needed.

Data basis of the European Union greenhouse gas inventory:

The 2010 EU-15 GHG inventory data consist of GHG submissions of the Member States to the European Commission in 2012; no gap filling was needed. Table 1.21 to Table 1.24 show the data basis of the 2012 EU GHG inventory.

Table 1.21 Data basis of CO_2 emissions excluding LULUCF (Tg)

EU Member State	1990	1995	2000	2005	2006	2007	2008	2009	2010
Austria	62	64	66	80	77	74	74	67	72
Belgium	119	124	125	125	121	117	120	109	115
Denmark	53	61	54	51	59	54	51	48	49
Finland	57	58	57	57	68	66	58	55	64
France	395	393	411	423	410	399	393	375	383
Germany	1,042	931	892	866	871	849	847	784	819
Greece	83	87	103	113	112	114	111	104	97
Ireland	32	35	45	48	47	47	47	42	41
Italy	435	445	462	488	484	475	464	415	426
Luxembourg	12	9	9	12	12	11	11	11	11
Netherlands	159	171	170	176	172	172	175	170	181
Portugal	44	53	65	69	64	61	60	57	53
Spain	226	254	307	367	357	365	335	297	284
Sweden	57	59	54	53	53	52	50	47	53
United Kingdom	586	549	549	554	552	545	532	481	499
EU-15	**3,362**	**3,293**	**3,368**	**3,480**	**3,459**	**3,404**	**3,328**	**3,062**	**3,147**

Table 1.22 Data basis of CH_4 emissions in CO_2 equivalents (Tg)

EU Member State	1990	1995	2000	2005	2006	2007	2008	2009	2010
Austria	8	8	7	6	6	6	6	6	6
Belgium	10	9	8	7	7	7	7	7	7
Denmark	6	6	6	6	6	6	6	6	6
Finland	6	6	5	5	5	5	4	4	4
France	64	68	68	64	64	64	65	64	64
Germany	107	91	73	56	53	50	51	49	48
Greece	10	11	11	10	10	10	10	10	10
Ireland	14	14	13	13	13	12	12	12	12
Italy	44	44	46	41	40	40	38	38	38
Luxembourg	0	0	0	0	0	0	0	0	0
Netherlands	26	24	20	17	17	17	17	17	17
Portugal	10	12	11	12	12	12	12	12	12
Spain	26	29	33	35	35	35	35	35	35
Sweden	7	7	6	6	6	6	5	5	5
United Kingdom	97	84	64	47	46	44	43	42	41
EU-15	**437**	**413**	**373**	**325**	**319**	**314**	**311**	**306**	**304**

Table 1.23 Data basis of N_2O emissions in CO_2 equivalents (Tg)

EU Member State	1990	1995	2000	2005	2006	2007	2008	2009	2010
Austria	6	7	6	5	6	6	6	5	5
Belgium	11	12	11	10	9	8	8	8	9
Denmark	10	9	8	6	6	6	6	6	6
Finland	7	7	7	7	7	7	7	6	5
France	93	91	79	69	67	66	67	63	61
Germany	85	80	62	62	61	63	64	64	55
Greece	10	9	9	8	8	8	8	7	7
Ireland	9	10	9	8	8	8	8	8	8
Italy	37	40	40	38	32	32	30	28	27
Luxembourg	0	0	0	0	0	0	0	0	0
Netherlands	20	20	18	16	16	14	10	10	9
Portugal	6	6	6	5	5	5	5	5	5
Spain	28	27	32	28	29	29	26	26	28
Sweden	8	8	8	7	7	7	7	7	7
United Kingdom	68	57	46	41	39	38	37	35	36
EU-15	**400**	**382**	**341**	**311**	**298**	**297**	**289**	**278**	**269**

Table 1.24 Data basis of actual HFCs, PFCs and SF_6 emissions in CO_2 equivalents (Gg)

Member State		1990	1995	2000	2005	2006	2007	2008	2009	2010
Austria	HFC	26	412	902	986	963	1,062	1,058	1,057	1,161
	PFC	1,079	71	85	134	146	190	174	35	70
	SF_6	494	1,154	596	507	465	375	383	349	345
Belgium	HFC	NA,NO	443	916	1,414	1,501	1,670	1,747	1,770	1,803
	PFC	1,753	2,335	361	154	159	180	201	115	85
	SF_6	1,662	2,205	112	86	75	81	89	96	105
Denmark	HFC	NA,NE,NO	218	607	802	823	850	853	799	800
	PFC	NA,NE,NO	1	18	14	16	15	13	14	13
	SF_6	44	107	59	21	36	30	31	36	38
Finland	HFC	0	29	492	863	747	903	993	889	1,164
	PFC	0	0	22	10	15	8	11	9	1
	SF_6	94	69	51	35	40	36	40	41	31
France	HFC	3,736	3,190	7,123	11,961	13,187	13,710	14,396	14,846	16,908
	PFC	4,293	2,562	2,487	1,430	1,167	924	563	365	383
	SF_6	2,016	2,237	1,575	995	865	746	693	553	565
Germany	HFC	4,592	6,912	7,040	10,252	10,794	11,369	11,657	12,128	11,597
	PFC	2,627	1,773	781	709	571	510	521	359	309
	SF_6	4,642	6,779	4,269	3,475	3,396	3,332	3,114	3,059	3,250
Greece	HFC	935	3,305	4,345	4,086	2,229	2,574	2,957	3,356	3,558
	PFC	163	54	105	70	66	76	89	70	102
	SF_6	3	4	4	6	8	10	8	5	6
Ireland	HFC	1	54	259	474	547	534	565	521	563
	PFC	0	75	305	168	148	131	106	66	37
	SF_6	36	83	54	102	63	66	57	38	35
Italy	HFC	351	671	1,986	5,401	6,106	6,855	7,513	8,164	8,755
	PFC	2,487	1,266	1,217	1,715	1,714	1,652	1,501	1,063	1,331
	SF_6	333	601	493	465	406	428	436	398	373
Luxembourg	HFC	12	16	29	53	57	61	63	66	66
	PFC	NA,NO	NA,NO	0	0	0	0	0	0	0
	SF_6	1	2	2	5	6	6	7	7	7
Netherlands	HFC	4,432	6,019	3,892	1,523	1,727	1,843	1,922	2,040	2,282
	PFC	2,264	1,938	1,582	266	257	323	251	168	209
	SF_6	218	287	297	240	199	188	184	170	184
Portugal	HFC	NA,NE,NO	66	307	772	865	962	1,065	1,147	1,232
	PFC	NA,NE,NO	NA,NO	0	0	0	0	0	0	0
	SF_6	NA,NE,NO	5	6	7	8	7	6	6	7
Spain	HFC	2,403	4,646	8,366	5,404	5,970	6,273	7,005	7,220	8,145
	PFC	883	833	436	288	294	298	315	297	303
	SF_6	67	108	205	272	324	340	354	351	361
Sweden	HFC	4	132	568	790	818	838	867	869	849
	PFC	377	343	241	257	245	248	225	35	158
	SF_6	107	127	94	142	111	151	84	81	73
United Kingdom	HFC	11,386	15,317	9,281	11,994	12,666	12,968	13,542	13,884	14,235
	PFC	1,401	462	465	259	303	218	206	144	220
	SF_6	1,030	1,239	1,798	1,108	874	792	711	661	689
EU-15	HFC	27,879	41,430	46,112	56,776	59,000	62,471	66,201	68,755	73,119
	PFC	17,329	11,713	8,105	5,474	5,100	4,774	4,176	2,742	3,221
	SF_6	10,748	15,007	9,615	7,468	6,875	6,588	6,195	5,854	6,070

1.7.3 Geographical coverage of the European Union inventory

Table 1.25 shows the geographical coverage of the EU-15 Member States' national inventories. As the EU-15 inventory is the sum of the Member States' inventories, the EU-15 inventory covers the same geographical area as the inventories of the Member States.

Table 1.25 Geographical coverage of the EU-15 inventory

Member State	Geographical coverage	EU-territory coverage (UNFCCC and Kyoto)	Party coverage (UNFCCC)	Party coverage (Kyoto Protocol)
Austria	Austria	x	x	x
Belgium	Belgium consisting of Flemish Region, Walloon Region and Brussels Region	x	x	x
Denmark	Denmark (excluding Greenland and the Faeroe Islands)	x		
	Denmark, Faroe Islands and Greenland		x	
	Denmark and Greenland			x
Finland	Finland including Åland Islands	x	x	x
France	France mainland and the overseas territories under the EU (Guadeloupe, Martinique, Guyana, Reunion, Saint-Barthélémy and Saint-Martin)	x		x
	France mainland and the overseas territories under the EU (Guadeloupe, Martinique, Guyana, Reunion, Saint-Barthélémy and Saint-Martin) and the overseas territories not covered by the EU (New Caledonia, Wallis and Futuna, Austral and Antarctic territories)		x	
Germany	Germany	x	x	x
Greece	Greece	x	x	x
Ireland	Ireland	x	x	x
Italy	Italy	x	x	x
Luxembourg	Luxembourg	x	x	x
Netherlands	The reported emissions have to be allocated to the legal territory of The Netherlands. This includes a 12-mile zone from the coastline and also inland water bodies. It excludes Aruba and The Netherlands Antilles, which are self-governing dependencies of the Royal Kingdom of The Netherlands. Emissions from offshore oil and gas production on the Dutch part of the continental shelf are included.	x	x	x
Portugal	Mainland Portugal and the two Autonomous regions of Madeira and Azores Islands. Includes also emissions from air traffic and navigation bunkers realized between these areas.	x	x	x
Spain	Spanish part of Iberian mainland, Canary Islands, Balearic Islands, Ceuta and Melilla	x	x	x
Sweden	Sweden	x	x	x
United Kingdom	England, Scotland, Wales and Northern Ireland, and Gibraltar, excluding the UK Crown Dependencies (Jersey, Guernsey and the Isle of Man) and the UK Overseas Territories (except Gibraltar).	x		
	England, Scotland, Wales and Northern Ireland, Gibraltar, the UK Crown Dependencies (Jersey, Guernsey and the Isle of Man) and the UK Overseas Territories that have ratified the UNFCCC and the Kyoto Protocol (Bermuda, Cayman, Falkland Islands, Montserrat and Gibraltar).		x	x
EU-15		x		

1.7.4 Completeness of the European Union submission

1.7.4.1 National inventory report

The EU NIR follows – as far as posible - the annotated outline of the UNFCCC secretariat with the exception of the annexes. The main reason for this is the nature of the EU inventory being the sum of Member States' inventories. Therefore the main purpose of the annexes is to make transparent the EU emission estimates by providing the basic basic Member States tables for every CRF table. Table 1.26 provides explanations for not including the annexes as required by the UNFCCC reporting guidelines.

Table 1.26 Explanations for exclusion of annexes as outlied in the UNFCCC reporting guidelines

Annex required in the UNFCCC reporting guidelines	Comment
Annex 1: Key categories	This annex is included in the EU NIR
Annex 2: Detailed discussion of methodology and data for estimating CO_2 emissions from fossil fuel combustion	Due to the nature of the EU inventory being the sum of Member States' inventories detailed methodologies for estimating CO_2 emissions from fossil fuel combustion are included in Member States' NIRs. However, summary information on methodologies used by Member States is provided in the EU NIR for the EU key sources.

Annex 3: Other detailed methodological descriptions for individual source or sink categories (where relevant)	Due to the nature of the EU inventory being the sum of Member States' inventories detailed methodological descriptions for other source or sink categories are included in Member States' NIRs. However, summary information on methodologies used by Member States is provided in the EU NIR for the EU key sources.
Annex 4: CO_2 reference approach and comparison with sectoral approach, and relevant information on the national energy balance	Information on the reference approach is included in the EU NIR. Due to the nature of the EU inventory being the sum of Member States' inventories there is no national energy balance which could be included in this annex.
Annex 5: Assessment of completeness and (potential) sources and sinks of greenhouse gas emissions and removals excluded	Information on completeness as reported by Member States in CRF Table 9 is included in the EU NIR in Table 1.20. In addition, for the EU key sources explanations for the NE are included in the sector chapters of the NIR, where relevant.
Annex 6: Additional information to be considered as part of the NIR submission (where relevant) or other useful reference information	The EU considers the Member States CRF and NIR as part fo the EU submission.
Annex 7: Tables 6.1 and 6.2 of the IPCC good practice guidance	Due to the nature of the EU inventory EU uncertainties are not estimated on basis of uncertainties of emission factors and activity data (see chapter 1.7). Therefore no Table 6.1 can be provided for the EU. Tier 2 uncertainty analysis has not yet been carried out.
Annex 8: Other annexes - (Any other relevant information – optional).	

CRF tables in Annex 1.2

The European Union cannot provide all data in the sectoral background tables. The main reasons for not completing all sectoral background data tables are: (1) limited data availability partly due to confidentiality issues; and (2) the use of different type of activity data by Member States. Latter is due to the fact that the Member States are responsible for calculating emissions. If they use country-specific methods they may also use different types of activity data. At EU-15 level these different types of activity data cannot be simply added up. As at EU-15 level no emissions are calculated directly on the basis of activity data, the documentation of very detailed background data seems to be of lower importance. All the details for the calculation of the emissions are documented in the Member States' CRF tables, as part of their national GHG inventories, which also form part of the EU GHG inventory submission (see Annex 1.12, which is available at the EEA website http://www.eea.europa.eu) and in the sector annexes.

Table 1.27 provides an overview of sectoral report and sectoral background tables available in Annex 1.2, an explanation for each table which is not filled in at EU-15 level and activity data provided for the calculation of implied emission factors. Further information is provided in the relevant sector chapters.

Table 1.27 Inclusion of CRF tables in Annex 1.2

Table	Included in Annex 1.2	Comment
Energy		
Table 1	Yes	
Table 1.A (a)	Yes	
Table 1.A (b)	Yes	
Table 1.A (c)	Yes	
Table 1.A (d)	Yes	
Table 1B1	Yes	
Table 1B2	Partly	Emissions are included, activity data is not estimated because type of activity data used by the MS varies; overview table for 1B2b included in the NIR
Table 1.C	Yes	
Industrial processes		
Table 2(I)	Yes	

Table	Included in Annex 1.2	Comment
Table 2(II)	Yes	
Table 2(I). A-G	Partly	Emissions are included, activity data is not estimated because type of activity data used by the MS varies; overview tables for large key sources included in the NIR
Table 2(II). C,E	Partly	Emissions are included, activity data is not estimated because type of activity data used by the MS varies; limited data availability; confidentiality issues
Table 2(II). F	Yes	For those MS which did not provide Table 2(II).F emissions are allocated to the sub-categories according to the aggregated average allocation of those MS which provided Table 2(II).F.
Solvent use		
Table 3	Yes	
Table 3. A-D	No	Type of activity data used by the MS varies
Agriculture		
Table 4	Yes	
Table 4. A	Yes	
Table 4. B(a)	Yes	
Table 4. B(b)	Yes	
Table 4. C	Yes	
Table 4. D	Yes	
Table 4. E	Yes	
Table 4. F	Yes	
LUCF		
Table 5	Yes	
Table 5. A	Yes	
Table 5. B	Yes	
Table 5. C	Yes	
Table 5. D	Yes	
Table 5. E	Yes	
Table 5. F	Yes	
Table 5 (I)	Yes	
Table 5 (II)	Yes	
Table 5 (III)	Yes	
Table 5 (IV)	Yes	
Table 5 (V)	Partly	Emissions are included, activity data is not estimated because type of activity data used by the MS varies
Waste		
Table 6	Yes	
Table 6. A, C	Partly	Emissions and some activity data are included
Table 6. B	Partly	Emissions are included, activity data is not estimated because of limited data availability
Summary Tables		
Summary 1.A	Yes	
Summary 1.B	Yes	
Summary 2	Yes	
Summary 3	Yes	
Other Tables		
Table 7	Yes	
Table 8(a)	Yes	
Table 8(b)	Partly	It is indicated in which MS recalculations were performed. In addition, the explanations for recalculations are provided in the EU NIR for the EU key sources together with the contribution of every MS to the EU recalculations. Summary information is also provided in Chapter 10 (Tables 10.1 and 10.2).
Table 9	Partly	Annex 1.4 provides a list of all NEs and IEs and includes explanations taken from the Member States' CRF Tables 9. This information is equivalent to CRF Table 9 which cannot be filled-in automatically for the EU-15 due to the amount of information from the Member States. In addition, information on completeness is included in the NIR for the EU key sources explanations for the NE and IE are included in the sector chapters of the NIR, where relevant.
Table 10	Yes	

Table 1.28 provides for specific sectoral background tables an overview of activity data used by Member States in order to explain why this activity data cannot be reported at EU-15 level.

Table 1.28 Activity data reported by Member States in CRF background data tables

Table	Source category		Activity data reported by MS
Table 1B2	1. B. 2. a. Oil (3)	I.Exploration	number of wells drilled
			crude oil
			number of wells drilled/tested
		ii. Production	Oil throughput
			PJ of oil produced
			Crude oil and NGL production
			Crude oil produced
			Oil and gas produced
		iii.Transport	oil loaded in tankers
			PJ Loaded
			Crude oil imports
			Transport of crude oil
			Offshore loading of oil only
		iv.Refining / Storage	Oil refined (SNAP 0401)
			PJ oil refined
			crude oil & products
			kt oil refined
			Refinery input (crude oil and NGL)
			Refery input: crude oil, NGL
			crude oil & products
			Oil refinery throughput
		v. Distribution of Oil Products	Gasoline Consumption (SNAP 0505)
			kt oil refined
			Domestic supply of gasoline
			Oil products
		vi.Other	Transfer loss gas works gas
			onshore loading of oil only
	1. B. 2. b. Natural Gas	i.Exploration	natural gas
			number of wells drilled/tested
		ii. Production (4) / Processing	Gas throughput
			PJ gas produced
			natural gas from crude oil extraction
			Natural gas production
			Mm3 gas produced
		iii.Transmission	Pipelines length (km)
			total amount of gas consumed
			PJ gas consumed
			Length of transmission pipeline
			Mm3 gas transported
			gas transported
			PJ gas (NCV)
			Pressure levelling losses
		iv.Distribution	Distribution network length
			consumption
			distribution net
			PJ gas distributed via local networks
			PJ gas consumed
			Length of distribution mains

			Mm3 gas transported
		v. Other Leakage	PJ gas consumed t of natural gas released from pipelines
	1. B. 2. c. Venting(5)	i.Oil	PJ oil produced kt oil refined Crude oil and NGL production
		ii. Gas	PJ gas produced Sour Natural gas production
		iii.Combined	
	Flaring	i.Oil	PJ gas consumption kt oil refined Consumed Crude oil and NGL production Mm3 gas consumption oil produced Refinery gas other liquid fuels
		ii. Gas	PJ gas consumption natural gas Natural gas production quantity of gas flared
		iii.Combined	
Table 2(I)	2.A Mineral products	1. Cement production	Clinker production AD confidential
		2. Lime production	Lime produced Lime and dolomite production Production of lime and bricks Limestone consumed
		3. Limestone and dolomite use	Limestone and dolomite used Limestone consumption Clay, shale and limestone use Carbonates input to brick, tiles, ceramic production
		4. Soda ash production	Soda ash production
		4. Soda ash use	Soda ash use Use of soda
		5. Asphalt roofing	Roofing material production Bitumen consumption
		6. Road paving with asphalt	Asphalt production Bitumen consumption Asphalt used in paving Asphalt liquefied
	2B Chemical industry	1. Ammonia production	Ammonia production Natural gas consumption
		2. Nitric acid production	Nitric acid production Nitric acid production: Medium pressure plants
Table 2(II) C	2C Metal production	1. Iron and steel production	
		Steel	Steel production Crude steel production Production of secondary steel
		Pig iron	Iron production

			Production of primary iron Pig iron production
		Sinter	Sinter production Sinter consumption
		Coke	Coke production Coke consumption Coke consumed in blast furnace
		2. Ferroalloys production	Ferroalloys production Laterite consumption Use of coal and coke electrodes
		3. Aluminium production	Aluminium production Primary aluminium production
	C.PFCs and SF_6 from MetalProduction	PFCs from aluminium production	Aluminium production Primary aluminium production
		SF_6 used in Aluminium and Magnesium Foundries	
		Aluminium foundries	Cast aluminium Consumption of aluminium foundries SF_6 consumption
		Magnesium foundries	Cast magnesium Consumption Mg-Production SF_6 consumption
Table 4D	1. Direct soil emissions	3. N-fixing crops	Nitrogen fixed by N-fixing crops Dry pulses and soybeans produced Area of cultivated soils
		4. Crop residues	Nitrogen in crop residues returned to soils Dry production of other crops
Table 5(V)	A. Forest land		Area burned (ha) Biomass burned (kg dm)
	B. Cropland		Area burned (ha) Biomass burned (kg dm)
	C. Grassland		Area burned (ha) Biomass burned (kg dm)
	E. Settlements		Area burned (ha) Biomass burned (kg dm)

2 EU-15 greenhouse gas emission trends

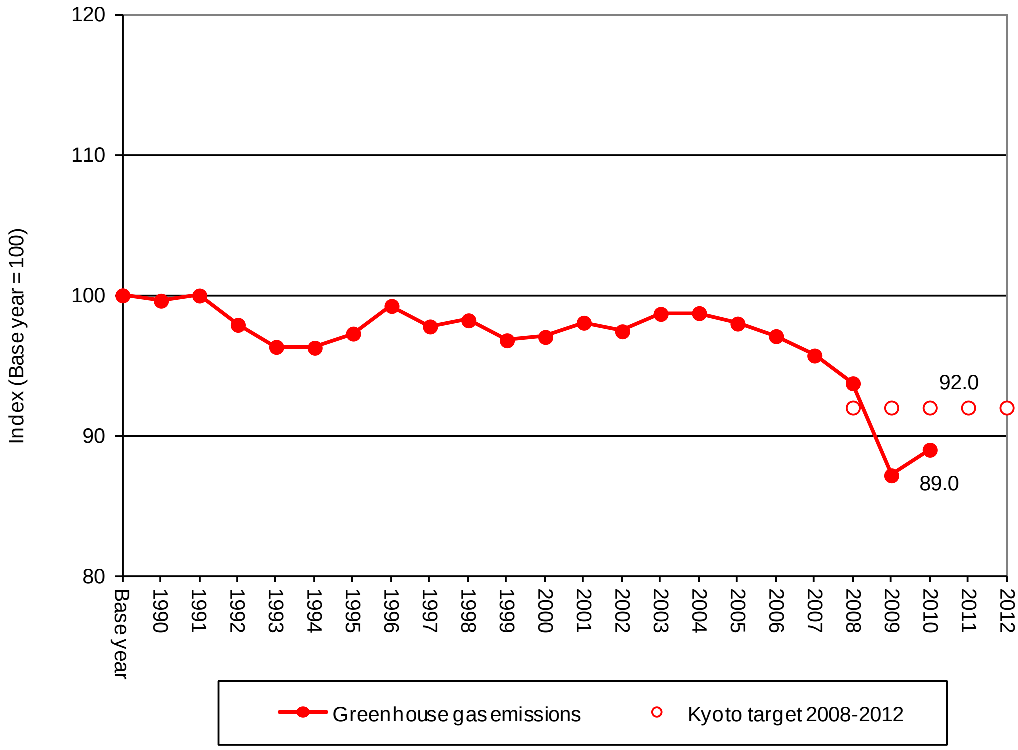
This chapter presents the main GHG emission trends in the EU-15. Firstly, aggregated results are described as regards total GHG emissions and progress towards fulfilling the EU Kyoto target (for EU-15 only). Then, emission trends are briefly analysed mainly at gas level and a short overview of Member States' contributions to EU GHG trends is given. Finally, the trends of indirect GHGs and SO_2 emissions are presented.

2.1 Aggregated greenhouse gas emissions

In 2010 total GHG emissions in the EU-15, without LULUCF, were 10.6 % (453 million tonnes CO_2 equivalents) below 1990. Emissions increased by 2.1 % (78 million tonnes CO_2 equivalents) between 2009 and 2010.

Under the Kyoto Protocol, the EU agreed to reduce its GHG emissions by 8 % by 2008–12 compared to the'base year'[20]. This can be achieved by a combination of existing and planned domestic policies and measures, the use of carbon sinks and the use of Kyoto mechanisms. Since 2009 emissions are below the EU-15 Kyoto target (Figure ES.2).

Figure 2.1 EU-15 GHG emissions 1990–2010 compared with target for 2008–12 (excl. LULUCF)



Notes: *GHG emission data for the EU-15 as a whole refer to domestic emissions (i.e. within its territory) and do not include emissions and removals from LULUCF; nor do they include emissions from international aviation and international maritime transport. CO_2 emissions from biomass with energy recovery are reported as a Memorandum item according to UNFCCC Guidelines and not included in national totals. In addition, no adjustments for temperature variations or electricity trade are considered. The global warming potentials are those from the 1996 revised IPCC Guidelines for National Greenhouse Gas Inventories.*

[20] Following the UNFCCC reviews of Member States' 'initial reports' during 2007 and 2008 and pursuant to Article 3, Paragraphs 7 and 8 of the Kyoto Protocol, the base-year emissions for the EU-15 have been fixed to 4 265.5 Mt CO_2 equivalent.

2.1.1 *Main trends by source category, 1990-2010*

Table 2.1 shows the source categories contributing the most to changes in greenhouse gas emissions between 1990 and 2010.

Table 2.1 EU-15: Overview of Top decreasing/increasing source categories 1990-2010 (+/- 20 Million tonnes CO_2 equivalents)

Source category	EU-15 Million tonnes (CO_2 eq.)
Road Transportation (CO2 from 1A3b)	108.28
Consumptions of halocarbons (HFC from 2F)	70.95
Production of halocarbons (HFC from 2E)	-25.76
Nitric Acid Production (N2O from 2B2)	-26.09
Households and servicies (CO2 from 1A4)	-28.46
Agricultural soils (N2O from 4D)	-40.13
Iron and Steel Production (CO2 from 1A2a +2C1)	-42.95
1B Fugitive emissions from fuels (CH4)	-49.57
Manufacture of Solid fuels (CO2 from 1A1c)	-51.38
Adipic Acid Production (N2O from 2B3)	-57.34
Solid waste disposal on land (CH4 from 6A)	-59.89
Public Electricity and Heat Production (CO2 from 1A1a)	-61.06
Manufacturing industries (excl. Iron and steel) (Energy-related CO2 from 1A2 excl. 1A2a)	-114.21
Total	**-451.70**

Notes: *As the table only presents sectors whose emissions increased or decreased by 20 million tonnes CO_2-equivalents, the sum for each country grouping EU-15/EU-27 does not match the total change listed at the bottom of the table.*

2.1.2 *Main trends by source category, 2009-2010*

Table 2.2 shows the source categories contributing the most to changes in greenhouse gas emissions between 2009 and 2010.

Table 2.2 EU-15: Overview of Top decreasing/increasing source categories 2009-2010 (+/- 3 Million tonnes CO_2 equivalents)

Source category	EU-15 Million tonnes (CO_2 eq.)
Households and servicies (CO2 from 1A4)	32.7
Iron and Steel Production (CO2 from 1A2a +2C1)	28.0
Manufacturing industries (excl. Iron and steel) (Energy-related CO2 from 1A2 excl. 1A2a)	18.4
Manufacture of Solid fuels (CO2 from 1A1c)	5.1
Consumptions of halocarbons (HFC from 2F)	4.4
Road Transportation (CO2 from 1A3b)	-5.2
Adipic Acid Production (N2O from 2B3)	-9.2
Total	**78.5**

Notes: *As the table only presents sectors whose emissions have increased or decreased by at least 3 million tonnes of CO_2- equivalents, the sum for each country grouping does not match the total change listed at the bottom of the table*

Main reasons for changes in EU-15 emissions, 2009–2010

The increase in emissions in 2010 was partly driven by the economic recovery from the 2009 recession in many European countries, which itself had caused substantial emission reductions in 2008 and 2009 in all Member States. In 2010 the winter was also colder than in the previous year, in particular in northern, central and eastern European countries, leading to increased demand for heating and higher emissions from the residential and commercial sectors.

The 77.8 million tonnes (CO_2 equivalents) increase in GHG emissions between 2009-2010 was mainly due to:

- Increasing emissions in households and services (+32.7 million tonnes or +5.7 %) were mainly caused by Belgium, Germany and the Netherlands. Winter temperatures in Europe in 2010 were, on average, below 2009 levels (i.e. colder).
- A substantial increase in emissions from the iron and steel production (+28.0 million tonnes or +24.8 %) which was caused by a significant increase in crude steel production due to the recovery from the economic crisis. According to the World Steel Association crude steel production in EU-15 declined in in all major steel producing countries in 2009 (-30 %) and increased again in 2010 (+25 %).
- Strong emission increase in the category manufacturing industries excluding iron and steel industry (18.4 million tonnes or -5.1 %) mainly caused by Germany and Italy.
- Increases in HFC emissions from the consumption of halocarbons (+4.4 million tonnes or +6.6 %) stem from Refrigeration and Air Conditioning, continuing the trend observed since 1990. Finland, Italy, Spain and the United Kingdom report the highest increases in absolut terms.

Substantial decreases in GHG emissions between 2009-2010 took place in the following source categories:

- Emissions fell in in road transportation (-5.2 million tonnes or -0.7 %) and adipic acidic production (-9.2 million tonnes or -85.3 %).

2.1.3 Overview of GHG emissions in EU Member States

Table 2.3 Greenhouse gas emissions in CO_2 equivalents (excl. LULUCF) and Kyoto Protocol targets for 2008–12

MEMBER STATE	1990 (million tonnes)	Kyoto Protocol base year [(a)] (million tonnes)	2010 (million tonnes)	2009–2010 (million tonnes)	Change 2009–2010 (%)	Change 1990-2010 (%)	Change base year–2010 (%)	Targets 2008–12 under Kyoto Protocol and "EU burden sharing" (%)
Austria	78.2	79.0	84.6	4.9	6.1%	8.2%	7.0%	-13.0%
Belgium	143.3	145.7	132.5	7.3	5.8%	-7.6%	-9.1%	-7.5%
Denmark	68.6	69.3	61.1	0.4	0.6%	-11.0%	-11.9%	-21.0%
Finland	70.4	71.0	74.6	8.4	12.8%	6.0%	5.0%	0.0%
France	559.0	563.9	522.4	7.8	1.5%	-6.6%	-7.4%	0.0%
Germany	1246.1	1232.4	936.5	24.7	2.7%	-24.8%	-24.0%	-21.0%
Greece	105.0	107.0	118.3	-6.4	-5.1%	12.6%	10.6%	25.0%
Ireland	55.2	55.6	61.3	-0.4	-0.7%	11.2%	10.3%	13.0%
Italy	519.2	516.9	501.3	9.8	2.0%	-3.5%	-3.0%	-6.5%
Luxembourg	12.8	13.2	12.1	0.56	4.9%	-5.9%	-8.3%	-28.0%
Netherlands	212.0	213.0	210.1	11.1	5.6%	-0.9%	-1.4%	-6.0%
Portugal	60.1	60.1	70.6	-3.8	-5.1%	17.5%	17.4%	27.0%
Spain	282.8	289.8	355.9	-10.4	-2.8%	25.8%	22.8%	15.0%
Sweden	72.8	72.2	66.2	6.6	11.0%	-9.0%	-8.2%	4.0%
United Kingdom	763.9	776.3	590.2	17.9	3.1%	-22.7%	-24.0%	-12.5%
EU-15	**4249.3**	**4265.5**	**3797.6**	**78.5**	**2.1%**	**-10.6%**	**-11.0%**	**-8.0%**

([a])The base year under the Kyoto Protocol for each Member State and EU-15 is further outlined in Table 1.4 and 1.5.

2.2 Emission trends by gas

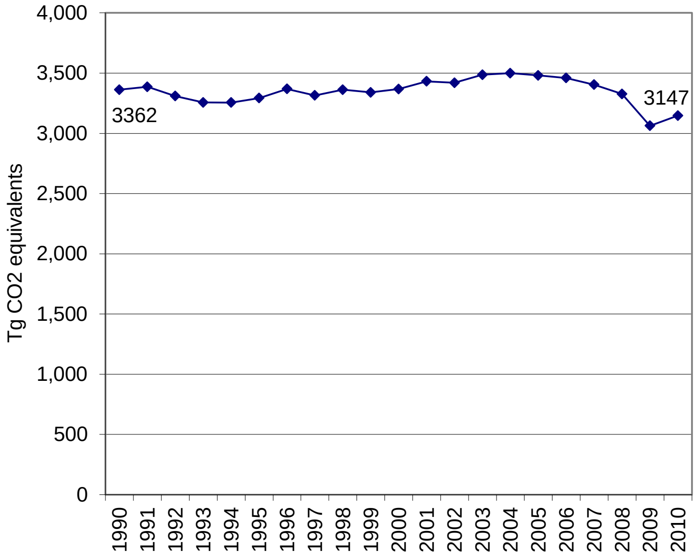


Table 2.4, Figure 2.2 and

Figure 2.3 give an overview of the main trends in EU-15 GHG emissions and removals for 1990–2010. In the EU-15 the most important GHG is CO_2, accounting for 82.9 % of total EU-15 emissions in 2010. In 2010, EU-15 CO_2 emissions without LULUCF were 3 147 Tg, which was 6.4 % below 1990 levels. Compared to 2009, CO_2 emissions increased by 2.8 %.

Table 2.4 Overview of EU-15 GHG emissions and removals from 1990 to 2010 in CO_2 equivalents (Tg)

GREENHOUSE GAS EMISSIONS	1990	1995	2000	2005	2006	2007	2008	2009	2010
Net CO_2 emissions/removals	3,191	3,100		3,302	3,261	3,227	3,137	2,859	2,964
CO_2 emissions (without LULUCF)	3,362	3,293	3,368	3,480	3,459	3,404	3,328	3,062	3,147
CH_4	437	413	373	325	319	314	311	306	304
N_2O	400	382	341	311	298	297	289	278	269
HFCs	28	41	46	57	59	62	66	69	73
PFCs	17	12	8	5	5	5	4	3	3
SF_6	11	15	10	7	7	7	6	6	6
Total (with net CO_2 emissions/removals)	**4,083**	**3,964**	**3,941**	**4,008**	**3,949**	**3,912**	**3,813**	**3,521**	**3,620**
Total (without CO2 from LULUCF)	**4,254**	**4,156**	**4,145**	**4,186**	**4,147**	**4,089**	**4,004**	**3,724**	**3,803**
Total (without LULUCF)	**4,249**	**4,149**	**4,139**	**4,180**	**4,142**	**4,083**	**3,999**	**3,719**	**3,798**

Figure 2.2 CO_2 emissions without LULUCF 1990 to 2010 in CO_2 equivalents (Tg)

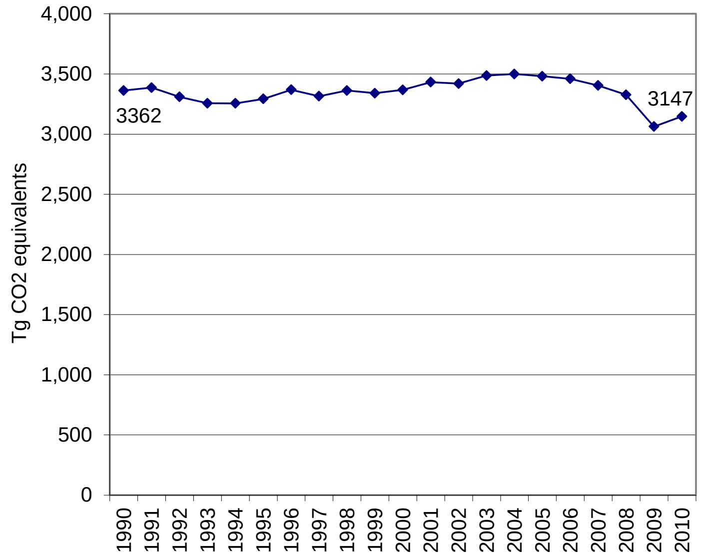
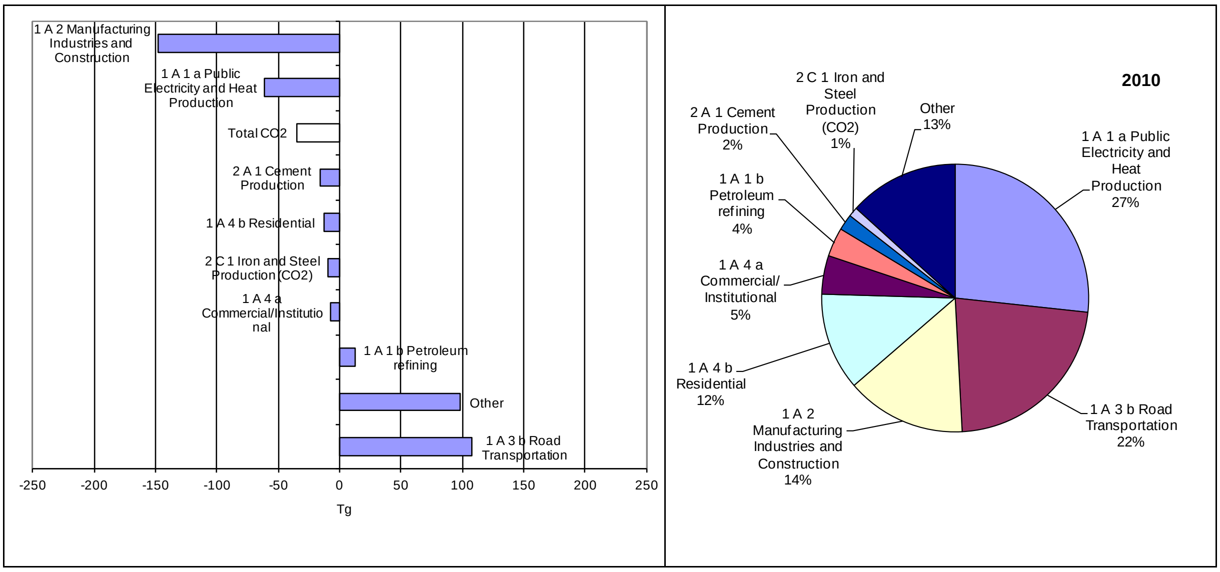


Figure 2.3 Absolute change of CO_2 emissions by large key source categories 1990 to 2010 in CO_2 equivalents (Tg) for EU-15 and share of largest key source categories in 2010 for EU-15



CH_4 emissions account for 8.0 % of total EU-15 GHG emissions in 2010 and decreased by 30 % since 1990 to 304 Tg CO_2 equivalents in 2010 (Figure 2.4). The two largest key sources account for 57 % of CH_4 emissions in 2010. Figure 2.5 shows that the main reasons for declining CH_4 emissions were reductions in managed waste disposal on land and coal mining.

Figure 2.4 **CH_4 emissions 1990 to 2010 in CO_2 equivalents (Tg)**

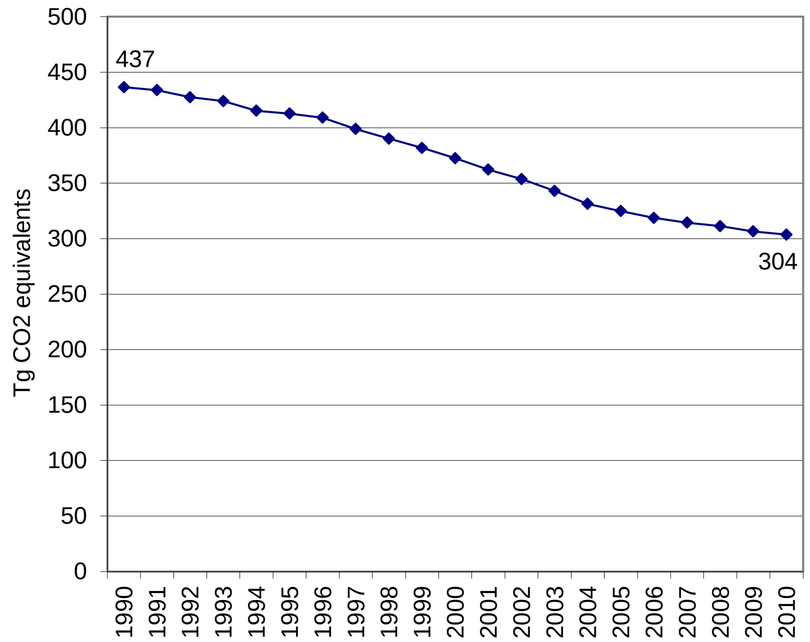
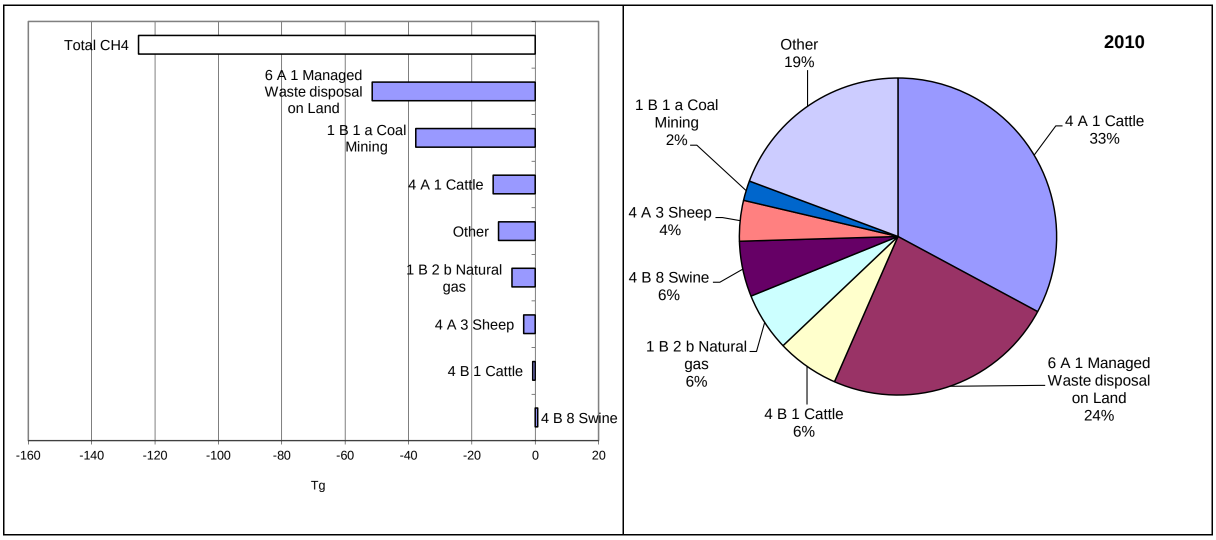


Figure 2.5 **Absolute change of CH_4 emissions by large key source categories 1990 to 2010 in CO_2 equivalents (Tg) for EU-15 and share of largest source categories in 2010 for EU-15**



N_2O emissions are responsible for 7.1 % of total EU-15 GHG emissions and decreased by 32.7 % to 269 Tg CO_2 equivalents in 2010 (Figure 2.6). The two largest key sources account for about 55 % of N_2O emissions in 2010. Figure 2.7 shows that the main reason for large N_2O emission cuts were reduction measures in the adipic acid production.

Figure 2.6 N$_2$O emissions 1990 to 2010 in CO$_2$ equivalents (Tg)

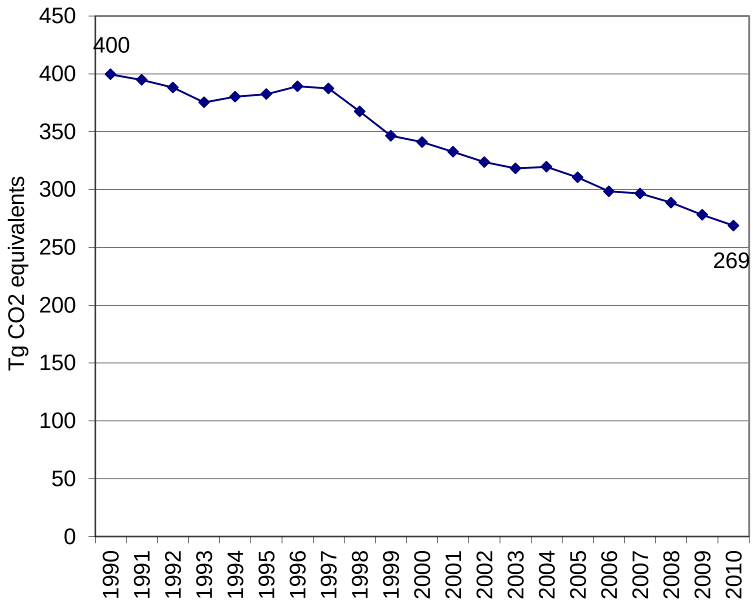
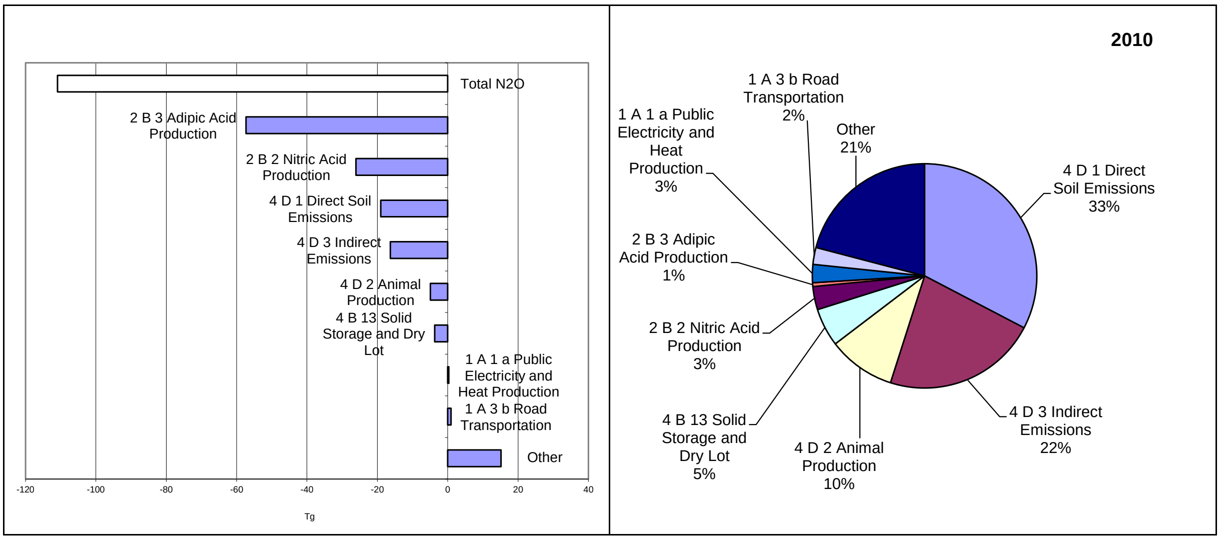


Figure 2.7 Absolute change of N$_2$O emissions by large key source categories 1990 to 2010 in CO$_2$ equivalents (Tg) for EU-15 and share of largest source categories in 2010 for EU-15



Fluorinated gas emissions account for 2 % of total EU-15 GHG emissions. In 2010, emissions were 82 Tg CO$_2$ equivalents, which was 46 % above 1990 levels (Figure 2.8). The two largest key sources account for 94 % of fluorinated gas emissions in 2010. Figure 2.9 shows that HFCs from consumption of halocarbons showed large increases between 1990 and 2010. The main reason for this is the phase-out of ozone-depleting substances such as chlorofluorocarbons under the Montreal Protocol and the replacement of these substances with HFCs (mainly in refrigeration, air conditioning, foam production and as aerosol propellants). On the other hand, HFC emissions from production of halocarbons decreased substantially. The decrease started in 1998 and was strongest in 1999 and 2000.

Figure 2.8 **Fluorinated gas emissions 1990 to 2010 in CO_2 equivalents (Tg)**

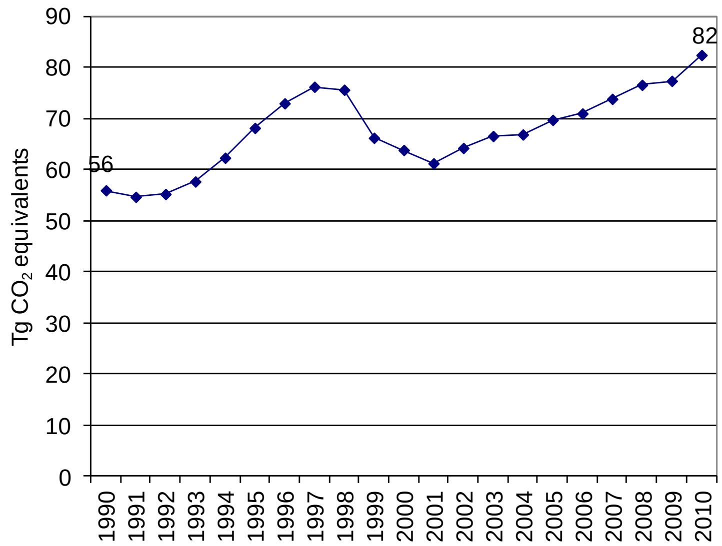
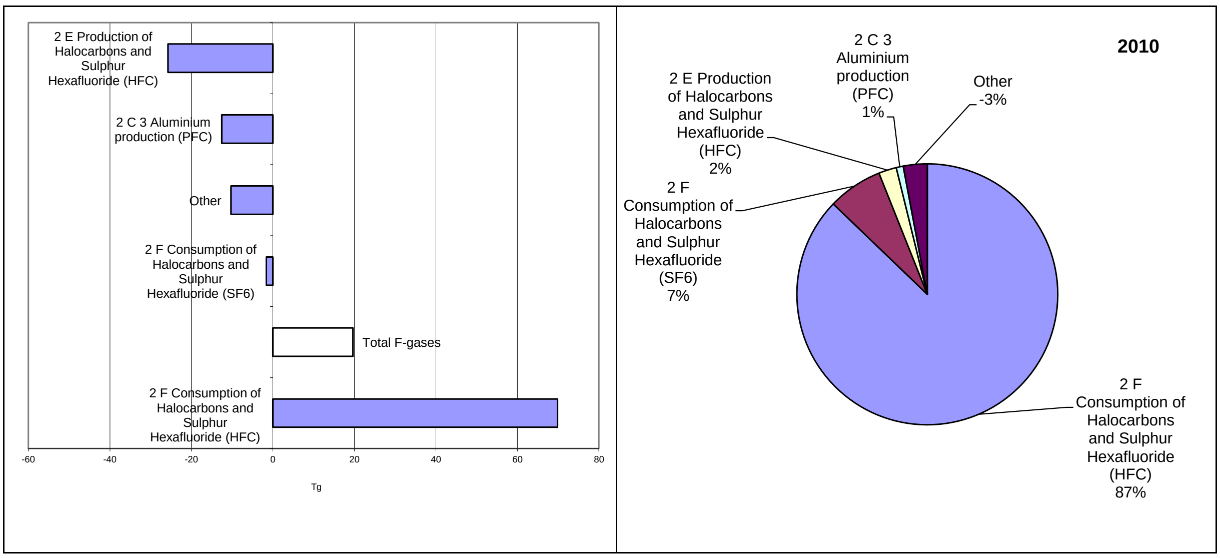


Figure 2.9 **Absolute change of fluorinated gas emissions by large key source categories 1990 to 2010 in CO_2 equivalents (Tg) for EU-15 and share of largest source categories in 2010 for EU-15**



2.3 Emission trends by source

Table 2.5 gives an overview of EU-15 GHG emissions in the main source categories for 1990–2010. More detailed trend descriptions are included in Chapters 3 to 9.

Table 2.5 **Overview of EU-15 GHG emissions in the main source and sink categories 1990 to 2010 in CO_2 equivalents (Tg)**

GHG SOURCE AND SINK	1990	1995	2000	2005	2006	2007	2008	2009	2010
1. Energy	3,278	3,205	3,258	3,348	3,324	3,264	3,198	2,969	3,042
2. Industrial Processes	353	352	311	313	306	311	296	257	265
3. Solvent and Other Product Use	13	12	12	10.483	11	10	10	9	10
4. Agriculture	434	414	414	389	384	384	383	375	374
5. Land-Use, Land-Use Change and Forestry	-166	-185	-198	-172	-193	-171	-186	-198	-178
6. Waste	171	166	145	120	118	114	112	110	108
7. Other	0	0	0	0	0	0	0	0	0
Total (with net CO_2 emissions/removals)	**4,083**	**3,964**	**3,941**	**4,008**	**3,949**	**3,912**	**3,813**	**3,521**	**3,620**
Total (without LULUCF)	**4,249**	**4,149**	**4,139**	**4,180**	**4,142**	**4,083**	**3,999**	**3,719**	**3,798**

2.4 Emission trends by Member State

Table 2.6 gives an overview of EU-15 Member States' contributions to the EU GHG emissions for 1990–2010. Member States show large variations in GHG emission trends.

Table 2.6 **Overview of Member States' contributions to EU-15 GHG emissions excluding LULUCF from 1990 to 2010 in CO_2 equivalents (Tg)**

Member State	1990	1995	2000	2005	2006	2007	2008	2009	2010
Austria	78	80	80	93	90	87	87	80	85
Belgium	143	151	146	144	139	134	137	125	132
Denmark	69	76	68	64	72	67	64	61	61
Finland	70	71	69	69	80	78	70	66	75
France	559	555	565	567	552	542	537	515	522
Germany	1,246	1,117	1,039	997	999	977	976	912	937
Greece	105	110	127	136	132	135	131	125	118
Ireland	55	59	68	69	69	68	68	62	61
Italy	519	532	552	575	564	556	542	492	501
Luxembourg	13	10	10	13	13	12	12	12	12
Netherlands	212	223	213	211	207	206	205	199	210
Portugal	60	70	82	87	82	79	78	74	71
Spain	283	314	381	435	427	436	404	366	356
Sweden	73	74	69	67	67	66	64	60	66
United Kingdom	764	706	670	654	650	640	626	572	590
EU-15	**4,249**	**4,149**	**4,139**	**4,180**	**4,142**	**4,083**	**3,999**	**3,719**	**3,798**

The overall EU GHG emission trend is dominated by the two largest emitters Germany and the United Kingdom accounting for 40 % of total EU-15 GHG emissions in 2010. These two Member States have achieved total GHG emission reductions of 483 million tonnes CO_2-equivalents compared to 1990[21].

The main reasons for the favourable trend in Germany were increasing efficiency in power and heating plants and the economic restructuring of the five new Länder after German reunification. The reduction of GHG emissions in the United Kingdom was primarily the result of liberalising energy markets and the subsequent fuel switches from oil and coal to gas in electricity production and N_2O emission reduction measures in the production of adipic acid.

France and Italy were the third and fourth largest emitters with a share of 14 % and 13 %, respectively. Italy's GHG emissions were 3.5 % below 1990 levels in 2010. Italian GHG emissions

(*21*) The EU-15 as a whole needs emission reductions of total GHG of 8 %, i.e. 341 million tonnes on the basis of the 2008 inventory in order to meet the Kyoto target. This can be achieved by a combination of existing and planned domestic policies and measures, the use of carbon sinks and the use of Kyoto mechanisms.

increased since 1990 primarily from road transport, electricity and heat production and petrol refining, however, decreased significantly since 2004. France's emissions were 6.6 % below 1990 levels in 2010. In France, large reductions were achieved in N_2O emissions from the adipic acid production, but CO_2 emissions from road transport and HFC emissions from consumption of halocarbons increased considerably between 1990 and 2010.

Spain is the fifth largest emitter in the EU-15, accounting for 9 % of total EU-15 GHG emissions. Spain increased emissions by nearly 26 % between 1990 and 2010. This was largely due to emission increases from road transport, electricity and heat production, and manufacturing industries.

2.5 Emission trends for indirect greenhouse gases and sulphur dioxide

Emissions of CO, NO_x, NMVOC and SO_2 have to be reported to the UNFCCC Secretariat because they influence climate change indirectly: CO, NO_x and NMVOC are precursor substances for ozone which itself is a greenhouse gas. Sulphur emissions produce microscopic particles (aerosols) that can reflect sunlight back out into space and also affect cloud formation. Table 2.7 shows the total indirect GHG and SO_2 emissions in the EU-15 between 1990 and 2010. All emissions were reduced significantly from 1990 levels: the largest reduction was achieved in SO_2 (-85 %), followed by CO (-65 %), NMVOC (-55 %) and NO_x (-47 %).

Table 2.7 Overview of EU-15 indirect GHG and SO_2 emissions for 1990–2010 (Gg)

GREENHOUSE GAS EMISSIONS	1990	1995	2000	2005	2006	2007	2008	2009	2010
	(Gg)								
NOx	13,695	12,054	10,512	9,504	9,191	8,882	8,175	7,460	7,259
CO	53,271	42,107	31,816	24,029	22,710	21,735	20,569	18,191	18,745
NMVOC	15,379	12,765	10,400	8,514	8,391	7,804	7,412	7,063	6,978
SO2	16,501	9,987	6,191	4,623	4,396	4,174	3,097	2,660	2,429

Table 2.8 shows the NO_x emissions of the EU-15 Member States between 1990–2010. The largest emitters, the United Kingdom, Spain, Germany, France and Italy made up 76 % of total EU-15 NO_x emissions in 2010. All EU-15 Member States reduced their NO_x emissions between1990 and 2010.

Table 2.8 Overview of Member States' contributions to EU-15 NO_x emissions for 1990–2010 (Gg)

Member State	1990	1995	2000	2005	2006	2007	2008	2009	2010
Austria	195	181	205	235	221	215	203	186	187
Belgium	400	388	330	289	263	260	236	205	218
Denmark	275	264	198	180	182	168	150	131	128
Finland	295	245	211	176	193	184	169	154	167
France	1,921	1,790	1,671	1,505	1,429	1,361	1,265	1,178	1,155
Germany	2,884	2,176	1,925	1,576	1,562	1,489	1,415	1,318	1,319
Greece	330	332	363	419	415	418	395	382	322
Ireland	120	122	134	126	122	119	109	88	76
Italy	2,018	1,897	1,427	1,218	1,164	1,133	1,062	979	969
Luxembourg	0.2	0.5	1	0.4	IE,NA,NE,N	IE,NA,NE,N	IE,NA,NE,N	IE,NA,NE,N	IE,NA,NE,N
Netherlands	558	464	391	333	324	300	292	268	261
Portugal	250	283	281	278	250	242	222	210	199
Spain	1,294	1,350	1,383	1,418	1,372	1,368	1,186	1,069	993
Sweden	271	248	206	176	175	169	159	154	162
United Kingdom	2,884	2,313	1,786	1,576	1,520	1,456	1,313	1,139	1,101
EU-15	**13,695**	**12,054**	**10,512**	**9,504**	**9,191**	**8,882**	**8,175**	**7,460**	**7,259**

Table 2.9 shows the CO emissions of the EU-15 Member States between 1990–2010. The largest emitters, France, Germany, Italy and the United Kingdom that made up 67 % of the total CO emissions in 2010, reduced their emissions from 1990 levels substantially. But also all other EU-15 Member States reduced emissions.

Table 2.9 Overview of Member States' contributions to EU-15 CO emissions for 1990–2010 (Gg)

Member State	1990	1995	2000	2005	2006	2007	2008	2009	2010
Austria	1,436	1,272	957	807	768	715	676	630	637
Belgium	1,354	1,055	1,026	715	701	616	612	378	459
Denmark	720	628	467	444	437	450	430	403	397
Finland	710	634	587	521	508	497	471	458	474
France	11,489	9,769	6,967	5,687	5,122	4,857	4,688	4,012	4,352
Germany	12,368	6,556	4,804	3,651	3,571	3,473	3,387	3,002	3,322
Greece	1,143	962	960	723	741	749	630	600	533
Ireland	417	313	252	191	182	170	161	154	140
Italy	7,325	7,092	4,935	3,505	3,281	3,410	3,035	2,811	2,764
Luxembourg	17	10	7	4	IE,NA,NE,N	IE,NA,NE,N	IE,NA,NE,N	IE,NA,NE,N	IE,NA,NE,N
Netherlands	1,238	943	829	662	654	632	630	578	573
Portugal	948	956	795	734	531	474	463	442	476
Spain	3,750	3,243	2,762	2,223	2,312	2,096	1,963	1,798	1,857
Sweden	1,280	1,127	824	661	627	618	607	612	640
United Kingdom	9,075	7,548	5,645	3,500	3,276	2,979	2,817	2,310	2,120
EU-15	**53,271**	**42,107**	**31,816**	**24,029**	**22,710**	**21,735**	**20,569**	**18,191**	**18,745**

Table 2.10 shows the NMVOC emissions of the EU-15 Member States between 1990–2010. The largest emitters France, Germany and Italy that made up 60 % of the total NMVOC emissions in 2010, reduced their emissions from 1990 levels, together with all other EU-15 Member States.

Table 2.10 Overview of Member States' contributions to EU-15 NMVOC emissions for 1990–2010 (Gg)

Member State	1990	1995	2000	2005	2006	2007	2008	2009	2010
Austria	276	226	178	162	172	158	149	121	133
Belgium	365	322	255	193	205	177	167	155	154
Denmark	166	163	134	110	105	100	96	89	86
Finland	229	192	165	139	137	133	119	112	115
France	3,868	3,497	2,997	2,607	2,617	2,230	2,143	2,187	2,079
Germany	3,127	1,805	1,390	1,143	1,131	1,069	1,015	929	1,051
Greece	269	260	265	221	231	220	228	212	184
Ireland	92	84	72	55	54	52	50	48	44
Italy	2,024	2,087	1,612	1,318	1,286	1,272	1,196	1,134	1,082
Luxembourg	6	6	5	6	5	5	5	5	4
Netherlands	475	337	237	175	165	162	160	150	149
Portugal	327	320	291	262	229	218	212	201	211
Spain	1,040	968	995	839	822	810	757	704	702
Sweden	359	278	223	197	195	197	196	197	197
United Kingdom	2,757	2,223	1,583	1,086	1,037	1,000	920	820	787
EU-15	**15,379**	**12,765**	**10,400**	**8,514**	**8,391**	**7,804**	**7,412**	**7,063**	**6,978**

Table 2.11 shows the SO_2 emissions of the EU-15 Member Statesbetween 1990–2010. The largest emitters, the United Kingdom, Spain and Germany, that made up 55 % of the total SO_2 emissions in 2010, reduced their emissions from 1990 levels substantially, together with all other EU-15 Member States.

Table 2.11 Overview of Member States' contributions to EU-15 SO_2 emissions for 1990–2010 (Gg)

Member State	1990	1995	2000	2005	2006	2007	2008	2009	2010
Austria	74	47	32	27	28	24	22	17	19
Belgium	362	261	172	145	135	125	97	77	67
Denmark	176	139	29	23	26	24	19	14	14
Finland	249	105	81	68	85	83	69	59	67
France	1,380	1,008	673	494	457	440	372	308	280
Germany	5,292	1,718	653	517	520	497	490	435	449
Greece	476	540	496	541	533	538	445	426	265
Ireland	182	161	139	71	61	55	45	32	26
Italy	1,795	1,320	750	403	381	340	284	233	211
Luxembourg	0.2	0.2	0.2	0.2	IE,NA,NE,N	IE,NA,NE,N	IE,NA,NE,N	IE,NA,NE,N	IE,NA,NE,N
Netherlands	198	139	79	70	81	59	50	38	34
Portugal	323	330	304	195	171	164	117	80	72
Spain	2,181	1,795	1,514	1,326	1,218	1,208	566	515	484
Sweden	105	69	42	36	36	33	31	30	35
United Kingdom	3,707	2,356	1,228	706	665	586	491	397	406
EU-15	**16,501**	**9,987**	**6,191**	**4,623**	**4,396**	**4,174**	**3,097**	**2,660**	**2,429**

3 Energy (CRF Sector 1)

This chapter starts with an overview on emission trends in CRF Sector 1 Energy. For each EU-15 key category overview tables are presented including the Member States' contributions to the key category in terms of level and trend, information on methodologies and emission factors. The chapter includes also sections on uncertainty estimates, sector-specific QA/QC, recalculations, the reference approach, and international bunkers.

3.1 Overview of sector (EU-15)

CRF Sector 1 Energy contributes 80 % to total GHG emissions and is the largest emitting sector in the EU-15. Total GHG emissions from this sector decreased by 7,2 % from 3278 Tg in 1990 to 3042 Tg in 2010 (Figure 3.1). In 2010, emissions increased by 2 % compared to 2009, mainly as a consequence of the economic recovery after the economic downturn in 2009.

The most important energy-related gas is CO_2 that makes up 78 % of the total EU-15 GHG emissions. CH_4 and N_2O are each responsible for 1 % of the total GHG emissions. The key sources in this sector are as follows.

- 1 A 1 a Public Electricity and Heat Production: Gaseous Fuels (CO_2)
- 1 A 1 a Public Electricity and Heat Production: Liquid Fuels (CO_2)
- 1 A 1 a Public Electricity and Heat Production: Other Fuels (CO_2)
- 1 A 1 a Public Electricity and Heat Production: Solid Fuels (CO_2)
- 1 A 1 b Petroleum refining: Gaseous Fuels (CO_2)
- 1 A 1 b Petroleum refining: Liquid Fuels (CO_2)
- 1 A 1 b Petroleum refining: Solid Fuels (CO_2)
- 1 A 1 c Manufacture of Solid fuels and Other Energy Industries: Gaseous Fuels (CO_2)
- 1 A 1 c Manufacture of Solid fuels and Other Energy Industries: Solid Fuels (CO_2)
- 1 A 2 a Iron and Steel: Gaseous Fuels (CO_2)
- 1 A 2 a Iron and Steel: Liquid Fuels (CO_2)
- 1 A 2 a Iron and Steel: Solid Fuels (CO_2)
- 1 A 2 b Non-Ferous Metals: Solid Fuels (CO_2)
- 1 A 2 c Chemicals: Gaseous Fuels (CO_2)
- 1 A 2 c Chemicals: Liquid Fuels (CO_2)
- 1 A 2 c Chemicals: Other Fuels (CO_2)
- 1 A 2 c Chemicals: Solid Fuels (CO_2)
- 1 A 2 d Pulp, Paper and Print: Gaseous Fuels (CO_2)
- 1 A 2 d Pulp, Paper and Print: Liquid Fuels (CO_2)
- 1 A 2 e Food Processing, Beverages and Tobacco: Gaseous Fuels (CO_2)
- 1 A 2 e Food Processing, Beverages and Tobacco: Liquid Fuels (CO_2)
- 1 A 2 e Food Processing, Beverages and Tobacco: Solid Fuels (CO_2)
- 1 A 2 f Other: Gaseous Fuels (CO_2)
- 1 A 2 f Other: Liquid Fuels (CO_2)
- 1 A 2 f Other: Other Fuels (CO_2)
- 1 A 2 f Other: Solid Fuels (CO_2)
- 1 A 3 a Civil Aviation: Jet Kerosene (CO_2)
- 1 A 3 b Road Transportation: Diesel oil (CO_2)
- 1 A 3 b Road Transportation: Diesel oil (N_2O)
- 1 A 3 b Road Transportation: Gasoline (CH_4)
- 1 A 3 b Road Transportation: Gasoline (CO_2)
- 1 A 3 b Road Transportation: LPG (CO_2)

- 1 A 3 c Railways: Liquid Fuels (CO_2)
- 1 A 3 d Navigation: Gas/Diesel Oil (CO_2)
- 1 A 3 d Navigation: Residual Oil (CO_2)
- 1 A 4 a Commercial/Institutional: Gaseous Fuels (CO_2)
- 1 A 4 a Commercial/Institutional: Liquid Fuels (CO_2)
- 1 A 4 a Commercial/Institutional: Solid Fuels (CO_2)
- 1 A 4 b Residential: Gaseous Fuels (CO_2)
- 1 A 4 b Residential: Liquid Fuels (CO_2)
- 1 A 4 b Residential: Solid Fuels (CO_2)
- 1 A 4 c Agriculture/Forestry/Fisheries: Gaseous Fuels (CO_2)
- 1 A 4 c Agriculture/Forestry/Fisheries: Liquid Fuels (CO_2)
- 1 A 4 c Agriculture/Forestry/Fisheries: Solid Fuels (CO_2)
- 1 A 5 a Stationary: Solid Fuels (CO_2)
- 1 A 5 b Mobile: Liquid Fuels (CO_2)
- 1 B 1 a Coal Mining: (CH_4)
- 1 B 2 a Oil: (CO_2)
- 1 B 2 b Natural gas: (CH_4)

Figure 3.1 **CRF Sector 1 Energy: EU-15 GHG emissions in CO_2 equivalents (Tg) for 1990–2010**

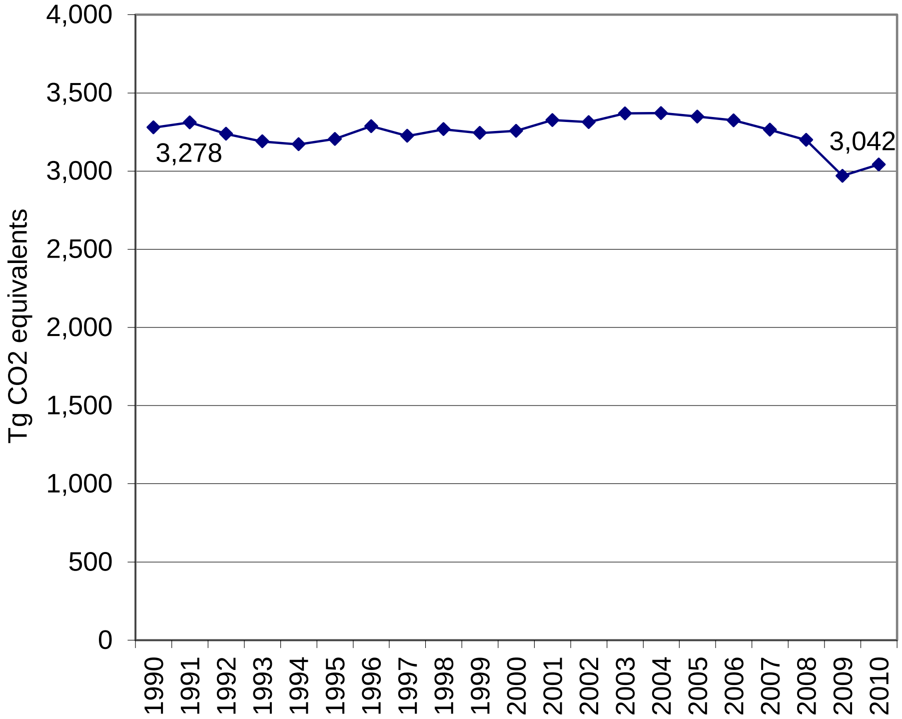
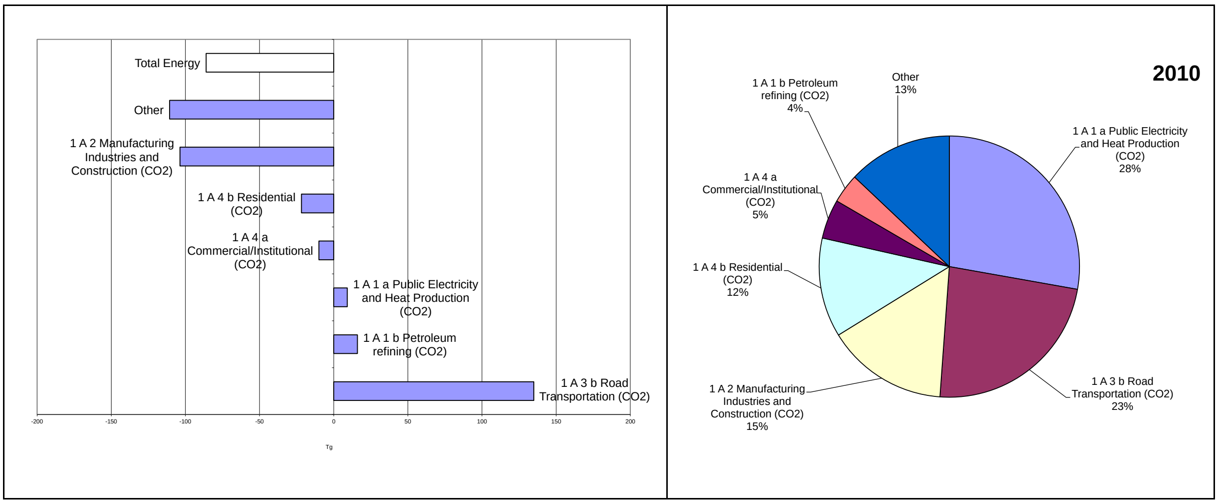


Figure 3.2 shows that CO_2 emissions from road transport had the highest increase in absolute terms of all energy-related emissions, while CO_2 emissions from 1A2 Manufacturing Industries decreased substantially between 1990 and 2010. The increases in road transport occurred in almost all Member States, whereas the emission reductions from manufacturing industries mainly occurred in Germany after the reunification. The decline of coal-mining (CH_4) and decreasing CO_2 emissions from 1A1c Manufacture of Solid Fuels and Other Energy Industries are the main reasons for the large absolute emission reductions from Other in Figure 3.2. Figure 3.2 shows that the six largest key sources account for about 80 % of emissions in Sector 1.

Figure 3.2 **CRF Sector 1 Energy: Absolute change of GHG emissions in CO_2 equivalents (Tg) by large key source categories for 1990–2010 and share of largest key source categories in 2010**



3.2 Source categories (EU-15)

3.2.1 Energy industries (CRF Source Category 1A1)

Energy industries (CRF 1A1) comprises emissions from fuels combusted by the fuel extraction or energy-producing industries. For the EU-15, this source category includes three key sources: CO_2 from ‘Public electricity and heat production’ (CRF 1A1a), CO_2 from ‘Petroleum-refining’ (CRF 1A1b), and CO_2 from ‘Manufacture of solid fuels and other energy industries’ (CRF 1A1c).

Figure 3.3 shows the trends in emissions in energy industries for the EU-15 between 1990 and 2010, which was mainly dominated by CO_2 emissions from public electricity and heat production. CO_2 from 1A1a currently represents about 83 % of greenhouse gas emissions in 1A1 (i.e. including methane and nitrous oxide).

Total greenhouse gas emissions from 1A1 decreased by 8 %, between 1990 and 2010. This was mainly due to a decrease of CO_2 emission from Public Electricity and Heat Production (-61 TG $CO_2$and the manufacturing of solid fuels -51 Tg CO_2). CO_2 emissions from petroleum refining increased by 13 Tg in the period 1990-2010.

Figure 3.3 1A1 Energy Industries: Total GHG, CO_2 and N_2O emission trends and Activity Data

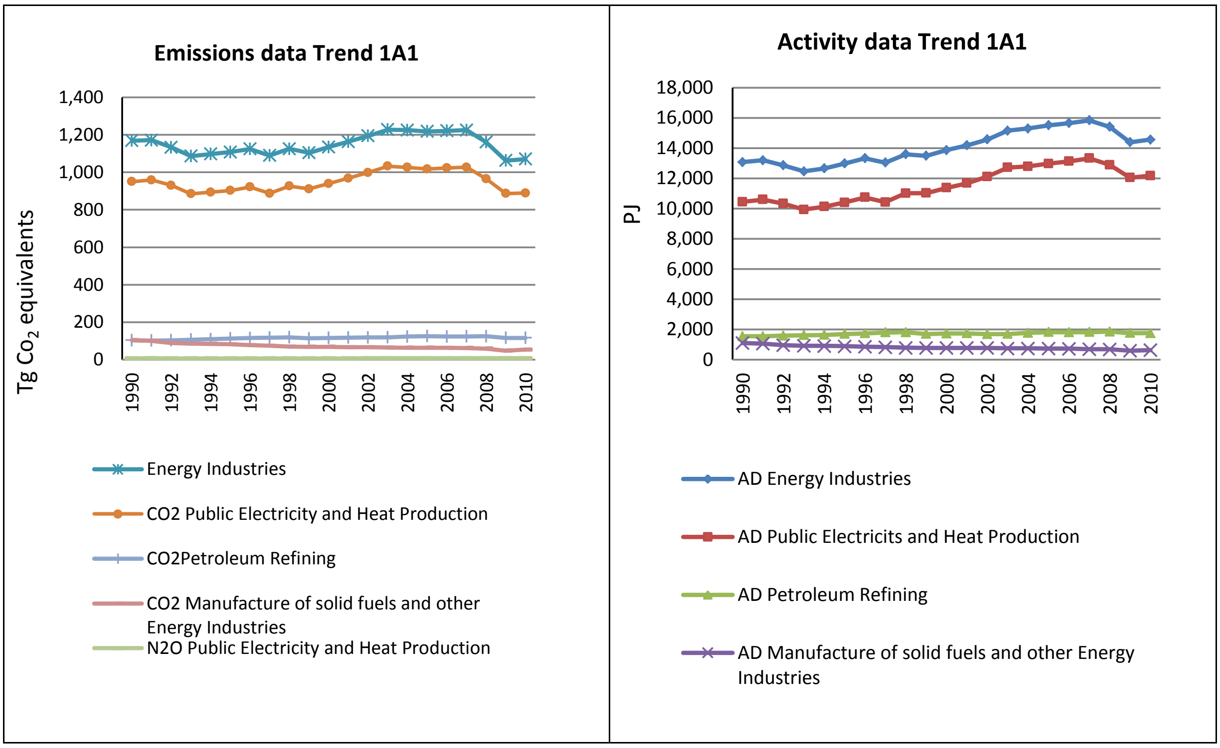


Table 3.1 summarises the information by Member State. Between 1990 and 2010, greenhouse gas emissions from energy industries increased in seven Member States and fell in eight. The highest absolute increase was accounted for by Finland, the Netherlands and Greece. Germany and the UK account for the largest part of reductions (-119 Tg).The change in the EU-15 was a net decrease of 106 Tg. The table also shows the shares of CO_2 and N_2O separately.

Table 3.1 1A1 Energy industries: Member States' contributions to CO_2 and N_2O emissions

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2010 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO2 emissions in 2010 (Gg)	N_2O emissions in 1990 (Gg CO_2 equivalents)	CO2 emissions in 2010 (Gg CO_2 equivalents)
Austria	13,842	14,293	13,792	14,174	46	111
Belgium	30,052	26,434	29,826	26,221	208	168
Denmark	26,246	23,915	26,146	23,577	86	107
Finland	19,187	30,547	19,057	30,166	122	357
France	64,772	61,564	64,048	60,810	593	697
Germany	428,118	354,506	423,418	349,060	4,416	3,736
Greece	43,159	52,222	42,993	52,037	154	171
Ireland	11,239	13,328	11,159	13,171	74	151
Italy	137,214	133,255	136,503	132,634	516	517
Luxembourg	36	1,271	33	1,267	2	3
Netherlands	52,699	66,613	52,501	66,237	139	261
Portugal	16,369	14,586	16,303	14,460	61	119
Spain	77,663	72,418	77,354	71,706	278	586
Sweden	10,145	13,091	9,795	12,461	328	529
United Kingdom	237,724	192,184	235,444	190,547	2,064	1,368
EU-15	**1,168,463**	**1,070,225**	**1,158,372**	**1,058,527**	**9,088**	**8,880**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.4 shows the relative contributions of greenhouse gas emissions from energy industries in each Member State, ranging from relatively low shares in Luxembourg and France to relatively high in Finland, Germany, Denmark, and Greece. Figure 3.5 shows the absolute contributions to EU-15 greenhouse gas emissions from energy industries, which are clearly dominated by Germany and the UK. These two countries represent about half of the EU's greenhouse gas emissions from energy industries.

Figure 3.4 Share of greenhouse gas emissions from energy industries in total greenhouse gas emissions by Member State in 2010

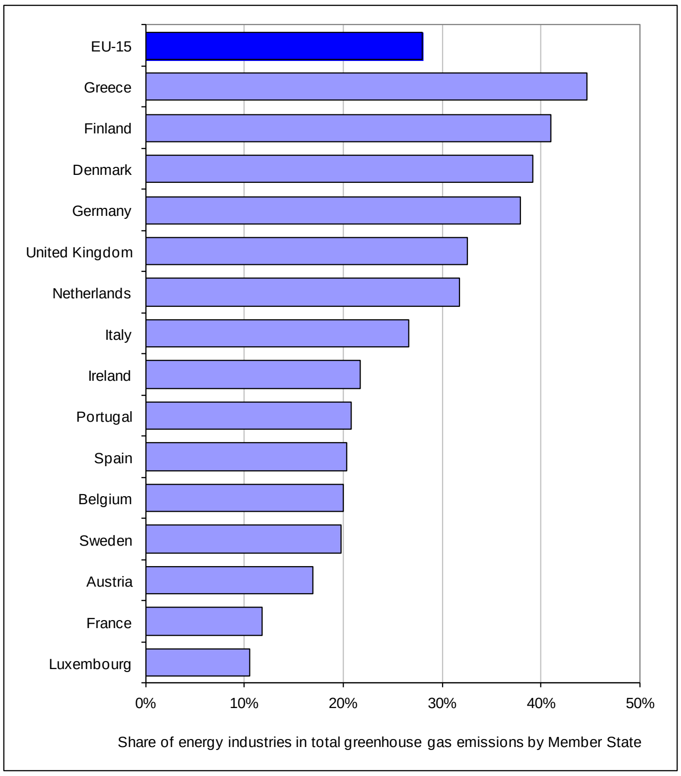
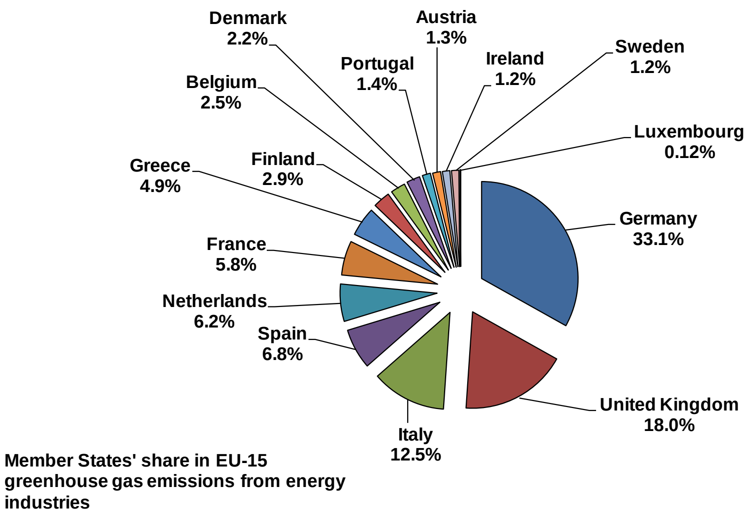


Figure 3.5 Member States' share of greenhouse gas emissions from energy industries in EU-15



Public heat and electricity production is the largest source category in the EU-15, as well as the main source of emissions from energy industries. Differences in the intensity of greenhouse gas emissions of heat and electricity production between the Member States are to a large extent explained by the mix of fuels. The relatively low share of greenhouse gas emissions from energy industries in France can be partly explained by the use of nuclear energy for power generation. Luxembourg is a net importer of electricity from neighbouring countries. Some countries rely more on coal than on gas. At the EU-15 level, about 39 % of the fuel used in energy industries comes from solid fuels. Its contribution has been steadily declining in favour of relatively cleaner natural gas, whose share stood at about 36 % in 2010.

Table 3.2 provides information on the Member States' contribution to EU-15 recalculations in CO_2 from 1A1 Energy Industries for 1990 and 2009 as well as the main explanations for the largest recalculations in absolute terms.

Table 3.2 1A1 Energy Industries: Contribution of MS to EU-15 recalculations in CO_2 for 1990 and 2009 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2009		Main explanations
	Gg CO_2 equiv.	Percent	Gg CO_2 equiv.	Percent	
Austria	0	0.0	103	0.8	Revised energy balance.
Belgium	0	0.0	-649	-2.5	In the Flemish region some corrections were made during the 2012 submission compared to previous submission in the category 1A1a: - a part of the emissions of CO2 from other fuels (waste not biodegradable) was double counted for 2006 and 2007 and corrected during the 2012 submission; - some corrections in calculations for the emissions of CO2 were made during the 2012 submission for the years 2007, 2008 and 2009 for natural gas (corrections of default values with emissions reported from companies involved) and for 'other fuels' (for 1 company ETS-emissions of CO2 were taken over instead of using default emission factor); - emissions of CO2 from CHP-installations in refineries (operational since 2000) were optimized during the 2012 submission and replaced by emissions reported by the companies involved in their annual integrated environmental reports.
Denmark	194	0.7	134	0.6	- For stationary combustion plants, the emission estimates for the years 1990-2009 have been updated according to the latest energy statistics published by the Danish Energy Agency. The update included both end use and transformation sectors as well as a source category update. - The relatively large recalculations for CO2 emission from the fuel category "Other fuels" is a result a revised CO2 emission factor fossil waste incineration. This emission factor has been recalculated based on a large number of measurements performed at Danish plants in 2010-2011. The CO2 emission factor is 14 % higher than the emission factor applied last year. The estimated emission from fuel category Other fuels in 1A1a Public electricity and Heat production in 2009 has increased 14 % corresponding to 170 Gg CO2.
Finland	0	0.0	-199	-0.8	- Monitored emission factors from ETS - Corrections in plant level activity data
France	-957	-1.5	342	0.6	- 1A1a: Modification de l'activité pour les usine d'incinération des ordures ménagères. - 1A1b: En 1990, suppression du double compte des émissions d'un vapocraqueur qui était compté à la fois en raffinage et en industrie pétrochimique.
Germany	0	0.0	-1,626	-0.5	- 1A1a, gaseous fuels, activity data: New statistical data available. - 1A1c, solid fuels, activity data: New statistical data available.
Greece	0	0.0	-139	-0.3	1A1a, gaseous fuels: updated activity data
Ireland	0	0.0	0	0.0	
Italy	0	0.0	-1,215	-0.9	- Update of CO2 emission factors for pet coke, synthesis gases and derived gases: update of CO2 natural gas emission factor - Reallocation of fuel oil and natural gas consumptions between energy production and manufacturing industries
Luxembourg	0	0.0	88	7.6	Revised AD due to revised energy balance (addition of Gasoil in the energy balance) on CHP and Heat plants
Netherlands	0	0.0	0	0.0	
Portugal	355	2.2	-124	-0.6	- Revised CO2 emission factors and oxidation factors for several power plants; - Revised data for Caniçal power plant was obtained from Madeira Regional Environmental entities; - Revision of the toe/ton conversion factors used to convert fuel consumption from energy balance toe to INERPA ton. The newer values were obtained from DGEG and updated for all times series for auto-producers. These new values were accompanied by revised LHV.
Spain	0	0.0	-124	-0.1	1A1a, liquid fuels: - Revision of the carbon content of the fuel consumed in a power plant. An error has been fixed in the emissions estimate for three installations. - Revision of gasoil burnt in landfills with energy recovery (stationary engines and gas turbines) and fuel consumption of low-power electricity generation plants. 1A1a, solid fuels: Revision of the characteristics (LHV and composition) of the coal (coal and waste mining coal) consumed in a power plant. 1A1a, gaseous fuels: - An error has been fixed in the emissions estimate for three installations. - Fuel consumption of low-power electricity generation plants has been revised. - Emissions from natural gas burnt in biomethanation plants with energy recovery (stationary engines and boilers) have been included for the first time in the current submission. 1A1b, liquid fuels: Revision of the amount of refinery gas consumed in a refinery plant. 1A1c, gaseous fuels: Activity included (fuel consumption) in the revision of the inventory fuel balance.
Sweden	225	2.4	132	1.3	1A1a, solid fuels: New plant specific implied emission factors for CO2 for coke oven gas, blast furnace gas and steelworks gas is used in submission 2012
UK	1,250	0.5	4,541	2.5	- Methods: A gap in reporting of OPG use in refineries has been identified and resolved. This affects 2005 onwards; also some revisions to assumptions on EU ETS data for recent years in power stations and refineries. - Emission factors: Revisions have been made to solid fuel carbon factors as GCVs are now reported to a higher level of precision. - Activity data: Offshore installation data revised following consultation with the offshore regulatory agency and site operators. Activity data revised for powerstations from 2001 for gas oil.
EU-15	**1,068**	**0.1**	**1,265**	**0.1**	

Table 3.3 provides information on the Member States' contribution to EU-15 recalculations in N_2O from 1A1 Energy Industries for 1990 and 2009 and main explanations for the largest recalculations in absolute terms.

Table 3.3 1A1 Energy industries: Contribution of MS to EU-15 recalculations in N_2O for 1990 and 2009 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2009		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	0	0.0	2	1.8	Revised energy balance.
Belgium	5	2.5	6	3.4	In the Flemish region emissions of CH4 and N2O were newly estimated for one waste incineration plant (new installation since 2006) of industrial waste. IPCC 1996 default emission factors are used to calculate these emissions.
Denmark	1	0.8	-10	-8.9	The N2O emission from gaseous fuels in sector 1A1c has been recalculated resulting in a decrease of 10 Gg CO2 eq. The N2O emission factor for off shore gas turbines now follows emission factor for on shore gas turbines.
Finland	0	0.0	-1	-0.3	
France	-7	-1.2	9	1.4	- 1A1a: Modification de l'activité pour les usine d'incinération des ordures ménagères. - 1A1c: Mis à jour consommations.
Germany	0	0.0	26	0.7	Changes in activity data: revision of municipal waste data
Greece	0	0.0	0	0.0	
Ireland	0	0.0	7	5.0	- Revised Energy data from National Energy Balance - Revised AD for LFG utilised in engines - Revised Natural Gas allocation between NEW and OLD gas fired plants
Italy	0	0.0	7	1.3	Reallocation of fuel oil and natural gas consumptions between energy production and manufacturing industries
Luxembourg	0	0.0	0.2	6.5	Revised AD due to revised energy balance (addition of Gasoil in the energy balance) on CHP and Heat plants
Netherlands	0	0.0	0	0.0	
Portugal	0	0.0	0.4	0.3	- Revised data for Caniçal power plant was obtained from Madeira Regional Environmental entities; - Revision of the toe/ton conversion factors used to convert fuel consumption from energy balance toe to INERPA ton. The newer values were obtained from DGEG and updated for all times series for auto-producers. These new values were accompanied by revised LHV.
Spain	-5	-1.7	16	2.4	1A1a, liquid fuels: - Revision of the emissions estimate in two power plants, after having indentified the omission of the corresponding EF related to gasoil and residual oil consumed in the previous reported data. - Revision of the lower heating value of petroleum coke consumed in a power plant. An error has been fixed in the emissions estimate for three installations, after having detected the omission of the emissions in the previous inventory edition. - Revision of gasoil burnt in landfills with energy recovery (stationary engines and gas turbines) and of fuel consumption of low-power electricity generation plants. - Emissions from gasoil and LPG burnt in biomethanation plants with energy recovery (stationary engines and boilers) have been included for the first time in the current submission. 1A1a, solid fuels: - Revision of the characteristics (LHV and composition) of the coal (coal and waste mining coal) consumed in a power plant. - Revision of the lower heating value of coal consumed in two power plants.
Sweden	0	0.0	0	0.0	
UK	45	2.2	42	3.2	- Methods: A gap in reporting of OPG use in refineries has been identified and resolved. This affects 2005 onwards; also some revisions to assumptions on EU ETS data for recent years in power stations and refineries. - Emission factors: Revisions have been made to solid fuel carbon factors as GCVs are now reported to a higher level of precision. - Activity data: Offshore installation data revised following consultation with the offshore regulatory agency and site operators. Activity data revised for powerstations from 2001 for gas oil.
EU-15	**39**	**0.4**	**104**	**1.2**	

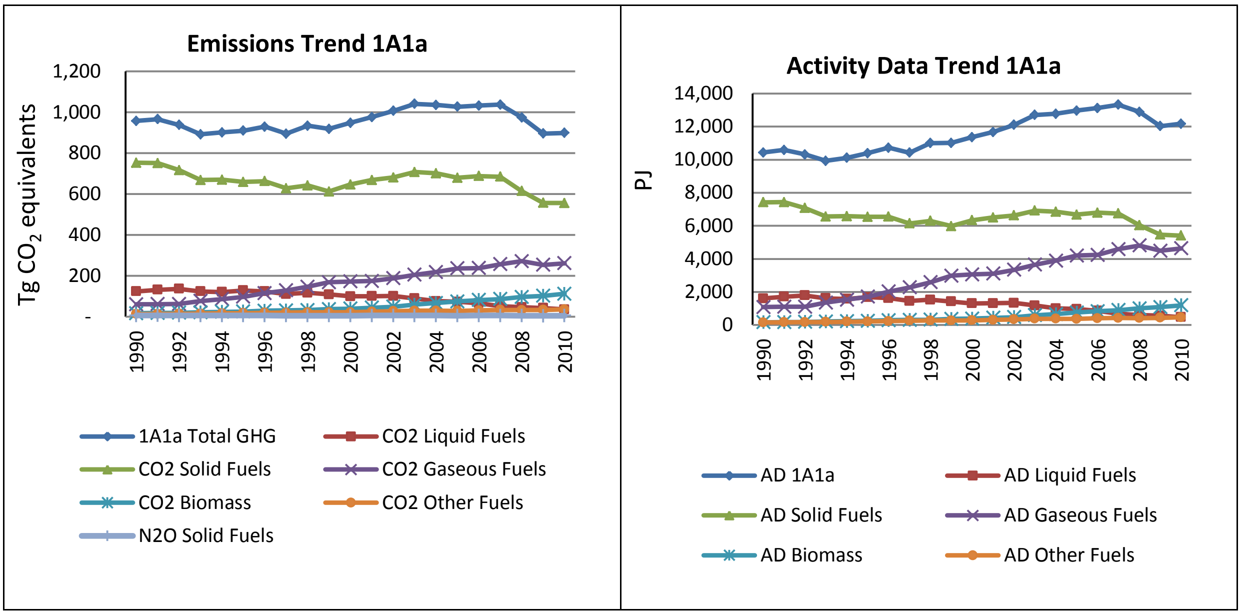
3.2.1.1 Public Electricity and Heat Production (1A1a) (EU-15)

According to the IPCC, emissions from public electricity and heat production (CRF 1A1a) should include emissions from main activity producers of electricity generation, combined heat and power generation, and heat plants. Main activity producers (i.e. public utilities) are defined as those undertakings whose primary activity is to supply the public. They may be in public or private ownership. Emissions from own on-site use of fuel should be included. Emissions from autoproducers (undertakings which generate electricity/heat wholly or partly for their own use, as an activity that supports their primary activity) should be assigned to the sector where they were generated and not under 1A1a. Autoproducers may be in public or private ownership.

CO_2 emissions from electricity and heat production is the largest key source in the EU-15 accounting for 23.4% of total greenhouse gas emissions in 2010 and for 83 % of greenhouse gas emissions of the Energy Industries Sector. Between 1990 and 2010, CO_2 emissions from electricity and heat production decreased by 6 % in the EU-15.

Figure 3.6 (left) shows the trends in emissions originating from the production of public heat and electricity by fuel in the EU-15 between 1990 and 2010. Figure 3.6 (right) shows the activity data behind the emissions[22].

Figure 3.6 1A1a-Public Electricity and Heat Production: Total, CO_2 and N_2O emission and activity trends

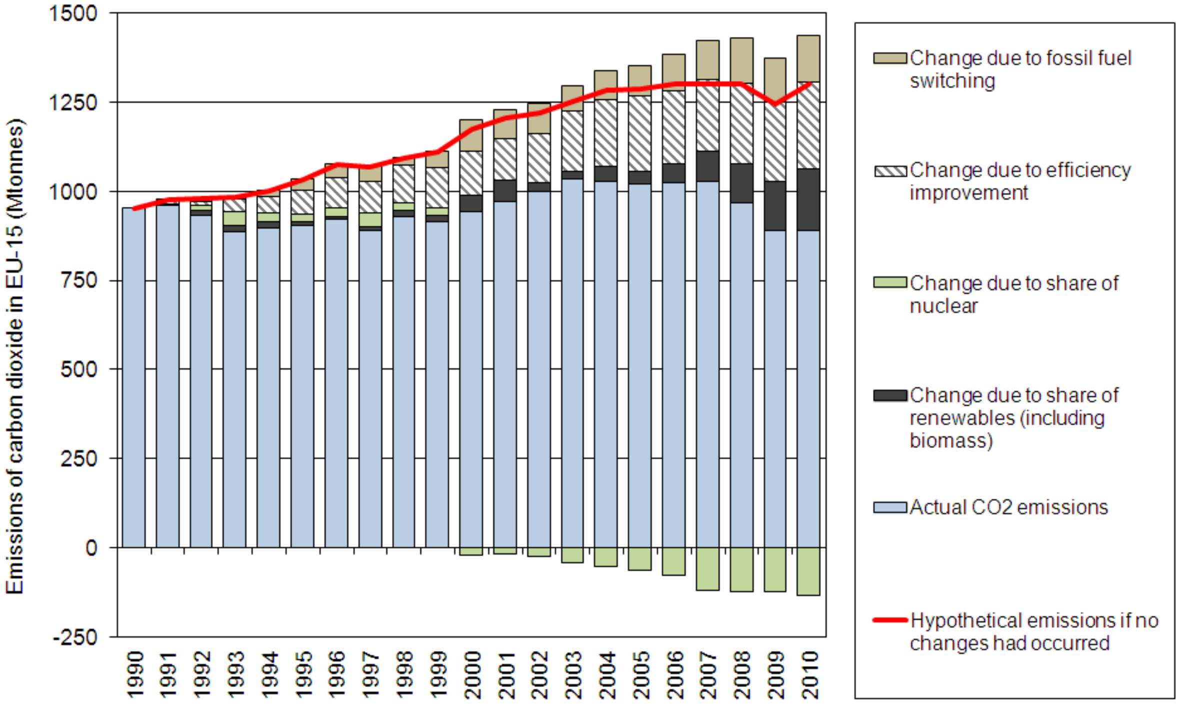


Fuel used for public electricity and heat production increased by 17 % in the EU-15 between 1990 and 2010. Solid fuels still represent almost half of the fuel used in public conventional thermal power plants, although its share in the fuel mix has been declining (-27 %). Gas has increased very rapidly, by a factor of 3 between 1990 and 2010, and its share stands at 38 % of all the fuel used for the production of heat and electricity in the EU-15. Liquid fuels still account for some 4 % but its use has declined gradually during the past 20 years. The use of biomass has increased even more rapidly than the use of gas, but its share in the fuel mix is relatively small, at around 10 %.

CO_2 emissions from public electricity and heat production did not increase in line with fuel consumption. There are several reasons for this. Figure 3.7 below shows the estimated impact of different factors on the reduction of CO_2 emissions from public heat and electricity generation in the EU-15 between 1990–2010. The main explanatory factors at the EU-15 level during the past 20 years have been improvements in energy efficiency, (fossil) fuel switching from coal to gas, and an increasing share of power production from renewable energy sources.

[22] CO_2 emissions from the combustion of biomass fuels are reported as a memo item and are therefore not included in the emissions from public electricity and heat production. The biomass used as a fuel is however included in the national energy consumption (i.e. activity data). The fact that CO_2 emissions from biomass are treated differently from other fuel emissions does not imply emissions from the production of heat and electricity are due to fossil fuel combustion only. Biomass CO_2 emissions are just reported elsewhere. Non-CO_2 emissions from the combustion of biomass (CH_4 and N_2O) are reported under the energy sector.

Figure 3.7 **Estimated impact of different factors on the reduction in emissions of CO_2 from public electricity and heat production in the EU-15 between 1990 and 2010.**



Note: *The chart shows the estimated contributions of the various factors that have affected emissions from public electricity and heat production (including public thermal power stations, nuclear power stations, hydro power plants and wind plants). The top line represents the hypothetical development of emissions that would have occurred due to increasing public heat and electricity production between 1990 and 2010, if the structure of electricity and heat production had remained unchanged since 1990, i.e. if the shares of input fuels used to produce electricity and heat had remained constant, and if the efficiency of electricity and heat production also stayed the same. However, there were a number of changes that tended to reduce emissions. The contribution of each of these changes to reducing emissions are shown by each of the bars. The cumulative effect of all these changes was that emissions from electricity and heat production actually followed the trend shown by the blue bars. This is a frequently used approach for portraying the primary driving forces of emissions. It is based on the IPAT and Kaya identities. The explanatory factors should not be seen as fundamental factors in themselves nor should they be seen as independent from each other. The underpinning energy data is based on Eurostat's energy balances.*

Based on the chart above, CO_2 emissions from public heat and electricity production decreased by 6 % during 1990-2010, but emissions would have risen by over 37 %, had the shares of input fuels used to produce electricity and heat and the efficiency remained constant, an increase which would be in line with the additional amount of electricity and heat produced (37 %). The relationship between the increase in electricity generation and the actual reduction in emissions during 1990-2010 can be explained by the following factors:

- An improvement in the thermal efficiency of electricity and heat production. During 1990-2010, there was a 19 % reduction in the fossil-fuel input per unit of electricity produced from fossil fuels.

- Changes in the fossil fuel mix used to produce electricity, i.e. fuel switching from coal and lignite to natural gas. There was a 13 % reduction in the CO_2 emissions per unit of fossil-fuel input during 1990-2010.

- The higher combined share of nuclear and renewable energy for electricity and heat production in 2010 compared to 1990[23]. During 1990-2010, the share of electricity from fossil fuels in total electricity production decreased by 3 %. Note that the share of renewable increased considerably since 1990 whereas the share of nuclear power production decreased significantly.

These three factors interact with each other in a multiplicative way: Actual CO_2 emissions change = 1.37 (increase in electricity production) X 0.81 (efficiency improvement) X 0.87 (fossil fuel switching) X 0.97 (higher nuclear-renewable share)= 0.94. The combined effect was a decrease of about 6 % in CO_2 emissions in 2010 compared to the 1990 level.

Returning to the 2012 inventory, Table 3.4 summarises emissions arising from the production of public heat and electricity by Member State. CO_2 emissions increased in six Member States and fell in nine. Of the six countries where emissions were higher in 2010 than in 1990, almost 90% of the increase was accounted for by the Netherlands, Finland and Greece. Of the nine countries, where emissions fell, 85% of the total reduction were accounted for by the UK (47%), Germany (24%) and Italy (14%). The change in the EU-15 between 1990 and 2010 was a net increase of about 61 Tg.

Table 3.4 1A1a Public Electricity and Heat Production: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010	
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	10,888	9,344	10,730	1.2%	1,386	15%	-158	-1%
Belgium	23,504	20,741	21,258	2.4%	517	2%	-2,246	-10%
Denmark	24,695	21,378	21,231	2.4%	-147	-1%	-3,464	-14%
Finland	16,450	21,902	27,296	3.1%	5,394	25%	10,846	66%
France	47,235	43,844	45,697	5.1%	1,853	4%	-1,537	-3%
Germany	339,018	304,603	315,558	35.5%	10,955	4%	-23,460	-7%
Greece	40,582	50,681	48,319	5.4%	-2,362	-5%	7,736	19%
Ireland	10,876	12,466	12,745	1.4%	279	2%	1,869	17%
Italy	107,136	96,888	92,797	10.4%	-4,092	-4%	-14,339	-13%
Luxembourg	33	1,243	1,267	0.1%	24	2%	1,233	3705%
Netherlands	39,932	52,556	54,557	6.1%	2,001	4%	14,624	37%
Portugal	14,319	17,142	12,167	1.4%	-4,975	-29%	-2,151	-15%
Spain	64,331	75,223	58,935	6.6%	-16,288	-22%	-5,396	-8%
Sweden	7,718	7,658	10,014	1.1%	2,356	31%	2,296	30%
United Kingdom	203,076	150,744	156,162	17.6%	5,418	4%	-46,914	-23%
EU-15	**949,793**	**886,414**	**888,732**	**100.0%**	**2,318**	**0%**	**-61,062**	**-6%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Note that German CO_2 emissions from SO_2 scrubbing are included in this source category. Other Member States include these emissions in 1B1 or 2A3.

Figure 3.8 shows the relative contributions of greenhouse gas emissions from public electricity and heat production in each Member State, ranging from relatively low shares in France and Luxembourg to relatively high in Finland, Greece, Denmark, and Germany. Figure 3.9 shows the absolute contributions to EU-15 CO_2 emissions from this source category, dominated by Germany and the UK. These two countries represent about half of the EU's greenhouse gas emissions from public electricity and heat production.

[23] The specific nuclear effect can be separated from the renewable effect in an additive way. These two factors will then be additive to each other and the combined renewable and nuclear effect will remain multiplicative to the already-mentioned fuel-switching and efficiency factors.

Figure 3.8 Share of CO_2 emissions from public electricity and heat production in total greenhouse gas emissions by Member State in 2010

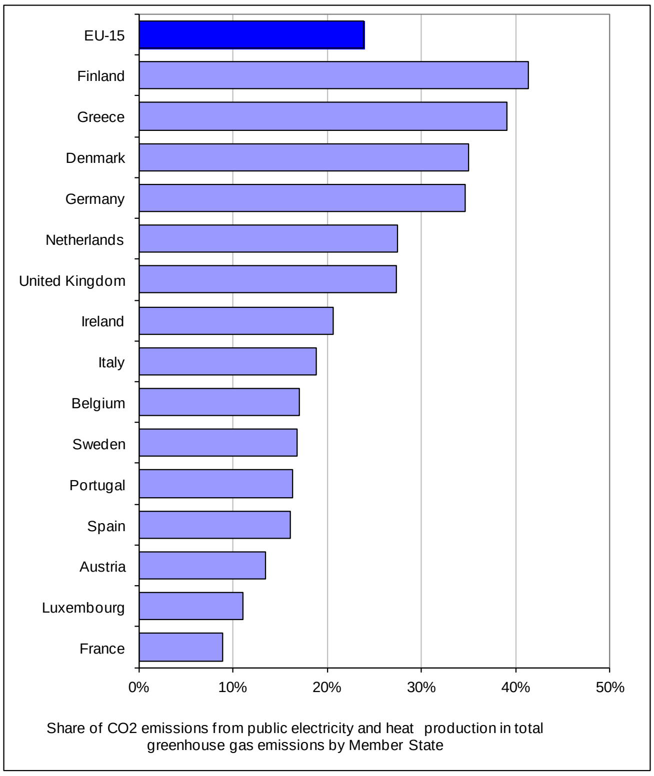
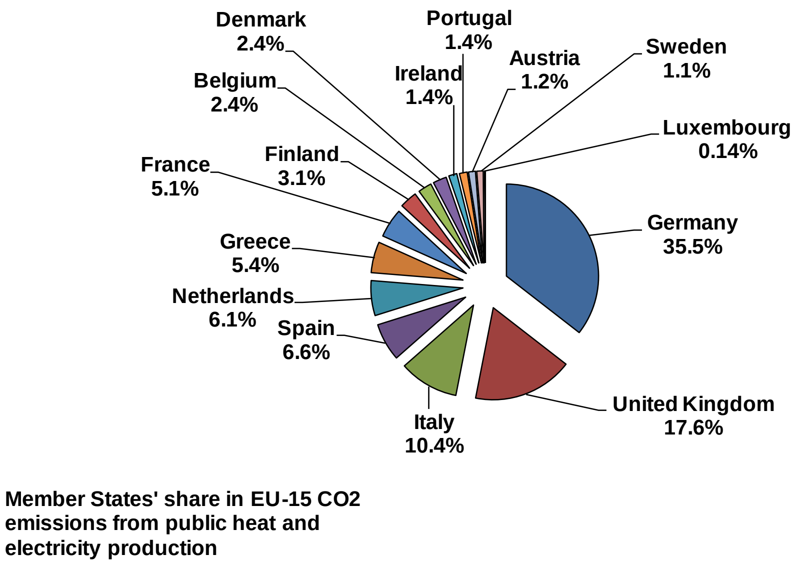


Figure 3.9 Member States' share of CO_2 emissions from public heat and electricity production in EU-15



Finally, N_2O emissions currently represent 0.5 % of greenhouse gas emissions from public electricity and heat production. Between 1990 and 2010, emissions increased by 4% (Table 3.5). Emissions from this source category only declined in the United Kingdom, Germany and Italy. The biggest increases occurred in Spain and Finland.

Table 3.5 1A1a Public Electricity and Heat Production: Member States' contributions to N_2O emissions

Member State	N_2O emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010	
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	41	92	106	1.4%	13	14%	65	157%
Belgium	76	88	94	1.2%	6	7%	18	24%
Denmark	79	94	98	1.3%	4	5%	19	24%
Finland	104	262	333	4.4%	72	27%	229	220%
France	460	555	581	7.7%	26	5%	121	26%
Germany	3,610	3,388	3,499	46.3%	111	3%	-111	-3%
Greece	147	171	160	2.1%	-11	-6%	13	9%
Ireland	74	145	151	2.0%	6	4%	77	104%
Italy	326	296	273	3.6%	-23	-8%	-53	-16%
Luxembourg	2	3	3	0.0%	0	-6%	1	72%
Netherlands	131	241	246	3.3%	5	2%	116	88%
Portugal	52	126	105	1.4%	-20	-16%	54	105%
Spain	197	565	490	6.5%	-76	-13%	292	148%
Sweden	304	425	502	6.6%	77	18%	198	65%
United Kingdom	1,668	886	922	12.2%	36	4%	-747	-45%
EU-15	**7,271**	**7,337**	**7,563**	**100.0%**	**226**	**3%**	**292**	**4%**

.Abbreviations explained in the Chapter 'Units and abbreviations'.

1A1a Electricity And Heat Production - Liquid Fuels (CO_2)

CO_2 emissions arising from the combustion of liquid fuels for public electricity and heat generation account for about 4 % of all greenhouse gas emissions from 1A1a. Within the EU-15, emissions fell by about 71 % between 1990 and 2010 (Table 3.6).

Table 3.6 1A1a Public Electricity and Heat Production, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

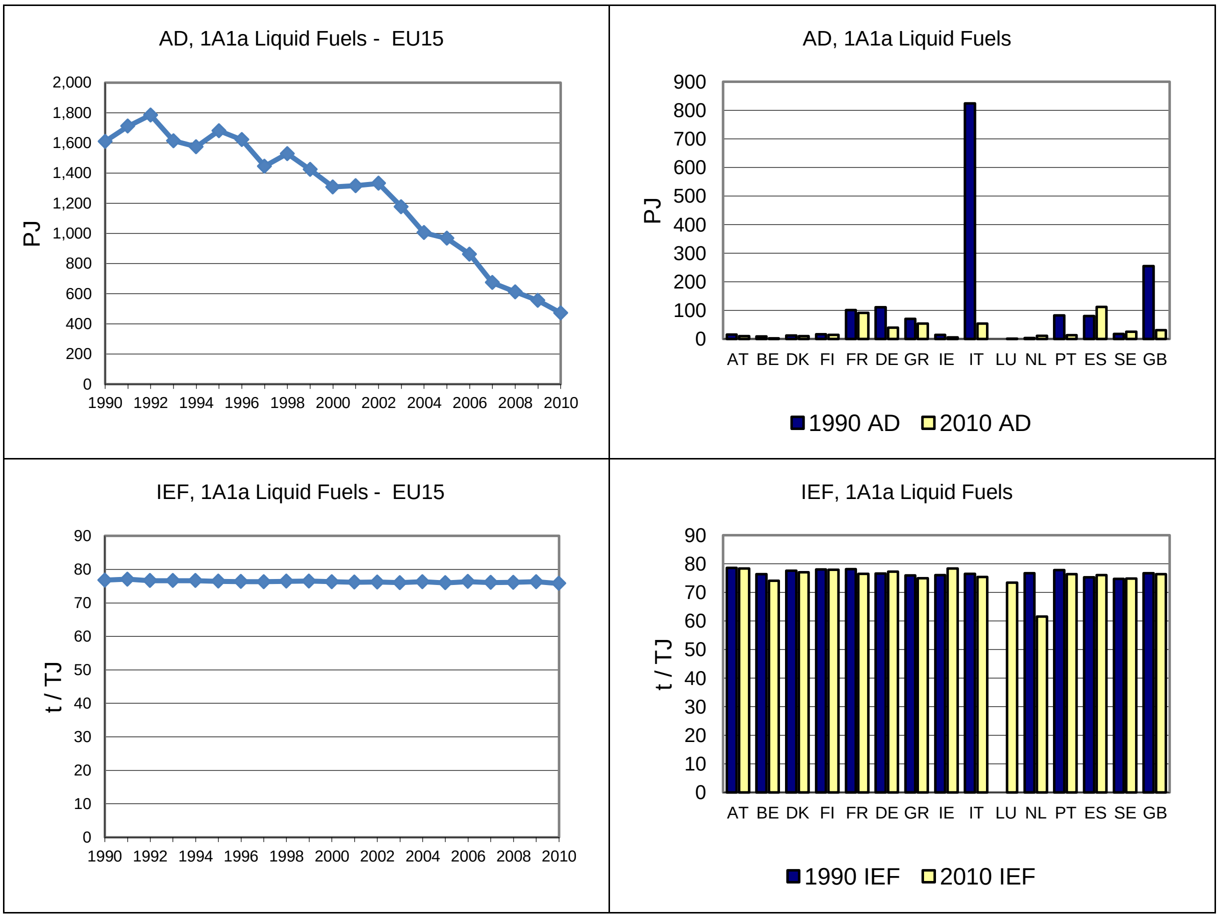
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	1228.70	695.77	728.01	2%	32.24	5%	-500.69	-41%	T2	CS,PS
Belgium	659.33	125.45	183.63	1%	58.18	46%	-475.70	-72%	CS,T1,T3	CS,D
Denmark	950.72	974.64	752.03	2%	-222.60	-23%	-198.69	-21%	CR	CS,D,PS
Finland	1243.64	1033.48	1124.21	3%	90.73	9%	-119.42	-10%	T3	CS,D,PS
France	7893.61	6892.84	7004.19	20%	111.35	2%	-889.42	-11%	T2, T3	CS
Germany	8506.92	3486.47	3048.47	9%	-438.00	-13%	-5458.45	-64%	CS	CS
Greece	5374.95	5329.16	3994.73	11%	-1334.43	-25%	-1380.22	-26%	T2	PS
Ireland	1086.52	680.41	423.79	1%	-256.62	-38%	-662.73	-61%	T3	PS
Italy	63047.35	7604.54	4041.66	11%	-3562.88	-47%	-59005.69	-94%	T3	CS
Luxembourg	NO	58.41	60.91	0%	2.50	4%	60.91	-	T2	CS
Netherlands	206.85	684.05	705.18	2%	21.13	3%	498.32	241%	T2	CS
Portugal	6405.44	1428.88	1037.74	3%	-391.13	-27%	-5367.70	-84%	T2	D, CR, PS
Spain	6006.63	8863.13	8499.33	24%	-363.79	-4%	2492.70	41%	T2	CR, PS
Sweden	1276.02	970.50	1914.90	5%	944.40	97%	638.88	50%	T2	CS
United Kingdom	19715.78	3554.32	2328.96	6%	-1225.36	-34%	-17386.82	-88%	T2	CS
EU-15	**123602.47**	**42382.06**	**35847.76**	**100%**	**-6534.29**	**-15%**	**-87754.71**	**-71%**		

.Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.10 shows the activity data and implied emission factors for CO_2 emissions from liquid fuels used in public electricity and heat production. The charts clearly show the importance of liquid fuels has been declining gradually since 1992. The implied emission factor has remained stable at the EU-15 level (76 t/TJ in 2010). The largest emitters in 2010 were Italy, Spain and France together responsible for 54 % of the EU-15 emissions, although emissions have fallen markedly in Italy compared to 1990.

In the Netherlands, the IEF declined from 71 t/TJ in 1994 to about 60 t/TJ in 1995. This is explained by the sharp increase in the use of residual chemical gas. In the Netherlands in this sector, among others, residual gases from the chemical industry are combusted. The implied emission factor is low because these residual gases contain hydrogen gas.

Figure 3.10 **1A1a-Public Electricity and Heat Production, liquid fuels: Activity Data and Implied Emission Factors for CO_2**



1A1a Electricity and Heat Production - Solid Fuels (CO_2, N_2O)

CO_2 emissions from the combustion of solid fuels represented about two thirds of all greenhouse gas emissions from public electricity and heat production. Within the EU-15, emissions fell by 26 % between 1990 and 2010 (Table 3.7).

Table 3.7 **1A1a Public Electricity and Heat Production, solid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor**

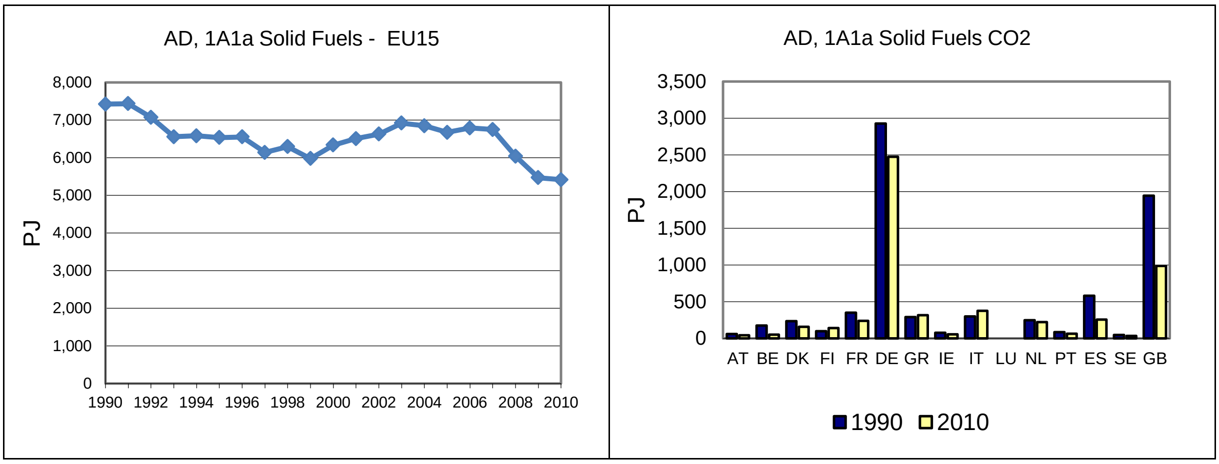
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	6,247	3,018	3,870	4.3%	852	28%	-2,377	-38%	T2	CS,PS
Belgium	19,345	7,058	7,320	1.3%	262	4%	-12,025	-62%	CS,T3	CS,D
Denmark	22,225	15,336	14,755	2.7%	-581	-4%	-7,470	-34%	CR	CS,D,PS
Finland	9,281	10,320	12,872	2.3%	2,552	25%	3,591	39%	T3	CS,D,PS
France	36,565	24,873	24,133	4.3%	-740	-3%	-12,433	-34%	T2, T3	CS
Germany	307,928	254,304	262,536	47.2%	8,232	3%	-45,392	-15%	CS	CS
Greece	35,207	41,185	39,680	7.1%	-1,505	-4%	4,472	13%	T2	CS
Ireland	7,909	5,766	5,688	1.0%	-77	-1%	-2,221	-28%	T3	PS
Italy	28,148	35,438	34,626	6.2%	-812	-2%	6,479	23%	T3	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	25,776	23,621	24,098	4.3%	477	2%	-1,678	-7%	T2	CS
Portugal	7,913	10,481	6,002	1.1%	-4,479	-43%	-1,911	-24%	T2	D, CR, PS
Spain	57,778	35,929	25,542	4.6%	-10,387	-29%	-32,236	-56%	T2	PS
Sweden	5,404	4,059	4,725	0.8%	666	16%	-679	-13%	T2	CS
United Kingdom	183,150	85,825	90,047	16.2%	4,222	5%	-93,102	-51%	T2	CS
EU-15	**752,876**	**557,214**	**555,893**	**100.0%**	**-1,320**	**0%**	**-196,983**	**-26%**		

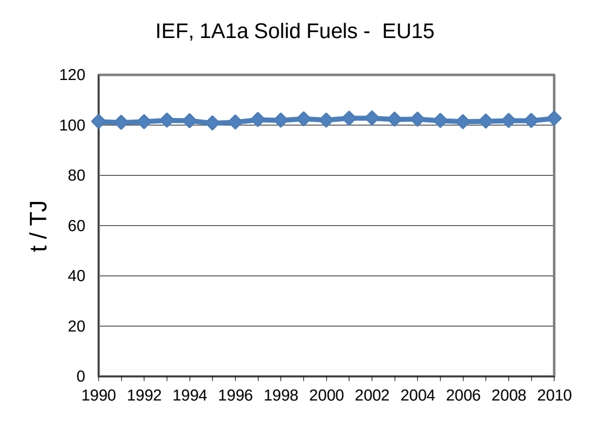
Note that German CO_2 emissions from SO_2 scrubbing are included in this source category. Other Member States include these emissions in 1B1 or 2A3.
Abbreviations explained in the Chapter 'Units and abbreviations'.

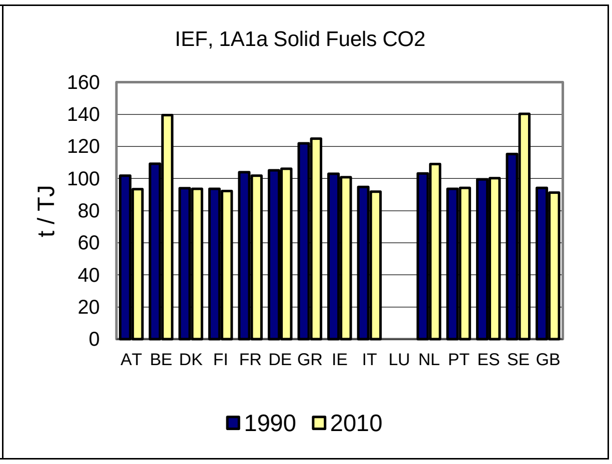
Figure 3.11 shows the relevant activity data and implied emission factors for solid fuels. The amount of solid fuels used decreased gradually until 1999 and has slight increased thereafter. In 2003 the upwards trend in solid fuel use in public electricity and heat production has stopped; the trend reversed since 2007. Between 1990 and 2010 activity data decreased by 27%, mainly due to decreases in the UK, Germany and Spain. The EU-15 implied emission factor has remained fairly stable (103 t/TJ in 2010). The largest emitters in 2010 were Germany and the UK, jointly responsible for 63 % of EU-15 emissions. In both countries, however, emissions have fallen compared to 1990, particularly in the UK where a large shift to gas use in electricity production occurred.

In Belgium and Sweden, the emission factors increased sharply since the late 1990s due to the use of blast furnace gas.

Figure 3.11 **1A1a- Public Electricity and Heat Production, solid fuels: Activity Data and Implied Emission Factors for CO_2**







The related N_2O emissions from the use of solid fuels are responsible for 0.5 % of all greenhouse gas emissions in the heat and power sector. For the EU-15, emissions in 2010 decreased by 24 % between 1990 and 2010 (Table 3.8).

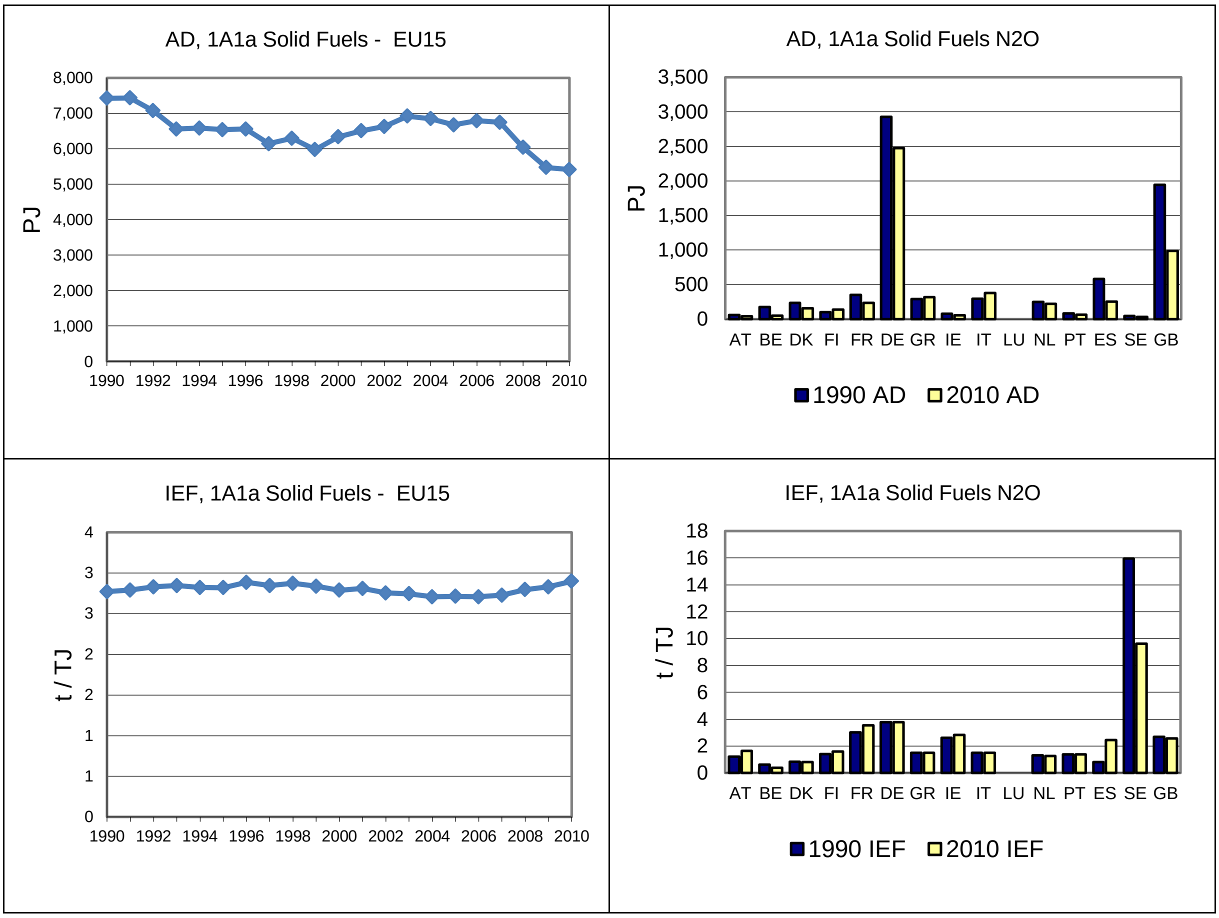
Table 3.8 1A1a Electricity and heat production, solid fuels: Member States' contributions to N_2O emissions and information on method applied and emission factor

Member State	N_2O emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010	
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	23	16	21	0.4%	5	28%	-2	-9%
Belgium	33	8	6	0.1%	-2	-24%	-27	-82%
Denmark	60	41	39	0.8%	-2	-4%	-21	-35%
Finland	43	62	68	1.4%	7	11%	26	60%
France	329	267	259	5.3%	-7	-3%	-70	-21%
Germany	3,431	2,820	2,906	59.8%	85	3%	-526	-15%
Greece	134	156	148	3.0%	-8	-5%	14	10%
Ireland	62	56	49	1.0%	-6	-11%	-13	-20%
Italy	138	179	175	3.6%	-4	-2%	37	27%
Luxembourg	NO	NO	NO	-	-	-	0.0	-
Netherlands	101	91	86	1.8%	-5	-6%	-15	-15%
Portugal	36	48	27	0.6%	-21	-43%	-9	-25%
Spain	146	227	194	4.0%	-33	-15%	48	33%
Sweden	232	83	100	2.1%	18	22%	-132	-57%
United Kingdom	1,610	748	785	16.1%	37	5%	-826	-51%
EU-15	**6,378**	**4,800**	**4,863**	**100.0%**	**63**	**1%**	**-1,515**	**-24%**

.Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.12 shows the related activity data and implied emission factors for N_2O. The EU-15 implied emission factor has somewhat remained stable compared to 1990, and stood at 2.9 kg/TJ in 2010. The largest emitters in 2010 were Germany and the UK, accounting for 76% of EU-15 emissions. Sweden has the highest IEF (about 10 kg/TJ in 2010); it declined gradually between 1990 and 2010. This was due to the increased use of blast furnace gas and a lower use of coal. Since the IEF for coal is ten times higher than the IEF for blast furnace gas, the IEF for solid fuels declined overall during the period. This comparatively high implied emission factor is regularly reviewed and found to be correct for Swedish conditions.

Figure 3.12 **1A1a Public Electricity and Heat Production, solid fuels: Activity Data and Implied Emission Factors for N_2O**



1A1a Electricity and Heat Production - Gaseous Fuels (CO_2)

CO_2 emissions from the combustion of gaseous fuels accounted for 29 % of all greenhouse gas emissions from public electricity and heat generation in 2010. Emissions increased by a factor of three in the EU-15 between 1990 and 2010 (Table 3.9). In all EU-15 Member States the consumption of gas was higher in 2010 than in 1990.

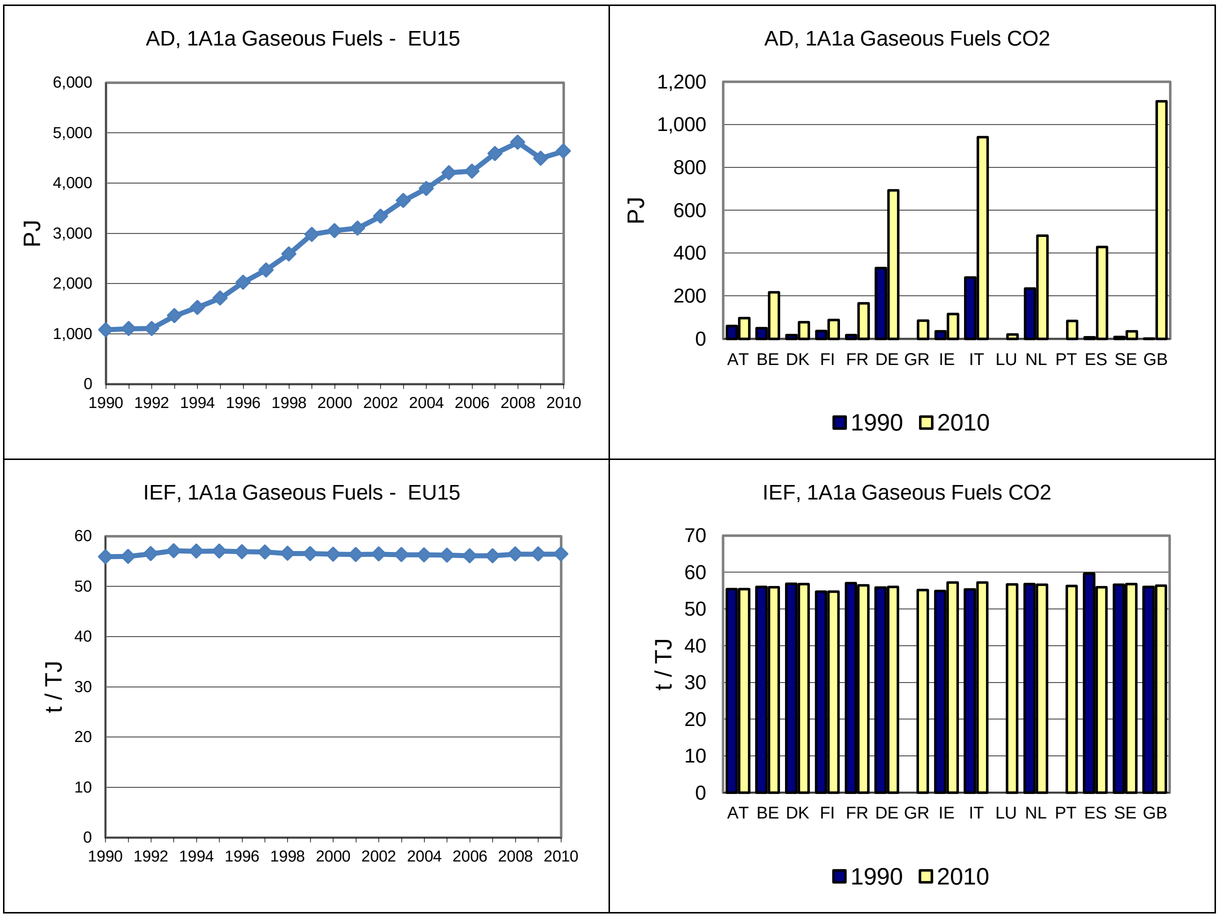
Table 3.9 **1A1a Electricity and heat production, gaseous fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor**

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	3,294	4,853	5,307	2.0%	454	9%	2,013	61%	T2	CS
Belgium	2,751	11,977	12,142	4.6%	165	1%	9,391	341%	CS,T1,T3	CS,D
Denmark	980	3,700	4,381	1.7%	681	18%	3,401	347%	CR	CS
Finland	1,976	4,191	4,796	1.8%	605	14%	2,820	143%	T3	CS
France	984	6,906	9,311	3.6%	2,405	35%	8,327	847%	T2, T3	CS
Germany	18,462	35,617	38,773	14.8%	3,156	9%	20,311	110%	CS	CS
Greece	NO	4,167	4,644	1.8%	477	11%	4644	-	T2	PS
Ireland	1,881	6,020	6,633	2.5%	613	10%	4,753	253%	T3	PS
Italy	15,787	53,539	53,853	20.6%	314	1%	38,066	241%	T3	CS
Luxembourg	NO	1,114	1,144	0.4%	29	3%	1,144	-	T2	CS
Netherlands	13,348	25,720	27,281	10.4%	1,560	6%	13,932	104%	T2	CS
Portugal	NO	4,869	4,704	1.8%	-165	-3%	4,704	-	T2	D, CR, PS
Spain	437	29,492	23,961	9.2%	-5,531	-19%	23,523	5382%	T2	CS, PS
Sweden	486	1,232	1,930	0.7%	698	57%	1,445	298%	T2	CS
United Kingdom	16	60,123	62,485	23.9%	2,362	4%	62,469	391821%	T2	CS
EU-15	**60,401**	**253,521**	**261,344**	**100.0%**	**7,824**	**3%**	**200,943**	**333%**		

.Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.12 shows the activity data and implied CO_2 emission factors from gaseous fuels. Gas use in the power generating sector increased strongly after 1992. The EU-15 implied emission factor has remained fairly stable (56 t/TJ in 2010). The increase in the EU-15 factor observed in the early 1990s can be explained by the higher UK's gas share in the EU-15 and by an increase in the UK's implied emission factor. The latter is the result of the commissioning of the Peterhead power station in Scotland, which uses sour gas, a fuel with a much higher factor than natural gas. The largest emitters in 2010 were the UK and Italy, jointly responsible for almost half the EU-15 emissions.

Figure 3.13 **1A1a-Public Electricity and Heat Production, gaseous fuels: Activity Data and Implied Emission Factors for CO_2**



1A1a Electricity and Heat Production - Other Fuels (CO_2)

In 2010, the share of CO_2 emissions from other fuels stood at about 4 % of total greenhouse gas emissions from public electricity and heat generation. Emissions increased by 176% at EU-15 level between 1990 and 2010 and increased in all countries where 'other fuels' are used in heat and power generation. Other fuels cover the fossil part of municipal solid waste incineration where there is energy recovery, including plastics (Table 3.10).

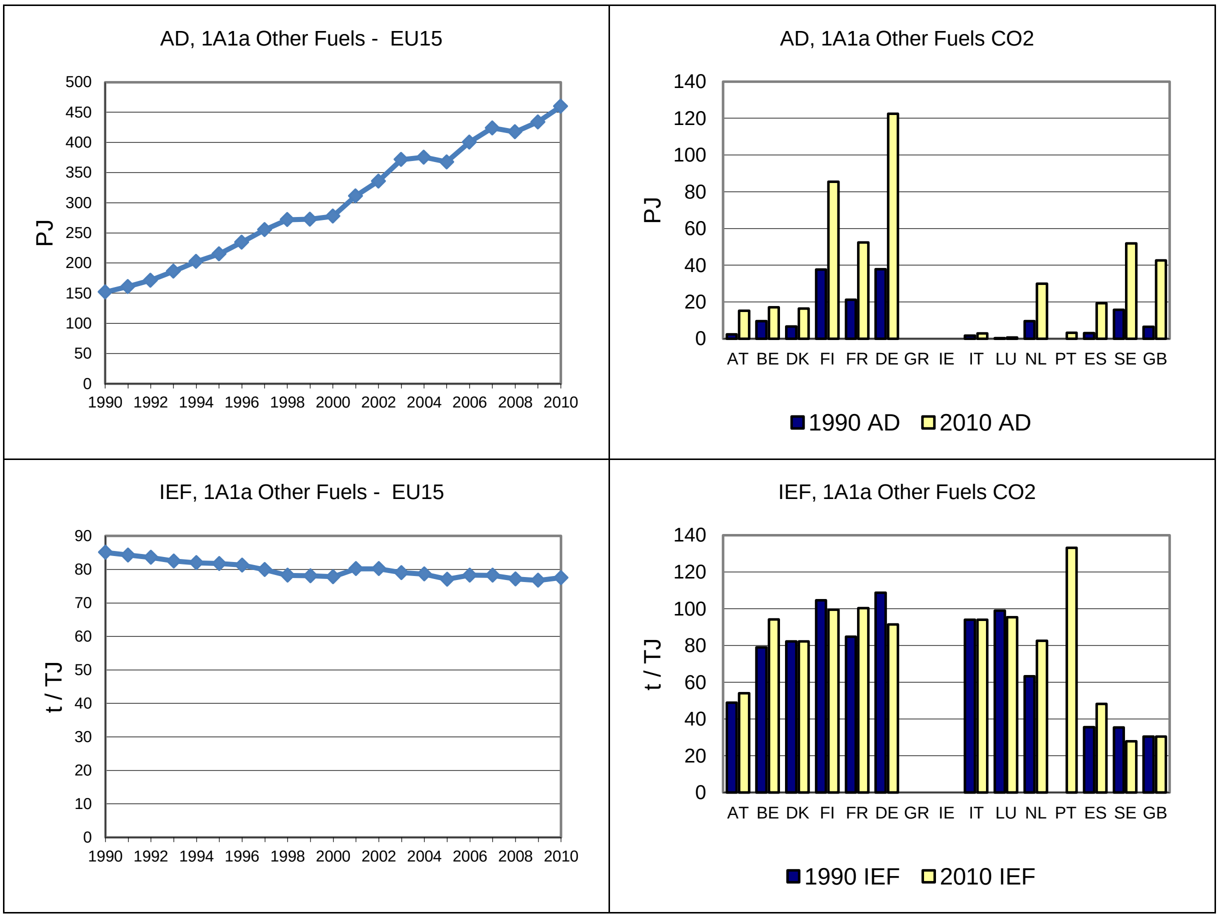
Table 3.10 1A1a Public Electricity and Heat Production, other fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	118	777	825	2.3%	48	6%	707	599%	T2	CS,PS
Belgium	749	1,581	1,613	4.5%	32	2%	864	115%	CS,T1,T3	CS,D
Denmark	539	1,366	1,343	3.8%	-24	-2%	804	149%	CR	CS
Finland	3,950	6,358	8,504	23.9%	2,146	34%	4,554	115%	T3	CS
France	1,792	5,172	5,250	14.7%	78	2%	3,458	193%	T2, T3	CS
Germany	4,121	11,195	11,200	31.4%	5	0%	7,079	172%	CS	CS
Greece	NO	NO	NO	-	-	-	-	-	NA	NA
Ireland	NO	NO	NO	-	-	-	-	-	NA	NA
Italy	153	307	275	0.8%	-31	-10%	122	79%	T3	CS
Luxembourg	33	70	62	0.2%	-8	-12%	29	86%	T2	D
Netherlands	601	2,531	2,473	6.9%	-57	-2%	1,872	311%	T2	CS
Portugal	NO	363	423	1.2%	60	16%	423	-	T2	D, CR, PS
Spain	110	939	934	2.6%	-5	-1%	823	748%	T2	CR, CS, PS
Sweden	553	1,396	1,443	4.0%	47	3%	891	161%	T2	CS
United Kingdom	194	1,242	1,300	3.6%	59	5%	1,106	570%	OTH,T1	CS
EU-15	**12,913**	**33,297**	**35,647**	**100.0%**	**2,349**	**7%**	**22,733**	**176%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.14 shows the activity data and implied emission factors. The EU-15 implied emission factor has fallen gradually since 1990, standing at 77 t/TJ in 2010. The largest emitters in 2010 were Germany, Finland and France, which together accounted for 70% of EU-15 emissions.

Figure 3.14 1A1a Public Electricity and Heat Production, other fuels: Activity Data and Implied Emission Factors for CO_2



In Germany, the IEF declined continuously between 1990 and 2010 (from 109 to 91). This is because the combustion of industrial waste has been greatly reduced in the early 1990s whereas the combustion of residential waste for electricity and heat has increased in the complete reporting period; furthermore, the calorific value of the applied waste has increased due to a better national waste separation management.

Figure 3.14 also shows that the share of Finnish activity in the EU-15 is disproportionally high. This is due to the reporting of 'peat' under 'other fuels' instead of under 'solid fuels' as recommended by the revised 1996 IPCC Guidelines. This apparent mis-allocation is clearly explained and argued[24] and is consistent with national energy statistics as well as with the IPCC 2006 Guidelines. In the Netherlands, the IEF increases considerably after 2003 to reach 82 t/TJ in 2010. This was mainly due to the increase in the share of plastics (with a high carbon fraction) in combustible.

3.2.1.2 Petroleum Refining (1A1b) (EU-15)

According to the IPCC, petroleum refining (CRF 1A1b) should include all combustion activities supporting the refining of petroleum products including on-site combustion for the generation of electricity and heat for own use. It does not include evaporative emissions occurring at the refinery. These emissions should be reported separately under 1B2a.

CO_2 emissions from petroleum refining is the ninth largest key source in the EU-15 accounting for 3.0 % of total greenhouse gas emissions in 2010. Between 1990 and 2010, EU-15 CO_2 emissions increased by 12% (Table 3.11). Emissions in 2010 were above 1990 levels in all Member States, with the exception of the UK, the Netherlands, Denmark, France and Germany.

Table 3.11 1A1b Petroleum Refining: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010	
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	2,394	2,809	2,724	2.3%	-85	-3%	330	14%
Belgium	4,299	4,758	4,703	4.0%	-55	-1%	404	9%
Denmark	906	933	854	0.7%	-79	-8%	-52	-6%
Finland	2,260	2,832	2,634	2.3%	-198	-7%	373	17%
France	11,986	13,007	11,861	10.2%	-1,146	-9%	-125	-1%
Germany	20,006	20,793	19,857	17.0%	-936	-5%	-149	-1%
Greece	2,308	3,714	3,669	3.1%	-45	-1%	1,361	59%
Ireland	182	315	305	0.3%	-10	-3%	123	68%
Italy	16,337	25,251	28,035	24.1%	2,784	11%	11,698	72%
Luxembourg	NO	NO	NO	0.0%	-	-	-	-
Netherlands	11,041	9,741	9,637	8.3%	-104	-1%	-1,404	-13%
Portugal	1,910	2,239	2,293	2.0%	53	2%	383	20%
Spain	10,906	11,637	11,398	9.8%	-238	-2%	493	5%
Sweden	1,778	2,092	2,130	1.8%	38	2%	352	20%
United Kingdom	17,566	16,469	16,375	14.1%	-94	-1%	-1,192	-7%
EU-15	**103,879**	**116,590**	**116,475**	**100.0%**	**-115**	**0%**	**12,596**	**12%**

[24] There are several reasons for reporting peat separately from solid fuels in Finland. Solid fuels include hard coal, coke and other fuels derived from coal (BFG, coke oven gas). The origin of these fuels is totally from imported sources, whereas peat is totally a domestic energy source. This categorization follows the practice used in national energy statistics as well as in the IPCC 2006 Guidelines. Moreover, the CO_2 IEF of peat is higher than the IEF of hard coal. Combining both fuels would cause significant variation in the IEF of solid fuels. Finally, other properties of peat and hard coal are very different, and would justify the reporting under two different fuel categories. See also the 2008 Finnish NIR to the UNFCCC.

Figure 3.15 shows the trends in emissions originating from the refining of petroleum by fuel in the EU-15 between 1990 and 2010 and the activity data behind the emissions.

Fuel used for petroleum refining increased by about 14 % in the EU-15 between 1990 and 2010. Liquid fuels represent 84 % of all fuel used in the refining of petroleum. Gaseous fuels almost fully account for the remaining part and their use has almost tripled since 1990. There remains a small amount of solid fuels used in petroleum refining in France and Germany.

Figure 3.15 1A1b Petroleum Refining: Total and CO_2 emission trends

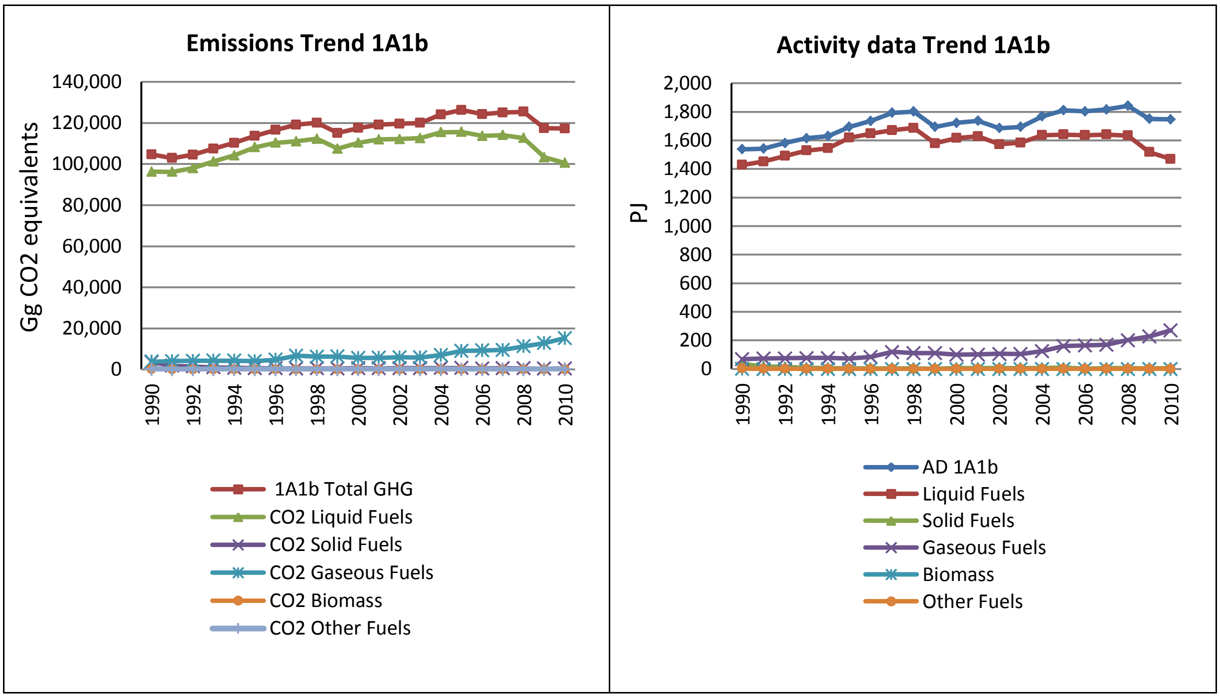


Figure 3.16 shows the relative importance of CO_2 emissions from petroleum refining in total greenhouse gas emissions by Member State, ranging from the relatively low share in Ireland to relatively high share in the Netherlands and Italy. Figure 3.17 shows the absolute contributions to EU-15 CO_2 emissions from petroleum refining. Italy was the largest EU-15 emitter in 2009, accounting for more than 20 % of all EU-15 emissions.

Figure 3.16 **Share of CO_2 emissions from petroleum refining in total greenhouse gas emissions by Member State in 2010**

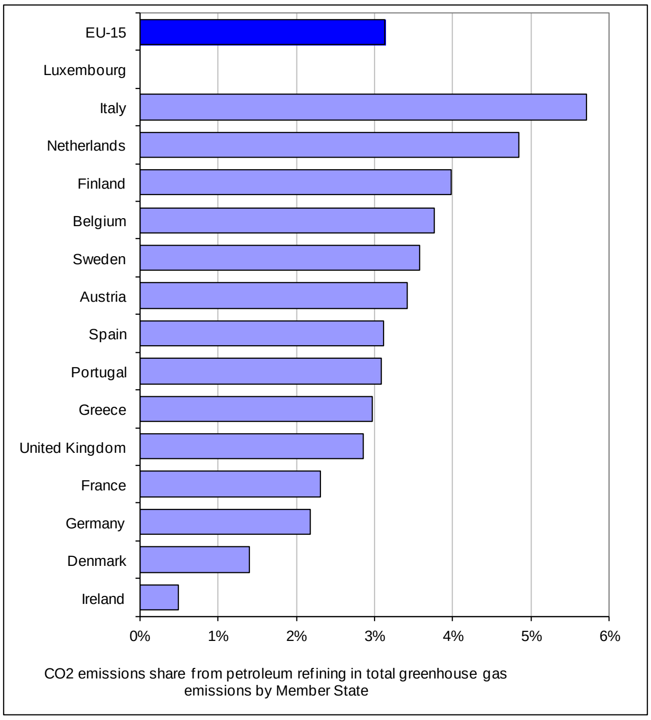
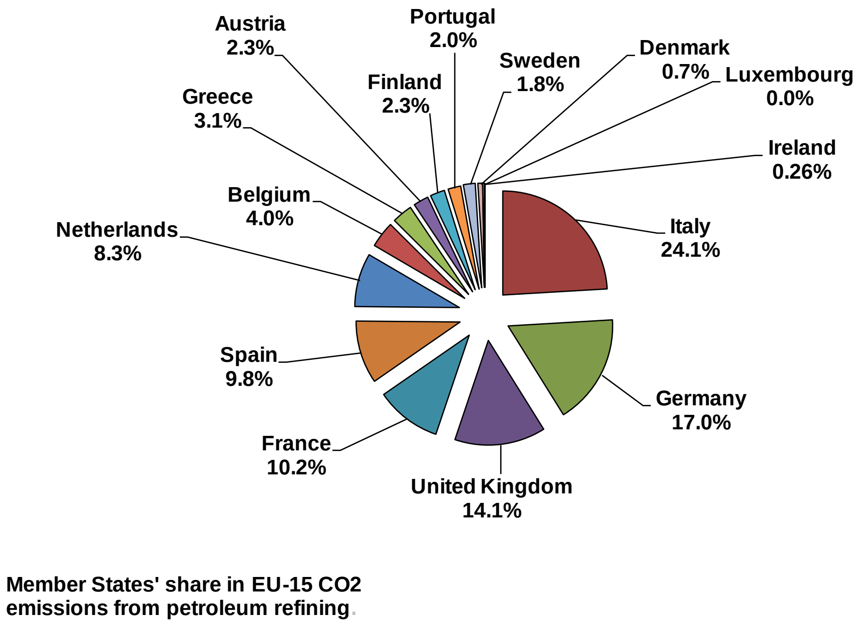


Figure 3.17 **Member States' share of CO_2 emissions from petroleum refining in EU-15**



1A1b Petroleum Refining - Liquid Fuels (CO_2)

CO_2 emissions from the combustion of liquid fuels used for petroleum refining accounted for 86 % of all greenhouse gas emissions from petroleum refining in 2010. Emissions increased by 4 % between

1990 and 2010 (Table 3.12). Italy had by far the largest emission increase between 1990 and 2010 (more than double of the EU-15 gross emission increase).

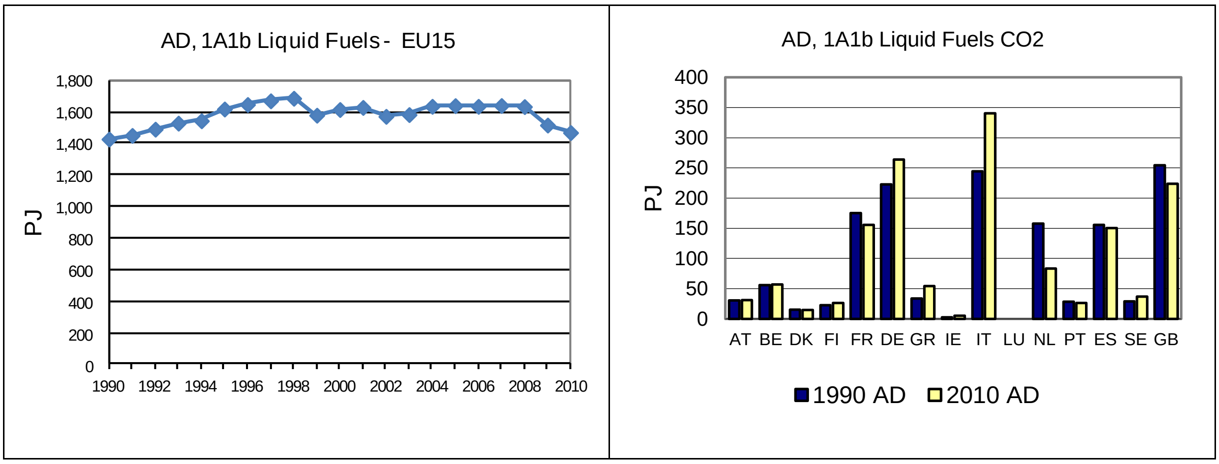
Table 3.12 1A1b Petroleum Refining, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

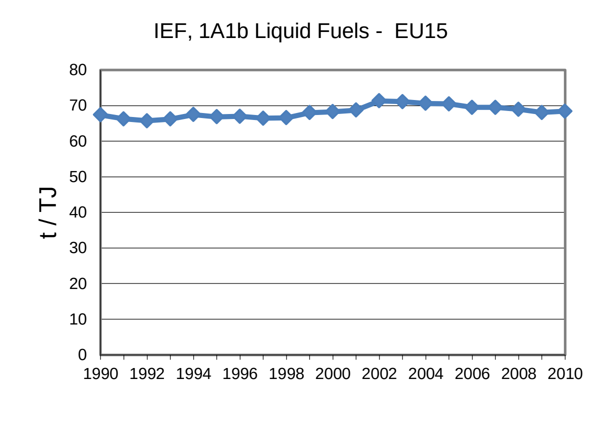
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	1,958	2,233	2,195	2.2%	-39	-2%	237	12%	T2	CS
Belgium	4,285	3,858	3,643	3.6%	-215	-6%	-643	-15%	CS,T3	PS
Denmark	906	933	854	0.8%	-79	-8%	-52	-6%	CR	CS,D,PS
Finland	1,603	1,842	1,708	1.7%	-134	-7%	105	7%	T3	CS,PS
France	11,456	11,374	10,098	10.0%	-1,277	-11%	-1,359	-12%	T2, T3	CS
Germany	15,315	18,980	17,960	17.9%	-1,019	-5%	2,645	17%	CS	CS
Greece	2,308	3,714	3,669	3.6%	-45	-1%	1,361	59%	T2	PS
Ireland	182	315	305	0.3%	-10	-3%	123	68%	T3	PS
Italy	16,178	23,406	25,123	25.0%	1,717	7%	8,946	55%	T3	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	9,999	7,150	6,575	6.5%	-575	-8%	-3,424	-34%	T2	CS
Portugal	1,910	1,944	1,724	1.7%	-219	-11%	-185	-10%	T2	D, CR, PS
Spain	10,861	9,978	9,245	9.2%	-733	-7%	-1,616	-15%	T2	CR, PS
Sweden	1,778	2,061	2,100	2.1%	39	2%	322	18%	T2	CS
United Kingdom	17,517	15,485	15,342	15.3%	-143	-1%	-2,175	-12%	T2	CS
EU-15	**96,256**	**103,273**	**100,541**	**100.0%**	**-2,731**	**-3%**	**4,286**	**4%**		

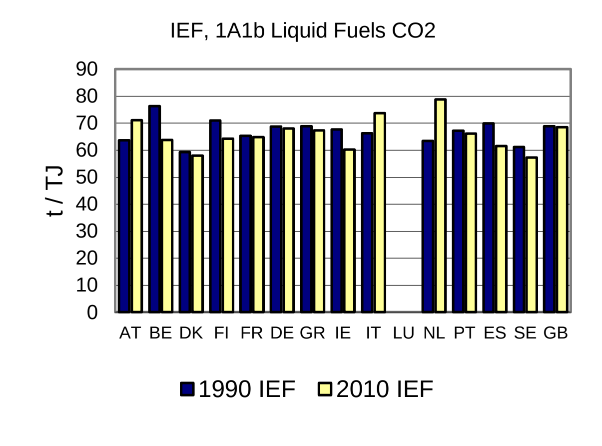
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.18 shows the activity data and implied emission factors for CO_2 emissions from liquid fuels. The use of liquid fuels increased rapidly from 1990 to 1998 and had a decreasing tendency thereafter, in particular after 2008. The EU-15 implied emission factor has varied between 66 t/TJ and 72 t/TJ. The increase in the EU-15 factor can be partly explained by the growing Italian share in EU-15 activity and emissions and by the increase in Italy's implied emission factor during the period. The largest emitters in 2010 were Italy and Germany, which together contributed 43 % of EU-15 emissions.

Figure 3.18 1A1b Petroleum Refining, liquid fuels: Activity Data and Implied Emission Factors for CO_2







1A1b Petroleum Refining - Solid Fuels (CO_2)

CO_2 emissions from the combustion of solid fuels in petroleum refining represented less than 1 % of all greenhouse gas emissions from 1A1b in 2010. There are only two countries reporting emissions in the EU-15 in 1990 and/or 2010. EU-15 emissions fell by 85 % on average between 1990 and 2010 (Table 3.13).

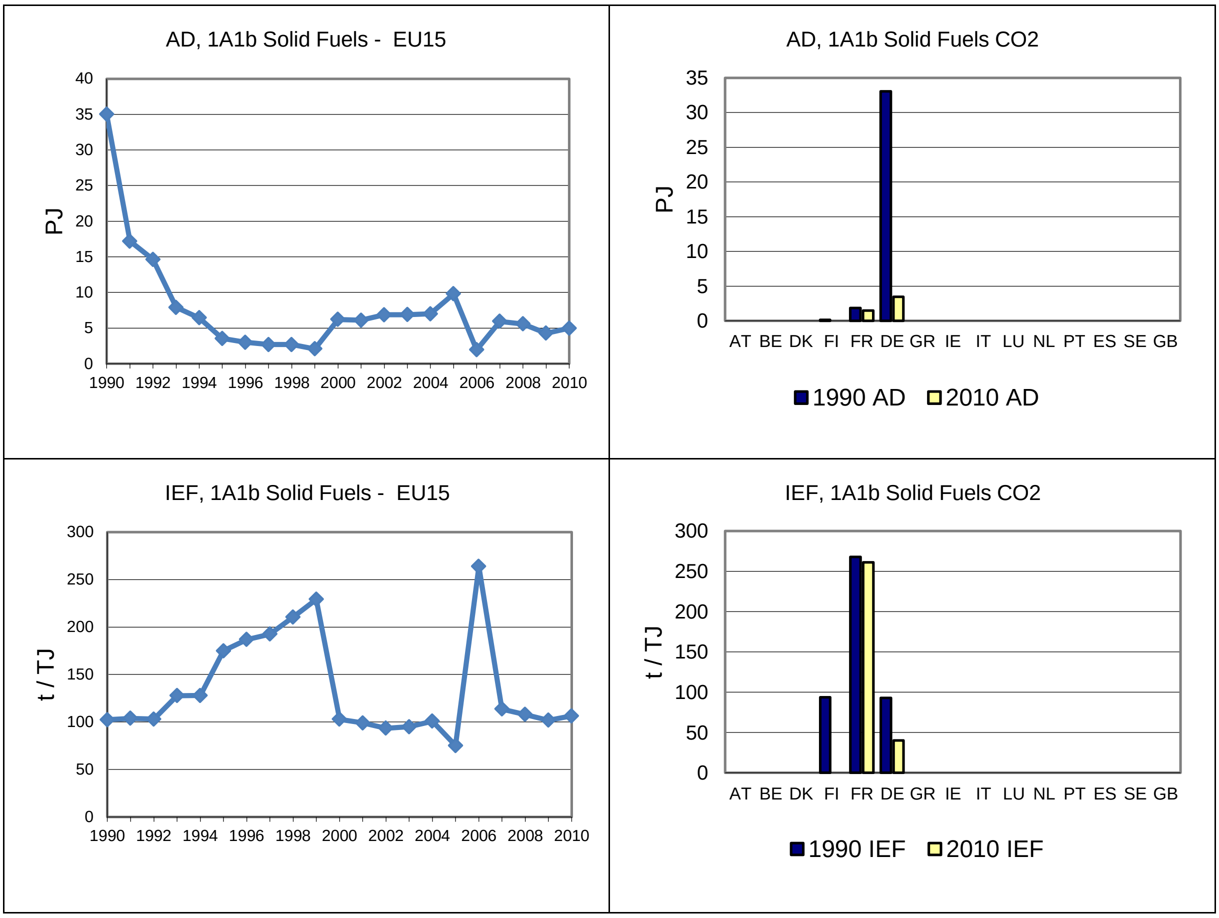
Table 3.13 1A1b Petroleum Refining, solid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010	
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	NO	NO	NO	-	-	-	-	-
Belgium	NO	NO	NO	-	-	-	-	-
Denmark	NO	NO	NO	-	-	-	-	-
Finland	12	NO	NO	-	-	-	-12	-100%
France	492	313	389	73.7%	76	24%	-103	-21%
Germany	3,076	123	139	26.3%	16	13%	-2,937	-95%
Greece	NO	NO	NO	-	-	-	-	-
Ireland	NO	NO	NO	-	-	-	-	-
Italy	NO	NO	NO	-	-	-	-	-
Luxembourg	NO	NO	NO	-	-	-	-	-
Netherlands	NO	NO	NO	-	-	-	-	-
Portugal	NO	NO	NO	-	-	-	-	-
Spain	NA	NA	NA	-	-	-	-	-
Sweden	NO	NO	NO	-	-	-	-	-
United Kingdom	NO	NO	NO	-	-	-	-	-
EU-15	**3,581**	**437**	**528**	**100.0%**	**91**	**21%**	**-3,052**	**-85%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.19 shows the relevant activity data and implied emission factors. The use of solid fuels in petroleum refining has declined markedly since 1990. The EU-15 implied emission factor showed strong fluctuations, and stood at 106 t/TJ in 2010. The variation in the EU-15 factor can be partly explained by the declining use of solid fuels in petroleum refining in Germany between 1990 and 1999. This explains the bigger contribution of the much higher implied emission factor of France. The relatively higher emission factor in France is due to the use of blast furnace gas in the Dunkerque refinery. In Germany, there was a decline in the IEF in the early 1990s compared to a rather stable IEF since the mid-1990s. The reason is that the use of - mainly - lignite has constantly been reduced in favour of cokery gas. The increased EU-15 solid fuel combustion in 2000-2005 and 2007-2008 is due to an increase in fuel combustion in Germany in these years. The higher weight of the German IEF also explains the lower IEF at EU-15 level during these years.

Figure 3.19 1A1b-Petroleum Refining, solid fuels: Activity Data and Implied Emission Factors for CO_2



1A1b Petroleum Refining - Gaseous Fuels (CO_2)

In 2010, CO_2 emissions from the combustion of gaseous fuels used for petroleum refining accounted for about 13 % of total greenhouse gas emissions from 1A1b. Emissions in the EU-15 increased by a factor of three between 1990 and 2010 (Table 3.14). None of the member states reduced their emissions.

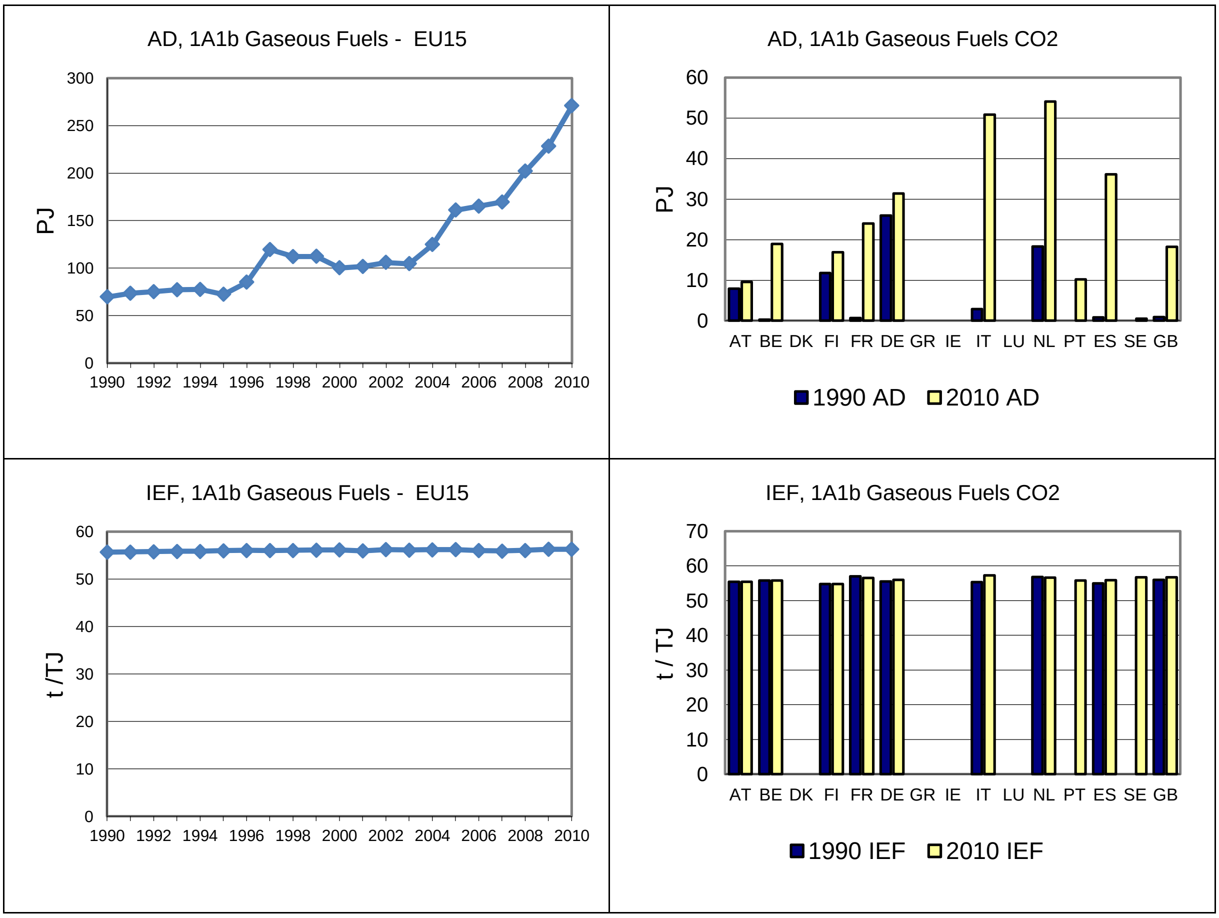
Table 3.14 1A1b Petroleum Refining, gaseous fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	437	576	530	3.5%	-46	-8%	93	21%	T2	PS
Belgium	14	900	1,060	7.0%	160	18%	1,046	7569%	CS,T3	PS
Denmark	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	644	990	925	6.1%	-65	-7%	281	44%	T3	CS
France	37	1,301	1,356	8.9%	55	4%	1,319	3581%	T2, T3	CS
Germany	1,441	1,690	1,758	11.5%	68	4%	317	22%	CS	CS
Greece	NO	IE	IE	-	-	-	-	-	NA	NA
Ireland	NO	NO	NO	-	-	-	-	-	NA	NA
Italy	159	1,845	2,912	19.1%	1,067	58%	2,753	1728%	T3	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	1,042	2,591	3,062	20.1%	471	18%	2,020	194%	T2	CS
Portugal	NO	296	568	3.7%	272	-	568	-	T2	D, CR, PS
Spain	45	1,658	2,017	13.2%	359	22%	1,972	4375%	T2	CS, PS
Sweden	NO	31	30	0.2%	-1	-2%	30	-	T2	CS
United Kingdom	49	984	1,033	6.8%	48	5%	983	1989%	T2	CS
EU-15	**3,869**	**12,862**	**15,251**	**100.0%**	**2,389**	**19%**	**11,382**	**294%**		

Abbreviations explained in the Chapter 'Units and abbreviations'

Figure 3.20 shows the activity data and implied emission factors for CO_2 emissions from gaseous fuels. The use of gaseous fuels increased by a factor of more than three between 1990 and 2010. The EU-15 implied emission factor has remained broadly stable, standing at 56 t/TJ in 2010. The largest emitter in 2010 was the Netherlands with 20 % of all EU-15 emissions, followed by Italy and Spain.

Figure 3.20 1A1b Petroleum Refining, gaseous fuels: Activity Data and Implied Emission Factors for CO_2



3.2.1.3 Manufacture of Solid Fuels and Other Energy Industries (1A1c) (EU-15)

According to the IPCC, the manufacture of solid fuels and other energy industries includes combustion emissions from fuel use during the manufacture of secondary and tertiary products from solid fuels including production of charcoal. It comprises combustion emissions from the production of coke, brown coal briquettes and patent fuel. It can also cover the emissions from own-energy use in coal mining and gas extraction. Emissions from own on-site fuel use should be included.

CO_2 emissions from the manufacture of solid fuels accounted for 1.4 % of total greenhouse gas emissions in 2010. Between 1990 and 2010, CO_2 emissions fell by 49 % in the EU-15 (Table 3.15). Emissions from solid fuels fell gradually during the 1990s, but remained stable since 2000.

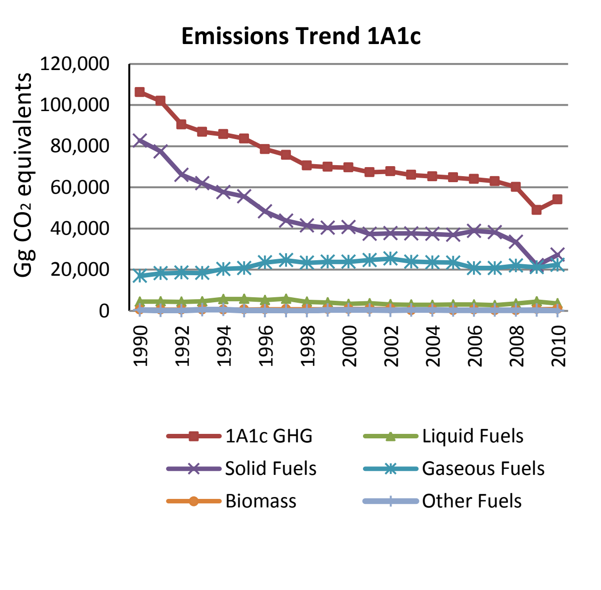
Table 3.15 1A1c Manufacture of Solid Fuels and Other Energy Industries: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010	
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	510	599	719	1.3%	121	20%	209	41%
Belgium	2,023	211	260	0.5%	49	23%	-1,763	-87%
Denmark	545	1,522	1,492	2.8%	-30	-2%	947	174%
Finland	347	188	237	0.4%	49	26%	-111	-32%
France	4,828	3,329	3,252	6.1%	-77	-2%	-1,576	-33%
Germany	64,394	11,514	13,646	25.6%	2,132	19%	-50,748	-79%
Greece	102	86	49	0.1%	-37	-43%	-53	-52%
Ireland	100	145	121	0.2%	-24	-17%	21	21%
Italy	13,030	9,014	11,802	22.1%	2,789	31%	-1,228	-9%
Luxembourg	NO	NO	NO	-	-	-	-	-
Netherlands	1,528	1,937	2,043	3.8%	106	5%	515	34%
Portugal	75	NO	NO	0.0%	-	-	-75	-100%
Spain	2,117	2,082	1,373	2.6%	-709	-34%	-744	-35%
Sweden	299	278	317	0.6%	38	14%	18	6%
United Kingdom	14,802	17,307	18,011	33.8%	703	4%	3,209	22%
EU-15	**104,700**	**48,211**	**53,320**	**100.0%**	**5,109**	**11%**	**-51,380**	**-49%**

Figure 3.21 shows the trends in emissions from this source category by fuel in the EU-15 between 1990 and 2010. About 90 % of greenhouse gas emissions from the manufacture of solid fuels can be accounted for by CO_2 emissions from solid (50 %) and gaseous (41 %) fuels. The figure also shows the activity data behind the emissions.

Fuel used for manufacturing solid fuels fell by 42 % in the EU-15 between 1990 and 2010. In 2010, solid fuels represented 34 % of all fuel use, whereas gaseous fuels took a share of 57%.

Figure 3.21 **1A1c-Manufacture of Solid Fuels and Other Energy Industries: Total and CO_2 emission and activity trends**



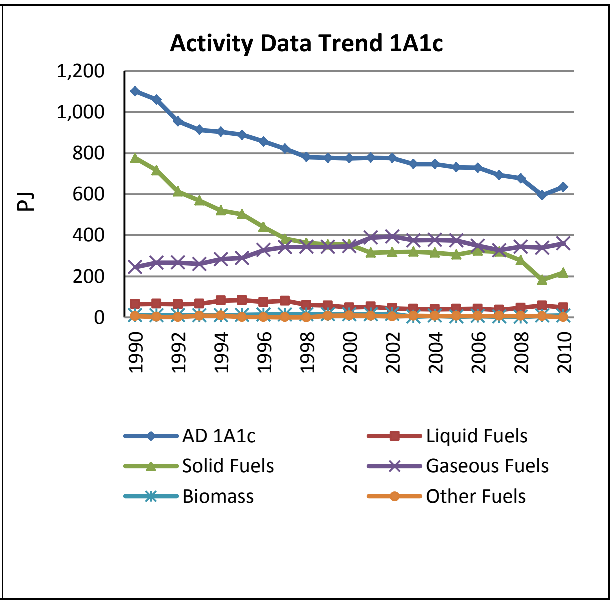


Figure 3.22 shows the relative importance of CO_2 emissions from the manufacture of solid fuels in total greenhouse gas emissions by Member State. The country shares range from the highest in the UK to the lowest in Greece (Luxembourg and Portugal do not have emissions from this key source category). Figure 3.23 shows the absolute contributions to EU-15 CO_2 emissions from the manufacture of solid fuels. Italy, Germany and the UK take about 80 % of all EU-15 emissions.

Figure 3.22 **Share of CO_2 emissions from the manufacture of solid fuels in total greenhouse gas emissions by Member State in 2010**

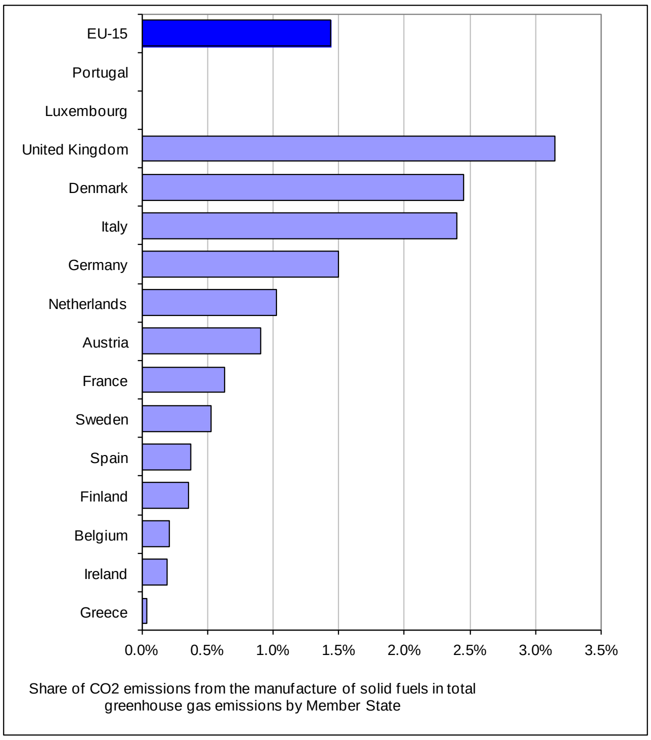
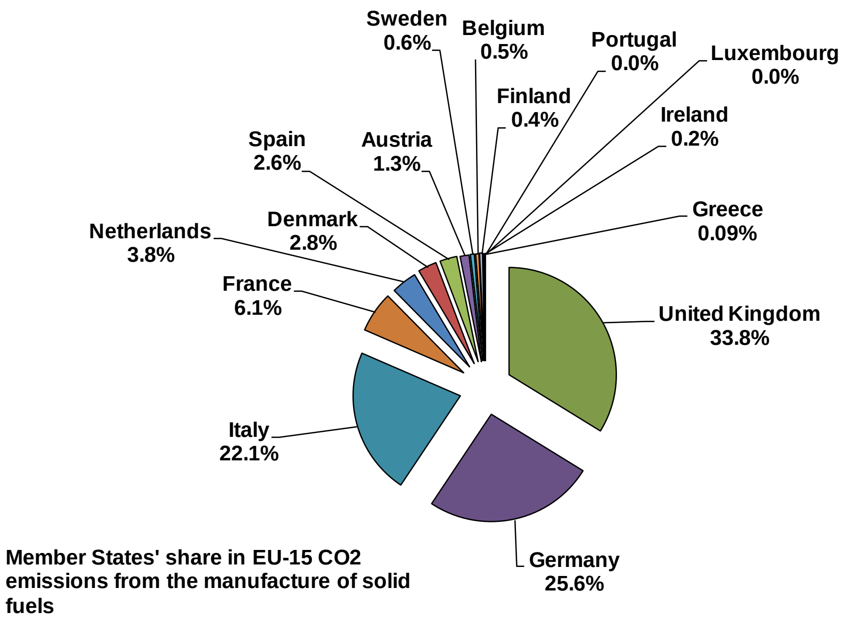


Figure 3.23 **Member States' share of CO_2 emissions from the manufacture of solid fuels in EU-15**



1A1c Manufacture of Solid Fuels and Other Energy Industries – Gaseous Fuels (CO_2)

CO_2 emissions from the combustion of gaseous fuels used for manufacturing solid fuels accounted for 41 % of total greenhouse gas emissions from 1A1c in 2010. Emissions in the EU-15 increased steadily by 32 % (Table 3.16) since 1990, although there has been a significant reduction in the last few years. Almost 80 % of the gross increase in EU-15 emissions between 1990 and 2010 was due to the UK alone.

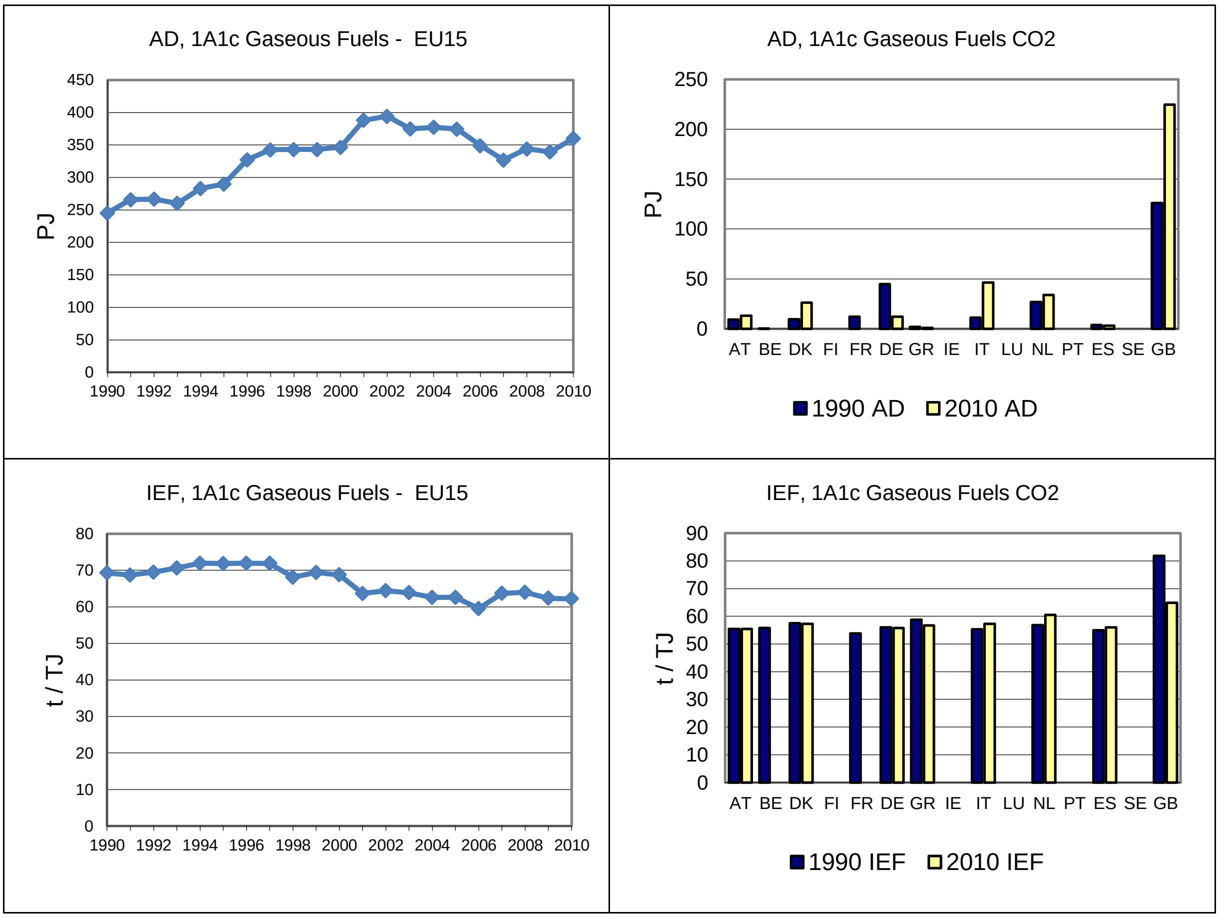
Table 3.16 **1A1c Manufacture of Solid Fuels and Other Energy Industries, gaseous fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor**

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	506	599	719	3.2%	121	20%	213	42%	T2	CS
Belgium	3	NO	NO	-	0	-	-3	-100%	NA	NA
Denmark	545	1,522	1,492	6.7%	-30	-2%	947	174%	CR	CS
Finland	NO	NO	NO	-	-	-	-	-	NA	NA
France	654	NO	NO	-	-	-	-654	-	NA	NA
Germany	2,501	583	675	3.0%	91	16%	-1,826	-73%	CS	CS
Greece	102	86	49	0.2%	-37	-43%	-53	-52%	T2	PS
Ireland	NO	NO	NO	-	-	-	-	-	NA	NA
Italy	615	2,018	2,656	11.9%	637	32%	2,041	332%	T3	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	1,526	1,936	2,042	9.1%	105	5%	515	34%	T2	CS
Portugal	NO	NO	NO	-	-	-	-	-	NA	NA
Spain	213	177	173	0.8%	-4	-2%	-40	-19%	T2	CS
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom	10,320	14,258	14,586	65.1%	328	2%	4,266	41%	T2	CS
EU-15	**16,985**	**21,179**	**22,391**	**100.0%**	**1,212**	**6%**	**5,406**	**32%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.24 shows the activity data and implied emission factors for CO_2. The use of gaseous fuels increased by 47 % between 1990 and 2010. The EU-15 implied emission factor has declined gradually since 1990. This was mainly due to a comprehensive review of emissions from the offshore oil & gas industry in the UK, which dominates the trend in emissions from this source category.

Figure 3.24 1A1c Manufacture of Solid Fuels and Other Energy Industries, gaseous fuels: Activity Data and Implied Emission Factors for CO_2



1A1c Manufacture of Solid Fuels and Other Energy Industries – Solid Fuels (CO_2)

CO_2 emissions from the combustion of solid fuels used for the manufacture of solid fuels accounted for 50 % of total greenhouse gas emissions from 1A1c in 2010. Emissions in the EU-15 declined by 67%, mainly during the 1990s (Table 3.17). This was almost-entirely due to a strong decline in emissions in Germany.

Table 3.17 1A1c Manufacture of Solid Fuels and Other Energy Industries, solid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

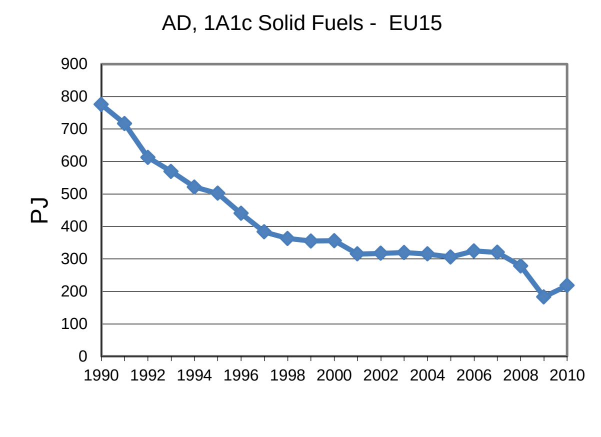
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	NO	NO	NO	-	-	-	-	-	NA	NA
Belgium	2,016	211	260	1.0%	49	23%	-1,756	-87%	CS,T3	PS
Denmark	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	347	188	237	0.9%	49	26%	-111	-32%	T3	CS
France	4,034	2,986	3,217	11.8%	230	8%	-817	-20%	T2, T3	CS
Germany	60,327	9,776	11,940	43.8%	2,165	22%	-48,387	-80%	CS	CS
Greece	NO	NO	NO	-	-	-	-	-	NA	NA
Ireland	100	145	121	0.4%	-24	-17%	21	21%	T1	CS
Italy	11,473	6,666	9,072	33.3%	2,406	36%	-2,401	-21%	T3	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	IE	NO	NO	-	-	-	-	-	NA	NA
Portugal	25	NO	NO	-	0	-	-25	-100%	NA	NA
Spain	1,847	745	733	2.7%	-12	-2%	-1,114	-60%	T2	CS, PS
Sweden	298	275	313	1.1%	38	14%	16	5%	T2	CS
United Kingdom	2,326	1,179	1,369	5.0%	191	16%	-956	-41%	T2	CS
EU-15	**82,793**	**22,171**	**27,262**	**100.0%**	**5,091**	**23%**	**-55,531**	**-67%**		

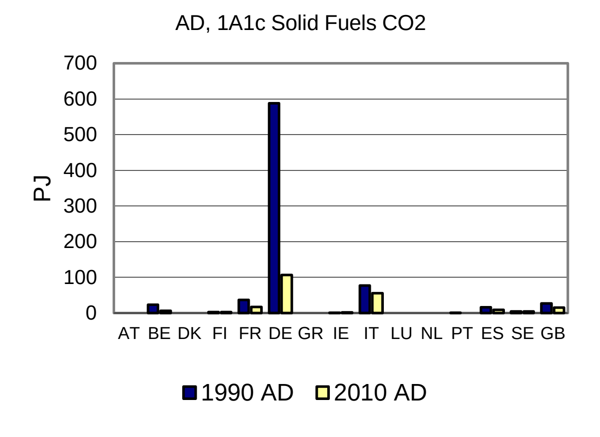
Emissions of the Netherlands are included in 1A2.A

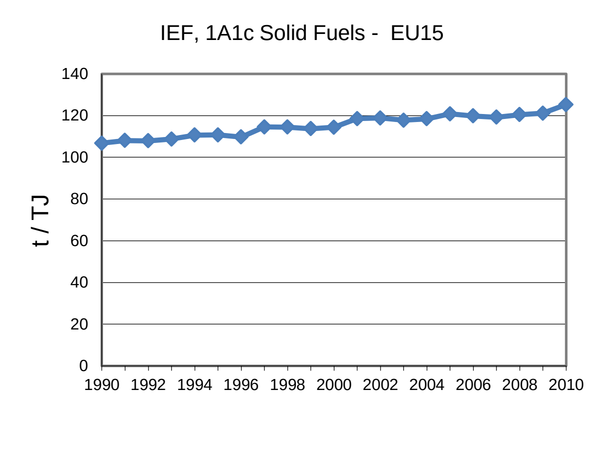
Abbreviations explained in the Chapter 'Units and abbreviations'.

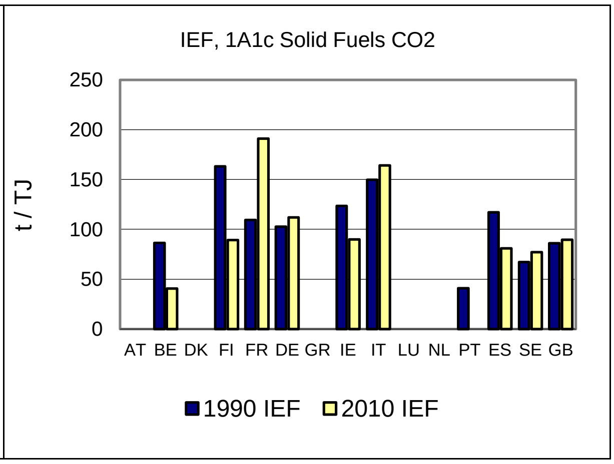
Figure 3.25 shows the relevant activity data and implied emission factors. Solid fuels have fallen steadily to less than half of the 1990-level. The EU-15 implied emission factor has increased to reach 125 t/TJ in 2010. This increase is mainly due to a decline in the German share in EU-15 emissions and a parallel increase in the share of Italy, which has a significantly higher implied emission factor. The largest emitters in 2010 were Italy and Germany, jointly responsible for 77 % of all EU-15 emissions.

Figure 3.25 1A1c Manufacture of Solid Fuels and Other Energy Industries, solid fuels: Activity Data and Implied Emission Factors for CO_2






IEF, 1A1c Solid Fuels - EU15
t / TJ
140
120
100
80
60
40
20
0
1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010


IEF, 1A1c Solid Fuels CO2
t / TJ
250
200
150
100
50
0
AT BE DK FI FR DE GR IE IT LU NL PT ES SE GB
1990 IEF
2010 IEF

3.2.2 Manufacturing industries and construction (CRF Source Category 1A2)

Category 1A2 includes emissions from combustion of fuels in manufacturing industries and construction including fuel use of non public electricity and heat generation (autoproducers). According to the guidelines emissions from fuel combustion in coke ovens are reported under 1A1c except for Austria and the Netherlands, which report on site coke ovens of integrated iron and steel plants under category 1A2a. Some MS report emissions of blast furnace and coke oven gas combustion under categories 1A1a public electricity and heat production or 1A4 other sectors. Emissions from category 1A2 are specified by the sum of subsectors that correspond to the International Standard Industrial Classification of All Economic Activities (ISIC, see listing below). Emissions from transport used by industry are reported under category 1A3 Transport. Most MS report emissions arising from off-road and other mobile machinery used in industry (e.g. construction machinery) under category 1A2f. Emissions from non energy fuel use (e.g. reducing agents used in blast furnaces or natural gas used for ammonia production) are reported under category 2 Industrial Processes.

The following enumeration shows the correspondence of 1A2 sub categories and ISIC Rev 3.1 codes:

- 1 A 2 a Iron and Steel: ISIC Group 271 and Class 2731.
- 1 A 2 b Non-Ferrous Metals: ISIC Group 272 and Class 2732.
- 1 A 2 c Chemicals: ISIC Division 24.
- 1 A 2 d Pulp, Paper and Print: ISIC Divisions 21 and 22
- 1 A 2 e Food Processing, Beverages and Tobacco: ISIC Divisions 15 and 16.
- 1 A 2 f Other: Other manufacturing industries: ISIC Divisions 17 to 20, 25, 26, 28 to 37 and 45.

In 2010 category 1A2 contributed to 489,102 Gg CO_2 equivalents of which 98.5% CO_2, 1.2% N_2O and 0.3% CH_4.

Figure 3.26 shows the emission trends within source category 1A2, which is dominated by CO_2 from 1A2f Other contributing by 49 % and 1A2a Iron and steel by 21 %. Some Member States still have difficulties to allocate emissions to all sub-categories under 1A2, which is a main reason for 1A2f being the largest sub-category within 1A2 source category.

Figure 3.26 **1A2 Manufacturing Industries and Construction: Total and CO_2 emission trends**

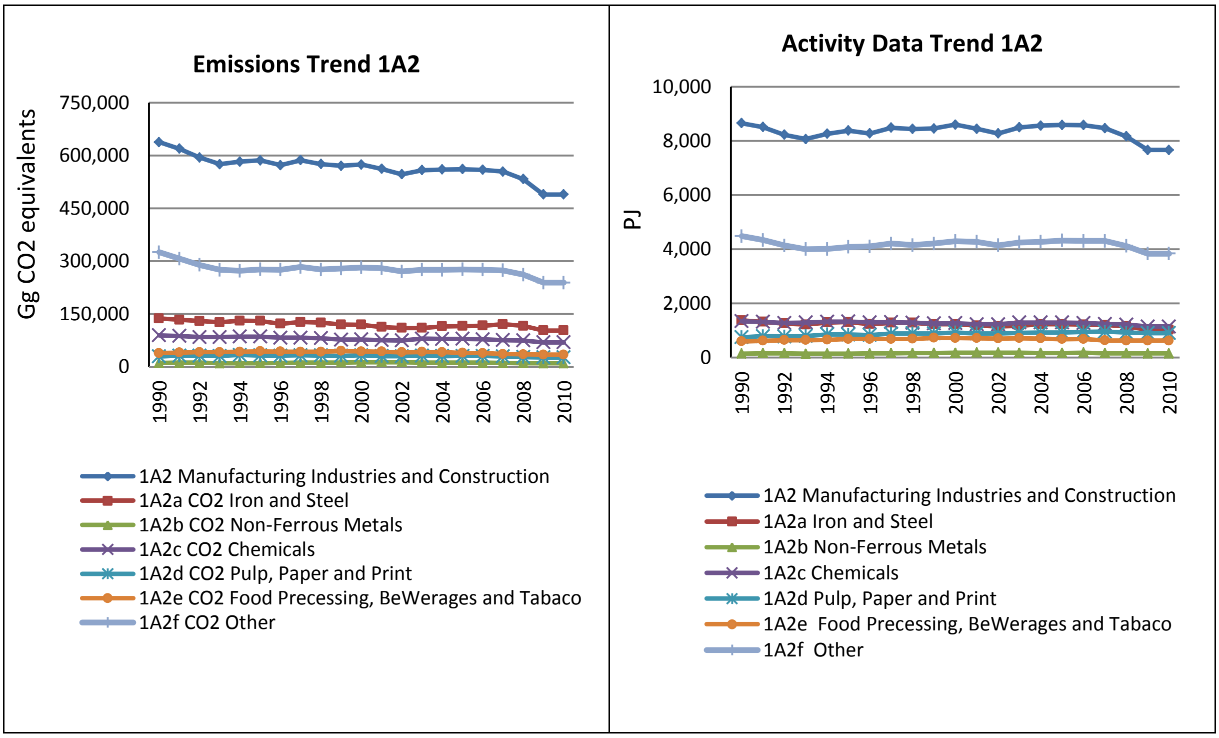


Table 3.18 summarises information by Member State on GHG emission trends and CO_2 emissions from 1A2 Manufacturing Industries and Construction.

Table 3.18 **1A2 Manufacturing Industries and Construction: Member States' contributions to total GHG and CO_2 emissions**

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2010 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO2 emissions in 2010 (Gg)
Austria	12,774	15,618	12,685	15,456
Belgium	32,722	23,708	32,543	23,492
Denmark	5,446	4,453	5,385	4,402
Finland	13,357	9,905	13,172	9,752
France	84,878	68,440	83,859	67,458
Germany	177,284	115,007	175,635	114,096
Greece	9,619	6,764	9,566	6,717
Ireland	3,961	4,549	3,943	4,526
Italy	87,303	61,375	85,631	60,016
Luxembourg	6,306	1,401	6,286	1,371
Netherlands	33,098	27,326	33,008	27,240
Portugal	9,270	9,487	9,171	9,340
Spain	46,923	63,434	46,424	62,261
Sweden	12,037	10,122	11,490	9,586
United Kingdom	103,270	67,546	101,202	66,243
EU-15	**638,248**	**489,135**	**630,000**	**481,955**

Abbreviations explained in the Chapter 'Units and abbreviations'.

CO_2 emissions from 1A2 Manufacturing Industries and Construction is the fourth largest key source in the EU-15 accounting for 13 % of total GHG emissions in 2010. Between 1990 and 2010, CO_2

emissions from manufacturing industries declined by 23 % in the EU-15. The emissions from this key source are due to fossil fuel consumption in manufacturing industries and construction, which was 11 % below 1990 levels in 2010. A shift from solid and liquid fuels to mainly natural gas took place and an increase of biomass and other fuels has been recorded.

Between 1990 and 2010, Germany shows by far the largest emission reductions in absolute terms. Also United Kingdom, France and Italy show emission reductions of more than ten million tonnes CO_2, whereas large emission increases occurred mainly in Spain. The main reason for the large decline in Germany was the restructuring of the industry and efficiency improvements after German reunification. Between 2009 and 2010 GHG emissions increase by 8 % with 1A2a iron and steel showing the strongest increase of +23% from all sub categories. Between 2009 and 2010 crude steel production of the EU-15 shows an increase by 25% (from 117.9 to 147.5 mio t) [25].

Table 3.19 provides information on the contribution of Member States to EU-15 recalculations in CO_2 from 1A2 Manufacturing Industries for 1990 and 2009 and main explanations for the largest recalculations in absolute terms. The biggest recalculations in 2009 were due to reallocations of CO_2 emissions of Germany. France and the UK revised their data sets and improved the methods.

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25 Worldsteel Association. www.worldsteel.org statistics archive

Table 3.19 1A2 Manufacturing Industries and Construction: Contribution of MS to EU-15 recalculations in CO_2 for 1990 and 2009 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

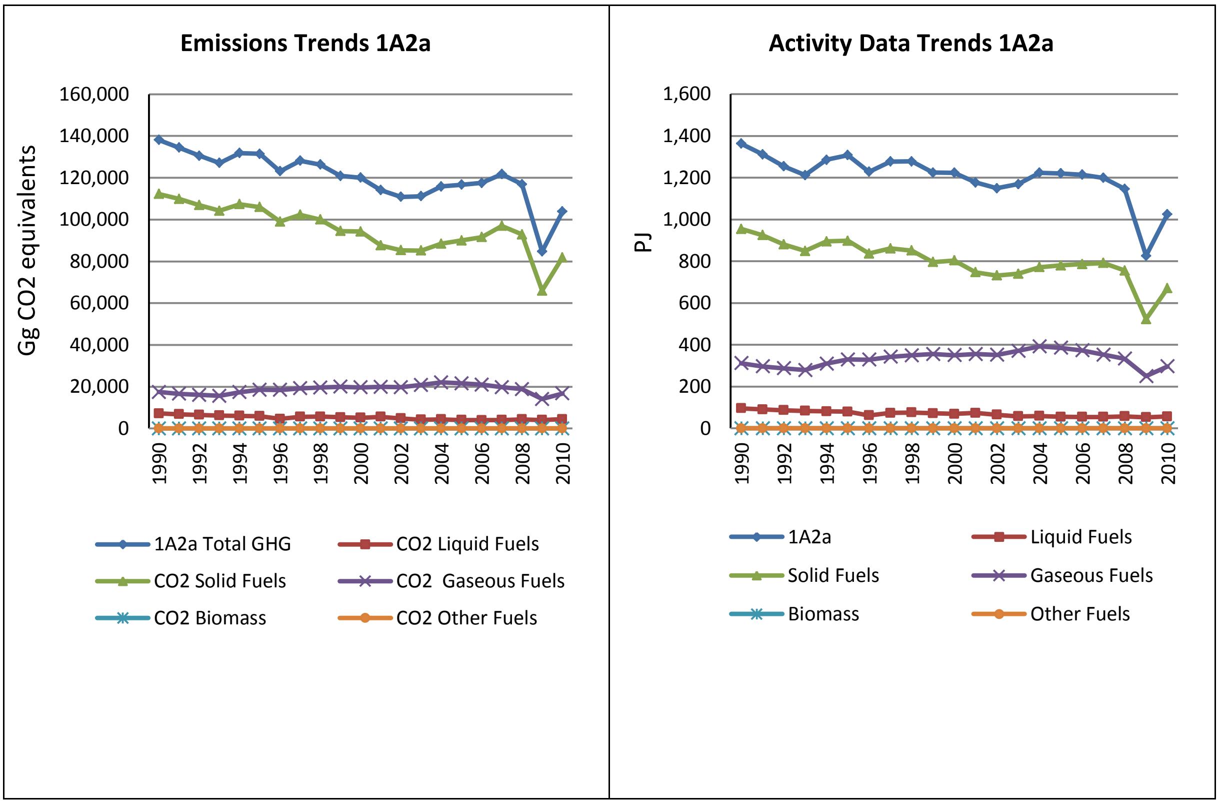
	1990		2009		Main explanations
	Gg	Percent	Gg	Percent	
Austria	3	0.0	268	1.9	Revised energy balance.
Belgium	312	1.0	627	3.3	- During the 2012 submission some corrections were made of the emissions of CO2 from the biggest plant in the iron & steel sector in the Flemish region; besides the revisions in 2009, corrections were made in the year 2007 for gaseous fuels and in the years 2005 and 2007 for liquid fuels. - During the 2012 submission a re-allocation took place in the Flemish region for the emissions from off-road (liquid fuels). The off-road emissions from construction are no longer allocated to the commercial/institutional sector (category 1A4a) but to the sector of manufacturing industry and construction/other (category 1A2f). - During the 2012 submission, the industrial off-road emissions are included for the for the first time in the Walloon region and in the Brussels region (see section 3.2.9. for more information). These emissions were
Denmark	-27	-0.5	66	1.7	- For stationary combustion plants, the emission estimates for the years 1990-2009 have been updated according to the latest energy statistics published by the Danish Energy Agency. The update included both end use and transformation sectors as well as a source category update. - The relatively large recalculations for CO2 emission from the fuel category "Other fuels" is a result a revised CO2 emission factor fossil waste incineration. This emission factor has been recalculated based on a large number of measurements performed at Danish plants in 2010-2011. The CO2 emission factor is 14 % higher than the emission factor applied last year. The estimated emission from fuel category Other fuels in 1A1a Public electricity and Heat production in 2009 has increased 14 % corresponding to 170 Gg CO2.
Finland	0	0.0	57	0.7	- Monitored emission factors from ETS - Corrections in plant level activity data
France	1,635	2.0	-472	-0.8	1990 : report grandes installations de combustion 1992 donc prise en compte des combustibles hors bilan de l'énergie (gaz industriels notamment) 2009 : Mise à jour bilan de l'énergie
Germany	0	0.0	-532	-0.5	Activity data: new statistical data available
Greece	0	0.0	0	0.0	
Ireland	-1	0.0	-118	-2.6	Revised Energy data from the National Energy Balance
Italy	-849	-1.0	-1,782	-3.2	- Update of CO2 emission factor for residual gas from chemical processes; update of CO2 natural gas emission factor; update of CO2 emission factors for petcoke, refinery gas and derived solid gases. - Reallocation of fuel oil and natural gas consumptions between energy production and manufacturing
Luxembourg	8	0.1	103	9.0	1A2F: - Error correction (mainly on residual fuel oil which was omitted due to wrong link between excel files) - Revised AD (natural gas) due to revised energy balance by national statistics
Netherlands	-19	-0.1	-20	-0.1	1A2f: Improvement based on new survey
Portugal	17	0.2	277	3.3	- Revision of the toe/ton conversion factors used to convert fuel consumption from energy balance toe to INERPA ton. The newer values were obtained from DGEG and updated for all times series for auto-producers. These new values were accompanied by revised LHV; - In depth revision of the Pulp and Paper industrial sector resulted in revised fuel consumption and pulp production data, and more extensive use of plant specific emissions factors; - Updated fuel consumption values for the Chemical industrial sector were obtained from LCP directive; - For the Cement industrial sector several small revisions/updates were made to the emission estimation, resulting from data
Spain	145	0.3	-262	-0.5	1A2b, liquid fuels: Amount of petroleum coke in non-energy use whose consumption sector was not identified has been allocated as energy fuel for combustion in this category following the ERT recommendations. 1A2c, gaseous fuels: Revision of the natural gas consumed in a cogeneration plant. Activity included (fuel consumption) in the revision of the inventory fuel balance. 1A2f, gaseous fuels: Revision of the natural gas consumption. Amount of natural gas in non-energy use whose consumption sector was not identified has been allocated as energy fuel for combustion in this category following the ERT recommendations.
Sweden	-208	-1.8	-94	-1.1	1A2c, liquid fuels: Revised emission factor for in-house produced gas. 1A2f, machinery, liquid fuels: New method for off-road vehicles & working machinery.
UK	1,260	1.3	146	0.2	- Emission factors: Revision to coke emission factor due to updated GCV figures. Now reported to greater accuracy in national energy statistics - Activity data: Revisions made for some fuels from 2005 onwards in the national energy statistics. - Reallocation: Reallocations across sectors for Gas Oil. Reallocations within 1A2 to disaggregate emissions from 1A2f. More detail within the NIR.
EU-15	**2,277**	**0.4**	**-1,736**	**-0.4**	

3.2.2.1 Iron and Steel (1A2a) (EU-15)

This chapter provides information about emission trends, Member States contribution, activity data and emission factors for category 1A2a on a fuel base. CO_2 emissions from 1A2a Iron and Steel accounted for 22 % of 1A2 source category and 2.7 % of total GHG emissions in 2010.

Figure 3.27 shows the emission trend within the category 1A2a, which is mainly dominated by CO_2 emissions from solid fuels. Between 1990 to 2010 total emissions decreased by 25 %, mainly due to improved efficiency of restructured iron and steel plants and the increased share of gaseous fuels. The strong increase of 23% between 2009 and 2010 correlates with crude steel production which was 25% higher in 2010. Between 1990 and 2010 emissions from solid fuels decreased by 27 %, emissions from liquid fuels by 38 % and emissions from gaseous fuels by 4%. Some Member States report emissions from blast furnace gas under categories 1A1a or other sub-categories of 1A2 where it is used for energy recovery in the respective industrial branches. Emissions from coke ovens of integrated iron and steel plants are sometimes not reported in the respective category 1A1c but included in this category. Emissions from blast furnace and coke oven gas flaring without energy recovery are partly reported under category 1B1b. The methodology of splitting emissions from blast furnaces into energy related and process related emissions reported under category 2C1 does not follow a specific standard. E.g. Germany reports 65% of total CO_2 emissions from categories 1A2a and 2C1 under this category and France reports 93% in 2010. However, the main driver of category 1A2a CO_2 emissions is blast furnace iron (BFI) production which decreased from about 99 mio tonnes to 80 mio tonnes in 2010 (www.worldsteel.org statistics) whereas total steel production only slightly decreased since 1990 from about 149 mio tonnes to 147 mio tonnes in 2010 (www.worldsteel.org statistics).

Figure 3.27 1A2a Iron and Steel: Total, CO_2 emission and activity trends



Between 1990 and 2010, CO_2 emissions from 1A2a Iron and Steel decreased by 25 % in the EU-15 (Table 3.20), mainly due to decreases in Belgium, France, Italy, Luxembourg and the United Kingdom. Between 2009 and 2010 emissions increased by 23%.

Table 3.20 **1A2a Iron and Steel: Member States' contributions to CO_2 emissions**

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010	
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	4,944	5,091	5,835	5.7%	744	15%	890	18%
Belgium	13,426	4,125	6,097	5.9%	1,973	48%	-7,328	-55%
Denmark	107	81	88	0.1%	7	9%	-18	-17%
Finland	2,494	2,296	2,994	2.9%	698	30%	500	20%
France	18,414	11,121	12,262	11.9%	1,141	10%	-6,152	-33%
Germany	34,742	25,422	34,269	33.2%	8,847	35%	-473	-1%
Greece	475	160	159	0.2%	0	0%	-316	-66%
Ireland	175	2	2	0.0%	0	0%	-173	-99%
Italy	18,272	8,768	14,092	13.7%	5,325	61%	-4,180	-23%
Luxembourg	5,418	359	457	0.4%	98	27%	-4,961	-92%
Netherlands	4,011	4,075	4,398	4.3%	323	8%	387	10%
Portugal	624	137	156	0.2%	19	14%	-468	-75%
Spain	8,535	5,926	6,763	6.6%	837	14%	-1,772	-21%
Sweden	1,638	1,097	1,773	1.7%	676	62%	135	8%
United Kingdom	23,672	15,454	13,750	13.3%	-1,704	-11%	-9,922	-42%
EU-15	**136,947**	**84,113**	**103,096**	**100.0%**	**18,983**	**23%**	**-33,850**	**-25%**

1A2a Iron and Steel - Liquid Fuels (CO_2)

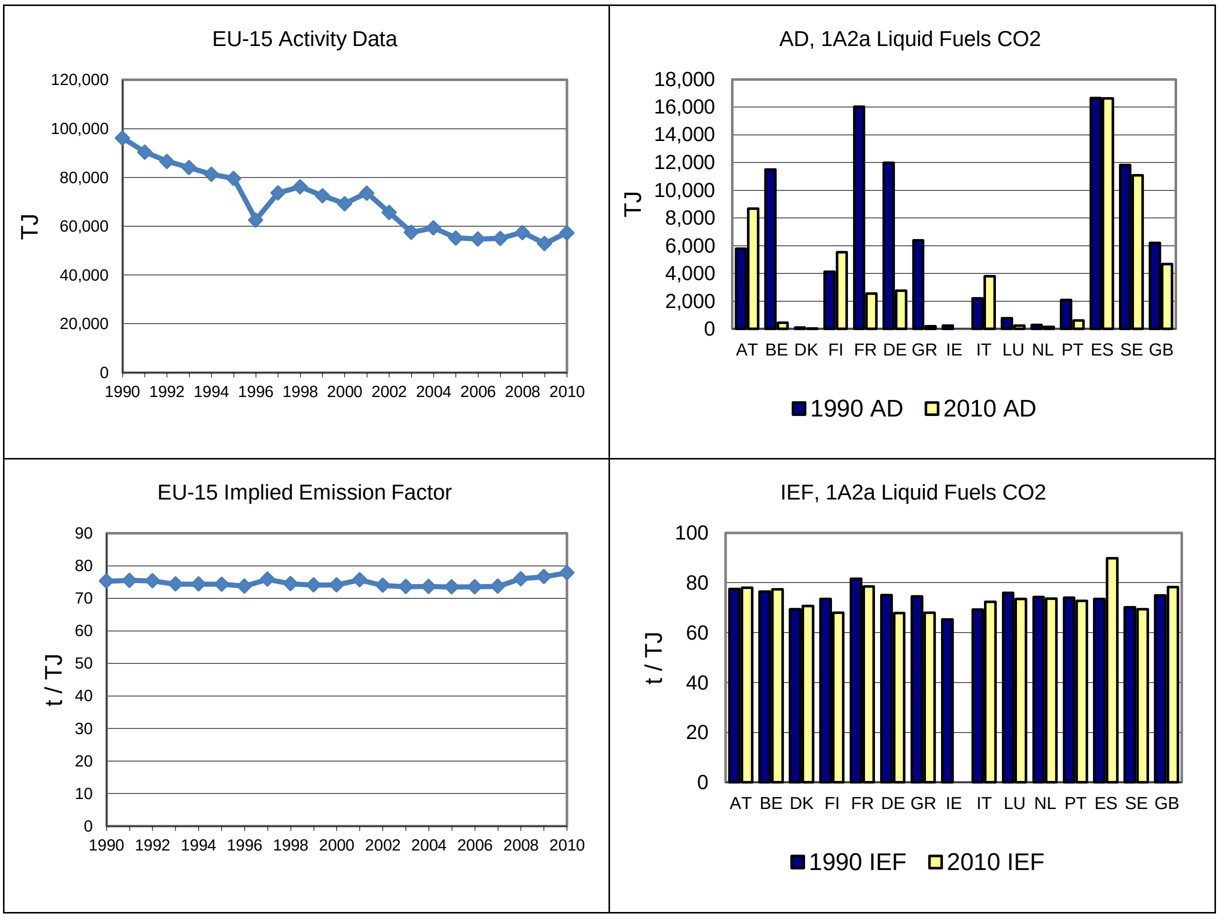
In 2010 CO_2 from liquid fuels had a share of 4 % within this category compared to 5 % in 1990. Between 1990 and 2010 emissions decreased by 38 % (Table 3.21). Significant absolute decreases could be achieved in Belgium, France and Germany whereas Austria and Spain reported considerable increases until 2010. This activity mainly consists of residual fuel oil used for iron ore reduction in blast furnaces.

Table 3.21 **1A2a Iron and Steel, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor**

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	448	590	676	15.1%	85	14%	227	51%	T2	CS,PS
Belgium	878	64	35	0.8%	-30	-46%	-844	-96%	T3	PS
Denmark	7	1	1	0.0%	0	-5%	-6	-85%	CR	CS
Finland	303	342	377	8.4%	35	10%	74	25%	T3	CS
France	1,307	182	200	4.5%	18	10%	-1,108	-85%	T2, T3	CS
Germany	900	192	187	4.2%	-5	-3%	-713	-79%	CS	CS
Greece	475	14	14	0.3%	0	0%	-461	-97%	T2	PS
Ireland	16	NO	NO	-	-	-	-16	-100%	NA	NA
Italy	153	384	274	6.1%	-110	-29%	121	79%	T2	CS
Luxembourg	59	13	18	0.4%	5	39%	-41	-70%	T1,T2	CS,D
Netherlands	21	16	12	0.3%	-4	-27%	-9	-43%	T2	CS
Portugal	155	44	44	1.0%	0	0%	-110	-71%	T2	D, CR, PS
Spain	1,224	1,067	1,494	33.5%	427	40%	269	22%	T2	CR, PS
Sweden	828	649	768	17.2%	118	18%	-60	-7%	T2, T3	CS, PS
United Kingdom	465	499	365	8.2%	-134	-27%	-100	-21%	T2	CS
EU-15	**7,240**	**4,058**	**4,463**	**100.0%**	**406**	**10%**	**-2,777**	**-38%**		

Figure 3.28 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. Liquid fuel consumption in the EU-15 decreased by 40 % between 1990 and 2010. The CO_2 implied emission factor of EU-15 was 77,84 t/TJ in 2010. The higher implied emission factor of Spain in 2010 is due to usage of petroleum coke with a high carbon content.

Figure 3.28 **1A2a Iron and Steel, Liquid fuels: Activity Data and Implied Emission Factors for CO_2**



1A2a Iron and Steel - Solid Fuels (CO_2)

In 2010, CO_2 from solid fuels had a share of 79 % within this category and 81 % in 1990. Between 1990 and 2009 the emissions decreased by 41 % (Table 3.22) but increased by 24 % in 2010. Between 1990 and 2010 Belgium, France, Italy, Luxembourg, Spain and the United Kingdom showed major decreases. Between 2009 to 2010, all member states except the United Kingdom show increases up to 136 %.

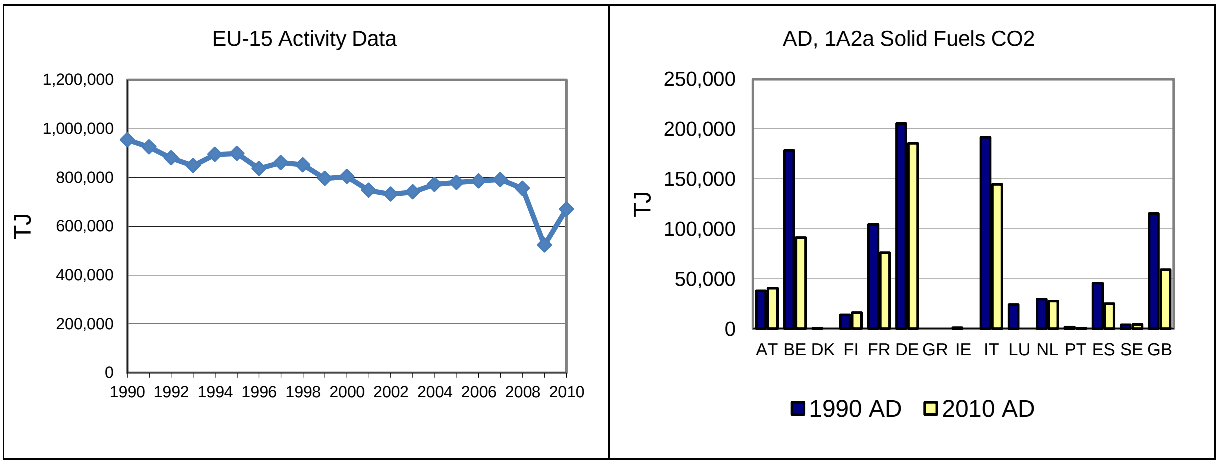
Table 3.22 1A2a Iron and Steel, solid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

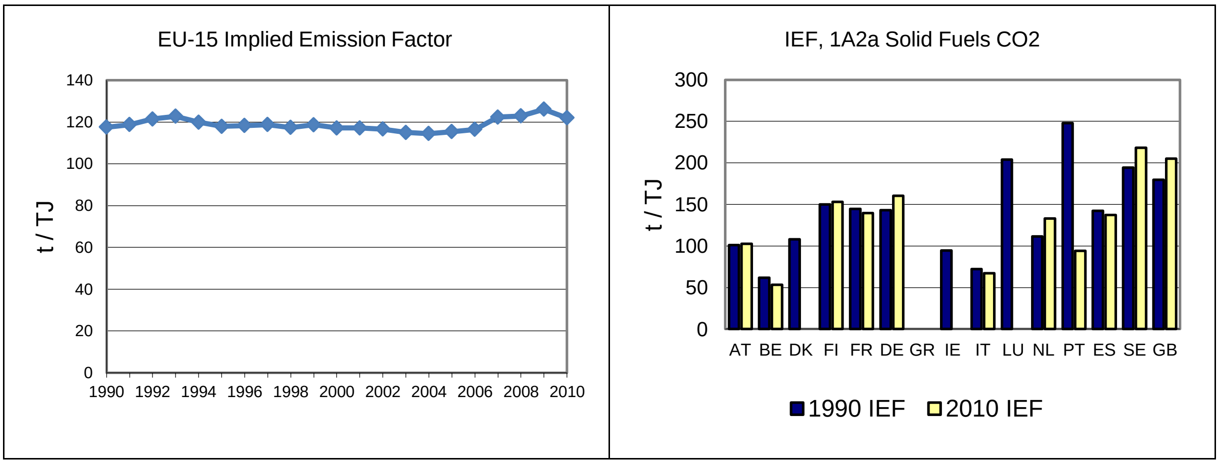
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	3,846	3,456	4,156	5.1%	700	20%	310	8%	T2	CS,PS
Belgium	11,062	3,118	4,851	5.9%	1,733	56%	-6,211	-56%	T3	PS
Denmark	5	NA	NA	-	-	-	-5	-100%	NA	NA
Finland	2,084	1,862	2,499	3.1%	637	34%	415	20%	T3	CS,PS
France	15,113	9,723	10,623	13.0%	900	9%	-4,490	-30%	T2, T3	CS
Germany	29,396	21,840	29,792	36.4%	7,952	36%	396	1%	CS	CS
Greece	NO	NO	NO	-	-	-	-	-	NA	NA
Ireland	115	NO	NO	-	-	-	-115	-100%	NA	NA
Italy	13,842	5,218	9,706	11.9%	4,488	86%	-4,136	-30%	T2	CS
Luxembourg	4,959	NO	NO	-	-	-	-4,959	-100%	NA	NA
Netherlands	3,323	3,499	3,706	4.5%	208	6%	384	12%	T2	CS
Portugal	466	14	16	0.0%	1	-	-450	-97%	T2	D, CR, PS
Spain	6,524	2,946	3,456	4.2%	510	17%	-3,068	-47%	T2	CR, CS, PS
Sweden	785	402	948	1.2%	546	136%	163	21%	T2, T3	CS, PS
United Kingdom	20,744	13,870	12,121	14.8%	-1,749	-13%	-8,623	-42%	T2	CS
EU-15	**112,264**	**65,948**	**81,874**	**100.0%**	**15,927**	**24%**	**-30,389**	**-27%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.29 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emitters are France, Germany, Italy and the UK; together they cause 76 % of the CO_2 emissions from solid fuels in 1A2a. Solid fuel combustion in the EU-15 decreased by 45 % between 1990 and 2009 and increased by 28 % in 2010. The implied emission factor in 2010 of EU-15 was 122 t/TJ. Belgium and Italy report fuel consumption under this category which was not used for the calculation of the CO_2 emissions and thus results untypically low CO_2 emission factors.

Figure 3.29 1A2a Iron and Steel, solid fuels: Activity Data and Implied Emission Factors for CO_2





1A2a Iron and Steel - Gaseous Fuels (CO_2)

In 2010 CO_2 from gaseous fuels had a share of 16 % within source category 1A2a (compared to 13 % in 1990). Between 1990 and 2010 the emissions decreased by 4 %. Between 2009 and 2010 emissions increased by 19% (Table 3.23).

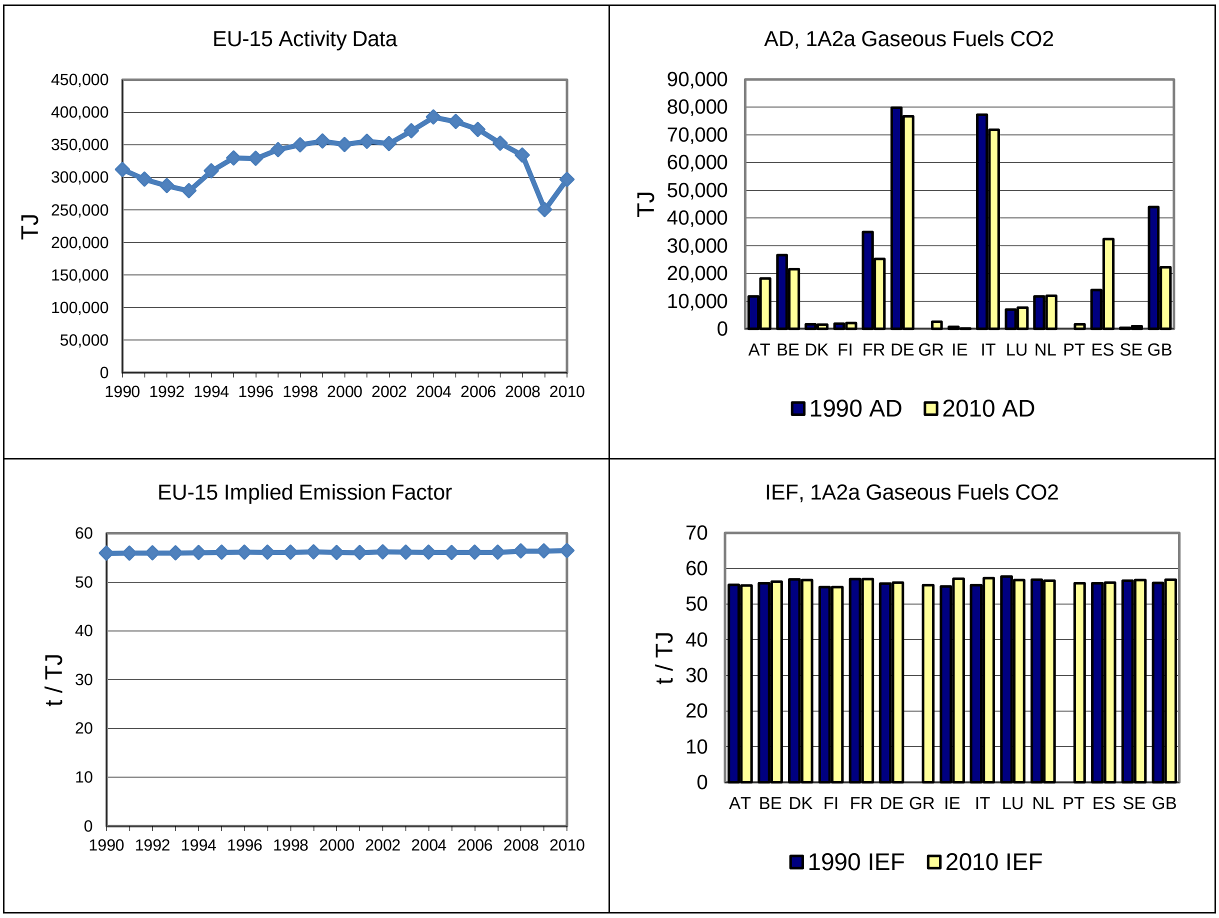
Table 3.23 1A2a Iron and Steel, gaseous fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	650	1,045	1,003	6.0%	-42	-4%	353	54%	T2	CS,PS
Belgium	1,485	942	1,211	7.2%	269	29%	-274	-18%	T3	PS
Denmark	96	80	87	0.5%	7	9%	-8	-9%	CR	CS
Finland	107	92	118	0.7%	26	28%	11	10%	T3	CS
France	1,994	1,217	1,440	8.6%	223	18%	-554	-28%	T2, T3	CS
Germany	4,446	3,391	4,291	25.6%	900	27%	-156	-4%	CS	CS
Greece	NO	146	146	0.9%	0	0%	146	-	T2	CS
Ireland	44	2	2	0.0%	0	0%	-41	-95%	T1	CS
Italy	4,276	3,166	4,111	24.5%	946	30%	-165	-4%	T2	CS
Luxembourg	400	346	439	2.6%	93	27%	38	10%	T2	CS
Netherlands	667	560	680	4.1%	119	21%	13	2%	T2	CS
Portugal	NO	77	96	0.6%	18	23%	96	-	T2	D, CR, PS
Spain	786	1,912	1,813	10.8%	-99	-5%	1,027	131%	T2	CS
Sweden	25	45	57	0.3%	12	27%	32	128%	T2	CS
United Kingdom	2,463	1,084	1,264	7.5%	179	17%	-1,199	-49%	T2	CS
EU-15	**17,440**	**14,107**	**16,758**	**100.0%**	**2,651**	**19%**	**-682**	**-4%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.30 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by France, Germany, Italy and Spain which contribute 70 % to CO_2 emissions from gaseous fuels in 1A2a. Gaseous fuel consumption in the EU-15 decreased by 20 % between 1990 and 2009 and increased by 19 % in 2010. The implied emission factor of EU-15 was 56.5 t/TJ in 2010.

Figure 3.30 1A2a Iron and Steel, gaseous fuels: Activity Data and Implied Emission Factors for CO_2

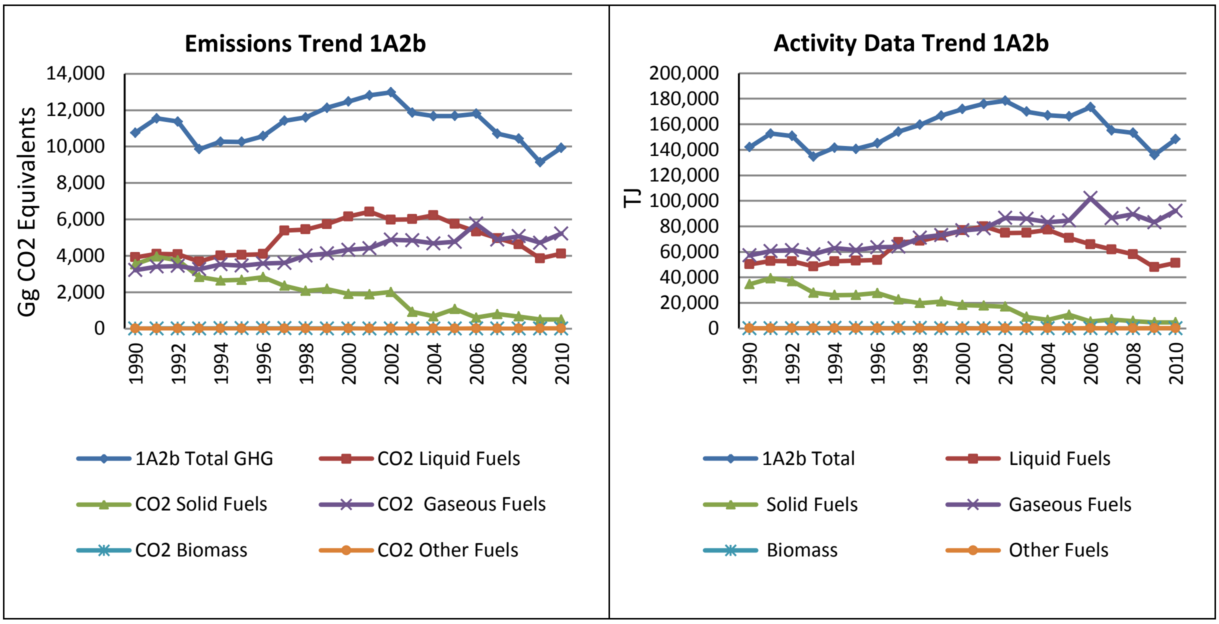


3.2.2.2 Non Ferrous Metals (1A2b) (EU-15)

In this chapter information is provided about emission trends, Member States contribution, activity data and emission factors for category 1A2b by fuels. CO_2 emissions from 1A2b Non-Ferrous Metals accounted for 2 % of 1A2 source category and 0.3 % of total GHG emissions in 2010.

Figure 3.31 shows the emission trend within the category 1A2b, which is in 2010 mainly dominated by CO_2 emissions from liquid and gaseous fuels. The share of solid fuels emissions decreased from 33 % in 1990 to 5 % in 2010. In 2001 total GHG emissions were 4 % above 1990 level. Increasing emissions were reported for CO_2 from gaseous fuels (+63 %) and liquid fuels (+5%)

Figure 3.31 **1A2b Non ferrous Metals: Total and CO_2 emission trends**



EU-15 CO_2 emissions from 1A2b were 8 % below 1990 levels in 2010. In absolute terms, France and Germany reported the highest decreases, while Spain, Ireland and Italy reported substantial increases in this period (Table 3.24).

Table 3.24 **1A2b Non ferrous Metals: Member States' contributions to CO_2 emissions**

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010	
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	132	272	243	2.5%	-29	-11%	111	84%
Belgium	624	424	442	4.5%	17	4%	-182	-29%
Denmark	11	8	8	0.1%	1	11%	-2	-22%
Finland	336	90	111	1.1%	21	23%	-226	-67%
France	2,721	1,305	1,434	14.5%	129	10%	-1,287	-47%
Germany	1,601	173	167	1.7%	-7	-4%	-1,434	-90%
Greece	608	534	504	5.1%	-30	-6%	-104	-17%
Ireland	809	1,225	1,517	15.4%	292	24%	709	88%
Italy	738	1,021	1,130	11.5%	109	11%	392	53%
Luxembourg	28	45	53	0.5%	8	18%	25	90%
Netherlands	216	175	204	2.1%	28	16%	-12	-6%
Portugal	IE,NO	IE	IE	0.0%	-	-	-	-
Spain	1,578	3,025	3,272	33.2%	247	8%	1,694	107%
Sweden	128	83	90	0.9%	8	9%	-37	-29%
United Kingdom	1,143	692	682	6.9%	-10	-1%	-461	-40%
EU-15	**10,672**	**9,073**	**9,856**	**100.0%**	**783**	**9%**	**-816**	**-8%**

Portugal includes emissions under 1A2f.
Abbreviations explained in the Chapter 'Units and abbreviations'.

1A2b Non-Ferrous Metals - Solid Fuels (CO_2)

In 2010 CO_2 from solid fuels had a share of 5 % within source category 1A2b category (compared to 33 % in 1990). Between 1990 and 2010 the emissions decreased by 86 % (Table 3.25). Greece and Portugal reported emissions as 'Included elsewhere' and Ireland, the Netherlands, Luxembourg, Denmark and Sweden as 'Not occurring' or 'Not applicable'. Substantial decreases between 1990 and 2010 were reported by France and Germany.

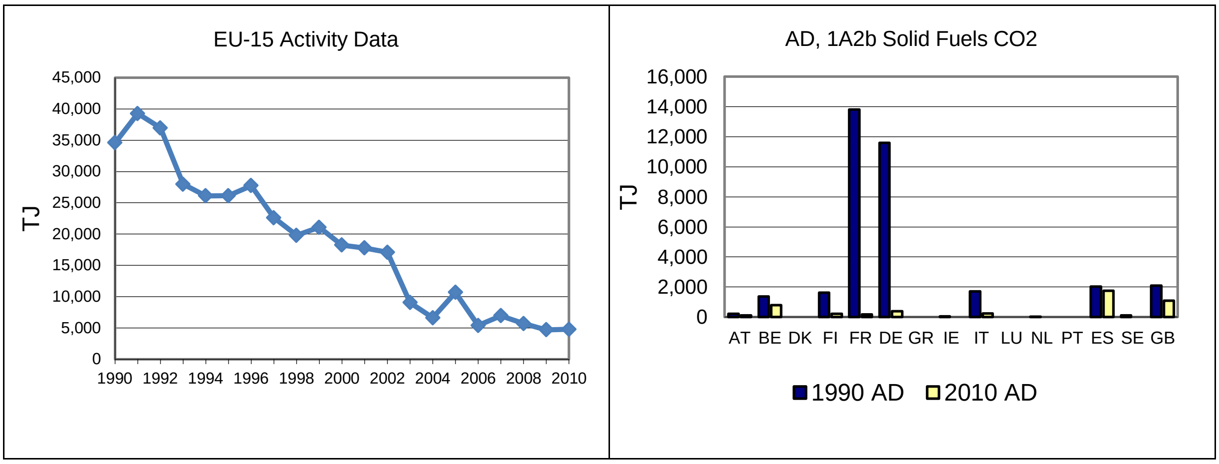
Table 3.25 1A2b Non ferrous Metals, solid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

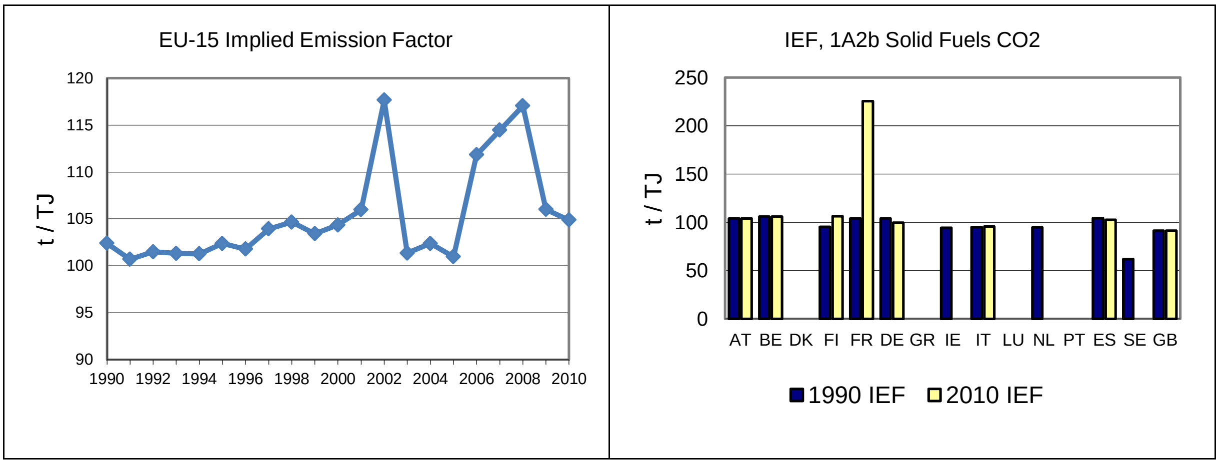
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	22	16	12	2.4%	-4	-25%	-10	-45%	T2	CS
Belgium	146	89	84	16.8%	-5	-5%	-62	-42%	T1	D
Denmark	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	155	17	22	4.4%	5	30%	-133	-86%	T3	CS
France	1,436	70	40	8.0%	-30	-42%	-1,396	-97%	T2, T3	CS
Germany	1,206	36	39	7.8%	3	8%	-1,167	-97%	CS	CS
Greece	IE	IE	IE	-	-	-	-	-	NA	NA
Ireland	4	NA	NA	-	-	-	-4	-100%	NA	NA
Italy	163	23	23	4.7%	0	0%	-139	-86%	T2	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	0	NO	NO	-	-	-	-0.4	-100%	NA	NA
Portugal	IE	IE	IE	-	-	-	-	-	NA	NA
Spain	211	137	179	35.7%	41	30%	-32	-15%	T2	CS
Sweden	7	NO	NO	-	-	-	-7	-100%	NA	NA
United Kingdom	191	108	100	20.1%	-8	-7%	-91	-47%	T2	CS
EU-15	**3,542**	**497**	**500**	**100.0%**	**3**	**1%**	**-3,041**	**-86%**		

Portugal includes emissions under 1A2f because the separation of AD between ferrous and non-ferrous industry is not available.
Greece includes emissions in the Industrial processes sector (as non-energy use of fuels).
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.32 shows activity data and implied emission factors for CO_2 comparing the EU-15 average and the Member States. The largest emissions are reported by Belgium, France and Spain; together they cause 73 % of the CO_2 emissions from solid fuels in 2010. Consumption of solid fuels in the EU-15 decreased by 86 % between 1990 and 2010. The implied emission factor of EU-15 was 104.9 t/TJ in 2010. The high implied emission factor of France in 2010 is caused by the high share of blast furnace and steel plants gases with an emission factor of 268 kg CO_2/ GJ and 183 kg CO_2/ GJ respectively. This also implies the peak in the EU-15 implied emission factor for 2002. The strong decline in 1993 AD is mainly due to a high decrease reported by France.

Figure 3.32 1A2b Non ferrous Metals, solid fuels: Activity Data and Implied Emission Factors for CO_2





1A2b Non-Ferrous Metals - Gaseous Fuels (CO_2)

In 2010 CO_2 from gaseous fuels had a share of 53 % within source category 1A2b (compared to 30 % in 1990). Between 1990 and 2010 emissions increased by 63 % (Table 3.26). Between 1990 and 2010 the highest absolute increases occurred in Spain, Ireland, Italy and France.

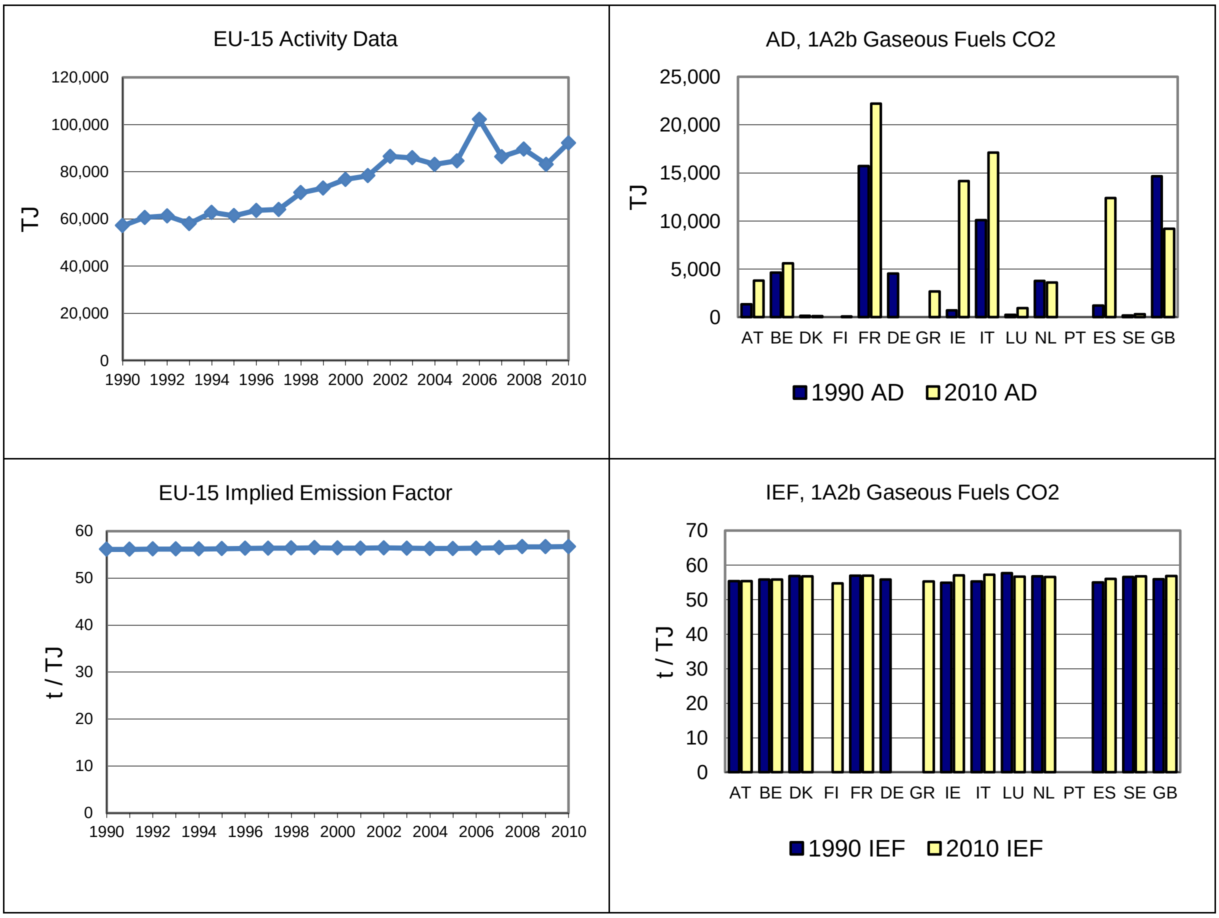
Table 3.26 1A2b Non ferrous Metals, gaseous fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010	
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	75	232	211	4.0%	-21	-9%	136	182%
Belgium	260	277	312	6.0%	36	13%	53	20%
Denmark	7	6	7	0.1%	1	9%	0	-5%
Finland	NO	2	3	0.1%	1	28%	3	-
France	895	1,088	1,267	24.2%	179	16%	372	42%
Germany	253	IE	IE	0.0%	-	-	-253	-100%
Greece	NO	130	148	2.8%	18	14%	148	-
Ireland	39	782	807	15.4%	26	-	769	1994%
Italy	558	852	981	18.8%	129	15%	423	76%
Luxembourg	13	45	53	1.0%	8	18%	40	-
Netherlands	213	175	204	3.9%	28	16%	-9	-4%
Portugal	NO	IE	IE	-	-	-	-	-
Spain	66	608	694	13.3%	85	14%	628	956%
Sweden	10	18	18	0.3%	0	0%	8	72%
United Kingdom	819	498	522	10.0%	24	5%	-297	-36%
EU-15	**3,209**	**4,713**	**5,227**	**100.0%**	**514**	**11%**	**2,018**	**63%**

Portugal includes emissions under 1A2f because the separation of AD between ferrous and non-ferrous industry not available.
Germany reported emissions under 1A2f other (unspecified industrial power plants) because of confidential data.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.33 shows activity data and CO_2 implied emission factors for EU-15 and the Member States. The largest emissions are reported by France, Ireland, Italy and Spain; together they cause around 72 % of the CO_2 emissions in 2010 from gaseous fuels in 1A2b. Consumption of gaseous fuels in the EU-15 rose by 61 % between 1990 and 2010. The implied emission factor of EU-15 was 56.7 t/TJ in 2010. The jump in 2006 AD is mainly due to Ireland which reports a high increase in 2006 and Spain which reports a high decrease in 2007.

Figure 3.33 1A2b Non ferrous Metals, gaseous fuels: Activity Data and Implied Emission Factors for CO_2

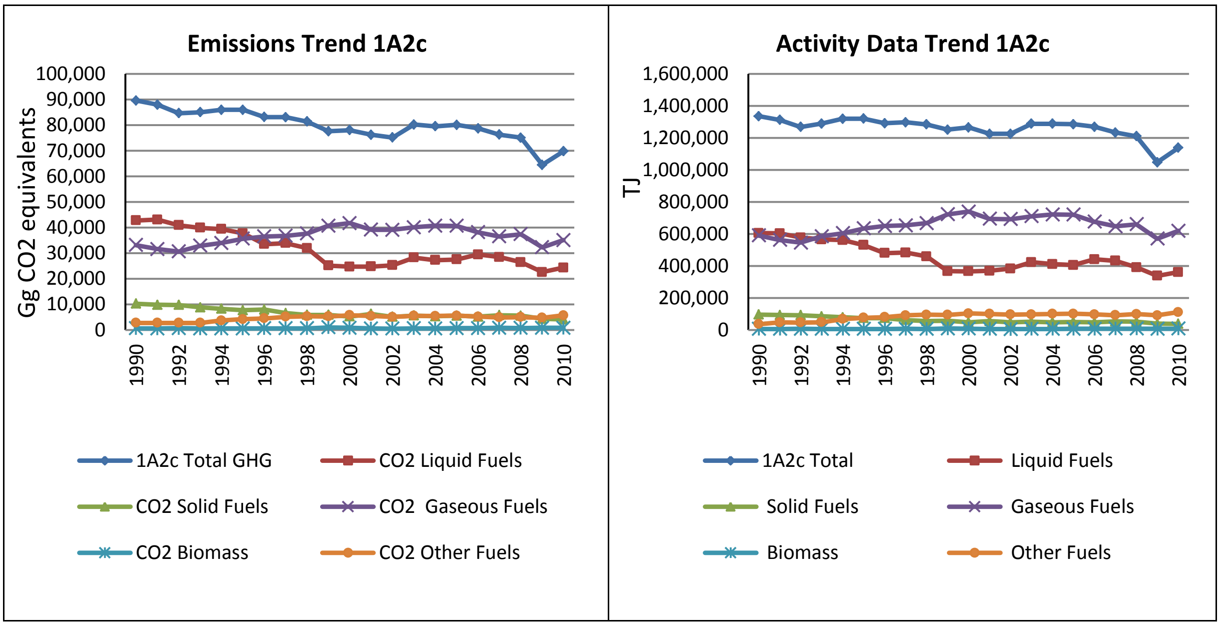


3.2.2.3 Chemicals (1A2c) (EU-15)

In this chapter information about emission trends, Member States contribution, activity data and emission factors is provided for category 1A2c on a fuel base. CO_2 emissions from 1A2c Chemicals accounted for 14.2 % of 1A2 category and 1.8 % of total GHG emissions in 2010.

Figure 3.34 shows the emission trend within the category 1A2c, which is mainly dominated by CO_2 emissions from liquid and gaseous fuels. Total emissions decreased by 22 %, mainly due to decreases in emissions from liquid (-43 %) fuels. Increasing emissions were reported for gaseous fuels (+6 %) and other fuels (+ 107 %).

Figure 3.34 **1A2c Chemicals: Total and CO_2 emission and activity trends**



Between 1990 and 2010, CO_2 emissions from 1A2c Chemicals decreased by 22 % in the EU-15 (

Table 3.27), mainly due to decreases in Italy, the Netherlands and France; Spain and Belgium reported substantial emission increases in this period. Between 2009 and 2010 emissions increased substantially in Belgium, France, the Netherlands and Spain.

Table 3.27 **1A2c Chemicals: Member States' contributions to CO_2 emissions**

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010	
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	883	1,306	1,360	2.0%	55	4%	478	54%
Belgium	6,585	6,772	7,589	11.0%	817	12%	1,004	15%
Denmark	282	113	150	0.2%	38	33%	-132	-47%
Finland	1,286	681	780	1.1%	99	14%	-506	-39%
France	21,088	18,706	19,524	28.2%	818	4%	-1,564	-7%
Germany	IE	IE	IE	-	-	-	-	-
Greece	1,153	840	930	1.3%	90	11%	-223	-19%
Ireland	410	283	282	0.4%	-1	0%	-129	-31%
Italy	19,203	7,384	7,778	11.2%	394	5%	-11,425	-59%
Luxembourg	178	141	166	0.2%	25	17%	-13	-7%
Netherlands	17,133	11,589	13,211	19.1%	1,622	14%	-3,923	-23%
Portugal	1,480	1,237	1,412	2.0%	174	14%	-68	-5%
Spain	5,658	6,529	7,033	10.2%	504	8%	1,375	24%
Sweden	1,128	1,031	1,276	1.8%	245	24%	148	13%
United Kingdom	12,572	7,379	7,768	11.2%	389	5%	-4,804	-38%
EU-15	**89,039**	**63,991**	**69,257**	**100.0%**	**5,266**	**8%**	**-19,782**	**-22%**

Emissions of Germany are included in 1A2f.
Abbreviations explained in the Chapter 'Units and abbreviations'.

1A2c Chemicals - Liquid Fuels (CO_2)

In 2010, CO_2 from liquid fuels had a share of 35 % within source category 1A2c (compared to 48 % in 1990). Between 1990 and 2010, the emissions decreased by 43 % (Table 3.28). Several EU-15 Member States reported decreasing CO_2 emissions from this source category with Italy showing the highest reduction in absolute terms. Germany includes emissions under 1A2f.

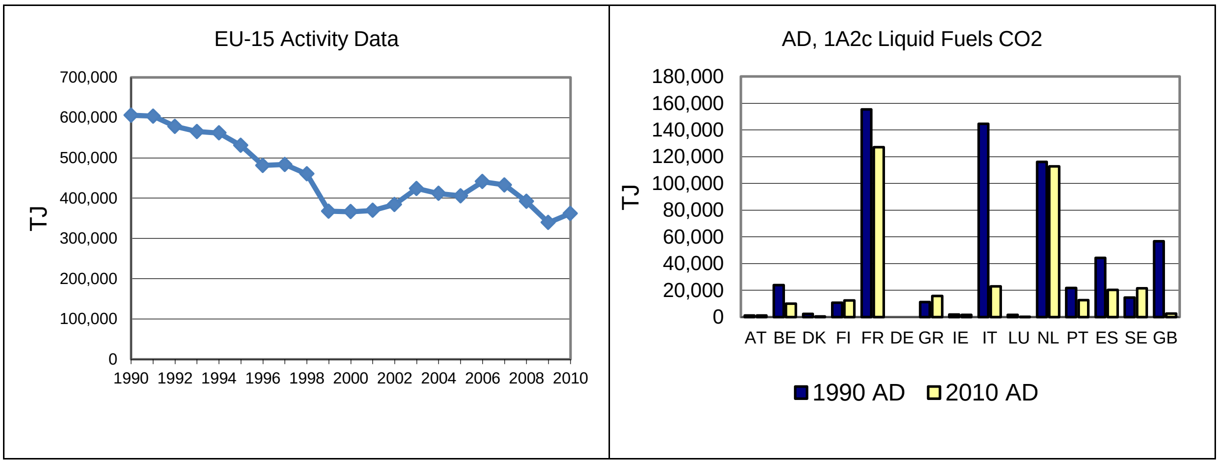
Table 3.28 1A2c Chemicals, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

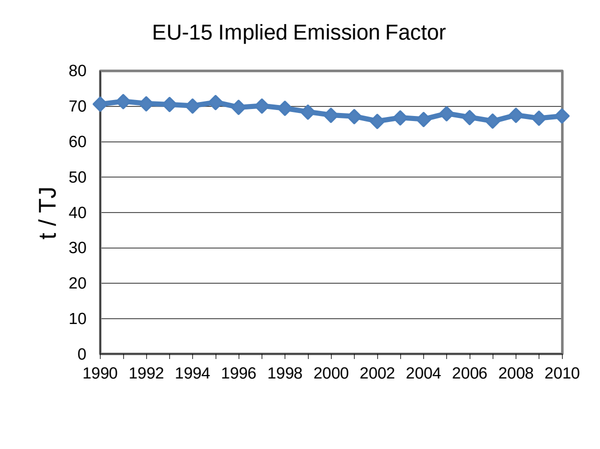
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	82	108	83	0.3%	-25	-23%	0	1%	T2	CS,PS
Belgium	1,835	258	772	3.2%	514	199%	-1,063	-58%	T1	D
Denmark	180	0	28	0.1%	28	9565%	-152	-84%	CR	CS,D
Finland	772	635	732	3.0%	97	15%	-40	-5%	T3	CS
France	11,702	8,662	9,073	37.3%	411	5%	-2,629	-22%	T2, T3	CS
Germany	IE	IE	IE	-	-	-	-	-	NA	NA
Greece	584	613	633	2.6%	20	3%	49	8%	T2	PS
Ireland	131	152	128	0.5%	-25	-16%	-3	-3%	T1	CS
Italy	10,956	1,970	1,554	6.4%	-417	-21%	-9,402	-86%	T2	CS
Luxembourg	121	8	10	0.0%	3	35%	-111	-91%	T1,T2	CS,D
Netherlands	6,570	6,799	7,804	32.0%	1,005	15%	1,234	19%	T2	CS
Portugal	1,373	774	774	3.2%	0	0%	-599	-44%	T2	D, CR
Spain	3,276	1,590	1,524	6.3%	-66	-4%	-1,753	-53%	T2	CR, CS
Sweden	861	812	1,036	4.3%	224	28%	175	20%	T2	CS
United Kingdom	4,386	230	206	0.8%	-24	-11%	-4,181	-95%	T2	CS
EU-15	**42,830**	**22,611**	**24,356**	**100.0%**	**1,745**	**8%**	**-18,474**	**-43%**		

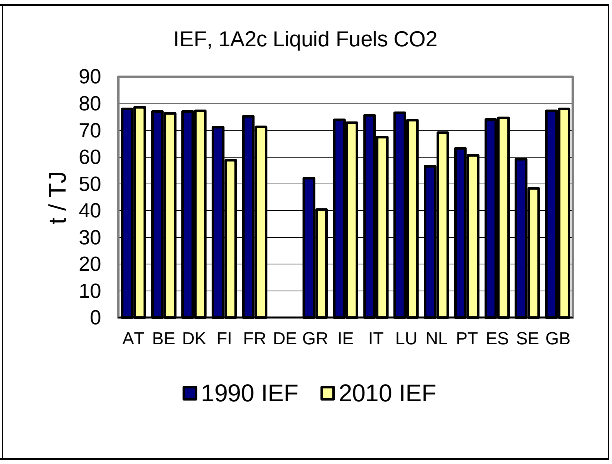
Emissions of Germany are included in 1A2f
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.35 shows activity data and implied emission factors for CO_2 comparing the EU-15 average and the Member States. The largest contributions are reported by France and the Netherlands; together they cause around 69 % of the CO_2 emissions from liquid fuels in 1A2c. Fuel combustion in the EU-15 decreased by 40 % between 1990 and 2010. The implied emission factor of EU-15 was 67.3 /TJ in 2010. The low implied emission factor of Greece is because non-energy use is included in activity data. The lower implied emission factor of the Netherlands is because chemical gases are included in liquid fuels. Sweden reports methane and methane based gas mixtures together with liquid fuels which implies a rather low IEF too. The decline in 1999 AD is due strong decreases reported by France and Italy.

Figure 3.35 1A2c Chemicals, liquid fuels: Activity Data and Implied Emission Factors for CO_2







1A2c Chemicals - Solid Fuels (CO_2)

In 2010, solid fuels had a share of 6 % within source category 1A2c (compared to 11 % in 1990). Between 1990 and 2010, the emissions decreased by 60 % (Table 3.29). In absolute terms France and the Netherlands reported a significant decrease during this period. Germany includes emissions from this source category in source category 1A2f.

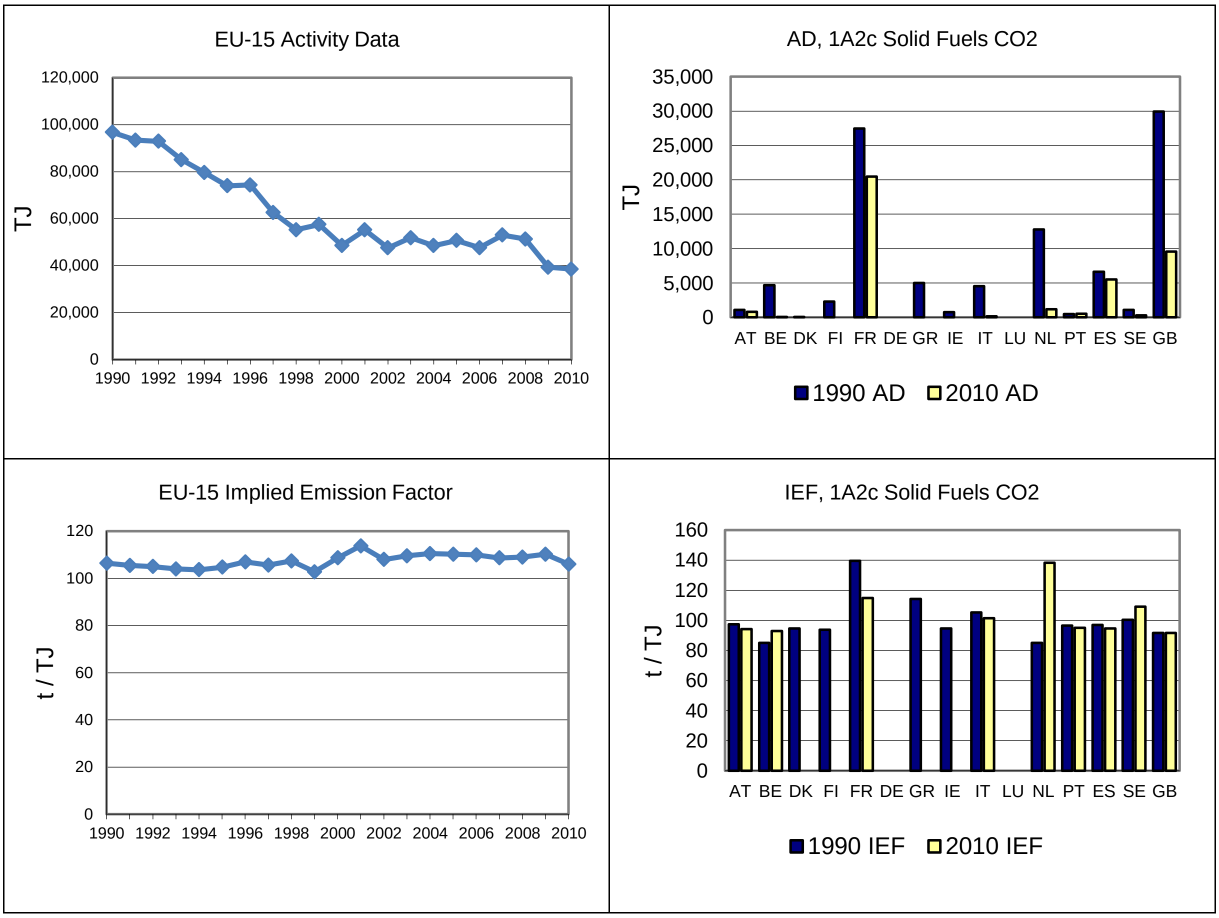
Table 3.29 1A2c Chemicals, solid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	107	70	76	1.9%	7	10%	-31	-29%	T2	CS,PS
Belgium	397	4	3	0.1%	-1	-17%	-394	-99%	T1	D
Denmark	7	NA	NA	-	-	-	-7	-100%	NA	NA
Finland	214	NA	NA	-	0.0	-	-214	-100%	NA	NA
France	3,834	2,568	2,349	57.5%	-219	-9%	-1,485	-39%	T2, T3	CS
Germany	IE	IE	IE	-	-	-	-	-	NA	NA
Greece	569	NO	NO	-	-	-	-569	-100%	NA	NA
Ireland	72	NO	NA	-	-	-	-72	-100%	NA	NA
Italy	478	15	15	0.4%	0	2%	-462	-97%	T2	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	1,087	144	162	4.0%	19	13%	-925	-85%	T2	CS
Portugal	44	51	49	1.2%	-2	-4%	5	11%	T2	D, CR
Spain	642	579	521	12.8%	-57	-10%	-121	-19%	T2	CR, CS, PS
Sweden	107	29	29	0.7%	0	0%	-78	-73%	T2	CS
United Kingdom	2,743	869	878	21.5%	9	1%	-1,865	-68%	T2	CS
EU-15	**10,301**	**4,327**	**4,082**	**100.0%**	**-245**	**-6%**	**-6,218**	**-60%**		

Emissions of Germany are inlcuded in 1A2f.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.36 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by France, Spain and the United Kingdom; together they cause 92 % of the CO_2 emissions from solid fuels in 1A2c. Solid fuel combustion in the EU-15 decreased by -60 % between 1990 and 2010. The implied emission factor of EU-15 was 106.0 t/TJ in 2010. The Netherlands include chemical waste gas within this category which implies the change in their IEF. The high IEF of France is due to inclusion of blast furnace gas.

Figure 3.36 1A2c Chemicals, solid fuels:Activity Data and Implied Emission Factors for CO_2



1A2c Chemicals – Gaseous Fuels (CO_2)

In 2010, CO_2 from gaseous fuels had a share of 50 % within source category 1A2c (compared to 37 % in 1990). Between 1990 and 2010, the emissions increased by 6 % (Table 3.30). Between 1990 and 2010 only Finland, Ireland and the Netherlands reported decreases. The highest increases occurred in Spain and France. Germany includes emissions from this source category in source category 1A2f.

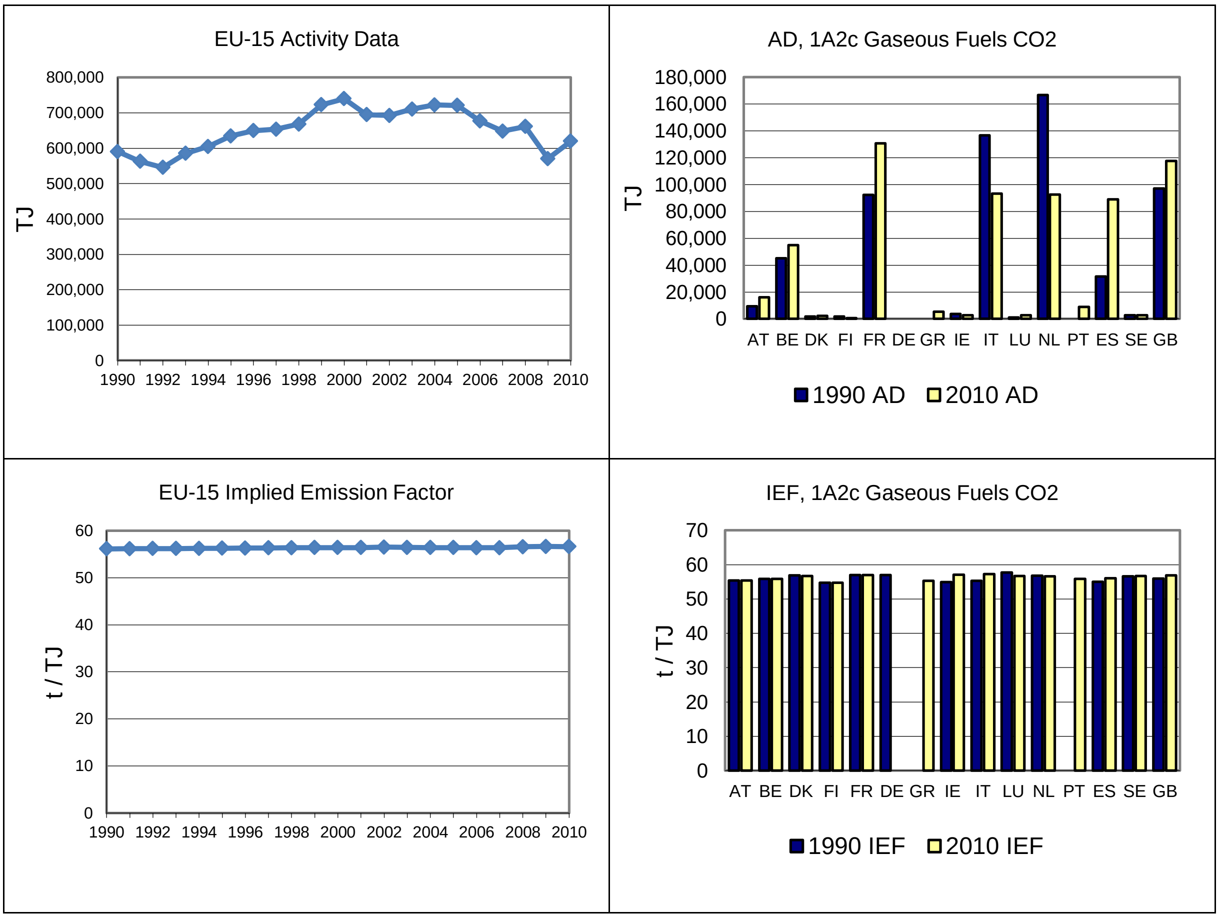
Table 3.30 **1A2c Chemicals, gaseous fuels: Member States' contributions to CO_2 and information on method applied and emission factor**

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	519	881	890	2.5%	10	1%	372	72%	T2	CS
Belgium	2,519	2,673	3,067	8.7%	394	15%	548	22%	T1	D
Denmark	96	112	122	0.3%	10	9%	26	27%	CR	CS
Finland	98	36	37	0.1%	1	4%	-61	-62%	T3	CS
France	5,270	7,159	7,452	21.2%	293	4%	2,181	41%	T2, T3	CS
Germany	IE	IE	IE	-	-	-	-	-	NA	NA
Greece	NO	227	296	0.8%	70	31%	296	-	T2	CS
Ireland	207	131	154	0.4%	23	18%	-53	-26%	T1	CS
Italy	7,561	5,146	5,346	15.2%	200	4%	-2,216	-29%	T2	CS
Luxembourg	57	133	155	0.4%	22	16%	98	170%	T2	CS
Netherlands	9,476	4,646	5,244	14.9%	598	13%	-4,232	-45%	T2	CS
Portugal	NO	359	492	1.4%	133	37%	492	-	T2	D, CR
Spain	1,739	4,360	4,988	14.2%	627	14%	3,249	187%	T2	CS
Sweden	155	156	159	0.5%	4	3%	5	3%	T2	CS
United Kingdom	5,443	6,280	6,685	19.1%	404	6%	1,241	23%	T2	CS
EU-15	**33,140**	**32,299**	**35,088**	**100.0%**	**2,789**	**9%**	**1,947**	**6%**		

Emissions of Germany are included in 1A2f.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.37 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by France, Italy, the Netherlands, Spain and the United Kingdom; together they cause 85 % of the CO_2 emissions from gaseous fuels in 1A2c. Gaseous fuel consumption in the EU-15 rose by 5 % between 1990 and 2010. The implied emission factor of EU-15 was 56.6 t/TJ in 2010.

Figure 3.37 1A2c Chemicals, gaseous fuels: Activity Data and Implied Emission Factors for CO_2



1A2c Chemicals - Other Fuels (CO_2)

In 2010 , CO_2 from other fuels had a share of 8 % within source category 1A2c (compared to 3 % in 1990). Between 1990 and 2009, the emissions increased by 107 % (Table 3.31). Several Member States reported emissions as 'Not occurring' or 'Not applicable', Germany included emissions in 1A2f. The major absolute increase was reported by Belgium between 1990 and 2010. Belgium reports recovered fuels from cracking units or other processes under this category; Italy reports gaseous fuels resulting from the petrochemical production processes.

Table 3.31 **1A2c Chemicals, other fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor**

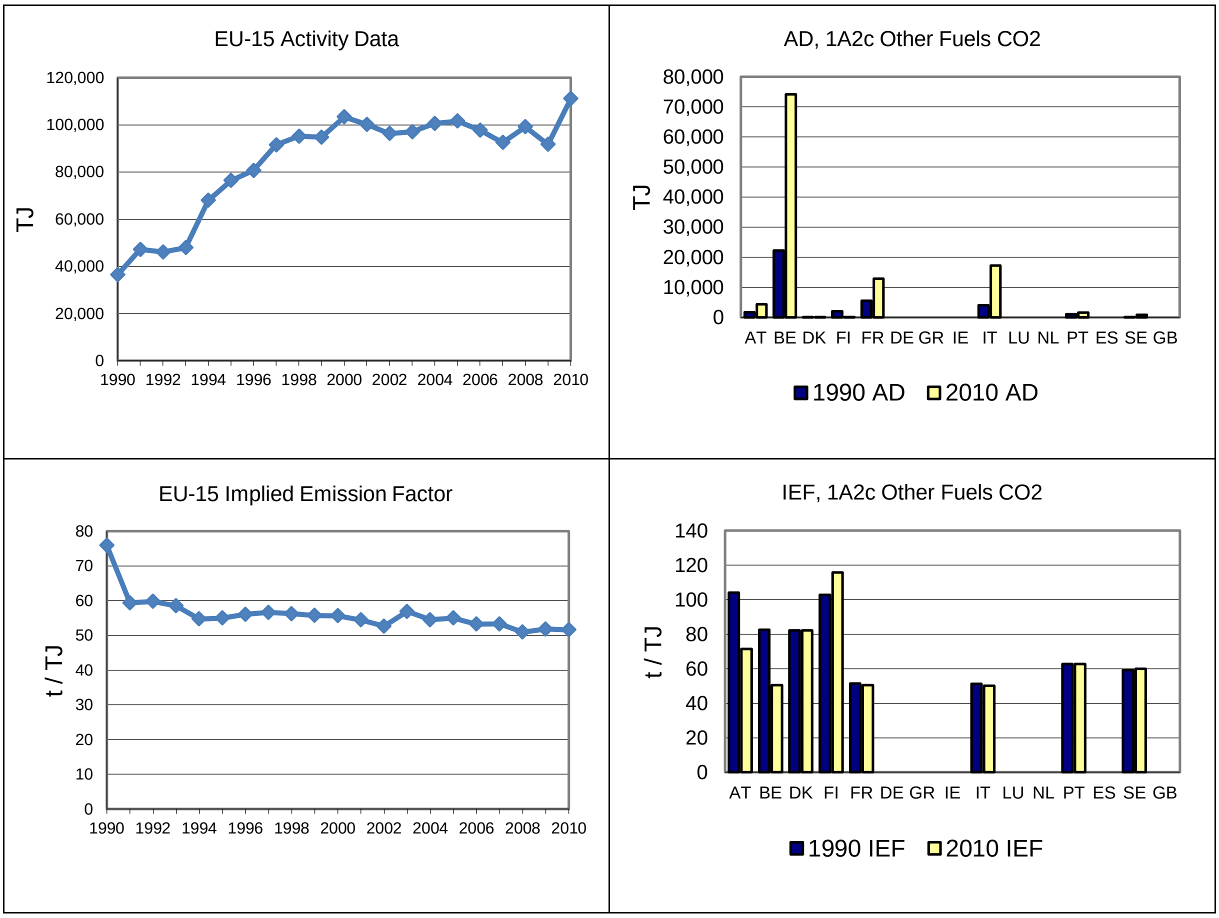
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	174	247	311	5.4%	64	26%	137	79%	T2	D,PS
Belgium	1,834	3,837	3,747	65.4%	-90	-2%	1,913	104%	T3	PS
Denmark	0	1	1	-	0	0%	0	66%	CR	CS
Finland	202	10	11	0.2%	1	7%	-191	-95%	T3	CS
France	282	317	650	11.3%	333	105%	368	131%	T2, T3	CS
Germany	IE	IE	IE	-	-	-	-	-	NA	NA
Greece	NO	NO	NO	-	-	-	-	-	NA	NA
Ireland	NO	NO	NO	-	-	-	-	-	NA	NA
Italy	208	253	863	15.1%	611	242%	655	315%	T2	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	NO	NO	NO	-	-	-	-	-	NA	NA
Portugal	63	54	97	1.7%	43	80%	34	55%	T2	D, CR
Spain	NA	NA	NA	-	0	-	-	-	NA	NA
Sweden	6	35	51	0.9%	16	47%	46	816%	T2	CS
United Kingdom	NO	NO	NO	-	-	-	-	-	NA	NA
EU-15	**2,768**	**4,754**	**5,731**	**100.0%**	**978**	**21%**	**2,963**	**107%**		

Emissions of Germany are included in 1A2f.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.38 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by Belgium, France and Italy; together they cause 92 % of the CO_2 emissions from other fuels in 1A2c. Other fuel consumption in the EU-15 increased by 205 % between 1990 and 2010. The implied emission factor of EU-15 was 51.6 t/TJ in 2010. The increase in activity data 2010 is reported by Italy.

The high implied emission factor 1990 is due to new naphta cracking plants in Belgium which started operation in 1991 and which use recovered fuels with a high share of hydrogen gas. Therefore the IEF of Belgium is much lower for the years after 1990. Because Belgium contributes to 65 % of EU-15 emissions in 2010 it strongly affects the EU-15 IEF.

Figure 3.38 1A2c Chemicals, other fuels: Activity Data and Implied Emission Factors for CO_2

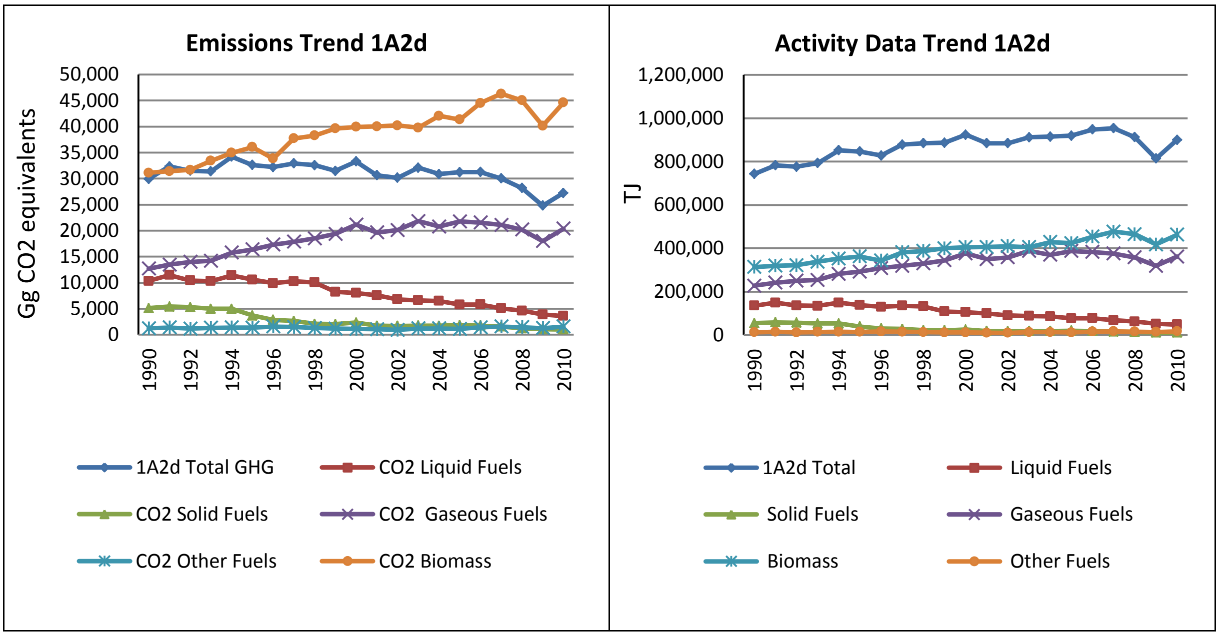


3.2.2.4 Pulp, Paper and Print (1A2d) (EU-15)

In this chapter information about emission trends, Member States contribution, activity data and emission factors is provided for category 1A2d by fuels. CO_2 emissions from 1A2d Pulp, Paper and Print accounted for 5.4 % of 1A2 source category and 0.7 % of total GHG emissions in 2010.

Figure 3.39 shows the emission trend within the category 1A2d, which is mainly dominated by CO_2 emissions from gaseous and liquid fuels. Total GHG emissions decreased by 9 %. The share of gaseous fuels (and of biomass) is gradually increasing since 1990.

Figure 3.39 **1A2d Pulp, Paper and Print: Total and CO_2 emission trends**



Between 1990 and 2010, CO_2 emissions from 1A2d Pulp, Paper and Print decreased by 10 % in the EU-15 (Table 3.32), mainly due to decreases in Finland, France, Sweden and the Netherlands. Between 2009 and 2010 emissions rose by 10 %. Between 1990 and 199 Luxembourg reported emissions as ‘Not occurring’ and “Included elsewhere”.

Table 3.32 **1A2d Pulp, Paper and Print: Member States’ contributions to CO_2 emissions**

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010	
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	2,213	2,101	2,229	8.4%	128	6%	16	1%
Belgium	637	480	575	2.2%	95	20%	-63	-10%
Denmark	339	96	112	0.4%	16	16%	-227	-67%
Finland	5,336	3,175	3,663	13.8%	489	15%	-1,673	-31%
France	4,980	3,085	3,378	12.7%	294	10%	-1,602	-32%
Germany	4	12	9	0.0%	-3	-27%	5	146%
Greece	301	197	179	0.7%	-19	-9%	-123	-41%
Ireland	28	23	22	0.1%	-1	-5%	-6	-23%
Italy	3,076	3,803	4,578	17.2%	776	20%	1,502	49%
Luxembourg	IE,NO	7	5	0.0%	-2	-27%	5	-
Netherlands	1,743	1,091	1,192	4.5%	101	9%	-552	-32%
Portugal	746	701	1,086	4.1%	385	55%	340	46%
Spain	3,211	4,701	4,719	17.8%	18	0%	1,507	47%
Sweden	2,186	1,369	1,399	5.3%	30	2%	-787	-36%
United Kingdom	4,554	3,346	3,417	12.9%	71	2%	-1,137	-25%
EU-15	**29,356**	**24,186**	**26,563**	**100.0%**	**2,377**	**10%**	**-2,793**	**-10%**

E
missions of the UK are included in 1A2f.
Abbreviations explained in the Chapter ‘Units and abbreviations’.

1A2d Pulp, Paper and Print - Liquid (CO_2)

In 2010 CO_2 from liquid fuels had a share of 13 % within source category 1A2d (compared to 34 % in 1990). Between 1990 and 2010 emissions decreased by 65 % (Table 3.33). Between 1990 and 2010 all Member States reported decreasing CO_2 emissions from this source category.

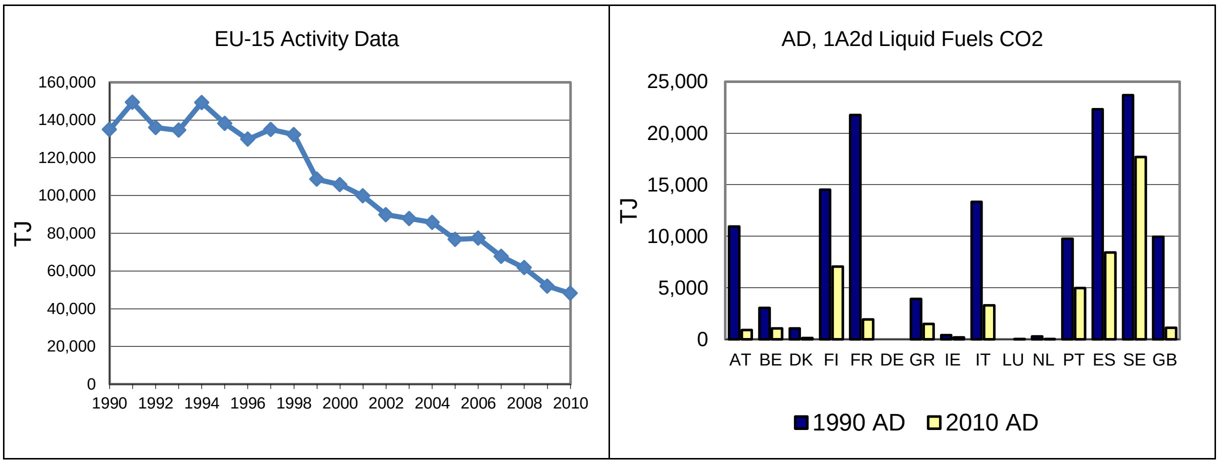
Table 3.33 1A2d Pulp, Paper and Print, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

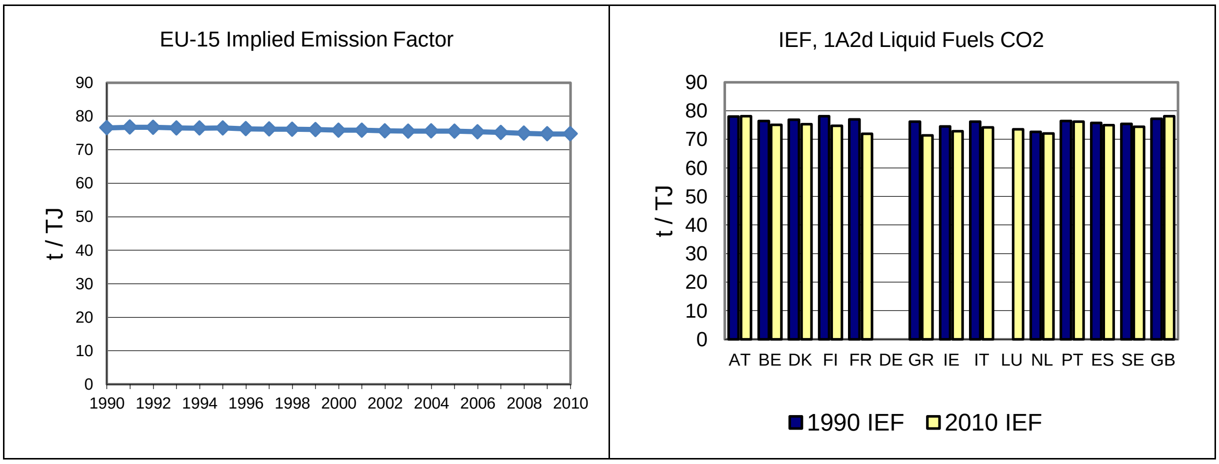
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	853	103	70	1.9%	-33	-32%	-783	-92%	T2	CS,PS
Belgium	232	120	79	2.2%	-41	-34%	-153	-66%	T1	D
Denmark	79	2	9	0.2%	7	488%	-71	-89%	CR	CS,D
Finland	1,132	476	526	14.6%	50	11%	-606	-54%	T3	CS
France	1,675	258	137	3.8%	-121	-47%	-1,538	-92%	T2, T3	CS
Germany	IE	IE	IE	-	-	-	-	-	NA	NA
Greece	297	119	107	3.0%	-12	-10%	-190	-64%	T2	PS
Ireland	28	15	13	0.4%	-2	-14%	-16	-56%	T1	CS
Italy	1,015	365	243	6.8%	-122	-33%	-772	-76%	T2	CS
Luxembourg	IE	2	2	0.04%	0	-14%	2	-	T2	CS
Netherlands	20	1	1	0.0%	0	-41%	-19	-97%	T2	CS
Portugal	746	320	378	10.5%	58	18%	-368	-49%	T2	D, CR
Spain	1,692	720	630	17.5%	-90	-13%	-1,062	-63%	T2	CR, PS
Sweden	1,786	1,268	1,317	36.6%	49	4%	-468	-26%	T2	CS
United Kingdom	768	112	86	2.4%	-26	-24%	-682	-89%	T2	CS
EU-15	**10,323**	**3,879**	**3,596**	**100.0%**	**-283**	**-7%**	**-6,727**	**-65%**		

Emissions of Germany and the UK are included in 1A2f.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.40 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by Finland, Portugal, Spain and Sweden; together they cause 79% of the CO_2 emissions from liquid fuels in 1A2d. Fuel consumption in the EU-15 decreased by 64 % between 1990 and 2010. The implied emission factor of EU-15 was 74.7 t/TJ in 2010.

Figure 3.40 1A2d Pulp, Paper and Print, liquid fuels: Activity Data and Implied Emission Factors for CO_2





1A2d Pulp, Paper and Print - Solid Fuels (CO_2)

In 2010 CO_2 from solid fuels had a share of 4 % within source category 1A2d (compared to 17 % in 1990). Between 1990 and 2010 emissions decreased by 80 % (Table 3.34). Only eight of the EU-15 Member States reported CO_2 emissions from this source category for the years 2009 and 2010.

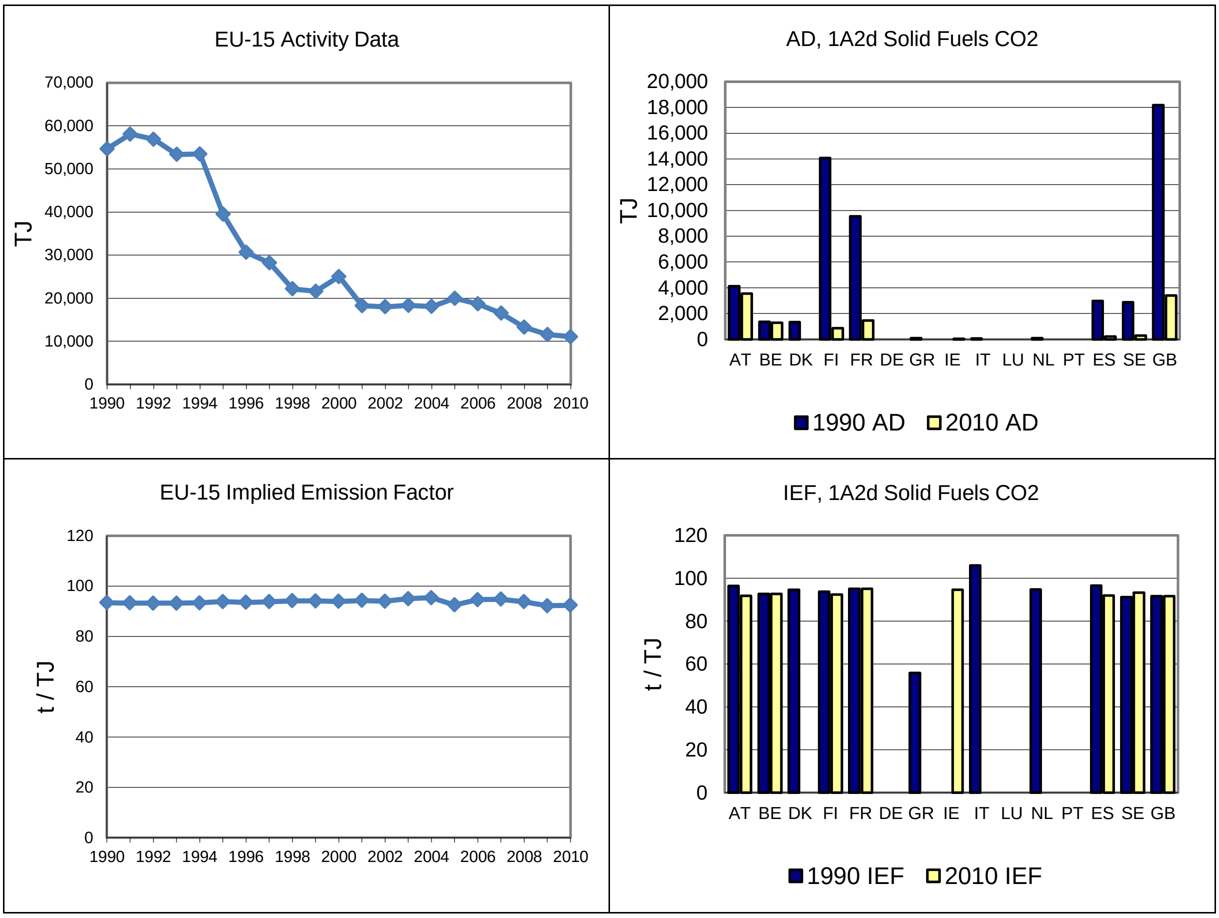
Table 3.34 1A2d Pulp, Paper and Print, solid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	397	345	326	31.9%	-19	-6%	-72	-18%	T2	CS,PS
Belgium	125	113	118	11.6%	4	4%	-7	-6%	T1	D
Denmark	125	NA	NA	-	-	-	-125	-100%	NA	NA
Finland	1,318	53	80	7.8%	27	50%	-1,238	-94%	T3	CS
France	908	144	139	13.6%	-5	-3%	-769	-85%	T2, T3	CS
Germany	IE	IE	IE	-	-	-	-	-	NA	NA
Greece	5	NO	NO	-	-	-	-5	-100%	NA	NA
Ireland	NO	2	3	-	-	-	3	-	T1	CS
Italy	6	NO	NO	-	-	-	-6	-100%	NA	NA
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	8	NO	NO	-	-	-	-8	-100%	NA	NA
Portugal	NO	NO	NO	-	-	-	-	-	NA	NA
Spain	286	59	19	1.9%	-40	-67%	-267	-93%	T2	CR, PS
Sweden	263	38	26	2.5%	-12	-32%	-237	-90%	T2	CS
United Kingdom	1,664	312	311	30.5%	0	0%	-1,353	-81%	T2	CS
EU-15	**5,105**	**1,066**	**1,021**	**100.0%**	**-45**	**-4%**	**-4,084**	**-80%**		

Emissions of Germany are included in 1A2f.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.41 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by Austria, Belgium, France and the United Kingdom; together they cause around 88 % of the CO_2 emissions from solid fuels in 1A2d. Solid fuel consumption in the EU-15 decreased by 80 % between 1990 and 2009. The implied emission factor of EU-15 was 92.3 t/TJ in 2010.

Figure 3.41 **1A2d Pulp, Paper and Print, solid fuels:Activity Data and Implied Emission Factors for CO_2**



1A2d Pulp, Paper and Print - Gaseous Fuels (CO_2)

In 2010, CO_2 from gaseous fuels had a share of 75 % within source category 1A2d (compared to 42 % in 1990). Between 1990 and 2010, the emissions increased by 61 % (Table 3.35). Germany includes emissions in 1A2f.

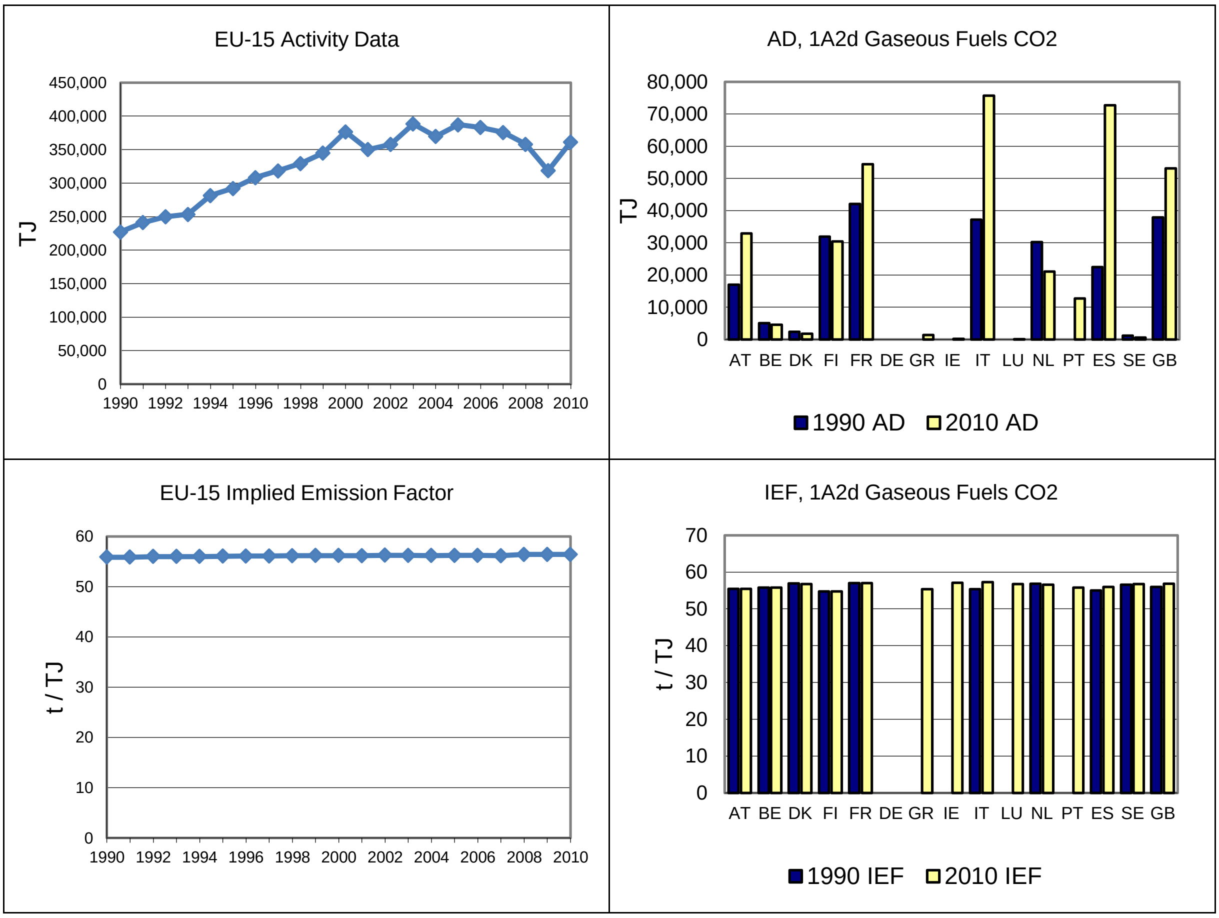
Table 3.35 **1A2d Pulp, Paper and Print, gaseous fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor**

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	943	1,644	1,825	9.0%	181	11%	883	94%	T2	CS
Belgium	280	229	255	1.3%	26	11%	-25	-9%	T1	D
Denmark	134	93	101	0.5%	8	9%	-33	-25%	CR	CS
Finland	1,748	1,456	1,665	8.2%	209	14%	-83	-5%	T3	CS
France	2,398	2,681	3,101	15.2%	419	16%	703	29%	T2, T3	CS
Germany	IE	IE	IE	-	-	-	-	-	NA	NA
Greece	NO	79	72	0.4%	-6	-8%	72	-	T2	CS
Ireland	NO	6	7	0.0%	1	-	7	-	T1	CS
Italy	2,055	3,438	4,335	21.3%	897	26%	2,280	111%	T2	CS
Luxembourg	IE	5	4	0.0%	-2	-31%	4	-	T2	CS
Netherlands	1,715	1,089	1,191	5.8%	101	9%	-524	-31%	T2	CS
Portugal	NO	381	708	3.5%	328	86%	708	-	T2	D, CR
Spain	1,233	3,922	4,069	20.0%	147	4%	2,837	230%	T2	CS
Sweden	66	35	32	0.2%	-3	-9%	-34	-52%	T2	CS
United Kingdom	2,122	2,922	3,020	14.8%	98	3%	898	42%	T2	CS
EU-15	**12,693**	**17,981**	**20,386**	**100.0%**	**2,404**	**13%**	**7,693**	**61%**		

Emissions of Germany are included in 1A2f.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.42 shows activity data and implied emission factors for CO_2 comparing the EU-15 average and the Member States. The largest emissions are reported by Austria, Finland, France, Italy, Spain and the United Kingdom; together they cause 88 % of the CO_2 emissions from gaseous fuels in 1A2d. Gaseous fuel consumption in the EU-15 rose by 59 % between 1990 and 2010. The implied emission factor of EU-15 was 56.4 t/TJ in 2010.

Figure 3.42 1A2d Pulp, Paper and Print, gaseous fuels: Activity Data and Implied Emission Factors for CO_2

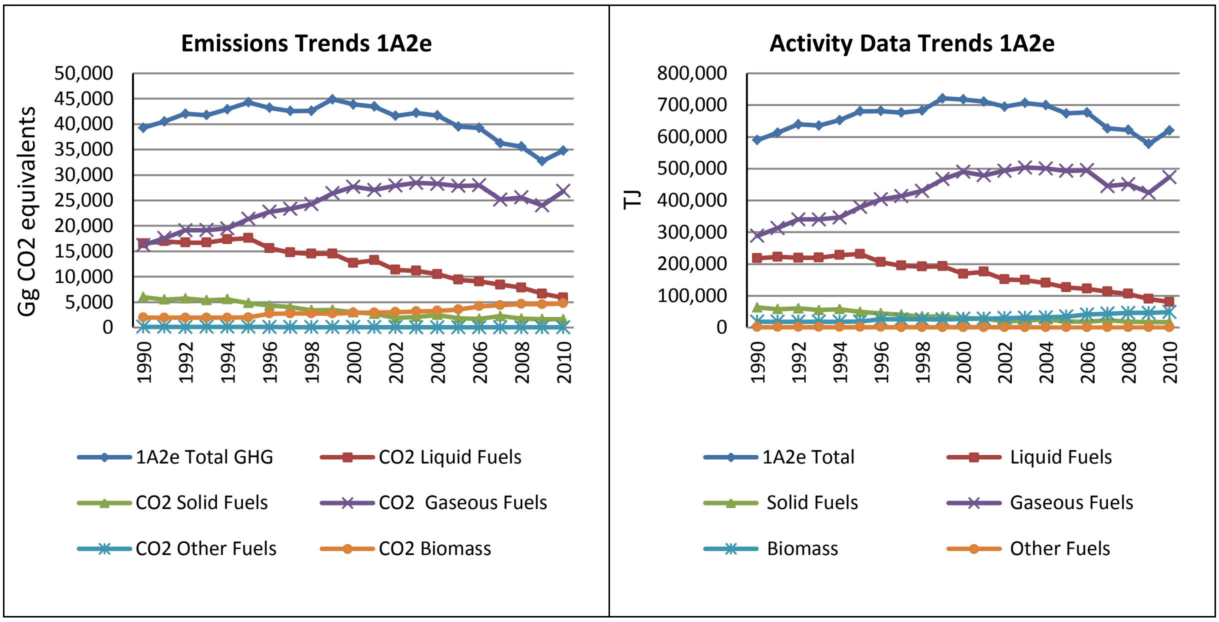


3.2.2.5 Food Processing, Beverages and Tobacco (1A2e) (EU-15)

In this chapter information about emission trends, Member States contribution, activity data and emission factors is provided for category 1A2e by fuels. CO_2 emissions from 1A2e Food Processing, Beverages and Tobacco accounted for 7 % of 1A2 source category and for 0.9 % of total GHG emissions in 2010.

Figure 3.43 shows the emission trend within the category 1A2e, which is mainly dominated by CO_2 emissions from gaseous and liquid fuels. Total GHG emissions decreased by 12 % between 1990 and 2010. Emissions from gaseous fuels increased by 65 %, whereas emissions from all other fossil fuel types decreased.

Figure 3.43 1A2e Food Processing, Beverages and Tobacco: Total and CO_2 emission trends



Between 1990 and 2010, CO_2 emissions from 1A2e Food Processing, Beverages and Tobacco decreased by 12 % in the EU-15 (Table 3.36). Large increases in France, Italy and Spain were offset by large decreases in Germany, the Netherlands and Belgium. Between 2009 and 2010 emissions increased by 6 %.

Table 3.36 1A2e Food Processing, Beverages and Tobacco: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010	
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	870	952	1,021	3.0%	69	7%	151	17%
Belgium	2,990	1,927	2,069	6.0%	142	7%	-921	-31%
Denmark	1,441	978	979	2.8%	1	0%	-462	-32%
Finland	815	242	237	0.7%	-5	-2%	-578	-71%
France	8,285	8,690	10,045	29.2%	1,355	16%	1,760	21%
Germany	1,989	450	459	1.3%	8	2%	-1,531	-77%
Greece	902	588	499	1.4%	-89	-15%	-404	-45%
Ireland	1,017	1,066	1,018	3.0%	-48	-4%	1	0%
Italy	3,853	4,661	4,398	12.8%	-263	-6%	544	14%
Luxembourg	16	16	15	0.0%	-1	-5%	-1	-6%
Netherlands	4,079	3,268	3,447	10.0%	180	5%	-632	-15%
Portugal	822	934	1,062	3.1%	129	14%	240	29%
Spain	3,373	3,668	3,945	11.5%	277	8%	572	17%
Sweden	948	487	484	1.4%	-3	-1%	-464	-49%
United Kingdom	7,556	4,459	4,749	13.8%	289	6%	-2,807	-37%
EU-15	**38,957**	**32,384**	**34,426**	**100.0%**	**2,042**	**6%**	**-4,531**	**-12%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A2e Food Processing, Beverages and Tobacco - Liquid (CO_2)

In 2010 CO_2 from liquid fuels decreased to a share of 17 % within source category 1A2e (compared to 42 % in 1990). Between 1990 and 2010, the emissions decreased by 64 % (Table 3.37). Between 1990 and 2010 all Member States except for Ireland showed reduction of emissions.

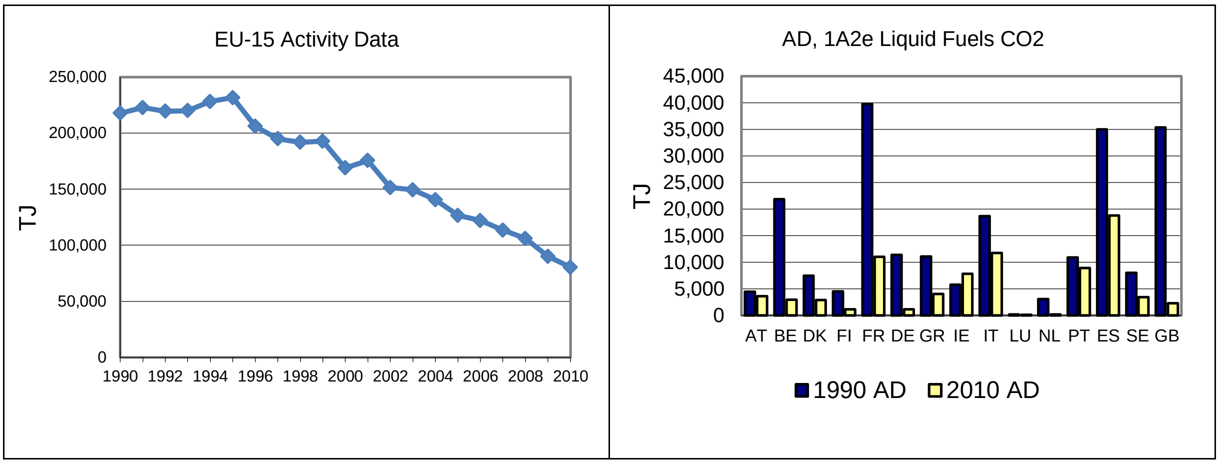
Table 3.37 **1A2e Food Processing, Beverages and Tobacco, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor**

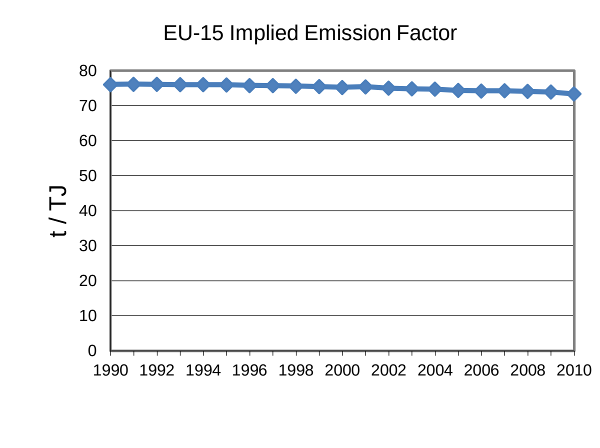
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	345	212	262	4.4%	50	24%	-83	-24%	T2	CS,PS
Belgium	1,671	338	218	3.7%	-120	-35%	-1,453	-87%	T1	D
Denmark	576	245	226	3.8%	-18	-7%	-349	-61%	CR	CS,D
Finland	353	103	90	1.5%	-14	-13%	-263	-75%	T3	CS
France	2,999	928	777	13.2%	-151	-16%	-2,223	-74%	T2, T3	CS
Germany	889	101	92	1.6%	-10	-10%	-797	-90%	CS	CS
Greece	847	340	294	5.0%	-46	-13%	-553	-65%	T2	PS
Ireland	433	657	565	9.6%	-93	-14%	132	30%	T1	CS
Italy	1,421	1,293	867	14.7%	-427	-33%	-554	-39%	T2	CS
Luxembourg	12	11	8	0.1%	-3	-24%	-4	-32%	T1,T2	CS,D
Netherlands	235	7	11	0.2%	4	59%	-224	-95%	T2	CS
Portugal	821	579	669	11.4%	90	16%	-152	-18%	T2	D, CR
Spain	2,633	1,417	1,390	23.6%	-28	-2%	-1,243	-47%	T2	CR
Sweden	596	251	247	4.2%	-5	-2%	-350	-59%	T2	CS
United Kingdom	2,730	174	179	3.0%	5	3%	-2,551	-93%	T2	CS
EU-15	**16,560**	**6,655**	**5,893**	**100.0%**	**-763**	**-11%**	**-10,668**	**-64%**		

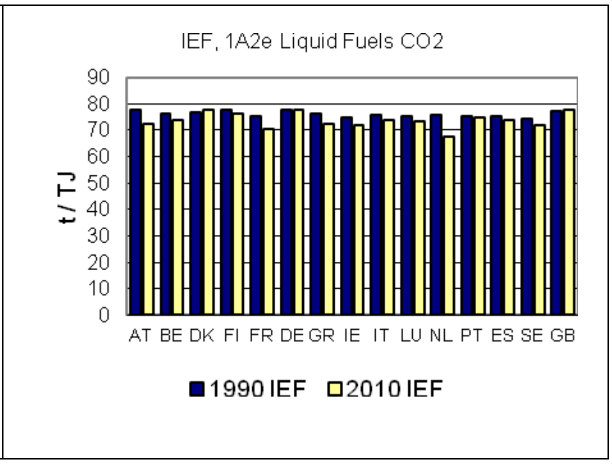
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.44 shows activity data and implied emission factors for CO_2 comparing the EU-15 average and the Member States. The largest emissions are reported by France, Italy and Spain; together they cause 51 % of the CO_2 emissions from liquid fuels in 1A2e. Fuel consumption in the EU-15 decreased by 63 % between 1990 and 2010. The implied emission factor of EU-15 was 73.4 t/TJ in 2010.

Figure 3.44 **1A2e Food Processing, Beverages and Tobacco, liquid fuels: Activity Data and Implied Emission Factors for CO_2**







1A2e Food Processing Beverages and Tobacco - Solid (CO_2)

In 2010 solid fuels had a share of 5 % within source category 1A2e (compared to 15 % in 1990). Between 1990 and 2010 the emissions decreased by 73 % (Table 3.38) and all Member States reported decreasing CO_2 emissions from this source category.

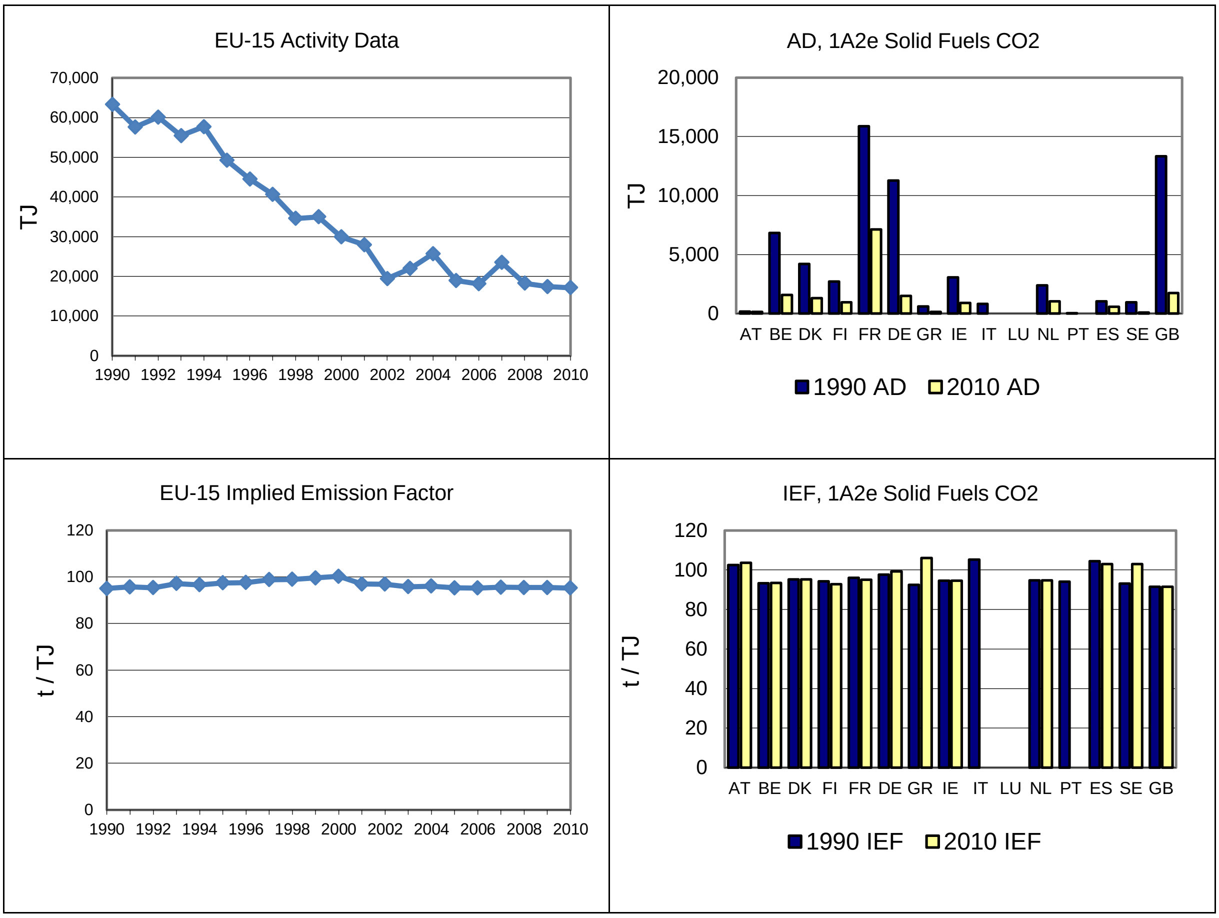
Table 3.38 1A2e Food Processing, Beverages and Tobacco, solid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	18	14	15	0.9%	1	7%	-3	-17%	T2	CS,PS
Belgium	638	105	148	9.1%	43	41%	-490	-77%	T1	D
Denmark	402	157	125	7.7%	-32	-20%	-276	-69%	CR	CS,D
Finland	257	88	89	5.5%	2	2%	-167	-65%	T3	CS
France	1,525	688	677	41.5%	-11	-2%	-848	-56%	T2, T3	CS
Germany	1,100	137	149	9.1%	12	9%	-952	-86%	CS	CS
Greece	56	15	15	0.9%	0	0%	-40	-72%	T2	PS
Ireland	292	79	86	5.3%	8	10%	-205	-70%	T1	CS
Italy	86	NO	NO	-	-	-	-86	-100%	NA	NA
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	227	100	99	6.1%	0	0%	-128	-56%	T2	CS
Portugal	1	NO	NO	-	-	-	-1	-100%	NA	NA
Spain	109	99	59	3.6%	-40	-40%	-49	-46%	T2	CR
Sweden	90	10	9	0.6%	-1	-9%	-81	-90%	T2	CS
United Kingdom	1,221	172	160	9.8%	-12	-7%	-1,062	-87%	T2	CS
EU-15	**6,021**	**1,663**	**1,632**	**100.0%**	**-31**	**-2%**	**-4,389**	**-73%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.45 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by France which contributes 41 % of the CO_2 emissions from solid fuels in 1A2e. Fuel consumption in the EU-15 decreased by 73 % between 1990 and 2010. The implied emission factor of EU-15 was 95.2 t/TJ in 2010.

Figure 3.45 **1A2e Food Processing, Beverages and Tobacco, solid fuels: Activity Data and Implied Emission Factors for CO_2**



1A2e Food Processing Beverages and Tobacco - Gaseous (CO_2)

In 2010 CO_2 from gaseous fuels had a share of 77 % within source category 1A2e (compared to 41 % in 1990). Between 1990 and 2010 the emissions increased by 65 % (Table 3.39). Between 1990 and 2010 most Member States reported increasing CO_2 emissions from this source category. Major absolute increases occurred in Belgium, France, Italy and Spain. For specific years Germany reports emissions in 1A2f.

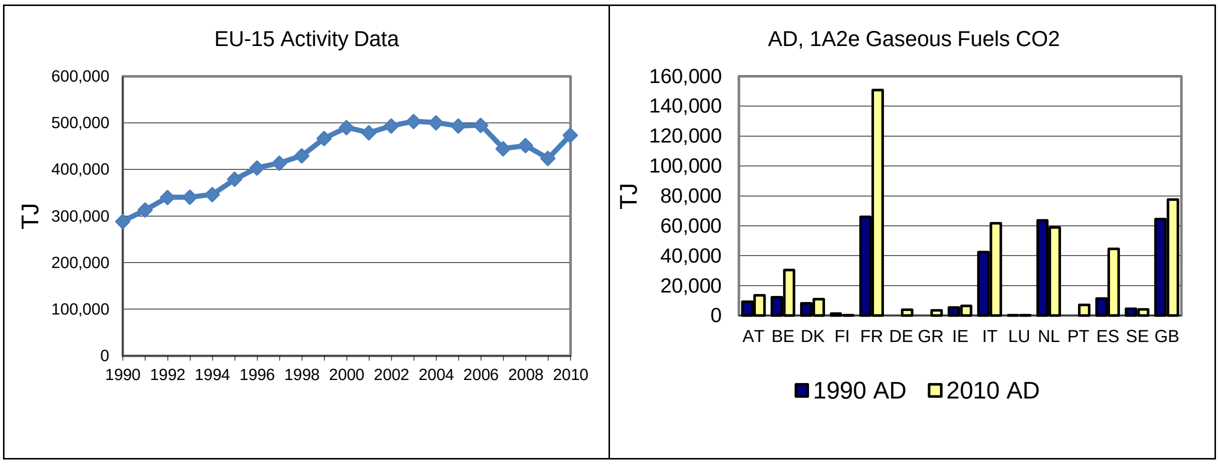
Table 3.39 **1A2e Food Processing, Beverages and Tobacco, gaseous fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor**

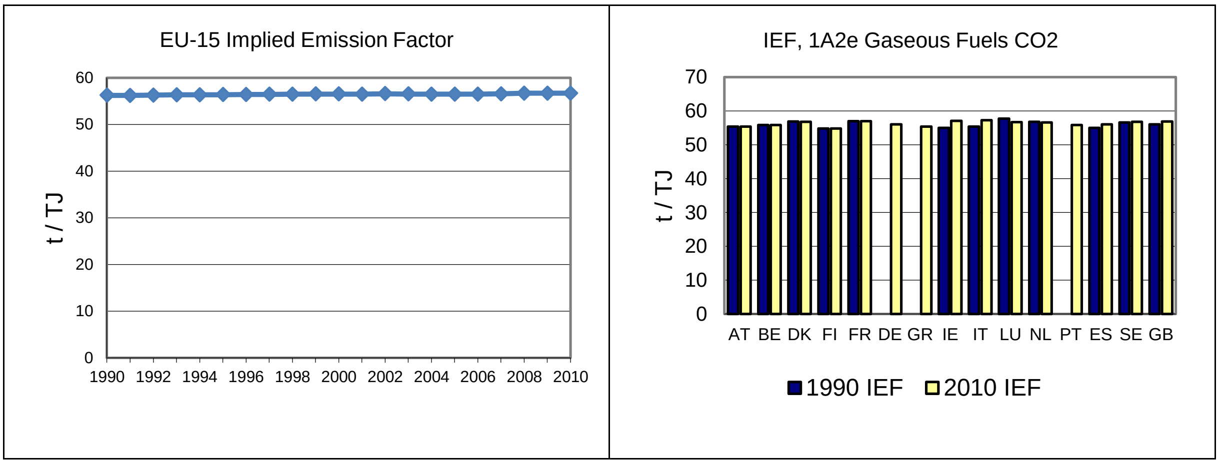
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	507	726	744	2.8%	18	2%	237	47%	T2	CS
Belgium	681	1,484	1,703	6.3%	219	15%	1,022	150%	T1	D
Denmark	463	574	624	2.3%	51	9%	161	35%	CR	CS
Finland	67	12	9	0.0%	-3	-24%	-58	-86%	T3	CS
France	3,762	7,075	8,592	32.0%	1,517	21%	4,830	128%	T2, T3	CS
Germany	IE	212	218	0.8%	7	3%	-	-	CS	CS
Greece	NO	233	189	0.7%	-44	-19%	189	-	T2	CS
Ireland	293	330	367	1.4%	37	11%	74	25%	T1	CS
Italy	2,346	3,367	3,531	13.15%	164	5%	1,184	50%	T2	CS
Luxembourg	4	5	7	0.03%	1.8	34%	3	80%	T2	CS
Netherlands	3,617	3,161	3,337	12.4%	176	6%	-280	-8%	T2	CS
Portugal	NO	355	393	1.5%	38	11%	393	-	T2	D, CR
Spain	631	2,151	2,496	9.3%	345	16%	1,865	295%	T2	CS
Sweden	254	226	228	0.9%	2	1%	-25	-10%	T2	CS
United Kingdom	3,605	4,114	4,410	16.4%	297	7%	805	22%	T2	CS
EU-15	**16,229**	**24,024**	**26,850**	**100.0%**	**2,825**	**12%**	**10,621**	**65%**		

Emissions of Germany are included in 1A2f.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.46 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by France, Italy, the Netherlands and the United Kingdom; together they cause about 74 % of the CO_2 emissions from gaseous fuels in 1A2e. Fuel consumption in the EU-15 rose by 64 % between 1990 and 2010. The implied emission factor of EU-15 was 56.7 t/TJ in 2010.

Figure 3.46 **1A2e Food Processing, Beverages and Tobacco, gaseous fuels: Activity Data and Implied Emission Factors for CO_2**



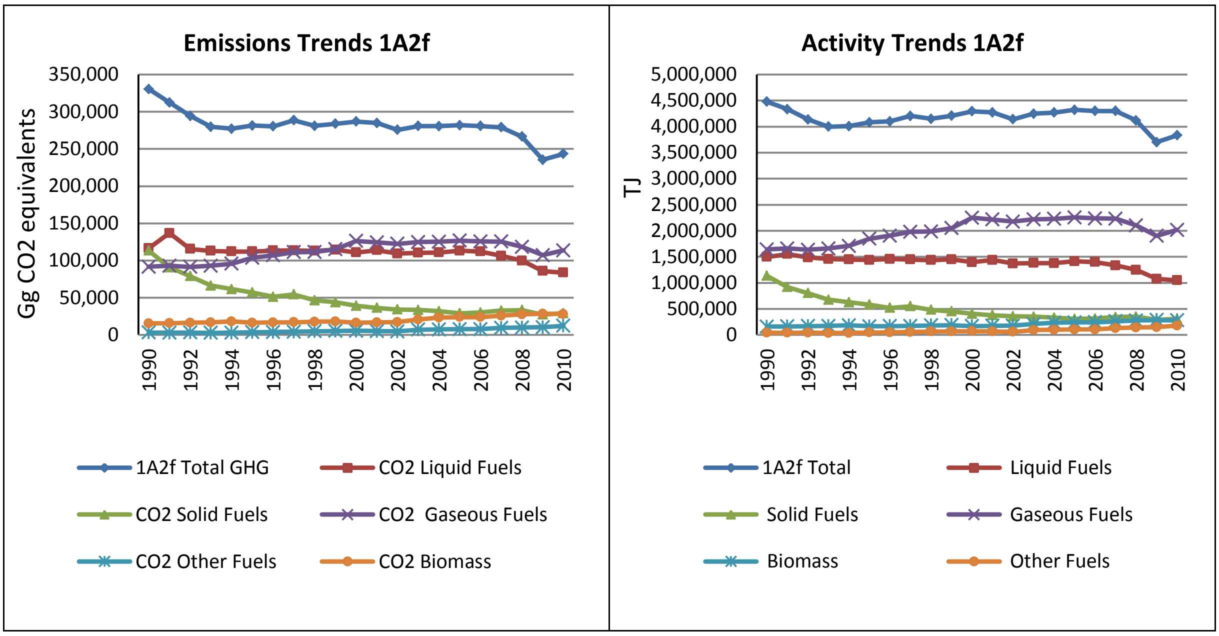


3.2.2.6 Other (1A2f) (EU-15)

In this chapter information about emission trends, Member States contribution, activity data and emission factors is provided for category 1A2f by fuels. CO_2 emissions from 1A2f Other accounted for 48.8 % for 1A2 source category and for 6.3 % of total GHG emissions in 2010.

Figure 3.47 shows the emission trend within the category 1A2f, which is mainly dominated by CO_2 emissions from gaseous and liquid fuels; the decrease in the early 1990s was mainly due to a decline of solid fuel consumption. Total GHG emissions decreased by 26 %, mainly due to decreases in emissions from solid (-74 %) and liquid (-28 %) fuels.

Figure 3.47 1A2f Other: Total and CO_2 emission trends



Between 1990 and 2010, CO_2 emissions from 1A2f Other decreased by 27 % in the EU-15 (Table 3.40), mainly due to decreases in Germany (-42 %) and the United Kingdom (-31 %). Spanish emissions increased by 52 % in the same period.

Table 3.40 1A2f Other: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010	
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	3,644	4,816	4,768	2.0%	-48	-1%	1,124	31%
Belgium	8,282	6,138	6,720	2.8%	582	9%	-1,561	-19%
Denmark	3,205	2,705	3,064	1.3%	359	13%	-142	-4%
Finland	2,904	1,762	1,966	0.8%	204	12%	-938	-32%
France	28,371	19,369	20,814	8.7%	1,445	7%	-7,556	-27%
Germany	137,299	75,213	79,192	33.2%	3,979	5%	-58,106	-42%
Greece	6,126	5,094	4,447	1.9%	-646	-13%	-1,679	-27%
Ireland	1,503	1,808	1,684	0.7%	-124	-7%	181	12%
Italy	40,489	29,015	28,040	11.7%	-975	-3%	-12,449	-31%
Luxembourg	646	679	676	0.3%	-4	-1%	30	5%
Netherlands	5,826	4,723	4,789	2.0%	66	1%	-1,036	-18%
Portugal	5,499	5,547	5,623	2.4%	76	1%	124	2%
Spain	24,070	33,649	36,530	15.3%	2,881	9%	12,460	52%
Sweden	5,462	4,077	4,564	1.9%	487	12%	-898	-16%
United Kingdom	51,705	36,208	35,879	15.0%	-329	-1%	-15,827	-31%
EU-15	**325,029**	**230,803**	**238,756**	**100.0%**	**7,953**	**3%**	**-86,273**	**-27%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A2f Other - Liquid Fuels (CO_2)

In 2010 liquid fuels had a share of 34 % within source category 1A2f (compared to 35 % in 1990). Between 1990 and 2010 emissions decreased by 28 % (Table 3.41). Between 1990 and 2010 the highest absolute decreases were achieved by France, Germany, Italy and the United Kingdom. The highest absolute increases were reported from Greece and Spain.

Table 3.41 1A2f Other, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

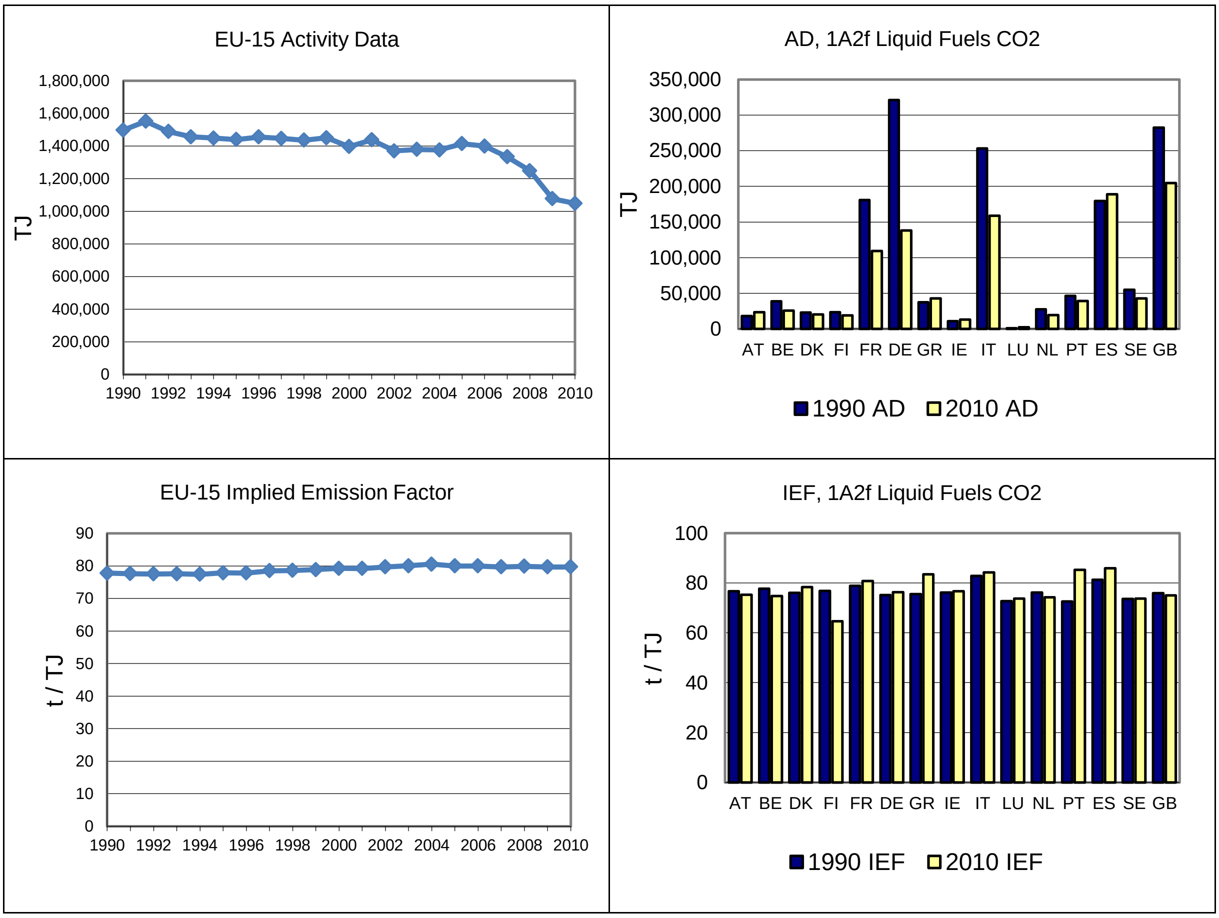
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	1,376	1,744	1,771	2.1%	27	2%	395	29%	T2,T3	CS,PS
Belgium	3,002	1,955	1,937	2.3%	-18	-1%	-1,065	-35%	CS,T1	D,PS
Denmark	1,766	1,423	1,610	1.9%	188	13%	-156	-9%	CR	CS,D,PS
Finland	1,809	1,098	1,221	1.5%	123	11%	-588	-33%	CS,M,T3	CS
France	14,241	9,233	8,823	10.6%	-410	-4%	-5,418	-38%	T2,T3	CS
Germany	24,094	11,209	10,522	12.6%	-687	-6%	-13,572	-56%	CS	CS
Greece	2,828	4,495	3,564	4.3%	-931	-21%	736	26%	T2	PS
Ireland	824	1,093	999	1.2%	-94	-9%	175	21%	T1	CS
Italy	20,965	14,354	13,381	16.0%	-973	-7%	-7,584	-36%	T2	CS
Luxembourg	88	207	193	0.2%	-13	-6%	105	119%	T1,T2	CS,D
Netherlands	2,107	1,613	1,453	1.7%	-160	-10%	-654	-31%	T2	CS
Portugal	3,361	3,476	3,361	4.0%	-115	-3%	0	0%	T2	CR,D,PS
Spain	14,565	16,197	16,257	19.4%	60	0%	1,691	12%	T2,T3	CR,CS
Sweden	4,055	3,020	3,175	3.8%	156	5%	-879	-22%	T1,T2	CS
United Kingdom	21,428	14,752	15,349	18.4%	598	4%	-6,079	-28%	T2	CS
EU-15	**116,510**	**85,867**	**83,616**	**100.0%**	**-2,251**	**-3%**	**-32,894**	**-28%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.48 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by France, Germany, Italy, Spain and the United Kingdom; together they cause 57 % of the CO_2 emissions from liquid fuels in 1A2f. Fuel consumption in the EU-

15 decreased by 30 % between 1990 and 2010. The implied emission factor of EU-15 was 80.0 t/TJ in 2010.

Figure 3.48 1A2f Other, liquid fuels: Activity Data and Implied Emission Factors for CO_2



1A2f Other - Solid (CO_2)

In 2010 CO_2 from solid fuels had a share of 12 % within source category 1A2f (compared to 34 % in 1990). Between 1990 and 2010 emissions decreased by 74 % (Table 3.42). Between 1990 and 2010 all Member States reported (partly significant) decreases of emissions; the highest absolute decreases were reported by Germany and the UK. Between 2009 and 2010 EU-15 emissions increased by 7 %.

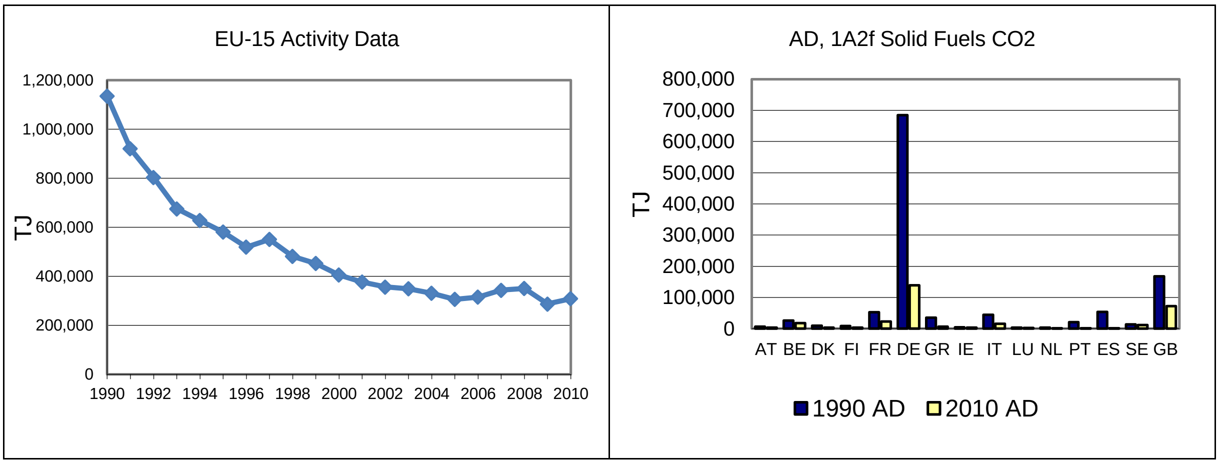
Table 3.42 **1A2f Other, solid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor**

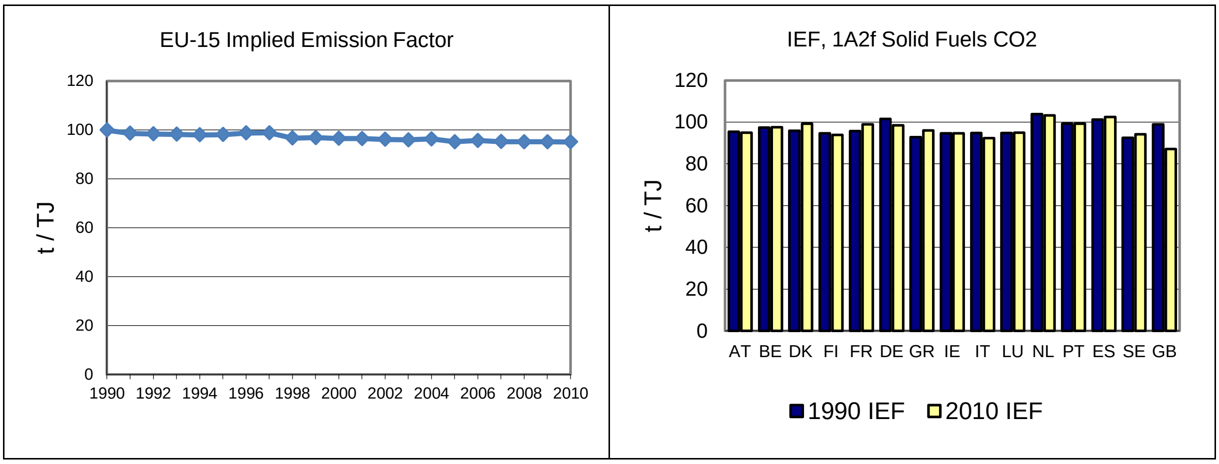
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	625	527	359	1.2%	-167	-32%	-266	-43%	T2	CS,PS
Belgium	2,537	1,468	1,716	5.8%	249	17%	-821	-32%	CS,T1	D,PS
Denmark	901	252	340	1.2%	88	35%	-561	-62%	CR	CS,D,PS
Finland	815	287	376	1.3%	90	31%	-439	-54%	T3	CS
France	5,034	1,967	2,285	7.8%	318	16%	-2,749	-55%	T2,T3	CS
Germany	69,494	11,967	13,728	46.8%	1,761	15%	-55,766	-80%	CS	CS
Greece	3,298	330	655	2.2%	325	98%	-2,644	-80%	T2	PS
Ireland	389	364	320	1.1%	-44	-12%	-69	-18%	T1	CS
Italy	4,233	1,909	1,508	5.1%	-402	-21%	-2,726	-64%	T2	CS
Luxembourg	333	209	196	0.7%	-12	-6%	-136	-41%	T1	D
Netherlands	388	169	172	0.6%	3	2%	-216	-56%	T2	CS
Portugal	2,126	53	158	0.5%	105	200%	-1,968	-93%	T2	CR,D,PS
Spain	5,465	245	146	0.5%	-99	-41%	-5,320	-97%	T2	CR,CS
Sweden	1,229	783	1,071	3.6%	288	37%	-158	-13%	T2	CS
United Kingdom	16,659	6,832	6,333	21.6%	-499	-7%	-10,326	-62%	T2	CS
EU-15	**113,525**	**27,360**	**29,363**	**100.0%**	**2,003**	**7%**	**-84,163**	**-74%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.49 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are still reported by Germany and the United Kingdom; together they cause about 68 % of the CO_2 emissions from solid fuels in 1A2f. Fuel consumption in the EU-15 decreased by 73 % between 1990 and 2010. The implied emission factor of EU-15 was 95.1 t/TJ in 2010.

Figure 3.49 **1A2f Other, solid fuels: Activity Data and Implied Emission Factors for CO_2**





1A2f Other - Gaseous (CO_2)

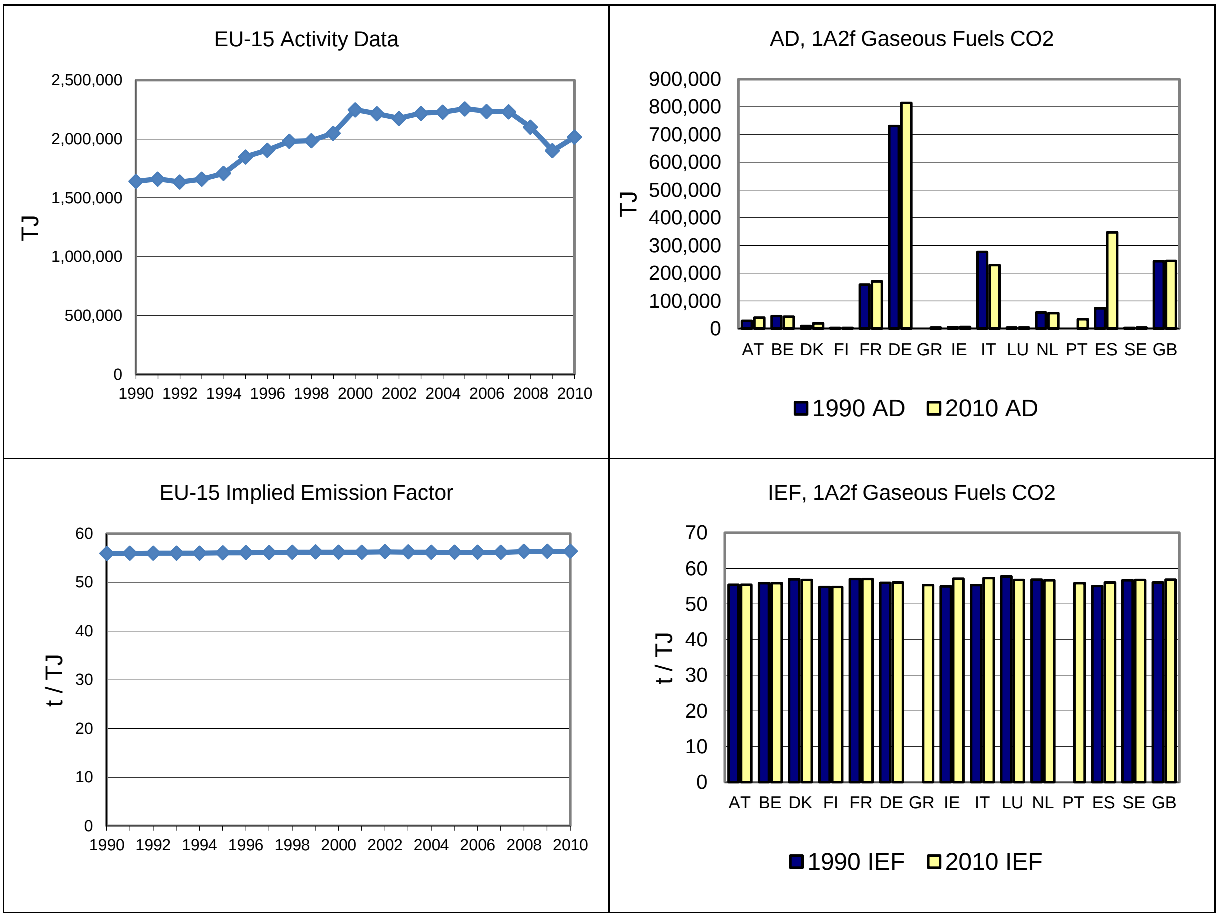
In 2010 CO_2 from gaseous fuels had a share of 47 % within source category 1A2f (compared to 28 % in 1990). Between 1990 and 2010, the emissions increased by 24 % (Table 3.43). Between 1990 and 2010, most Member States showed increasing emissions. Spain, the United Kingdom and Portugal showed the highest absolute increases.

Table 3.43 1A2f Other, gaseous fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	1,573	2,091	2,174	1.9%	83	4%	601	38%	T2	CS
Belgium	2,556	2,119	2,429	2.1%	310	15%	-126	-5%	CS,T1	D
Denmark	538	940	1,055	0.9%	115	12%	517	96%	CR	CS
Finland	171	142	122	0.1%	-20	-14%	-49	-28%	T3	CS
France	9,074	8,141	9,679	8.5%	1,538	19%	605	7%	T2,T3	CS
Germany	40,841	44,114	45,552	40.1%	1,438	3%	4,712	12%	CS	CS
Greece	NO	252	210	0.2%	-42	-17%	210	-	T2	CS
Ireland	290	321	348	0.3%	27	8%	58	20%	T1	CS
Italy	15,290	12,752	13,151	11.6%	399	3%	-2,139	-14%	T2	CS
Luxembourg	225	228	234	0.2%	6	3%	9	4%	T2	CS
Netherlands	3,331	2,942	3,165	2.8%	223	8%	-166	-5%	T2	CS
Portugal	NO	1,872	1,908	1.7%	35	2%	1,908	-	T2	CR,D,PS
Spain	4,039	16,701	19,463	17.1%	2,762	17%	15,424	382%	T2	CS
Sweden	178	222	247	0.2%	25	11%	69	39%	T1,T2	CS
United Kingdom	13,617	14,335	13,871	12.2%	-464	-3%	254	2%	T2	CS
EU-15	**91,723**	**107,173**	**113,609**	**100.0%**	**6,436**	**6%**	**21,886**	**24%**		

Figure 3.50 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by Germany, Italy, Spain and the United Kingdom; together they cause 81 % of the CO_2 emissions from gaseous fuels in 1A2f. Fuel combustion in the EU-15 rose by 23 % between 1990 and 2010. The implied emission factor of EU-15 was 56.3 t/TJ in 2010.

Figure 3.50 1A2f Other, gaseous fuels: Activity Data and Implied Emission Factors for CO_2



1A2f Other Fuels (CO_2)

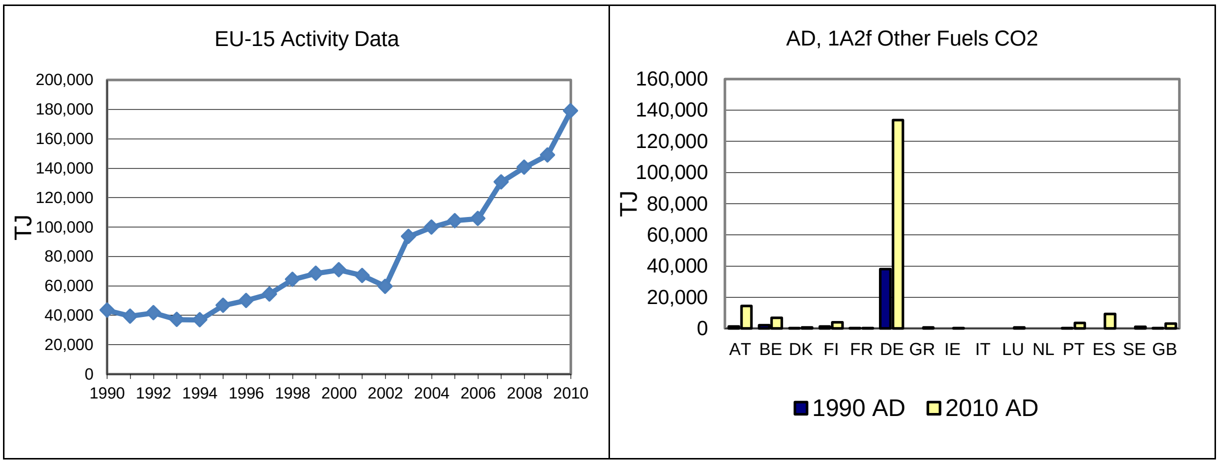
In 2010 CO_2 from other fuels had a share of 5 % within source category 1A2f (compared to 1 % in 1990). Between 1990 and 2010, the emissions increased by 272 % (Table 3.44). Between 1990 and 2010 all Member States showed increasing emissions. Germany showed the highest absolute increase by far.

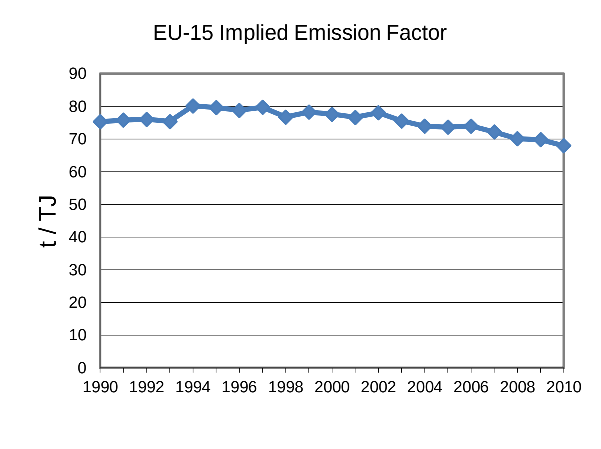
Table 3.44 **1A2f Other Fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor**

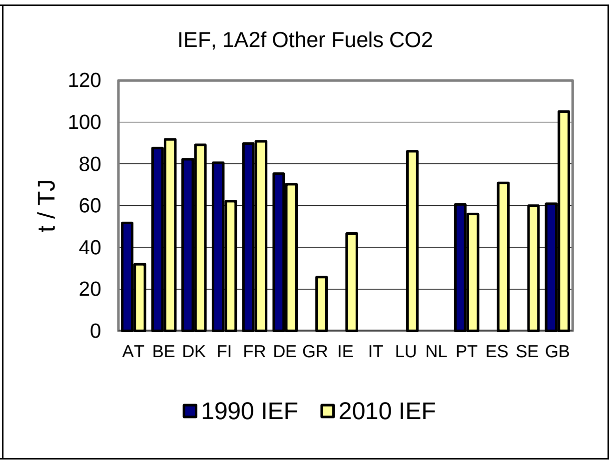
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	70	454	464	3.8%	10	2%	394	562%	T2	D,PS
Belgium	186	596	638	5.2%	41	7%	451	242%	CS,T1	D
Denmark	0	90	59	0.5%	-31	-35%	59	25821%	CR	CS,PS
Finland	109	236	247	2.0%	11	5%	137	126%	T3	CS
France	22	29	28	0.2%	-1	-3%	6	27%	T2,T3	CS
Germany	2,870	7,923	9,390	77.2%	1,467	19%	6,520	227%	CS	CS
Greece	NO	16	19	0.2%	2	15%	19	-	T2	PS
Ireland	NO	29	17	0.1%	-13	-	17	-	T3	PS
Italy	NO	NO	NO	-	-	-	-	-	NA	NA
Luxembourg	NO	36	52	0.4%	16	44%	52	-	T1	PS
Netherlands	NA,NO	NA,NO	NO	-	-	-	-	-	NA	NA
Portugal	12	146	196	1.6%	50	34%	184	1522%	T2	CR,D,PS
Spain	NA	506	664	5.5%	159	31%	664	-	T2	CR
Sweden	NO	52	70	0.6%	18	34%	70	-	T2	CS
United Kingdom	1	289	325	2.7%	36	12%	324	30158%	T2	CS
EU-15	**3,271**	**10,404**	**12,169**	**100.0%**	**1,765**	**17%**	**8,898**	**272%**		

Figure 3.51 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by Germany which contributes to 77 % of the CO_2 emissions from other fuels in 1A2f. The implied emission factor of EU-15 was 68 t/TJ in 2010.

Figure 3.51 **1A2f Other Fuels: Activity Data and Implied Emission Factors for CO_2**



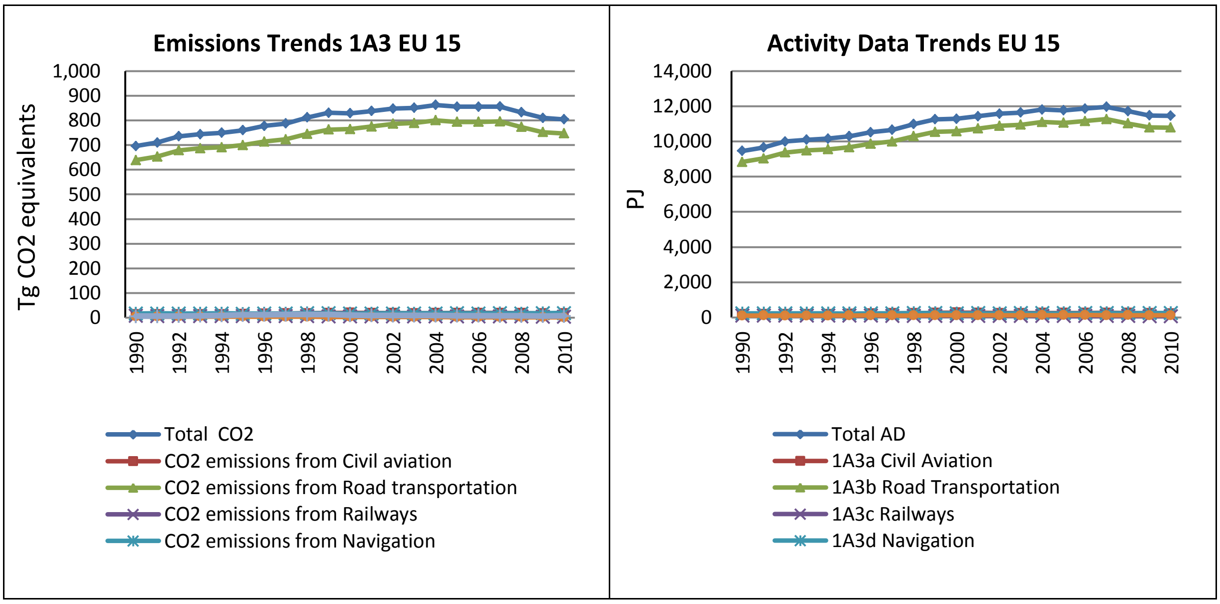

EU-15 Implied Emission Factor
t / TJ
0
10
20
30
40
50
60
70
80
90
1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010


IEF, 1A2f Other Fuels CO2
t / TJ
0
20
40
60
80
100
120
AT BE DK FI FR DE GR IE IT LU NL PT ES SE GB
1990 IEF
2010 IEF

3.2.3 Transport (CRF Source Category 1A3) (EU-15)

Greenhouse gas emissions from 1A3 Transport are shown in Figure . CO_2 emissions from this source category account for 21%, CH_4 for 0.03 %, N_2O for 0.21 % of total GHG emissions. Between 1990 and 2010, greenhouse gas emissions from transport increased by 15.6 % in the EU-15.

Figure 3.52 1A3 Transport: Greenhouse gas emissions in CO_2 equivalents (Tg) and Activity Data in TJ



This source category includes ten key categories:

- 1 A 3 a Civil Aviation: Jet Kerosene (CO_2)
- 1 A 3 b Road Transportation: Diesel oil (CO_2)
- 1 A 3 b Road Transportation: Diesel oil (N_2O)
- 1 A 3 b Road Transportation: Gasoline (CO_2)
- 1 A 3 b Road Transportation: Gasoline (CH_4)
- 1 A 3 b Road Transportation: LPG (CO_2)
- 1 A 3 c Railways: Liquid Fuels (CO_2)
- 1 A 3 d Navigation: Gas/Diesel Oil (CO_2)
- 1 A 3 d Navigation: Residual Oil (CO_2)

Table 3.45 shows total GHG, CO_2 and N_2O emissions from 1A3 Transport.

Table 3.45 1A3 Transport: Member States' contributions to CO_2 emissions and N_2O emissions

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2010 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO2 emissions in 2010 (Gg)	N_2O emissions in 1990 (Gg CO_2 equivalents)	CO2 emissions in 2010 (Gg CO_2 equivalents)
Austria	14,030	22,452	13,772	22,323	193	263
Belgium	20,472	24,257	20,101	27,366	255	236
Denmark	10,784	13,248	10,617	13,862	113	144
Finland	12,757	13,570	12,483	13,419	174	175
France	121,211	132,154	119,376	130,415	991	1,468
Germany	164,716	154,730	162,366	153,405	1,243	1,142
Greece	14,911	22,996	14,487	22,378	319	447
Ireland	5,118	11,606	5,022	13,596	59	125
Italy	103,078	118,849	101,269	122,273	1,027	1,188
Luxembourg	2,644	6,288	2,600	6,365	26	72
Netherlands	26,454	34,988	26,007	35,495	288	440
Portugal	10,309	18,936	10,140	18,971	83	207
Spain	54,976	91,423	54,138	100,253	528	959
Sweden	19,304	20,744	18,900	20,647	218	151
United Kingdom	115,264	118,455	113,234	122,294	1,394	1,202
EU-15	**696,029**	**804,696**	**684,512**	**823,061**	**6,910**	**8,219**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.46 provides information on the contribution of Member States to EU-15 recalculations in CO_2 from 1A3 Transport for 1990 and 2009 and main explanations for the largest recalculations in absolute terms.

Table 3.46 1A3 Transport: Contribution of MS to EU-15 recalculations in CO_2 for 1990 and 2009 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2009		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	18	0.1	154	0.7	Revised model parameters. Inclusion of LPG and CNG.
Belgium	2	0.0	150	0.6	- During the 2012 submission energy consumption data from warming up the natural gas that is imported from Norway (Statoil) and consequently the emissions of CO2 are revised from 2001 on in the Flemish region (category 1A3e / other transportation). - In Flemish Region, the EMMOSS model used to calculate the emissions from sea navigation and railways was updated in the course of 2010. Emissions for the entire
Denmark	0	0.0	32	0.2	1A3b: The total mileage per vehicle category from 1985-2009 have been updated based on new data prepared by DTU Transport. Important changes are a different split of total mileage between gasoline and diesel passenger cars based on data for the year 2008 from the Danish vehicle inspection and maintenance programme. Also
Finland	0	0.0	40	0.3	Updated activity data
France	1,301	1.1	253	0.2	Mise à jour des chiffres des Comptes des Transports de la Nation (CCTN)
Germany	449	0.3	236	0.2	- 1A3a, activity data: corrected Energy Balance 2009; ratio domestic : international recalculated by EUROCONTROL - 1A3b, activity data: revised Energy Balance 2009; revision of TREMOD
Greece	0	0.0	9	0.03	- 1A3b, natural gas: country-specific emission factor was used - 1A3e, pipeline transport, natural gas: updated activity data
Ireland	-17	-0.3	-590	-4.5	- New methodology based on airport to airport data - Revised Energy Balance data
Italy	0	0.0	23	0.0	Update of CO2 natural gas emission factor
Luxembourg	0	0.0	-170	-2.8	Revised AD due to revised energy balance by national statistics
Netherlands	-2	0.0	-32	-0.1	Improvement based on new survey
Portugal	223	2.2	301	1.6	1) New version of COPERT IV (version 9.0 - October 2011) available; 2) New data on km/vehicles for passenger cars and light duty vehicles from a model based on data from the vehicle inspection centers; 3) Information available from national statistics on activity data from HDV and Buses; 4) Adoption of CO2 default emission factor to calculate emissions from the combustion of gasoline since country-specific EF was not available. 5) Revision of the toe/ton conversion factors used to convert railways fuel consumption from energy balance toe to INERPA ton. The newer values were obtained from DGEG and updated for all times series for auto-producers. These new
Spain	-145	-0.3	-8	0.0	1A3a, jet kerosene: The national MECETA model for aviation has updated the fuel consumption functions and emission factors corresponding to the cruise phase for the years where detailed information on flight movements per type of aircraft and
Sweden	122	0.6	-21	-0.1	New models for road traffic and off-road vehicles/working machinery also affecting navigation.
UK	-561	-0.5	-407	-0.3	Re-allocation of more petrol and DERV to off-road and inland waterways sectors. Revised vkm and vehicle fleet data.
EU-15	**1,389**	**0.2**	**-32**	**0.0**	

Table 3.47 provides information on the contribution of Member States to EU-15 recalculations in N_2O from 1A3 Transport for 1990 and 2009.

Table 3.47 **1A3 Transport: Contribution of MS to EU-15 recalculations in N_2O for 1990 and 2009 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)**

	1990		2009		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	-1	-0.8	2	0.8	Revised model parameters. Inclusion of LPG and CNG.
Belgium	1	0.5	7	3.4	- In Flemish Region, the EMMOSS model used to calculate the emissions from sea navigation and railways was updated in the course of 2010. Emissions for the entire time series were recalculated based on this improved model during the 2012 submission. - The Brussels region has performed a recalculation for the non-CO2 emissions of road transport by tuning the Copert IV model (harmonization of some parameters
Denmark	-1	-0.7	1	0.5	1A3b: The total mileage per vehicle category from 1985-2009 have been updated based on new data prepared by DTU Transport. Important changes are a different split of total mileage between gasoline and diesel passenger cars based on data for the year 2008 from the Danish vehicle inspection and maintenance programme. Also
Finland	0	0.0	0	0.0	
France	-9	-0.9	-277	-17.9	- 1A3b: Mise à jour Facteur Emission - 1A3d: Mise à jour données CCTN pour la plaisance.
Germany	562	82.7	209	21.2	- Emission factors: Revision of TREMOD; - Activity data: revision of energy balance
Greece	150	89.1	137	51.1	1A3e, pipeline transport, natural gas: updated activity data
Ireland	0	0.0	-5	-3.9	- New methodology based on airport to airport data - Revised Energy Balance data
Italy	124	13.7	74	6.9	- Update of COPERT version (COPERT 4.9) - Update of average recreational boats emission factor
Luxembourg	0	0.0	-2	-2.6	Revised AD due to revised energy balance by national statistics
Netherlands	16	5.7	0.4	0.1	Improvement based on new survey
Portugal	4	4.9	-13	-6.9	1) New version of COPERT IV (version 9.0 - October 2011) available; 2) New data on km/vehicles for passenger cars and light duty vehicles from a model based on data from the vehicle inspection centers; 3) Information available from national statistics on activity data from HDV and Buses; 4) Update of sulphur content in gasoline and diesel according to DL 235/2004 (Directive 2003/17/CE) with implications on N2O emissions 5) Revision of the toe/ton conversion factors used to convert railways fuel consumption from energy balance toe to INERPA ton. The newer values were obtained from DGEG and updated for all times series for auto-producers. These new
Spain	0	0.0	-4	-0.5	1A3b, gasoline + diesel oil: It was discovered an error in the vehicle fleet of the light duty vehicles and heavy duty vehicles from this year.
Sweden	73	50.3	-5	-3.1	New models for road traffic and off-road vehicles/working machinery also affecting navigation.
UK	3	0.2	-127	-10.0	Re-allocation of more petrol and DERV to off-road and inland waterways sectors. Revised vkm and vehicle fleet data.
EU-15	**922**	**15.4**	**-2**	**0.0**	

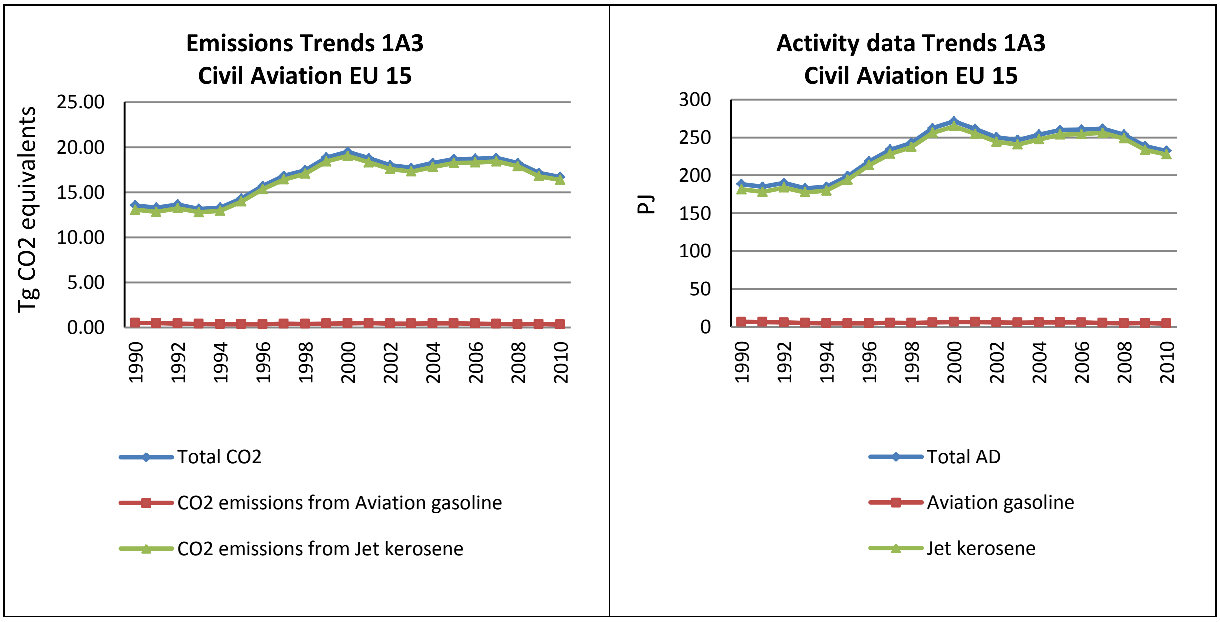
3.2.3.1 Civil Aviation (1A3a) (EU-15)

This source category includes emissions from civil domestic passenger and freight traffic that departs and arrives in the same country (commercial, private, agriculture, etc.), including take-offs and landings for these flight stages.

CO_2 emissions from 1A3a Civil Aviation account for 2.1% of total transport-related GHG emissions in 2010. Between 1990 and 2010, CO_2 emissions from civil aviation increased by 23 % in the EU-15 (Table 3.47, Figure 3.53).

CO_2 emissions from Jet Kerosene account for 98.1 % of total CO_2 emissions from 1A3a Civil Aviation. Between 2009 and 2010, CO_2 emissions from civil aviation decreased by 3 % in the EU-15 (Table 3.47, Figure 3.53).

Figure 3.53 **1A3a Civil Aviation: CO_2 Emissions in CO_2 equivalents (Tg) and Activity data in TJ**



The Member States France, Germany, Italy and Spain alone contributed 73.9 % to the emissions from this source. Most Member States increased emissions from civil aviation between 1990 and 2010 (Table 3.48).

Table 3.48 **1A3a Civil Aviation: Member States' contributions to CO_2 emissions**

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010	
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	32	67	64	0.4%	-4	-6%	32	99%
Belgium	12	9	10	0.1%	1	9%	-2	-18%
Denmark	243	153	156	0.9%	3	2%	-87	-36%
Finland	385	275	253	1.5%	-22	-8%	-132	-34%
France	4,241	4,456	4,520	27.1%	64	1%	279	7%
Germany	2,309	2,114	1,990	11.9%	-125	-6%	-320	-14%
Greece	717	1,452	1,308	7.8%	-144	-10%	591	82%
Ireland	51	55	40	0.2%	-14	-26%	-11	-21%
Italy	1,613	2,197	2,319	13.9%	122	6%	706	44%
Luxembourg	0.2	1	1	0.003%	-0.01	-1%	0.3	149%
Netherlands	41	41	41	0.2%	0	0%	0	0%
Portugal	228	396	398	2.4%	3	1%	170	75%
Spain	1,762	3,629	3,513	21.0%	-115	-3%	1,752	99%
Sweden	673	517	465	2.8%	-52	-10%	-208	-31%
United Kingdom	1,254	1,793	1,631	9.8%	-162	-9%	378	30%
EU-15	**13,561**	**17,155**	**16,709**	**100.0%**	**-446**	**-3%**	**3,147**	**23%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A3a Civil Aviation – Jet Kerosene (CO_2)

In 2010 CO_2 emissions resulting from jet kerosene within the category 1A3a were responsible for 98.1 % of CO_2 emissions in 1A3a. Within the EU-15 the emissions increased between 1990 and 2010 by 25 % (Table 3.49). By far the largest absolute increase occurred in Spain. Between 2009 and 2010, the emissions decreased by 2 %.

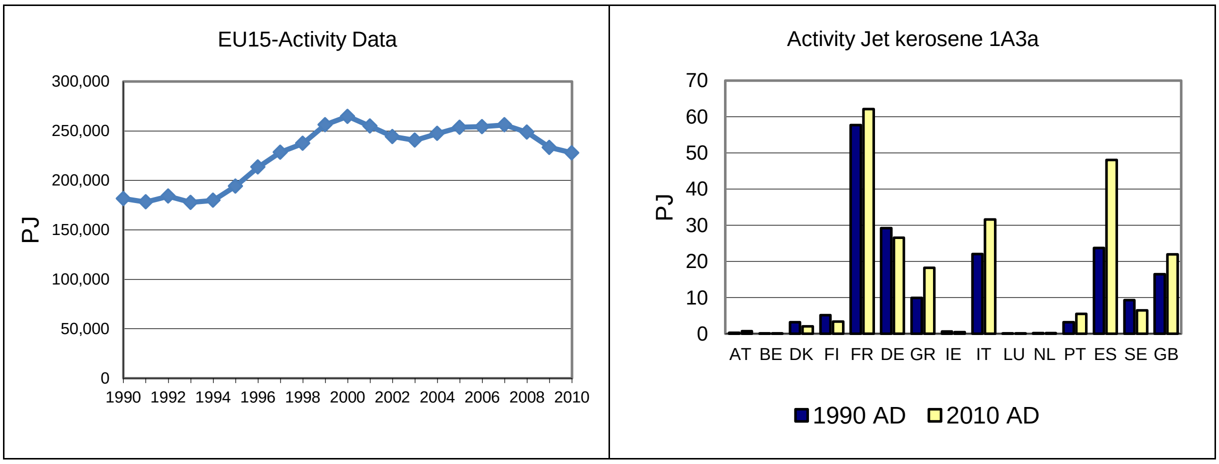
Table 3.49 1A3a Civil Aviation, jet kerosene: Member States' contributions to CO_2 emissions and information on method applied and emission factor

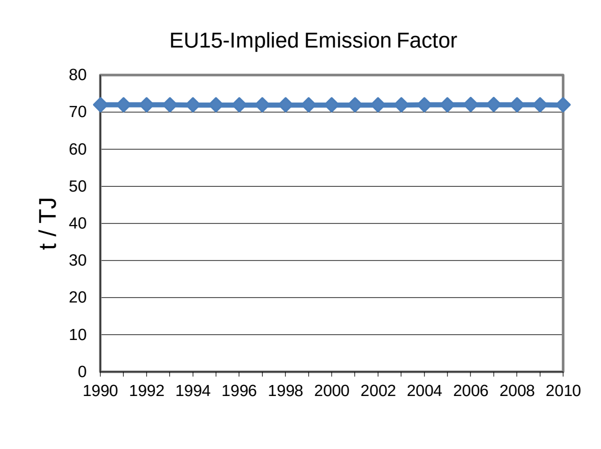
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	24	57	54	0.3%	-3	-5%	30	125%	T3	CS
Belgium	5	0	0	0.00%	0	11%	-5	-94%	T1	D
Denmark	234	148	151	0.9%	3	2%	-84	-36%	OTH	CS
Finland	377	272	250	1.5%	-22	-8%	-127	-34%	M	CS
France	4,135	4,374	4,448	27.1%	73	2%	313	8%	T2	CS
Germany	2,140	2,073	1,950	11.9%	-123	-6%	-190	-9%	T2	CS
Greece	705	1,401	1,291	7.9%	-110	-8%	586	83%	T2	D
Ireland	48	52	38	0.2%	-14	-28%	-11	-22%	T2	CS
Italy	1,579	2,145	2,261	13.8%	116	5%	681	43%	T1,T2	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	16	16	16	0.1%	0	0%	0	0%	T2	CS
Portugal	226	393	393	2.4%	0	0%	167	74%	T2	D
Spain	1,727	3,597	3,491	21.3%	-106	-3%	1,764	102%	T2	D
Sweden	668	515	463	2.8%	-52	-10%	-205	-31%	T1	CS
United Kingdom	1,184	1,737	1,578	9.6%	-159	-9%	394	33%	T3	CS
EU-15	**13,071**	**16,782**	**16,385**	**100.0%**	**-397**	**-2%**	**3,315**	**25%**		

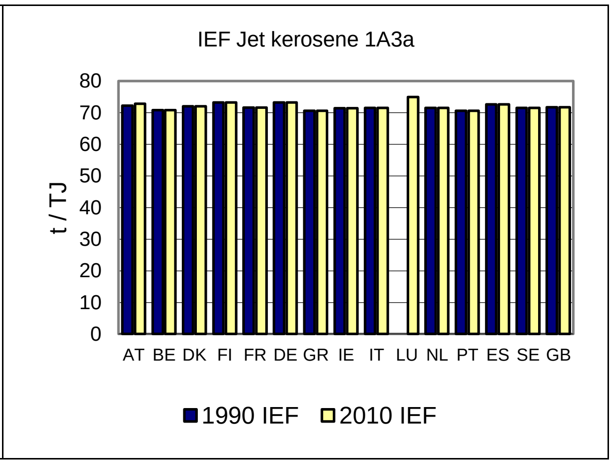
Abbreviations explained in the Chapter 'Units and abbreviations'.

France, Germany, Italy, Spain and the UK account for 83,7 % of CO_2 emissions and for 83.6 % of activity data from jet kerosene in 2010 (Figure 3.54). The IEF for the EU-15 is 71.94 t/TJ jet kerosene in 2010. Table 3.49 shows that the majority of emissions from Civil Aviation jet kerosene were calculated using a higher tier method.

Figure 3.54 1A3a Civil Aviation, jet kerosene: Activity data and implied emission factors for CO_2







3.2.3.2 Road Transportation (1A3b) (EU-15)

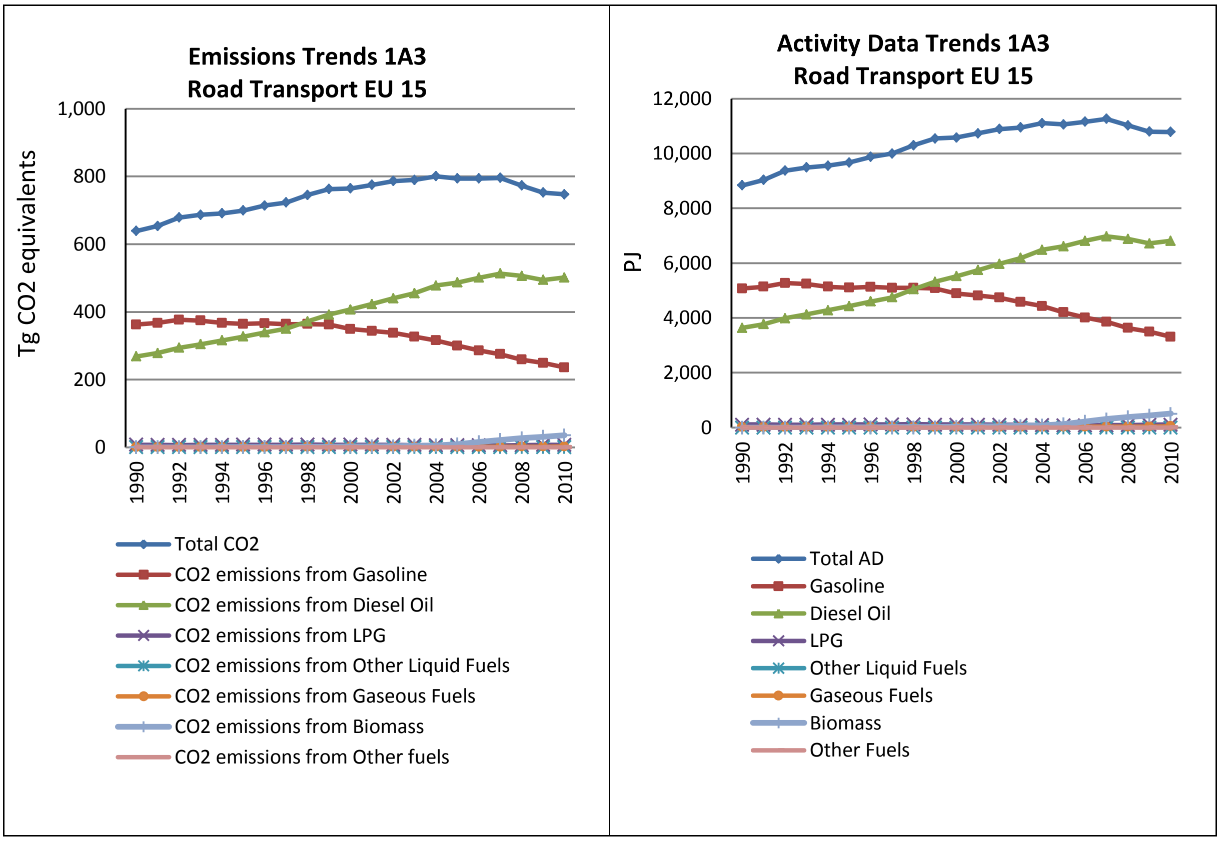
CO_2 emissions from 1A3b Road Transportation

The mobile source category Road Transportation includes all types of light-duty vehicles such as passenger cars and light commercial trucks, and heavy-duty vehicles such as tractors, trailers and buses, and two and three-wheelers (including mopeds, scooters, and motorcycles). These vehicles operate on many types of gaseous and liquid fuels.

CO_2 emissions from 1A3b Road Transportation is the second largest key source of all categories in the EU-15 accounting for 19,7 % of total GHG emissions in 2010. Between 1990 and 2010, CO_2 emissions from road transportation increased by 17 % in the EU-15 (Table 3.50). The emissions from this key source are due to fossil fuel consumption in road transport, which increased by 17 % between 1990 and 2010.

Figure 3.55 gives an overview of the CO_2 trend caused by different fuels. The trend is mainly dominated by emissions resulting from the combustion of gasoline and diesel oil. The decline of gasoline and the strong increase of diesel show the gradual switch from gasoline to diesel passenger cars in several EU-15 Member States.

Figure 3.55 **1A3b Road Transport: CO_2 Emission Trend and Activity Data**



The Member States Germany, France, Italy, Spain and the United Kingdom contributed most to the CO_2 emissions from this source (76.5 %). All Member States, except for Germany (-3%), increased emissions from road transportation between 1990 and 2010. The Member States with the highest increases in absolute terms were Spain, Italy, France and Portugal. The countries with the lowest increase in relative terms were Finland, France, Sweden and the United Kingdom (Table 3.50).

Table 3.50 **1A3b Road Transport: Member States' contributions to CO_2 emissions**

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010	
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	13,324	20,894	21,662	2.9%	768	4%	8,338	63%
Belgium	19,270	25,914	23,222	3.1%	-2,692	-10%	3,952	21%
Denmark	9,282	12,160	12,108	1.6%	-52	0%	2,826	30%
Finland	10,806	11,278	11,810	1.6%	532	5%	1,004	9%
France	112,787	122,270	123,829	16.6%	1,558	1%	11,041	10%
Germany	150,358	144,134	145,438	19.5%	1,304	1%	-4,920	-3%
Greece	11,742	20,964	18,907	2.5%	-2,057	-10%	7,165	61%
Ireland	4,691	11,860	10,951	1.5%	-909	-8%	6,260	133%
Italy	93,387	109,906	108,678	14.5%	-1,227	-1%	15,291	16%
Luxembourg	2,574	5,823	6,202	0.8%	379	7%	3,628	141%
Netherlands	25,470	33,344	33,757	4.5%	413	1%	8,286	33%
Portugal	9,476	18,263	18,046	2.4%	-216	-1%	8,571	90%
Spain	50,442	86,114	82,943	11.1%	-3,172	-4%	32,500	64%
Sweden	17,310	18,752	18,962	2.5%	209	1%	1,652	10%
United Kingdom	108,135	110,812	110,822	14.8%	10	0%	2,687	2%
EU-15	**639,055**	**752,488**	**747,336**	**100.0%**	**-5,152**	**-0.7%**	**108,280**	**17%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A3b Road Transportation – Diesel Oil (CO_2)

CO_2 emissions from Diesel oil account for 67.1 % of CO_2 emissions from 1A3b Road Transport in 2010 (Figure 3.55). All Member States increased emissions from Diesel oil between 1990 and 2010 (Table 3.51). Member States with the highest increase in percent were Austria, Ireland, Luxembourg, Spain and Portugal. Some of these increases are due to fuel bought in the respective countries but consumed abroad (fuel tourism).

Table 3.51 1A3b Road Transport, diesel oil: Member States' contributions to CO_2 emissions and information on method applied and emission factor

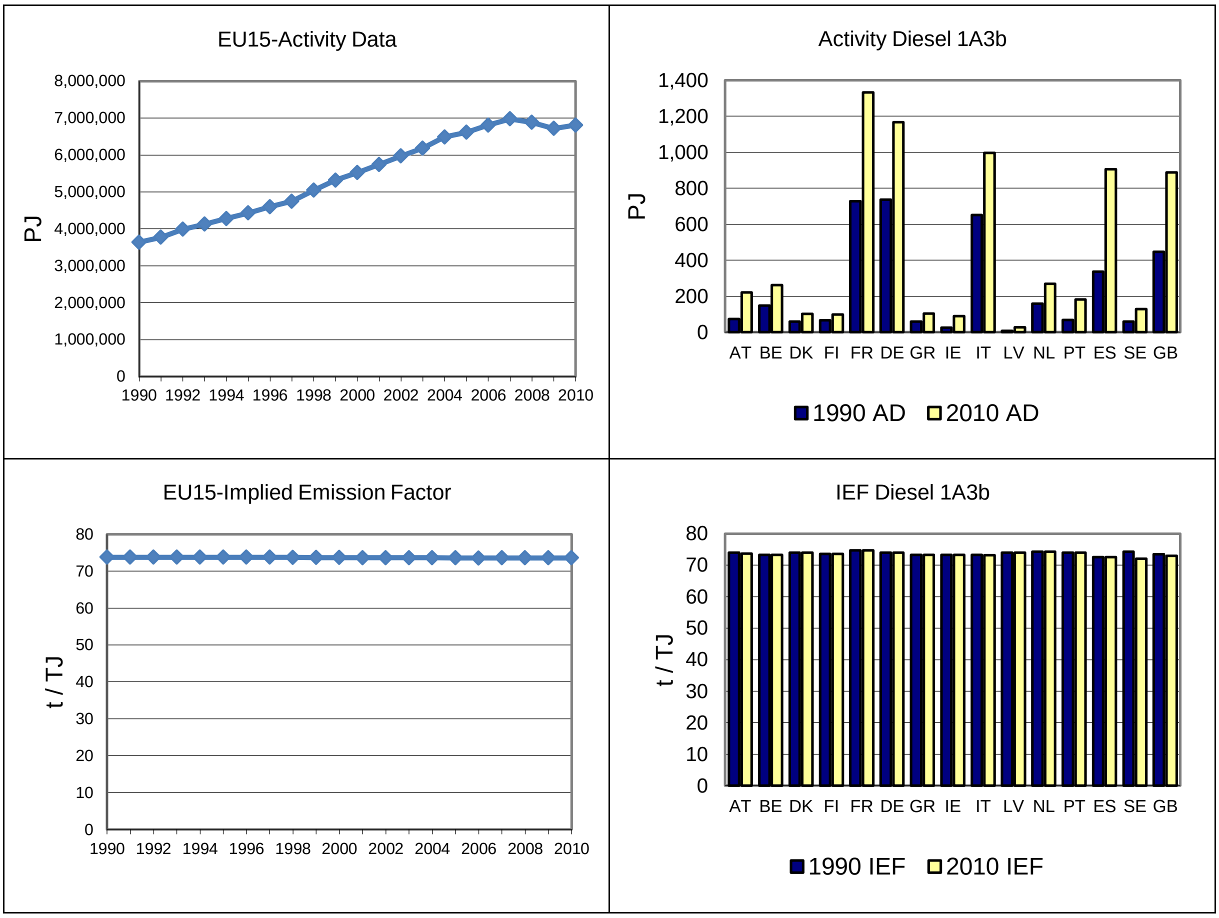
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	5,362	15,429	16,280	3.2%	851	6%	10,918	204%	CS,M	CS
Belgium	10,892	21,631	19,132	3.8%	-2,498	-12%	8,240	76%	T1	CR,CS
Denmark	4,436	7,209	7,525	1.5%	316	4%	3,089	70%	OTH	CS
Finland	4,923	6,626	7,188	1.4%	562	8%	2,264	46%	M	CS
France	54,305	96,581	99,477	19.8%	2,897	3%	45,173	83%	T3	CS
Germany	54,458	82,455	86,301	17.2%	3,846	5%	31,843	58%	T2	CS
Greece	4,326	8,628	7,592	1.5%	-1,036	-12%	3,266	75%	T1	D
Ireland	1,915	6,978	6,541	1.3%	-438	-6%	4,626	242%	T1	CS
Italy	47,776	72,845	72,866	14.5%	21	0%	25,090	53%	M	CS
Luxembourg	1,343	4,707	5,158	1.0%	451	10%	3,816	284%	T3	CS
Netherlands	11,821	19,543	20,001	4.0%	459	2%	8,180	69%	T2	CS
Portugal	5,055	13,470	13,497	2.7%	26	0%	8,441	167%	T2	CS
Spain	24,436	67,593	65,827	13.1%	-1,766	-3%	41,391	169%	CR,CS,T3	CR
Sweden	4,406	8,293	9,200	1.8%	907	11%	4,793	109%	T1	CS
United Kingdom	32,754	62,253	64,746	12.9%	2,493	4%	31,991	98%	T3	CS
EU-15	**268,209**	**494,240**	**501,330**	**100.0%**	**7,090**	**1.4%**	**233,122**	**87%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

France, Germany, Italy, Spain and the UK account for 77.5 % of CO_2 emissions and for 77.6 % of activity data from diesel oil in 2010 (Figure 3.56). The IEF for the EU-15 is 73.60 t/TJ diesel in 2010. The CO_2 IEF for diesel oil decreased by 0.2 per cent between 1990 (73.78 t/TJ) and 2010 (73.60 t/TJ). The main reason for the decline of the IEF is the changing in fuel specifications of some countries and their contribution to the weighted average. The contribution to diesel consumption of Germany and France, the two largest contributing countries with higher IEFs than the average Member State, declined between 1990 and 2010 (Germany from 20.2 per cent to 17.1 per cent; France from 20 per cent to 19.6 per cent). On the other hand, the contribution to diesel consumption of Spain, which has a low IEF, increased from 9.3 per cent in 1990 to 13.3 per cent in 2010. In addition, a few member States (e.g. Austria, Italy, and the United Kingdom) show declining IEFs for the time-series 1990–2010 because of the increased use of diesel blended with biofuels.

Table 3.51 shows that the majority of CO_2 emissions from the combustion of diesel oil in road transportation were calculated using a higher tier method.

Figure 3.56 **1A3b Road Transport, diesel oil: Activity Data and Implied Emission Factor for CO_2**



1A3b Road Transportation – Gasoline (CO_2)

Between 1990 and 2010, CO_2 emissions from gasoline decreased by 35 % in the EU-15 (Table 3.52).

Table 3.52 **1A3b Road Transport, gasoline: Member States' contributions to CO_2 emissions and information on method applied and emission factor**

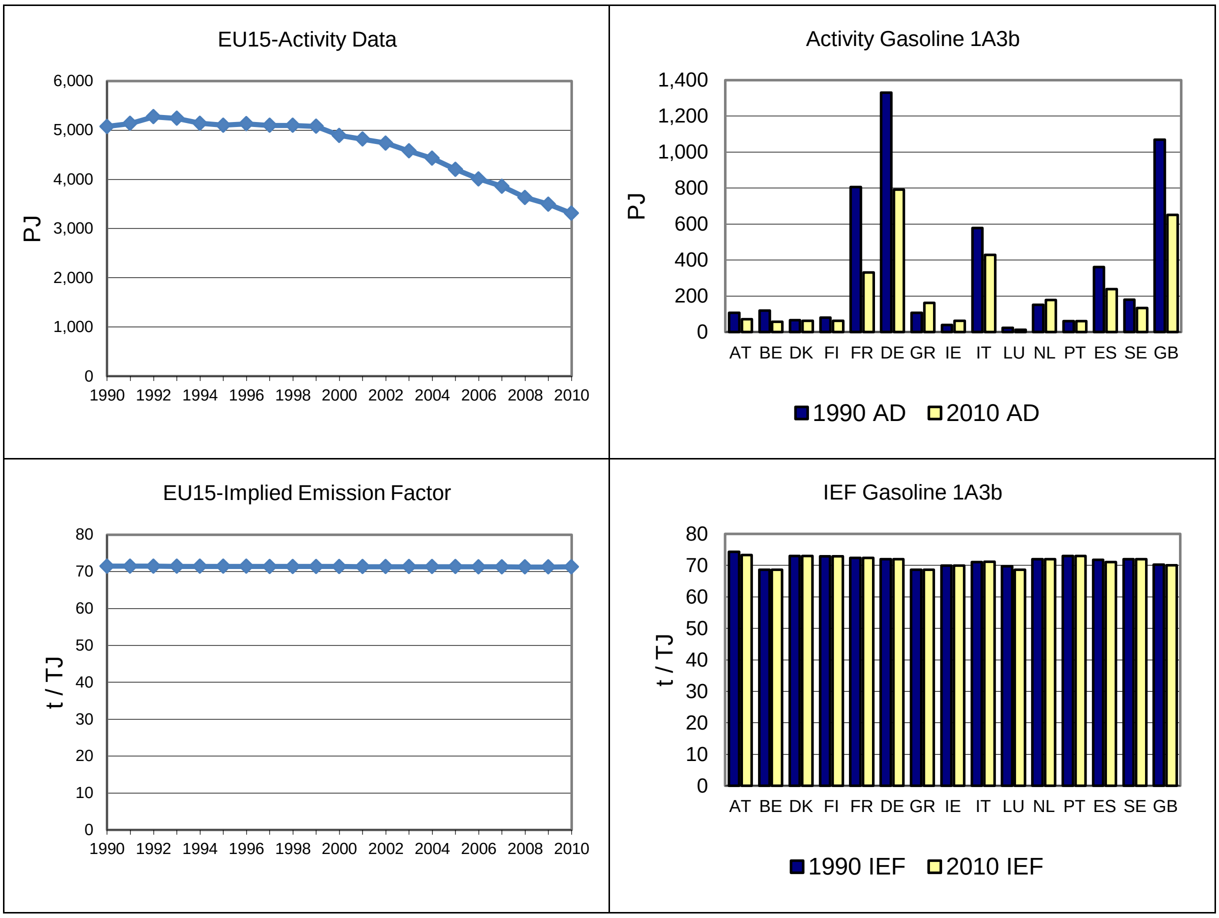
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	7,936	5,357	5,270	2.2%	-87	-2%	-2,666	-34%	CS,M	CS
Belgium	8,223	4,103	3,920	1.7%	-183	-4%	-4,304	-52%	T1	CR,CS
Denmark	4,838	4,950	4,583	1.9%	-367	-7%	-255	-5%	OTH	CS
Finland	5,883	4,641	4,611	2.0%	-30	-1%	-1,272	-22%	M	CS
France	58,333	25,393	24,006	10.2%	-1,387	-5%	-34,327	-59%	T3	CS
Germany	95,794	59,704	57,042	24.2%	-2,662	-4%	-38,752	-40%	T2	CS
Greece	7,294	12,191	11,100	4.7%	-1,092	-9%	3,806	52%	T1	D
Ireland	2,758	4,878	4,404	1.9%	-474	-10%	1,646	60%	T1	CS
Italy	41,094	32,339	30,503	12.9%	-1,836	-6%	-10,591	-26%	M	CS
Luxembourg	1,221	1,112	1,040	0.4%	-72	-6%	-180	-15%	T3	CS
Netherlands	10,908	12,815	12,819	5.4%	4	0%	1,910	18%	T2	CS
Portugal	4,420	4,672	4,432	1.9%	-240	-5%	12	0%	T2	CS
Spain	25,928	18,352	16,907	7.2%	-1,445	-8%	-9,022	-35%	CR,CS,T3	CR
Sweden	12,900	10,402	9,687	4.1%	-715	-7%	-3,214	-25%	T1	CS
United Kingdom	75,118	48,121	45,624	19.3%	-2,497	-5%	-29,494	-39%	T3	CS
EU-15	**362,649**	**249,030**	**235,947**	**100.0%**	**-13,083**	**-5%**	**-126,702**	**-35%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

France, Germany, Italy, Spain and the United Kingdom account for 73.8 % for CO_2 emissions and for 73.8 % of activity data from gasoline in 2010 (Figure 3.57). The IEF for the EU-15 is 71.28 t/TJ gasoline in 2010. The CO_2 IEF for gasoline decreased by 0.2 percent between 1990 (71.46 t/TJ) and 2010 (71.28 t/TJ). The main reason for the decline of the IEF is the changing specifications of gasoline in Germany and France, the two largest contributing countries with higher IEFs than the average Member State. The contribution to gasoline consumption in Germany and France declined between 1990 and 2010 (Germany from 26.2 per cent to 23.9 per cent; France from 15.9 per cent to 10 per cent). On the other hand, the contribution to gasoline consumption of Italy, which has a lower IEF than the average Member State, increased from 11.4 per cent in 1990 to 13 per cent in 2010. Also, the United Kingdom, which has a much lower IEF than the average Member State, can be seen here as an influencing factor as the contribution to gasoline consumption amounts to 19.7 per cent in 2010.

Table 3.52 shows that the majority of CO_2 emissions from gasoline combustion in road transportation were calculated using a higher tier method.

Figure 3.57 1A3b Road Transport, gasoline: Activity data and implied emission factors for CO_2



1A3b Road Transportation –LPG (CO_2)

Between 1990 and 2010, CO_2 emissions from LPG decreased by 2 % in the EU-15. Two Member States report emissions as ‘Not occurring’. Between 2009 and 2010 EU-15 emissions increased by 4 % (Table 3.53) mainly due to emission increases in Italy and Greece.

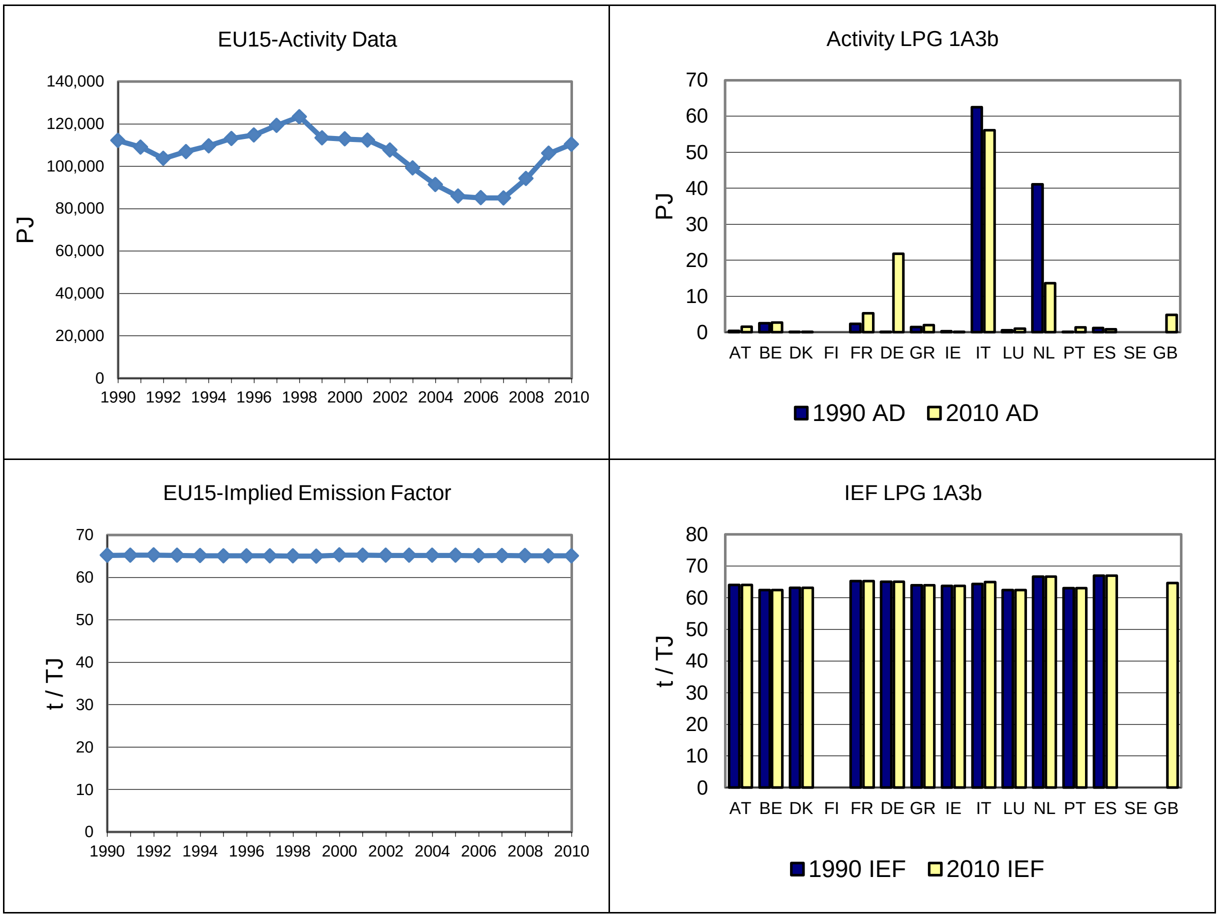
Table 3.53 1A3b Road Transport, LPG: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	27	97	100	-	3	3%	73	276%	CS,M	CS
Belgium	154	181	170	2.4%	-11	-6%	15	10%	T1	CR,CS
Denmark	7	0.12	0.11	0.0%	0	-9%	-7	-99%	OTH	CS
Finland	NO	NO	NO	-	-	-	-	-	NA	NA
France	150	297	346	4.8%	48	16%	195	130%	T3	CS
Germany	9	1,550	1,419	19.8%	-130	-8%	1,410	15723%	T1	CS
Greece	91	51	127	1.8%	76	147%	36	40%	T1	D
Ireland	19	3	6	0.1%	3	82%	-13	-68%	T1	CS
Italy	4,026	3,285	3,644	50.7%	359	11%	-382	-9%	M	CS
Luxembourg	11	4	4	-	0	0%	-7	-65%	T3	CS
Netherlands	2,740	985	911	12.7%	-74	-7%	-1,829	-67%	T2	CS
Portugal	0	88	84	1.2%	-4	-5%	84	136385%	T2	CS
Spain	78	48	57	0.8%	9	19%	-21	-27%	CR,CS,T3	CR
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom	NO	316	314	4.4%	-2	-1%	314	-	T3	CS
EU-15	**7,313**	**6,904**	**7,182**	**100.0%**	**277**	**4%**	**-131**	**-2%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

France, Germany, Italy, Spain and the United Kingdom account for80.5 % of CO_2 emission and for 80.6 % of activity data from LPG in 2010 (Figure 3.58). The IEF for the EU-15 is 65.07 t/TJ LPG in 2010. Table 3.53 shows that the majority of CO_2 emissions from LPG consumption in road transportation were calculated using a higher tier method.

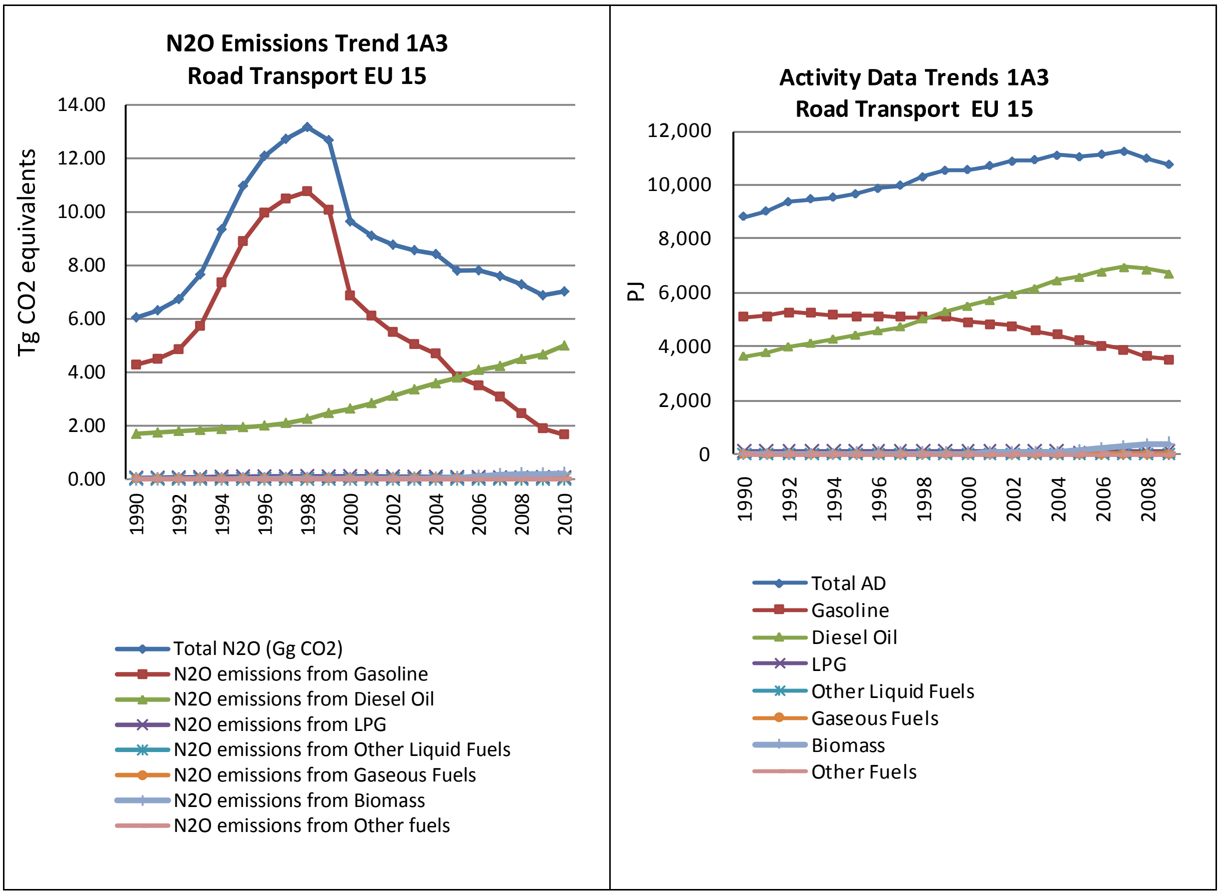
Figure 3.58 1A3b Road Transport, LPG: Activity data and implied emission factors for CO_2



N_2O emissions from 1A3b Road Transportation

N_2O emissions from 1A3b Road Transportation account for 0.18 % of total EU-15 GHG emissions in 2010. Figure 3.59 gives an overview of the N_2O trend caused by different fuels. The trend is mainly dominated by emissions resulting from gasoline and diesel oil.

Figure 3.59 1A3b Road Transport: N_2O Emissions Trend and Activity Data



N_2O emissions increased between 1990 and 2010 by 16 % (Table 3.56). N_2O emissions from gasoline cars increased in the 1990s due to the implementation of the catalytic converter in the early Euro vehicles (mainly Euro 1), but decreased thereafter (for post Euro 2 vehicles). A further reduction in emissions was achieved due to the penetration of low and zero sulphur gasoline. On the other hand, N_2O emissions from diesel cars increase with Euro technologies for both passenger cars and heavy duty vehicles (and in particular with the introduction of Euro V trucks). Although two different models are being used by the EU-15 MS to estimate N_2O emissions, namely the HBEFA - Handbook of emissions factors and the COPERT model, the emissions calculated are consistent as both models use in principle the same emission factors (differences are rather small). At the moment two versions of the COPERT model are being used in EU-15 countries to estimate emissions, namely COPERT III and COPERT 4. COPERT 4 is used in all cases for the latest inventory year, whereas the use of COPERT III is limited to previous inventory years in very few cases.

COPERT III was developed in 2000 and incorporated the EMEP/CORINAIR Emission Inventory Guidebook (3rd edition, 2002) methodology that was valid until 2006. COPERT III included rough assumptions on N_2O emission factors, summarised on Table 3.54.

Table 3.54: N_2O Emission Factors in COPERT III / Emission Inventory Guidebook (3rd edition, 2002)

Vehicle category	Urban	Rural	Highway
Passenger Cars			
Gasoline Conventional	5	5	5
Gasoline Euro I and on	53	16	35
Diesel CC < 2.0 l	27	27	27
Diesel CC > 2.0 l	27	27	27
LPG	15	15	15
2 - stroke	5	5	5
Light Duty Vehicles			
Gasoline Conventional	6	6	6
Gasoline Euro I and on	53	16	35
Diesel	17	17	17
Heavy Duty Vehicles			
Gasoline > 3.5 t	6	6	6
Diesel < 7.5 t	30	30	30
Diesel 7.5 t < W < 16 t	30	30	30
Diesel 16 t < W < 32 t	30	30	30
Diesel W > 32 t	30	30	30
Urban Buses	30	-	-
Coaches	30	30	30
Motorcycles			
< 50 cm³	1	1	1
> 50 cm³ 2 stroke	2	2	2
> 50 cm³ 4 stroke	2	2	2

These emission factors were fully updated for passenger cars and light commercial vehicles with the launch of the first official COPERT 4 version 3.0 (November 2006) and were introduced in the EMEP/CORINAIR Emission Inventory Guidebook – 2006. These emission factors introduced reductions in N_2O as the emission technology improved. In particular for gasoline vehicles, these emission factors also introduced an increase in the emission level as the vehicle grows older and a decrease as the fuel sulfur decreased. All emission factors were based on an extensive literature review and synthesis of the findings that was conducted in 2005. Use of the new emission factors over COPERT III should in general lead to reductions of the national N_2O levels.

In 2007, the HDV N_2O emission factors were updated based on a relevant report that was published by the Dutch Institute TNO (Report TNO 03.OR.VM.006.1/IJR). These emission factors were sensitive to vehicle size and driving conditions (urban, rural, highway). Depending on the national stock details, use of the emission factors could lead to both slight increases or slight decreases compared to the previous set. The new emission factors were introduced in COPERT 4 v5.0 (December 2007) but were then introduced in the EMEP/EEA air pollutant emission inventory guidebook (EEA Technical report 9/2009 – June 2009).

Since June 2009 this basic methodology of N_2O calculation has remained without changes.

The COPERT 4 implementation of the methodology introduced some calculation errors that were fixed in the subsequent software versions. Also a number of slight updates (extension of the methodology to other categories) have been incorporated. A summary of these updates and software fixes is provided in

Table 3.55.

Table 3.55: N_2O relevant changes in the COPERT 4 methodology

Version: 3.0	Date: November 2006
METHODOLOGY: Update of the gasoline and diesel passenger car and light duty vehicle N_2O emission factors. Introduction of impact of vehicle technology, vehicle age and fuel sulfur.	
Reference: http://www.emisia.com/versions.html	
Version: 5.0	Date: December2007
METHODOLOGY: Update of the diesel HDV emission factors based on Dutch study	
Reference: http://www.emisia.com/versions.html	
Version: 5.1	Date: February 2008
SOFTWARE CORRECTION: Use of the cumulative mileage instead of annual mileage to calculate N_2O degradation. The correction should lead to an increase in emissions	
Reference: http://www.emisia.com/versions.html	
Version: 6.1	Date: February 2009
METHODOLOGY: The Euro 5 and 6 passenger car and light duty trucks N_2O emission factors have been inherited by default from Euro 4. They were zero in the previous version. The revision will slightly increase total N_2O emissions.	
Reference: http://www.emisia.com/versions.html	
Version: 7.0	Date: December 2009
SOFTWARE CORRECTION: There was a software bug during the calculation of N_2O hot and cold emissions. Because of this bug there was a misallocation between the hot and cold emissions of these pollutants. Furthermore the N_2O cold emissions were stored in place of NH_3 cold emissions and vice versa, This is now corrected. The corrections is expected to lead to MS specific changes	
Reference: http://www.emisia.com/download_file.html?file=COPERT4_v7_0.pdf	
Version: 8.1	Date: May 2011
METHODOLOGY: N_2O hot and cold emission factors parameters for Euro 5 and Euro 6 LPG passenger cars are set equal to Euro 5 and Euro 6 gasoline ones. This is estimated to slightly increase N_2O in some MS were LPG vehicles are widespread.	
Reference: http://www.emisia.com/download_file.html?file=COPERT4_v8_1.pdf	
Version: 9.0	Date: October 2011
METHODOLOGY: Bioethanol was introduced as a fuel. N_2O emissions are now split to a fossil and a non-fossil (biomass) part (for exporting to CRF).	
Reference: http://www.emisia.com/download_file.html?file=COPERT4_v9_0.pdf	

Table 3.57 shows that all Member States use recent N_2O emission factors in 2010. Four MS use different or country specific models or emission factors, as can be seen in Table 3.57.

Table 3.56 1A3b Road Transport: Member States' contributions to N_2O emissions

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010	
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)
Austria	174	227	213	3.0%	-13	-6%	40	23%
Belgium	224	206	223	3.2%	17	8%	-1	0%
Denmark	93	120	119	1.7%	0	0%	27	29%
Finland	160	161	164	2.3%	3	2%	4	3%
France	929	1,203	1,265	18.0%	61	5%	336	36%
Germany	1,165	1,146	1,250	17.8%	104	9%	86	7%
Greece	145	252	190	2.7%	-62	-24%	45	31%
Ireland	41	100	93	1.3%	-7	-7%	52	126%
Italy	913	1,053	1,041	14.8%	-12	-1%	128	14%
Luxembourg	23	66	65	0.9%	0	0%	42	180%
Netherlands	286	429	435	6.2%	6	1%	149	52%
Portugal	67	173	175	2.5%	2	1%	108	162%
Spain	494	814	837	11.9%	23	3%	342	69%
Sweden	157	99	106	1.5%	7	7%	-51	-32%
United Kingdom	1,174	833	842	12.0%	10	1%	-331	-28%
EU-15	**6,044**	**6,881**	**7,021**	**100.0%**	**140**	**2%**	**977**	**16%**

Table 3.57 Methods/models used for road transport by EU-15 MS

1A3b	Method/Emission factors	Remark
Austria	CS / HBEFA	
Belgium	CS / COPERT IV	Emissions of CH4 and N2O are not calculated based on the Belgian energy statistics, but are the sum of the emissions calculated by the 3 regions using a methodology based on the COPERT-methodology. A region-specific methodology (the so-called MIMOSA-model, also based on COPERT IV) is used in the Flemish region. A recalculation is started in Belgium for the non-CO2-emissions of road transport during the 2010 submission by switching the COPERT III-based methodology to COPERT IV. In Wallonia, this switch has only been done for the years 2007 and 2008. In Brussels, the recalculation is still in progress and resultats will be available for next submission.
Denmark	CS / COPERT IV	An internal NERI model with a structure similar to the European COPERT III emission model (Ntziachristos, 2000) is used to calculate the Danish annual emissions for road traffic. For most vehicle categories, updated fuel use and emission data from the new COPERT IV version is incorporated in the NERI model.
Finland	CS / COPERT IV	According to the recommendations in the review the N2O emission factors have been updated in the LIISA model. Emission factors used in the COPERT IV program have been used as the reference values.
France	COPERT IV	
Germany	CS / HBEFA	
Greece	COPERT IV	
Ireland	COPERT IV	
Italy	COPERT IV	
Luxembourg	COPERT IV	
Netherlands	CS-T2 / HBEFA	
Portugal	COPERT IV	
Spain	COPERT IV	
Sweden	ARTEMIS	
United Kingdom	COPERT IV	

1A3b Road Transportation – Diesel Oil (N_2O)

N_2O emissions from Diesel oil account for 71 % of N_2O emissions from 1A3b “Road Transportation” in 2010. Between 1990 and 2010 N_2O emissions from Diesel oil increased in all Member States; within the EU-15 the emission increased by 194 %. The smallest increase in absolute terms was reported by Greece, Finland, Ireland and Luxembourg. Between 2009 and 2010, EU-15 emissions rose by 7 % (Table 3.58).

Table 3.58 **1A3b Road Transport, diesel oil: Member States' contributions to N_2O emissions and information on method applied and emission factor**

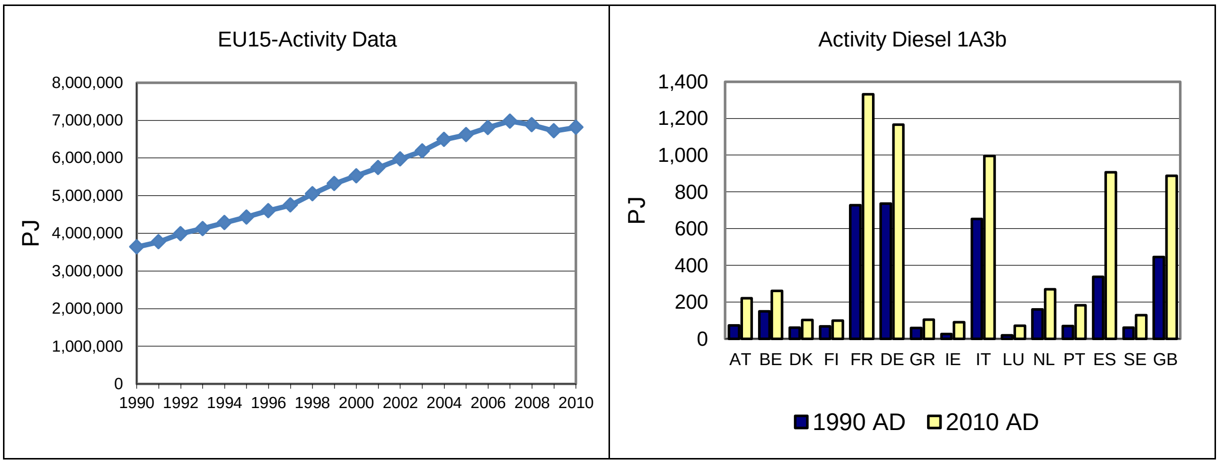
Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)		
Austria	41	131	130	2.6%	-2	-1%	89	218%	CS,M	CS
Belgium	133	181	202	4.0%	21	12%	69	52%	M,T2	CR,CS
Denmark	31	83	88	1.8%	5	6%	57	181%	OTH	OTH
Finland	68	101	107	2.1%	6	6%	39	57%	M	CS
France	263	854	930	18.6%	76	9%	667	253%	T3	CS
Germany	128	789	926	18.5%	137	17%	799	625%	T3	CS,M
Greece	55	83	59	1.2%	-24	-29%	4	8%	M	M
Ireland	8	56	55	1.1%	-1	-1%	47	558%	T3	M
Italy	374	717	730	14.6%	13	2%	356	95%	M	CS
Luxembourg	5	50	52	1.0%	2	4%	47	942%	T3	D
Netherlands	71	190	196	3.9%	6	3%	124	174%	T2	CS
Portugal	17	118	123	2.5%	5	4%	107	644%	T3	CR
Spain	210	697	729	14.6%	32	5%	519	247%	CR,CS,T3	CR
Sweden	12	53	63	1.3%	10	18%	51	416%	M	M
United Kingdom	281	559	609	12.2%	50	9%	328	117%	T3	CS
EU-15	**1,697**	**4,662**	**4,998**	**100.0%**	**336**	**7%**	**3,301**	**194%**		

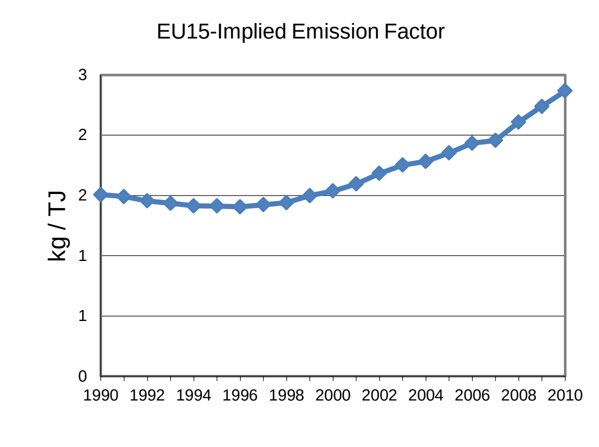
Abbreviations explained in the Chapter 'Units and abbreviations'.

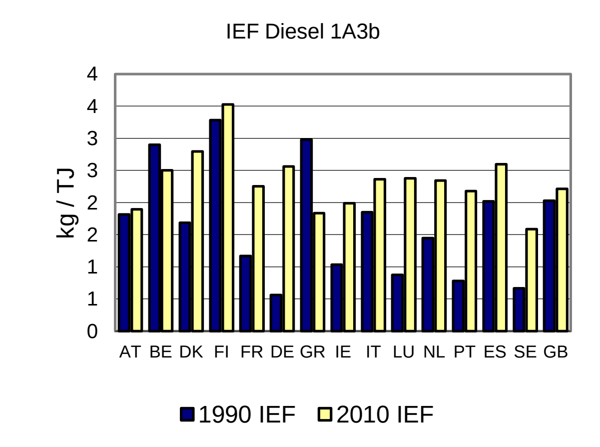
France, Germany, Italy, Spain and the United Kingdom account for 78.5 % of N_2O emissions and for 77.6 % of activity data from diesel oil in 2010 (Figure 3.60). The IEF for the EU-15 is 2.37 kg/TJ Diesel in 2010.

Table 3.58 shows that all N_2O emissions from combustion of diesel oil in road transportation were calculated using a higher tier method.

Figure 3.60 **1A3b Road Transport, diesel oil: Activity Data and Implied Emission Factor for N_2O emission**







1A3b Road Transportation – Gasoline (N_2O)

N_2O emissions from Gasoline account for 24 % of N_2O emissions from 1A3b Road Transportation in 2010. Between 1990 and 2010, N_2O emissions from gasoline decreased by 61 % in the EU-15. Between 2009 and 2010, all Member States, except for Netherlands which increased their emissions by 3 %, showed a decreasing trend. The EU-15 total N_2O emissions dropped by 12 % (Table 3.59).

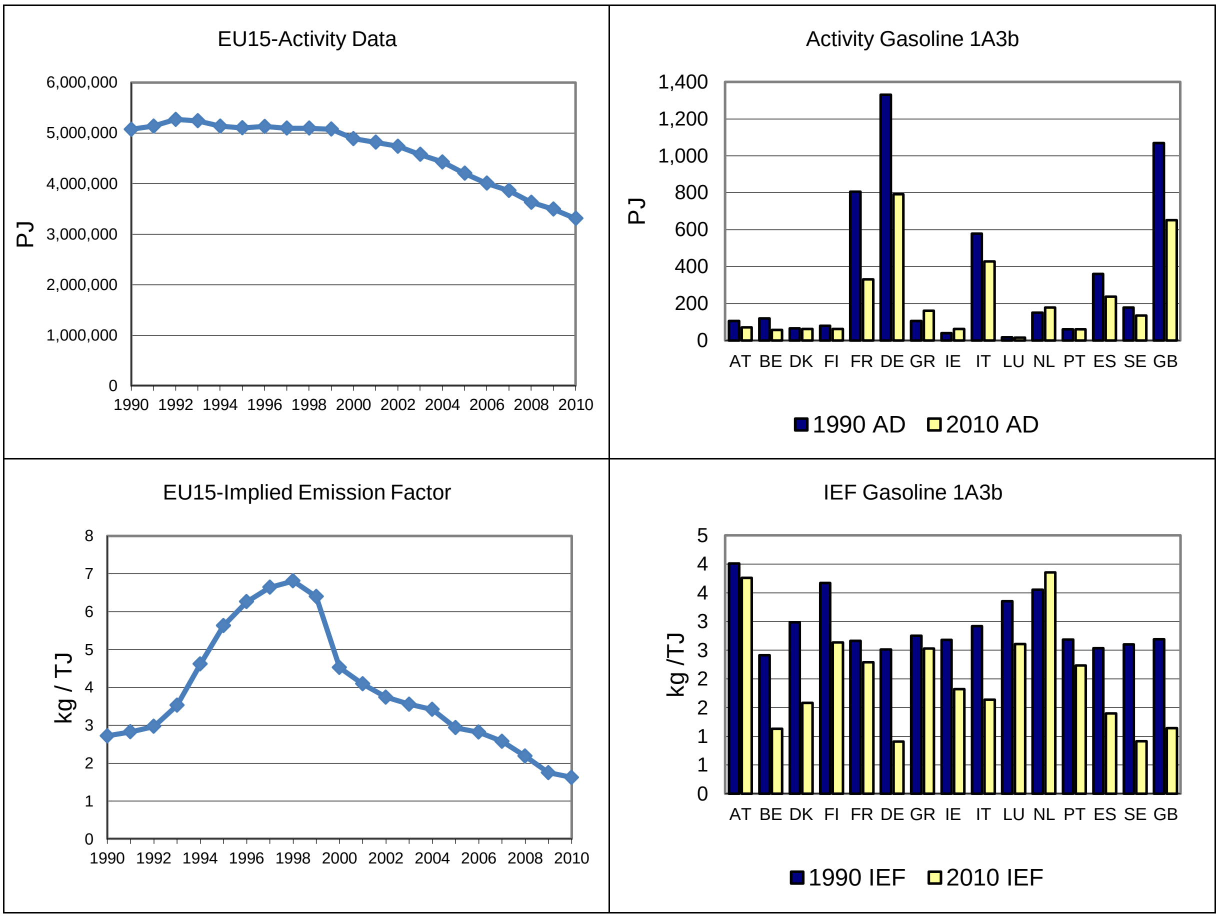
Table 3.59 1A3b Road Transport, gasoline: Member States' contributions to N_2O emissions and information on method applied and emission factor

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010	
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)
Austria	133	95	84	5.0%	-12	-12%	-49	-37%
Belgium	90	24	20	1.2%	-4	-15%	-70	-78%
Denmark	61	37	31	1.8%	-6	-16%	-31	-50%
Finland	92	54	52	3.1%	-2	-5%	-40	-44%
France	666	264	235	14.2%	-29	-11%	-430	-65%
Germany	1,037	268	223	13.4%	-46	-17%	-814	-79%
Greece	91	166	127	7.6%	-39	-24%	36	40%
Ireland	33	42	36	2.1%	-7	-16%	3	9%
Italy	523	248	218	13.1%	-30	-12%	-306	-58%
Luxembourg	18	15	12	0.7%	-2	-16%	-6	-34%
Netherlands	167	207	213	12.8%	6	3%	46	27%
Portugal	50	48	42	2.5%	-5	-11%	-8	-16%
Spain	284	113	103	6.2%	-10	-9%	-181	-64%
Sweden	144	42	38	2.3%	-4	-9%	-106	-74%
United Kingdom	893	271	231	13.9%	-40	-15%	-662	-74%
EU-15	**4,282**	**1,894**	**1,664**	**100.0%**	**-231**	**-12%**	**-2,619**	**-61%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

France, Germany, Italy, Spain and the United Kingdom accounted for 60.8 % of N_2O emissions and for 73.8 % of activity data from gasoline in 2010 (Figure 3.61). The IEF for the EU-15 is 1.62 kg/TJ Gasoline in 2010.

Figure 3.61 **1A3b Road Transport, gasoline: Activity data and implied emission factors for N_2O**

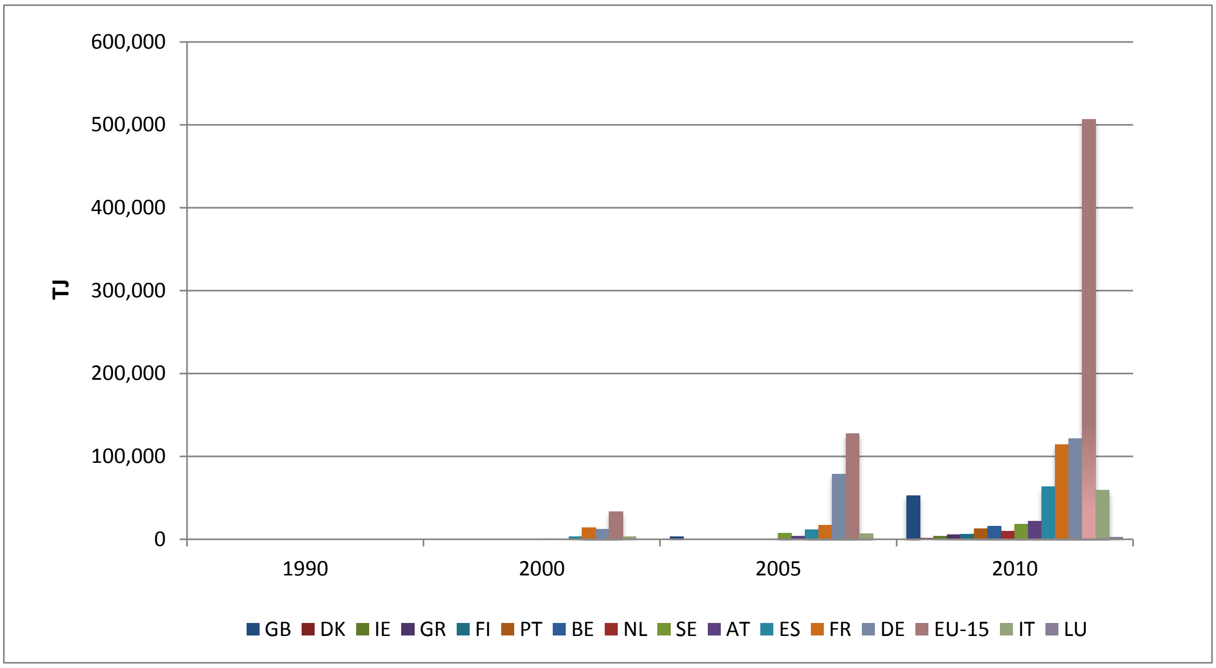


1A3b Road Transportation – Activity Data Biofuels

According to the European Directive on the promotion of the use of biofuels or other renewable fuels for transport (2003/30/EG), Member States should ensure that a minimum proportion of biofuels and other renewable fuels is placed on their markets, and, to that effect, shall set national indicative targets, to reduce greenhouse gas emissions. Member States brought into force the laws, regulations and administrative provisions necessary to comply with this Directive by 31 December 2004. A reference value for these targets shall be 2 %, calculated on the basis of energy content, of all petrol and diesel for transport purposes placed on their markets by 31 December 2005. A reference value for these targets shall be 5,75 %, calculated on the basis of energy content, of all petrol and diesel for transport purposes placed on their markets by 31 December 2010. Due to the possibility of different national implementation the MS need to approach partly different targets.

Between 1990 and 2010, activity data of biofuels increased from 19.7 TJ to 506.6 TJ in the EU-15 (Figure 3.62). Germany still reports most of total amount of biofuels (23.9 % of total EU-15 activity in 2010 vs. 25.4 % in 2009) over the last years, followed by France (22.6 %). All Member States except for the UK report biofuels activity data under 1A3b for 2010. Note that some countries might still not report biofuels separately from gasoline or diesel oil (additive) in particular also in other source categories (e.g. 1A2f and 1A4c for other mobile machineries). In this case the use of biofuels is visible in a decreasing trend of the IEFs of gasoline/diesel or liquid fuels.

Figure 3.62 **1A3b Road Transport, biofuels: Trend of Activity data of biofuels**



1A3b Road Transportation – Gasoline (CH_4)

CH_4 emissions from Gasoline account for 24 % of CH_4 emissions from 1A3b Road Transportation in 2010. Between 1990 and 2010, CH_4 emissions from gasoline decreased by 79 % in the EU-15. Between 2009 and 2010, all Member States, showed a decreasing trend. The EU-15 total CH_4 emissions dropped by 8 % (Table 3.).

Table 3.59 **1A3b Road Transport, gasoline: Member States' contributions to CH_4 emissions and information on method applied and emission factor**

Member State	CH4 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)		
Austria	62	13	12	1.4%	-1	-10%	-50	-81%	CS,M	CS
Belgium	96	8	7	0.8%	-1	-14%	-89	-93%	M,T2	CR,CS
Denmark	44	11	10	1.1%	-1	-12%	-34	-78%	OTH	OTH
Finland	78	20	19	2.2%	-1	-5%	-59	-76%	M	CS
France	734	145	132	15.6%	-13	-9%	-602	-82%	T3	CS
Germany	1,070	144	130	15.3%	-14	-10%	-940	-88%	T3	CS,M
Greece	89	76	71	8.4%	-4	-6%	-17	-19%	M	M
Ireland	33	17	16	1.8%	-2	-11%	-18	-53%	T3	M
Italy	644	238	227	26.8%	-11	-5%	-416	-65%	M	CS
Luxembourg	16	5	5	0.6%	0	-9%	-11	-70%	T3	D
Netherlands	133	43	42	5.0%	-2	-4%	-91	-68%	T3	CS
Portugal	77	27	25	2.9%	-3	-9%	-53	-68%	T3	CR
Spain	267	71	63	7.5%	-7	-10%	-203	-76%	CR,CS,T3	CR
Sweden	181	45	41	4.9%	-4	-9%	-140	-77%	M	M
United Kingdom	525	58	47	5.6%	-11	-18%	-477	-91%	T3	CS
EU15	**4,048**	**922**	**847**	100.0%	-76	-8%	-3,201	-79%		

CH_4 emissions from all vehicles decreased in the 1990s due to the implementation of the catalytic converter in the early Euro vehicles (mainly Euro 1). CH_4 emissions increased for Euro 2 gasoline light duty cars (passenger cars and light commercial vehicles) but decreased thereafter (for post Euro 2 vehicles). On the other hand, CH_4 emissions from diesel vehicles decrease steadily with Euro technologies for both light and heavy duty vehicles. As mentioned previously for N_2O emissions, CH_4 emissions calculated with HBEFA and COPERT are consistent as both models use in principle the same emission factors.

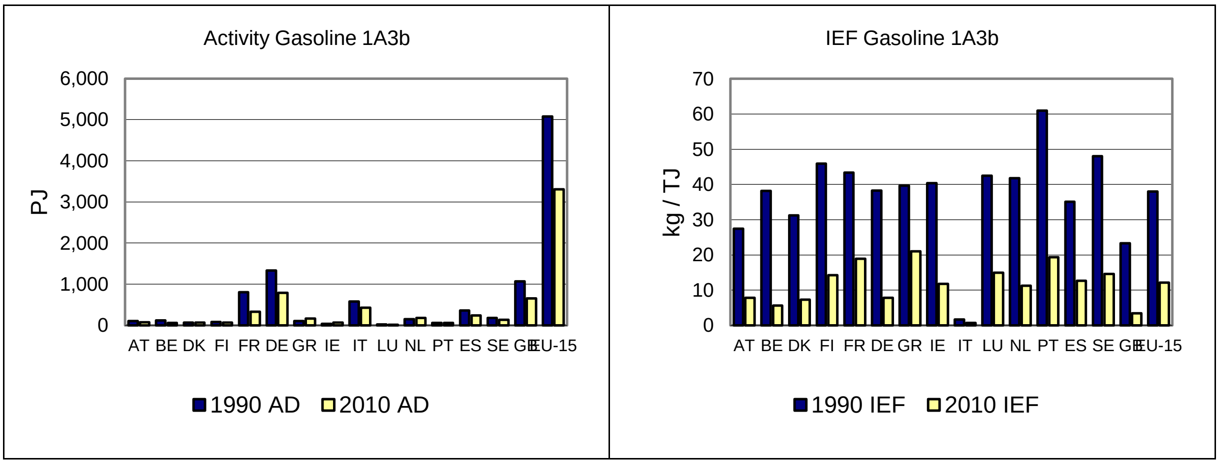
Similarly to N_2O as presented previously, a summary of the various updates and software fixes relevant to CH_4 in the COPERT model is provided in Table 3.60.

Table 3.60: CH_4 relevant changes in the COPERT 4 methodology

Version: 4.0	Date: October 2007
METHODOLOGY: Update of CH_4 emission factors and calculation algorithm.	
Reference: http://www.emisia.com/versions.html	
Version: 6.1	Date: February 2009
METHODOLOGY: The Euro 5 and 6 passenger car and light duty trucks CH_4 emission factors have been inherited by default from Euro 4. They were zero in the previous version.	
Reference: http://www.emisia.com/versions.html	
Version: 7.0	Date: December 2009
METHODOLOGY: The Euro 4 gasoline passenger car CH_4 cold emission factors are used for Euro 5 and Euro 6 technologies as well. They have been also transferred to the corresponding technologies for gasoline light duty vehicles. These values were zero in the previous version of the software. SOFTWARE CORRECTION: There was a software bug during the calculation of CH_4 hot and cold emissions. Because of this bug there was a misallocation between the hot and cold emissions of these pollutants.	
Reference: http://www.emisia.com/download_file.html?file=COPERT4_v7_0.pdf	
Version: 8.1	Date: May 2011
METHODOLOGY: CH_4 hot and cold emission factors for Euro 4, Euro 5 and Euro 6 diesel light duty trucks and passenger cars are set equal to 0.0011 gr/km (bulk emission factor).	
Reference: http://www.emisia.com/download_file.html?file=COPERT4_v8_1.pdf	

France, Germany, Italy and the United Kingdom accounted for 63.6 % of activity data from gasoline in 2010 (Figure 3.63). The IEF for the EU-15 is 12.18 kg/TJ Gasoline in 2010.

Figure 3.63 1A3b Road Transport, gasoline: Activity data and implied emission factors for CH_4

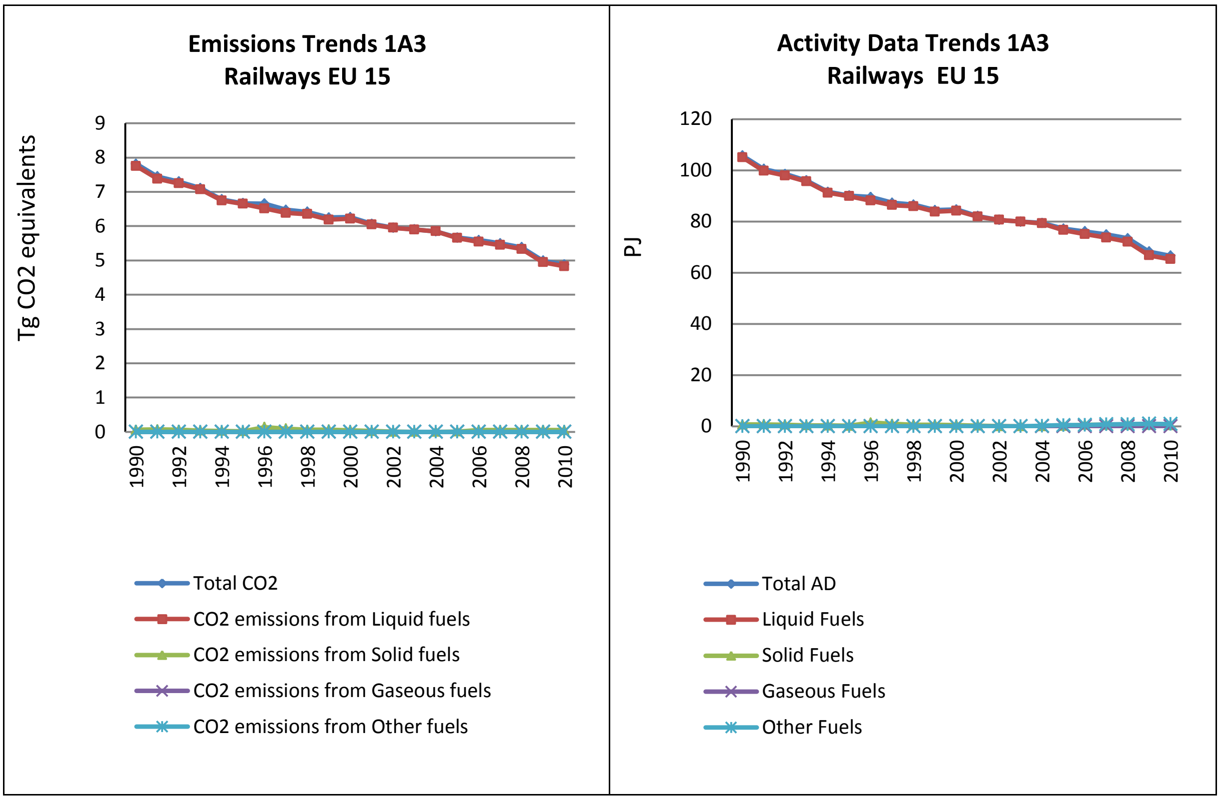


3.2.3.3 Railways (1A3c) (EU-15)

Railway locomotives generally are one of these types: diesel, coal, electric, or steam. Diesel locomotives generally use diesel engines in combination with an alternator or generator to produce the electricity required to power their traction motors. Emissions from Railways arise from the combustion of liquid and solid fuels.

CO_2 emissions from 1A3c Railways account for 0.13 % of total EU-15 GHG emissions in 2010. Between 1990 and 2010, CO_2 emissions from rail transportation decreased by 38 % in the EU-15. The total trend is dominated by CO_2 emissions from liquid fuels (Figure 3.64). The emissions from this key category are due to fossil fuel consumption in rail transport, which decreased by 37.7% between 1990 and 2010.

Figure 3.64 1A3c Railways: CO_2 Emission Trend and Activity Data



The Member States France, Germany and the United Kingdom contributed most to the emissions from this source (70.1 %). Between 1990 and 2010, Germany had by far the highest decreases in absolute terms (Table 3.60).

Table 3.60 1A3c Railways: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010	
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	178	148	149	3.0%	1	0%	-29	-17%
Belgium	224	118	106	2.2%	-13	-11%	-118	-53%
Denmark	297	230	242	5.0%	12	5%	-55	-18%
Finland	191	92	95	1.9%	3	4%	-96	-50%
France	1,070	504	480	9.8%	-24	-5%	-590	-55%
Germany	2,881	1,061	945	19.4%	-116	-11%	-1,935	-67%
Greece	203	97	63	1.3%	-34	-35%	-140	-69%
Ireland	133	123	122	2.5%	-1	-1%	-11	-9%
Italy	441	187	197	4.0%	9	5%	-244	-55%
Luxembourg	25	10	11	0.2%	1	8%	-13	-55%
Netherlands	91	66	106	2.2%	40	61%	15	17%
Portugal	176	55	46	0.9%	-9	-16%	-130	-74%
Spain	414	268	257	5.3%	-11	-4%	-157	-38%
Sweden	103	66	62	1.3%	-4	-6%	-41	-40%
United Kingdom	1,389	1,967	1,997	40.9%	30	2%	608	44%
EU-15	**7,815**	**4,993**	**4,877**	**100.0%**	**-115**	**-2%**	**-2,938**	**-38%**

1A3c Railways –Liquid Fuels (CO_2)

Between 1990 and 2010, CO_2 emissions from liquid fuels decreased by 38 % in the EU-15. Between 2009 and 2010, EU-15 emissions decreased by 2 % (Table 3.).

Table 3.62 1A3c Railways, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

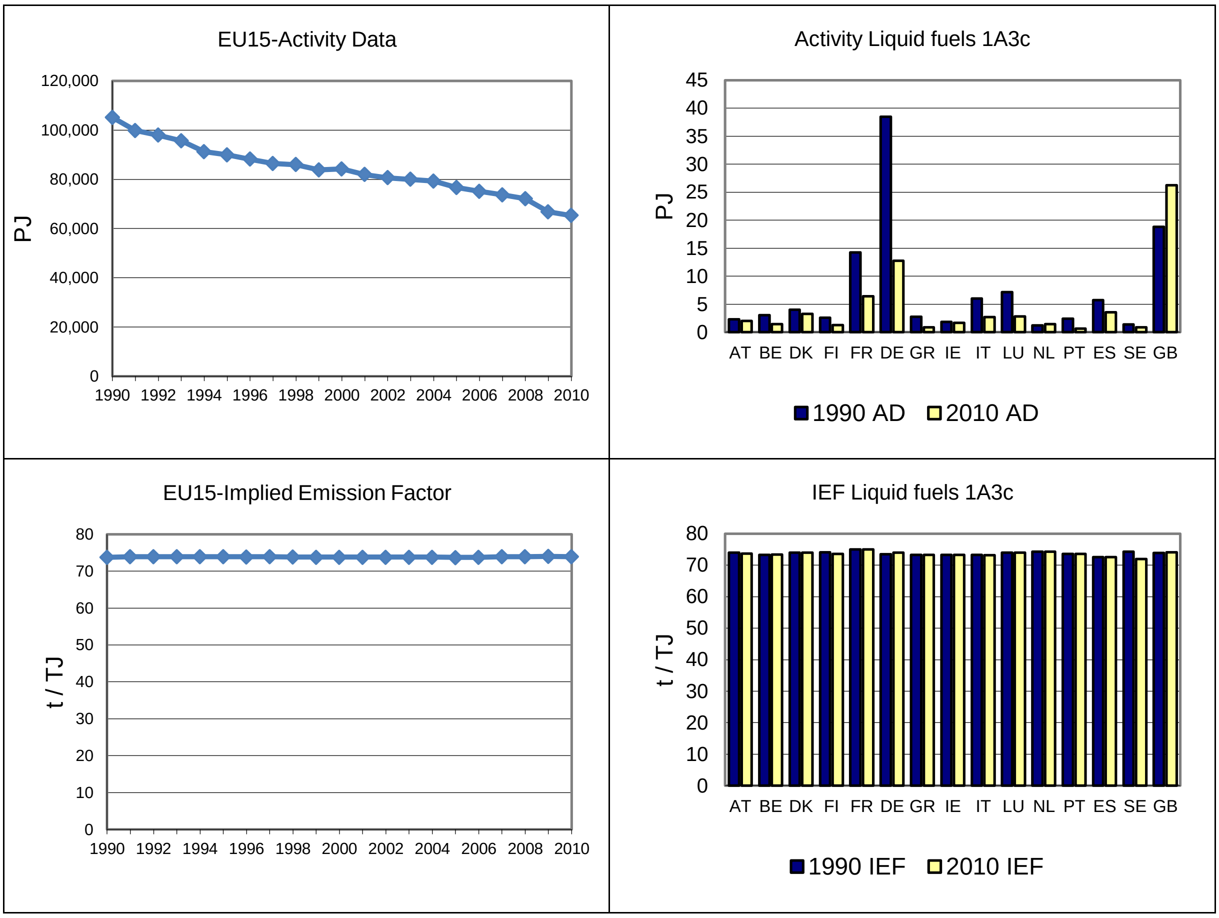
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	171	147	148	3.1%	1	1%	-23	-14%	CS	CS
Belgium	224	118	106	2.2%	-13	-11%	-118	-53%	CS,M,T1	CS,D
Denmark	297	230	242	5.0%	12	5%	-55	-18%	OTH	CS
Finland	191	92	95	2.0%	3	4%	-96	-50%	M	CS
France	1,070	504	480	9.9%	-24	-5%	-590	-55%	T1	CS
Germany	2,827	1,061	945	19.6%	-116	-11%	-1,882	-67%	CS,T1,T2	CS,D
Greece	200	97	63	1.3%	-34	-35%	-137	-69%	T1	D
Ireland	133	123	122	2.5%	-1	-1%	-11	-9%	T1	CS
Italy	441	187	197	4.1%	9	5%	-244	-55%	D	CS
Luxembourg	25	10	11	0.2%	1	8%	-13	-55%	T2	CS
Netherlands	91	66	106	2.2%	40	61%	15	17%	CS	CS
Portugal	176	55	46	0.9%	-9	-16%	-130	-74%	T1	OTH
Spain	414	268	257	5.3%	-11	-4%	-157	-38%	T2	CR
Sweden	103	66	62	1.3%	-4	-6%	-41	-40%	T1	CS
United Kingdom	1,389	1,917	1,947	40.3%	30	2%	558	40%	T2	CS
EU-15	**7,752**	**4,943**	**4,827**	**100.0%**	**-115**	**-2%**	**-2,925**	**-38%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

France, Germany, Italy, Spain and the United Kingdom account for 79.2 % of CO_2 emissions and for 79.1 % of activity data from liquid fuels in 2010 (Figure 3.65). The IEF for the EU-15 is 73.96 t/TJ Liquid fuels in 2010.

Table 3. shows that the majority of CO_2 emissions from the combustion of liquid fuels in railways were calculated using a higher tier method.

Figure 3.65 1A3c Railways, liquid fuels: Activity data and implied emission factors for CO_2

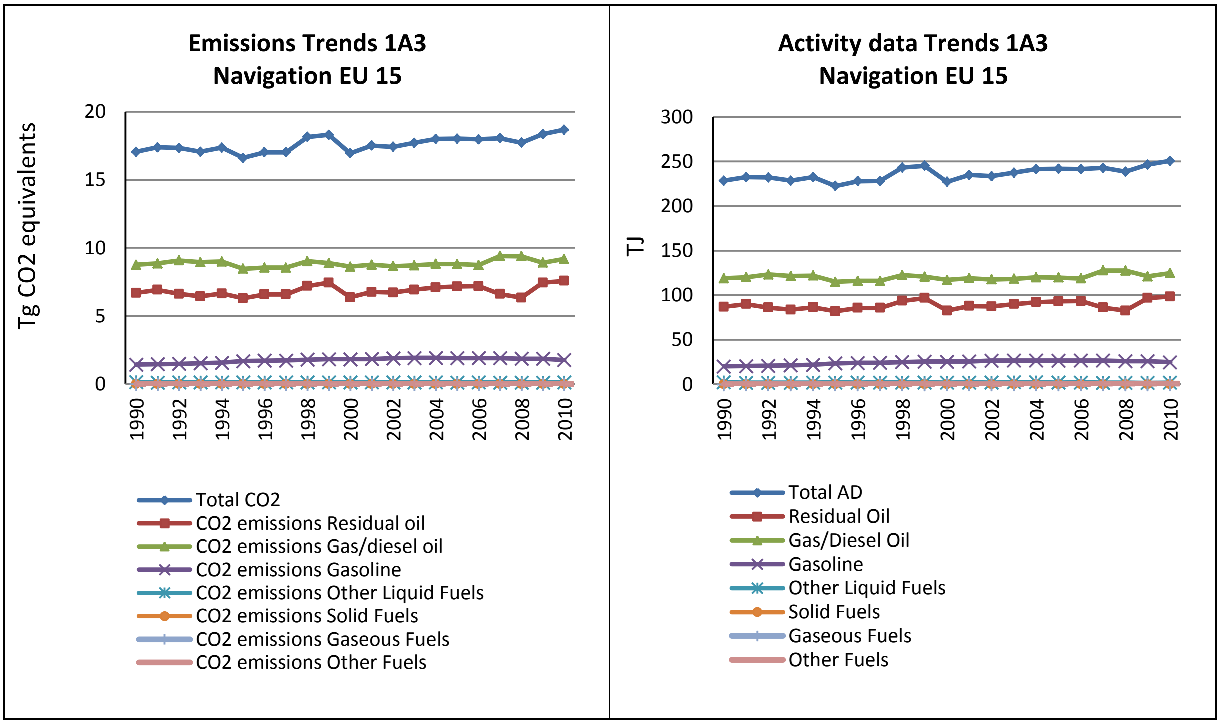


3.2.3.4 Navigation (1A3d) (EU-15)

This source category covers all water-borne transport from recreational craft to large ocean-going cargo ships that are driven primarily by large, slow and medium speed diesel engines and occasionally by steam or gas turbines. Emissions arise from gas/diesel oil, residual oil or other.

CO_2 emissions from 1A3d Navigation account for 0.5 % of total EU-15 GHG emissions in 2010. Between 1990 and 2010, CO_2 emissions from navigation increased by 9 % in the EU-15 (Table 3.). The emissions from this key source are due to fossil fuel consumption in navigation. The total CO_2 emission trend is dominated by emissions from gas/diesel oil and residual oil (Figure 3.66).

Figure 3.66 1A3d Navigation: CO_2 Emission Trend and Activity Data



Five Member States (Greece, Italy, France, Spain and the United Kingdom) contributed the most to the emissions from this source (77.8%). Most Member States had increasing emissions from navigation between 1990 and 2010. The Member States with the highest increases in absolute terms were Spain, Greece and the Netherlands (Table 3.).

Table 3.63 1A3d Navigation: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010	
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	14	11	11	0.1%	0	0%	-3	-21%
Belgium	398	395	471	2.5%	76	19%	73	18%
Denmark	796	598	593	3.2%	-5	-1%	-203	-25%
Finland	441	508	564	3.0%	55	11%	122	28%
France	1,065	1,225	1,248	6.7%	23	2%	183	17%
Germany	2,066	823	758	4.1%	-65	-8%	-1,307	-63%
Greece	1,825	2,808	2,286	12.2%	-522	-19%	461	25%
Ireland	85	199	198	1.1%	-1	-1%	113	133%
Italy	5,420	4,762	5,096	27.3%	334	7%	-324	-6%
Luxembourg	1	1	1	0.0%	0	8%	0	10%
Netherlands	405	590	595	3.2%	5	1%	191	47%
Portugal	260	224	227	1.2%	3	1%	-33	-13%
Spain	1,500	3,294	3,547	19.0%	253	8%	2,047	136%
Sweden	542	503	729	3.9%	226	45%	187	34%
United Kingdom	2,231	2,401	2,343	12.6%	-58	-2%	112	5%
EU-15	**17,049**	**18,343**	**18,668**	**100.0%**	**325**	**2%**	**1,619**	**9%**

1A3d Navigation – Residual Oil (CO_2)

CO_2 emissions from residual oil account for 40.6 % of CO_2 emissions from 1A3d Navigation in 2010. Between 1990 and 2010, CO_2 emissions from residual oil increased by 13 % in the EU-15. The countries with the highest increase in absolute terms were Greece and Spain. Austria, Germany, Ireland, Luxembourg and the Netherlands reported emissions as 'Not Occurring' (Table 3.61) for 2010, whereas Belgium reported emissions as 'Included Elsewhere' and specifically, the aforementioned emissions are included in gas/diesel oil, since the amounts of residual oil are very small.

Table 3.61 1A3d Navigation, residual oil: Member States' contributions to CO_2 emissions and information on method applied and emission factor

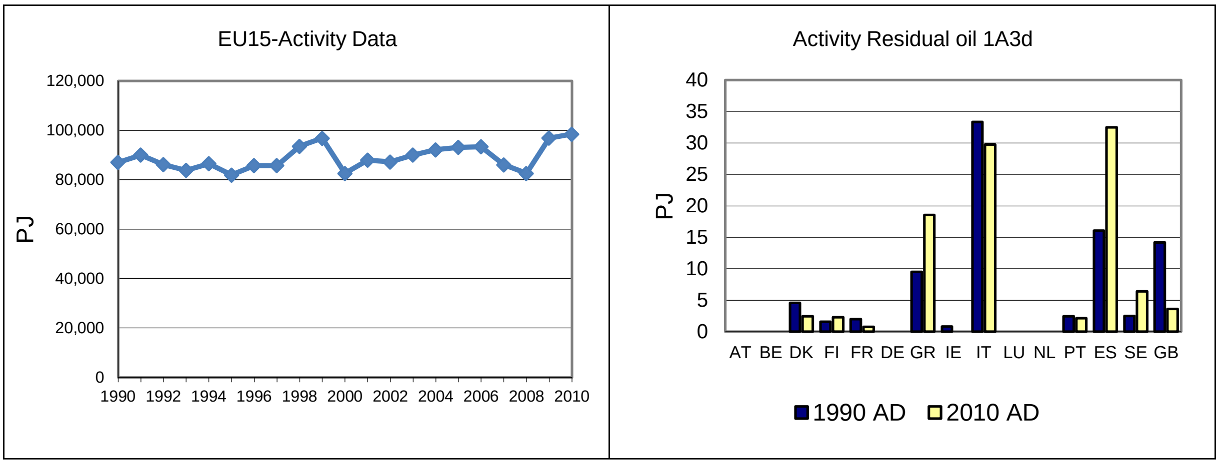
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	NO	NO	NO	-	-	-	-	-	NA	NA
Belgium	IE	IE	IE	-	-	-	-	-	NA	NA
Denmark	357	179	192	2.5%	13	7%	-165	-46%	OTH	CS
Finland	123	158	182	2.4%	24	15%	59	48%	M	CS
France	157	52	59	0.8%	8	15%	-97	-62%	T1	CS
Germany	NO	NO	NO	-	-	-	-	-	NA	NA
Greece	730	1,939	1,422	18.8%	-517	-27%	693	95%	T1	D
Ireland	63	NO	NO	-	0	-	-63	-100%	NA	NA
Italy	2,553	2,056	2,274	30.0%	219	11%	-279	-11%	T1,T2	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	NO	NO	NO	-	-	-	-	-	NA	NA
Portugal	188	162	164	2.2%	2	1%	-24	-13%	CR	CR
Spain	1,234	2,318	2,496	33.0%	178	8%	1,262	102%	T2	CR
Sweden	194	277	499	6.6%	221	80%	304	157%	T1	CS
United Kingdom	1,098	304	283	3.7%	-21	-7%	-816	-74%	T2	CS
EU-15	**6,696**	**7,444**	**7,570**	**100.0%**	**126**	**2%**	**874**	**13%**		

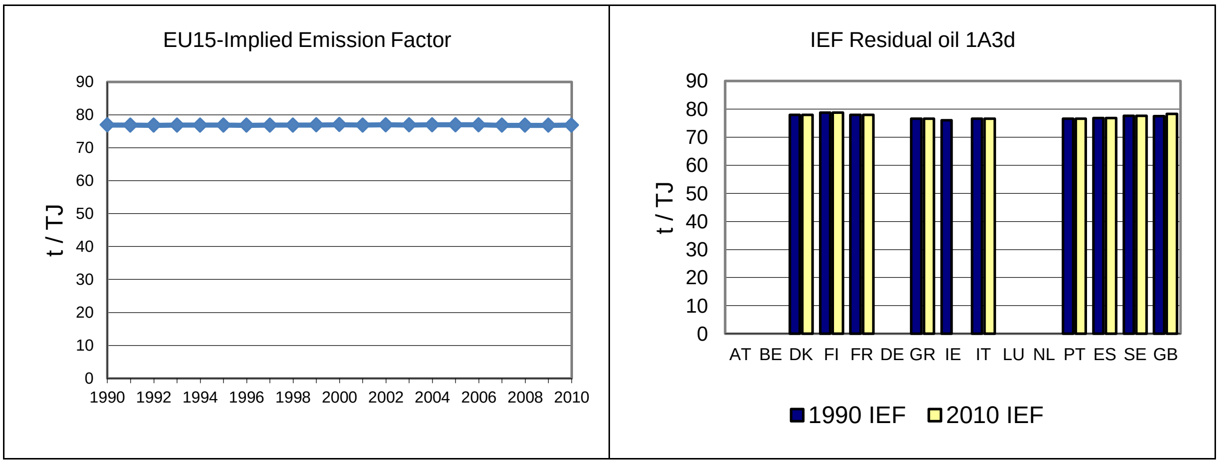
Abbreviations explained in the Chapter 'Units and abbreviations'.

Greece, Italy and Spain account for 81.8 % of CO_2 emissions and for 82 % of activity data from residual oil in 2010 (Figure 3.67). The IEF for the EU-15 is 76.87 t/TJ Residual oil in 2010.

Table 3.61 shows, that the majority of CO_2 emissions from the combustion of residual oil in navigation were calculated using a higher tier method.

Figure 3.67 1A3d Navigation, residual oil: Activity data and implied emission factors for CO_2





1A3d Navigation – Gas/Diesel Oil (CO_2)

CO_2 emissions from Gas/Diesel oil account for 49.2 % of CO_2 emissions from 1A3d Navigation in 2010 (Table 3.62). The CO_2 emissions from Gas/Diesel oil increased by 5 % between 1990 and 2010.

Table 3.62 1A3d Navigation, gas/diesel oil: Member States' contributions to CO_2 emissions and information on method applied and emission factor

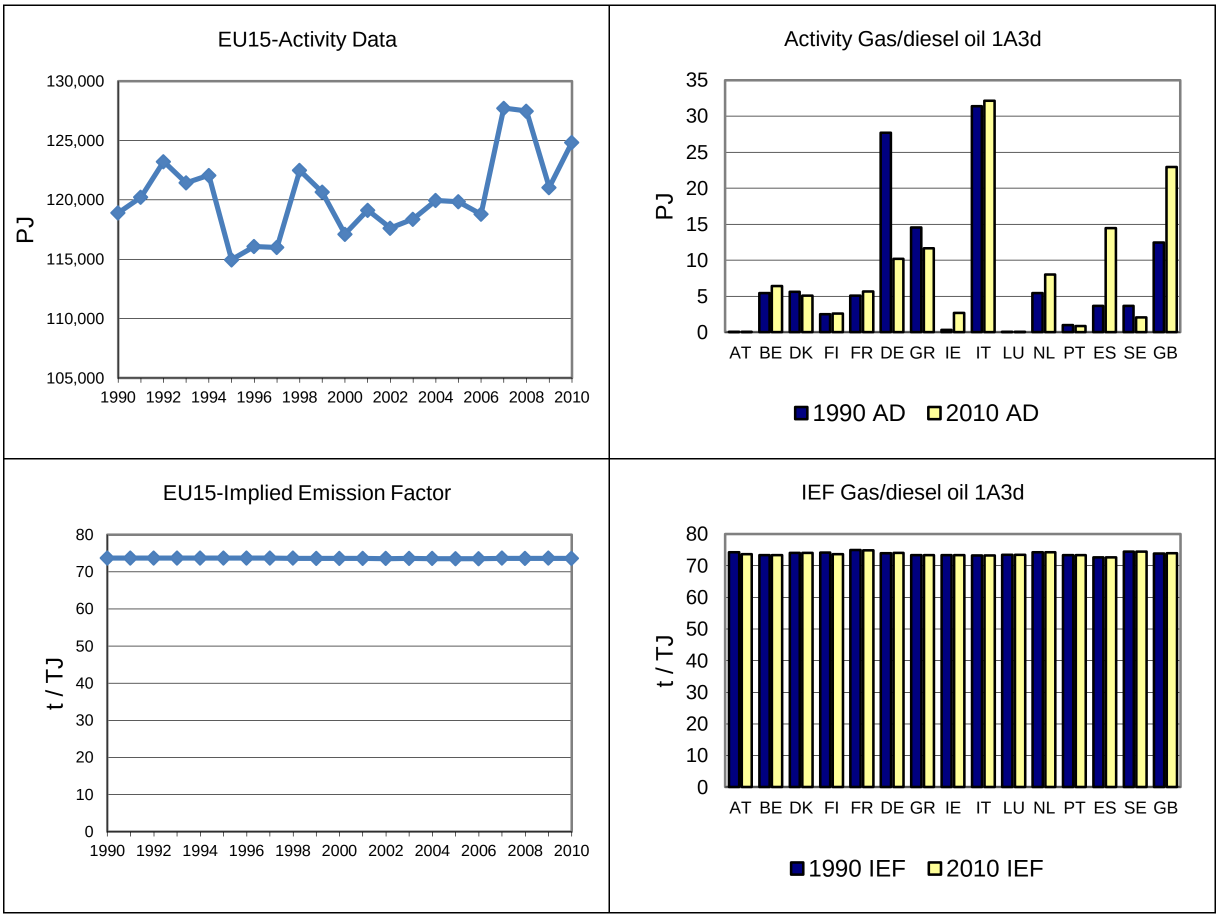
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	4	2	3	0.0%	0	7%	-1	-37%	CS	CS
Belgium	398	395	471	5.1%	76	19%	73	18%	CS,M,T1	CS,D
Denmark	417	393	375	4.1%	-18	-5%	-41	-10%	OTH	CS
Finland	186	173	191	2.1%	18	10%	4	2%	M,T3	CS
France	382	396	423	4.6%	26	7%	41	11%	T1	CS
Germany	2,050	821	756	8.2%	-65	-8%	-1,294	-63%	T1	CS
Greece	1,068	863	854	9.3%	-9	-1%	-214	-20%	T1	D
Ireland	22	199	198	2.2%	-1	-1%	176	790%	T1	CS
Italy	2,299	2,147	2,356	25.6%	209	10%	57	2%	T1,T2	CS
Luxembourg	1	1	1	0.0%	0	10%	0	29%	T2	CS
Netherlands	405	590	595	6.5%	5	1%	191	47%	T2	CS
Portugal	72	62	63	0.7%	1	1%	-9	-13%	CR	CR
Spain	266	976	1,051	11.4%	75	8%	785	296%	T2	CR
Sweden	271	148	154	1.7%	5	4%	-118	-43%	T1	CS
United Kingdom	921	1,742	1,696	18.5%	-47	-3%	775	84%	T2	CS
EU-15	**8,762**	**8,912**	**9,186**	**100.0%**	**274**	**3%**	**424**	**5%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Germany, Greece, Italy, Spain and the United Kingdom account for 73 % of the CO_2 emissions and for 73.2 % of activity data from gas/diesel oil in 2010 (Figure 3.68). The IEF for the EU-15 is 73.58 t/TJ residual oil in 2010.

Table 3.62 shows that the majority of CO_2 emissions from the combustion of gas/diesel oil in navigation were calculated using a higher tier method.

Figure 3.68 **1A3d Navigation, gas/diesel oil: Activity data and implied emission factors for CO_2**



3.2.3.5 Other (1A3e) (EU-15)

CO_2 emissions from 1A3e Other account for 0.21 % of total EU-15 GHG emissions in 2010. This source includes mainly pipeline transport and ground activities in airports and harbours. The emissions from this key source are due to fossil fuel consumption in other transportation, which increased by 13.5 % between 1990 and 2010. A fuel shift occurred from oil to gas.

Germany contributed 51.9 % to the EU-15 emissions from this source in 2010 (Table 3.63). Between 1990 and 2010 the EU-15 emissions increased by 13 %. Denmark, Luxembourg and the Netherlands report emissions as ‘Not occurring’ or ‘Not applicable’. Portugal includes off-road vehicles and machines from manufacturing industries, residential and commercial/institutional with the other combustion equipment of these source categories; emissions from the consumption of jet fuel from military operation in 1 A 5 b (Other Mobile); and emissions from off-road vehicles and machines from agriculture/forestry sector in 1 A 4 c Agriculture/Forestry/Fisheries (see country NIR Portugal, p.149-150).

Table 3.63 1A3e Other: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010	
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	224	425	320	4.0%	-104	-25%	96	43%
Belgium	197	203	191	2.4%	-13	-6%	-6	-3%
Denmark	NO	NO	NO	-	-	-	-	-
Finland	660	595	634	7.9%	39	7%	-26	-4%
France	213	606	537	6.7%	-69	-11%	324	152%
Germany	4,752	4,286	4,141	51.9%	-146	-3%	-611	-13%
Greece	NO	9	9	0.1%	0	2%	9	-
Ireland	62	151	165	2.1%	14	9%	103	165%
Italy	407	844	1,093	13.7%	249	30%	686	169%
Luxembourg	NA	NA	NA	-	-	-	-	-
Netherlands	NO	NO	NO	-	-	-	-	-
Portugal	IE	IE	IE	-	-	-	-	-
Spain	20	162	162	2.0%	0	0%	142	702%
Sweden	271	300	304	3.8%	4	1%	32	12%
United Kingdom	225	439	424	5.3%	-15	-3%	199	89%
EU-15	**7,031**	**8,020**	**7,980**	**100.0%**	**-40**	**0%**	**948**	**13%**

Abbreviations explained in the Chapter 'Units and abbreviation

3.2.4 Other Sectors (CRF Source Category 1A4) (EU-15)

Category 1A4 mainly includes emissions from 'small scale fuel combustion' used for space heating and hot water production in commercial and institutional buildings, households, agriculture and forestry. It includes also emissions from mobile machinery used within these categories (e.g mowers, harvesters, tractors, chain saws, motor pumps) as well as fuel used for grain drying, horticultural greenhouse heating or CO_2 fertilisation and stall heatings. Category 1A4c includes emissions from domestic inland, coastal and deep sea fishing wheras emissions from international fishing are included under category 1A3d. Emissions from transportation of agricultural goods are reported under category 1A3 Transport.

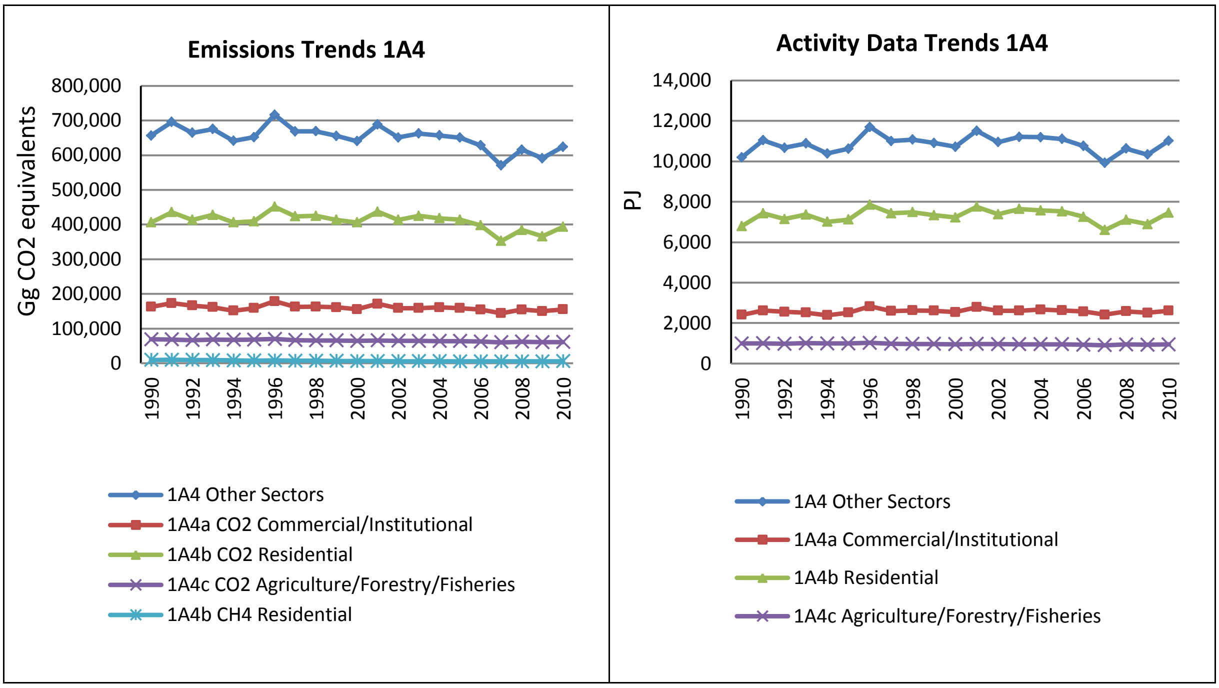
The following enumeration shows the correspondence of 1A4 sub categories and ISIC 3.1 rev codes:

- 1 A 4 a Commercial/Institutional: ISIC categories 4103, 42, 6, 719, 72, 8, and 91-96
- 1 A 4 b Residential: All emissions from fuel combustion in households
- 1 A 4 b Agriculture/Forestry/Fishing: ISIC categories 05, 11, 12, 1302

In 2010 category 1A4 contributed to 624.303 Gg CO_2 equivalents of which 97.7 % CO_2, 1.3 % CH_4 and 1.0 % N_2O.

Figure 3.69 shows the trend of total GHG emissions within source category 1A4 and the dominating sources: CO_2 emissions from 1A4b Residential and from 1A4a Commercial/Residential. The emissions of the large key sources fluctuated between 1990 and 2010, all emissions from 1A4 decreased.

Figure 3.69 1A4 Other Sectors: Total, CO_2 and CH_4 emission trends



In 2010 GHG emissions from source category 1A4 accounted for 16 % of total GHG emissions. This source category includes ten key sources:

- 1 A 4 a Commercial/Institutional: Gaseous Fuels (CO_2)
- 1 A 4 a Commercial/Institutional: Liquid Fuels (CO_2)
- 1 A 4 a Commercial/Institutional: Solid Fuels (CO_2)
- 1 A 4 b Residential: Gaseous Fuels (CO_2)
- 1 A 4 b Residential: Liquid Fuels (CO_2)
- 1 A 4 b Residential: Solid Fuels (CO_2)
- 1 A 4 c Agriculture/Forestry/Fisheries: Gaseous Fuels (CO_2)
- 1 A 4 c Agriculture/Forestry/Fisheries: Liquid Fuels (CO_2)
- 1 A 4 c Agriculture/Forestry/Fisheries: Solid Fuels (CO_2)

Table 3.64 shows total GHG, CO_2 and CH_4 emissions from 1A4 Other sectors. Between 1990 and 2010 CO_2 emissions from 1A4 Other Sectors decreased by 5 %, CH_4 decreased by 31 % and N_2O emissions decreased by 2 %.

Table 3.64 1A4 Other Sectors: Member States' contributions to total GHG, CO_2 and CH_4 emissions

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2010 (Gg CO_2 equivalents)	CO2 emissions in 1990 (Gg)	CO2 emissions in 2010 (Gg)	CH_4 emissions in 1990 (Gg CO_2 equivalents)	CH4 emissions in 2010 (Gg CO_2 equivalents)
Austria	14,405	11,401	13,785	10,970	386	211
Belgium	27,741	32,602	27,382	32,276	249	214
Denmark	9,132	6,600	8,954	6,331	108	171
Finland	7,433	5,083	7,161	4,731	184	269
France	100,631	103,199	95,598	100,223	3,736	1,505
Germany	208,066	145,928	204,483	144,557	2,595	830
Greece	8,592	9,839	8,126	9,519	84	75
Ireland	10,518	10,996	10,031	10,725	379	168
Italy	78,343	94,153	76,634	91,038	309	1,078
Luxembourg	1,322	1,643	1,310	1,623	7	9
Netherlands	38,291	45,820	37,791	44,292	455	1,482
Portugal	4,656	5,242	4,068	4,886	348	193
Spain	26,454	39,252	25,320	38,143	817	734
Sweden	10,914	4,239	10,383	3,606	243	350
United Kingdom	109,944	108,315	107,457	107,102	1,519	582
EU-15	**656,442**	**624,311**	**638,483**	**610,025**	**11,420**	**7,871**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.65 provides information on the contribution of Member States to EU-15 recalculations in CO_2 from 1A4 Other sectors for 1990 and 2010 and main explanations for the largest recalculations in absolute terms.

Table 3.65 1A4 Other Sectors: Contribution of MS to EU-15 recalculations in CO_2 for 1990 and 2009 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2009		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	-27	-0.2	-987	-9.1	Revised energy balance. Exclusion of LPG for transport.
Belgium	-184	-0.7	-596	-2.1	- During the 2012 submission a re-allocation took place in the Flemish region for the emissions from off-road. The off-road emissions from construction are no longer allocated to the commercial/institutional sector (category 1A4a) but to the sector of manufacturing industry and construction (category 1A2f) for the complete time series; - During the 2012 submission the off-road emissions are included for the first time in the Walloon region and in the Brussels region.
Denmark	11	0.1	-148	-2.4	- For stationary combustion plants, the emission estimates for the years 1990-2009 have been updated according to the latest energy statistics published by the Danish Energy Agency. The update included both end use and transformation sectors as well as a source category update. - 1A4c, mobile combustion: the sales distribution into engine sizes for harvesters has been updated for the years 2002, 2003 and 2009.
Finland	121	1.7	-380	-7.9	Updated activity data from Raklam model
France	-137	-0.1	1,844	1.9	Mise à jour activité
Germany	0	0.0	-4,252	-2.9	New statistical data available.
Greece	0	0.0	3	0.03	For 1A4c, liquid fuels, an error of the working file of the year 2009 was corrected (concerning AD), and the emissions of CO2, CH4 and N2O from liquid fuels combustion were recalculated for the year 2009.
Ireland	-22	-0.2	-57	-0.5	- Revised Energy data from the National Energy Balance - This submission now includes gasoil used in Fishing from 2003 onwards
Italy	-42	-0.1	1,191	1.4	- Update of CO2 natural gas emission factor - Update of waste fuel consumption for commercial heating
Luxembourg	0	0.0	-211	-11.6	Revised AD due to revised energy balance by national statistics
Netherlands	0	0.0	0	0.0	
Portugal	42	1.1	154	3.2	1) Revision of the toe/ton conversion factors used to convert fuel consumption from energy balance toe to INERPA ton. The newer values were obtained from DGEG and updated for all times series for auto-producers. These new values were accompanied by revised LHV; 2) Update of fuel consumption in fishing bunkers.
Spain	0	0.0	742	2.1	1A4a, gaseous fuels: Data on energy from natural gas allocated within this category have been revised in order to: i) apply the annual mean values of NCV provided by the main gas transport company (default values for the national Inventory); ii) correct a mistake committed by the data source in the units associated to the figures related to cogeneration; iii) eliminate a double-accounting for a consumption of gas natural for cogeneration allocated to plants (incineration plants) that appear in the data on cogeneration reported by the data source for this category and, moreover, they have been already computed in the category of energy sector; and iv) include natural gas consumption of a few autoproducer plants allocated in this category. 1A4c, liquid fuels: Revision of diesel consumption data in the following activities: - Mobile forestry machinery: The extrapolated data for 2007, based in available time series to 2006, have now been updated according to new statistical data (source: MARM Statistical Yearbook). - Agricultural stationary combustion engines (except irrigation pump engines). Updating of the diesel consumption amount, calculated as a function of diesel consumption of mobile machinery (the latter having been updated). An additional recalculation has been effected on irrigation pump engines as data for 2009 have been come available (instead of extrapolated data of 2008)
Sweden	94	0.9	-38	-1.2	New method for off-road vehicles & working machinery.
UK	-1,450	-1.3	-445	-0.5	- Revised assumptions: No domestic combustion of natural gas in Gibraltar. - Revisions to gas oil activity data based on new research. - Revisions made for some fuels in national energy statistics from 2005 onwards.
EU-15	**-1,594**	**-0.2**	**-3,179**	**-0.5**	

Table 3.66 provides information on the contribution of Member States to EU-15 recalculations in CH_4 from 1A4 Other sectors for 1990 and 2009.

Table 3.66 1A4 Other Sectors: Contribution of MS to EU-15 recalculations in CH_4 for 1990 and 2009 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

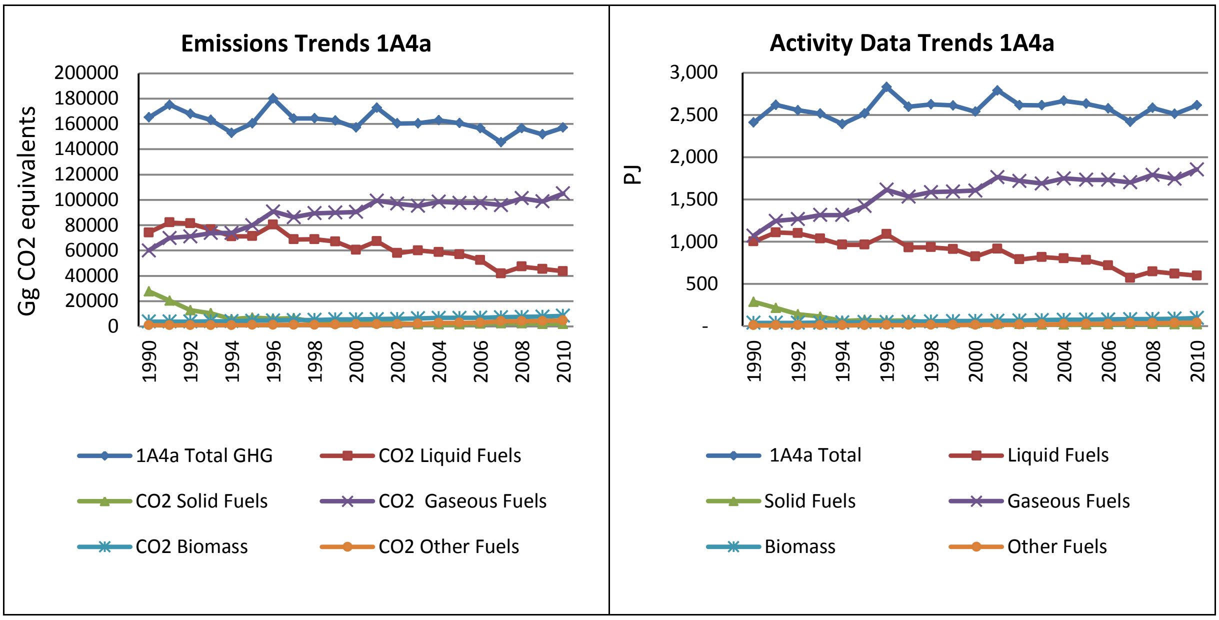
	1990		2009		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	0	0.0	-14	-6.7	Revised energy balance. Exclusion of LPG for transport.
Belgium	4	1.5	8	4.6	- During the 2012 submission the activity data of wood consumption in the category 1A4a (commercial/institutional) was corrected in the Flemish region for the years 2000, 2001 and 2004, consequently emissions did change. - During the 2012 submission all greenhouse gas emissions from biomass are optimized in the Flemish region in the category 1A4a (commercial/institutional) from 2000 on because wrong emission factors were used. Biomass used for non-self producers consists of wood and not biogas like assumed in previous submissions. - During the 2012 submission the off-road emissions are included for the first time in the Walloon region and in the Brussels region.
Denmark	-7	-5.8	-18	-9.8	- For stationary combustion plants, the emission estimates for the years 1990-2009 have been updated according to the latest energy statistics published by the Danish Energy Agency. The update included both end use and transformation sectors as well as a source category update. - 1A4c, mobile combustion: the sales distribution into engine sizes for harvesters has been updated for the years 2002, 2003 and 2009.
Finland	0	0.2	6	2.7	Updated activity data from Raklam model
France	0	0.0	7	0.5	Mise à jour activité + Mise à jour des Facteurs Emission
Germany	1	0.1	16	2.4	- Activity data, all categories: new statistical data available - Emission factor, 1A4c, liquid fuels: actualization of EF time series reflecting the measures taken to improve the emission behavior
Greece	0	0.0	0.05	0.1	For 1A4c, liquid fuels, an error of the working file of the year 2009 was corrected (concerning AD), and the emissions of CO2, CH4 and N2O from liquid fuels combustion were recalculated for the year 2009.
Ireland	0	0.0	1	0.7	- Revised Energy data from the National Energy Balance - This submission now includes gasoil used in Fishing from 2003 onwards
Italy	0	0.0	247	31.5	Update of biomass and waste fuel consumption for heating
Luxembourg	0	0.0	-1	-6.4	Revised AD due to revised energy balance by national statistics
Netherlands	1	0.2	1	0.1	Improvement based on new survey; error correction
Portugal	0	0.0	-113.0	-36.0	1) Revision of the toe/ton conversion factors used to convert fuel consumption from energy balance toe to INERPA ton. The newer values were obtained from DGEG and updated for all times series for auto-producers. These new values were accompanied by revised LHV; 2) Update of fuel consumption in fishing bunkers.
Spain	0	0.0	46	6.7	1A4a, gaseous fuels: - Application of annual mean values of NCV provided by the main gas transport company (default values for the national Inventory); - Correct of a mistake committed by the data source in the units associated to the figures related to cogeneration; - Elimination of double-accounting for a consumption of gas natural for cogeneration in incineration plants; - Inclusion of natural gas consumption of a few autoproducer plants allocated in this category. 1A4a, biomass: - Removal of biogas and solid biomass to eliminate a double-accounting for the fuel consumption in cogeneration of a landfill and a plant allocated in the inventory to power plants for public service; - Inclusion of consumption of residual wastes from a few autoproducer plants in the current submission.
Sweden	0	0.1	21	7.8	New method for off-road vehicles & working machinery.
UK	-17	-1.1	-8	-1.5	- Revised assumptions: No domestic combustion of natural gas in Gibraltar. - Revisions to gas oil activity data based on new research. - Revisions made for some fuels in national energy statistics from 2005 onwards.
EU-15	**-18**	**-0.2**	**201**	**2.8**	

3.2.4.1 Commercial/Institutional (1A4a) (EU-15)

In this chapter information about emission trends, Member states' contribution, activity data, and emission factors is provided for category 1A4a by fuels. CO_2 emissions from 1A4a Commercial/Institutional was the fifth largest key category of GHG emissions in the EU-15 and accounted for 4.1 % of total GHG emissions in 2010.

Figure 3.70 shows the emission trend within the category 1A4a, which is mainly dominated by CO_2 emissions from liquid and gaseous fuels. Total emissions decreased by 4.9 %, mainly due to decreases in CO_2 emissions from solid (-93 %) and liquid (-41 %) fuels while CO_2 emissions from gaseous fuels show a continuous uptrend for the whole time series.

Figure 3.70 **1A4a Commercial/Institutional: Total and CO_2 emission and activity trends**



Between 1990 and 2010, CO_2 emissions from 1A4a decreased by 5 % in the EU-15 (Table 3.67). Main factors influencing CO_2 emissions from this source category are (1) outdoor temperature, (2) number and size of offices, (3) building codes, (4) thermal properties of building stock, (5) fuel split for heating and warm water, (6) use of renewable energy sources, e.g. biomass or solar panels, and (7) use of district heating. Fossil fuel consumption in Commercial/Institutional increased by 4 % between 1990 and 2010, with a fuel switch from coal and oil to gas.

France, Germany, Italy and the United Kingdom contributed the most to the emissions from this source (75 %). The Member States with the highest increases in absolute terms were Spain, Italy and the Netherlands. The Member States with the highest reduction in absolute terms were Germany and the United Kingdom.

Table 3.67 1A4a Commercial/Institutional: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010	
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)
Austria	2,568	1,956	2,303	1.5%	347	18%	-265	-10%
Belgium	4,348	6,119	6,850	4.4%	732	12%	2,503	58%
Denmark	1,486	999	1,106	0.7%	107	11%	-380	-26%
Finland	1,964	958	1,067	0.7%	109	11%	-897	-46%
France	28,786	31,307	30,691	19.7%	-616	-2%	1,905	7%
Germany	63,950	37,155	36,399	23.4%	-756	-2%	-27,550	-43%
Greece	527	1,230	1,140	0.7%	-89	-7%	613	116%
Ireland	2,319	2,320	2,323	1.5%	3	0%	4	0%
Italy	16,144	28,598	30,987	19.9%	2,389	8%	14,843	92%
Luxembourg	634	392	509	0.3%	117	30%	-125	-20%
Netherlands	8,379	11,192	13,179	8.5%	1,987	18%	4,800	57%
Portugal	746	1,890	1,326	0.9%	-564	-30%	580	78%
Spain	3,743	8,079	8,606	5.5%	527	7%	4,863	130%
Sweden	2,533	571	722	0.5%	150	26%	-1,811	-72%
United Kingdom	24,818	17,616	18,402	11.8%	786	4%	-6,416	-26%
EU-15	**162,945**	**150,382**	**155,611**	**100.0%**	**5,228**	**3%**	**-7,334**	**-5%**

1A4 a Commercial/Institutional – Liquid Fuels (CO_2)

In 2010 CO_2 emissions from liquid fuels had a share of 28 % within source category 1A4a (compared to 45 % in 1990). Between 1990 and 2010, the emissions decreased by 41 % (Table 3.68). Three Member States had increases in this period, with the highest absolute increase in Spain. The highest absolute decrease was achieved in Germany. Between 2009 and 2010 EU-15 total emissions decreased by 4 %. The strong decrease from 2006 to 2007 for Germany is due to low gasoil sales to end consumers. Many end consumers did not restock their oil tanks in 2007 because of high outdoor temperatures and rising oil prices. Additionally end consumer gasoil stocks were comparatively high in 2007 due to a mild winter 2006. It is assumed that the circumstances were similar for other MS (e.g. Austria).

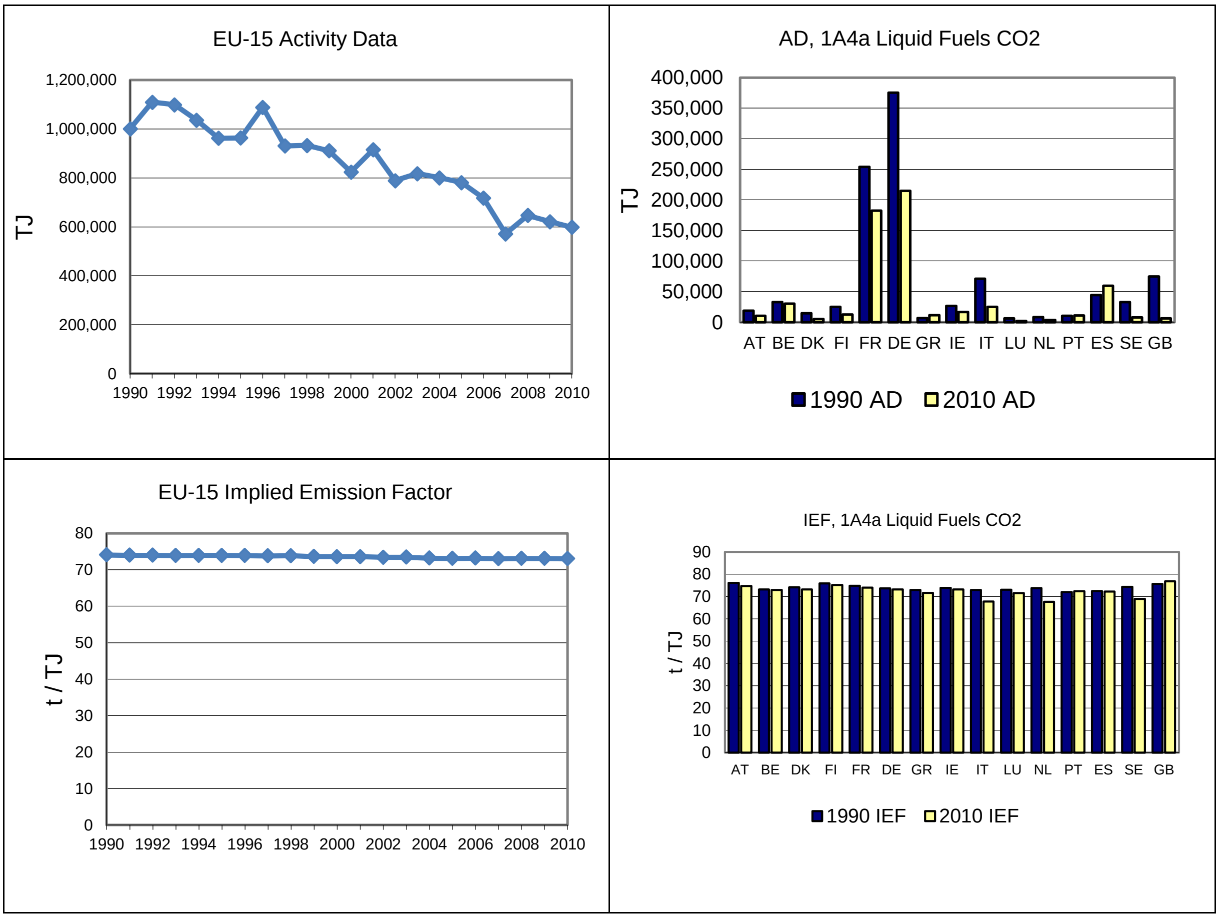
Table 3.68 1A4a Commercial/Institutional, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)		
Austria	1,421	994	792	1.8%	-202	-20%	-630	-44%	T2	CS
Belgium	2,385	1,881	2,216	5.1%	336	18%	-168	-7%	T1	D
Denmark	1,081	410	385	0.9%	-25	-6%	-697	-64%	CR	CS,D
Finland	1,898	860	942	2.2%	82	10%	-956	-50%	T1	CS
France	18,979	15,090	13,497	30.9%	-1,594	-11%	-5,482	-29%	T2	CS
Germany	27,633	15,364	15,685	35.9%	321	2%	-11,948	-43%	CS	CS
Greece	505	895	819	1.9%	-76	-9%	313	62%	T2	D
Ireland	1,957	1,259	1,230	2.8%	-28	-2%	-727	-37%	T1	CS
Italy	5,157	1,856	1,689	3.9%	-168	-9%	-3,469	-67%	T2	CS
Luxembourg	464	35	132	0.3%	98	283%	-332	-72%	T2	CS
Netherlands	619	265	241	0.6%	-24	-9%	-378	-61%	T2	CS
Portugal	746	1,336	767	1.8%	-569	-43%	21	3%	T2	D, CR
Spain	3,193	4,309	4,294	9.8%	-16	0%	1,100	34%	T2	CR
Sweden	2,447	396	516	1.2%	120	30%	-1,931	-79%	T1	CS
United Kingdom	5,656	459	484	1.1%	25	5%	-5,172	-91%	T2	CS
EU-15	**74,142**	**45,408**	**43,687**	**100.0%**	**-1,721**	**-4%**	**-30,455**	**-41%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.71 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by France, Germany and Spain; together they cause 77 % of the CO_2 emissions from liquid fuels in 1A4a. Fuel consumption in the EU-15 decreased by 40 % between 1990 and 2010. The implied emission factor of EU-15 was 73.0 t/TJ in 2010. The dip in activity data 2007 is mainly due to Germany due to reasons explained earlier in this chapter.

Figure 3.71 1A4a Commercial/Institutional, liquid fuels: Activity Data and Implied Emission Factors for CO_2



1A4a Commercial/Institutional – Solid Fuels (CO_2)

In 2010, CO_2 from solid fuels had a share of 1 % within source category 1A4a (compared to 17 % in 1990). Between 1990 and 2010 the emissions decreased by 93 % (Table 3.69). Eight countries report emissions as ‘Not occurring’ in 2010; all other Member States reduced emissions between 1990 and 2010 except Spain. Between 2009 and 2010 EU-15 emissions increased by 3 %.

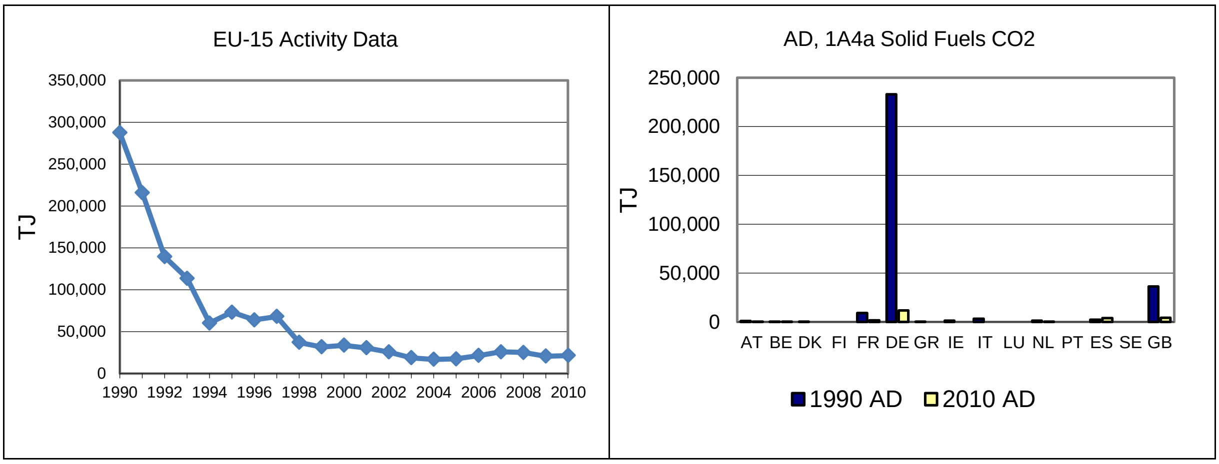
Table 3.69 1A4a Commercial/Institutional, solid fuels: Member States’ contributions to CO_2 emissions and information on method applied and emission factor

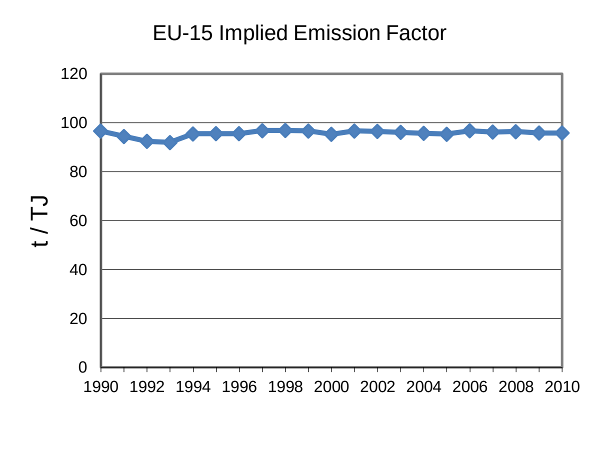
Member State	CO2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)		
Austria	90	18	19	0.9%	1	7%	-71	-79%	T2	CS
Belgium	9	3	3	0.1%	0	-5%	-6	-71%	T1	D
Denmark	8	NO	NO	-	-	-	-8	-100%	NA	NA
Finland	NO	NO	NO	-	-	-	-	-	NA	NA
France	868	157	137	6.7%	-20	-13%	-731	-84%	T2	CS
Germany	22,712	1,034	1,192	58.2%	158	15%	-21,520	-95%	CS	CS
Greece	22	NO	NO	-	-	-	-22	-100%	NA	NA
Ireland	138	NO	NO	-	0	-	-138	-100%	NA	NA
Italy	218	NO	NO	-	-	-	-218	-100%	NA	NA
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	128	12	6	0.3%	-6	-48%	-122	-95%	T2	CS
Portugal	NO	NO	NO	-	-	-	-	-	NA	NA
Spain	154	284	312	15.2%	28	10%	158	102%	T2	CR
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom	3,441	481	379	18.5%	-102	-21%	-3,062	-89%	T2	CS
EU-15	**27,789**	**1,988**	**2,047**	**100.0%**	**60**	**3%**	**-25,742**	**-93%**		

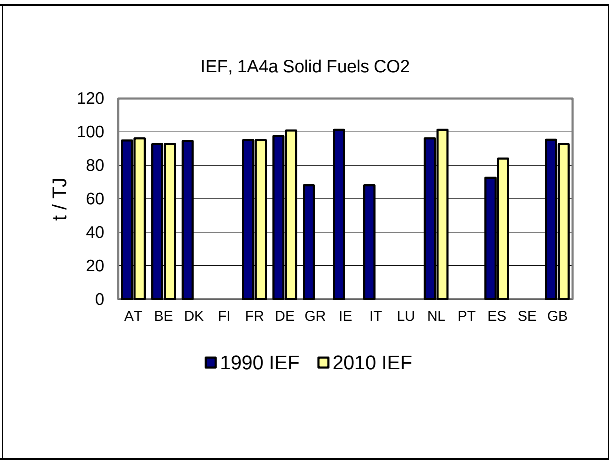
Abbreviations explained in the Chapter ‘Units and abbreviations’.

Figure 3.72 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are still reported by Germany and the United Kingdom in 2010; together they cause 77 % of the CO_2 emissions from solid fuels in 1A4a. Fuel consumption in the EU-15 decreased by 93 % between 1990 and 2010. The implied emission factor of EU-15 was 95.9 t/TJ in 2010. The implied emission factors of Italy and Spain are comparatively low because of a high share of gas works gas is included.

Figure 3.72 1A4a Commercial/Institutional, solid fuels: Activity Data and Implied Emission Factors for CO_2







1A4a Commercial/Institutional – Gaseous Fuels (CO_2)

In 2010 CO_2 from gaseous fuels had a share of 67 % within source category 1A4a (compared to 36 % in 1990). Between 1990 and 2010, the emissions increased by 75 % (Table 3.70). All Member States reported increasing emissions. The highest absolute increases occurred in Germany, France; Italy and the Netherlands. Between 2009 and 2010 EU-15 emissions increased by 6 %.

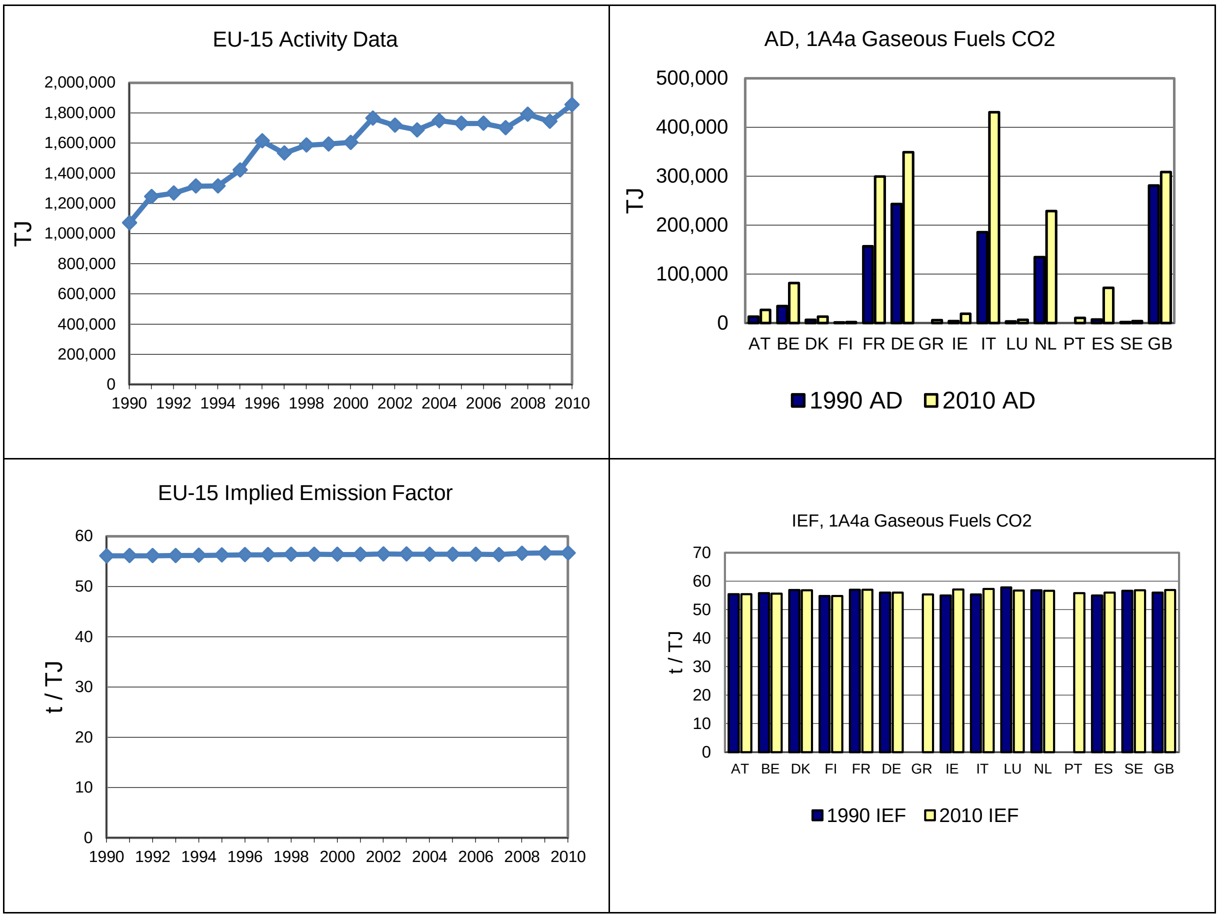
Table 3.70 1A4a Commercial/Institutional, gaseous fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)		
Austria	707	899	1,490	1.4%	591	66%	783	111%	T2	CS
Belgium	1,924	4,134	4,525	4.3%	391	9%	2,601	135%	T1	D
Denmark	363	588	719	0.7%	131	22%	356	98%	CR	CS
Finland	50	87	101	0.1%	14	16%	50	100%	T1	CS
France	8,939	16,060	17,057	16.2%	997	6%	8,119	91%	T2	CS
Germany	13,605	20,757	19,523	18.6%	-1,235	-6%	5,917	43%	CS	CS
Greece	NO	335	322	0.3%	-13	-4%	322	-	T2	CS
Ireland	223	1,061	1,093	1.0%	31	3%	869	389%	T1	CS
Italy	10,243	22,645	24,647	23.5%	2,002	9%	14,405	141%	T2	CS
Luxembourg	170	358	377	0.4%	19	5%	207	122%	T2	CS
Netherlands	7,632	10,915	12,932	12.3%	2,017	18%	5,300	69%	T2	CS
Portugal	NO	554	559	0.5%	5	1%	559	-	T2	D, CR
Spain	395	3,485	4,000	3.8%	515	15%	3,606	913%	T2	CS
Sweden	86	175	206	0.2%	30	17%	119	139%	T1	CS
United Kingdom	15,721	16,676	17,539	16.7%	863	5%	1,818	12%	T2	CS
EU-15	**60,058**	**98,729**	**105,089**	**100.0%**	**6,360**	**6%**	**45,031**	**75%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.73 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by France, Germany, Italy, the Netherlands and the UK; together they cause 87 % of the CO_2 emissions from gaseous fuels in 1A4a. Fuel combustion in the EU-15 rose by 73 % between 1990 and 2010. The implied emission factor of EU-15 was 56.7 t/TJ in 2010.

Figure 3.73 1A4a Commercial/Institutional, gaseous fuels: Activity Data and Implied Emission Factors for CO_2

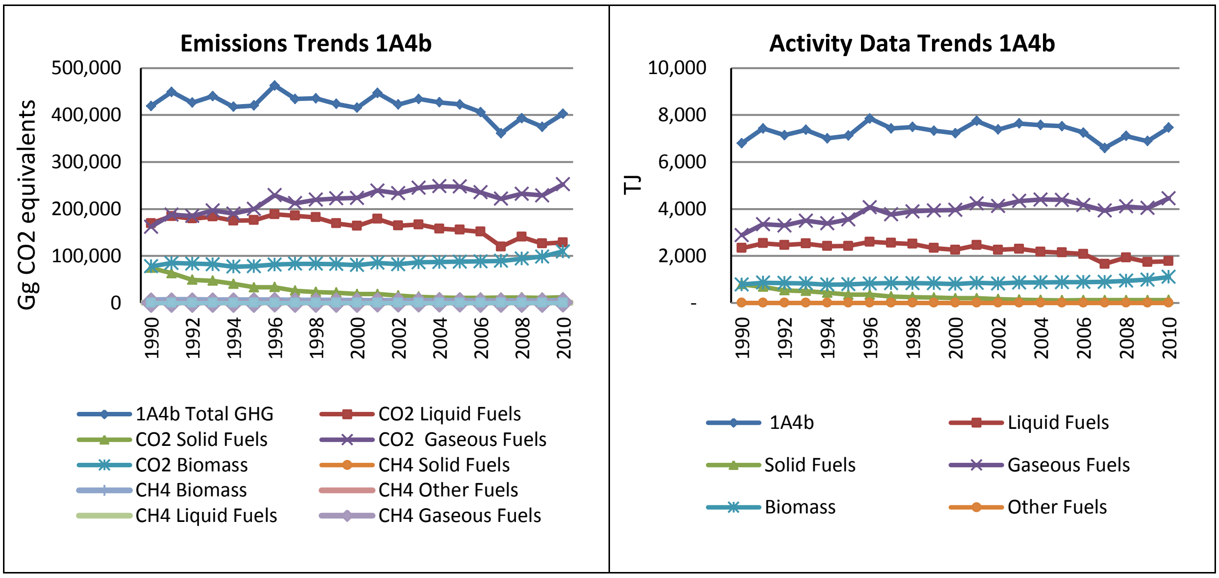


3.2.4.2 Residential (1A4b) (EU-15)

In this chapter information about emission trends, Member States' contribution, activity data, and emission factors is provided for category 1A4b by fuels. CO_2 emissions from 1A4b Residential are the fourth largest key category of GHG emissions in the EU-15 and account for 10.4 % of total GHG emissions in 2010.

Figure 3.74 shows the emission trend within the category 1A4b, which is mainly dominated by CO_2 emissions from liquid and gaseous fuels. Total GHG emissions decreased by 4% since 1990, although CO_2 emissions from gaseous fuels increased strongly (+46 %) which was counterbalanced by decreasing emissions from other fossil fuels.

Figure 3.74 **1A4b Residential: Total, CO_2 and CH_4 emission and activity trends**



CO_2 emissions from 1A4b Residential

Between 1990 and 2010, CO_2 emissions from households decreased by 3 % in the EU-15 (Table 3.71). Main factors influencing CO_2 emissions from this source category are (1) outdoor temperature, (2) number and size of dwellings, (3) building codes, (4 thermal properties of of building stock, (5) fuel split for heating and warm water, (6) use of renewable energy sources, e.g. biomass or solar panels, and (7) use of district heating. Fossil fuel consumption in households increased by 6 % between 1990 and 2010, with a fuel shift from coal and oil to gas.

Between 1990 and 2010, the largest reduction in absolute terms was reported by Germany reducing emissions by 27.5 million tonnes. Austria, Denmark, Finland and Sweden also showed reductions of emissions between 1.3 to 5 million tonnes. In absolute terms Belgium, France, Greece, Spain and the United Kingdom had the largest emission increases. One reason for the performance of the Nordic countries and Austria is increased use of district heating. As district heating replaces heating boilers in households, an increase in the share of district heating reduces CO_2 emissions from households (but increases emissions from energy industries if fossil fuels are used). In Germany, efficiency improvements and the fuel switch in eastern German households are two reasons for the emission reductions.

Table 3.71 1A4b Residential: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010	
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)
Austria	9,964	7,084	7,813	2.0%	729	10%	-2,151	-22%
Belgium	20,269	19,875	23,197	5.9%	3,321	17%	2,928	14%
Denmark	4,983	2,944	3,060	0.8%	116	4%	-1,923	-39%
Finland	3,180	1,692	1,861	0.5%	169	10%	-1,319	-41%
France	55,987	57,542	58,947	15.0%	1,405	2%	2,960	5%
Germany	129,474	98,461	101,946	25.9%	3,485	4%	-27,527	-21%
Greece	4,671	7,404	6,678	1.7%	-726	-10%	2,006	43%
Ireland	7,052	7,236	7,635	1.9%	399	6%	583	8%
Italy	52,118	51,015	52,790	13.4%	1,775	3%	672	1%
Luxembourg	660	1,160	1,050	0.3%	-110	-9%	390	59%
Netherlands	19,495	17,976	20,812	5.3%	2,836	16%	1,318	7%
Portugal	1,660	1,998	2,481	0.6%	482	24%	820	49%
Spain	12,979	17,914	19,139	4.9%	1,224	7%	6,159	47%
Sweden	6,256	1,068	1,200	0.3%	132	12%	-5,055	-81%
United Kingdom	77,477	72,804	84,615	21.5%	11,811	16%	7,138	9%
EU-15	**406,224**	**366,175**	**393,224**	**100.0%**	**27,049**	**7%**	**-13,001**	**-3%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A4b Residential – Liquid Fuels (CO_2)

In 2010 CO_2 from liquid fuels had a share of 32 % within source category 1A4b (compared to 40 % in 1990). Between 1990 and 2010 the emissions decreased by 24 % (Table 3.72). The highest absolute increases showed Greece, Ireland and the UK. The highest absolute decreases were reported by Germany, France, Italy and Sweden. Between 2009 and 2010 EU-15 emissions decreased by 2 %. The strong decrease from 2006 to 2007 for Germany is due to low gasoil sales to end consumers. Many end consumers did not restock their oiltanks in 2007 because of high outdoor temperatures and rising oil prices. Additionally end consumer gasoil stocks were comparatively high in 2007 due to a mild winter 2006. It is assumed that the circumstances were similar for other MS (e.g. Austria).

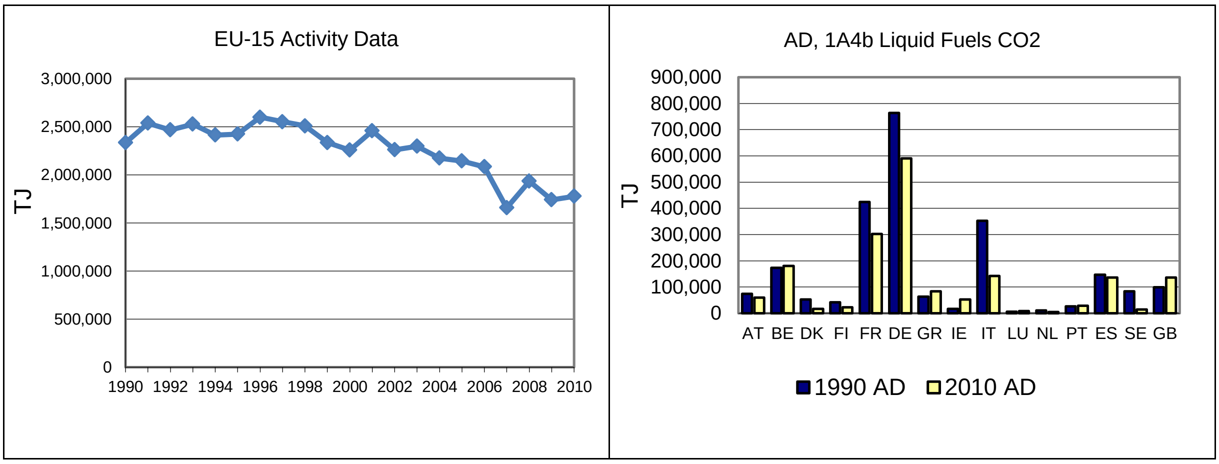
Table 3.72 1A4b Residential, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

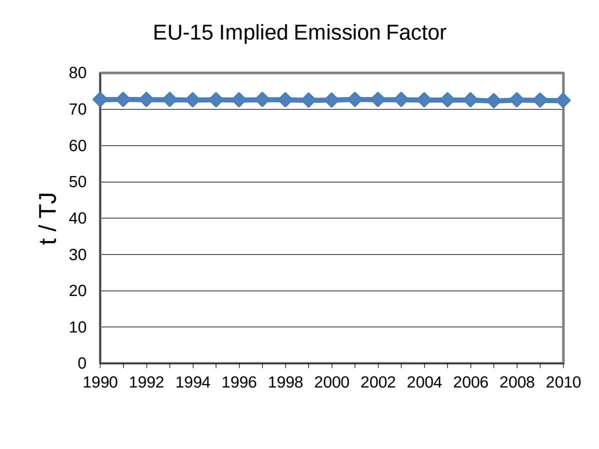
Member State	CO2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)		
Austria	5,605	4,026	4,452	3.5%	426	11%	-1,153	-21%	T2,T3	CS
Belgium	12,665	11,117	13,186	10.2%	2,069	19%	522	4%	T1	D
Denmark	3,923	1,349	1,202	0.9%	-147	-11%	-2,721	-69%	CR	CS,D
Finland	3,059	1,548	1,698	1.3%	150	10%	-1,362	-45%	T1	CS
France	30,988	22,800	22,137	17.2%	-664	-3%	-8,851	-29%	T2	CS
Germany	56,344	42,933	43,450	33.7%	518	1%	-12,894	-23%	CS	CS
Greece	4,585	6,797	6,074	4.7%	-724	-11%	1,489	32%	T2	D
Ireland	1,175	3,529	3,803	3.0%	274	8%	2,628	224%	T1	CS
Italy	25,292	11,099	9,873	7.7%	-1,226	-11%	-15,419	-61%	T2	CS
Luxembourg	464	688	581	0.5%	-108	-16%	117	25%	T2	CS
Netherlands	737	276	314	0.2%	38	14%	-423	-57%	T2	CS
Portugal	1,660	1,398	1,841	1.4%	443	32%	181	11%	T2	D, CR
Spain	9,971	9,303	9,463	7.3%	160	2%	-508	-5%	T2	CR
Sweden	6,170	899	1,002	0.8%	103	11%	-5,168	-84%	T1, T2	CS
United Kingdom	7,019	8,524	9,671	7.5%	1,147	13%	2,652	38%	T2	CS
EU-15	**169,658**	**126,287**	**128,748**	**100.0%**	**2,460**	**2%**	**-40,910**	**-24%**		

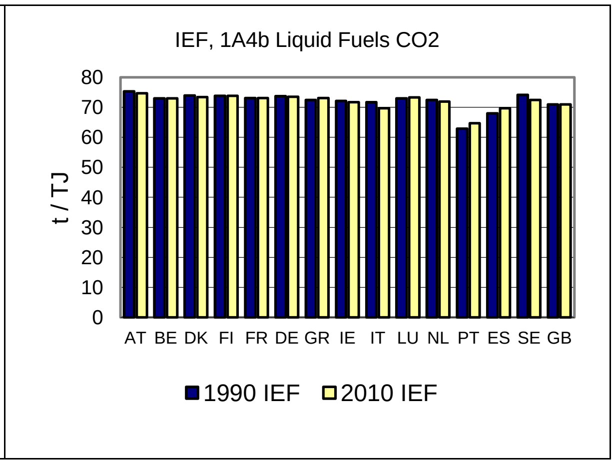
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.75 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by Belgium, France, Germany, Italy, Spain and the United Kingdom; together they cause 84 % of the CO_2 emissions from liquid fuels in 1A4b. Fuel consumption in the EU-15 decreased by 24 % between 1990 and 2010. The implied emission factor of EU-15 was 72.4 t/TJ in 2010. The implied emission factor of Portugal is lower than for other countries because a high share of city gas and LPG is used by the domestic sector.

Figure 3.75 1A4b Residential, liquid fuels: Activity Data and Implied Emission Factors for CO_2







1A4b Residential –Solid Fuels (CO_2)

In 2010 CO_2 from solid fuels had a share of 3 % within source category 1A4b (compared to 18 % in 1990). Between 1990 and 2010 the emissions decreased by 84 %

Table 3.73). All Member States reported decreasing emissions with the highest reductions in absolute terms in Germany, the United Kingdom, Ireland and France. Between 2009 and 2010 EU-15 emissions increased by 9 %. Sweden and Portugal report emissions as 'Not occuring'.

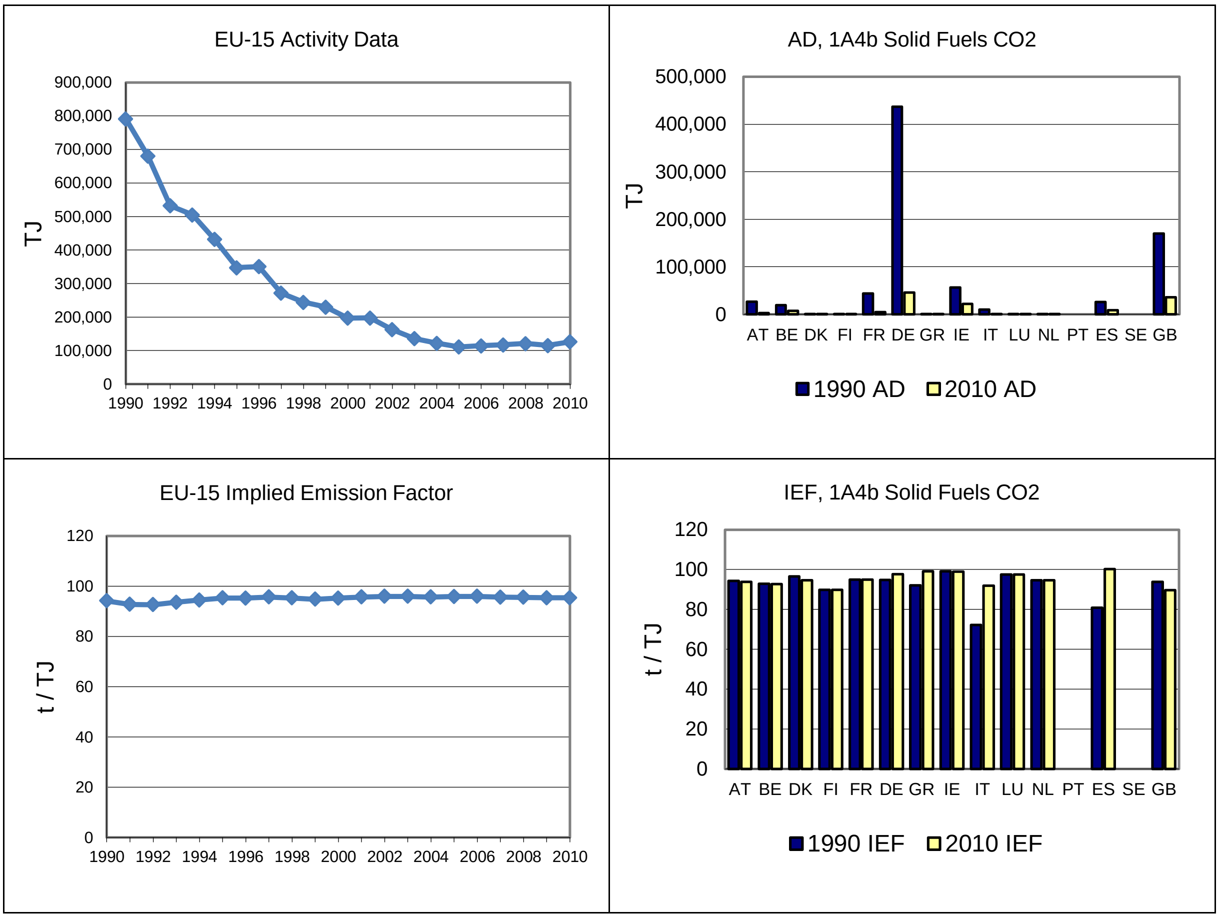
Table 3.73 1A4b Residential, solid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)		
Austria	2,512	200	221	1.8%	21	11%	-2,292	-91%	T2	CS
Belgium	1,759	580	692	5.7%	112	19%	-1,067	-61%	T1	D
Denmark	72	2	3	0.0%	1	47%	-69	-96%	CR	CS,D
Finland	33	1	1	0.0%	0	0%	-32	-97%	T1	D
France	4,168	470	411	3.4%	-59	-13%	-3,757	-90%	T2	CS
Germany	41,415	3,543	4,486	37.3%	943	27%	-36,929	-89%	CS	CS
Greece	87	15	14	0.1%	-1	-5%	-73	-84%	T2	D
Ireland	5,607	2,216	2,135	17.7%	-80	-4%	-3,472	-62%	T1	CS
Italy	702	17	17	0.1%	0	0%	-685	-98%	T2	CS
Luxembourg	26	2	2	0.0%	0	17%	-24	-91%	T1	D
Netherlands	61	19	22	0.2%	3	15%	-39	-64%	T2	CS
Portugal	NO	NO	NO	-	-	-	-	-	NA	NA
Spain	2,091	967	834	6.9%	-134	-14%	-1,257	-60%	T2	CR
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom	15,979	2,974	3,197	26.6%	224	8%	-12,782	-80%	T2	CS
EU-15	**74,513**	**11,006**	**12,035**	**100.0%**	**1,029**	**9%**	**-62,478**	**-84%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.76 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by Germany, Ireland and the United Kingdom; together they cause 82 % of the CO_2 emissions from solid fuels in 1A4b. Fuel consumption in the EU-15 decreased by 84 % between 1990 and 2010. The implied emission factor of EU-15 was 95.3 t/TJ in 2010. The 1990 implied emission factors of Italy and Spain are comparatively low because of a high share of gas works gas is included.

Figure 3.76 **1A4b Residential, solid fuels: Activity Data and Implied Emission Factors for CO_2**



1A4b Residential – Gaseous Fuels (CO_2)

In 2010, CO_2 from gaseous fuels had a share of 63 % within source category 1A4b (compared to 39 % in 1990). Between 1990 and 2010, the emissions increased by 56 % (Table 3.74). All Member States reported increasing emissions. The highest absolute increase occurred in Germany, France, the United Kingdom, Spain and Italy. Between 2009 and 2010, EU-15 emissions increased by 10 %.

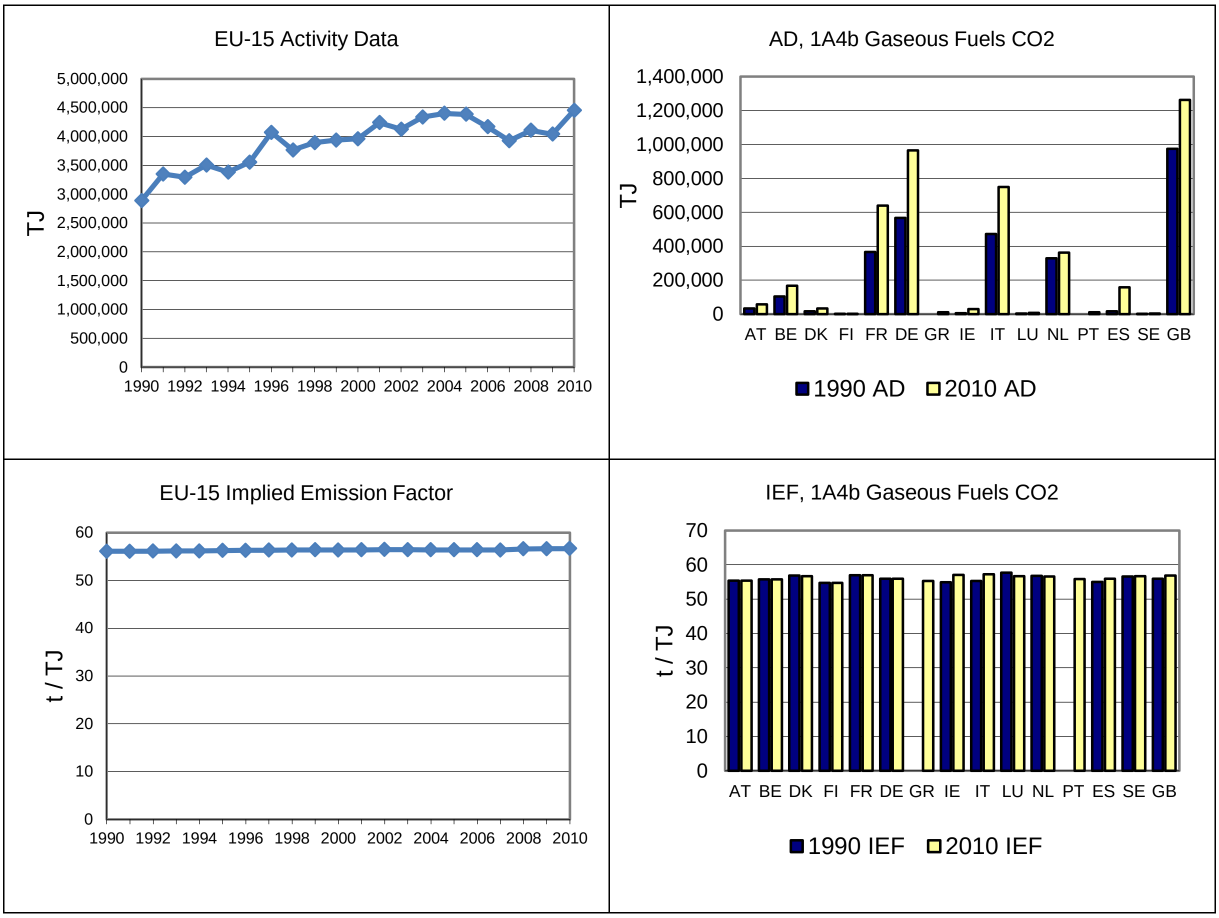
Table 3.74 1A4b Residential, gaseous fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)		
Austria	1,847	2,858	3,140	1.2%	282	10%	1,294	70%	T2	CS
Belgium	5,824	8,164	9,310	3.7%	1,147	14%	3,486	60%	T1	D
Denmark	988	1,593	1,855	0.7%	263	16%	867	88%	CR	CS
Finland	22	96	108	0.0%	12	12%	86	393%	T1	CS
France	20,831	34,271	36,399	14.4%	2,128	6%	15,569	75%	T2	CS
Germany	31,714	51,985	54,010	21.4%	2,025	4%	22,296	70%	CS	CS
Greece	NO	592	590	0.2%	-2	0%	590	-	T2	CS
Ireland	270	1,491	1,697	0.7%	205	14%	1,427	529%	T1	CS
Italy	26,123	39,899	42,900	17.0%	3,001	8%	16,777	64%	T2	CS
Luxembourg	170	469	467	0.2%	-3	-1%	297	175%	T2	CS
Netherlands	18,696	17,681	20,476	8.1%	2,795	16%	1,779	10%	T2	CS
Portugal	NO	600	639	0.3%	39	7%	639	-	T2	D, CR
Spain	918	7,644	8,842	3.5%	1,198	16%	7,924	864%	T2	CS
Sweden	86	169	199	0.1%	29	17%	113	131%	T1	CS
United Kingdom	54,478	61,306	71,746	28.4%	10,440	17%	17,268	32%	T2	CS
EU-15	**161,967**	**228,819**	**252,378**	**100.0%**	**23,558**	**10%**	**90,411**	**56%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.77 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by France, Germany, Italy and the United Kingdom; together they cause 81 % of the CO_2 emissions from gaseous fuels in 1A4b. Fuel consumption in the EU-15 rose 54 % between 1990 and 2010. The implied emission factor of EU-15 was 56.6 t/TJ in 2010.

Figure 3.77 1A4b Residential, gaseous fuels: Activity Data and Implied Emission Factors for CO_2



CH_4 emissions from 1A4b Residential

CH_4 emissions from 1A4b Residential accounted for 0.2 % of total GHG emissions in 2010. Between 1990 and 2010, CH_4 emissions from households decreased by 36 % in the EU-15 (Table 3.75). In 2010 France was responsible for 23 % of EU-15 CH_4 emissions even though emissions were reduced by 61 % between 1990 and 2010. Italy reported the highest increase in emissions. Between 2009 and 2010 EU-15 emissions increased by 8%.

Table 3.75 1A4b Residential: Member States' contributions to CH_4 emissions

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010	
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)
Austria	377	173	193	3.2%	20	12%	-184	-49%
Belgium	209	145	169	2.8%	24	16%	-41	-19%
Denmark	78	121	123	2.0%	2	2%	45	58%
Finland	164	227	251	4.1%	24	10%	87	53%
France	3,649	1,386	1,421	23.3%	35	2%	-2,228	-61%
Germany	1,200	593	746	12.2%	153	26%	-455	-38%
Greece	80	69	68	1.1%	-2	-2%	-12	-16%
Ireland	372	161	159	2.6%	-3	-2%	-213	-57%
Italy	260	862	933	15.3%	70	8%	673	259%
Luxembourg	6	7	7	0.1%	1	10%	2	31%
Netherlands	361	345	388	6.4%	43	12%	27	8%
Portugal	344	198	190	3.1%	-8	-4%	-155	-45%
Spain	775	663	656	10.8%	-7	-1%	-119	-15%
Sweden	234	246	293	4.8%	47	19%	58	25%
United Kingdom	1,444	451	494	8.1%	43	10%	-950	-66%
EU-15	**9,555**	**5,648**	**6,090**	**100.0%**	**442**	**8%**	**-3,465**	**-36%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A4b Residential – Biomass (CH_4)

In 2010 CH_4 from biomass had a share of 1.1 % within source category 1A4b (compared to 1.4 % in 1990). Between 1990 and 2010 the emissions decreased by 22 % (Table 3.76). France reported the highest absolute decrease, while Germany's (+133 %) and Italy's (+380 %) CH_4 emissions increased significantly. Between 2009 and 2010, EU-15 emissions increased by 6%.

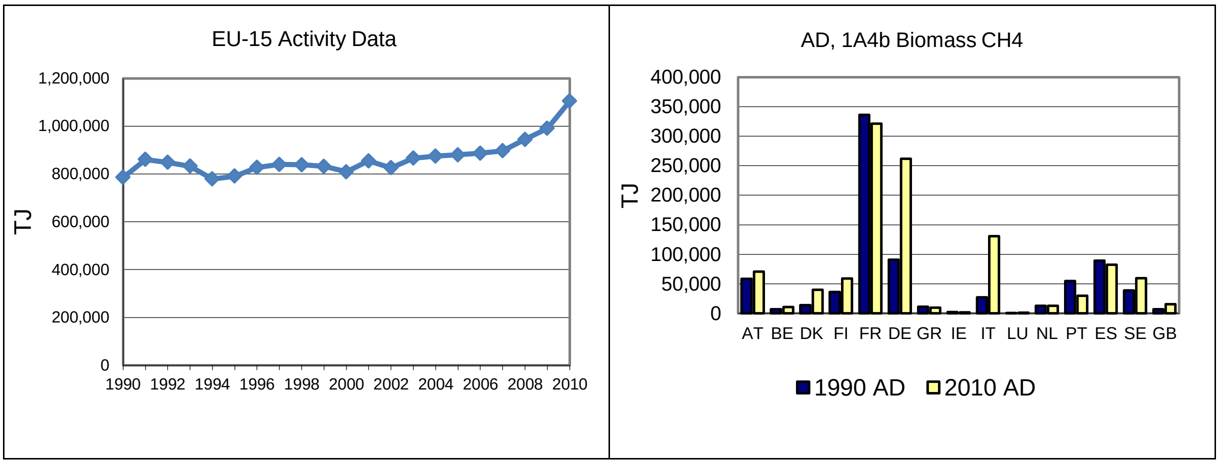
Table 3.76 1A4b Residential, biomass: Member States' contributions to CH_4 emissions and information on method applied and emission factor

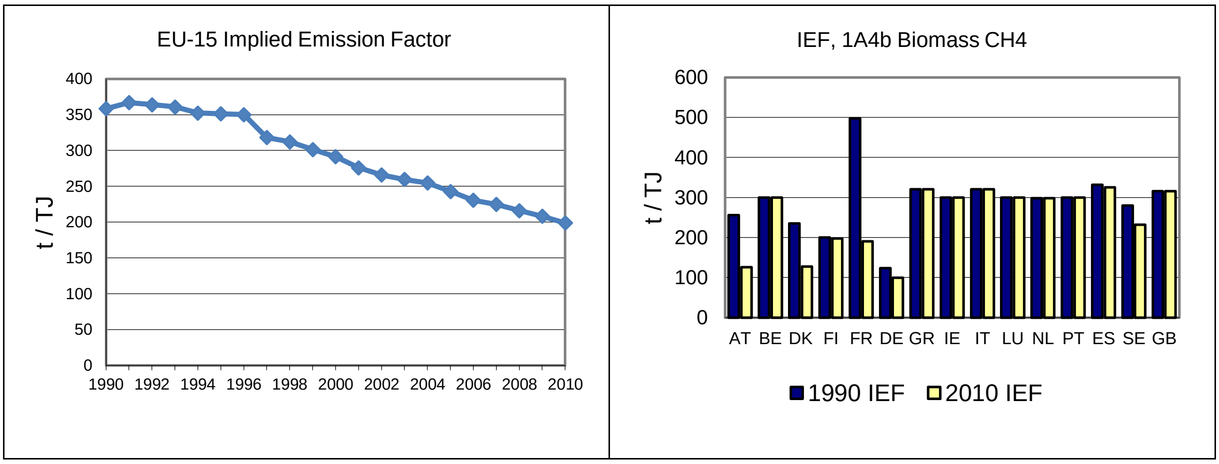
Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010	
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)
Austria	313	167	187	4.0%	20	12%	-127	-40%
Belgium	42	58	66	1.4%	8	14%	24	56%
Denmark	69	105	106	2.3%	2	2%	37	54%
Finland	152	222	245	5.3%	23	10%	93	61%
France	3,511	1,253	1,286	27.9%	33	3%	-2,225	-63%
Germany	235	467	548	11.9%	80	17%	313	133%
Greece	77	63	63	1.4%	-1	-1%	-14	-18%
Ireland	12	7	9	0.2%	1	15%	-3	-27%
Italy	183	809	880	19.1%	70	9%	696	380%
Luxembourg	4	4	5	0.1%	1	25%	1	22%
Netherlands	79	78	79	1.7%	1	1%	0	0%
Portugal	343	196	188	4.1%	-9	-4%	-156	-45%
Spain	621	562	562	12.2%	0	0%	-59	-9%
Sweden	229	242	289	6.3%	47	20%	60	26%
United Kingdom	46	99	103	2.2%	4	4%	57	125%
EU-15	**5,917**	**4,333**	**4,614**	**100.0%**	**281**	**6%**	**-1,302**	**-22%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.78 shows activity data and implied emission factors for CH_4 from biomass for EU-15 and the Member States. The largest emissions are reported by France, Germany, Italy and Spain; together they cause 71 % of the CH_4 emissions from biomass fuels in 1A4b. Fuel consumption in the EU-15 rose by 41 % between 1990 and 2010. The implied emission factor of EU-15 was 198.9 kg/TJ in 2010. The decrease of the IEF is because of improved combustion in new (automated) heating devices and less use of small stoves having higher CH_4 emissions.

Figure 3.78 1A4b Residential, biomass: Activity Data and Implied Emission Factors for CH_4



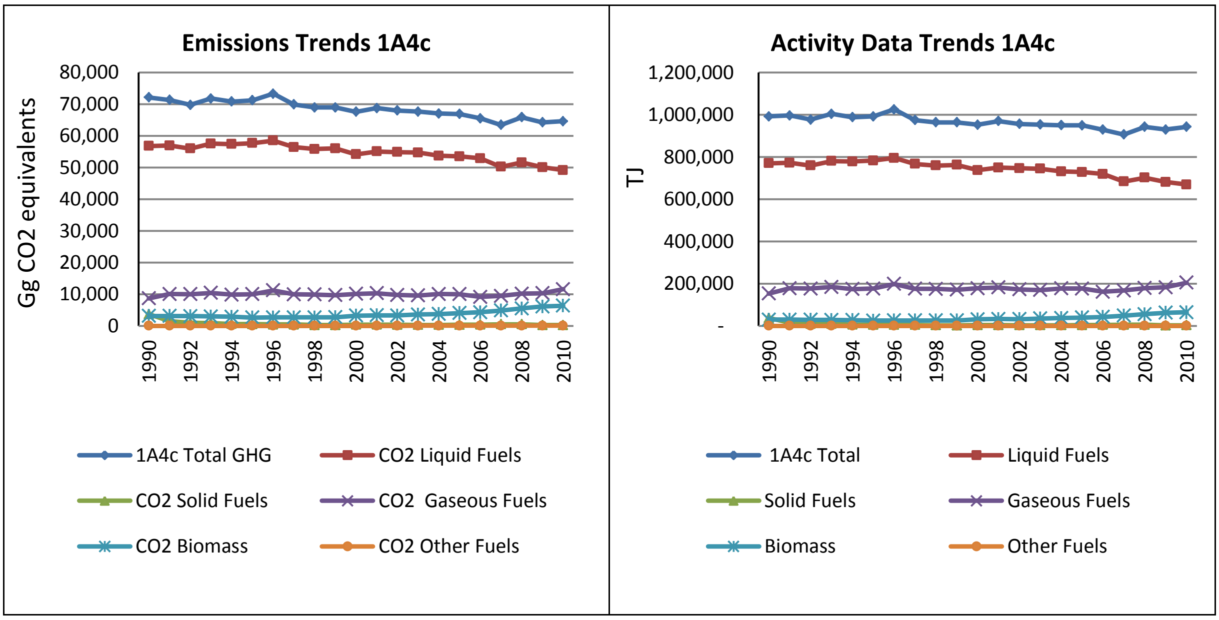


3.2.4.3 Agriculture/Forestry/Fisheries (1A4c) (EU-15)

In this chapter information about emission trends, Member States' contribution, activity data, and emission factors is provided for category 1A4c by fuels. CO_2 emissions from 1A4c Agriculture/Forestry/Fisheries accounted for 1.6 % of total EU-15 GHG emissions in 2010. Between 1990 and 2010, CO_2 emissions from 1A4c Agriculture/Forestry/Fisheries decreased by 12 % in the EU-15 (Table 3.77).

Figure 3.79 shows the emission trend within source category 1A4c, which is mainly dominated by CO_2 emissions from liquid fuels. Total GHG emissions decreased by 12 %, mainly due to decreases in CO_2 emissions from liquid fuels (-13 %).

Figure 3.79 1A4c Agriculture/Forestry/Fisheries: Total and CO_2 emission trends



Only five Member States, France, Germany, Italy, the Netherlands and Spain together contributed 73 % to the emissions from this source. Spain was the Member State with the highest increase in absolute terms between 1990 and 2010, while the highest decreases were achieved in Germany, Greece, Italy and the United Kingdom.

Table 3.77 **1A4c Agriculture/Forestry/Fisheries: Member States' contributions to CO_2 emissions**

Member State	CO2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010	
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)
Austria	1,252	832	854	1.4%	22	3%	-399	-32%
Belgium	2,765	2,040	2,229	3.6%	189	9%	-536	-19%
Denmark	2,485	2,044	2,165	3.5%	121	6%	-320	-13%
Finland	2,017	1,806	1,804	2.9%	-2	0%	-213	-11%
France	10,825	11,010	10,585	17.3%	-425	-4%	-240	-2%
Germany	11,060	6,183	6,211	10.2%	28	0%	-4,848	-44%
Greece	2,927	1,980	1,701	2.8%	-278	-14%	-1,226	-42%
Ireland	660	816	767	1.3%	-48	-6%	107	16%
Italy	8,372	7,679	7,261	11.9%	-419	-5%	-1,112	-13%
Luxembourg	16	63	64	0.1%	2	3%	49	311%
Netherlands	9,917	9,298	10,301	16.8%	1,004	11%	384	4%
Portugal	1,661	1,027	1,080	1.8%	52	5%	-581	-35%
Spain	8,598	10,350	10,399	17.0%	48	0%	1,801	21%
Sweden	1,595	1,633	1,684	2.8%	51	3%	89	6%
United Kingdom	5,162	4,026	4,086	6.7%	60	1%	-1,076	-21%
EU-15	**69,313**	**60,786**	**61,191**	**100.0%**	**405**	**1%**	**-8,123**	**-12%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A4c Agriculture/Forestry/Fisheries – Liquid Fuels (CO_2)

In 2010 CO_2 from liquid fuels had a share of 76 % within source category 1A4c (compared to 79 % in 1990). Between 1990 and 2010 the emissions decreased by 13 % (Table 3.78). Only Ireland, Luxembourg, Spain and Sweden reported increasing emissions with the highest increases in absolute terms in Spain. Between 2009 and 2010 EU-15 emissions decreased by 2 %.

Table 3.78 **1A4c Agriculture/Forestry/Fisheries, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor**

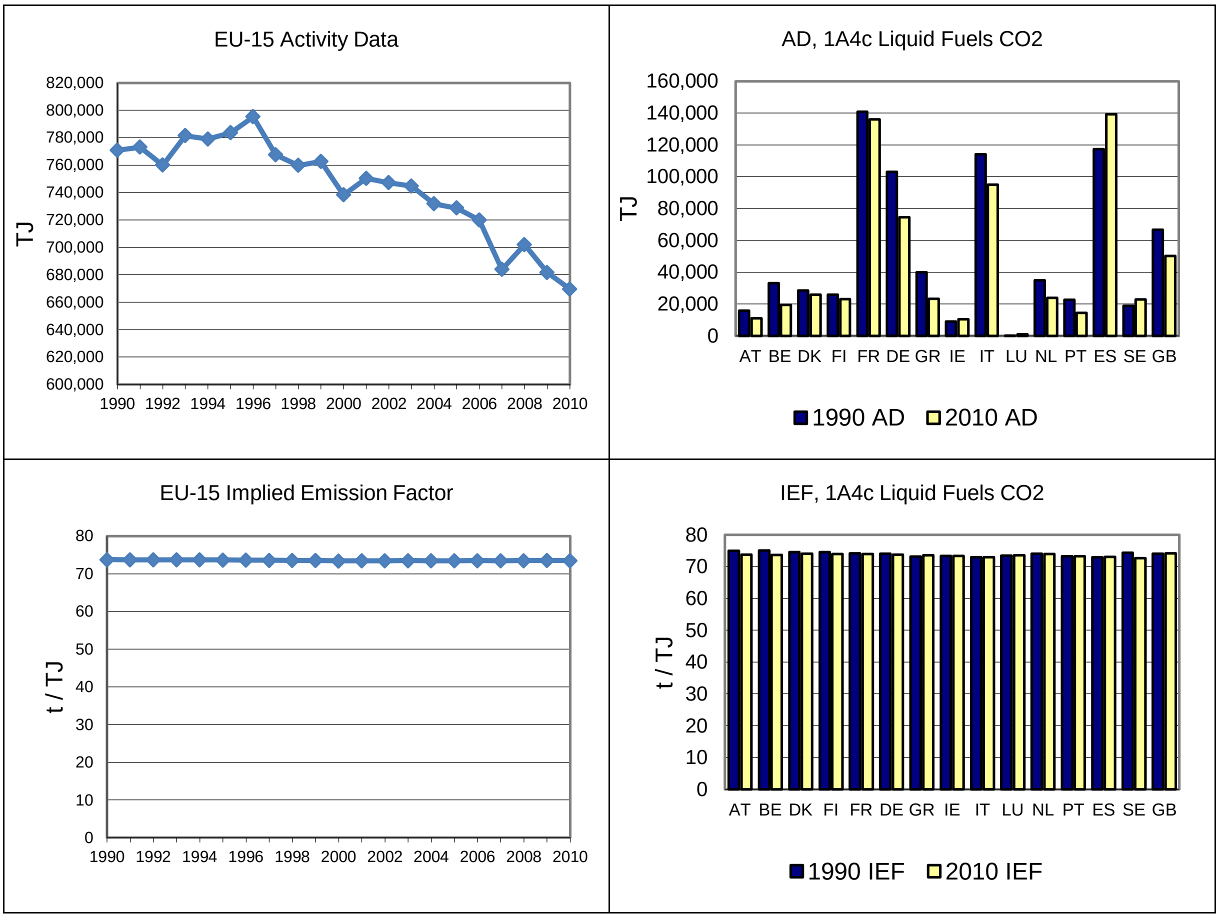
Member State	CO2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)		
Austria	1,181	795	813	1.7%	18	2%	-367	-31%	T2,T3	CS
Belgium	2,490	1,425	1,425	2.9%	0	0%	-1,065	-43%	T1	D
Denmark	2,120	1,851	1,913	3.9%	61	3%	-207	-10%	CR	CS,D
Finland	1,932	1,719	1,704	3.5%	-15	-1%	-227	-12%	M,T1	CS
France	10,442	10,484	10,058	20.4%	-425	-4%	-384	-4%	T2	CS
Germany	7,627	5,416	5,491	11.2%	74	1%	-2,136	-28%	CS	CS
Greece	2,917	1,980	1,701	3.5%	-278	-14%	-1,215	-42%	T2	D
Ireland	660	816	767	1.6%	-48	-6%	107	16%	T1	CS
Italy	8,321	7,341	6,919	14.1%	-421	-6%	-1,402	-17%	T2	CS
Luxembourg	16	63	64	0.1%	2	2%	49	310%	T2	CS
Netherlands	2,587	1,805	1,763	3.6%	-42	-2%	-824	-32%	T2	CS
Portugal	1,661	1,007	1,058	2.1%	51	5%	-604	-36%	T2	D, CR
Spain	8,555	10,135	10,163	20.7%	28	0%	1,608	19%	T2, T3	CR
Sweden	1,405	1,606	1,652	3.4%	46	3%	247	18%	T1, T2	CS
United Kingdom	4,932	3,683	3,720	7.6%	37	1%	-1,212	-25%	T2	CS
EU-15	**56,845**	**50,125**	**49,212**	**100.0%**	**-913**	**-2%**	**-7,633**	**-13%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.80 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by France, Germany, Italy and Spain; together they cause

66 % of the CO_2 emissions from liquid fuels in 1A4c. Fuel consumption in the EU-15 decreased by 13 % between 1990 and 2010. The implied emission factor of EU-15 was 73.5 t/TJ in 2010.

Figure 3.80 **1A4c Agriculture/Forestry/Fisheries, liquid fuels: Activity Data and Implied Emission Factors for CO_2**



1A4c Agriculture/Forestry/Fisheries – Solid Fuels (CO_2)

In 2010 CO_2 from solid fuels had a share of 0.5 % within source category 1A4c (compared to 5 % in 1990). Between 1990 and 2010 the emissions decreased by 92 % (Table 3.79). Nine member states reported CO_2 emissions from this source category as 'Not occurring' or "Not applicable" in 2010. All other Member States reported decreasing emissions between 1990 and 2010. Between 2009 and 2010 EU-15 emissions increased by 18 %, mainly due to increases reported by Denmark. The strong decrease in 1990 to 1992 emissions is due to the reporting of Germany.

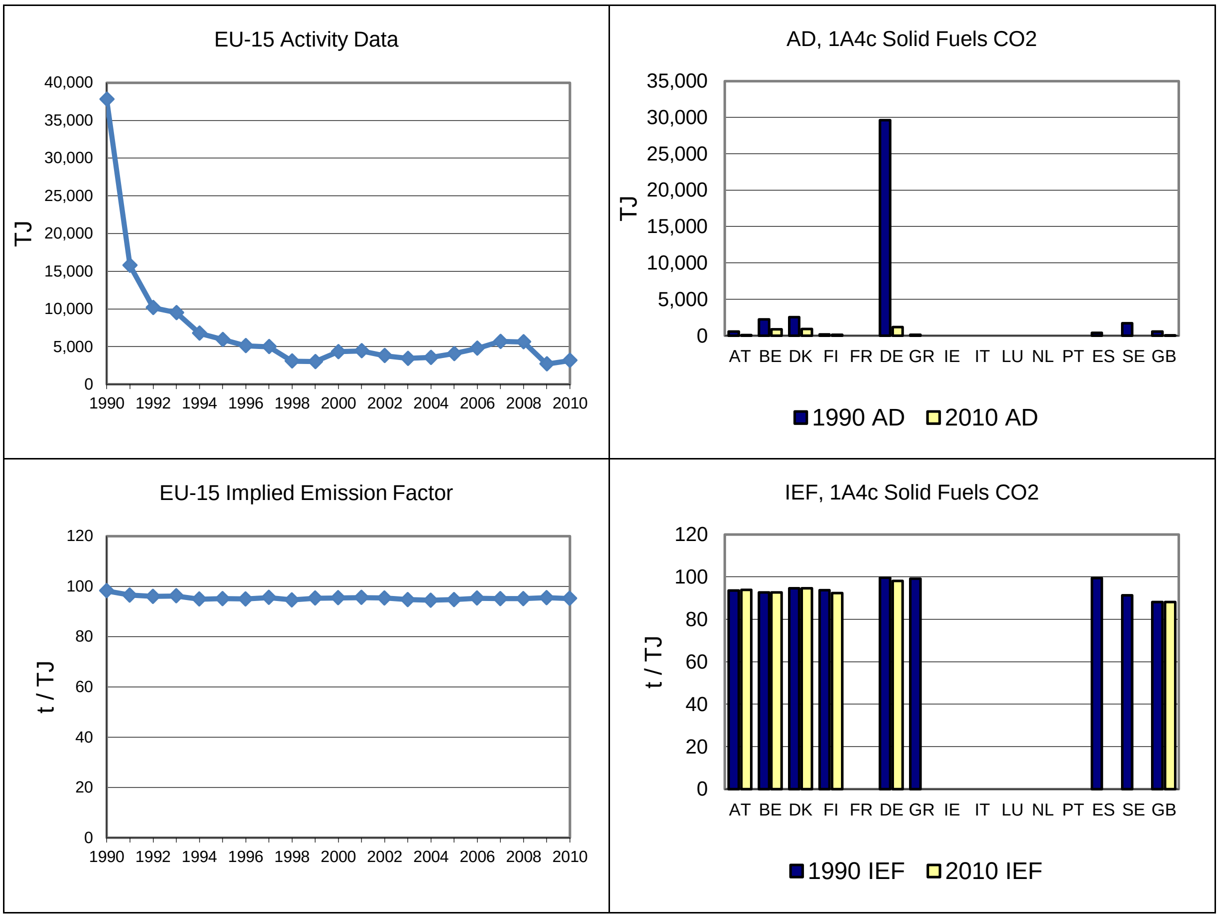
Table 3.79 1A4c Agriculture/Forestry/Fisheries, solid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CO2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)		
Austria	51	4	5	1.6%	0	11%	-47	-91%	T2	CS
Belgium	208	81	81	26.8%	0	0%	-127	-61%	T1	D
Denmark	238	39	88	29.1%	48	122%	-151	-63%	CR	CS,D
Finland	13	12	12	3.9%	0	3%	-1	-10%	T3	CS
France	NO	NO	NO	-	-	-	-	-	NA	NA
Germany	2,948	120	113	37.4%	-7	-6%	-2,836	-96%	CS	CS
Greece	11	NO	NO	-	0	-	-11	-100%	NA	NA
Ireland	NO	NO	NO	-	-	-	-	-	NA	NA
Italy	NO	NO	NO	-	-	-	-	-	NA	NA
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	NO	NO	NO	-	-	-	-	-	NA	NA
Portugal	NO	NO	NO	-	-	-	-	-	NA	NA
Spain	37	NA	NA	-	-	-	-37	-100%	NA	NA
Sweden	157	NO	NO	-	-	-	-157	-100%	NA	NA
United Kingdom	48	NO	3	-	3	-	-45	-93%	T2	CS
EU-15	**3,712**	**256**	**301**	**100.0%**	**45**	**18%**	**-3,411**	**-92%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.81 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. Fuel consumption in the EU-15 decreased by 92 % between 1990 and 2010. The implied emission factor of EU-15 was 95.2 t/TJ in 2010.

Figure 3.81 1A4c Agriculture/Forestry/Fisheries, solid fuels: Activity Data and Implied Emission Factors for CO_2



1A4c Agriculture/Forestry/Fisheries –Gaseous Fuels (CO_2)

In 2010, CO_2 from gaseous fuels had a share of 18 % within source category 1A4c (compared to 12 % in 1990). Between 1990 and 2010 the emissions increased by 33 % (Table 3.80). All Member States reported increasing emissions except for Finland and Sweden. The highest relative increase occurred in Spain (+3737 %) and the highest increase in absolute terms was reported by the Netherlands. Between 2009 and 2010 EU-15 emissions increased by 12 %. This source is dominated by the Netherlands were natural gas is used for greenhouse horticulture.

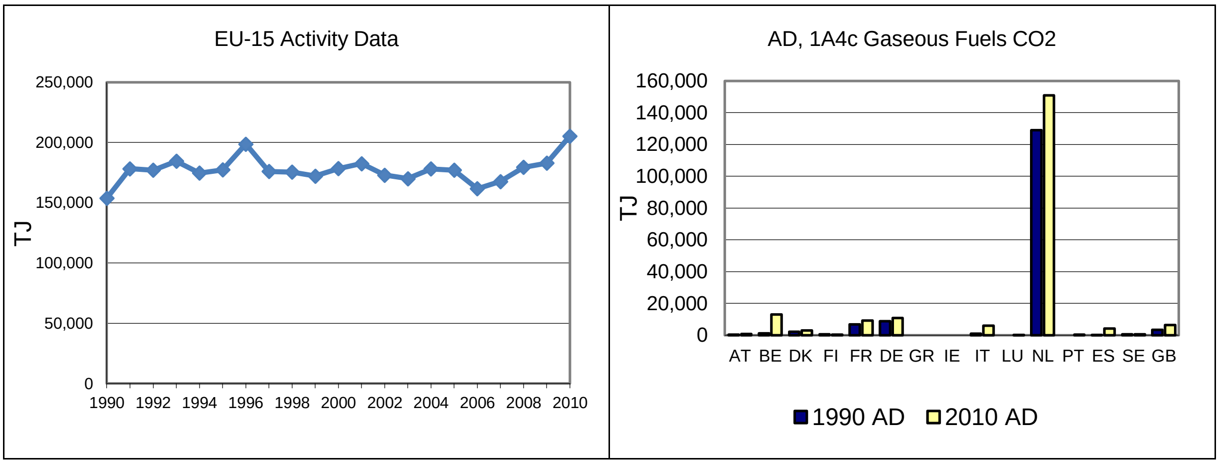
Table 3.80 1A4c Agriculture/Forestry/Fisheries, gaseous fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

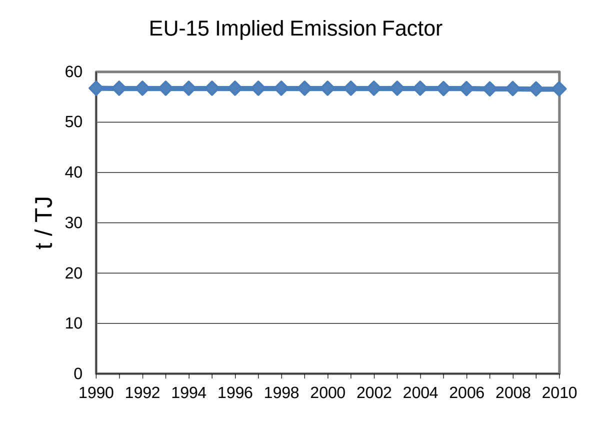
Member State	CO2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)		
Austria	20	32	36	0.3%	3	10%	15	76%	T2	CS
Belgium	67	534	723	6.2%	189	35%	656	979%	T1	D
Denmark	126	153	165	1.4%	12	8%	38	30%	CR	CS
Finland	32	16	16	0.1%	0	0%	-16	-50%	T1	D
France	383	527	527	4.5%	0	0%	144	38%	T2	CS
Germany	485	646	608	5.2%	-38	-6%	123	25%	CS	CS
Greece	NO	NO	NO	-	-	-	-	-	NA	NA
Ireland	NO	NO	NO	-	-	-	-	-	NA	NA
Italy	52	339	341	2.9%	3	1%	290	561%	T2	CS
Luxembourg	NO	0	0	-	-	-	-	-	T2	CS
Netherlands	7,330	7,492	8,538	73.6%	1,045	14%	1,208	16%	T2	CS
Portugal	NO	21	22	0.2%	2	8%	22	-	T2	D, CR
Spain	6	215	236	2.0%	21	10%	230	3737%	T2	CS
Sweden	33	27	32	0.3%	5	17%	-2	-5%	T1	CS
United Kingdom	182	343	363	3.1%	20	6%	181	100%	T2	CS
EU-15	**8,716**	**10,345**	**11,606**	**100.0%**	**1,260**	**12%**	**2,889**	**33%**		

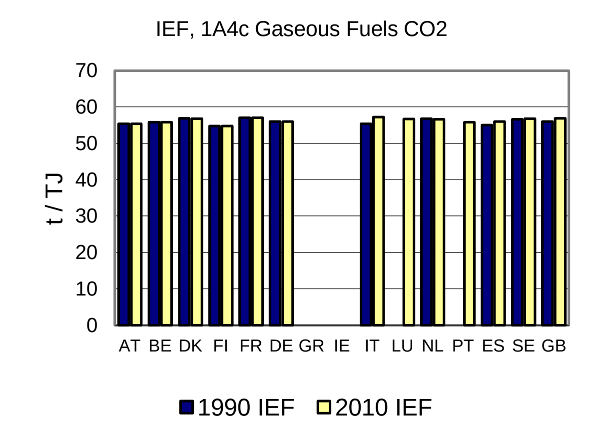
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.82 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by the Netherlands, accounting for 74 % of the CO_2 emissions from gaseous fuels in 1A4c. Fuel consumption in the EU-15 decreased by 34 % between 1990 and 2010. The implied emission factor of EU-15 was 56.5 t/TJ in 2010.

Figure 3.82 1A4c Agriculture/Forestry/Fisheries, gaseous fuels: Activity Data and Implied Emission Factors for CO_2







3.2.5 Other (CRF Source Category 1A5) (EU-15)

Source category 1A5 Other includes emissions from stationary and mobile military fuel use including air craft. In 2010 category 1A5 contributed to 7123 Gg CO_2 equivalents of which 95.0 % CO_2, 0.2 % CH_4 and 4.9 % N_2O.

Table 3.81 provides an overview of Member States' source allocation to Source Category 1A5 Other.

Table 3.81 1A5 Other: Member States' allocation of sources

Member State	Source allocation to 1A5 Other	Source
Austria	Mobile: Military use	CRF Table 1.s.2
Belgium	Mobile: Military use	CRF Table 1.s.2
Denmark	Mobile: Military use	CRF Table 1.s.2
Finland	Stationary: Other non-specified, Non-specified emissions of Fuels from non-energy use, Indirect N_2O emissions from NO_x Mobile: other non-specified	CRF Table 1.s.2
France	Emissions are 'Not occuring'	CRF Table 1.s.2
Germany	Military: stationary and mobile	CRF Table 1.s.2
Greece	Emissions are 'Not occuring'	CRF Table 1.s.2
Ireland	Emissions are 'Not occuring'	CRF Table 1.s.2
Italy	Mobile: other non-specified	CRF Table 1.s.2
Luxembourg	Emissions are 'Included elsewhere' or 'Not occuring'	CRF Table 1.s.2
Netherlands	Mobile: military use	CRF Table 1.s.2
Portugal	Stationary: emissions are reported for 1990-1994 and 'Not occuring' from 1995 on. Mobile: other non-specified	CRF Table 1.s.2
Spain	Emissions are 'Not occuring'	CRF Table 1.s.2
Sweden	Stationary: other non-specified Mobile: Military use and Other non-specified	CRF Table 1.s.2
United Kingdom	Mobile: military use	CRF Table 1.s.2

Figure 3.83 shows the total trend within source category 1A5 and the dominating emission sources: CO_2 emissions from 1A5b Mobile and from 1A5a Stationary. Total GHG emissions of source category 1A5 decreased by 68 % between 1990 and 2010. Germany has the most influence to the overall trend, it reports minus 89% CO_2 emissions since 1990 and contributes to 56% in 1990. The German NIR states that only military sources (incl. aircraft) are included in its inventory. Since 2001 the United Kingdom has a main share and contributes 25 % to CO_2 emissions in 2010. The United Kingdom reports military aircraft and naval vessels within this category.

Figure 3.83 1A5 Other: Total and CO_2 emission and activity trends

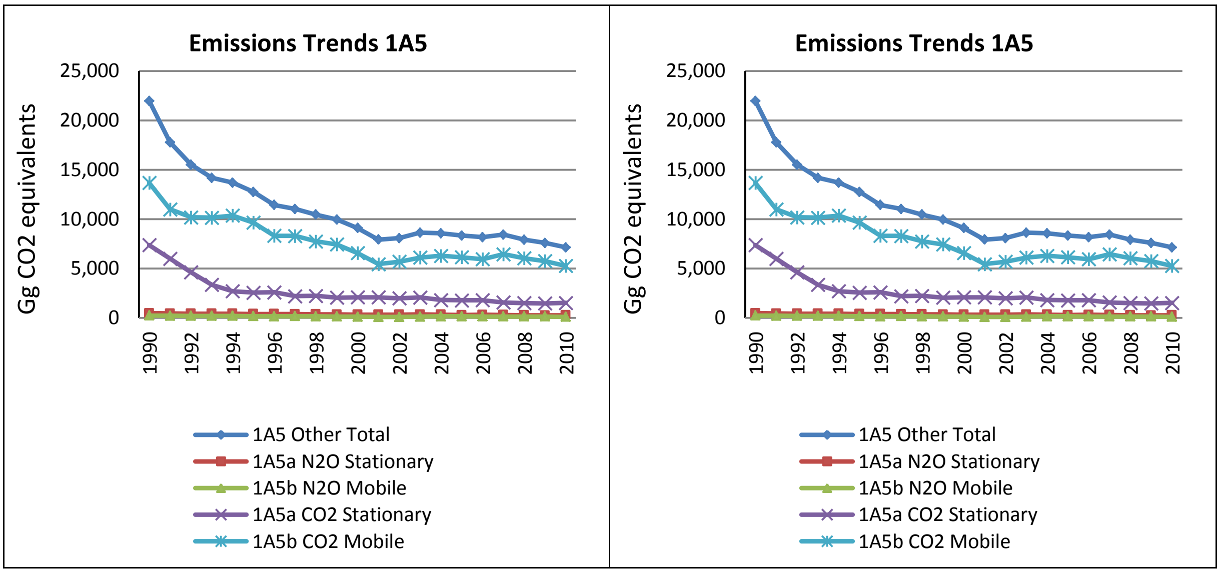


Table 3.82 shows total GHG and CO_2 emissions by Member State from 1A5. CO_2 emissions from 1A5 Other accounted for 0.2 % of total GHG emissions in 2010. Between 1990 and 2010, CO_2 emissions from this source decreased by 68 % in the EU-15. Between 1990 and 2010, the largest reduction in absolute terms was reported by Germany, which was partly due to reduced military operations after German reunification.

Table 3.82 1A5 Other: Member States' contributions to CO_2 emissions

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2010 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO2 emissions in 2010 (Gg)
Austria	36	47	35	46
Belgium	163	60	161	59
Denmark	120	108	119	107
Finland	1,531	1,364	1,080	1,104
France	NO	NO	NO	NO
Germany	12,117	1,311	11,811	1,298
Greece	NO	NO	IE,NO	IE,NO
Ireland	NO	NO	NO	NO
Italy	1,120	669	1,046	627
Luxembourg	29	0	26	NO
Netherlands	577	333	566	327
Portugal	105	86	104	86
Spain	0	0	IE,NA	IE,NA
Sweden	828	177	801	173
United Kingdom	5,337	2,967	5,285	2,938
EU-15	**21,963**	**7,123**	**21,035**	**6,765**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.83 provides information on the contribution of Member States to EU-15 recalculations in CO_2 from 1A5 Other for 1990 and 2010 and main explanations for the largest recalculations in absolute terms.

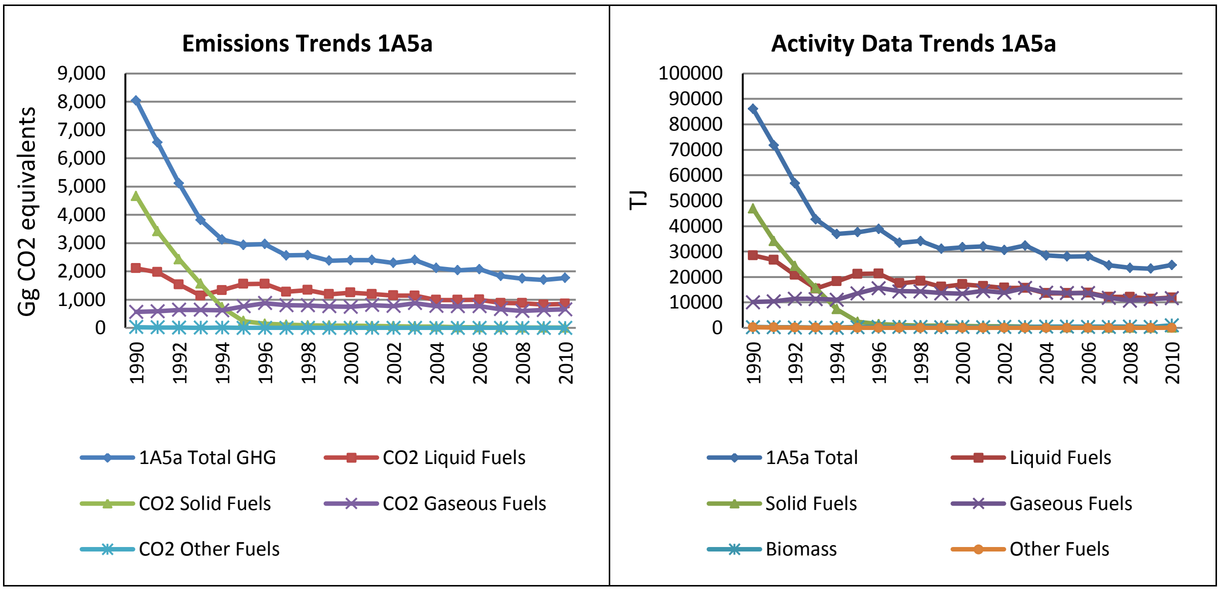
Table 3.83 1A5 Other: Contribution of MS to EU-15 recalculations in CO_2 for 1990 and 2009 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2009		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	0	0.0	0	0.0	
Belgium	0	0.0	0	0.0	
Denmark	0	0.0	0	0.0	
Finland	-108	-9.1	171	19.2	Reallocation of fuels
France	0	0.0	0	0.0	
Germany	0	0.0	0	0.0	
Greece	0	0.0	0	0.0	
Ireland	0	0.0	0	0.0	
Italy	0	0.0	0	0.0	
Luxembourg	0	0.0	0	0.0	
Netherlands	0	0.0	53	19.8	Improved activity data
Portugal	0.4	0.4	0	0.0	
Spain	0	0.0	0	0.0	
Sweden	0	0.0	-10	-3.9	1A5a, Pressure levelling losses, gaseous fuels: Emissions have been reallocated from 1.AA.5.A to 1.AA.1.A
UK	0	0.0	622	25.6	Activity data revised. Military Casual Uplift included.
EU-15	**-108**	**-0.5**	**836**	**13.1**	

3.2.5.1 Stationary (1A5a) (EU-15)

In this chapter information about emission trends, Member States' contribution, activity data, and emission factors is provided for category 1A5a by fuels. CO_2 emissions from 1A5a Stationary accounted for 0.04 % of total EU-15 GHG emissions in 2010. Figure 3.84 shows the emission trend within the categories 1A5a, which is mainly dominated by CO_2 emissions from solid and liquid fuels. The reduction in the early 1990s was driven by CO_2 from solid fuels. Total emissions decreased by 78 %, mainly due to decreases in emissions from solid fuels (-99.8 %) and liquid fuels (-59.7 %).

Figure 3.84 1A5a Stationary: Total and CO_2 emission and activity trends



Only two Member States (Germany and Finland) reported emissions from this key source in 2010 (Table 3.84). Between 1990 and 2010, Finland had a decrease of 12 % and Germany of 90 %. Portugal reports emissions from 1990 to 1994 only. Luxembourg reports emissions 1990 to 2003 only. This led to an EU-15 decrease of 80 %. Between 2009 and 2010 CO_2 emissions increased by 3 %.

Table 3.84 1A5a Stationary: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010	
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)
Austria	NA	NA	NA	-	-	-	-	-
Belgium	NA	NA	NA	-	-	-	-	-
Denmark	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Finland	1,022	886	895	59.3%	8	1%	-128	-12%
France	NO	NO	NO	-	-	-	-	-
Germany	6,329	574	615	40.7%	41	7%	-5,715	-90%
Greece	NO	NO	NO	-	-	-	-	-
Ireland	NO	NO	NO	-	-	-	-	-
Italy	NA	NA	NA	-	-	-	-	-
Luxembourg	3	NO	NO	-	0	-	-3	-100%
Netherlands	NA	NA	NA	-	-	-	-	-
Portugal	9	NO	NO	-	-	-	-9	-100%
Spain	IE,NA	IE,NA	IE,NA	-	-	-	-	-
Sweden	NO	NO	NO	-	-	-	0	-
United Kingdom	NA	NA	NA	-	-	-	-	-
EU-15	**7,363**	**1,460**	**1,509**	**100.0%**	**49**	**3%**	**-5,854**	**-80%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A5a Stationary – Solid Fuels (CO_2)

In 2010 CO_2 from solid fuels had a share of 1 % within source category 1A5a (compared to 58 % in 1990). Between 1990 and 2010, the emissions decreased by nearly 100 % (Table 3.85). In 2010 only Germany reported emissions for this key source.

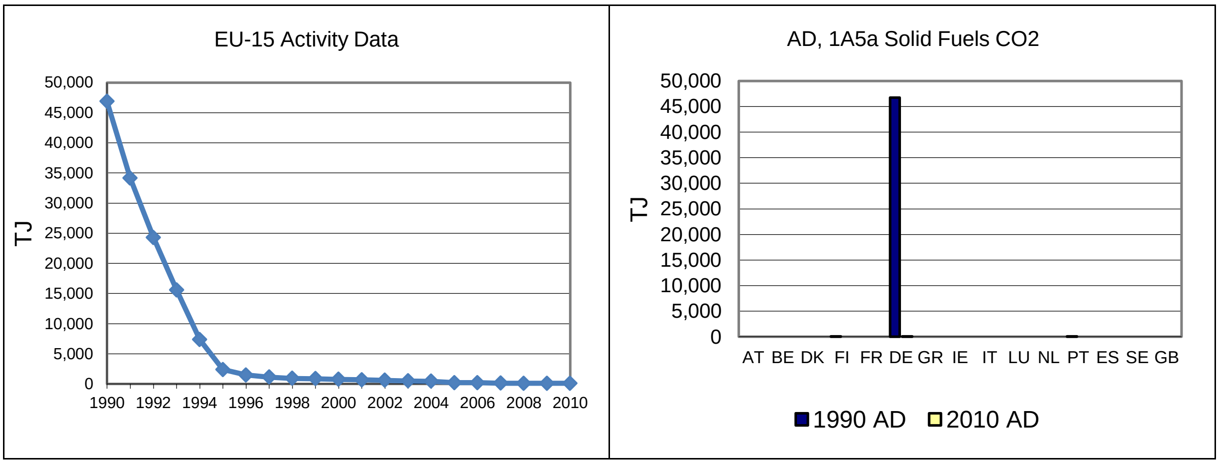
Table 3.85 1A5a Stationary, solid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

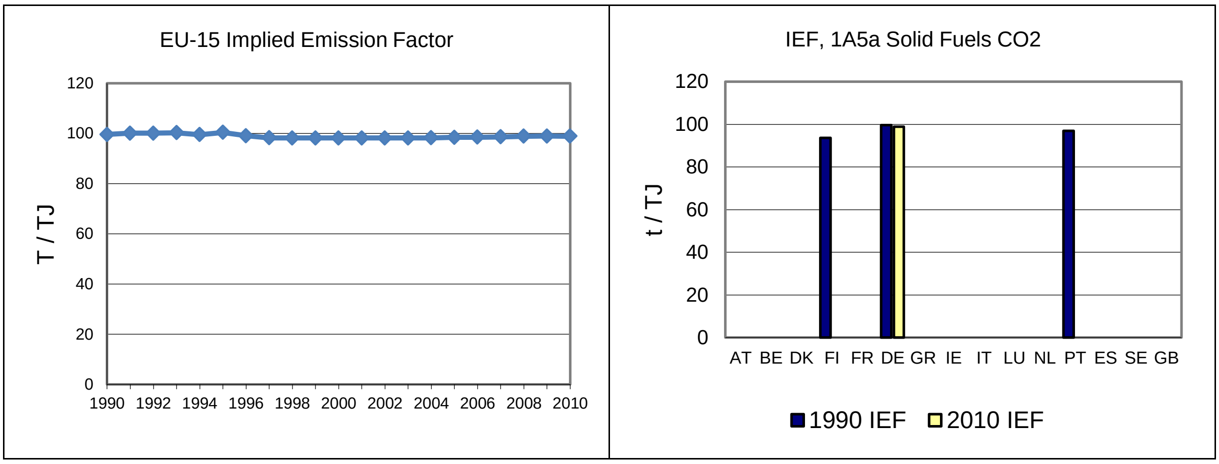
Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)		
Austria	NA	NA	NA	-	-	-	-	-	NA	NA
Belgium	NA	NA	NA	-	-	-	-	-	NA	NA
Denmark	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	1	NO	NO	-	-	-	-1	-100%	NA	NA
France	NO	NO	NO	-	-	-	-	-	NA	NA
Germany	4,657	10	10	100.0%	0	-1%	-4,648	-100%	CS	CS
Greece	NO	NO	NO	-	-	-	-	-	NA	NA
Ireland	NO	NO	NO	-	-	-	-	-	NA	NA
Italy	NA	NA	NA	-	-	-	-	-	NA	NA
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	NA	NA	NA	-	-	-	-	-	NA	NA
Portugal	9	NO	NO	-	-	-	-9	-100%	NA	NA
Spain	NA	NA	NA	-	-	-	-	-	NA	NA
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom	NA	NA	NA	-	-	-	-	-	NA	NA
EU-15	**4,667**	**10**	**10**	**100.0%**	**0**	**-1%**	**-4,657**	**-100%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.85 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. Germany accounts for 100 % of EU-15 CO_2 emissions from this source category since 1995. Fuel combustion in the EU-15 decreased by 99.8 % between 1990 and 2010. The implied emission factor is 98.9 t/TJ in 2010.

Figure 3.85 1A5a Stationary, solid fuels: Activity Data and Implied Emission Factors for CO_2

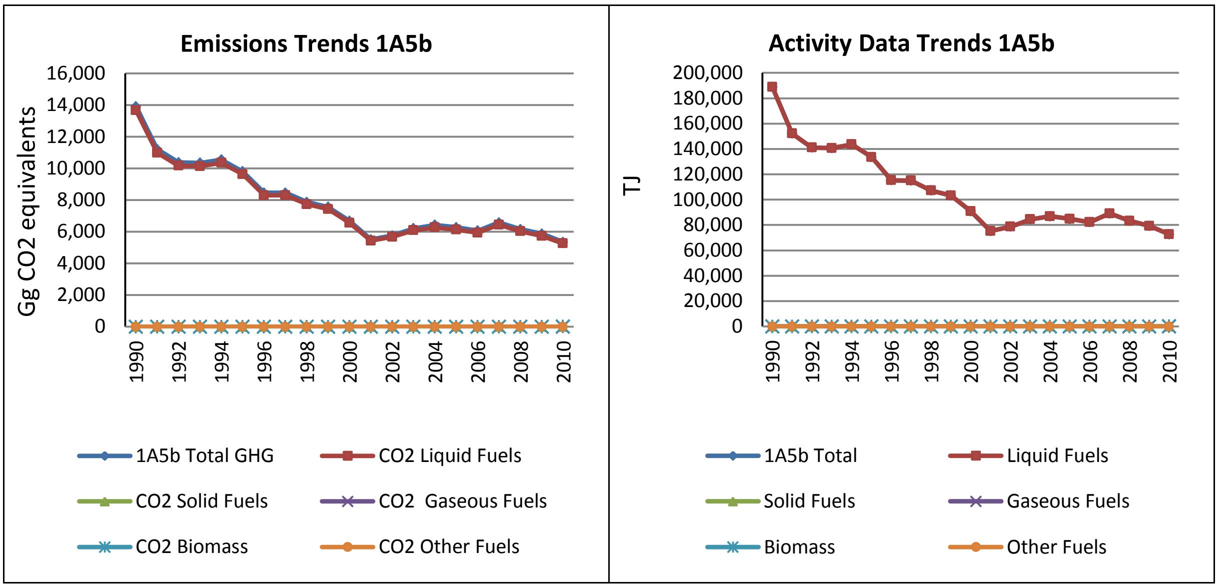




3.2.5.2 Mobile (1A5b) (EU-15)

In this chapter information about emission trends, Member States’ contribution, activity data, and emission factors is provided for category 1A5a by fuels. CO_2 emissions from 1A5b Mobile accounted for 0.1 % of total EU-15 GHG emissions in 2010. Figure 3.86 shows the emission trend within the category 1A5b, which is dominated by CO_2 emissions from liquid fuels. Total CO_2 emissions decreased by 62 %.

Figure 3.86 1A5b-Mobile: Total and CO_2 emission trends



Five Member States reported emissions as ‘Not occurring’, ‘Not applicable’ and/or "Included elsewhere". The United Kingdom had the highest emissions in 2010 and – together with Germany - decreased the most in absolute terms between 1990 and 2010. Finland reported an increase of 261 %. Between 2009 and 2010 Italy and the United Kingdom had the highest absolute decrease. The EU-15 emissions decreased by 8 % between 2009 and 2010 (Table 3.86).

Table 3.86 1A5b Mobile: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010	
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)
Austria	35	46	46	0.9%	1	1%	11	32%
Belgium	161	56	59	1.1%	4	6%	-102	-63%
Denmark	119	160	107	2.0%	-53	-33%	-12	-10%
Finland	58	176	210	4.0%	34	19%	152	261%
France	NO	NO	NO	-	-	-	-	-
Germany	5,482	766	683	13.0%	-83	-11%	-4,799	-88%
Greece	IE,NO	IE,NO	IE,NO	-	-	-	-	-
Ireland	NO	NO	NO	-	-	-	-	-
Italy	1,046	844	627	11.9%	-217	-26%	-419	-40%
Luxembourg	23	NO	NO	-	-	-	-23	-100%
Netherlands	566	320	327	6.2%	7	2%	-239	-42%
Portugal	95	85	86	1.6%	0	0%	-10	-10%
Spain	IE,NA	IE,NA	IE,NA	-	-	-	-	-
Sweden	801	237	173	3.3%	-64	-27%	-628	-78%
United Kingdom	5,285	3,049	2,938	55.9%	-111	-4%	-2,347	-44%
EU-15	**13,672**	**5,737**	**5,256**	**100.0%**	**-481**	**-8%**	**-8,416**	**-62%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A5b Mobile – Liquid Fuels (CO_2)

In 2010, CO_2 from liquid fuels had a share of 98 % within source category 1A5b (compared to 98 % in 1990). Between 1990 and 2010 the emissions decreased by 62 % (Table 3.87). France, Greece, Ireland, Luxembourg and Spain report emissions as 'Not occurring', or 'Included Elsewhere'. The highest decrease in absolute terms was achieved in Germany (-88 %) and Sweden (-78%), while Finland had increases by about 261 %.

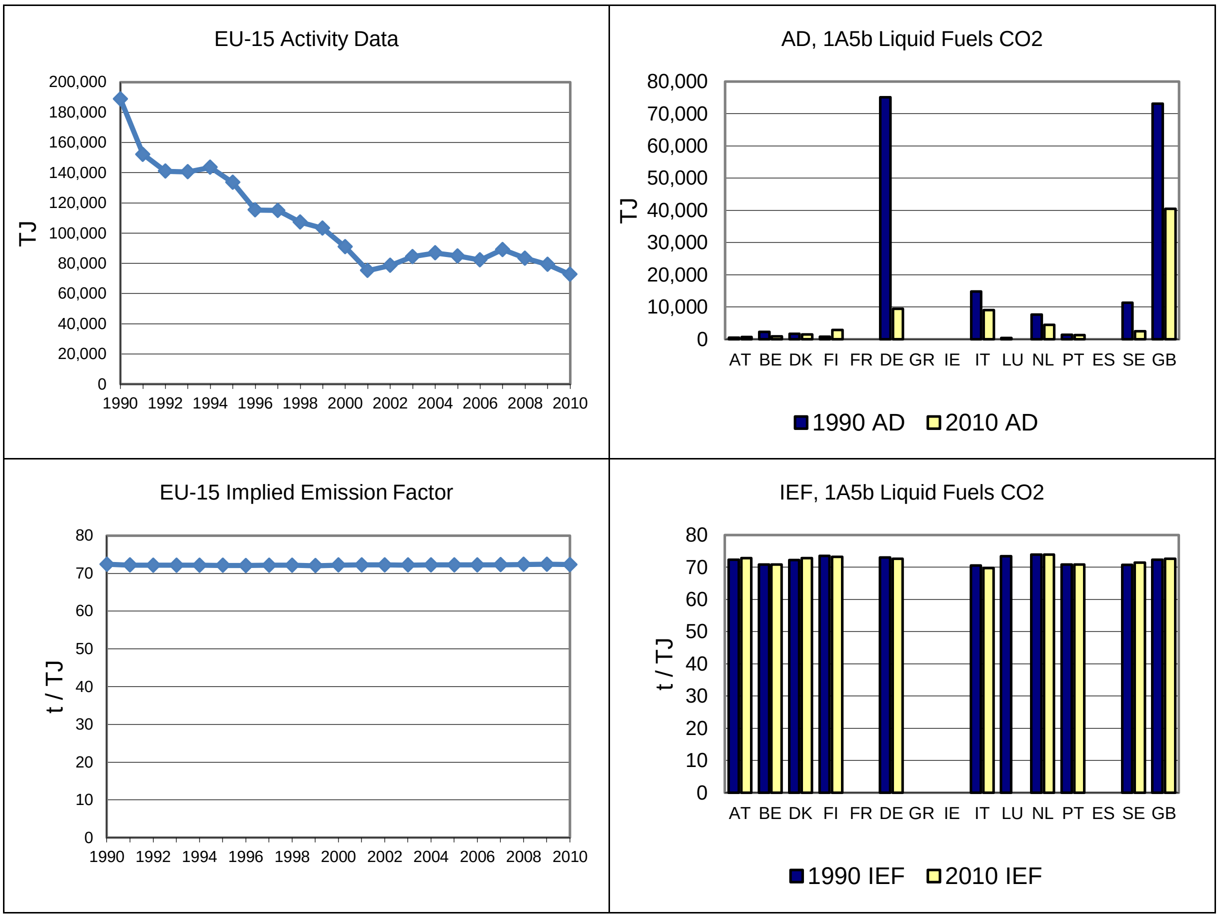
Table 3.87 1A5b Mobile, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied and emission factor

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)		
Austria	35	46	46	0.9%	1	1%	11	32%	CS,M	CS
Belgium	161	56	59	1.1%	4	6%	-102	-63%	T1	D
Denmark	119	160	107	2.0%	-53	-33%	-12	-10%	OTH	CS
Finland	58	176	210	4.0%	34	19%	152	261%	T1	CS
France	NO	NO	NO	-	-	-	-	-	NA	NA
Germany	5,482	766	683	13.0%	-83	-11%	-4,799	-88%	CS,T1	CS,D
Greece	IE	IE	IE	-	-	-	-	-	NA	NA
Ireland	NO	NO	NO	-	-	-	-	-	NA	NA
Italy	1,046	844	627	11.9%	-217	-26%	-419	-40%	T2	CS
Luxembourg	23	NO	NO	-	-	-	-23	-100%	NA	NA
Netherlands	566	320	327	6.2%	7	2%	-239	-42%	D,T2	D
Portugal	95	85	86	1.6%	0	0%	-10	-10%	T1	CR,D
Spain	IE	IE	IE	-	-	-	-	-	NA	NA
Sweden	801	237	173	3.3%	-64	-27%	-628	-78%	T1	CS
United Kingdom	5,285	3,049	2,938	55.9%	-111	-4%	-2,347	-44%	T2,T3	CS
EU-15	**13,672**	**5,737**	**5,256**	**100.0%**	**-481**	**-8%**	**-8,416**	**-62%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.87 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by Germany, Italy and the United Kingdom; together they cause 81 % of the CO_2 emissions from liquid fuels in 1A5b. Fuel consumption in the EU-15 decreased by 62 % between 1990 and 2010. The implied emission factor of EU-15 was 72.3 t/TJ in 2010.

Figure 3.87 **1A5b Mobile, liquid fuels Activity Data and Implied Emission Factors for CO_2**

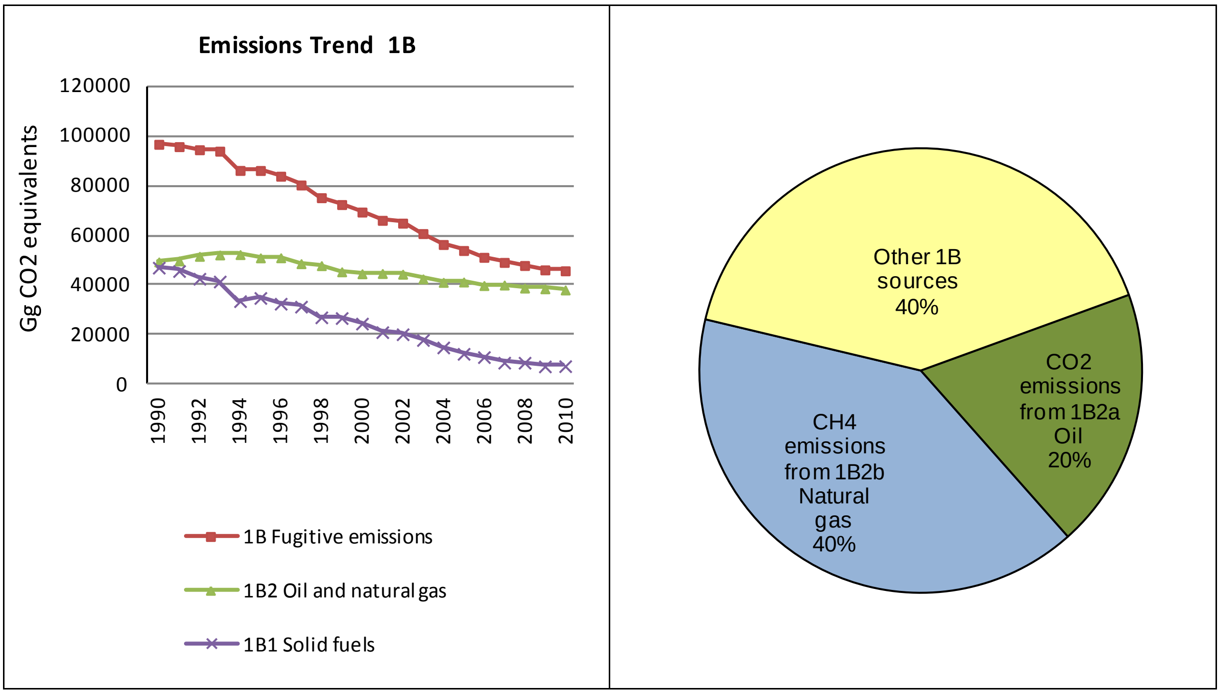


3.2.6 Fugitive emissions from fuels (CRF Source Category 1.B) (EU-15)

This chapter describes gaseous or volatile emissions which occur during extraction, handling and consumption of fossil fuels. In the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories fugitive emissions are defined as intentional or unintentional releases of gases from anthropogenic activities that in particular may arise from the production, processing, transmission, storage and use of fuels. Emissions from combustion are only included where it does not support a productive activity (e.g., flaring of natural gases at oil and gas production facilities). Evaporative emissions from vehicles are included under Road Transport as Subsection 1A3b v (Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories).

In 2010, in terms of CO_2 equivalents, almost two thirds of emissions from source category 1B were fugitive CH_4 emissions while more than a third were fugitive CO_2 emissions. Together, they represented 2.3% of total GHG emissions in the EU-15. Fugitive GHG emissions have been steadily declining (Figure 3.88). Between 1990 and 2010, the total fugitive GHG emissions decreased by 52 %. This was mainly due to the decrease in underground mining activities: underground mining activity decreased by 87 % since 1990 and decreases in CH_4 emissions from category 1B1a i underground mines are responsible for three fourths of the total decrease of fugitive emissions. Between 1990 and 2010, GHG emissions from 1B1 Solid Fuels decreased by 84 %, while emissions from 1B2 Oil and Natural Gas decreased only by 23 %. While emissions from these two sources (1B1 Solid Fuels and 1B2 Oil and Natural Gas) each were responsible for roughly 50 % of total fugitive emissions in 1990, fugitive emissions from 1B1 Solid Fuels represented only 17 % of total fugitive emissions in 2010.

Figure 3.88 1B Fugitive Emission from Fuel: GHG Emissions trend and proportion of fugitive emissions within source category



Fugitive emissions includes three key sources:

- 1B1a Coal Mining (CH_4)
- 1B2a Oil (CO_2)
- 1B2b Natural Gas (CH_4)

The two largest key sources, i.e. CH_4 emissions from 1B2b Natural Gas and CO_2 emissions from 1B2a Oil account together for 59.3 % of total fugitive GHG emissions (Figure 3.88).

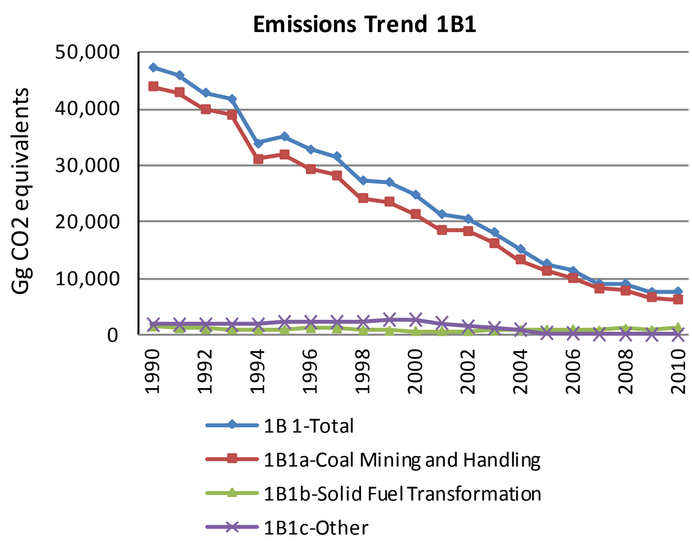
3.2.6.1 Fugitive emissions from Solid Fuels (1B1) (EU-15)

In the revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories fugitive emissions from solid fuels are defined as the total release of methane during coal mining and post-mining activities. Combustion emissions from colliery methane recovered and used are excluded here and reported under Fuel Combustion Emissions.

In 2010 fugitive emissions from solid fuels accounted for 0.2 % of the total GHG emissions in the EU-15 and 17 % of total fugitive emissions in the EU-15:

- 82 % of these emissions were CH_4 emissions from coal mining. The emissions arise by the natural production of methane when coal is formed. Methane is partly stored within the coal seam and escapes when mined. Most CH_4 emissions resulted from underground mines; surface mines were a smaller source.
- 16 % of these emissions were CO_2 emissions due to solid fuel transformation.
- Since 1990 fugitive CH_4 emissions from 1B1 Solid fuels have been steadily decreasing, caused by the reduction of coal mining (Figure 3.89)

Figure 3.89 1B1 Fugitive Emissions from Solid Fuels: Trend



In 2010 three countries, Germany, the United Kingdom and Greece represented 79 % of total fugitive GHG emissions from solid fuels (Table 3.88).

Table 3.88 1B1 Fugitive Emissions from Solid Fuels: Member States Contribution

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2010 (Gg CO_2 equivalents)	CH_4 emissions in 1990 (Gg CO_2 equivalents)	CH4 emissions in 2010 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO2 emissions in 2010 (Gg)
Austria	11	IE,NA,NO	11	IE,NA,NO	IE,NA,NO	IE,NA,NO
Belgium	330	6	330	6	NO	NO
Denmark	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Finland	NO	NO	NO	NO	NO	NO
France	4.065	52	4.065	52	NA,NO	NA,NO
Germany	20.240	2.794	20.240	2.793	0	0
Greece	1.095	1.193	1.095	1.193	NO	IE,NO
Ireland	NE, NO	NO	NE,NO	NO	NE,NO	NO
Italy	122	65	122	65	NA	NA
Luxembourg	NO	NO	NO	NO	NO	NO
Netherlands	436	994	33	21	403	972
Portugal	75	IE, NO	66	IE,NO	9	IE,NO
Spain	1.835	584	1.818	536	18	48
Sweden	5	5	0,0	0,0	5	5
United Kingdom	19.140	2.020	18.282	1.799	856	220
EU-15	**47.354**	**7.713**	**46.062**	**6.467**	**1.291**	**1.245**

For methodological issues and remarks on completeness see Table 3.89.
Abbreviations explained in the Chapter 'Units and abbreviations'

Between 1990 and 2010 fugitive CH_4 emissions from solid fuels decreased by 86 % (Table 3.88). Large reductions (in absolute terms) were observed in Germany and in the United Kingdom, while emissions actually increased by about 9% in Greece. Table 3.89 provides information on the methodologies used by EU-15 Member States.

Table 3.89 1B1 Fugitive Emissions from Solid Fuels: Methodological Issues according to NIRs (submitted in 2010) and Member State information of EU-15 Member States

Member State	Methodology
Austria	**General:** This category covers methane emissions from one brown coal surface mine. CH_4 emissions from this category decreased by more than 50% from 1990 to 1999 due to lower mining activities. Before coal mining was stopped in 2007 emissions decreased sharply between 2003 and 2004. **Activity data:** are taken from the national energy balance and statistical year books (e.g. yearbook of the Association of Mining and Steel). **Emission factor:** CORINAIR default emission factor 214g CH_4/Mg coal
Belgium	**General:** During the in-country review in June 2007, the expert review team of UNFCCC detected some missing underground mining activities in the Belgian greenhouse gas emission inventory. In the beginning of the nineties until 1992 there still was some mining activity in the Flemish region. Until 1999 energetic mining activities remained existent. These activities consisted of an auto-producer of electricity that was active until 1996 (the waste of the coal was used to produce electricity) and of energy needed for the sorting machines which were active until 1999. The latter energetic activities are allocated to the category 1A1c. **Activity data:** federal statistics, delivered by corresponding industry

Member State	Methodology
	Emission factor: IPCC 2006 guidelines, CITEPA, EMEP/CORINAIR Handbook (400 g CH_4/ton cokes)
Denmark	**General:** Coal mining does not occur
Finland	**General:** Emissions from the peat production were reported in LULUCF sector (category Wetlands, CRF 5.D 2) as suggested in GPG LULUCF (IPCC 2003) (see chapter 7.5). There were no coal mines in Finland.
France	**General:** closure of surface mines 2002, closure of underground mines 2004, methane emissions after closure are accounted under 1B1c **Activity data:** plant specific for 1B1b, bottom up approach according to site specific data, Tier 2/3 depending on sub-sector, for closed mines: a tier 2 is used **Emission factor:** specific EF for sites, Tier 2/3 depending on site, EMEP/CORINAIR 350 g CH_4/Mg coke
Germany	**General**: hard coal mining Tier 3, brown coal Tier 2 Coal mining (1B1a): mainly emissions from current mining (coalseam methane, CSM) Emissions from hard coal dressing are included in 1B1b. For hard coal emissions from closed coal mines (coalmine methane, CMM) are included in 1B1c. Because of the chosen method of calculation, for brown coal all emissions are included in 1B1a (ii). **Activity data:** Statistik der Kohlenwirtschaft, national statistics **Emission factor**: country specific, study FHG ISI (1993), German lignite-industry association, Deutsche Montan Technologie GmbH. The emission factors for non-greenhouse gases from coking plants were mainly taken from BFI (2012) **Change of methodology**: Sector 1.B.1.b:For CO emissions a change of method was required as the emission factors used in the past overestimated the emissions and did not reflect the emission source correctly. (Up to the resubmission in 2010 higher CO emissions were reported in 1.B.1.b as in1.A.1.c, however according to BFI (2012) emissions from diffuse sources are smaller (by a factor of 55) than emissions from 1.A.1.c Sector 1.B.1.c: recalculations were made based on updated figures provided by the „Gesamtverband Steinkohle (GVSt) “(NIR 2012)
Greece	**General:** only brown coal surface mines **Activity data:** national energy balance **Emission factor:** IPCC Good Practice Guidance (Default)
Ireland	**General:** coal mining does not occur
Italy	**General**: CH_4 emissions from coal mining referred to only two mines with very low production in the last ten years, one of which was underground and produced coal and the other, on the surface, produced lignite. The surface mine stopped the activity in 2001. CH_4 emissions from solid fuel transformation referred to the coke production in the iron and steel industry, which was also decreasing in the last years. CO_2 and N_2O emissions from 1B1 are not occurring. **Activity Data:** National Energy Balance **Emission Factor**: IPCC Guidelines (1997), Corinair Guidebook
Luxembourg	**General:** This source category does not exist in Luxembourg.

Member State	Methodology
Netherlands	**General:** The Netherlands currently has only one on-site coke production facility at the iron and steel plant of Tata Steel. A second independent coke producer in Sluiskil discontinued its activities in 1999. The fugitive emissions of CO_2 and CH_4 from both coke production sites are included here. There are no fugitive emissions from coal mining and handling activities (1B1a) in the Netherlands; these activities ceased with the closing of the last coal mine in the early 1970s. **Activity data:** individual company data, national energy statistics (CBS) **Emission factor:** country specific, IPCC default values **Changes of methodology**: As a result of the in-country review of September 2011, the emissions from the integrated iron and steel company have been reassessed and a mass balance has been made available. Based on new available information an emission time-series for the CH_4 emission of the production from charcoal is presented. The following emission factors have been used: • 1990-1997: 0.03 kg CH_4/kg charcoal (IPCC 1996 Guidelines) • 1998-2010: 0.0000111 kg CH_4/kg charcoal (Reumermann,P.J. Frederiks, B., proceedings 12th European conference on Biomass for Energy, Industry and Climate protection, Amsterdam, 2002).The lower EF for 1998-2010 has been used because the operator changed from traditional production to Twin retort system (Charcoal production with reduced emissions). Activity data based on the production data of charcoal have become available in "IEA Renewable Information 2011".
Portugal	**General:** Since 1990 in Portugal there was extraction of coal at only two coal mines, but both were latter closed down in 1992 and 1994 and did not resume activity since. **Activity data:** General-Directorate for Energy and Geology (DGEG). **Emission factor:** emission factors from IPCC96 (IPCC,1997)
Spain	**Activity Data**: national studies, AITEMIN (Asociación de Investigación Tecnológica de Equipos Mineros) **Emission Factor**: country specific
Sweden	**General:** There are no coalmines in Sweden and hence no fugitive emissions from coalmines occur. SO_2 emissions from quenching and extinction at coke ovens are reported in CFR 1B1b. Flaring of coke oven gas from the coke oven is reported in CRF 1B1c since submission 2004. Since submission 2010, flaring of blast furnace gas in the blast furnace and steel converter gas in the steel converter are reported under CRF 2C1. **Changes of methodology**: improved data for 2009 from one of the facilities became available, CO_2 emissions have been revised for that year.
United Kingdom	**General:** Methane emissions from closed coal mines are accounted for within Sector 1B1a of the UK inventory. Carbon emissions from coke ovens are based on a carbon balance approach. **Activity data:** saleable coal production statistics (national study) **Emission factor:** UK Coal Mining Ltd data, national studies, US EPA **Changes of methodology**: In 2011, DECC commissioned a study to update work looking at emissions from closed coal mines, to reflect known changes in the mining industry (e.g. mines that closed earlier or remained open longer than projected). The results of this study are included in the 2012 inventory submission, hence leading to recalculations of emissions.

○ **CH_4 from Coal Mining (1B1a)**

Fugitive emissions from coal mining correspond to the total emissions from:

- underground mining (emissions from underground mines, brought to the surface by ventilation systems),
- surface mining (emissions primarily from the exposed coal surfaces and coal rubble, but also emissions associated with the release of pressure on the coal),
- post-mining (emissions from coal after extraction from the ground, which occur during preparation, transportation, storage, or final crushing prior to combustion).

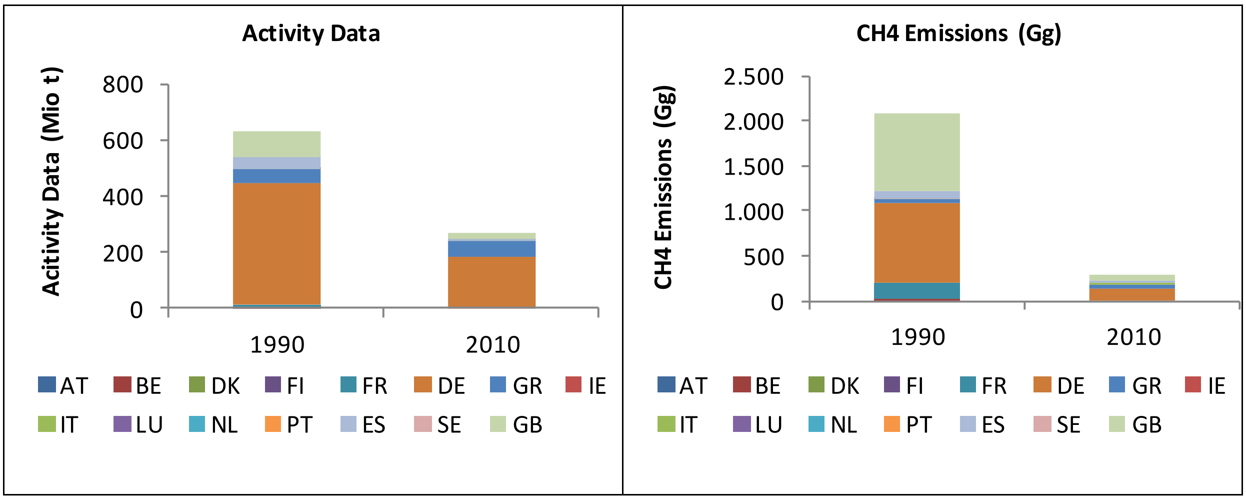
CH_4 emissions from 1B1a coal-mining accounted for 0.2 % of total GHG emissions in 2010 and for 7,3 % of all fugitive emissions in the EU-15. CH_4 emissions from this source decreased by 86 % in the EU-15 between 1990 and 2010 and by 6 % between 2009 and 2010 (Table 3.90). In 2010 Germany and the United Kingdom accounted together for 72 % of EU-15 CH_4 emissions from 1B1a. They both used higher tier methods for the estimation of emissions from 1B1a and both had substantially reduced their emissions between 1990 and 2010 due to the decline of coal mining (Figure 3.90).

Table 3.90 1B1a Coal Mining: Member States contribution to CH_4 emissions and information on method applied and emission factor

Member State	CH_4 emissions (Gg CO2 equivalents)			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010	
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)
Austria	11	IE,NO	IE,NO	-	-	-	-11	-100%
Belgium	299	NO	NO	-	-	-	-299	-100%
Denmark	NO	NO	NO	-	-	-	-	-
Finland	NO	NO	NO	-	-	-	-	-
France	4.016	NA,NO	NA,NO	-	-	-	-4.016	-100%
Germany	18.415	2.764	2.770	44,0%	6	0%	-15.645	-85%
Greece	1.095	1.370	1.193	18,9%	-177	-13%	98	9%
Ireland	NE,NO	NO	NO	-	-	-	-	-
Italy	55	16	22	0,3%	6	40%	-33	-60%
Luxembourg	NO	NO	NO	-	-	-	-	-
Netherlands	NA	NA	NA	-	-	-	-	-
Portugal	66	IE,NO	IE,NO	-	-	-	-66	-100%
Spain	1.794	610	521	8,3%	-89	-15%	-1.273	-71%
Sweden	NO	NO	NO	-	-	-	-	-
United Kingdom	18.263	1.952	1.789	28,4%	-163	-8%	-16.473	-90%
EU-15	**44.014**	**6.711**	**6.295**	**100,0%**	**-416**	**-6%**	**-37.718**	**-86%**

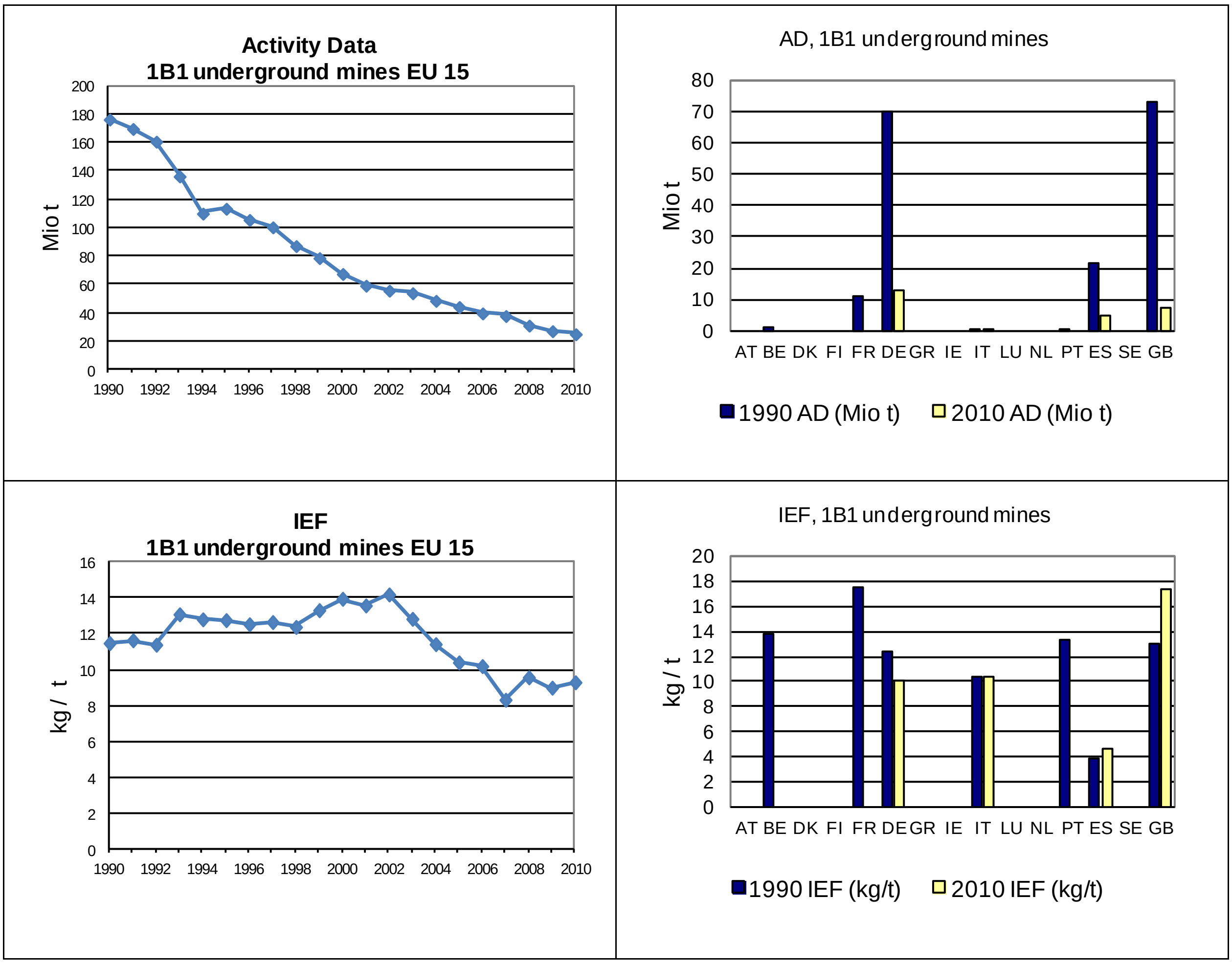
For methodological issues and remarks on completeness see Table 3.88.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.90 **1B1a Coal Mining and Handling: Contribution of MS to CH_4 Emission and Activity Data**



In 2010 most fugitive emissions from coal mines were due to underground mines. Within the EU-15 coal mining in underground mines decreased substantially (84 %) (Figure 3.91). The strong change in underground mining activities is opposed by a moderate change in the implied emissions factor for CH_4 emissions (with a maximum of 15 kg/t (2002) and a minimum of 9 kg/t (2007)).

Figure 3.91 **1B1ai Underground Mines: Activity Data and Implied Emission Factors for EU-15 and the emitting countries of CH_4**



Overall, in the EU-15 coal production from surface mines decreased by 53 % between 1990 and 2010 (Figure 3.92). Coal mining in surface mines decreased in all Member States except in Greece.

Figure 3.92 1B1aii Surface Mines: Activity Data and Implied Emission Factors for EU-15 and the emitting countries of CH_4

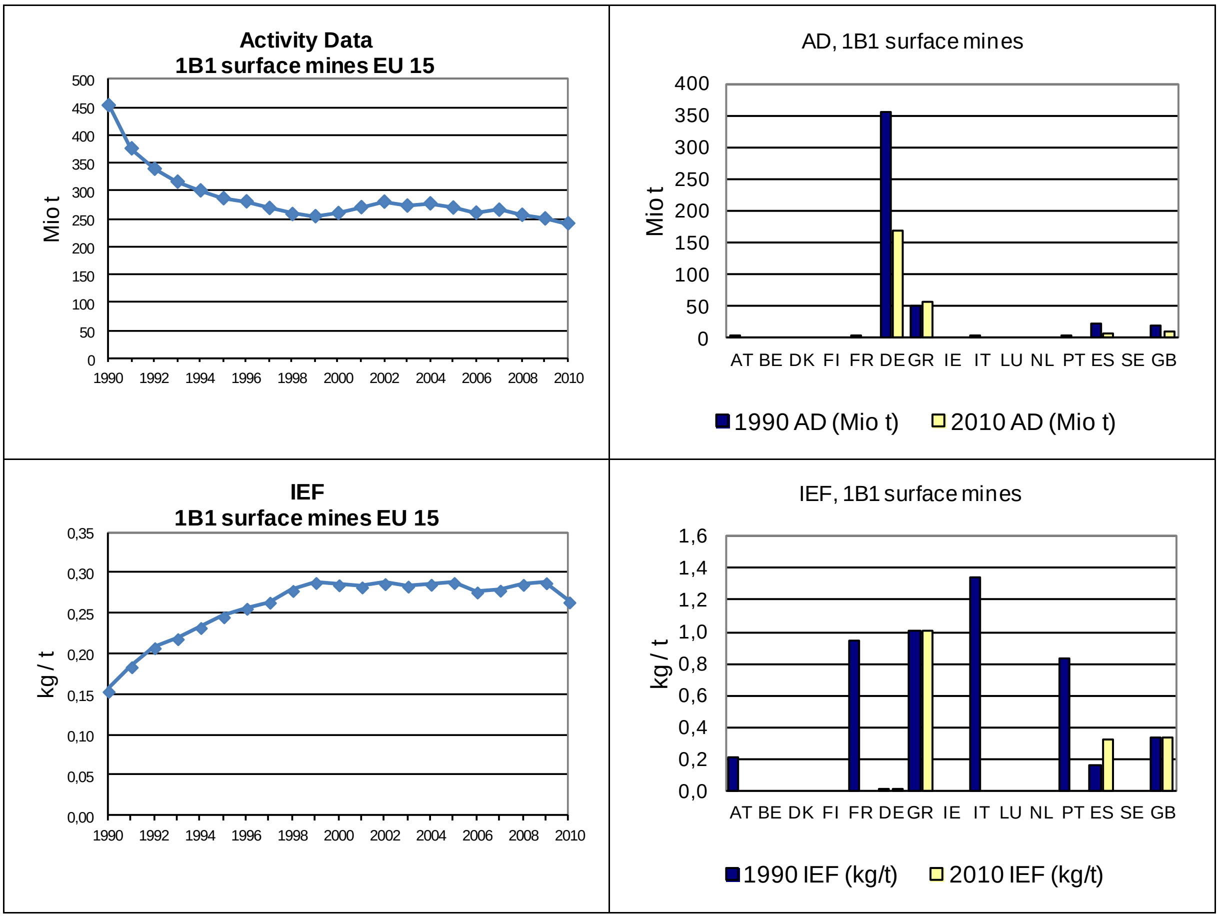


Table 3.91 provides information on the contribution of Member States to EU-15 recalculations in CH_4 from 1B1 Solid fuels for 1990 and 2009.

Table 3.91 **1B1 Fugitive Emissions from Solid Fuels: Contribution of MS to EU-15 recalculations in CH_4 for 1990 and 2009 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)**

	1990		2009		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	0	0.0	0	0.0	
Belgium	0	0.0	0	0.0	
Denmark	0	0.0	0	0.0	
Finland	0	0.0	0	0.0	
France	0	0.0	0	0.0	
Germany	0	0.0	-50	-1.7	New method for calculating emissions from 1B1b (coke ovens)
Greece	0	0.0	0	0.0	
Ireland	0	0.0	0	0.0	
Italy	0	0.0	0	0.0	
Luxembourg	0	0.0	0	0.0	
Netherlands	3	10.4	0	0.0	Error correction for CH4 recovery
Portugal	0	0.0	0	0.0	
Spain	0	0.0	-1	-0.2	Revision of the activity variable (coke produced) after having detected that the previous figure was expressed on dry basis instead of on a wet basis.
Sweden	0	0.0	0	0.0	
UK	-8	0.0	-908	-31.7	- New data used on mine closure dates and methane capture - Activity data revised in national energy statistics 2008 onwards
EU-15	**-5**	**0.0**	**-959**	**-12.3**	

3.2.6.2 Fugitive emissions from oil and natural gas (1B2) (EU-15)

Fugitive emissions from oil and natural gas correspond to the total fugitive emissions from oil and gas activities. Fugitive emissions may arise from equipment exhaust (non-combustion), leakages, upsets and mishaps at any point in the chain from production through final use. Emissions from flaring are also included (the combustion is considered a non-productive activity) (Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories).

Fugitive emissions from 1B2 Oil and natural gas include all emissions from exploration, production, processing, transport, and handling of oil and natural gas. They account for 1.1 % of the total GHG emissions in 2010 and for 83 % of all fugitive emissions in the EU-15.

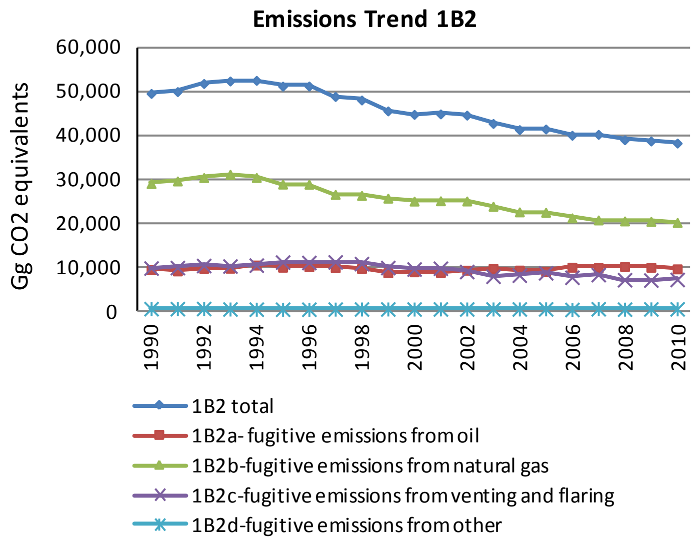
Of all fugitive emissions from oil and natural gas, in 2010:

- 40 % were CH_4 emissions from natural gas (exploration, production, processing, transport and distribution).
- 19 % were CO_2 emissions from oil (exploration, production, transport, refining and storage and distribution)
- 13 % were CO_2 emissions due to flaring

This source category includes two key source categories:

- CO_2 from 1B2a Oil
- CH_4 from 1B2b Natural Gas

Figure 3.93 **1B2-Fugitive Emissions Oil and Natural Gas: Trend**



Fugitive emissions from oil and natural gas arose in all Member States (Table 3.92). Total greenhouse gas emissions from 1B2 decreased by 22 % between 1990 and 2010 (Figure 3.92). This trend was mainly due to the reduction of fugitive CH_4 emissions from natural gas activities, which decreased by 28 % over that period.

In 2010, 76% of all fugitive GHG emissions from oil and natural gas were emitted by four countries: France, Germany, Italy and the United Kingdom. The largest reductions (in absolute terms) were observed in the United Kingdom (mainly CH_4 emissions) and in Italy (both CH_4 and CO_2 emissions), while emissions increased most in Portugal.

Table 3.92 **1B2 Fugitive emissions from oil and natural gas: Member States' contributions**

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2010 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO2 emissions in 2010 (Gg)	CH_4 emissions in 1990 (Gg CO_2 equivalents)	CH4 emissions in 2010 (Gg CO_2 equivalents)
Austria	300	516	102	237	198	279
Belgium	613	541	84	103	528	438
Denmark	369	465	325	357	44	107
Finland	231	180	219	139	11	40
France	5.553	4.613	4.045	3.435	1.474	1.149
Germany	10.218	8.036	1.691	1.451	8.526	6.585
Greece	162	199	70	11	92	188
Ireland	131	32	IE,NO	IE,NO	131	32
Italy	10.654	7.361	3.344	2.322	7.298	5.027
Luxembourg	16	45	0	0	16	45
Netherlands	2.418	1.745	775	1.022	1.643	723
Portugal	197	1.316	143	713	52	600
Spain	2.270	2.725	1.656	2.183	614	542
Sweden	372	981	304	882	67	95
United Kingdom	16.143	9.626	5.778	4.388	10.323	5.191
EU-15	**49.647**	**38.381**	**18.536**	**17.244**	**31.017**	**21.040**

For For methodological issues and remarks on completeness see Table 3.92.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.93 provides information on the methodologies used by EU-15 Member States.

Table 3.93 1B2 –Fugitive Emissions from Oil and Gas: Methodological Issues according to NIRs and Member State information of EU-15 Member States

Member State	Methodology
Austria	**General:** 1 B 2 a i Oil Exploration, 1 B 2 a iii Transport, 1 B 2 b Natural Gas Exploration and 1 B 2 b i Natural Gas Production/Processing, except CO_2 emissions from processing of sour gas, are included in 1 B 2 a ii. CO_2 emissions from 1 B 2 a iv Refining/Storage due to combustion are included in 1 A 1 b Petroleum Refining, fugitive CO_2 emissions are assumed to be negligible. 1 B 2 a v Distribution of oil products also includes storage in storage tanks and refinery dispatch station – only NMVOC emissions are estimated as CH_4 emissions are assumed to be negligible. CO_2 emissions from 1 B 2 c Venting/Flaring are included in 1 A 1 b Petroleum Refining. CH_4 emissions from 1 B 2 c Venting/Flaring are included in 1 B 2 a iv Petroleum Refining **Activity data:** national energy balance, Association of the Austrian Petroleum Industry, Austrian Natural Gas and District Heat Association., E-Control (Austrian Energy Regulator) **Emission factor:** IPCC Reference Manual, country specific
Belgium	**General**: CO_2 of the refineries were allocated to the sectors 1A1a for the involved combined heat-power installations of the refineries, 1B2c for the flaring emissions and 1A1b for the total emissions excluding the emissions of the combined heat-power installations and excluding the emissions from flaring activities. The emissions of CH_4 reported in 1B2a also contain the emissions of flaring activities, as a consequence these CH_4 emissions are allocated in category 1B2a and not in category 1A1b. **Activity data:** The activity data reported in the category 1B2b is the annual total natural gas amount consumed in Belgium. These activity data originate from SYNERGRID, the federation of the gridoperators of gas and electricity. **Emission factor:** plant specific, country specific **Methodological changes compared to previous submission:** Activity Data in the sector 1B2b3 in the Brussels region was revised for the year 2008 following the finalization of the 2008 energy balance of the region. Activity Data in the sector 1B2b4 in the Brussels region was revised for the complete time series in order to be consistent with sector 1B2b3. As a result of the UNFCCC centralized review of September 2011 the emissions in the category 1B2 (oil and natural gas) were completed during the 2012 submission with the diffuse emissions of CH (category 1B2a3) in the Flemish region for the complete time series. Some minor corrections (round o the emissions of CH_4 in the sector 1B2a4 (refining/storage) in the Flemish region for the complete tim
Denmark	**General:** 1B2a: Fugitive emissions from oil include emissions from offshore activities and refineries. 1B2b: Fugitive emissions from natural gas include emissions from transmission and distribution of natural gas. Emissions from gas storage are included in the transmission. 1B2c: Venting and flaring include activities onshore and offshore. Flaring occur both offshore and onshore in gas treatment and storage plants and in refineries. Venting occurs in gas storage plants. Venting of gas is assumed to be negligible in extraction and in refineries as controlled venting enters the gas flare system. **Activity data:** Danish gas transmission company DONG Energy, Danish Energy Agency, Danish energy statistics, A/S Dansk Shell, 2009 and Statoil A/S, Danish Gas Technology Centre and the Danish gas distribution companies, Energinet.dk **Emission factor:** EMEP/EEA Guidebook (2009), country specific, national studies, UK Emission

Member State	Methodology
	Factor Database ,Danish EPA
Finland	**General:** There is no exploration or production of oil or natural gas in Finland.CO_2, CH_4 and N_2O emissions from flaring at oil refineries and in the petrochemical industry, fugitive methane emissions from oil refining and methane emissions from gas transmission and distribution were included. **Activity data:** Energy Statistics (Energy Statistics, Yearbook 2009), flares reported to the VAHTI system **Emission factor:** IPCC guidelines
France	**General:** Emissions from exploration, production, transport, refining were included. There are 14 refineries in France. The fugitive CO_2 emissions from the gas extraction site 'bassin de Lacq' decreased along with production strongly. The production of petrol emits CO_2 and CH_4, but compared to the transformation of petroleum products much less. **Activity data:** national and plant statistics **Emission factor**: country specific, extraction Tier 1 (liquid) and 3 (gaseous fuel), refining Tier 2/3, pipeline compressors (tier 3), transport Tier 2/3
Germany	**General**: Emissions from 1 B 2 b i are included in 1 B 2 a i **Activity data**: Jahresbericht des Wirtschaftsverbandes Erdöl- und Erdgasgewinnung e.V. (WEG), Jahresbericht Mineralöl-Zahlen, Mineralölwirtschaftsverband **Emission factor**: IPCC GPG default emission factors, country specific **Changes of methodology:** New perception regarding exploration , exploitation and refinement of oil and gas led to recalculations (NIR 2012) Sector: 1.B.2.a.ii: overall recalculations due to changes from default to CS factors Sector: 1.B.2.a v: more specific emission factors for CH_4 and NMVOC available for emission calculation
Greece	**General**: Extraction, processing, storage, transmission/distribution were included. The introduction of natural gas in the Greek energy system started in 1996. Emissions estimated according to the Tier 1 methodology described in the IPCC Good Practice Guidance (IPCC 2000). Emissions from crude oil transport are reported under venting, while emissions from LPG transport are reported under Other (1.B.2d - Other) **Activity data:** national energy balance, Public Gas Corporation, international institutes and databases **Emission factor:** IPCC Guidelines, IPCC Good Practice Guidancev **Recalculations** were performed for the categories 1.B.2.b.3 and 1.B.2.b.4 for the year 2009. The reason of the recalculations was the availability of updated activity data as concerns the activated NG distribution and transmission network.
Ireland	**General:** Ireland has no oil industries and therefore fugitive emissions of greenhouse gases are limited to those associated with natural gas production and distribution. **Activity data:** energy balance, reports to the department of communications energy and natural resources (DCENR) under the OSPARConvention

Member State	Methodology
	Emission factor: country specific
Italy)	**General**: Fugitive CO_2 emissions reported in 1B2 referred to fugitive emissions in refineries during petroleum production processes, e.g. fluid catalytic cracking and flaring, and emissions from the production of oil and natural gas. CH_4 emissions reported in 1B2 referred mainly to the production of oil and natural gas and to the transmission in pipelines and distribution of natural gas. CO_2 and CH_4 fugitive emissions from oil exploration are included in those from production because no detailed information is available. N_2O emissions from flaring in oil exploration and in refining activities are reported under oil flaring. Emissions from transport and distribution of oil result as not occurring. CO_2 and CH_4 emissions from gas exploration are also included in those from production while CH_4 emissions from other leakage are included in distribution emission estimates. **Activity Data:** National Energy Balance, specific industry data **Emission factor**: IPCC GPG (2000) **Methodological changes compared to previous submission:** CO_2 and CH_4 from 1B2C.1.1. Disaggregation of fugitive emissions from oil among venting, flaring and production. Addition of natural gasoline production; CO_2 and CH_4 from 1B2C.2.1. Disaggregation of fugitive emissions from oil among venting, flaring and production. Emissions from flaring in refineries have been moved from 1.B.2.C.2.1 to 1.B.2.D. Addition of natural gasoline production N_2O from 1B2C.2.1. Emissions from flaring in refineries have been moved from 1.B.2.C.2.1 to 1.B.2.D CO_2 and CH_4 from 1B2C.2.2. Disaggregation of fugitive emissions from oil among venting, flaring and production CO_2 from 1B2D. Emissions from flaring in refineries have been moved from 1.B.2.C.2.1 to 1.B.2.D. Reallocation of fugitive emissions from petroleum refining between production processes and flaring CH_4 from 1B2D. Emissions from flaring in refineries have been moved from 1.B.2.C.2.1 to 1.B.2.D N_2O from 1B2D. Emissions from flaring in refineries have been moved from 1.B.2.C.2.1 to 1.B.2.D. Addition of N_2O emissions from flaring in refineries CO_2, CH_4: reallocation of CO_2 emissions between flaring and production processes; update of losses by one operator and the length of high pressure pipelines for natural gas transport has been updated for 2009. 2012 NIR par.3.9.2
Luxembourg	**General:** In Luxembourg, fugitive emissions only occur from natural gas transmission, distribution and leakages (IPCC Sub-categories 1B2b3, 1B2b4 and 1B2b5). Other fugitive emissions are not occurring in Luxembourg. With regards to natural gas, methane emissions from leaks or accidental events are included in IPCC sub-categories 1B2b3 − Transmission and 1B2b4 − Distribution, hence notation key IE used in IPCC sub-category 1B2b5 − Other Leakage. **Activity Data:** national natural gas consumption: national statistics **Emission factor**: 2006 IPCC Guidelines default emission factors for natural gas transmission and distribution. (2006 IPCC Guidelines Tier 1 approach has been applied).
Netherlands	**General:** The fugitive emissions – mostly CH_4 – from category 1B2 comprise non-fuel combustion emissions from flaring and venting, emissions from oil and gas production, emissions from gas transport (compressor stations) and gas distribution networks (pipelines for local transport) and oil refining. The fugitive CO_2 emissions from refineries are included in the combustion emissions reported in category 1A1b. In addition, the combustion emissions from exploration and production are reported under 1A1c. From the 2007 submission the process emissions of CO_2 from a hydrogen plant of a refinery (about 0.9 Tg CO_2 per year) are reported in this category. Refinery data specifying these fugitive CO_2 emissions are available from 2002 onwards (environmental report from the plant) and re-allocated from 1A1b to 1B2a-iv for 2002 onwards.

Member State	Methodology
	Activity data: plant and country specific **Emission factor:** country specific Tier 3. Since 2004, the gas distribution sector annually records the number of leaks found per material, and any future possible trends in the emission factors will be derived from these data. **Changes of methodology**: As from the resubmission of November 2011 the Netherlands has accounted for fugitive emissions of gas transmission using the total transmission pipeline length and default IPCC CO_2 emission factor. The default IPCC emission factor is taken from the IPCC Good Practice guidelines Table 2.16 page 2.86. The transmission pipeline length is taken from the publication Transport insight 2009 of GasTransport Services B.V. (separate company for the transport services of Gasunie).
Portugal	**General:** Extraction and production of crude oil did never occur in the Portuguese territory. Therefore, fugitive emissions comprised only those resulting from refining, storage and transport of crude oil, other raw materials, intermediate products and final products - particularly gasoline - from terminal receiving of crude oil and other petroleum products till delivering to final consumer. There is no production of natural gas in Portugal. The use of natural gas in Portugal was initiated only in 1997 (DGEG). All natural gas is imported and received through shipping transport from Algeria and Nigeria as Liquefied Natural Gas (LNG). There are also no major processing operations in Portugal. **Activity data:** plant and country specific, GALP (the company operating all refineries in Portugal), PETROGAL, TRANSGAS, General-Directorate for Energy and Geology (DGEG) **Emission factor:** IPCC Good Practice (IPCC,2000), EMEP/CORINAIR, plant specific, USEPA **Changes of Methodology**: Revised values for pipeline extension were given by DGEG (2008 and 2009). These new values do not change emissions from 1B2d since emissions from distribution are calibrated using total losses reported in the energy balance - emissions from transmission rise while emissions from distribution fall.
Spain	**Activity Data:** OILGAS, Enciclopedia Nacional del Petróleo, Petroquímica y Gas, SEDIGAS **Emission factors:** estadística de prospección y producción de hidrocarburos, country specific, EMEP/CORINAR Guidebook, IPCC GPG 2000 **Nuevos calculus (NIR 2012)**: • Revisión de las emisiones de CO_2 imputadas a una planta de hidrógeno de una refinería (dentro de la categoría 1B2aiv) para el año 2009 al detectarse una doblecontabilización de dichas emisiones en el inventario. • Corrección de los factores de emisión de CO_2, específicos por planta, aplicados para el proceso de regeneración del catalizador en el craqueo catalítico fluido de dos plantas de refino (dentro de la categoría 1B2aiv). En el proceso de control desarrollado en la presente edición del inventario se detectó el empleo de factores de emisión no actualizados en dos instalaciones de dos refinerías para los últimos años del periodo, habiéndose aplicado en cada uno de los casos el factor correspondiente a 2007 y a 2008 para años posteriores. • Revisión de las emisiones de CH_4 asignadas al proceso de destilación al vacío (dentro de la categoría 1B2aiv) en dos plantas de refino para todo el periodo 1990-2009. • Revisión de la información relativa a la longitud de tubería según presión de operación y material del conducto, variable de actividad considerada para la estimación de emisiones en la red de distribución (categoría 1B2biv) En la edición actual del inventario se ha implementado la actualización de la información relativa al año 2007 (longitud de la red a finales de año) aportada por la propia asociación del sector, SEDIGAS. Los nuevos datos disponibles inducen modificaciones en las estimaciones de la variable de actividad, longitud de la red a mediados de año, para los años 2007 y 2008, y, en consecuencia, en las emisiones de CO_2 y CH_4 asociadas.
Sweden	**General:** According to 2006 IPCC Guidelines, emissions from hydrogen production plants should be reported in this sector. Since 2005, one such facility is in operation in Sweden, and another one was taken into operation in 2006. Emissions from these facilities are reported in CRF 1B2ai in

Member State	Methodology
	accordance with 2006 IPCC Guidelines. In Sweden, crude oil is transported to and from the country by tankers. In response to recommendations from the UNFCCC expert review teams, Sweden estimates for the first time in the 2010 submission inventory emissions of CH_4 from transport of crude oil. **Activity data:** plant specific, report to the EU ETS system, Statistics Sweden, Swedish EPA **Emission factor:** plant specific, country specific and default, IPCC guidelines, 2000 Good Practice Guidance **Changes of methodology**: • The time series in CRF 1.B.2.A.4 for fugitive CH_4 emissions from refineries was revised in submission 2012 as revised plant specific data became available: 5% of the company´s total hydrocarbon emissions are CH_4 (as opposed to 0,5% used for the calculation in previous years) CH_4 emissions from this plant have been revised for the whole time series using this new percentage. Fur-thermore, fugitive CH_4 emissions from two other refineries from which the CH_4 emissions not have been estimated before submission 2012 were estimated also as 5% of the total hydro carbon emissions. For the remaining refineries in Sweden the CH_4 emissions are reported as in the facilities' environmental reports. • A new road emission model, HBEFA 3.1A, has been used in submission 2012 for calculating the distributed amounts of gasoline. The model estimates around 10% lower amounts of used gasoline than the previous model. • Year specific CO_2 emission factors for methane-rich gas mixtures used in the chemical industry have been devel-oped in submission 2012. This also affects the emissions of CO_2 in CRF 1.B.2.c.2, as some of the gas is flared. • Fugitive CH_4 and CO_2 emissions from transmission of natural gas have been estimated by using the default method in the IPCC good practice guidance. • Fugitive CH_4 emissions from distribution of natural gas have been estimated by using the default method in the IPCC good practice guidance.
United Kingdom	**General:** Emissions occurred from oil and gas production facilities, gas and oil terminals, gas processing facilities, oil refineries, gas transmission networks, and storage and distribution of petrol. Most of the UK's oil and gas production occurs offshore but there are a number of mostly small onshore production sites as well. **Activity data:** Oil and Gas UK trade association (through their annual emissions reporting mechanism to the UK regulatory agency (the Department of Energy & Climate Change), called the Environmental Emissions Monitoring System (EEMS), for years prior to 1995 emission totals are based on an internal Oil and Gas UK summary report produced in 1998, UK Petroleum Industry Association, UK Energy Statistics **Emission factor:** plant specific and aggregated, calculated by UK Institute of Petroleum **Changes of methodology**: A number of recalculations have been made due to revisions to source data in the oil and gas sector from operator-reported data through EEMS (NIR 2012)

- **CO_2 from Oil (1B2a)**

Fugitive emissions from oil correspond to fugitive emissions from oil exploration, fugitive emissions from the production of crude oil, fugitive emissions resulting from the loading and unloading of crude oil from tankers, fugitive emissions from the refining of oil and from storage in tanks and emissions (primarily NMVOCs) from transport and handling of oil products.(Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories).

CO_2 emissions from 1B2a 'Fugitive CO_2 emissions from oil' account for 0.2 % of total EU-15 GHG emissions in 2010 and for 19 % of all fugitive emissions in the EU-15. Between 1990 and 2010, CO_2 emissions from this source increased by 12 % in the EU-15 (Table 3.93). By contrast, during the same period 1990-2010, CH_4 emissions of this source category were reduced by 42 %.

Together France, Italy and Spain accounted for 69 % of the EU-15 total CO_2 emissions of 1B2a 'Fugitive CO_2 emissions from oil' (Table 3.94). All three Member States used higher tier methods for the estimation of 1B2a. During the period 1990-2010, the largest decreases in CO_2 emissions (in absolute terms) were observed in Italy and the United Kingdom, while emissions increased most in the Netherlands and in Sweden.

Table 3.94 1B2a Fugitive CO_2 emissions from oil: Member States' contributions and information on method applied and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)		
Austria	43	163	145	1,7%	-18	-11%	102	237%	CS	PS
Belgium	0	0	0	0,0%	0	7%	0	33%	T1	D
Denmark	2	5	5	-	0	-6%	2	94%	CR	D
Finland	1,0	1,4	1,3	0,0%	-0,1	-6%	0	35%	CS	D
France	2.762	3.117	2.723	31,1%	-394	-13%	-39	-1%	T1,T2,T3	CS
Germany	1	1	1	0,0%	0	-9%	0	-8%	T1,T2	CS,D
Greece	0	0,03	0,04	0,0%	0,012	41%	-0,23	-	T1	D
Ireland	NO	NO	NO	-	-	-	-	-	NA	NA
Italy	2.366	1.323	1.447	16,5%	124	9%	-920	-39%	T1,T2	CS,D
Luxembourg	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Netherlands	0	1.013	956	10,9%	-57	-6%	956	-	CS,D	CS,D
Portugal	92	395	474	5,4%	80	20%	382	415%	D	D
Spain	1.477	1.837	1.906	21,7%	69	4%	429	29%	T1,T2	D,PS
Sweden	234	819	803	9,2%	-15	-2%	569	243%	T1,T2,T3	CS,PS
United Kingdom	859	456	306	3,5%	-150	-33%	-553	-64%	T2	CS,PS
EU-15	**7.838**	**9.131**	**8.768**	**100,0%**	**-362**	**-4%**	**930**	**12%**		

For methodological issues and remarks on completeness see Table 3.93.
Abbreviations explained in the Chapter 'Units and abbreviations'.

o CH_4 from Natural gas (1B2b)

Fugitive emissions from natural gas correspond to emissions from the production of gas, gas gathering systems and gas separation plants, emissions from pipelines for long distance and local transport of methane, compressor stations and their maintenance facilities, and the release of gas at point of use, including residential, commercial, industrial and electricity generation users (Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories).

CH_4 emissions from 1B2b 'Fugitive CH_4 emissions from natural gas' account for 0.5 % of total EU-15 GHG emissions in 2010 and for 40 % of all fugitive emissions in the EU-15. Between 1990 and 2010, CH_4 emissions from this source decreased by 28 % in the EU-15 (Table 3.95).

In 2010, 82 % of the EU-15 CH_4 emissions from 1B2b were emitted by three Member States: Germany, Italy and the United Kingdom (Table 3.95). All three Member States used higher tier methods for the estimation of the emissions from 1B2b. The emission decreases between 1990 and 2010 observed in the United Kingdom (-51 %) and in Italy (-32 %) contributed most significantly to the overall reduction in the EU-15 between 1990 and 2010.

Various parameters (e.g. pipelines length, PJ gas consumed, m^3 gas produced, see Table 3.97) were used as activity data for calculation of the sub categories of 1B2b by Member States and thus a meaningful implied emission factor could not be calculated for the EU-15.

Table 3.95 **1B2b Fugitive CH_4 emissions from natural gas: Member States' contributions and information on method applied and emission factor**

Member State	CH_4 emissions (Gg CO2 equivalents)			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)		
Austria	96	142	139	0,7%	-4	-2%	42	44%	T2,T3	CS
Belgium	519	387	432	2,3%	45	12%	-87	-17%	CS,M	CS
Denmark	9	3	4	0,0%	1	17%	-5	-60%	CS	CS
Finland	4	35	30	0,2%	-6	-16%	26	727%	T1,T2	CS,D,PS
France	1.344	1.004	1.105	6,0%	101	10%	-240	-18%	T1,T2,T3	CS
Germany	7.400	6.190	6.174	33,3%	-16	0%	-1.226	-17%	CS,T2,T3	CS,D
Greece	10	118	124	0,7%	7	6%	115	1199%	T1	D
Ireland	131	35	31	0,2%	-4	-11%	-100	-76%	CS	CS
Italy	7.063	4.685	4.788	25,8%	103	2%	-2.275	-32%	T1,T2	CS,D
Luxembourg	16	42	45	0,2%	3	8%	29	178%	T1	D
Netherlands	373	399	405	2,2%	6	1%	31	8%	T2,T3	CS
Portugal	NO	606	544	2,9%	-62	-10%	544	-	CR,OTH	CR,OTH
Spain	420	462	473	2,5%	11	2%	53	13%	CS,T1	CS,D
Sweden	46	71	72	-	0	0%	26	56%	T1	D
United Kingdom	8.506	4.294	4.188	22,6%	-106	-2%	-4.318	-51%	T2,T3	CS,PS
EU-15	**25.937**	**18.474**	**18.552**	**100,0%**	**78**	**0%**	**-7.385**	**-28%**		

For methodological issues and remarks on completeness see Table 3.93.
Abbreviations explained in the Chapter 'Units and abbreviations'.

o CO_2 from Venting and Flaring (1B2c)

Fugitive emissions from venting and flaring correspond to the release and/or combustion of excess gas at facilities for the production of oil or gas and for the processing of gas (Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories).

In 2010 fugitive CO_2 emissions from 1B2c Venting and Flaring accounted for 0.2 % of total GHG emissions in 2010 and for 13 % of all fugitive emissions in the EU-15. The United Kingdom used a higher tier method for the estimation of emissions from 1B2c and was responsible for more than two thirds of the emissions from this source.

Between 1990 and 2009, CO_2 emissions from this source decreased by 11 % in the EU-15 (Table 3.96).

Table 3.96 1B2c Fugitive CO_2 emissions from venting and flaring: Member States' contributions and information on method applied and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)		
Austria	IE	IE	IE	-	-	-	-	-	NA	NA
Belgium	84	117	103	1,7%	-14	-12%	19	22%	T3	PS
Denmark	322	260	352	6,0%	92	35%	30	9%	CR,CS	CS,PS
Finland	122	77	98	1,7%	21	28%	-24	-19%	CS	CS
France	499	448	447	7,6%	-1	0%	-53	-11%	T1,T2,T3	CS
Germany	281	300	284	4,8%	-16	-5%	3	1%	T2	CS
Greece	70	7	11	0,2%	3	41%	-59,44	-	T1	D
Ireland	IE,NO	IE,NO	IE,NO	-	-	-	-	-	NA	NA
Italy	293	271	301	5,1%	31	11%	8	3%	T2	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	774	52	65	1,1%	13	25%	-709	-92%	T2	PS
Portugal	49	53	39	0,7%	-14	-27%	-10	-20%	D	D
Spain	179	253	277	4,7%	24	9%	98	55%	CS,T1,T2	CS
Sweden	70	79	79	1,3%	0	0%	9	12%	T2	CS,PS
United Kingdom	3.920	3.858	3.861	65,3%	2	0%	-59	-2%	T3	CS
EU-15	**6.663**	**5.776**	**5.915**	**100,0%**	**139**	**2%**	**-747**	**-11%**		

For methodological issues and remarks on completeness see Table 3.93.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.97 1B2b Fugitive CH_4 emissions from natural gas: Information on activity data, emission factors by Member State

		1990					2010				
		Activity data					Activity data				
Member State	GHG source category	Description	Unit	Value	Implied emission factor (kg/unit)	CH4 emissions (Gg)	Description	Unit	Value	Implied emission factor (kg/unit)	CH4 emissions (Gg)
Austria	**Natural Gas**					**4.59**					**6.61**
	i. Exploration			1288	IE	IE			1816	IE	IE
	ii. Production (4) / Processing	gas produced	10^6 m^3	1288	IE	IE	gas produced	10^6 m^3	1816	IE	IE
	iii. Transmission	Pipelines length (km)	km	3628	494.56	1.79	Pipelines length (km)	km	6798	494.56	3.36
	iv. Distribution	Distribution network length	km	11672	239.81	2.80	Distribution network length	km	28733	113.02	3.25
	v. Other Leakage	Gas consumed	PJ	NO	NO	NO	Gas consumed	PJ	NO	NO	NO
	at industrial plants and power stations			NO	NO	NO			NO	NO	NO
	in residential and commercial sectors			NO	NO	NO			NO	NO	NO
Belgium	**Natural Gas**					**24.71**					**20.57**
	i. Exploration								NO	NO	NO
	ii. Production (4) / Processing								NO	NO	NO
	iii. Transmission	(e.g. PJ gas consumed)	PJ	341	5979.11	2.04	(e.g. PJ gas consumed)	PJ	701	7165.73	5.02
	iv. Distribution	PJ gas consumed	PJ	341	66474.61	22.67	PJ gas consumed	PJ	701	22185.88	15.55
	v. Other Leakage								NO	NO	NO
	at industrial plants and power stations								NO	NO	NO
	in residential and commercial sectors								NO	NO	NO
Denmark	**Natural Gas**					**0.43**					**0.17**
	i. Exploration			IE	IE	IE			IE	IE	IE
	ii. Production (4) / Processing	Gas produced	10^6 m^3	5137	IE	IE	Gas produced	10^6 m^3	8056	IE	IE
	iii. Transmission	Gas transmission	10^6 m^3	2739	62.03	0.17	Gas transmission	10^6 m^3	7462	3.55	0.03
	iv. Distribution	Gas distributed	10^6 m^3	1905	134.03	0.26	Gas distributed	10^6 m^3	2493	57.08	0.14
	v. Other Leakage	Incl. in transmission		IE	IE	IE	Incl. in transmission		IE	IE	IE
	at industrial plants and power stations			IE	IE	IE			IE	IE	IE
	in residential and commercial sectors			IE	IE	IE			IE	IE	IE
Finland	**Natural Gas**					**0.17**					**1.41**
	i. Exploration			NO	NO	NO			NO	NO	NO
	ii. Production (4) / Processing	(e.g. PJ gas produced)		NO	NO	NO	(e.g. PJ gas produced)		NO	NO	NO
	iii. Transmission	PJ gas consumed	PJ	92	1855.49	0.17	PJ gas consumed	PJ	160	1912.65	0.31
	iv. Distribution	PJ gas distributed via local networks	PJ	5	NO	NO	PJ gas distributed via local networks	PJ	9	127241.65	1.10
	v. Other Leakage	t of natural gas released from pipelines		NO	NO	NO	t of natural gas released from pipelines		NO	NO	NO
	at industrial plants and power stations			NO	NO	NO			NO	NO	NO
	in residential and commercial sectors			NO	NO	NO			NO	NO	NO
France	**Natural Gas**					**64.02**					**52.61**
	i. Exploration			NO	NO	NO			NO	NO	NO
	ii. Production (4) / Processing	PJ Production	PJ	309	2614.24	0.81	PJ Production	PJ	95	194.90	0.02
	iii. Transmission	PJ Consumed	PJ	1055	59888.21	63.21	PJ Consumed	PJ	1778	29581.80	52.59
	iv. Distribution			IE	IE	IE			IE	IE	IE
	v. Other Leakage			NO	NO	NO			NO	NO	NO
	at industrial plants and power stations			NO	NO	NO			NO	NO	NO
	in residential and commercial sectors			NO	NO	NO			NO	NO	NO

		1990					2010				
Germany	**Natural Gas**					**352.38**					**294.00**
	i. Exploration	numbers of wells drilled	number	IE	IE	IE	numbers of wells drilled	number	IE	IE	IE
	ii. Production (4) / Processing	production and processing	TJ	631232	94.93	59.92	production and processing	TJ	401518	5.51	2.21
	iii. Transmission	pipelines and containers	TJ	2292780	12.89	29.56	pipelines and containers	TJ	3074942	13.15	40.43
	iv. Distribution	distribution net	km	245852	811.74	199.57	distribution net	km	456124	421.73	192.36
	v. Other Leakage	gas consumed	TJ	893519	70.89	63.34	gas consumed	TJ	1331425	44.31	58.99
	at industrial plants and power stations		TJ	IE	IE	14.07		TJ	IE	IE	12.59
	in residential and commercial sectors	gas consumed	TJ	893519	55.14	49.27	gas consumed	TJ	1331425	34.85	46.40
Greece	**Natural Gas**					**0.46**					**5.92**
	i. Exploration			NO	NO	NO			NO	NO	NO
	ii. Production (4) / Processing	Natural gas production	10^6 m^3	123	3708.46	0.46	Natural gas production	10^6 m^3	7	455.00	0.00
	iii. Transmission	Length of transmission pipeline	km	NO	NO	NO	Length of transmission pipeline	km	1280	2537.68	3.25
	iv. Distribution	Length of distribution mains	km	NO	NO	NO	Length of distribution mains	km	4346	615.00	2.67
	v. Other Leakage	(e.g. PJ gas consumed)		11567	IE	IE	(e.g. PJ gas consumed)		270607	IE	IE
	at industrial plants and power stations	NG consumption		5783	IE	IE	NG consumption		135303	IE	IE
	in residential and commercial sectors	NG Consumption		5783	IE	IE	NG Consumption		135303	IE	IE
Ireland	**Natural Gas**					**6.24**					**1.49**
	i. Exploration			IE	IE	IE			IE	IE	IE
	ii. Production (4) / Processing	PJ of Gas produced	PJ	79	14330.75	1.13	PJ of Gas produced	PJ	13	514.16	0.01
	iii. Transmission	(e.g. PJ gas consumed)		IE	IE	IE	(e.g. PJ gas consumed)		IE	IE	IE
	iv. Distribution	PJ of gas consumed	PJ	25	206094.75	5.12	PJ of gas consumed	PJ	79	18813.94	1.49
	v. Other Leakage	(e.g. PJ gas consumed)	PJ	NO	NO	NO	(e.g. PJ gas consumed)	PJ	NO	NO	NO
	at industrial plants and power stations		PJ	NO	NO	NO		PJ	NO	NO	NO
	in residential and commercial sectors		PJ	NO	NO	NO		PJ	NO	NO	NO
Italy	**Natural Gas**					**336.33**					**227.99**
	i. Exploration	0.0%		NA	IE	IE	0.0%		NA	IE	IE
	ii. Production (4) / Processing	PJ of Gas produced	PJ	17296	2899.93	50.16	PJ of Gas produced	PJ	8265	1537.45	12.71
	iii. Transmission	(e.g. PJ gas consumed)	0	45684	822.12	37.56	(e.g. PJ gas consumed)	0	83320	407.46	33.95
	iv. Distribution	PJ of gas consumed	PJ	20632	12049.80	248.61	PJ of gas consumed	PJ	36523	4965.01	181.34
	v. Other Leakage			NA	IE	IE			NA	IE	IE
	at industrial plants and power stations			NA	IE	IE			NA	IE	IE
	in residential and commercial sectors			NA	IE	IE			NA	IE	IE
Luxembourg	**Natural Gas**					**0.77**					**2.16**
	i. Exploration	gas exploration		NO	NO	NO	gas exploration		NO	NO	NO
	ii. Production (4) / Processing	gas produced		NO	NO	NO	gas produced		NO	NO	NO
	iii. Transmission	gas consumed	TJ	18	13120.17	0.24	gas consumed	TJ	50	13069.63	0.65
	iv. Distribution	gas consumed		17933	30.07	0.54	gas consumed		50099	29.95	1.50
	v. Other Leakage	(specify)		IE	IE	IE	(specify)		IE	IE	IE
	at industrial plants and power stations	gas leakage		IE	IE	IE	gas leakage		IE	IE	IE
	in residential and commercial sectors	gas leakage		IE	IE	IE	gas leakage		IE	IE	IE

Netherlands	**Natural Gas**					**17.79**					**19.28**
	i. Exploration	number of wells drilled/tested	number	NA	IE	IE	number of wells drilled/tested	number	NA	IE	IE
	ii. Production (4) / Processing	gas produced	PJ	2300	IE	IE	gas produced	PJ	2360	IE	IE
	iii. Transmission	gas transported	PJ	2648	2137.02	5.66	gas transported	PJ	3130	2070.29	6.48
	iv. Distribution	natural gas distribution network	10^3 km	100	121283.21	12.13	natural gas distribution network	10^3 km	124	103392.57	12.80
	v. Other Leakage			IE	IE	IE			IE	IE	IE
	at industrial plants and power stations			IE	IE	IE			IE	IE	IE
	in residential and commercial sectors			IE	IE	IE			IE	IE	IE
Portugal	**Natural Gas**					**NO**					**25.90**
	i. Exploration			NO	NO	NO			NO	NO	NO
	ii. Production (4) / Processing			NO	NO	NO			NO	NO	NO
	iii. Transmission	gas consumed	Gg	NO	NO	NO	gas consumed	Gg	5705	4540.85	25.90
	iv. Distribution	gas consumed	Gg	NO	NO	NO	gas consumed	Gg	IE	IE	IE
	v. Other Leakage			NO	NO	NO			IE	IE	IE
	at industrial plants and power stations	gas consumed	10^3 m^3	NO	NO	NO	gas consumed	10^3 m^3	IE	IE	IE
	in residential and commercial sectors	gas consumed	10^3 m^3	NO	NO	NO	gas consumed	10^3 m^3	IE	IE	IE
Spain	**Natural Gas**					**19.99**					**22.51**
	i. Exploration			IE	IE	IE			IE	IE	IE
	ii. Production (4) / Processing	PJ gas produced (NCV)	PJ	51	70657.76	3.62	PJ gas produced (NCV)	PJ	2	70657.76	0.17
	iii. Transmission	PJ gas (NCV)	PJ	218	759.33	0.17	PJ gas (NCV)	PJ	1324	650.46	0.86
	iv. Distribution	PJ gas consumed (NCV)	PJ	226	71758.21	16.20	PJ gas consumed (NCV)	PJ	1329	16160.36	21.48
	v. Other Leakage	(e.g. PJ gas consumed)	0	NE	NE	NE	(e.g. PJ gas consumed)		NE	NE	NE
	at industrial plants and power stations			NE	NE	NE			NE	NE	NE
	in residential and commercial sectors			NE	NE	NE			NE	NE	NE
Sweden	**Natural Gas**					**2.19**					**3.41**
	i. Exploration			NO	NO	NO			NO	NO	NO
	ii. Production (4) / Processing			NO	NO	NO			NO	NO	NO
	iii. Transmission	Length of pipeline	km	320	2900.00	0.93	Length of pipeline	km	620	2900.00	1.80
	iv. Distribution	Length of pipeline	km	2050	615.00	1.26	Length of pipeline		2620	615.00	1.61
	v. Other Leakage			NO	NO	NO			NO	NO	NO
	at industrial plants and power stations			NO	NO	NO			NO	NO	NO
	in residential and commercial sectors			NO	NO	NO			NO	NO	NO
United Kingdom	**Natural Gas**					**405.04**					**199.41**
	i. Exploration			225518	15.66	3.53			17860	45.00	0.80
	ii. Production (4) / Processing			1709	12758.51	21.81			2153	1077.81	2.32
	iii. Transmission			IE	IE	IE			IE	IE	IE
	iv. Distribution	gas distributed	PJ	1573	240730.77	378.78	gas distributed	PJ	3293	59335.20	195.37
	v. Other Leakage			1081498	0.85	0.92			1531601	0.60	0.92
	at industrial plants and power stations			NO	NO	NO			NO	NO	NO
	in residential and commercial sectors			1081498	0.85	0.92			1531601	0.60	0.92

Table 3.98 and Table 3.99 provide information on the contribution of Member States to EU-15 recalculations in CO_2 and CH_4 from 1B2 'Oil and natural gas' for 1990 and 2009 and main explanations for the largest recalculations in absolute terms.

Table 3.98 1B2 Fugitive CO_2 emissions from Oil and natural gas: Contribution of MS to EU recalculations in CO_2 for 1990 and 2009 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2009		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	0	0.0	0	0.0	
Belgium	0.01	0.02	0.02	0.01	As a result of the UNFCCC centralized review of September 2011 the emissions in the category 1B2 (oil and natural gas) were completed during the 2012 submission with the diffuse emissions of CH4 and CO2 from oil transport (category 1B2a3) in the
Denmark	25	8.3	8	3.0	Off shore flaring: Activity data has been corrected for 2008 for two offshore installations. The calorific value has been corrected for the whole time series according to the average calorific value in the EU ETS reports for 2008-2010 which affects the emission factor for CO2 and NMVOC. Further the emission factor for NMVOC has been corrected by including a conversion from ms3 to mn3. For 2007 the emission factor is changed to the average CO2 emission factor from EU ETS for
Finland	0	0.0	-0.2	-0.2	Change due to updated NMVOC emissions of a single plant at the VAHTI system.
France	-463	-10.3	-30	-0.8	Mise à jour Facteuer Emission et consomation sur FCC (craqueur catalytique)
Germany	-24	-1.4	-21	-1.2	New country-specific emission factors
Greece	0	0.0	0	0.0	
Ireland	0	0.0	0	0.0	
Italy	0	0.0	0	0.0	
Luxembourg	0	0.0	0	0.0	
Netherlands	0	0.0	0	0.0	
Portugal	-13	-8.1	2	0.3	Revised values for pipeline extension were given by DGEG.
Spain	0	0.0	-101	-4.6	1B2a.4, refining/storage: Revision of the CO2 EF for the FCC unit in a refinery plant. Revision of the CO2 emissions estimate in a refinery plant, after having indentified a double counting in the hydrogen production in this refinery in the previous CO2
Sweden	0	0.0	0	0.0	
UK	0	0.0	29	0.6	Revisions to operator activity data from 2008 onwards
EU-15	**-475**	**-2.5**	**-113**	**-0.6**	

Table 3.99 1B2 Fugitive CH_4 emissions from Oil and natural gas: Contribution of MS to EU-15 recalculations in CH_4 for 1990 and 2009 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2009		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	0	0.0	0	0.0	
Belgium	3	0.6	6	1.6	- As a result of the UNFCCC centralized review of September 2011 the emissions in the category 1B2 (oil and natural gas) were completed during the 2012 submission with the diffuse emissions of CH4 and CO2 from oil transport (category 1B2a3) in the Flemish region for the complete time series. - Some minor corrections (round off of figures) were made in the emissions of CH4
Denmark	0	0.1	2	1.5	Refineries: Emissions of CH4 and NMVOC has been changed for the years 1994-2000 and 2002-2009 according to VOC measurements in carried out in 2001, as no further information on fugitive emissions from the refineries are or will become available for other historical years. This is the result of an extended communication with one refinery leading to a recommendation to use measured emissions, and not an estimated emissions calculated by weighting the measured emissions by the annual processed crude oil amount as done in previous inventories. The fugitive emissions are
Finland	0	0.0	0	0.0	
France	-79	-5.1	8	0.8	Mise à jour Facteuer Emission et consomation sur FCC
Germany	906	11.9	-711	-9.7	New country-specific emission factors
Greece	0	0.0	3	2.0	Updated AD (length of transmission system)
Ireland	0	0.0	0.1	0.4	1B2b.4, Distribution: Revised AD (PJ of gas consumed)
Italy	0	0.0	-3	-0.1	Upate of losses by one operator
Luxembourg	0	0.0	0	0.0	
Netherlands	0	0.0	2	0.3	1B2a.4, refining/storage: improved activity data
Portugal	0	0.0	0.4	0.1	Revised values for pipeline extension were given by DGEG.
Spain	0	0.0	0	0.0	
Sweden	51	315.4	75	417.3	Emissions from transmission and distribution of natural gas has been estimated. 1B2a.4, refining/storage: New information from plants available
UK	0	0.0	0	0.0	
EU-15	**881**	**2.9**	**-616**	**-2.9**	

3.3 Methodological issues and uncertainties (EU-15)

The previous section presented for each EU-15 key source in CRF Sector 1 an overview of the Member States' contributions to the key source in terms of level and trend, and information on methodologies, emission factors, completeness and qualitative uncertainty estimates. Detailed information on national methods and circumstances is available in the Member States' national inventory reports.

Table 3.100 shows the total EU-15 uncertainty estimates for the sector 'Energy' excluding 1A3 'Transport' and the uncertainty estimates for the relevant gases for each source category. For those emissions for which no split by source category was available, uncertainty estimates were made for stationary combustion as a whole. The highest level uncertainty was estimated for N_2O from 1A2c and the lowest for CO_2 from 1A2f. With regard to trend N_2O from 1A4c shows the highest uncertainty estimates, CO_2 from 1A4b the lowest. For a description of the Tier 1 uncertainty analysis carried out for the EU-15 see Chapter 1.7.

The highest uncertainty for the sector 1A3 'Transport' was estimated for N_2O from 1A3a and the lowest for CO_2 from 1A3b. With regard to trend N_2O from 1A3d shows the highest uncertainty estimates, N_2O from 1A3b the lowest.

Table 3.100 Sector 1 Energy (excl. 1B): Uncertainty estimates for EU-15

Source category	Gas	Emissions 1990	Emissions 2010	Emission trends 1990-2010	Level uncertainty estimates based on MS uncertainty estimates	Trend uncertainty estimates based on MS uncertainty estimates
1.A.1.a Public electricity and heat production	CO_2	499,634	483,593	-3%	3%	0.0%
1.A.1.a Public electricity and heat production	CH_4	220	1,830	731%	66%	4.8%
1.A.1.a Public electricity and heat production	N_2O	4,042	4,201	4%	43%	0.1%
1.A.1.b Petroleum refining	CO_2	52,508	53,563	2%	3%	0.0%
1.A.1.b Petroleum refining	CH_4	16	9	-42%	46%	0.1%
1.A.1.b Petroleum refining	N_2O	281	172	-39%	107%	0.2%
1.A.1.c Manufacture of solid fuels	CO_2	70,597	18,110	-74%	5%	0.0%
1.A.1.c Manufacture of solid fuels	CH_4	92	23	-75%	87%	0.8%
1.A.1.c Manufacture of solid fuels	N_2O	690	179	-74%	20%	0.1%
1.A.2.a Iron and Steel	CO_2	55,847	42,752	-23%	4%	0.0%
1.A.2.a Iron and Steel	CH_4	104	70	-33%	24%	0.3%
1.A.2.a Iron and Steel	N_2O	186	144	-23%	42%	0.1%
1.A.2.b Non-Ferous Metals	CO_2	2,353	1,995	-15%	8%	0.0%
1.A.2.b Non-Ferous Metals	CH_4	2	2	4%	61%	0.1%
1.A.2.b Non-Ferous Metals	N_2O	21	10	-53%	77%	0.3%
1.A.2.c Chemicals	CO_2	9,372	10,442	11%	11%	0.1%
1.A.2.c Chemicals	CH_4	10	14	31%	78%	0.2%

1.A.2.c Chemicals	N_2O	36	37	3%	375%	1.3%
1.A.2.d Pulp, Paper and Print	CO_2	3,573	3,069	-14%	4%	0.0%
1.A.2.d Pulp, Paper and Print	CH_4	42	58	38%	61%	0.1%
1.A.2.d Pulp, Paper and Print	N_2O	137	160	16%	167%	0.5%
1.A.2.e Food Processing, Beverages and Tobacco	CO_2	6,748	4,074	-40%	5%	0.0%
1.A.2.e Food Processing, Beverages and Tobacco	CH_4	10	7	-28%	89%	0.2%
1.A.2.e Food Processing, Beverages and Tobacco	N_2O	60	25	-58%	471%	0.7%
1.A.2.f Other	CO_2	158,027	96,503	-39%	3%	0.0%
1.A.2.f Other	CH_4	230	190	-17%	31%	0.2%
1.A.2.f Other	N_2O	1,649	1,109	-33%	80%	0.1%
1.A.3.a Civil aviation	CO_2	9,138	12,149	33%	11%	0.0%
1.A.3.a Civil aviation	CH_4	8	5	-32%	59%	0.2%
1.A.3.a Civil aviation	N_2O	80	81	2%	178%	0.3%
1.A.3.b Road transport	CO_2	511,085	601,153	18%	5%	0.0%
1.A.3.b Road transport	CH_4	3,165	718	-77%	22%	0.2%
1.A.3.b Road transport	N_2O	4,267	4,426	4%	39%	0.1%
1.A.3.c Railways	CO_2	3,883	1,516	-61%	7%	0.1%
1.A.3.c Railways	CH_4	3	2	-45%	48%	0.2%
1.A.3.c Railways	N_2O	54	23	-57%	142%	0.3%
1.A.3.d Navigation	CO_2	14,930	15,971	7%	25%	0.1%
1.A.3.d Navigation	CH_4	41	33	-18%	53%	0.1%
1.A.3.d Navigation	N_2O	107	97	-8.9%	167%	0.5%
1.A.3.e Other	CO_2	7,338	6,882	-6%	27%	0.0%
1.A.3.e Other	CH_4	17	14	-21%	52%	0.1%
1.A.3.e Other	N_2O	196	140	-29%	68%	0.3%
1.A.4.a Commercial/Institutional	CO_2	79,917	58,911	-26%	7%	0.0%
1.A.4.a Commercial/Institutional	CH_4	1,238	103	-92%	56%	0.5%
1.A.4.a Commercial/Institutional	N_2O	197	128	-35%	153%	0.3%
1.A.4.b Residential	CO_2	177,028	150,410	-15%	7%	0.0%
1.A.4.b Residential	CH_4	1,990	1,398	-30%	77%	0.2%
1.A.4.b Residential	N_2O	1,063	644	-39%	156%	0.3%
1.A.4.c Agriculture/Forestry/Fisheries	CO_2	28,912	23,435	-19%	10%	0.0%
1.A.4.c Agriculture/Forestry/Fisheries	CH_4	214	93	-57%	75%	0.4%
1.A.4.c Agriculture/Forestry/Fisheries	N_2O	393	356	-9%	177%	0.2%
1.A.5 Other	CO_2	13,554	2,049	-85%	7%	0.0%
1.A.5 Other	CH_4	240	8	-97%	29%	0.4%
1.A.5 Other	N_2O	548	273	-50%	65%	0.2%

1.A (where no subsector data were submitted)	*all*	913,848	*824,038*	*-10%*	*2%*	*1.0%*
1.A.1 (where no subsector data were submitted)	*all*	*75,900*	*75,923*	*0%*	*7%*	*3.7%*
1.A.2 (where no subsector data were submitted)	*all*	*181,600*	*180,104*	*-1%*	*4%*	*1.5%*
1.A.3 (where no subsector data were submitted)	*all*	*129,154*	*148,776*	*15%*	*3%*	*0.4%*
1.A.4 (where no subsector data were submitted)	*all*	*151,990*	*163,875*	*8%*	*5%*	*1.8%*
Total - 1.A (where no subsector data were submitted)	**all**	**913,848**	**824,038**	**-10%**	**1.8%**	**0.2%**
Total - 1.A.1	**all**	**703,980**	**637,605**	**-9%**	**2.4%**	**0.6%**
Total - 1.A.2	**all**	**420,006**	**340,764**	**-19%**	**2.1%**	**0.8%**
Total - 1.A.3	**all**	**683,466**	**791,988**	**16%**	**3.7%**	**0.5%**
Total - 1.A.4	**all**	**442,941**	**399,354**	**-10%**	**3.5%**	**1.0%**
Total - 1.A.5	**all**	**14,341**	**2,329**	**-84%**	**9.9%**	**3.7%**
Total - 1.A	**all**	**3,178,581**	**2,996,078**	**-6%**	**1.3%**	**0.4%**

Note: Emissions are in Gg CO_2 equivalents; trend uncertainty is presented as percentage points; the sum of the source category emissions may not be the total sector emissions because uncertainty estimates are not available for all source categories.

Table 3.101 shows the total EU-15 uncertainty estimates for the sector 1.B 'Fugitive emissions' and the uncertainty estimates for the relevant gases for each source category. The highest level and trend uncertainties were estimated for CH_4 from 1B2c and the lowest for CO_2 from 1B2b.

Table 3.101 1B Fugitive Emissions: Uncertainty estimates for EU-15

Source category	Gas	Emissions 1990	Emissions 2010	Emission trends 1990-2010	Level uncertainty estimates based on MS uncertainty estimates	Trend uncertainty estimates based on MS uncertainty estimates
1.B.1 Solid Fuels	CO_2	408	977	140%	50%	0.7%
1.B.1 Solid Fuels	CH_4	40,791	5,200	-87%	27%	0.2%
1.B.1 Solid Fuels	N_2O	2	1	-33%	113%	0.4%
1.B.2. Oil and Natural Gas	CO_2	12,628	11,796	-7%	13%	0.1%
1.B.2. Oil and Natural Gas	CH_4	30,000	19,976	-33%	9%	0.0%
1.B.2. Oil and Natural Gas	N_2O	61	67	9%	87%	0.1%
1.B (werhe no subsector data were submitted)	*all*	*8,023*	*6,030*	*-25%*	*70%*	*6.3%*
Total - 1.B	**all**	**91,913**	**44,047**	**-52%**	**11.5%**	**7.1%**

Note: Emissions are in Gg CO_2 equivalents; trend uncertainty is presented as percentage points; the sum of the source category emissions may not be the total sector emissions because uncertainty estimates are not available for all source categories.

3.4 Sector-specific quality assurance and quality control (EU-15)

There are several activities for improving the quality of GHG emissions from energy: Before and during the compilation of the EU GHG inventory, several checks are made of the Member States data in particular for time series consistency of emissions and implied emission factors, comparisons of implied emission factors across Member States and checks of internal consistency. In the second half of the year, the EU internal review is carried out for selected source categories. In 2006 the following source categories have been reviewed by Member States experts: 1A1 'Energy industries', 1A2a 'Iron and steel production' and 1.B 'Fugitive emissions from fuels'. In 2005, the EU internal review was carried out for the first time. In this pilot exercise two Member States experts reviewed the source categories 1A2 'Manufacturing industries' and 1A3 'Transport'. In 2008, N_2O from road transport were subject to the EU internal review.

Since the inventory 2005 plant-specific data is available from the EU Emission Trading Scheme (EU ETS). This information has been used by EU Member States for quality checks and as input for calculating total CO_2 emissions for the sectors Energy and Industrial Processes in this report (see Section 1.4.2).

After the annual compilation of the GHG inventory Eurostat checks with Member States remaining differences found when comparing the Member States' reference approach with the Eurostat reference approach. This crosscheck between the the European energy reporting system and the EU GHG inventory system is an important QA/QC element of the EU GHG inventrory compilation.

The quality of the EU GHG inventory is directly affected by the quality of Member States and EU energy statistics systems. Currently EU energy statistics are collected on the basis of gentlemen's' agreement. The Joint Eurostat/IEA/UNECE energy questionnaires are used for gathering nationally collected data. Since its creation in the early fifties, when the European energy statistics were essentially a collection of the main national aggregated data, the system has followed the development of energy policies and markets and adapted to meet new demands. Recent developments have been:

- a new questionnaire (in 2000) covering Renewable Energy Sources; intensive efforts at national level and EU financial support since the early 1990's lead to the successful adoption of this questionnaire alongside the already established existing four joint questionnaires
- expanded electricity questionnaire (in 2004) to allow coherence with the UNFCCC CO_2 emissions reporting system
- development of CHP (2004) statistics, following pilot projects over a decade

In 2007 the Commission presented the energy statistics regulation as part of the energy package. This regulation aims at collecting detailed statistical data on energy flows by energy commodity at annual and monthly level. It ensures harmonised and coherent reporting of national energy data, which is indispensable for the assessment of EU energy policies and targets. The content and structure of this regulation reflects the essence of the existing European statistical system, a system that is part of the international energy statistical system, and is in direct link with the national statistical structures (classifications) and methodologies. It also has concrete links to other statistical domains, such as economic, environment, trade and business statistics. These links provide an additional dimension in safeguarding data quality assurance. The energy statistics regulation was adopted by the European Parliament and Council in 2008 and is in force since 2009.

The European energy statistics system and the quality of the EU inventory is directly affected by this regulation that should:

- ensure a stable and institutional basis for energy statistics in the EU,
- guarantee long-term availability of energy data for EU policies,

- reinforce available resources for the production of the basic energy statistics at national level

The energy statistics regulation should help improving the QA/QC of the EU inventory as it should:

- make available more detailed energy statistics by fuel,
- allow the estimation of CO_2 emissions from energy with the reference and sectoral approach
- assure the quality of the underlying energy statistics
- improve timeliness of energy statistics
- provide a formal legal framework assuring consistency between national and Eurostat data

Moreover, Article 6, paragraph 2 stipulates that:

'Every reasonable effort shall be undertaken to ensure coherence between energy data declared in the energy statistics regulation, and data declared in accordance with Commission Decision No 280/2004/EC of the European Parliament and of the Council concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol'.

It also foresees the further development of the energy statistics system setting a time frame for the production of more detailed data on renewable energy and final energy consumption, stating:

'With a view to improving the quality of energy statistics, the Commission (Eurostat), in collaboration with the Member States, shall make sure that these statistics are comparable, transparent, detailed and flexible by:

a) reviewing the methodology used to generate renewable energy statistics in order to make available additional, pertinent, detailed statistics on each renewable energy source, annually and in a cost effective manner. The Commission (Eurostat) shall present and disseminate the statistics generated from 2010 (reference year) onwards

b) reviewing and determining the methodology used at national and Community level to generate final energy consumption statistics (sources, variables, quality, costs) based on the current state of play, existing studies and feasibility pilot-studies, as well as cost-benefit analysis yet to be conducted; and evaluating the findings of the pilot studies and cost benefit analysis with the view to establishing breakdown keys for final energies by sector and main energy uses and gradually integrating the resulting elements in the statistics from 2012 (reference year) onwards.'

The first annual statistics based were submitted to Eurostat on the basis of Energy Statistics Regulation in November 2010. The following improvements were observed:

- Information submission was more timely than in previous years, resulting to the availability of complete reference approach tables for 2010 by the end of February 2012;
- More detailed data are also used for the calculation of the reference approach, (availability of data on international aviation);
- More detailed energy balances are published by Eurostat.

3.5 Sector-specific recalculations (EU-15)

Table 3.102 shows that in the energy sector the largest recalculations in absolute terms in 1990 and 2009 were made for CO_2. In relative terms, the largest recalculations are found in N_2O emissions. They were +3.7 % and +0.9 % in 1990 and 2009, respectively.

Table 3.102 Sector 1 Energy: Recalculations of total GHG emissions and recalculations of GHG emissions for the years 1990 and 2009 by gas in Gg (CO_2-eq.) and percentage

1990	CO_2		CH_4		N_2O		HFCs		PFCs		SF_6	
	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent
Total emissions and removals	65,596	2.1%	-15,455	-3.4%	-3,212	-0.8%	-224	-0.8%	499	3.0%	-142	-1.3%
Energy	2,556	0.1%	868	0.9%	1,073	3.7%	NO	NO	NO	NO	NO	NO
2009												
Total emissions and removals	94,276	3.4%	-5,030	-1.6%	-2,289	-0.8%	3,203	4.9%	795	40.8%	-219	-3.6%
Energy	-2,884	-0.1%	-1,254	-3.0%	239	0.8%	NO	NO	NO	NO	NO	NO

NO: not occurring

Table 3.103 provides an overview of Member States' contributions to EU-15 recalculations. In absolute terms, Germany and the UK had the most influence on CO_2 recalculations in the EU-15 in 2009. The German and UK recalculations are due to a variety of changes including revised energy balance data, which are reported in chapter 3.2 in the source categories subchapters. Further explanations for the largest recalculations by Member State are provided in Section 10.1.

Table 3.103 Sector 1 Energy: Contribution of Member States to EU-15 recalculations for 1990 and 2009 by gas (difference between latest submission and previous submission Gg of CO_2 equivalents)

	1990						2009					
	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
Austria	-6	0	0	NO	NO	NO	-461	-13	-10	NO	NO	NO
Belgium	131	11	16	NO	NO	NO	-468	31	-10	NO	NO	NO
Denmark	202	-3	1	NO	NO	NO	92	-16	-5	NO	NO	NO
Finland	13	0	0	NO	NO	NO	-312	8	0	NO	NO	NO
France	1,379	-36	-14	NO	NO	NO	1,938	37	-259	NO	NO	NO
Germany	425	731	562	NO	NO	NO	-6,195	-700	147	NO	NO	NO
Greece	0	11	150	NO	NO	NO	-127	22	166	NO	NO	NO
Ireland	-40	0	0	NO	NO	NO	-765	0	10	NO	NO	NO
Italy	-891	57	123	NO	NO	NO	-1,782	267	284	NO	NO	NO
Luxembourg	8	0	0	NO	NO	NO	-190	0	13	NO	NO	NO
Netherlands	-21	5	16	NO	NO	NO	35	-1	1	NO	NO	NO
Portugal	626	1	7	NO	NO	NO	610	-112	-31	NO	NO	NO
Spain	0	-36	-3	NO	NO	NO	287	-4	22	NO	NO	NO
Sweden	233	134	59	NO	NO	NO	-32	130	4	NO	NO	NO
UK	498	-7	157	NO	NO	NO	4,484	-903	-94	NO	NO	NO
EU-15	**2,556**	**868**	**1,073**	**NO**	**NO**	**NO**	**-2,884**	**-1,254**	**239**	**NO**	**NO**	**NO**

Abbreviations explained in the Chapter 'Units and abbreviations'.

3.6 Comparison between the sectoral approach and the reference approach (EU-15)

The IPCC reference approach for CO_2 from fossil fuels for the EU-15 is based on Eurostat energy data (Eurostat database, April 2012 version). This submission includes the reference approach tables for 1990–2010.

Energy statistics are submitted to Eurostat by Member States on an annual basis with the five joint Eurostat/IEA/UNECE questionnaires on solid fuels, oil, natural gas, electricity and heat, and renewables and wastes. On the basis of this information Eurostat compiles the annual energy balances which are used for the estimation of CO_2 emissions from fossil fuels by Member State and for the EU-15 as a whole.

The Eurostat data for the EU-15 IPCC reference approach includes activity data and net calorific values as available in the Eurostat database. This year for the first time a more detailed fuel split is provided in the Eurostat database. Therefore, the fuel groupings used in previous years are not necessary anymore. For the calculation of CO_2 emissions, the IPCC default carbon emission factors are used.

The IPCC reference approach method at EU-15 level is a four-step process.

- **Step 1:** For each Member State, annual data on energy production, imports, exports, international bunkers and stock changes are available in the Eurostat database in fuel specific units (i.e. kt (= 1 000 tonnes)) for solid fuels and petroleum products, TJ for natural gas). The apparent consumption in TJ is calculated for each Member State by using country-specific average net calorific values.
- **Step 2:** The EU-15 CRF Table 1.A(b) are calculated by adding the relevant Member State activity and emission data, as calculated under Step 1. The net calorific values provided for the EU-15 in CRF Table 1.A(b) are calculated from dividing apparent consumption in TJ by apparent consumption in fuel-specific units for each fuel. Therefore, these net calorific values are 'implied calorific values'; there are no fuel-specific net calorific values at EU-15 level.
- **Step 3:** For the calculations of carbon stored in Tables 1.A(d), Eurostat data on non-energy use of fuels are used, as reported by Member States in the joint questionnaire. For the fraction of carbon stored and carbon emission factors IPCC default values are taken (IPCC, 1997).

Table 3.104 shows the apparent energy consumption from fossil fuel combustion from 1990 to 2010 as provided in Tables 1.A(b). Total fossil fuel energy consumption was 4 % above 1990 levels in 2010 after a strong decline 2008-2009 due to the economic recession and a small increase 2009-2010. Large increases had gas consumption (+76 %), whereas solid fuel combustion declined by 40 %.

Table 3.105 compares EU-15 CO_2 emissions calculated with the IPCC reference approach based on Eurostat data and the sectoral approach available from Member States. The reference approach and the sectoral approach, decreased by 3 % and 6 % respectively between 1990 and 2010; the percentage differences between the two data sets are below +/-3.6 % for all years.

Table 3.104 Reference Approach: Apparent EU-15 energy consumption (in PJ) (Eurostat data)

Fuel types	1990	1995	2000	2005	2006	2007	2008	2009	2010
Liquid Fuels	18,457	19,863	20,338	20,260	19,843	19,299	19,072	18,229	18,008
Solid Fuels	12,394	9,811	8,947	8,887	9,047	9,162	8,352	7,207	7,472
Gaseous Fuels	9,114	11,320	13,980	15,940	15,650	15,310	15,907	15,190	16,035
Total	**39,965**	**40,994**	**43,265**	**45,087**	**44,541**	**43,771**	**43,331**	**40,626**	**41,515**

Table 3.105 IPCC Reference approach (Eurostat data) and sectoral approach (Member State data) for EU-15 (in Tg)

CO2 emissions	1990	1995	2000	2005	2006	2007	2008	2009	2010
Sectoral approach	3,132	3,070	3,143	3,250	3,229	3,171	3,107	2,881	2,953
Reference approach	3,019	2,998	3,101	3,202	3,168	3,131	3,063	2,854	2,930
Percentage difference	-3.6%	-2.3%	-1.3%	-1.5%	-1.9%	-1.3%	-1.4%	-1.0%	-0.8%

Table 3.106 provides an overview for EU-15 and by EU-15 Member State on differences between the Eurostat and national reference approach for 2010. The table shows that for EU-15 the differences are very small. However, for some Member States the two data sets show larger differences. The main reasons for diverging energy data are:

- the use of different calorific values (CV) mainly for oil products, BKB (lignite briquettes) and patent fuels. For BKB and patent fuels, Eurostat is using the same CV for all countries which differs from the calorific values used by the Member States;
- differences in the basic energy balance data reported by Member States to Eurostat (in the joint questionnaires) and to the Commission and the UNFCCC (in the CRF tables).

To explain and resolve these differences Eurostat launched a project for harmonisation of the two (joint questionnaires and CRF) reporting systems of energy data and for revision of reported energy data back to 1990. Recently Eurostat has revised the CVs for liquid fuels which led to improved consistency with MS energy balance data which is also reflected in the comparisons below.

Table 3.106 Comparison between Eurostat and national reference approach for apparent consumption for EU-15 for 2010 (CRF 1.A)(26)

MS	Gaseous fuels			Liquid fuels			Solid fuels		
	Eurostat TJ	Crf TJ	Difference %	Eurostat TJ	Crf TJ	Difference %	Eurostat TJ	Crf TJ	Difference %
AT	343,922	347,395	1.0%	519,930	535,171	2.9%	141,841	141,317	-0.4%
BE	710,075	712,012	0.3%	1,008,644	1,016,130	0.7%	133,302	142,235	6.7%
DE	3,073,352	3,074,942	0.1%	4,443,326	4,346,003	-2.2%	3,218,802	3,215,418	-0.1%
DK	185,203	185,204	0.0%	254,106	293,238	15.4%	160,008	179,265	12.0%
ES	1,305,770	1,307,221	0.1%	2,410,403	2,350,393	-2.5%	329,133	335,942	2.1%
FI	160,668	160,342	-0.2%	407,407	381,516	-6.4%	287,949	292,696	1.6%
FR	1,781,056	1,798,429	1.0%	3,283,180	3,309,878	0.8%	501,479	518,604	3.4%
GR	135,398	134,493	-0.7%	602,130	612,709	1.8%	329,208	324,155	-1.5%
IE	196,608	197,170	0.3%	288,126	289,626	0.5%	87,705	84,452	-3.7%
IT	2,849,396	2,847,466	-0.1%	2,819,634	2,895,736	2.7%	593,288	596,012	0.5%
LU	50,099	50,099	0.0%	102,308	101,730	-0.6%	2,777	2,572	-7.4%
NL	1,645,772	1,642,667	-0.2%	1,325,193	1,296,478	-2.2%	318,010	317,962	0.0%
PT	187,935	188,691	0.4%	481,156	470,819	-2.1%	69,381	69,365	0.0%
SE	54,969	61,345	11.6%	578,616	561,866	-2.9%	105,114	97,297	-7.4%
UK	3,550,973	3,542,785	-0.2%	2,636,342	2,642,021	0.2%	1,275,507	1,277,870	0.2%
EU-15	16,231,196	16,250,261	0.1%	21,160,500	21,103,314	-0.3%	7,553,505	7,595,160	0.6%

3.7 Responses of EU 15 Member States to UNFCCC Reviews

Table provides an overview of EU 15 member state's response to the UNFCCC Review findings in the Energy sector.

(26) Minus means that Member State-based estimates are lower than the Eurostat-based estimates.

Table 3.107 EU 15 member State's responses to UNFCCC review findings in 2011.

Sector	Gas	Member State	Comment UNFCCC report of the review of the 2011 submission	MS comment / status of implementation
1 Energy		GR	The reporting on the energy sector is generally transparent and Greece has provided detailed information on the methodologies used, the descriptions of assumptions, the rationale for the recalculations and details of planned improvements in the sector. However, the ERT noted that the Party could further enhance transparency by providing, in the NIR, more background documentation on EFs (e.g. for other fuels in other sectors, and those based on data from the 2006 IPCC Guidelines for National Greenhouse Gas Inventories and from the core inventory of air emissions (CORINAIR), including an explanation of their appropriateness to the national circumstances of Greece) and disaggregated AD (e.g. other fuels in other (manufacturing industries and construction), waste fuels for combustion by category, lubricant use by category, bituminous coal and lignite by category and biomass in residential). The ERT recommends that Greece enhance the transparency of its reporting by providing the above information in its next NIR. (para 31)	Annex II of the Greek NIR 2012 was enriched with details of methodology and data for estimating CO_2 and other GHG emissions from fossil fuel combustion, in order to improve transparency of the energy sector.
1 Energy		GR	The present ERT agrees with the conclusion of the previous ERT that the Party has not provided sufficient information in its NIR to confirm whether the EU ETS data have been prepared and incorporated in the inventory submission in line with the IPCC good practice guidance. Since there is still a lack of relevant information provided in the 2011NIR, the ERT raised questions during the review on the AD, EFs and methodological tier levels used by Greece for the calculation of emissions in the energy sector. In response to these questions, Greece provided more background information for clarification purposes. The ERT recommends that Greece provide detailed information (e.g. in an annex to the NIR) on the EU ETS data used, including an analysis of their completeness and consistency with the IPCC methodology, and on the verification procedure applied to ensure conservation of the fuel mass balance and completeness of the data and that the Party report on the progress made with regard to this issue in its next NIR. (para 32)	Details of the use of ETS reporting in energy sector's inventory calculations are provided in Annex II of the Greek NIR 2012.
1 Energy		GR	The sectoral information in the report and in the CRF tables is generally correct and accurate. However, the ERT noticed some errors in the NIR (e.g. fugitive CH_4 emissions from solid fuels for the years 2008 and 2009 in NIR table 3.1; the notation keys used to report fugitive CO_2 emissions from solid fuels for the years 2000–2009, which should be reported as not occurring ("NO") and not as included elsewhere, not occurring ("IE, NO") in NIR table 3.1; and the EF for jet kerosene in civil aviation in NIR table 3.13) and in the CRF tables (e.g. the apparent energy consumption excluding non-energy use and feedstocks in CRF table 1.A(c); jet kerosene used in international aviation from 2003 to 2004 in CRF table 1.C; and CH_4 and N_2O emissions from liquid fuels in railway transportation). The ERT recommends that Greece correct these data and enhance its QC procedures for its next annual submission. (para 33)	Implemented
1 Energy		GR	The ERT noted that the data on jet kerosene in the CRF tables are high compared to the data from the International Energy Agency (IEA). Also, the inventory of Greece includes the consumption of aviation gasoline for civil aviation, while no such consumption is included in the IEA data. Greece explained that, since there is a discrepancy between the number of landings and take-offs (LTOs) and the corresponding fuel consumption from the national energy balance, the adjustment applied to the estimate for the base year is continuously applied in the estimation of CO_2 emissions from civil aviation. The ERT recommends that Greece continue its efforts to estimate the country-specific share of LTOs and the corresponding fuel consumption, and report on any progress made in this matter in its next annual submission. (para 35)	Issue not addressed in the Greek NIR 2012

1 Energy: reference and sectoral approach		GR	The ERT noted that there are some inconsistencies between CRF tables 1.A(d) and 1.A(c). In table 1.A(d), non-energy use of natural gas is reported as 8.2 PJ but in table 1.A(c), only 3.9 PJ is subtracted. For liquid fuels, table 1.A(d) reports 25 PJ, while the difference in table 1.A(c) is only 15 PJ. Greece explained these differences in response to questions raised by the ERT during the review. The ERT recommends that the Party include these explanations in its next NIR. (para 36)	Inconsistencies in tables 1Ab, 1Ac and 1Ad have been corrected. A description of how "Apparent energy consumption" is calculated has been added in section 3.2.1. of the Greek NIR 2012. Table 3.9 was updated, accordingly. Natural gas used as feedstock for hydrogen production was reallocated to the IP sector.
1 Energy: reference and sectoral approach		GR	The ERT also noted that some fuels used as feedstocks and for non-energy use are still accounted for in the energy sector (e.g. natural gas used for hydrogen production and some amounts of naphtha, lubricants and other petroleum), which leads to low implied emission factors (IEFs) for CO_2, CH_4 and N_2O emissions in relevant sectors. Furthermore, the additional information on the stored carbon of these fuels for feedstocks and non-energy use in CRF table 1.A(d) is far from complete and consistent. According to the Revised 1996 IPCC Guidelines, all feedstocks and non-energy use should be reallocated to the industrial processes sector and not included in the energy sector. The ERT recommends that Greece exclude all fuels for feedstocks and non- energy use from the energy sector and report, in line with the Revised 1996 IPCC Guidelines, in CRF tables 1.A(b) and 1.A(d) all feedstocks and non-energy use of fuels (as identified in the national energy balance), the associated CO_2 emissions and the category/sector under which they are allocated in the inventory. (para 36)	See above
1 Energy		GR	The ERT found that CO_2 emissions from solid fuel combustion in ferroalloys production have been allocated to the industrial processes sector as reported in the NIR. However, the amount consumed has not been indicated in CRF tables 1.A(d), 1.A(b) and 1.A(c) (e.g. in table 1.A(d), the solid fuel used for feedstock and non-energy use is reported as "NO", which is not in line with the Revised 1996 IPCC Guidelines). Greece also regarded this as one of the reasons for the difference between the reference and the sectoral approach in the NIR, which should be not relevant if the corresponding information is correctly included in the CRF tables. The ERT recommends that Greece report, in line with the Revised 1996 IPCC Guidelines, in CRF tables 1.A(b) and 1.A(d) the feedstocks and non-energy use of solid fuels (as identified in the national energy balance), the associated CO_2 emissions and the category/sector under which they are allocated in the inventory and revise the relevant information in the NIR of the next annual submission. (para 37)	See above
1 Energy		GR	In the course of the review, the ERT formulated a number of recommendations relating to the sectors. The key recommendations are that Greece: (a) Correct the reporting of feedstocks and non-energy use of fuels and provide more information on the use of EU ETS data in the energy sector; (para 121)	See above

1.A Stationary combustion, solid fuels	CO_2	GR	The ERT noted that the net calorific values and carbon EFs for lignite are significantly different for energy industries and for manufacturing industries and construction. In response to a question raised by the ERT during the review, Greece provided detailed information explaining and justifying this difference, including the fact that the lignite is distributed from different mining fields. The ERT recommends that Greece include this information in its next NIR. (para 38)	The following explanation was added in section 3.2.4.2 of the Greek NIR 2012: "The NCV and EF used for Electricity generation are mean values of lignite that is mined from various mining fields, located in 5 different locations in Greece (scattered both to north and south Greece). The lignite used in Industry originates from a single mining field. The quality of lignite from this mining field is superior than the others used for Electricity generation. For that reason both NCV and EF used in Industry are greater than the ones used for Electricity production".
1.A Stationary combustion, liquid fuels	CO_2, N_2O	GR	The ERT noted that the CO_2 IEF for liquid fuels in petroleum refining and in all subcategories under manufacturing industries and construction fluctuates with a general decreasing trend. In response to questions raised by the ERT, Greece explained that this is due to the change in the percentage of the fuels that compose the liquid fuel mix of these subcategories. he ERT recommends that Greece provide more detailed background information on the AD and EFs for all types of liquid fuels in these subcategories in its next NIR in order to improve the transparency of the reporting. (para 39)	Annex II of the Greek NIR 2012 was enriched with details of methodology and data for estimating CO_2 and other GHG emissions from fossil fuel combustion, in order to improve transparency of the energy sector.
1.A Stationary combustion, liquid fuels	CO_2, N_2O	GR	The ERT noted that the carbon content reported for refinery gas (15.42 t C/TJ) is low compared to the IPCC default value (18.2 t C/TJ). In response to a question raised by the ERT during the review, Greece provided more detailed data on refinery gas and explained how the EF (including the carbon content) is computed. The ERT recommends that Greece include this explanation in its next NIR in order to improve the transparency of the inventory. (para 40)	See Greek NIR 2012 Table II.10.
1.A Stationary combustion, liquid fuels	CO_2, N_2O	GR	The ERT noted that the N_2O IEF for liquid fuels in agriculture, forestry and fisheries is much lower in 2009 (23.44 kg/TJ) compared with the values in previous years (26.94– 27.70 kg/TJ). In response to a question raised by the ERT during the review, Greece explained that three liquid fuels are used in this category (i.e. diesel and heavy fuel oil for boilers, and diesel and motor gasoline for off-road machinery). In 2009, the IEF decreased due to the reduction in diesel use and the change in the allocation of diesel use between off-road machinery and boilers. The ERT recommends that Greece provide more background information on the N_2O IEF for liquid fuels in agriculture, forestry and fisheries in its next NIR. (para 41)	NIR 2012 section 3.2.4.5.2: An error of the working file of the year 2009 was corrected (concerning AD), and the emissions of CO_2, CH_4 and N_2O from liquid fuels combustion were recalculated for the year 2009. The impact on total emissions was minor (around +33 kt GHG).
1.A Stationary combustion, other fuels	CO_2	GR	In 2009, the CO_2 IEF for other fuels in other (manufacturing industries and construction) (32.73 t/TJ) is much lower compared with the value in previous years (89.25– 119.13 t/TJ). In response to a question raised by the ERT during the review, Greece explained that the other fuels in this category are alternative fuels (e.g. scrap tyres, cable coating, etc.) used in Greek cement plants and provided the AD and EFs for these fuels for further clarification. The ERT recommends that Greece include this information in its next NIR.(para 42)	See Greek NIR 2012 Table II.11.

1.A.3.b Road transportation, liquid fuels	CO_2	GR	The ERT noted that Greece continues to apply the method used by the ERT in the initial review for calculating the consumption of lubricants for road transportation, which is based on the average lubricant consumption/fuel consumption ratio for the cluster of countries for the whole time series rather than on the data from the national energy statistics. The present ERT reiterates the recommendation in previous review reports that Greece verify the data on lubricants used for road transportation and report thereon in ist next annual submission. (para 43)	Not addressed in the Greek NIR 2012
1 Energy: reference and sectoral approaches, International bunker fuels		FI	Finland reported emissions from international bunker fuels on the basis of fuel sales using country-specific CO_2 EFs and non-CO_2 EFs from the Revised 1996 IPCC Guidelines. Finland indicated the possibility of a minor double counting of emissions with domestic navigation, where ports are used for both national and international shipping purposes (NIR, page 124). The ERT recommends that Finland address this issue and ensure that emissions are not double counted. Finland has agreed to investigate this issue and will provide more information in its 2013 annual submission. (para 36)	Recalculations were made in Bunkers and in 1.A 5; sections 3.8 and 3.4.5. of the Finnish NIR 2012 address the issues.
1 Energy: reference and sectoral approaches, Feedstocks and non-energy use of fuels		FI	Finland reported lubricant usage as non-energy use of fuels, but did not split it between domestic and international usage, as only information on total sales of lubricants is available in the fuel statistics. The NIR identifies this issue as a planned improvement the ERT recommends that Finland implement this improvement in its next annual submission. (para 37)	Recalculations were made in Bunkers; section 3.8 of the Finnish NIR 2012 addresses the issue.
1 Energy: reference and sectoral approaches		FI	In the previous review report it was recommended that Finland report CO_2 emissions from fossil fuel combustion separately from those from biomass fuel combustion that are captured in PCC production, and subtract only CO_2 emissions from fossil fuel combustion as CO_2 stored, in order to avoid omitting CO_2 emissions. The ERT noted that Finland has chosen to account for forest management, and consequently all CO_2 emissions from domestic biomass are accounted for in its inventory. During the review, in response to questions raised by the ERT, Finland confirmed that all harvesting of woody biomass is included as carbon stock changes in the LULUCF sector in accordance with the IPCC good practice guidance for LULUCF. Finland also explained that it imports wood (mainly from the Russian Federation, which has also elected forest management), but for energy production the imported amounts are small. The biomass used may contain small amounts of bark from imported wood, but Finland considers this unlikely. The ERT recommends that Finland include this explanation in its next annual submission in order to improve transparency. (para 39)	Explanation included in section 3.2.7.2 of the Finnish NIR 2012.
1.A.3 Transport	CO_2, N_2O, CH_4	FI	In its NIR, page 85, Finland explains that, based on expert judgment, it has revised the allocation of diesel oil, off-road light fuel oil and heating gas oil used in the different subcategories within transport and energy industries. The ERT recommends that Finland provide additional information in its next annual submission, including documentation on how these allocations are derived from expert judgment, in order to improve transparency. (para 42)	More explanation included (see section 3.3 of the Finnish NIR 2012). Changes were needed in the existing calculation system, so that changes in the consumption could be taken into account. There was no actual reallocation of fuels.

1 Energy		LU	However, the ERT noticed that there are still discrepancies in terms of the reported fuel consumption data and emissions between the reference and the sectoral approaches. Some of these discrepancies are explained in the NIR and were also discussed during the review. Luxembourg already plans to separate the biogenic matter from fossil fuels under liquid fuels in the reference approach as part of its improvement plan. With regard to solid fuels, the ERT advised Luxembourg during the review to include the quantities of fuels used as reductant in the steel industry in CRF table 1.A(d), so that these consumptions and emissions are not taken into account in the apparent energy consumption of that table. Finally, the consumption of municipal solid waste (MSW) could be separated and directly added to CRF table 1.A(c) in order to avoid discrepancies. The ERT recommends that Luxembourg implement these improvements in the next annual submission so that the results from the reference and the sectoral approaches are comparable.	Implemented
1 Energy		LU	The ERT observed a difference of about 7 per cent between the two approaches (higher consumption in the sectoral approach than in the reference approach) in natural gas consumption. This issue was also identified in the previous review report. As this difference could represent an overestimation of about 2 per cent in total sectoral emissions, the ERT recommends that the Party conduct an analysis to provide an explanation for the difference observed between the two approaches in the NIR of its next annual submission.	No large difference for gaseous fuels in the 2012 inventory
1 Energy		LU	Luxembourg's estimates of emissions from the use of motor oil (by default, 50 per cent of the total quantity of lubricants sold) are not included under CO_2 emissions from transport, but should be included under that category. This task has already been defined in the Party's inventory improvement plan. The ERT recommends that Luxembourg allocate emissions from the use of motor oil under the transport sector.	From the NIR it is unclear if this was implemented
1.A Stationary combustion	CO_2	LU	MSW is used in waste incineration. The CO_2 EFs for the fossil fraction of MSW are based on regular studies carried out by the waste division of AEV. For the years where no data are available, EFs from available years are reported. The ERT noticed that this practice has led to time-series inconsistencies. The ERT recommends that Luxembourg improve the time-series consistency of the EF for MSW in its next annual submission. This could be done by extrapolating the EF between two years for which data are available.	From the NIR it is unclear if this was implemented
1.A Stationary combustion	CO_2, CH_4, N_2O	LU	The ERT noted a sharp increase in liquid fuel consumption in the category agriculture, forestry and fisheries between 2008 and 2009 (by 53 per cent). The ERT recommends that Luxembourg check for any updates to this category in the next version of the national energy balance and provide justified explanations for any large inter-annual changes.	There is not sharp increase anymore in the GHG inventory 2012.
1.A Stationary combustion	CH_4, N_2O	LU	The ERT noticed some time-series inconsistencies in the CH_4 and N_2O EFs for other sectors. The ERT recommends that the Party check the variation of the IEF across the time series to ensure that time-series consistency is maintained.	From the NIR it is unclear if this was implemented
1.A Stationary combustion	CO_2, CH_4, N_2O	LU	The ERT noticed that there is a time-series inconsistency in the data used to determine the share of biomass in the tyres consumed for clinker production. These data have been reported under the EU ETS since 2007. In total, 27 per cent of the weight of the used tyres is considered to be derived from biomass in the calculation. (see Party Response). The share of biomass was checked and agreed to by the ERT. However, as no data on the biomass content of the tyres consumed for clinker production were available for the previous years (1998–2006), the Party assumes that the share is 0 per cent. The ERT recommends that the Party check this assumption and, if needed, maintain time-series consistency by modifying this value for each year of the period 1998–2006 according to the IPCC good practice guidance for future annual submissions.	From the NIR it is unclear if this was implemented

1.A.3.c Railways	CO_2, CH_4, N_2O	LU	The ERT observed a sharp increase in the fuel consumption of railways for the most recent years of the time series (2006–2009). This was also observed by the previous ERT. The ERT recommends that Luxembourg recalculate these emissions using correct data in the next annual submission, as suggested by the ERT during the review.	According to the information provided by the Party during the review, this was due to errors detected in the file provided by the operator of Luxembourg's railway company (CFL). In the NIR2012 it is stated that "The reason for this increase is not very clear, and is currently being discussed with the company. The emissions for 2006 and 2007 should therefore be considered as provisional and might be revised in the next submission. The decrease in 2009 compared to 2008 could be due to the economic crisis, although this has also to be clarified with the operator" (pp. 205)
1.A.3.d Navigation	CO_2, CH_4, N_2O	LU	The emissions from leisure boats were included in the 2011 submission. The fuel consumption used as AD for this estimation is obtained from the fuel seller which is the sole marina in Luxembourg. The ERT noted that the Party has not checked whether the reported fuel consumption is already included in the national statistics which is used for the AD for other subcategories. The ERT recommends that Luxembourg check if the fuel consumption considered for these boats has already been taken into account in other subcategories of the energy balance, in order to avoid any double counting.	From the NIR it is unclear if this was implemented
1 Energy		BE	The comparison of the reference approach and sectoral approach shows a difference of 2.3 per cent for 2009. In previous submissions, the difference has fluctuated between –4.3 per cent (for 2002) and +4.0 per cent (for 2000). The main reason for the differences is that the reference approach is performed using the national energy balance whereas the sectoral approach is performed using the three regional energy balances. Several reasons for the differences have been identified and described in the NIR (e.g. different caloric values and EFs used for liquid fuels, and the allocation of some emissions under the industrial processes sector for the sectoral approach). The work to further harmonize the regional and national energy balances, and, subsequently, the reference and sectoral approaches, has been ongoing in Belgium for several years and is coordinated by a working group on energy balances (established in 2003) under the National Climate Commission. In 2010 the task of regionalizing the national statistics was taken over by ENOVER/CONCERE, a consultative body responsible for energy-related issues between the national and regional authorities. The latest developments are expected to help increase the consistency between the regional and national energy balances. The ERT commends Belgium for the efforts undertaken and reiterates the recommendation in the previous review report that the Party further improve the transparency of its reporting on the different approaches, and provide detailed information in the NIR on the progress made in harmonizing the different data sources, and the impact of the measures already undertaken and implemented to reduce the differences between the reference and sectoral approaches in the next annual submission.	Update included in the NIR

1 Energy		BE	According to the NIR, fuel consumption used as feedstock, non-energy use of fuels and related emissions are allocated to the categories manufacturing industries and construction, ammonia production and other (chemical industry). The ERT commends the Party for following the recommendation from the previous review report and correcting the notation key used for coal oils and tars (from coking coal), gas/diesel oil and residual fuel oil to "NO". The ERT recommends that Belgium increase the transparency of its reporting by providing additional information in CRF table 1.A(d) to facilitate the tracking of cross-sectoral information.	Not yet implemented
1.A Stationary combustion	CO_2	BE	The CO_2 IEF for iron and steel provided for 2009 (49.68 t/TJ) is much lower than the value provided for 2008 (65.50 t/TJ) and the lowest among reporting Parties (ranging from 49.68 to 206.44 t/TJ). (see Party Response). While this explanation has clarified the inter-annual change in the IEF, it is not sufficient to explain the large interregional difference in the IEF. The ERT recommends that Belgium include further information on the EFs used for this subcategory and on the deviations in the trend in its next annual submission.	Not yet implemented
1.A Stationary combustion	CO_2	BE	The CO_2 IEF reported for 2009 (40.98 t/TJ) for manufacture of solid fuels and other energy industries is 52.6 per cent lower than the value reported for 1990 (86.23 t/TJ). In addition, the values of this IEF are among the lowest reported by Parties (ranging from 33.73 to 196.60 t/TJ). The ERT recommends that the Party improve the transparency of its reporting of information on the trend of the IEF in the next annual submission.	In response to questions raised by the ERT during the review, Belgium explained that the low IEF for 2009 is due to the inclusion of coal consumption from energy-related activities in the Flemish coal mines until 1996 (waste coal was used for electricity production). The high CO_2 IEF in the 1990s is due to the much higher values of the EFs for coal compared to coke oven gas, and the use of blast furnace gas in some coke oven furnace plants in the Walloon Region during the period 1990–1999. Not yet implemented.
1.A Stationary combustion	N_2O, CH_4	BE	In the category public electricity and heat production, the CH_4 IEF value for liquid fuels used for 2009 (26.99 kg/TJ) is 784.8 per cent higher than the value used for 1990 (2.05 kg/TJ). This increase is the highest among all reporting Parties and the inter-annual change for 2008–2009 amounts to +49.3 per cent. Similarly, the 2009 N_2O IEF (8.97 kg/TJ) is 3,415.0 per cent higher than the value reported for 1990 (0.26 kg/TJ) and the inter-annual change for 2008–2009 is –31.4 per cent. The ERT recommends that the Party correct this error in the next annual submission and enhance the QC procedures performed prior to submitting the inventory. In response to questions raised by the ERT during the review, Belgium explained that the differences were caused by the misallocation of the CH_4 and N_2O emissions from combined heat and power installations in the Flemish refineries to liquid fuels instead of to gaseous fuels.	Error was corrected in the 2012 inventory.

1.A.3.b Road transportation	CH_4, N_2O	BE	Belgium has still not implemented the recommendation of the previous review report regarding the use of the same methodology for non-CO_2 emissions from road transportation for all regions and for the entire time series. In the 2011 submission, the Party has used different models to estimate emissions from road transportation (the COPERT IV model for the Brussels-Capital and Walloon Regions for the years 2007–2009 and the COPERT III model for the previous years of the time series and the MIMOSA model for the Flemish Region). (see Party Response). As a result of the different methods used across the inventory years and regions, the inter-annual changes in the values of the CH_4 and N_2O IEFs for gasoline and diesel oil show large deviations in recent years (e.g. inter-annual changes for gasoline for 2006–2007, 2007–2008 and 2008–2009 of –40.0, –25.3 and 20.0 per cent for CH_4, and –69.8, –15.4 and –5.1 per cent for N_2O; and inter-annual changes for diesel oil for 2006– 2007, 2007–2008 and 2008–2009 of –47.0 per cent, –5.9 per cent and –2.2 per cent for N_2O). The ERT recommends that, in addition to the inclusion of information on the methodological changes, Belgium include information explaining the trend in the IEFs across the years of the time series in its next annual submission.	In response to questions raised by the ERT during the review, the Party stated that the Flemish Region uses the MIMOSA model in accordance with the mobility policy in the Flemish Region, and explained that the MIMOSA model is similar to the COPERT model but different input data are used. However, for the estimation of CH_4 and N_2O emissions, the functions from the COPERT IV model are used in the MIMOSA model. This information is included in the NIR 2012 pp. 18, 59
1.A.3.b Road transportation	CH_4, N_2O	BE	With regard to the planned transition to a COPERT IV model for the entire time series in the Walloon Region, the Party has expressed concerns regarding data availability prior to 2003, and alternative ways to ensure time-series consistency at the national level from 1990 are currently under consideration. The ERT notes the efforts made by the Party and recommends that Belgium recalculate the entire time series, in order to ensure the accuracy of the emission estimates for road transportation, and document how time-series consistency is ensured in its next annual submission.	From the NIR it is unclear if this was implemented
1.A.3.b Road transportation	CH_4, N_2O	BE	The previous ERT encouraged Belgium to report CH_4 and N_2O emissions from biomass in road transportation even though they were considered negligible. In 2011, the notation key "NE" was replaced by the notation key "IE" (included elsewhere), indicating that the CH_4 and N_2O emissions were included under gasoline and diesel oil for the years 2007–2009. This information has not been further explained in the NIR. The ERT commends the Party for its efforts to improve the completeness of the data; however, in order to improve the transparency of its reporting, the ERT recommends that Belgium provide, in the NIR, background information on the biofuel use in the country and report the emission estimates for CH_4 and N_2O separately in the next annual submission.	From the NIR it is unclear if this was implemented
		NL	The ARR 2011 was published on 16 April 2012. In the Dutch NIR (page 143) mentions that the draft report by the ERT was not received until 28 February 2012. Therefore, the Netherlands could not use the recommendations of the ERT for further improvements in the NIR 2012. Therefore, the Dutch NIR includes improvements made in responses to the Saturday Paper which are listed below.	
Energy		NL	Missing emission estimates for CNG vehicles	Implemented in CRF and NIR chapter 3.2.8.2.
Energy		NL	Missing emission estimates for CO_2 from gas transmission	Implemented in CRF and NIR chapter 3.3.2.5.
Energy		NL	Missing emission estimates for CH_4 from charcoal production	Implemented in CRF and NIR chapter 3.3.1.1.
Energy		NL	Improve transparency of emissions in Iron & Steel	Implemented in NIR chapter 1.6.3. and 3.2.7.5.
Energy		NL	Missing emission estimates for charcoal use	Implemented in CRF and NIR chapter 3.2.9.5.
Energy		NL	Improve transparency on emissions from civil aviation	Implemented NIR chapter 3.2.8.1.
Energy		NL	Missing emission estimates for CO_2 from anode consumption in Iron & Steel	Implemented in CRF and NIR chapter 4.4.5.

1 Energy		GB	The inventory for the energy sector is generally complete. However, the ERT noted that gaseous fuels in road transportation and solid fuels in domestic navigation are reported as "NE". During the previous review, the Party had explained that gaseous fuels were "IE"; however, no change in the notation key has been made and there is no explanation for the "NE" notation key in CRF table 9. The ERT recommends that the United Kingdom use the appropriate notation keys in its next annual submission.	In the latest GHG inventory gaseous fuels from road transportation are reported as IE and solid fuels from navigation are reported as NO.
1 Energy		GB	The information on the impact of recalculations is presented in the corresponding chapters in the NIR, as well as summarized in tables 10.1 and 10.2 of the NIR. The ERT welcomes the Party's provision of aggregated data on all the recalculations as well as the provision of a comparison with the previous year's submission. However, the ERT noted that information provided in the tables does not fully correspond to the information provided in the sectoral chapters. For example, section 3.2.9.6.1 of the NIR explains that the AD for peat use was revised leading to a decrease of emissions, but this information is not provided in table 10.1 of the NIR. In addition, the ERT noted that some recalculations are not transparently described in the CRF tables or in the NIR (e.g. revisions to natural gas statistics, changes in the amount of fuel oil allocated to power stations). The ERT was not completely convinced that the recalculations improve the accuracy of the inventory and was unable to check all the background information during the review and the rational for the revised data in all instances. The ERT recommends that, in its next annual submission, the United Kingdom ensure and justify that any recalculation performed leads to an improvement of the inventory	The text on recalculations throughout the report has been cross checked with the information presented in Chapter 10. Further information on the rationale for making recalculations has been included throughout the report, and in Section 10.1
1 Energy		GB	The previous review report noted that the apparent energy consumption in the reference approach and the apparent energy consumption (excluding feedstocks and nonenergy use of fuels) reported in CRF table 1.A(c) are almost identical, even though a significant fuel consumption is listed for non-energy purposes in CRF table 1.A(d). The values are updated in the 2011 submission, but the ERT notes that there are a number of inconsistencies in the reported data. Thus the apparent energy consumption of liquid fuels (excluding international bunkers) amounts to 2,648.59 PJ, while the apparent energy consumption (excluding non-energy use of fuels and feedstocks) is higher (3,217.13 PJ), although the liquid fuels are reported as a feedstock. The ERT recommends that the United Kingdom: improve the accuracy of its reporting and correct errors in its next annual submission;	The descriptions in the NIR and inclusion in the CRF have been checked and improved for the 2012 submission.
1 Energy		GB	In the reference approach CRF table1.A(b), the oxidation factor for colliery CH_4 is reported as "not applicable" ("NA"). The ERT recommends that the United Kingdom correct the value in the CRF tables for the entire time series.	The latest CRF does not include colliery CH_4 in Table 1A(b)
1 Energy		GB	The ERT commends the United Kingdom for the inclusion of additional explanations on fuels used as feedstocks in the 2011 NIR (annex A3.3.9). However, the ERT noted that this additional information includes circular cross-references (e.g. chapter 3.2.3 gives reference to chapter 4.9.1 of the NIR and annex 3.3.9, while annex 3.3.9 gives references back to NIR chapter 3 and chapter 4) and that the additional information is not fully transparent. The ERT recommends that the Party further improve the quality of the documentation and improve the transparency of the NIR and reiterates the recommendation of the previous review report that additional information be reported in CRF table 1.A(d) indicating from which categories in the energy sector carbon stored is subtracted and where the associated CO_2 emissions are allocated.	The descriptions in the NIR and inclusion in the CRF have been checked and improved for the 2012 submission.
1 Energy		GB	The ERT noted some inconsistencies between CRF table 1.A(b) and 1.A(d), as there is carbon stored for other oil reported in table 1.A(b) and no values reported in table 1.A(d). The ERT recommends that, in its next annual submission, the Party report all data used as feedstocks and non-energy use of fuels in the CRF tables and ensure consistency between the data reported in table 1.A(d) and 1.A(b) and in the NIR.	There are still inconsistencies between Table 1A(d) and Table 1A(b).

1 Energy		GB	The United Kingdom has reported all emissions from fuels used in manufacturing industries and construction under the category other (manufacturing industries and construction), except for emissions from iron and steel. This significantly reduces comparability and transparency of the inventory. Given that the United Kingdom's energy statistics are disaggregated according to the same categories as required in the CRF tables, previous review reports have identified that the Party should have the institutional arrangements and/or capacity to report these emissions under the appropriate subcategories. Previous review reports have recommended that the United Kingdom allocate these emissions to the appropriate subcategories and the Party was planning to implement this recommendation for the 2010 submission. The present ERT therefore reiterates the recommendation of previous review reports, as set out above, and strongly recommends that the United Kingdom allocate these emissions to different subcategories in its next annual submission.	Emissions from fuels used in manufacturing industries are now reported in the appropriate categories where possible. See Section 3.2.7 for more details.
1.A Stationary combustion	CO_2, CH_4, N_2O	GB	The CO_2 EF used by the Party for combustion of municipal solid waste (MSW) was developed in 1993. The ERT considers that the composition of the waste has probably changed over time. The Party itself notes, in the NIR, that the CO_2 EF used for combustion of MSW is considered to be in need of improvement and this improvement is planned for the 2012 annual submission. The ERT reiterates the recommendation of previous review reports that the United Kingdom report and document revised emission estimates in its next annual submission.	It is not clear from the NIR if this was implemented
1.A Stationary combustion	CO_2, CH_4, N_2O	GB	Emissions from the incineration of MSW for heat generation are currently reported under other sectors, which is not in accordance with the IPCC good practice guidance. The ERT reiterates the recommendation of previous review reports that the United Kingdom reallocate these emissions to the category public electricity and heat production in its next annual submission.	Emissions from waste incineration are included in 1A1
1.A.3.a Civil aviation	CO_2, CH_4, N_2O	GB	Previous ERTs have noted that the geographical coverage of civil aviation estimates leads to an underestimation of the emissions from domestic aviation reported under the energy sector. Since the Party did not officially submit revised estimates as requested by the previous ERT, an adjustment was calculated and applied for this category. For its 2011 submission, the Party has recalculated the full time series (1990–2009) including the emissions for flights between the United Kingdom and the OTs under civil aviation. The ERT noted, however, that the CO_2 emissions from civil aviation in 2008 in the 2011 submission (2,363.65 Gg) are lower than those in the submission 2010 (adjusted value 2,416.37 Gg) The ERT recommends that, where any recalculations are made, the Party present both the previous and actual value of the AD in the NIR, together with the justification and impacts of the various recalculations. In addition, all the information should be included in CRF table 8(b), preferably at the level at which the recalculation takes place	CRF table 8(b) is filled in at very detailed level.
1 Energy		DK	For 2009, the CO_2 emission estimates calculated using the reference approach are 1.25 per cent lower than the emission estimates calculated using the sectoral approach. In addition, in the period 1990–2009 both fuel consumption and estimated CO_2 emissions differ by less than 1 per cent for all years except 1998 (for which the difference between the approaches is 1.8 per cent) and 2009. Additional explanations of the way in which the reference approach was prepared are provided in the documentation box of CRF table 1.A(c), and discussions on the comparison of the reference approach with the sectoral approach for Denmark, Greenland and the aggregate area of Denmark and Greenland are included in the NIR. Denmark indicates, in section 3.4 of the NIR, that the differences for 1998 and 2009 are due to large statistical differences in the official energy statistics for these years, and that the Danish Energy Agency is working on these issues and expects the statistical difference for 2009 to be lower in the next published energy statistics. The ERT commends the efforts that Denmark is making and recommends that the Party include information on the result of these efforts in its next annual submission.	This has been included in the NIR. Chapter 3.4.

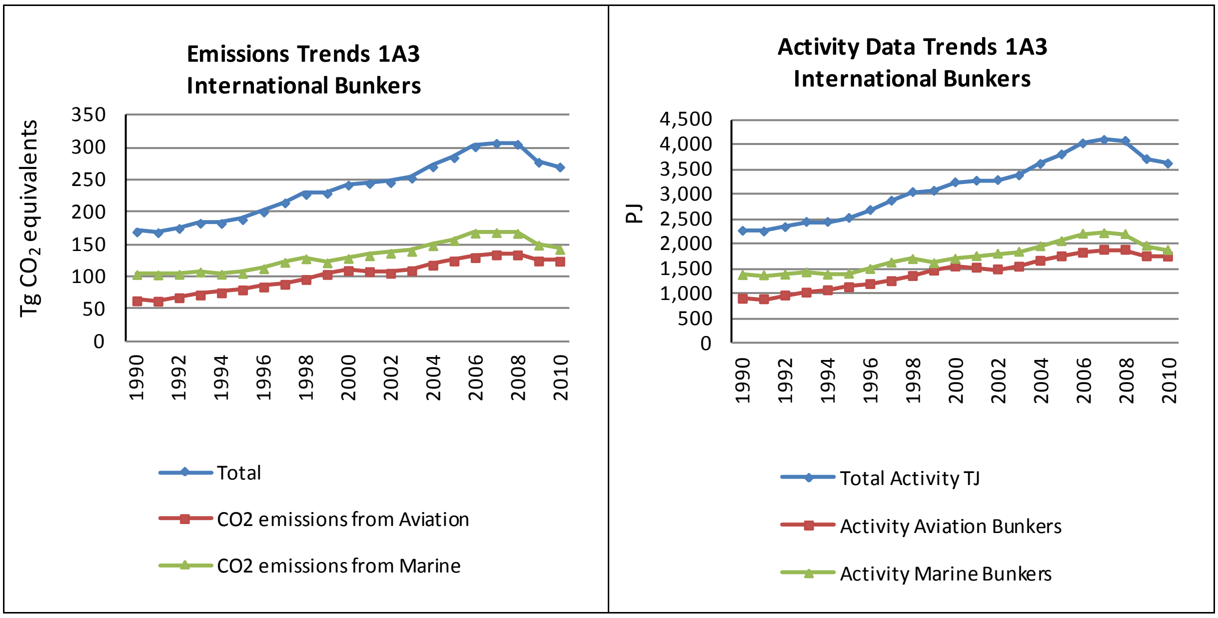
1 Energy		DK	Denmark reports in CRF table 1.A(d) three fuel types used for non-energy purposes: bitumen, white spirit and lubricants. The total non-energy use of fuels is 10,564.31 PJ, and 746.94 Gg CO_2 is not emitted. In the same table, Denmark indicates that some CO_2 emissions are included under the categories mineral products (bitumen), other industrial processes (lubricants) and solvent and other product use (white spirit), but the quantities emitted are not reported (the notation keys "NO" and included elsewhere ("IE") are used) and no explanations are provided either in the NIR or in the CRF tables. The ERT recommends that Denmark provide in the NIR information on how it determines the final carbon storage factors that are reported in CRF table 1.A(d), in order to improve the transparency of the reporting.	Text has been added in the NIR. In addition the implementation of data for associated CO_2 emissions in CRF table 1A(d) is now part of the planned improvements. Chapter 3.4.
1.A.3.b Road transportation	CO_2, CH_4, N_2O	DK	There are discrepancies between the CO_2 implied emission factors (IEFs) for gasoline and diesel for 2009 and those for 1990: the 2009 IEF for diesel (74.00 t/TJ) is higher than the value for 1990 (73.99 t/TJ), while the 2009 IEF (72.99 t/TJ) for gasoline is lower than the value for 1990 (73.00 t/TJ). Denmark explained to the ERT during the review that these small deviations were due to a rounding error made by the reporting software. The ERT recommends that Denmark correct the error and improve its QC procedures for its next annual submission.	It has been checked that the activity data and emissions reported in the CRF and hence the IEFs are correct.
1.A Stationary combustion	N_2O	DK	The N_2O EF for refinery gas used by Denmark for 2009 for the subcategory petroleum refining (0.1 kg/TJ) is low when compared to IPCC defaults for liquid fuels (0.3 – 0.4 kg/TJ). The ERT recommends that Denmark include the rationale for its selection of this EF in the NIR of its next annual submission.	The rationale for selection of the N_2O emission factor has been added in the NIR. Chapter 3.2.
1.A Stationary combustion	N_2O	DK	For 2008, in Denmark's 2011 annual submission, the N_2O EF for use of liquid fuels in manufacturing industries and construction (2.56 kg/TJ) has decreased by about 16.0 per cent when compared with that reported in the 2010 annual submission (3.05 kg/TJ). The ERT noted that Denmark has moved from the use of the EF from the EMEP/CORINAIR Emission Inventory Guidebook 2007 to the use of the default EF from the Revised 1996 IPCC Guidelines, but that it has not provided the rationale for this change in the NIR. Therefore, the ERT recommends that Denmark provide the rationale for changing the EF used in the NIR of its next annual submission.	The IPCC Guideline values have been preferred for all emission factors that are not nationally referenced. The IPCC Guidelines are considered a better reference for greenhouse gases than the EMEP/EEA Guidebook. Furthermore, the EMEP/EEA Guidebook was revised in 2009, so it no longer contains any guidance on greenhouse gases, therefore the emission factors will never be updated and as such can be considered obsolete.
1.A.3.a Civil aviation	CO_2, CH_4, N_2O	DK	Emissions from aviation were calculated using a tier 2 approach for mainland Denmark and a tier 1 approach for Greenland. The ERT recommends that Denmark improve the description of the methodology used for estimating emissions from aviation, such as the EF for the representative aircraft types and the number of movements per aircraft type, and additional details on how movements between Greenland and Denmark are considered and provide complementary data on landing and take-off (LTO) and EFs.	Due to the limited time available from the reception of the draft review report to the deadline for finalization of the NIR, it was not possible to include this information in the 2012 submission. The requested information will be included in the 2013 submission.
		AT	No annual review report 2011 available	
		DE	No annual review report 2011 available	
		FR	No annual review report 2011 available	
		ES	No annual review report 2011 available	

		IE	No annual review report 2011 available	
		IT	No annual review report 2011 available	
		PT	No annual review report 2011 available	
		SE	No annual review report 2011 available	

3.8 International bunker fuels (EU-15)

International bunker emissions include emissions from Aviation bunkers and Marine bunkers. The emissions of the EU inventory are the sum of the international bunker emissions of the Member States ([27]). Between 1990 and 2010, greenhouse gas emissions from international bunker fuels increased by 58.8 % in the EU-15. CO_2 emissions from "Marine bunkers" account for 53 % of total greenhouse gas emissions from international bunkers in 2010, CO_2 from "Aviation bunkers" accounts for 46.2 % (Figure 3.94).

Figure 3.94 International bunker fuels: GHG emission trend and activity data



3.8.1 Aviation bunkers (EU-15)

This source category includes emissions from flights that depart in one country and arrive in a different country (include take-offs and landings for these flight stages).

CO_2 emissions from Aviation Bunkers account for 3.3 % of total GHG emissions in 2010 but are not included in the national total GHG emissions (Table 3.108).

The Member States France, Germany, Spain and the United Kingdom contributed more than two thirds to the EU-15 emissions from this source. All Member States, except for Greece, increased emissions from Aviation bunkers between 1990 and 2010.

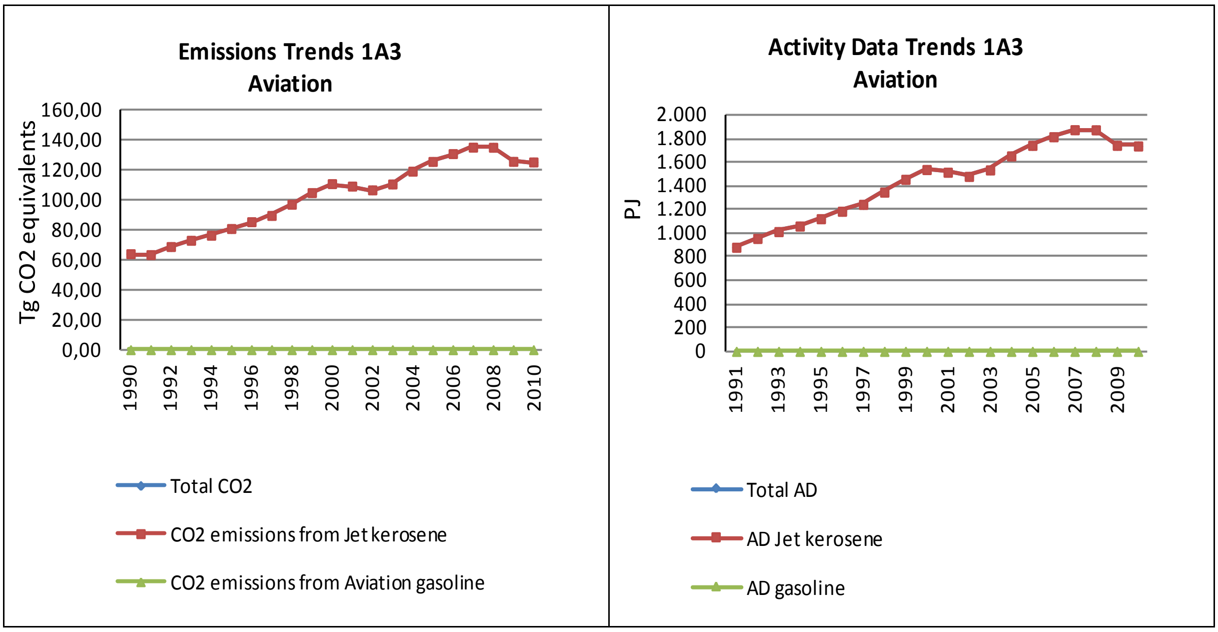
([27]) The definitions in Tables 2.8 and 2.9 of the IPCC good practice guidance are based on activities within 'one country". This means domestic aviation is defined for individual countries. The decision tree in Figure 2.8 of the IPCC good practice guidance considers 'national fuel statistics' for domestic aviation. As the EC is neither a country nor a nation, the EC's interpretation of the good practice guidance is that the emission estimate at EC level has to be the sum of Member States estimates for domestic air or marine transport as they are the countries or nations addressed in the definition and decision trees of the IPCC good practice guidance.

Table 3.108 Aviation bunkers: Member States' contributions to CO_2

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 1990-2010		Change 2009-2010	
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	886	1,893	2,050	1.6%	1,164	131%	156	8%
Belgium	3,095	3,918	4,218	3.4%	1,123	36%	300	7%
Denmark	1,736	2,316	2,421	1.9%	685	39%	105	4%
Finland	1,008	1,570	1,654	1.3%	646	64%	83	5%
France	8,549	15,832	15,926	12.7%	7,377	86%	94	1%
Germany	12,022	24,829	24,550	19.6%	12,528	104%	-279	-1%
Greece	2,448	2,615	2,092	1.7%	-355	-15%	-523	-25%
Ireland	1,070	2,241	2,315	1.8%	1,246	116%	75	3%
Italy	4,161	8,968	9,440	7.5%	5,280	127%	472	5%
Luxembourg	394	1,258	1,286	1.0%	891	226%	28	2%
Netherlands	4,540	10,411	10,168	8.1%	5,628	124%	-243	-2%
Portugal	1,461	2,367	2,608	2.1%	1,147	79%	242	9%
Spain	5,805	12,572	13,053	10.4%	7,248	125%	481	4%
Sweden	1,335	2,008	2,066	1.6%	731	55%	58	3%
United Kingdom	15,644	33,005	31,568	25.2%	15,924	102%	-1,437	-5%
EU-15	**64,154**	**125,804**	**125,415**	**100.0%**	**61,261**	**95%**	**-389**	**0%**

CO_2 emissions from jet kerosene account for 99,99 % of total emissions from "Aviation bunkers" in 2010 (Figure 3.95**).** All Member States, except for Greece, increased emissions from jet kerosene between 1990 and 2010. Member States with the highest increase between 1990 and 2010 in percent were Luxembourg, Austria, Italy and Spain. On the other hand, Greece was the country with a decrease in CO_2 emissions.

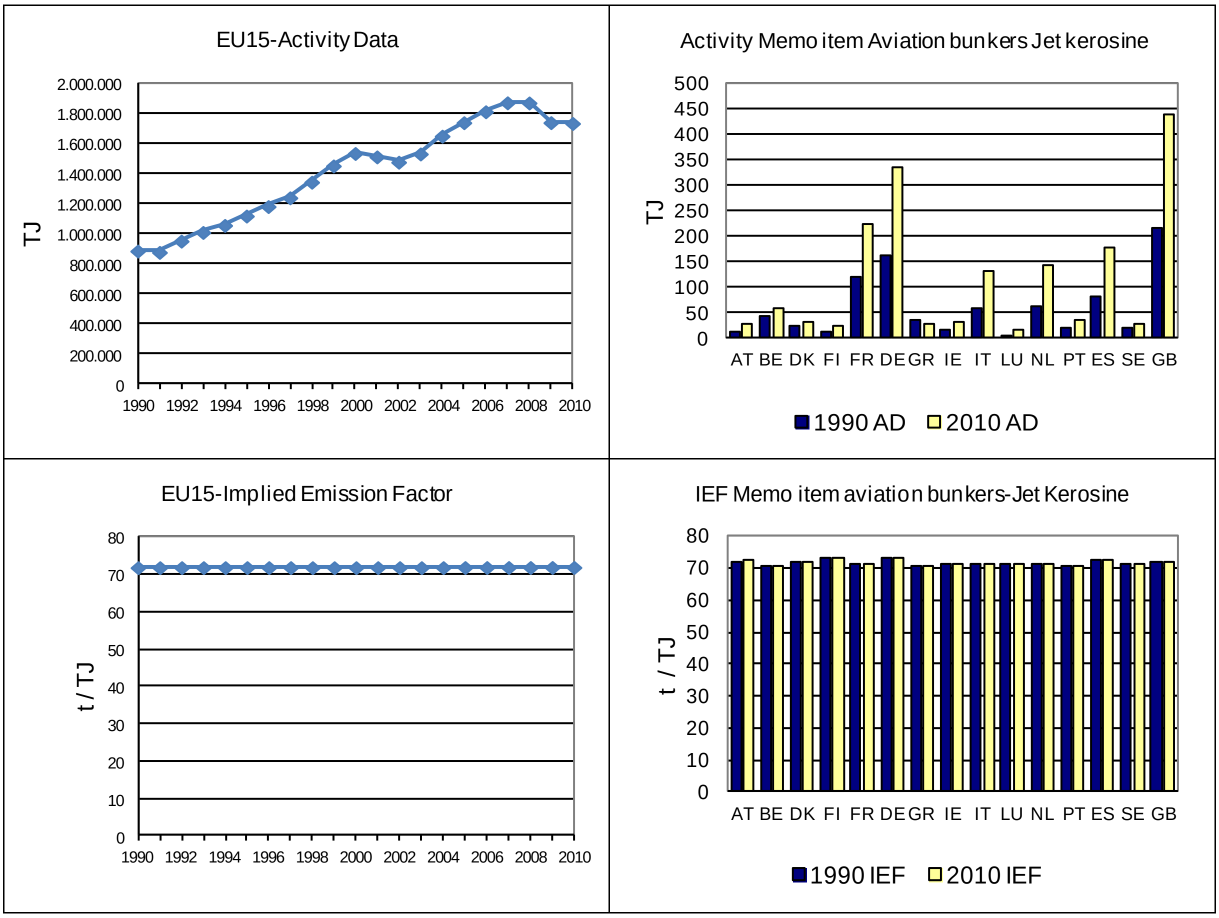
Figure 3.95 Aviation bunkers: Trend of CO_2 Emissions and Activity Data



3.8.1.1 Aviation Bunkers – Jet Kerosene (CO_2)

Figure 3.96 provides an overview of activity data and emission factors for EU-15 and those Member States contributing most to EU-15 emissions. Fuel combustion of EU-15 increased by 96 % between 1990 and 2010. The EU-15 implied emission factor was at 72.03 t/TJ in 2010.

Figure 3.96 **Aviation bunkers, Jet kerosene: Activity Data and Implied Emission Factors for CO_2**



3.8.2 Marine bunkers (EU-15)

This source category includes emissions from fuels used by vessels of all flags that are engaged in international water-borne navigation. The international navigation may take place at sea, on inland lakes and waterways and in coastal waters. Marine bunkers include emissions from journeys that depart in one country and arrive in a different country. Marine bunkers exclude consumption by fishing vessels (see Other Sector - Fishing).

CO_2 emissions from “Marine bunkers” account for 3.8 % of total GHG emissions in 2010 and are also not included in the national total GHG emissions. Between 1990 and 2010, CO_2 emissions from Marine bunkers increased by 37 % in the EU-15 (Table 3.109).

The Member States Belgium, Spain and the Netherlands contributed most to the emissions from this source (63.3 %) in 2010. Between 1990 and 2010, Denmark and Finland decreased emissions from Marine bunkers; France kept them constant whereas all the other Member States increased them. The Member States with the highest increase in absolute terms again were Belgium, Spain and the Netherlands.

Table 3.109 Marine bunkers: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 1990-2010		Change 2009-2010	
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	19	31	31	0.02%	13	68%	0	1%
Belgium	13,307	22,699	20,960	14.6%	7,653	58%	-1,738	-8%
Denmark	3,005	1,487	2,073	1.4%	-932	-31%	587	28%
Finland	1,835	783	657	0.5%	-1,178	-64%	-126	-19%
France	7,891	8,106	7,857	5.5%	-34	0%	-249	-3%
Germany	7,915	8,723	8,882	6.2%	967	12%	159	2%
Greece	8,028	8,294	8,643	6.0%	616	8%	349	4%
Ireland	57	303	430	0.3%	373	657%	127	29%
Italy	4,389	7,258	7,009	4.9%	2,620	60%	-249	-4%
Luxembourg	0.1	0.1	0.1	0.0%	0	52%	0	-4%
Netherlands	34,357	45,645	43,235	30.1%	8,878	26%	-2,410	-6%
Portugal	1,386	1,781	1,618	1.1%	232	17%	-163	-10%
Spain	11,528	27,667	26,665	18.6%	15,137	131%	-1,002	-4%
Sweden	2,228	7,281	6,710	4.7%	4,483	201%	-571	-9%
United Kingdom	8,804	10,243	8,904	6.2%	100	1%	-1,339	-15%
EU-15	**104,749**	**150,300**	**143,676**	**100.0%**	**38,927**	**37%**	**-6,624**	**-5%**

CO_2 emissions from residual fuel oil account for 87.4 % of total emissions from "Marine bunkers" in 2010 (Figure 3.97). Between 1990 and 2010, CO_2 emissions from residual fuel oil increased by 54.5 % in the EU-15. All Member States, except for Denmark and Finland, increased emissions from residual oil between 1990 and 2010. Member States with the highest increase in percent were Ireland and Sweden.

CO_2 emissions from gas/diesel oil account for 12.3 % of total emissions from "Marine bunkers" in 2010. Between 1990 and 2010, CO_2 emissions from gas/diesel oil decreased by 22.5 % in the EU-15.

Figure 3.97 Marine bunkers: Trend of CO_2 Emissions and Activity Data

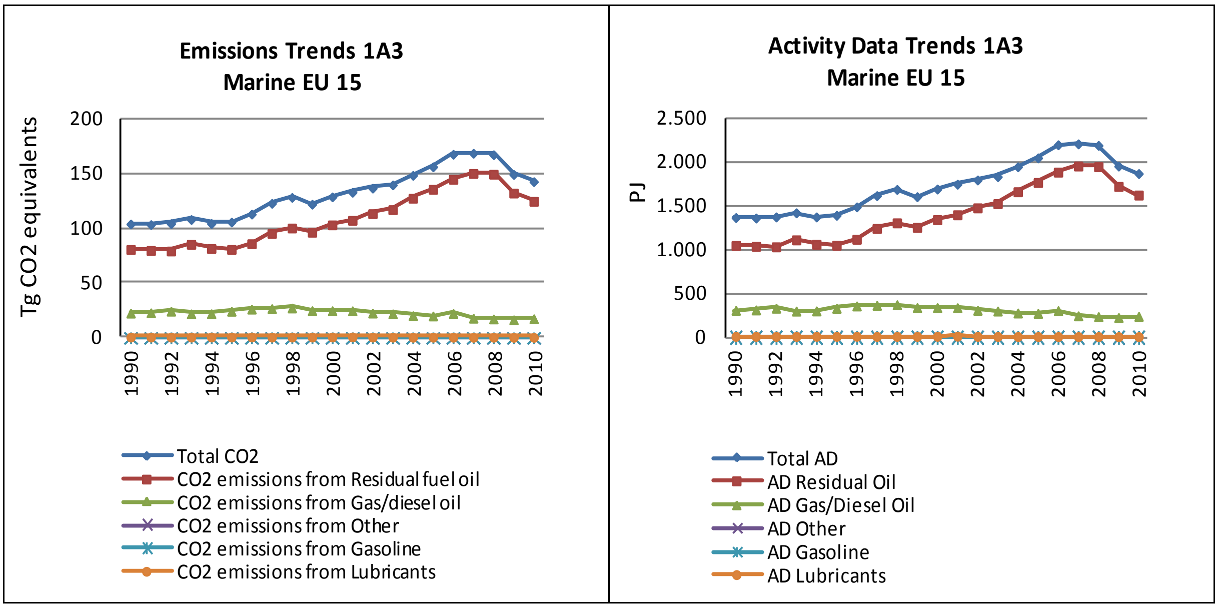
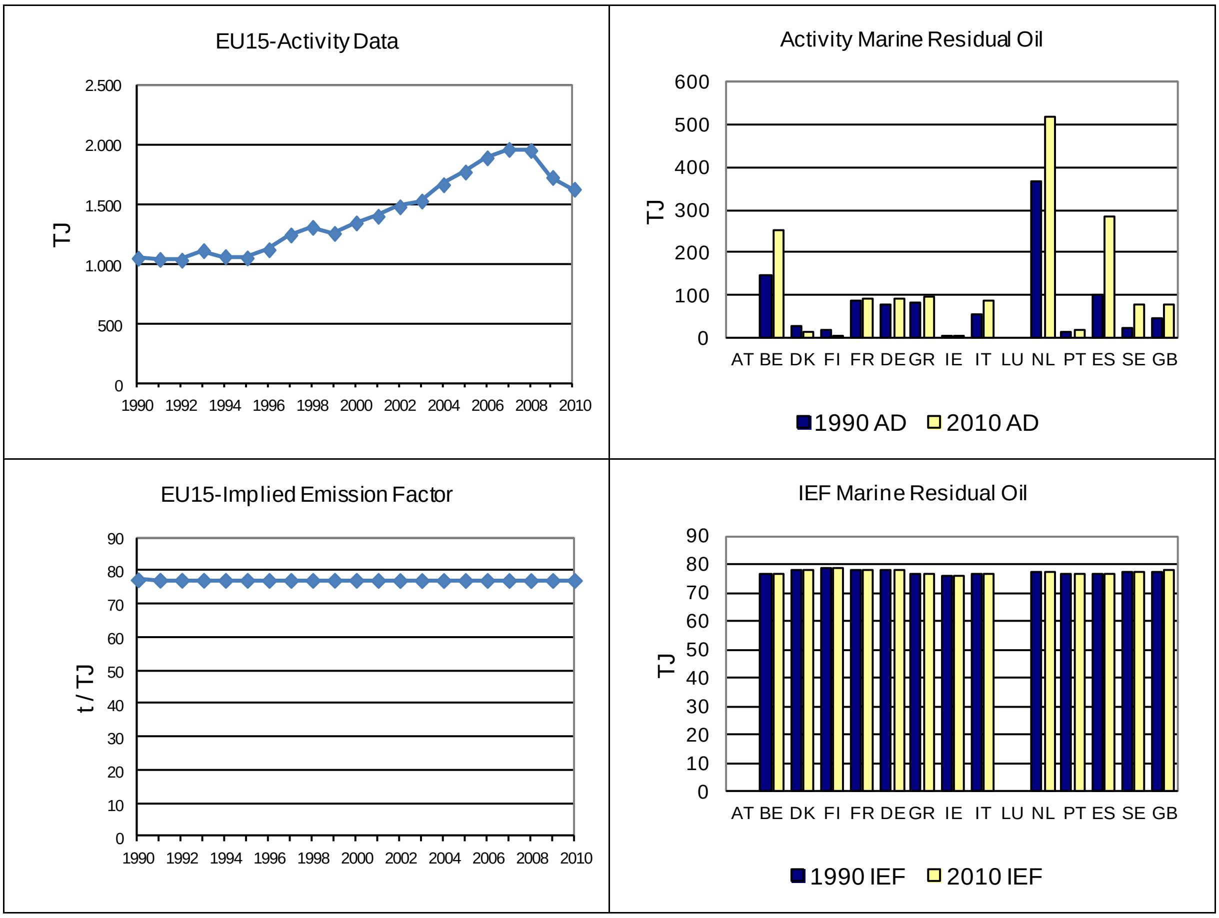


Figure 3.98 and Figure 3.99 provide an overview of activity data and emission factors for residual oil and gas/diesel oil for EU-15 and those Member States contributing most to EU-15 emissions.

3.8.3 Marine Bunkers – Residual Oil (CO_2)

Combustion of residual oil in the EU-15 increased by 54.5 % between 1990 and 2010. The EU-15 implied emission factor was at 77.20 t/TJ in 2010.

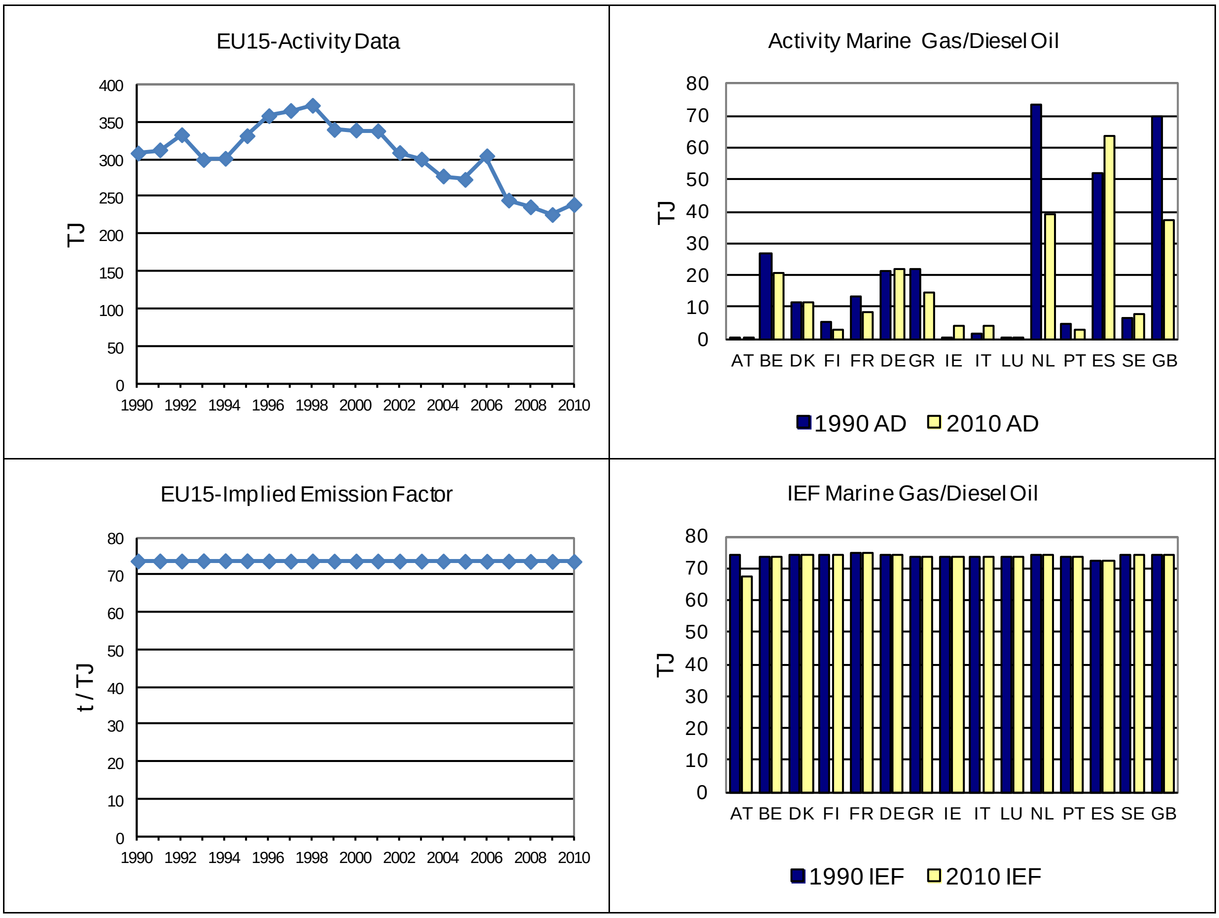
Figure 3.98 Marine bunkers' – Residual Oil: Activity Data and Implied Emission Factors for CO_2



3.8.3.1 Marine Bunkers – Gas/Diesel Oil (CO_2)

Combustion of gas/diesel oil in the EU-15 decreased by 22.5 % between 1990 and 2010. The EU-15 implied emission factor was at 73.62 t/TJ in 2010.

Figure 3.99 Marine bunkers, Gas/Diesel Oil: Activity Data and Implied Emission Factors for CO_2



3.8.4 QA/QC activities

3.8.4.1 2007 Study

The European Topic Centre on Air and Climate Change conducted a study in 2007 based on aviation emission estimates from Member States and calculations by the European Organisation for the Safety of Air Navigation (Eurocontrol). The purpose of the study was to compare emissions reported by Member States with modelling results provided by Eurocontrol to assess the quality of the emissions estimates and help identify areas in need for improvement. The calculations by Eurocontrol are based on flight movement data using an independent data set whereas most Member States use fuel sale statistics. The study assessed three questions: (i) how consistent are estimates for total fuel consumption between the two data sets; (ii) how consistent are estimates for the share of domestic aviation between the two data sets; (iii) does the consistency between the two estimates depend on the type of methodology applied by Member States. The main conclusions of the study were:

Comparing country estimates for fuel burn, CO_2 emissions and NO_x with Eurocontrol calculations is a genuine quality assurance exercise which can help both sides in improving their data. Despite significant uncertainties in the estimates the comparison was able to identify countries for which the differences could not be easily explained and where countries as well as Eurocontrol might need to do further analysis. Especially for the share of domestic aviation Eurocontrol data might be of use to several countries in the future.

The analysis showed that although in theory CO_2 estimates from aviation do not depend on the tier chosen, in practice countries applying higher tiers also had more consistent carbon dioxide emission estimates. One of the reasons might be that the application of higher tiers requires detailed statistics in the aviation sector which might also be reflected in the fuel sale estimates.

The use of bottom-up data for the determination of the split between domestic and international aviation could improve the accuracy of inventory estimates. The small country approach is a good and very easy methodology for countries without domestic IFR/GAT aviation; research projects can produce good estimates for the share of domestic emissions. Out of the 29 countries assessed those applying expert judgement or top-down data had the highest discrepancies compared to Eurocontrol.

In general, the European countries tend to overestimate domestic emissions. This is a conservative approach as it increases the emissions included in the emission reduction commitment under the Kyoto Protocol. For the same reason it would be in the interest of the concerned countries to improve their estimates: greenhouse gas emissions from aviation have increased substantially since 1990 and overestimating the domestic share will exacerbate the efforts for reaching the national targets. Applying the share of domestic aviation as calculated by Eurocontrol to total fuel consumption in the EU-15 leads to an overestimation of domestic emissions from aviation by 6.2 Mt CO_2 in 2005.

3.8.4.2 Collaboration with Eurocontrol during 2011/12

At the end of 2010 the European Commission signed a framework contract with Eurocontrol regarding ‘support to the European Commission in relation to climate change policy and the implementation of the EU ETS’. The support project is organised in different Work Packages corresponding to the different areas identified in the framework contract.

One of these Work Packages (WP) pertains to the improvement of GHG and air pollutant emissions inventories submitted by the 27 Member States and the European Union to the UNFCCC and to the UNECE. The main objective of the WP is to assist EU Member States improve the reporting of annual greenhouse gas (and other air pollutant) emission inventories by e.g. estimating the fuel split domestic/international using real flight data from Eurocontrol. The European Environment Agency and its European Topic Centre on Air Pollution and Climate Change Mitigation assist DG CLIMA regarding the technical requirements.

As shown in the NIR 2011, comparing emissions reported by Member States with independent modelling results such as performed by EUROCONTROL is a genuine quality assurance exercise and assists in identifying areas in need for improvement of aviation emission calculations. The EU’s ARR 2011 report mentions “The ERT again recommends that the European Union continue such QA exercises, that it try to address the issues identified, and that it continue to work on making data from EUROCONTROL available to member States on a regular basis”.

In 2011, the European Union followed up on earlier work and the ERT recommendation. First, the European Union supported by EEA, ETC-ACM has explored methods and data to be used in order to improve the aviation emission calculations by for example using real flight data to provide the fuel split between domestic and international aviation and to ensure that emissions reported under UNFCCC and CLRTAP are based on consistent methodologies and datasets. This resulted in an user requirement documentation on aviation fuel burn and emissions data system prepared by EUROCONTROL (available to the ERT upon request). Second -following this user requirement documentation- EUROCONTROL provided datasets in autumn 2011 that are currently being evaluated by EEA, ETC-ACM and EU Members States. Third, following the two activities above, the European Union has under a framework contract ensured that EUROCONTROL will provide support to the EEA and EU Member States in the provision of fuel and emissions data and the analysis and use of the data in the context of UNFCCC and CLRTAP reporting. The methodology and datasets to be used are described in a technical solution report by EUROCONTROL (available upon request) that will form the basis for a dataset to be delivered in fall 2012 enabling application of the data for QA/QC activities in preparation of the 2013 NIR.

3.9 Feedstocks and non-energy use of fuels

Following a recommendation of the expert review team the EU GHG inventory team analyzed in more detail the fractions of carbon stored as used by the EU and its Member States. The recommendation of the ERT was to use weighted average fractions in order to potentially reduce the differences for apparent consumption between the reference approach and the sectoral approach. Following this exercise the EU inventory team revised the fractions of carbon stored for those fuels where the IPCC default values (used by the EU up to 2008) are far from the weighted averages of the EU Member States (i.e., for natural gas and lubricants). Table 3.110 provides an overview of the fraction of carbon stored by fuel as used in the EU GHG inventory 2010. These values are compared with the IPCC default values and the weighted average values of the EU-15 MS.

Table 3.110 Fraction of carbon stored from Table 1A(c) used by the EU-15 Member States compared with IPCC default values and the values used in the EU GHG inventory since 2010

	Weighted average based on EU-15 MS GHG inventories 2009	IPCC default (used by the EU before 2009)	Values used in the EU GHG inventory
Naphtha	0,76	0,75	0,75
Lubricants	0,74	0,50	0,75
Bitumen	1,00	1,00	1,00
Coal Oils and Tars	0,78	0,75	0,75
Natural Gas	0,53	0,33	0,50
Gas/Diesel Oil	0,60	0,50	0,50
LPG	0,75	0,80	0,80
Ethane	0,70	0,80	0,80

Table 3.111 provides an overview on how Member States treat emissions from feedstocks and non-energy use of fuels.

Table 3.111 Information related to feedstocks and non-energy use from Member States' NIRs

MS	Information on feedstocks and non-energy use of fuels	Source
Austria	Non-energy use of fuels is considered in the national energy balance. Below explanations for the reported non-energy use is provided together with information on where CO_2 emissions due to the manufacture, use and disposal of carbon containing products are considered. For fraction of carbon stored the IPCC default values are applied for all fuels except for coke oven coke, of which the amount of carbon stored in steel was calculated. **Lubricants** manufacture: emissions are assumed to be included in total emissions from category 1 A 1 b petroleum refinery. use: emissions from the use of motor oil are included in CO_2 emissions from transport. VOC emissions from lubricants used in rolling mills are considered in category 2 C 1. It is assumed that other uses of lubricants do not result in VOC or CO_2 emissions due to the low vapour pressure of lubricants. disposal: emissions from incineration of lubricants (waste oil) are either included in categories 1 A 1 a and 1 A 2 if waste oil is used as fuels or in category 6 C respectively if energy is not recovered. **Bitumen** manufacture: emissions from the production of bitumen are assumed to be included in total emissions of category 1 A 1 b petroleum refinery. use: indirect CO_2 emissions from the use of bitumen for road paving and roofing that should be reported in categories 2 A 5 and 2 A 6 are included in sector 3 solvent and other product use. disposal: CO_2 emissions from the disposal from bitumen are assumed to be negligible. Recycling is not considered. **Natural Gas** manufacture: emissions from the use of natural gas as a feedstock in ammonia production are accounted for in the industrial processes sector (category 2 B 1). use/disposal: not applicable, no CO_2 emissions result from the use or disposal of ammonia. **Coke oven coke** manufacture: emissions from the production of coke are considered in category 1 A 2 a. use: CO_2 emissions from coke used in iron and steel industry are reported under 2 C. disposal: not applicable. **Other bituminous coal** In [IEA JQ 2011] non energy use is reported for the manufacture of electrodes. manufacture: No information about emissions from manufacture of electrodes is currently available. Therefore it is not clear if emissions are not estimated or not applicable. use: Emissions from the use of electrodes are considered in category 2 B 4 carbide production and 2 C metal production. disposal: not applicable. **Other oil products** manufacture: emissions from the production of ethylene and propylene are included in total emissions of category 1 A 1 b petroleum refinery. CO_2 emissions from solvent use are considered in sector 3 solvent and other product use. use: CO_2 emissions from solvent use are considered in sector 3. disposal: emissions from the disposal of plastics in landfills are considered in 6 A and from the use of plastic waste as a fuel in 1 A 2; emissions from the incineration of plastic in waste without energy recovery is included in 6 C; emissions from incineration of plastics in waste with energy recovery are considered in 1 A 1 a and 1 A 2.	Austria's National Inventory Report 2012, Mar 2012, pp.69-70

MS	Information on feedstocks and non-energy use of fuels	Source
Belgium	Categories 1A2 and 2B The emissions of non-energy use of fuels and related emissions (emissions from recovered fuels from processes) are reported under categories 1A2, 2B1 and 2B5. As a result of the in-country review performed by the expert review team of UNFCCC in June 2007, the emissions reported in category 2G during the previous submissions are no longer included in the Belgian emission inventory. In this category 2G the emissions from the non-energy use of fuel were reported, estimated by using the IPCC default emission factors of carbon stored during the use of lubricants and solvents. Following the advise of the expert review team, these emissions of CO_2 from the use of solvents and lubricants will only arise when they are burned or destroyed. As a consequence these emissions are excluded out of the Belgian emission inventory during this submission. In Flanders, a recalculation of the non-energy use and related CO_2 emissions was performed during the 2005 submission, based on the results of a study conducted in 2003 [43]. The default % of carbon stored in the IPCC Guidelines were considered to be inaccurate in the Flemish situation. The default % of carbon stored in the 1996 IPCC guidelines are not well defined: it is not clear what is included or excluded in these default % (f.i. is the waste phase included or not?). Belgium participated in a European network on the CO_2-emissions from non-energy use (see website **http://www.chem.uu.nl/nws/www/nenergy/**) and one of the conclusions of this network is that the new IPCC guidelines need to give more information on this subject. To our opinion, the guidelines are also not very clear on the allocation of the resulting emissions: in the CRF table 1.A(d), as part of the reference approach, a country should specify in the documentation box where these emissions are allocated. This problem of allocation should be tackled also. Since the petrochemical industry is important in Flanders and Belgium and the emissions from the feed stocks are a key source in the Belgian inventory, the study mentioned above was conducted to get more detailed, country-specific information. A distinction was made between: 1. The use of recovered fuels from cracking units or other processes where a fuel is used as raw material and where part of this fuel (or transformed product) is recovered for energy purposes. These emissions are reported under category 1A2c 'other fuels'. This is the largest source of CO_2 emissions. The involved industry is reporting the CO_2 emissions and PJ for these recovered fuels. 2. CO_2 emissions occurring during chemical processes, for example the production of ammonia based on natural gas or the production ethylene oxide where CO_2 is formed in a side reaction (reported respectively under 2B1 and 2B5 other). The industry involved is reporting these CO_2 emissions directly for these processes. 3. Waste treatment of final products is not included in the study. This is practically impossible due to import/export of plastic products, etc (it is also not clear if the waste phase is included in the default IPCC carbon stored % or not). The emissions of waste incineration are therefore calculated separately and are reported under the sector of waste (category 6C) or under the sector of energy (category 1A1a), whether or not energy recuperation takes place during the process. The result of the study made a recalculation possible for all years. The effect of the recalculation was greater in the more recent years because the petrochemical industry has expanded its activities in the beginning of the nineties (that's one of the reasons this sector is a key source). The resulting emissions are reported under different sections. The first and largest part (recovered fuels) of the resulting emissions is reported under 1A2c, under 'other fuels'. This includes other fuels in the chemical sector, a result of recovered fuels in the steam cracking units in petrochemical industry (approx. 2/3) and other recovered fuels from the chemical industry (approx. 1/3). These recovered fuels are reported directly in the yearly surveys carried out by the chemical federation in cooperation with the VITO [1] to establish a yearly Flemish energy balance. The choice was made to allocate these fuels under 'other fuels' and not 'liquid fuels' or 'gaseous fuels', for transparency reasons. Another part of the emissions surveyed in the study, are considered to be process emissions and are reported under 2B. These include the CO_2-emission during the production of ammonia (2B1) and other process CO_2 emissions (2B5) reported by the chemical industry in Flanders (for example production of ethylene oxide, production of acrylic acid from propene, production of cyclohexanone from cyclo-hexane, production of paraxylene/meta-xylene, etc). These CO_2 emissions result from the same surveys in the chemical sector in Flanders as those reported under 1A2c. In the survey, more sources of emissions from chemical processes are reported than are described in the IPCC 1996 guidelines. .	Belgium´s Greenhouse Gas Inventory 1990-2010, Mar 2012, pp.45-46

MS	Information on feedstocks and non-energy use of fuels	Source
Denmark	The Danish national energy statistics includes three fuels used for nonenergy purposes; bitumen, white spirit and lubricants. The total consumption for non-energy purposes is relatively low, e.g. 10.6 PJ in 2010. The use of white spirit is included in the inventory in *Solvent and other product use*. The emissions associated with the use of bitumen and lubricants are included in *Industrial Processes*. The non-energy use of fuels is included in the reference approach for Climate Convention reporting and appropriately corrected in line with the Revised 1996 IPCC Guidelines (IPCC, 1997).	Denmark's National Inventory Report 2012 Mar 2012 p. 151
Finland	To calculate the emissions from the non-specified burning of feedstocks there is a separate module in ILMARI. The ILMARI system includes point source (bottom-up) data on feedstock combustion in the petrochemical industry as well as recycled waste oil combustion in different branches of industry, and they are reported in corresponding subcategories of 1.A 2. These specified energy uses of feedstock and lubricants are subtracted from the corresponding total amounts. For the rest of the feedstock 100% of carbon is estimated to be stored in products (mainly plastics). For the rest of lubricants, 33% of carbon is estimated to be stored in products (recycled lubricants) and 67% of carbon released as CO_2 either in burning of lubricants in motors or illegal combustion of waste oil in small boilers. These non-specified emissions from burning of feedstocks (which are not included in 1.A 2) are included in category 1.A 5. Emissions from natural gas used as feedstock are calculated and reported in sector 2.B 5.	Greenhouse Gas emissions in Finland 1990-2010, Mar 2012 p. 116
France	Les combustibles fossiles peuvent être consommés pour différents usages tels que la combustion pour des besoins énergétiques ou en tant que matière première, intermédiaire ou agent réducteur. Tous les types de combustibles sont concernés et sont différenciés, en fonction des cas, selon les usages énergétiques et non énergétiques, dans le bilan de l‟énergie. Le cas des combustibles solides, liquides et gazeux sont différenciés ci-dessous : En ce qui concerne les consommations de combustibles solides (charbon et coke de charbon), le bilan de l‟énergie du SOeS comptabilise tous les usages dans les consommations énergétiques. Quoiqu‟il en soit, les usages énergétiques et non énergétiques sont bien distingués dans l‟inventaire. Les consommations de combustibles solides en tant que réducteurs ou intermédiaires sont considérées dans le code CRF 2C pour les sites sidérurgiques et de production de ferro-alliages. Les produits pétroliers à usage non énergétique sont essentiellement consommés sur les sites pétrochimiques. Ces usages sont bien connus et font l‟objet d‟une enquête exhaustive de la part du SOeS. Selon les résultats de cette enquête, environ 12% de la consommation française de produits pétroliers est utilisée non, comme source d‟énergie, mais comme matière première pour la chimie organique. Cette enquête définit les quantités des différentes bases pétrolières consommées ainsi que les productions des vapocraqueurs dont une part de produits autoconsommés par le vapocraqueur (fioul lourd et fuel gas) à des fins énergétiques. Les consommations de ces produits à usage énergétique sont bien comptabilisées dans les consommations énergétiques de produits pétroliers dans le bilan del‟énergie français et les émissions de GES associées sont prises en compte dans la catégorie CRF 1A2. Seules des émissions de CH_4 sont donc estimées pour les usages non énergétiques des vapocraqueurs et rapportées dans le code CRF 2B5. Les émissions liées à la combustion des huiles moteur sont prises en compte dans la catégorie CRF 1A3. Les émissions des huiles récupérées et brûlées dans les procédés type cimenterie sont prises en compte dans la catégorie CRF 1A2 et celles traitées en incinérateurs de déchets spéciaux en CRF 6. Enfin, les principaux usages non énergétiques du gaz naturel correspondent à la production d‟ammoniac et d‟acide cyanhydrique. Les émissions de CO_2 associées sont comptabilisées dans le code CRF 2B.	Rapport National D'Inventaire pour la France Mar 2012 p.83-84
Germany	In cooperation with the University Utrecht, the emissions from non-energy use of fuels were assessed within a research project in 2007. The results have been compared to the CO_2 reference approach. In the following results of the study are summarized (source: NIR 2007, Annex 2, chapter 13.9).	Nationaler Inventarbericht zum deutschen Treibhausgasinventar 1990-2010 Mar 2012 p. 149

MS	Information on feedstocks and non-energy use of fuels	Source
Greece	Non-energy fuel use concerns the consumption of fuels as raw materials (e.g. in chemical industry, metal production) for the production of other products, or the use of fuels for non-energy purposes (e.g. bitumen). Part of the carbon content of fuels is stored in final products and is not oxidized into carbon dioxide for a certain time period. The fraction of the carbon contained in final products and the time period for which carbon is stored in them, depend on the type of fuel used and of the products produced. The oxidation of the carbon stored in final products occurs either during the use of the product (e.g. solvents) or during their decomposition (e.g. through combustion). It should be noted that emissions during production processes (e.g. ammonia and hydrogen production) should be reported under the sector of industrial processes, while emissions from burning of products should be reported under the waste sector or energy sector (as long as energy exploitation takes place). Non-energy use of fuels in Greece refers to the consumption of: • naphtha, natural gas, and lignite (for the period 1990 – 1991) in chemical industry, • petroleum coke in the production of non-ferrous metals, • lubricants in transport (including off-road transportation), • bitumen in construction and • other petroleum products in the industrial and residential sectors Data on the non-energy consumption of fuels derive from the national energy balance. However, plant specific data derived from verified ETS reports and information provided by specific greek industries resulted to the improvement of reallocation of non-energy use fuels from the energy to the industrial processes sector: • The non-energy use of natural gas for ammonia production has been reallocated to industrial processes sector, by using data from ETS reports and plant specific information. Non-energy use of lignite is accounted in the Energy sector and refers only to ammonia production (in one installation for 1990 and 1991) and as a result the fraction of carbon stored is equal to 0. The operation of this installation ended at 1998 while it did not produce ammonia for the period 1992 – 1998. For the first time in this submission, the non-energy use of natural gas for hydrogen production has been reallocated to the industrial processes sector, by using data from ETS reports and information from Public Gas Corporation. • No data regarding non-energy use in the iron and steel industry are reported in the national energy balance and, as a result, CO_2 emissions from the use of fuels as reduction agents, are only reported under the industrial processes sector. • Solid fuels consumption in the ferroalloys production industry is included (in the national energy balance) in the solid fuels consumption of the non-ferrous metals sector. However, by using data from ETS reports and plant specific information, emissions from solid fuels for ferroalloys production are reallocated to the industrial processes sector, as from 2010 submission. • The non-energy use of petroleum coke (see Table 3.9) refers exclusively to the primary aluminium production. Given that the relevant emissions are reported under the industrial processes sector, petroleum coke consumption is not taken into account in the energy sector. On the basis of the above-mentioned clarifications, the possibility to double-count or underestimate CO_2 emissions from the non-energy use of fuels is minor.	Annual Inventory submission to the EC Mar 2012 pp.81-82
Ireland	Naphtha was previously the only petroleum product to be considered in relation to non-energy fuel-use, where the carbon is not fully released as in combustion. The IPCC default value of 0.50, 1.00 and 1.00 are used for the proportion of carbon stored in lubricants, bitumen and whites spirit respectively. Ireland's only oil refinery is a small hydroskimming refinery where there is no production of other petroleum products normally used for non-energy purposes, such as bitumen, lubricants, plastics and asphalt. The expanded SEAI energy balance sheets now record the import of some of these products, thereby allowing improved completeness in the Reference Approach estimation of CO_2 emissions and carbon storage. A significant amount of natural gas feedstock was traditionally used in ammonia production in Ireland but the company closed in 2003 and there is consequently no feedstock use of natural gas since then.	Ireland National Inventory Report 2012 Mar 2012 p. 62

MS	Information on feedstocks and non-energy use of fuels	Source
Italy	Data are based on a detailed yearly report available by Ministry of Economic development (MSE, several years [b]). The report summarizes answers from a detailed questionnaire that all operators in Italy prepare monthly. The data are more detailed than those normally available are by international statistics and refer to: - input to plants (gross input); - quantities of fuels returned to the market (with possibility to estimate the net input); - fuels used internally for combustion; - Quantities stored in products. National energy balances include only the input and output quantities from the petrochemical plants; so the output quantity could be greater than the input quantity, due to internal transformation. Therefore it is possible to have negative values for some products (mainly gasoline, refinery gas, fuel oil). Consequently for these fuels also the fraction of carbon stored could have negative values. The quantities of fuels stored in products, in percentage on net and gross petrochemical input, are estimated with these data, see Table 3.34 for details by product and Table 3.33 for the overall figure. Specifically, the amount of quantity stored in products for each fuel is calculated as the difference between input (petrochemical input) and output (returns to refinery and internal consumption and losses); carbon stored is therefore calculated from the amounts of fuels stored (in tonnes) multiplied by the emission factors (tC/t) reported in Table 3.34. The fuel quantity reported in Table 1.A(d) of the CRF in TJ is the amount of fuels stored and the fractions of carbon stored are consequently equal to 1. Non-energy products quantity amount stored from refineries are reported in the BEN and the carbon stored is estimated with emission factors reported in Table 3.35. As can be seen from the value reported for the year 2010, there is a sizeable difference of the estimated quantities of fuel stored in product if reference is made to “net” or “gross” input. Moreover the estimation of quantities stored in product are quite different from those reported in the Revised 1996 IPCC Guidelines for National GHG Inventories, Reference Manual, ch1, tables 1-5 (IPCC, 1997). An attempt was made to estimate the quantities stored in products using IPCC percentage values (tables 1-5 of the IPCC Guidelines) and the amount of fuels reported as “petrochemical input” in Table 3.34. The resulting estimate of about 6,279 Gg of products, for the year 2010, is almost 50% bigger than the quantities reported, 4,443 Gg.	Italian Greenhouse Gas Inventory 1990-2010 National Inventory Report 2012, March 2012, p100
Luxembourg	Non-energy use of fuels is considered in the national energy balance. Below explanations for the reported non-energy use is provided together with information on where CO_2 emissions due to the manufacture, use and disposal of carbon containing products are considered. For fraction of carbon stored the IPCC default values are applied for all. Lubricants Manufacturing: manufacturing of lubricants does not occur in Luxembourg. Use: Emissions from the use of motor oil (by default 50% of the total quantity of lubricants sold) should be included in CO_2 emissions from transport. It is assumed that other uses of lubricants do not result in VOC or CO_2 emissions due to the low vapour pressure of lubricants. Disposal: incineration of lubricants (waste oil) does not occur in Luxembourg. Waste oil is either recycled or exported. Bitumen Manufacturing: manufacturing of bitumen does not occur in Luxembourg. Use: by default the carbon contained in bitumen is considered to be entirely stored in the product, i.e. asphalt for road paving. Disposal: CO_2 emissions from the disposal of bitumen are assumed to be negligible. Recycling is not considered. Coke oven coke Manufacturing: not occurring. All coke used in the iron and steel industry was imported. Use: CO_2 emissions from coke used in iron and steel industry are reported under 2.C.1 – Iron and Steel Production. Disposal: not applicable. Other bituminous coal Manufacturing: Manufacturing of electrodes from anthracite used in the electric arc furnaces does not occur in Luxembourg. Use: Emissions from the use of electrodes in the iron and steel production are considered in category 2.C.1 – iron and steel production. Disposal: not applicable. Other oil products Manufacturing: not occurring. All products such as white spirits, etc. are imported. Use: CO_2 emissions from solvent use are considered in sector 3. Disposal: emissions from the disposal of plastics in landfills are considered in 6.A and emissions from incineration of plastics in waste with energy recovery are considered in 1 A 1 a.	Luxembourg’s National Inventory Report 1990-2009 Apr 2011 p. 154f

MS	Information on feedstocks and non-energy use of fuels	Source
Netherlands	51% of the gross national consumption of petroleum products is used in non-energy applications. These fuels are mainly used as feedstock (naphta) in the petrochemical industry and in products in many applications (bitumen, lubricants, etc.). Also a fraction of the gross national consumption of natural gas (6%, mainly in the ammonia production) and coal (3%, mainly in the iron and steel production) is used for non-energy applications and hence not directly oxidised. In many cases, these products will finally be oxidised in waste incinerators or during use (e.g. lubricants in two stroke engines). In the Reference Approach these product flows are excluded from the calculation of CO_2 emissions.	Greenhouse Gas Emissions in the Netherlands National Inventory report 2012 1990-2010 p. 61
Portugal	Emissions of greenhouse gas emissions from feedstock use are only clearly accounted in the inventory in the following situations: - emission of CO_2 resulting from use of feedstock sub-products as energy sources. That is the case of emissions from consumption of fuel gas in refinery and petrochemical industry; - emission of CO_2 liberated as sub-product in production processes such as ammonia production; - emission of NMVOC from fossil fuel origin, and occurring from solvent use and evaporation. Although in this case it is not possible to establish which part results from feedstock consumption in Portugal in the energy balance; However, some potential emissions are not estimated or are only partly estimated. Those that are estimated in the reference approach but not in sectoral approach are: - emissions from mineral oil use as lubricants; - emissions from wear of bitumen in roads. It is evident that more efforts should be made to estimate other emissions from feedstock use, although it is expected that reporting guidelines should give more clear guidance in the future.	Portuguese National Inventory Report on Greenhouse Gases 1990-2010 Ma 2012 p.3-209
Spain	The consumption of fuel for non-energy use is accounted for in the energy balance. The quantities of each fuel type are included in the reference approach. For each fuel type a split into two parts is given: a) the part that stays in the product and b) the part that is set free and causes the corresponding CO_2 emissions.	Inventario de emissiones de gases de efecto invernadero de Espana años 1990-2006, March 2008,p. 1.23
Sweden	Activity data on feedstocks and non-energy use of fuels is collected from the quar-terly fuel statistics. As also noted in Annex 2 section 1.1.1, in the survey form for the quarterly fuel statistics, respondents are among many other things asked to specify whether fuels are used as raw materials or for energy purposes. This facili-tates the use of data for CRF table 1.A.d, non-energy use of fuels. Data on carbon from coke, bound in produced ferroalloys is collected directly from the only ferroalloy producer and is added to the remaining data on carbon from coke. Estimates of carbon stored are derived by multiplying given energy amount with emission factors for CO_2 (as given in Annex 2 section 1.2 and Appendix 1) multiplied by 12/44 (the weight of one atom of carbon is by definition 12/44 the weight of one molecule of CO_2). CO_2 emissions derived from non-energy use of fuels and reported under CRF 1.B and CRF 2 (e.g. flaring of gases and iron and steel process emissions) are added under CRF 1.A.d and linked to the CRF 1.A.b as carbon stored (see Annex 4).	National Inventory Report 2012 Sweden Mar 2012 pp. 95-96

MS	Information on feedstocks and non-energy use of fuels	Source
United Kingdom	Following the review of stored carbon, the procedure adopted is to assume that emissions from the non-energy use of fuels are zero (i.e. the carbon is assumed to be sequestered as products), except for cases where emissions could be identified and included in the inventory: • Catalytic crackers – regeneration of catalysts; • Ammonia production; • Aluminium production – consumption of anodes; • Combustion of waste lubricants and waste solvents; • Burning of lubricants during use in engines; • Use of waste products from chemical production as fuels; • Emissions of carbon due to use and/or disposal of chemical products; • Incineration of fossil carbon in products disposed of as waste. In addition, an estimate is made of lubricants burnt in vehicle engines. Carbon emissions from these sources are calculated using a carbon factor derived from analysis of eight samples of waste oil (Passant, 2004). In 2005, the combustion of lubricating oils within engines was reviewed. Analysis by UK experts in transport emissions and oil combustion have lead to a revision to the assumptions regarding re-use or combustion of lubricating oils from vehicle and industrial machinery. The fate of the unrecovered oil has now been allocated across several IPCC source sectors including road, rail, marine, off-road and air transport. Emissions from these sources are reported under 1A3b, 1A3d & 1A4c. Some of the unrecovered oil is now allocated to non-oxidising fates such as coating on products, leaks and disposal to landfill. Emissions can occur from products from the chemical industry. Sources of emissions include burning of waste products and final products (e.g. flaring and use of wastes as fuels, or burning of candles, firelighters and other products etc.) or degradation of products after disposal resulting in CO_2 emissions (including breakdown of consumer products such as detergents etc.). After considering the magnitude of the sources in relation to the national totals, the uncertainty associated with emissions, and the likely reporting requirements in the 2006 IPCC Guidelines, emissions of carbon from the following sources were included in the 2004 GHG inventory (2006 NIR) and subsequent NIRs: • Petroleum waxes; • Carbon emitted during energy recovery - chemical industry; • Carbon in products - soaps, shampoos, detergents etc; and • Carbon in products – pesticides..	UK Greenhouse Gas Inventory, 1990 to 2010 Mar 2012 Annex 3, pp. 525-527

4 Industrial processes (CRF Sector 2)

This chapter starts with an overview on emission trends in CRF Sector 2 Industrial processes. Then for each EU-15 key source overview tables are presented including the Member States (MS)' contributions to the key source in terms of level and trend, and information on methodologies and emission factors. The quantitative uncertainty estimates are summarised in a separate section. Finally, the chapter includes a section on recalculations and on sector-specific QA/QC activities. In addition, overviews of Member States' responses to UNFCCC review findings for industrial processes source categories are provided.

4.1 Overview of sector (EU-15)

CRF Sector 2 Industrial Processes is the third largest sector contributing 8 % to total EU-15 GHG emissions in 2010. The most important GHGs from this sector are CO_2 (5 % of total GHG emissions), HFCs (1.5 %) and N_2O (0.8 %). The emissions from this sector decreased by 25 % from 353 Tg in 1990 to 265 Tg in 2010 (Figure 4.1). In 2010, the emissions increased by 3 % compared to 2009, due to the recovery from the economic recession. Cement production dominates the trend until 1997. Factors for declining emissions in the early 1990s were low economic activity and cement imports from Eastern European countries. Between 1997 and 1999 the trend is dominated by reduction measures in the adipic acid production in Germany, France and the UK. In addition, between 1998 and 1999 large reductions were achieved in the UK due to reduction measures in hydrochlorofluorocarbons (HCFC) production. The large decrease in 2009 was driven by reductions in cement production and a significant drop in the iron and steel production asa consequence of the economic crisis.

The key sources in this sector are:

- 2 A 1 Cement Production: (CO_2)
- 2 A 2 Lime Production: (CO_2)
- 2 A 3 Limestone and Dolomite Use: (CO_2)
- 2 B 1 Ammonia Production: (CO_2)
- 2 B 2 Nitric Acid Production: (N_2O)
- 2 B 3 Adipic Acid Production: (N_2O)
- 2 B 5 Other: (CO_2)
- 2 C 1 Iron and Steel Production: (CO_2)
- 2 C 3 Aluminium production: (PFC)
- 2 E 1 By-product Emissions: (HFC)
- 2 E 1 By-product Emissions: (SF_6)
- 2 E 2 Fugitive Emissions: (HFC)
- 2 F 1 Refrigeration and Air Conditioning Equipment : (HFC)
- 2 F 3 Fire Extinguishers: (HFC)
- 2 F 4 Aerosols/ Metered Dose Inhalers: (HFC)

Figure 4.1 **CRF Sector 2 Industrial Processes: EU-15 GHG emissions for 1990–2010 in CO_2 equivalents (Tg)**

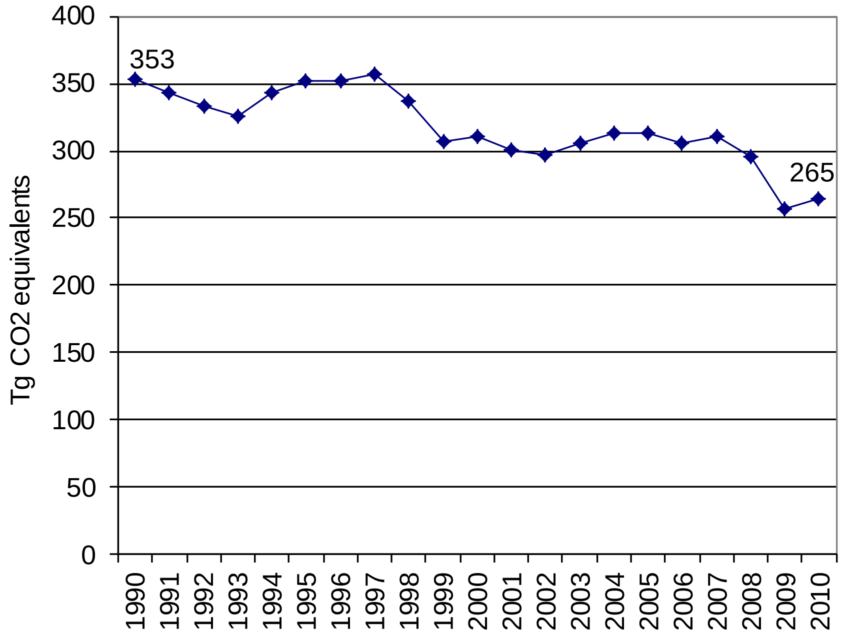
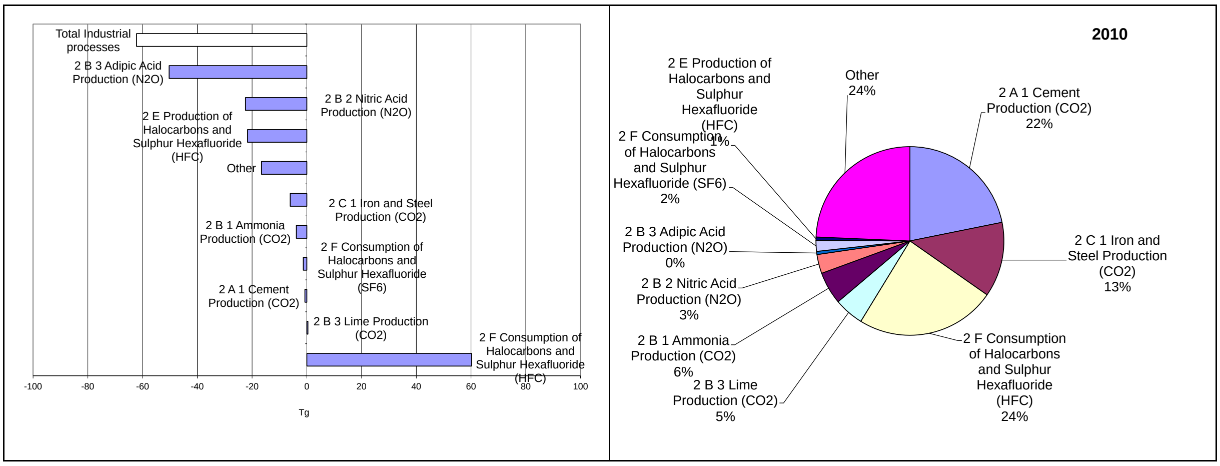


Figure 4.2shows that large emission reductions occurred in adipic acid production (N_2O) mainly due to reduction measures in Germany, France, the UK and Italy, and in production of halocarbons and SF_6 (HFCs). Additional N_2O emission reductions were achieved in nitric acid production. Large HFC emission increases can be observed from consumption of halocarbons and SF_6. Figure 4.2 shows that the three largest key sources account for about two thirds of total process-related GHG emissions in the EU-15.

Figure 4.2 **CRF Sector 2 Industrial processes: Absolute change of GHG emissions by large key source categories 1990–2010 in CO_2 equivalents (Tg) and share of largest key source categories in 2010**



4.2 Source categories (EU 15)

4.2.1 Mineral products (CRF Source Category 2A) (EU-15)

The source category 2A Mineral Products includes three key categories: CO_2 from 2A1 Cement Production, CO_2 from 2A2 Lime Production and CO_2 from 2A3 Limestone and Dolomite Use. In source category 2A1 Cement Production by-product CO_2 emissions occur during the production of clinker, an intermediate component in the cement manufacturing process. Source category 2A2 Lime Production accounts for CO_2 emitted through the calcination of the calcium carbonate in limestone or dolomite for lime production. Source category 2A3 Limestone and Dolomite Use covers a number of industrial applications generating CO_2 through the heating of limestone or dolomite, such as in metallurgy (iron and steel), ceramics production, non-metallurgical magnesia production or environmental pollution control (flue gas desulphurization). Sugar refining, CO_2 emissions from glass production are reported under 2A5 Other.

Table 4.1 summarizes Member States' emissions from Mineral Products in 1990 and 2010. CO_2 emissions from Mineral Products decreased by 18 %, especially since 2007 mainly driven by the decrease in cement production due to the economic crisis. Only four EU-15 Member States increased their CO_2 emissions during the period 1990 to 2010 (Ireland, the Netherlands, Portugal and Sweden); Portugal had the largest emission increase in absolute terms and United Kingdom the largest absolute emission reduction in the period 1990-2010.

Table 4.1 2A Mineral Products: Member States total GHG and CO_2 emissions

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2010 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO2 emissions in 2010 (Gg)
Austria	3,274	2,936	3,274	2,936
Belgium	5,337	4,609	5,337	4,609
Denmark	1,069	796	1,069	796
Finland	1,259	1,206	1,259	1,206
France	16,401	12,264	16,401	12,264
Germany	22,976	18,600	22,976	18,600
Greece	6,709	4,925	6,709	4,925
Ireland	1,117	1,299	1,117	1,299
Italy	21,303	17,676	21,303	17,676
Luxembourg	623	453	623	453
Netherlands	1,172	1,254	1,172	1,254
Portugal	3,489	4,084	3,488	4,083
Spain	15,404	14,535	15,404	14,535
Sweden	1,722	2,077	1,722	2,077
United Kingdom	10,190	5,483	10,166	5,477
EU-15	**112,044**	**92,196**	**112,020**	**92,189**

Abbreviations explained in the Chapter 'Units and abbreviations'.

4.2.1.1 2A1-Cement Production

CO_2 emissions from Cement Production account for 1.7 % of total EU-15 GHG emissions in 2010. In 2010, CO_2 emissions from Cement Production were 20 % below 1990 levels in the EU-15 (Table 4.2).

Figure 4.3 2A1 Cement Production: EU-15 CO_2 emissions

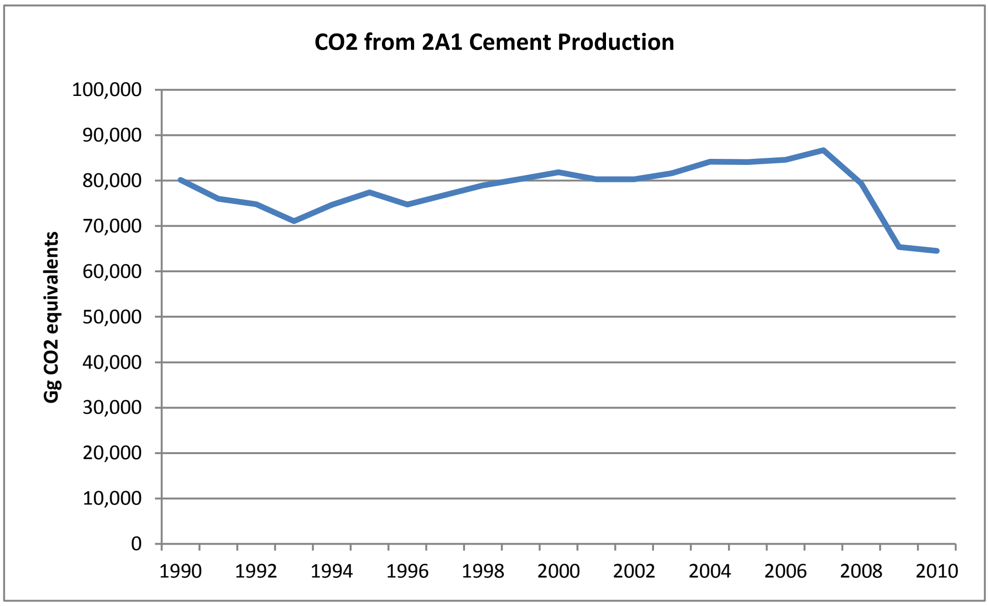


Figure 4.3 provides information on emission trends of the key source CO_2 from 2A1 Cement Production by Member State. In 2010, Italy and Germany are the largest emitters accounting for 20.6 % and 18.9 % respectively of EU-15 emissions, followed by Spain (17.4 %). Emissions from 2A1 Cement Production show a significant drop after 2007 in all Member States due to the economic crisis which decreased the construction activities in all countries. In 2010 CO_2 emissions increased again due to a recovery from the economic crisis in Finland, Luxembourg, Portugal, Sweden and UK, but continued to further decline in the other EU-15 MS which is mirrored by decreasing construction activities in these countries. In Italy, the effects of the global recession period have led to two plants closures.

Table 4.2 2A1 Cement production: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)		
Austria	2,033	1,799	1,622	2.5%	-176	-10%	-411	-20%	CS,T1	PS
Belgium	2,824	2,795	2,582	4.0%	-213	-8%	-241	-9%	T3	PS
Denmark	882	764	672	1.0%	-92	-12%	-210	-24%	CS	PS
Finland	734	382	524	0.8%	142	37%	-210	-29%	T2	CS
France	10,937	7,679	7,887	12.2%	208	3%	-3,050	-28%	T2, T3	PS
Germany	15,146	12,313	12,188	18.9%	-125	-1%	-2,958	-20%	T2	CS
Greece	5,641	4,582	4,209	6.5%	-373	-8%	-1,432	-25%	CS	PS
Ireland	884	1,327	1,105	1.7%	-222	-17%	221	25%	T2	PS
Italy	16,084	13,341	13,276	20.6%	-65	0%	-2,808	-17%	T2	CS,PS
Luxembourg	570	378	391	0.6%	13	4%	-178	-31%	T2	CS,PS
Netherlands	416	416	348	0.5%	-68	-16%	-68	-16%	CS	PS
Portugal	3,176	3,223	3,376	5.2%	154	5%	200	6%	T3	OTH
Spain	12,279	11,402	11,209	17.4%	-193	-2%	-1,070	-9%	T2	CS
Sweden	1,272	1,287	1,350	2.1%	64	5%	78	6%	T2	PS
United Kingdom	7,295	3,720	3,792	5.9%	72	2%	-3,503	-48%	T2	CS
EU-15	**80,174**	**65,407**	**64,532**	**100.0%**	**-874**	**-1%**	**-15,642**	**-20%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.3 shows information on methods applied, activity data, emission factors for CO_2 emissions from 2A1 Cement Production for 1990 and 2010. 100 % of EU-15 emissions are estimated with higher Tier methods and most MS use plant-specific emission factors. In response to the recommendations by the ERT, Denmark used clinker production data as activity data for its 2010 greenhouse gas (GHG) inventory submission, thus harmonization across Member States was achieved (FCCC/ARR/2009/EC, para 49).

The implied emission factors per tonne of clinker produced vary from 0.50 t CO_2/t of clinker produced for Finland and the Netherlands to 0.55 t CO_2/t of clinker produced for Sweden. Except for Portugal, all MS use country-specific and plant-specific emission factors. The EU-15 implied emission factor (IEF) (excluding UK that indicated that emission factors and activity data for the production of cement are commercially sensitive and therefore confidential) is 0.53 t CO_2/t of clinker produced.

A noticeable decrease of IEF in the period 1990 to 2010 could only be found for Denmark, Hungary and Latvia, whereas no significant increase or decrease of IEFs during that time could be found for the other MS (IEFs for Hungary and Latvia are explained in the section on new MS).

The EF in Denmark decreased primarily during 1990 and 1996 (-18 %) which is due to the ratio white/grey cement and the ratio rapid cement (GKL-clinker)/basis cement (FHK-clinker)/low alkali cement (SKL-RKL-clinker). The ratio white/grey cement is known from 1990-1997 with maximum in 1990 and thereafter decreasing.

Due to a question raised during the Centralized review in 2010, table 4.3 was corrected for Belgium and Luxembourg, as these MS use a Tier 2 methodology to estimate CO_2 emissions from cement production instead of Tier 3.

Table 4.3 2A1 Cement Production: Information on methods applied and emission factors for CO_2 emissions

Member State	Method applied	Emission factor	1990 Activity data Description	1990 Activity data (kt)	1990 Implied emission factor (t/t)	1990 CO_2 emissions (Gg)	2010 Activity data Description	2010 Activity data (kt)	2010 Implied emission factor (t/t)	2010 CO_2 emissions (Gg)
Austria	CS,T1	PS	Clinker production	3694	0.55	2033	Clinker production	3097	0.52	1622
Belgium	T3	PS	Clinker production	5292	0.53	2824	Clinker production	4740	0.54	2582
Denmark	CS	PS	Clinker production	1406	0.63	882	Clinker production	1314	0.51	672
Finland	T2	CS	Clinker production	1470	0.50	734	Clinker production	1049	0.50	524
France	T2, T3	PS	Clinker production	20854	0.52	10937	Clinker production	14901	0.53	7887
Germany	T2	CS	Clinker production	28577	0.53	15146	Clinker production	22996	0.53	12188
Greece	CS	PS	Clinker production	10645	0.53	5641	Clinker production	7927	0.53	4209
Ireland	T2	PS	Clinker production	1610	0.55	884	Clinker production	2053	0.54	1105
Italy	T2	CS,PS	Clinker production	29786	0.54	16084	Clinker production	25239	0.53	13276
Luxembourg	T2	CS,PS	Clinker production	1048	0.54	570	Clinker production	736	0.53	391
Netherlands	CS	PS	Clinker production	770	0.54	416	Clinker production	701	0.50	348
Portugal	T3	OTH	Clinker production	6128	0.52	3176	Clinker production	6484	0.52	3376
Spain	T2	CS	Clinker production	23212	0.53	12279	Clinker production	21229	0.53	11209
Sweden	T2	PS	Clinker production	2348	0.54	1272	Clinker production	2454	0.55	1350
UK	T2	CS	Clinker production	C	C	7295	Clinker production	C	C	3792
EU15			**EU15 w/o UK (91%)**	**136,839**	**0.53**	**72,878**	**EU15 w/o UK (94%)**	**114,920**	**0.53**	**60,740**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.4 summarizes the methodological information provided by EU-15 Member States in their national inventory reports for cement production. A number of Member States use data collected from plants under the EU emission trading scheme.

Table 4.4 2A1 Cement Production: Summary of methodological information provided by Member States

Cement Production	
Member State	**Methodology comment**
Austria	Emissions were estimated using a country specific method similar to the IPCC Tier 2 methodology. AD (clinker production) as well as emission were taken from studies from the Austrian cement production industry covering the years 1988 to 2003. The determination of the emission data took place by inspection of every single plant, recording and evaluation of plant specific records and also plant specific measurements and analysis carried out by independent scientific institutes. Activity data and emissions for 2004 were reported directly by the Association of the Austrian Cement Industry as well as activity data for 2005-2009. For 2005-2010 verified CO2 emissions, reported under the ETS, were used for the inventory. These data cover the whole cement industry in Austria. The methodology for these emission calculations is the same like in the years before. CO2 emissions from the raw meal calcination (decarbonising) were calculated from the raw meal composition determined at every Austrian plant, considering also the MgCO3 content of the raw meal. [NIR 2012].
Belgium	The AD is the clinker production collected directly from individual plants following the Tier 2 method. An average EF by plant has been estimated in 2002 and is applied for the time-series 1990-2001. Since 2002, the EF varies each year and was calculated directly for each plant. Since 2004, plant data’s include information on the CaO content of the clinker and non-carbonate sources of CaO. The CO2 EF is estimated as described for Tier 2 method. [NIR 2012]
Denmark	The CO2 emission from the production of cement has been estimated by the company. The emission factor has been estimated from the loss of ignition determined for the different kinds of clinkers produced, combined with the volumes of grey and white cements produced. Determination of loss of ignition takes into account all the potential raw materials leading to release of CO2 and omits the Ca-sources leading to generation of CaO in cement clinker without CO2 release. From the year 2005 onwards CO2 emissions determined by the company for EU-ETS is used in the inventory. [NIR 2012]
Finland	Emissions were calculated using a Tier 2 methodology. The amount of clinker produced annually is used as AD. Data for the years 1990-2006 are received directly from the company and for years 2007-2010 from EU ETS data. EFs used in the calculation of emissions from cement production are plant-specific provided by the industry for the whole time series (except for plant 3 where the mean of the two other plant is applied). [NIR 2012]
France	France uses a Tier 2 method for the earlier year and Tier 3 method for more recent years. The methodology based on national statistics (clinker statistics) from cement association and national EFs from industry. Since 2004 detailed plant-specific data with plant-specific EF and emissions reported under the EU-ETS are used. Since 2008, annual data considering all three sources (calcination of carbonates in the raw materials used to produce the clinker, the partial calcination of cement kiln dust or bypass dust, the non-carbonate carbon in raw materials) is used. [NIR 2012]
Germany	Activity data from BDZ were used until 1994. As of 1995, following improvement of data collection within the association, activity data were compiled by the VDZ, and by its cement-industry research institute, via surveys of German cement plants. The emission factor used is 0.53 t CO2 / t cement clinker, which is based on mass-weighted EFs for individual plants, i.e. the VDZ determined the emission factor by aggregating plant-specific data relative to fractions of CaO and other metal oxides (MgO; in raw materials, and containing carbonate) in clinker. [NIR 2012]
Greece	For the years 2005-2010 detailed data have been accessed via the verified EU ETS reports of the plants. These data refer to the quantities of carbonate raw material (CaCO3, MgCO3) used for the production of clinker. In the recent years (2008 – 2010) the plants report also emissions from non-carbonate carbon (organic carbon). Emissions prior to 2005 in the past were calculated using the Tier 2 methodology, based on clinker production. Following the change of the methodology to Tier 3, and according to the IPCC GPG, the overlap method has been used in order to ensure the consistency of the time-series. [NIR 2012]
Ireland	In 2004, plant-specific information relating to CO2 emissions in 2002 and 2003 was obtained by the EPA for all cement plants for the development of Ireland’s First National Allocation Plan. The reported process CO2 emissions for each plant in 2002 and 2003 were calculated using the Tier 2 method. As the EU ETS subsequently became operational, plant specific CO2 emissions and corresponding clinker production data are also available for all cement plants for the years 2004 through 2010 and these data are used directly to report emissions for category 2.A.1 in Ireland. [NIR 2012]
Italy	CO2 emissions from cement production are estimated by the IPCC Tier 2 approach. Activity data comprise data on clinker production provided by ISTAT (ISTAT, several years). Emission factors are estimated on the basis of information provided by the Italian Cement Association (AITEC, several years) and by cement facilities in the framework of the European pollutant emission register (EPER, now E-PRTR) and the European emissions trading scheme. [NIR 2012]
Luxembourg	In Luxembourg, one clinker production plant is operating. During the production of clinker, limestone, which is mainly calcium carbonate (CaCO3), is calcined to produce lime (CaO) and CO2 as a by-product. Activity data, i.e. clinker production, is obtained annually from the plant operator. For the estimation of CO2 emissions, the Tier 2 method of 2000 IPCC-GPG using clinker production data is applied. [NIR 2012]
Netherlands	For cement clinker production the environmental reports (AER) of the single Dutch company are used. Because of changes in raw material composition it is not possible to estimate reliable CO2 process emissions by calculating the clinker production (as AD) by a default EF. For that reason the company has chosen to base the calculation of CO2 emissions on the carbonate content of the process input. [NIR 2012]

Cement Production	
Member State	**Methodology comment**
Portugal	EU-ETS method A from Annex VII of Decision 2007/589/EC is used for the period 2005-2010. Calculation is based on the carbonate content of process inputs (including fly-ash or blast furnace slag) with cement kiln dust (CKD) and bypass dust deducted from raw material consumption (Tier 3). For the period 1990-2004, emissions were estimated based on clinker production time series. Data on consumption of raw materials, was obtained for the period 2005-2010 from EU-ETS. Clinker production for all the years from 1990 to 2010, was received directly from each industrial plant, and the correspondent time series may be observed in next figure. Total clinker production for 1990-2010 as reported in the National Statistical Database from INE is fully consistent with the sum of the information received from each individual plant. [NIR 2012]
Spain	The estimation of CO2 emissions for this activity has been performed by using the Tier 2 method and by applying an emission factor per quantity of clinker produced. Clinker production data and the applied EF are obtained from associations of cement production (OFICEMEN). The EF was derived from data on ton of clinker produced for the period 2005-2009 as provided by OFICEMEN. The original source of the EFs are the data provided by the cement plants under the EU ETS. For the years prior to the start of the EU ETS, the average EF for 2005 was used. [NIR 2012]
Sweden	Emissions have been estimated based on ETS data as well as direct information from the company based on clinker production. A cement kiln dust (CKD) correction factor is used. For CO2 estimates for 1990-2004, the cement company uses the GHG protocol made on initiative by the WRI for the WBCSD. Since 2005, data on clinker production has been acquired through the ETS. [NIR 2012]
UK	The methodology used for estimating CO2 emissions from calcination is to use data provided by theMineral Product Association (2011), which in turn is based on data generated by UK cement clinker producers for the purposes of reporting to the EU Emission Trading Scheme. The data are available for 2005 to 2010 only, and so the value for 2005 has been applied to earlier years as well. Previously, estimates had been based on the IPCC Tier 2 approach (IPCC, 2000), yielding an emission factor of 137.6 t C/kt clinker. The revised emission factors are about 10% higher than this figure and the reasons for this disparity are that the previous emission factor: • Slightly underestimated the CaO content of clinker produced; and • Failed to take account of CO2 emitted from dolomite (i.e. the method assumed a zero MgO content, which was not correct). [NIR 2012]
According to the analysis presented in Table [above] all MS estimate emissions with higher tier methods.	

Source: NIR 2012.

According to the analysis presented in Table 4.4 all MS estimate emissions with higher tier methods.

Table 4.5 summarizes the recommendations from the 2010 and 2011 UNFCCC inventory reviews in relation to the category 2A1 Cement Production. The overview shows that reports from the centralized and in-country reviews conducted in 2011 are still lacking for many Member States until now and were only available for Finland and Greece. Recommendations from the 2010 UNFCCC inventory review are included for those MS for which no 2011 review reports are available.

Table 4.5 **2A1 Cement Production: Findings of the 2010 and 2011 UNFCCC inventory reviews in relation to CO_2 emissions and responses in 2012 inventory submissions**

Member State	Review findings and responses related to 2A1 Cement Production	
	Comment UNFCCC report of the review of the 2010/2011 submission	**Status in 2012 submission**
Austria	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2010/AUT). Review report (Centralized review 2011) not yet available.	No follow-up necessary
Belgium	As indicated in the previous review report, it is not clear whether the impact of the magnesium oxide (MgO) content in clinker on the CO2 EFs has been considered for the whole time series. In response to questions raised by the ERT during the review, Belgium provided an additional description of the methodology used to determine the EFs and confirmed that the MgO content in clinker has been considered for the estimates since 2004. The ERT recommends that the Party apply the same approach to the EFs for the entire time series, in order to improve time-series consistency, and improve the documentation on the EF in the NIR, in order to improve the transparency of the next annual submission. (FCCC/ARR/2011/BEL para 58)	In the NIR it is explained that since 2004, plant data had included information on the CaO and MgO content of the clinker and non-carbonate sources of CaO. The calculation is performed by the operators themselves and subject to independent review in the framework of the Emission Trading Scheme. The same approach cannot be applied to the emission factors for the entire time series because of a lack of plant-specific data on the MgO and CaO content of the clinker and non-carbonate sources of CaO and MgO. That is the reason why an average emission factor by plant was estimated in 2002 and applied on the all time-series 1990-2001. [NIR 2012, p.91]
Denmark	The ERT also questioned the Party, during the review, as to whether it accounts for imports and exports for the early years of the time series, which are required to be taken into account when using a tier 1 approach. The Party responded to the ERT that it believes that clinker production at that time was solely for the company's own use, but that it will research this further and confirm in its next annual submission. The ERT recommends that Denmark conduct this research to ensure that the tier 1 approach is being implemented in accordance with the IPCC good practice guidance for estimating emissions for the early years of the time series. (FCCC/ARR/2011/DNK, para 71)	The work is on-going. [NIR 2012, p.565]
	The ERT further questioned Denmark on its consideration of cement kiln dust (CKD) in the time series of emission estimates, in particular for the earlier years. Denmark responded that, although it is known that the emission estimates are based on the different types of clinker used, there is no information to indicate whether CKD is included in the emission estimates. The ERT recommends that Denmark continue to pursue any information that could clarify whether CKD is included in the emission estimates for all years of the time series. (FCCC/ARR/2011/DNK, para 72)	The ERT has been informed that no further information is available for the years1990-1997. The work with including CKD in the emission estimates is on-going. [NIR 2012, p. 565]
Finland	The ERT recommends that Finland explain the increasing trend in CO2 emissions from 1993 onwards and provide the total rated clinker production capacity of cement plants in Finland in the next annual submission. For cement production Finland applies a correction factor of 0.92 to account for non-carbonate sources of calcium oxide (CaO) in the raw materials. This factor causes Finland to have one of the lowest IEFs (0.50 t/t for 2009) of all reporting Parties (0.49–0.56 t/t). The source of the IEF is mentioned; however, it is not included in the list of references in the NIR. The ERT recommends that Finland include this information in the NIR of the next annual submission. (FCCC/ARR/2011/FIN)	Finland explained that the decrease was due to the economic recession and the closing of a plant in 1993, while the increase in the latter period of the time series is due to an increase in clinker production. Finland also clarified that the production capacity is not relevant in this respect, and that it would increase the resources needed for data collection unduly.The reference related to the correction factor is included in the NIR.
France	Three different periods are visible: from 1990 to 2003 the IEF is 0.525 t/t clinker; between 2004 and 2007 the IEF decreases from 0.520 to 0.517 t/t clinker; and for 2008, the IEF is higher than in the three previous years and is based on a new methodology. The ERT notes that the time series is not consistent or in line with the IPCC good practice guidance, which requires time-series consistency. The ERT recommends that France recalculate the emissions for the entire time series for the next annual submission. The ERT recommends that France report this information on technologies and linkages to CKD consideration in the next annual submission. Review report (Centralized review 2011) not yet available.	The reasons for the different IEFs are explained in the NIR. The tier 2 method cannot be appplied for the entire time-series due to lack of historic data. The approach chosen seems to be in line with IPCC methodologies to achieve time-series consistency. It should also be noted that the differences in IEFs are very small and practically no longer visible, if values are rounded to 2 digits. It does not seem appropriate to note time series inconsistenciesdue to such small variations in IEFs. Improved information provided in the NIR.
Germany	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2010/AUT). Review report (Centralized review 2011) not yet available.	No follow-up necessary
Greece	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/GRC)	No follow-up necessary
Ireland	The Party does not report information on the calcium oxide (CaO) and magnesium oxide (MgO) contents of the clinker that are used to derive the country-specific estimates. Review report (Centralized review 2011) not yet available.	No information on CaO and MgO contents provided.
Italy	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2010/AUT). Review report (Centralized review 2011) not yet available.	No follow-up necessary
Luxembourg	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/LUX).	No follow-up necessary

Member State	Review findings and responses related to 2A1 Cement Production	
	Comment UNFCCC report of the review of the 2010/2011 submission	Status in 2012 submission
Netherlands	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/NLD).	No follow-up necessary
Portugal	The key recommendations are that Portugal develop country-specific values for CO2 emissions from cement production. During the review, the ERT was informed that Portugal will implement new estimates based on the EU ETS methodology (kiln input-based methodology) in its 2011 submission. The ERT welcomes this planned improvement and recommends that Portugal report its emission estimates accordingly in its next annual submission. Review report (Centralized review 2011) not yet available.	Higher Tier method based on EU ETS data was implemented.
Spain	The ERT recommends that Spain recalculate the emission estimates and the IEF time series for the whole period (1990–2008), ensuring consistency in accordance with the IPCC good practice guidance, and provide the necessary transparent information (e.g. on contents of CaO and MgO and CKD) in the NIR of its next annual submission. Review report (In-country review 2011) not yet available.	No recalculations performed, no information on CaO, MgO and CKD provided.
Sweden	The ERT recommends that Sweden report on the results of the aforementioned discussions with the cement producing company, improve the emission estimates, as appropriate, and provide clear descriptions of the AD used in its next annual submission. Review report (Centralized review 2011) not yet available.	Clear descriptions of AD used provided in the NIR. Plant-specific data based on information fro cement producting companies reported.
UK	Following the recommendations of the previous review report, the Party has identified CO2 emissions from cement production as a key category in its 2011 submission. The United Kingdom mentioned in the NIR that the emission estimates were based on plant-specific data since 2005 for the existing 13 cement plants, and that the EFs for 2005 have been applied to the early years to improve time-series consistency and accuracy. However, as both AD and EFs are reported as confidential in the CRF tables and in the NIR to protect the ommercial sensitivity of the single cement production plant in Northern Ireland, the ERT considers it is not clear whether the decrease of CO2 emission from this category (by 28.5 per cent between 2008 and 2009) was caused by a decline in AD or EFs. During the review, based on the aggregated clinker production figures provided by the United Kingdom, the ERT concluded that the decline in emissions in recent years was a result of a decline in clinker production, while the implied emission factors (IEFs) remain quite stable across the whole time series. The ERT recommends therefore that the United Kingdom explain the trend of cement production in its next annual submission. (FCCC/ARR/2011/GBR, para 62)	The NIR states that:" The sharp decrease in production since 2007 is linked to the recession, which has caused a decline in construction and therefore demand for cement. A number of cement kilns were closed or mothballed during 2008 and 2009." [NIR 2012, p.124]

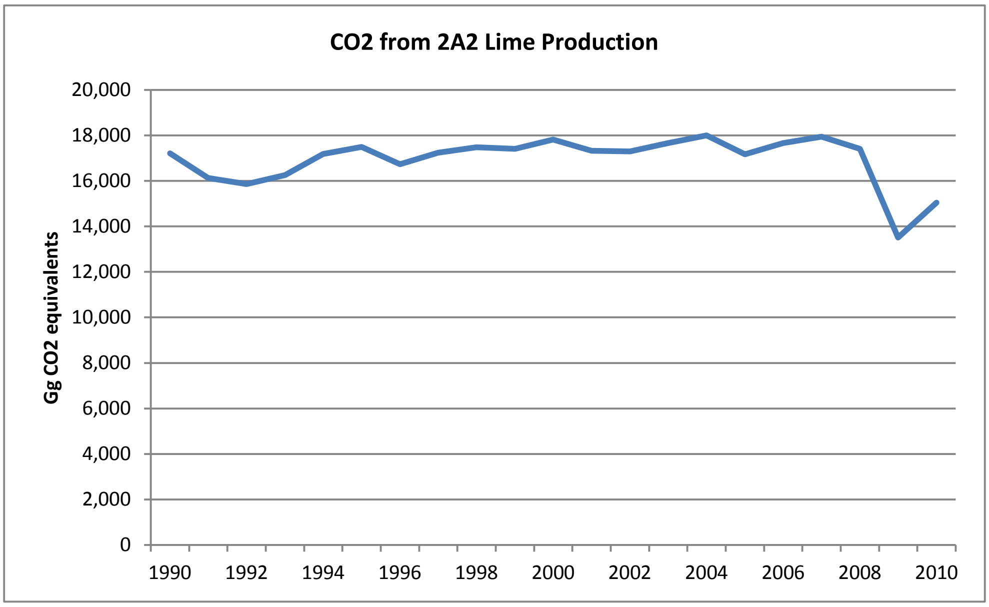
Source: NIR 2012, UNFCCC inventory review reports, as published at UNFCCC: http://unfccc.int/national_reports/annex_i_ghg_inventories/inventory_review_reports/items/5687.php

4.2.1.2 2A2 Lime Production

CO_2 emissions from 2A2 Lime Production account for 0.4 % of total GHG emissions in 2010. Between 1990 and 2010, CO_2 emissions from this source decreased by 13 % in the EU-15. Germany and France are the largest emitters accounting for 34 % and 15 % of EU-15 emissions respectively, followed by Italy (13 %). Compared to 2009, emissions increased by 11 % for the EU-15. The decrease of CO_2 emissions in the early nineties was dominated by emission reductions in Germany, Belgium, France and the UK due to a decreased production of lime and dolomite.

Between 1993 and 1994 emissions in the EU-15 increased by 6 %. This increase was caused by a raised production rate of lime in Germany and France in that period (Figure 4.4). In 2009, lime production decreased sharply due to the economic crisis in all MS, many MS also showed decreasing lime production in 2007 and 2008. In 2010 lime production increased again due to the improved economic situation in all MS, except for the UK. In the UK, limestone and dolomite consumption data are derived from the British Geological Survey, 2009, but have not been available in time for inclusion in the inventory. Therefore, it has been the practice to assume that limestone calcinations are the same in the latest year (in this case, 2010) as in the previous year.

Figure 4.4 **2A2 Lime Production: EU-15 CO_2 emissions**



Germany was responsible for 33.5 % of the emissions from this source in 2010. The decrease of emissions in the early nineties was dominated by the drop in German lime production due to the sector's restructuring following German reunification, as well as of economic factors and development of competing and substitute products. In 2010, 8 MS reduced their emissions since 1990 and 5 MS increased their emissions from this source category.

Table 4.6 **2A2 Lime Production: Member States' contributions to CO_2 emissions**

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)		
Austria	396	507	574	3.8%	67	13%	178	45%	CS	CS,PS
Belgium	2,097	1,475	1,648	11.0%	174	12%	-449	-21%	T3	PS
Denmark	116	43	46	0.3%	2	6%	-70	-60%	CS	D
Finland	383	382	412	2.7%	30	8%	29	8%	T2	CS
France	2,545	1,991	2,213	14.7%	222	11%	-332	-13%	T2, T3	PS
Germany	6,176	4,539	5,019	33.3%	480	11%	-1,157	-19%	T2	CS
Greece	432	289	230	1.5%	-59	-20%	-202	-47%	CS	PS
Ireland	214	156	192	1.3%	36	23%	-22	-10%	T2	PS
Italy	2,042	1,689	1,969	13.1%	280	17%	-73	-4%	T2	CS,PS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	IE	IE	IE	-	-	-	-	-	NA	NA
Portugal	194	373	431	2.9%	58	16%	237	122%	T3	OTH
Spain	1,123	1,450	1,557	10.3%	107	7%	435	39%	D	D, PS
Sweden	295	390	526	3.5%	136	35%	231	79%	D	D
United Kingdom	1,206	234	234	1.6%	0	0%	-973	-81%	T2	CS
EU-15	**17,220**	**13,519**	**15,053**	**100.0%**	**1,534**	**11%**	**-2,167**	**-13%**		

Emissions of the Netherlands are included in 2D2 Food industries.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.7 shows information on methods applied, activity data, emission factors for CO_2 emissions from 2A2 Lime Production for 1990 to 2010. The table shows that all EU-15 MS use lime production as activity data for calculating CO_2 emissions, except for the UK that uses limestone consumption.

The EU-15 IEF (excluding the UK) in 2010 is 0.76 t CO_2/t of lime produced. The implied emission factors per tonne of lime produced vary between 0.71 for Italy and 0.79 for Germany and Greece (excluding the UK). The table also suggests that 73 % of the EU-15 emissions are estimated using higher tier methodologies (country-specific, CORINAIR, Tier 2 and Tier 3).

An increase of IEFs during 1990 and 2010 in the inventories submission 2012 could be only found for Portugal, whereas the IEF decreased in all other EU-15 MS; for Belgium, Finland and Germany only very slight changes could be observed. Italy's IEF decreased most during 1990 and 2009 (-11 %), followed by Greece (-10 %) and Ireland (-9 %). Explanations for the development of the implied emission factors are given in the following overview:

Implied Emission Factor Lime production, Portugal

The IEF increased continuously during 1990 and 2010 (+5 %) due to different expression of activity data and emissions: Whilst for the activity data tons of lime produced is provided, the emissions are related both to lime production and to the use of lime in paper and pulp production.

Implied Emission Factor Lime production, Italy

The consistent trend of IEF was interrupted in 2004, when the IEF decreased by 11 % between 2004 and 2005. This break is caused by the use of data based on times series supplied in the framework of the EU ETS. An average emission factor that was supplied for the years 2000 to 2004 was also used for previous years. Data from the ETS submission for the first allocation plan was used for the years 2005 onwards.

Implied Emission Factor Lime production, Greece

The IEF decreased especially from 2005 onwards, interrupting a rather constant trend until that year (-0.65 % 1990-2005). This is due to the fact, that for years 2005-2010, the calculation of CO_2 emissions from lime production is based on the collection of plant-specific data on the type(s) and quantity(ies) of carbonate(s) consumed to produce lime, as well as the respective emission factor(s) of the carbonates consumed.

Implied Emission Factor Lime production, Ireland

The variations of IEF (0.753 t CO_2/t in 1992 to 0.877 t CO_2/t in 1997, reaching the second highest IEF among EU-15 MS in 1997) is caused by reporting of different activity data by the lime manufacturers in the past as the activity data is partly referred to limestone raw material on the one hand and partly to lime production data on the other. For recent years no significant variations of the IEF could be found; the implied emission factor for aggregated lime production was 0.76 t CO_2/t lime in 2010, which is very similar to that for the other years for which ETS data is available.

Neither 1996 IPCC Guidelines for Greenhouse Gas inventories nor IPCC Good Practice Guidance (2000) clearly define a lower or higher tier method. Draft 2006 IPCC Guidelines define three tiers, an output-based approach that uses default values (Tier 1), an output-based approach that estimates emissions from CaO and CaO·MgO production and country-specific information for correction factors

(Tier 2) and an input-based carbonate approach (Tier 3), the latter requiring plant-specific data. Lime production is covered under the EU emissions trading scheme and monitoring guidelines under the EU ETS (Commission Decision of 29/01/2004 establishing guidelines for the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council) allow methods equivalent to either Tier 2 or Tier 3 above. The use of plant-specific data reported and verified under the EU ETS by Member States therefore can be considered as equivalent to Tier 2 or Tier 3 as defined in draft 2006 IPCC Guidelines.

Table 4.7 2A2 Lime Production: Information on methods applied, activity data, emission factors for CO_2 emissions

			1990				2010			
Member State	Method applied	Emission factor	Activity data		Implied emission factor	CO_2 emissions	Activity data		Implied emission factor	CO_2 emissions
			Description	(kt)	(t/t)	(Gg)	Description	(kt)	(t/t)	(Gg)
Austria	CS	CS,PS	Lime Production	513	0.77	396	Lime Production	765	0.75	574
Belgium	T3	PS	Lime production	2661	0.79	2097	Lime production	2117	0.78	1648
Denmark	CS	D	Lime production	156	0.74	116	Lime production	62	0.74	46
Finland	T2	CS	Lime Production	488	0.78	383	Lime Production	534	0.77	412
France	T2, T3	PS	Lime Production	3319	0.77	2545	Lime Production	3031	0.73	2213
Germany	T2	CS	Lime Production	7772	0.79	6176	Lime Production	6339	0.79	5019
Greece	CS	PS	Lime Production	491	0.88	432	Lime Production	291	0.79	230
Ireland	T2	PS	Lime Production	255	0.84	214	Lime Production	252	0.76	192
Italy	T2	CS,PS	Lime Production	2583	0.79	2042	Lime Production	2789	0.71	1969
Portugal	T3	OTH	Lime Production	272	0.71	194	Lime Production	599	0.72	431
Spain	D	D, PS	Lime Production	1475	0.76	1123	Lime Production	2082	0.75	1557
Sweden	D	D	Lime Production	389	0.76	295	Lime Production	700	0.75	526
UK	T2	CS	Limestone consumption	2708	0.45	1206	Limestone consumption	525	0.45	234
EU15			**EU15 w/o UK (93%)**	**20,374**	**0.79**	**16,013**	**EU15 w/o UK (95%)**	**19,560**	**0.76**	**14,819**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.8 provides a more detailed overview on methods used in EU-15 Member States and the coverage of this source category. Austria, Denmark, Finland, France, Ireland, Italy and Portugal included an explicit reference to the use of plant-specific data under the EU ETS.

Table 4.8 2A2 Lime Production: Summary of methodological information provided by Member States

Lime Production	
Member State	**Methodology comment**
Austria	Emissions were estimated using a country specific method based on detailed production data. Activity data and emission values were reported by the Association of the Stone & Ceramic Industry. For 2005-2010 verified CO2 emissions reported under the ETS were used for the inventory. These data cover the whole lime producing industry in Austria. The methodology for this emission calculation is the same like in the years before. The reported CO2 emission data is based on data of each lime production plant in Austria, considering the CaO and MgO content either from limestone or lime at the different plants and calculating CO2 emissions from the stoichiometric ratios (using IPCC default emission factors). [NIR 2012]
Belgium	From 1990 to 2002, these emissions of lime production were estimated by using default emission factors in three different plants and a plant-specific emission factor in the three others plants. This plant-specific emission factor was coming from analyses performed in 2002. Since 2003, all the emission factors are plant-speficic (except for the dolomite lime in 2003 and 2004). The activity data are the lime and dolomite lime production and are collected directly from individual plants. The emission factors are also collected directly from individual plants. A part of the lime production is coming from the kraft pulping process: the CO2 liberated during the conversion of calcium carbonate to calcium oxide in the lime kiln in the kraft pulping process contains carbon which originates in wood. This CO2 is not included in the net emissions. [NIR 2012]
Denmark	The CO2 emission from the production of burnt lime (quicklime) as well as hydrated lime (slaked lime) has been estimated from the annual pro-duction figures, registered by Statistics Denmark, and emission factors. The EFs applied are 0.785 kg CO2/kg CaO as recommended by IPCC (IPCC (1996), vol. 3, p. 2.8) and 0.541 kg CO2/kg hydrated lime (calculated from company information on composition of hydrated lime (Faxe Kalk, 2003)).One Danish company – Faxe Kalk – is covered by the EUETS, however, the company do only account for approximately 75 % of the Danish production of lime and hydrated lime (average from 1999-2008). A number of small companies accounts for the remaining of the Danish production. [NIR 2012]
Finland	Emissions from lime production are calculated by multiplying emission factors with lime output. Activity data are collected mainly directly from the industry but industrial statistics have also been used for earlier years. Emissions from 2005 onwards have been calculated using production data reported to the EU ETS data, although the total amount of produced lime has been checked from industrial statistics. There are two emission factors used in Finland to calculate emissions of lime production. The first emission factor is based on the actual CaO and MgO contents of lime derived from measurements by a company that has five plants in Finland. It is a calculated mean value from emission and production data for the years 1998-2002. This emission factor has been used for the whole time series for those five plants. The second emission factor has been specified by a company founded in 2003 and it is also based on the actual CaO and MgO contents in lime. AD for the years 1990−1997 is partly collected from the industry and partly taken from industrial statistics and companies' reports. AD for years 1998-2003 was received directly from lime producing companies. For the year 2004 part of the AD was collected from industrial statistics and VAHTI database due to refusal of disclose of a company. Since the year 2005 the AD was received from the Energy Market Authority which grants the emission permits to companies for the EU Emission Trading Scheme. [NIR 2012]
France	Higher tier methodology considering three types of lime. AD from industrial associations are used until 2005 (plant-specific data were available for a subset of plants), since 2004 plant-specific AD for all installations are available. Stochiometric EF for lime, and CS EF for hydraulic lime used based on national data. Average EFs for the three lime types are used until 1995 which were gradually replaced by plant-specific EF. To take into account impurities corrections have been undertaken to be in accordance with the methodology applied in the EU ETS. [NIR 2012]
Germany	Default- EF based on stochiometric relationships. The approach conforms to the specifications in IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC 2000, Chapter 3.1.2). The German Lime Association (BVK) collects the production data for the entire time series, on a plant-specific basis, and makes them available for reporting purposes. The quantities produced by plants that are not included in the German Lime Association's association statistics are estimated on the basis of existing information (such as operator figures, data published in the framework of emissions trading) and then added to the German Lime Association's figures. This ensures that all of German lime production is taken into account. [NIR 2012]
Greece	For years 2005 – 2010, the calculation of carbon dioxide emissions from lime production is based on the collection of plant-specific data on the type (s) and quantity(ies) of carbonate(s) consumed to produce lime, as well as the respective emission factor(s) of the carbonates consumed. The lime production of Greece refers to high-calcium and hydraulic lime. Both values are provided by the NSSG for the years 1993-2010, whereas for the years 1990-1993 the missing data have been calculated using the trend extrapolation method as described in the IPCC GPG. Hydraulic lime data for 2008 - 2010 are provided directly by the sole plant producing it in Greece.Lime production in the national statistics is reported as non hydrated lime, hydrated lime and hydraulic lime. The hydrated lime production data are converted to non hydrated lime using the correction for the proportion of hydrated lime as described in the IPCC GPG, using a water content of 28%. [NIR 2012]
Ireland	Statistical data on lime production in Ireland are obtained annually from the lime manufacturers. Lime producers provided their own estimates of CO2 emissions from lime manufacture for the development of NAP1. These were calculated in accordance with the methods providing detailed information on emission estimates and activity data. The CO2 estimates for lime production in 2010 have been obtained from the ETS returns to the Climate Change Unit of the EPA as for other recent years covered by the scheme and these have been used to confirm the estimates for previous years of the time-series. [NIR 2012]
Italy	CO2 emissions from lime have been estimated on the basis of production activity data supplied by ISTAT (ISTAT, several years) and by operators in the frame of the ETS reporting obligations adding the amount of lime produced and used in the sugar and iron and steel production sectors; emission factors have been estimated on the basis of detailed information supplied by plants in the framework of the European emission trading scheme and checked with the industrial association (CAGEMA, 2005). [NIR 2012]

Lime Production	
Member State	**Methodology comment**
Luxembourg	Not occuring. [NIR 2012]
Netherlands	Lime production only occurs in sugar industry which is reported under category 2D2 Food and drink. [NIR 2012]
Portugal	EU-ETS method A from Annex VIII of Decision 2007/589/EC is used for the period 2005-2010. Calculation is based on the amount of calcium carbonate and magnesium carbonate in the raw materials consumed. For the period 1990-2004, emissions were estimated based on lime production time series. Data on consumption of raw materials, was obtained for the period 2005-2010 from EU-ETS. Lime production for the period 1990-2010, was obtained from National Statistics (INE) IAPI industrial survey. Lime production in the iron and steel industry was available from information received from the industry for the period 1991-1994. For the remaining years 1990 and 1995-2001 annual lime production, which data was unavailable, was forecasted using energy consumption as surrogate indicator. After year 2002 production of lime in this unit was interrupted and the production line dismantled. All lime produced in the iron and steel plant was high calcium lime. In the case of the paper pulp industry the IAIT/IAPI surveys have no available information in lime production but only of limestone and dolomite consumption. Lime production had to be estimated from consumption of those carbon bearing materials and assuming the stoichiometric ratios of limestone and dolomite rock. Consumption of limestone and dolomite materials is available for the period 1989-2000 from National Statistics (INE): for the period 1989-1991 from IAIT industrial survey, and for 1992-2010 from the IAPI industrial survey.[NIR 2012]
Spain	Higher tier methodology considering different types of lime. AD are obtained from lime producer association ANCADE. Emissions from lime production in integrated steel plants are included in this category for the years 1990-1992. Emission factors are derived from IPCC guidelines dependig on the quantities of the final product and the degree of purity. The purity degrees are derived from plant-specific data for each year and if such data was not available for individual plants, it was derived from adjacent years for which such information was available and in few cases from default parameters provided by WBSCD/WRI "The GHG Protocol: a corporate accounting and reporting standard." For dolomite in sinter emissions were estimates based on plant-specific information on CO2 content in primary matter was used and for lime production in other industries the default EF from 1996 IPCC Guidelines [NIR 2012]
Sweden	The emissions of CO2 from the production of lime are based on activity data on produced amounts of quicklime and hydraulic lime and dolomitic lime. As CO2 emissions also depend on the production process, the methods for collecting activity data and estimating CO2 emissions are described by data source. Activity data on used amounts of limestone for production of lime for sugar production are obtained directly from the sugar producing company. In earlier submissions the whole amount of lime produced and used within the sugar industry was reported as activity data without taking into account that a large amount of the produced lime is precipitated as CaCO3 in the carbonation process. Since submission 2010, only the part of CaO which is not recovered as CaCO3 is reported as activity data. Since the 2011 submission, detailed data on the quantities of lime used as make-up lime in the pulp and paper industry, and quantities of limestone and dolomite used for production of make-up lime, have been obtained from the Swedish Lime Association and The Swedish Lime Industry from 1995. Based on 2006 IPCC Guidelines, the purity of the limestone is set to 95% for the production of lime within the pulp and paper industry. The corresponding figure for dolomite is 100%. For all other production of quicklime, hydraulic lime and dolomite (mainly used in iron and steel production), detailed data from 1990 are obtained from the Swedish Lime Association. To avoid double counting of emissions, activity data for produced quicklime, hydraulic lime and dolomite lime in the sugar industry and the pulp and paper industry has been deducted. Based on 2006 IPCC Guidelines, the purity of the limestone is set to 95% for the production of lime in conventional lime mills. The corresponding figure for dolomite is 100%. The produced amounts of quick lime and dolomitic lime in conventional lime mills was very low in 2009 which led to a reduced amount of emitted CO2 in 2009 compared to previous years. [NIR 2012]
UK	The UK bases estimation of lime production on limestone and dolomite consumption data, which are readily available (British Geological Survey, 2011). The use of consumption data rather than production data is simpler and probably more reliable since it is not necessary to consider the different types of lime produced. An emission factor of 120 t carbon/kt limestone was used, based on the stoichiometry of the chemical reaction and assuming pure limestone. For dolomite, an emission factor of 130t carbon/kt dolomite would have been appropriate; however dolomite calcination data are not given separately by the British Geological Survey, but included in the limestone data. The use of the limestone factor for this dolomite calcination will cause a small under-estimate of emissions. Dolomite calcination is believed to be a small proportion of the total hence the underestimate is unlikely to be significant. The limestone calcination data exclude limestone calcined in the chemical industry since a large proportion of this is used in the Solvay process, which does not release CO2. The calcination of limestone in the sugar industry is also excluded for the same reason. [NIR 2012]

Source: NIR 2012.

Table 4.9 summarizes the recommendations from the 2010 and the 2011 UNFCCC inventory reviews in relation to the category 2A2 Lime Production as well as the status of the review finding in the 2012 inventory submission.

Table 4.9 **2A2 Lime Production: Findings of the 2010 and 2011 UNFCCC inventory reviews in relation to CO_2 emissions and responses in 2012 inventory submissions**

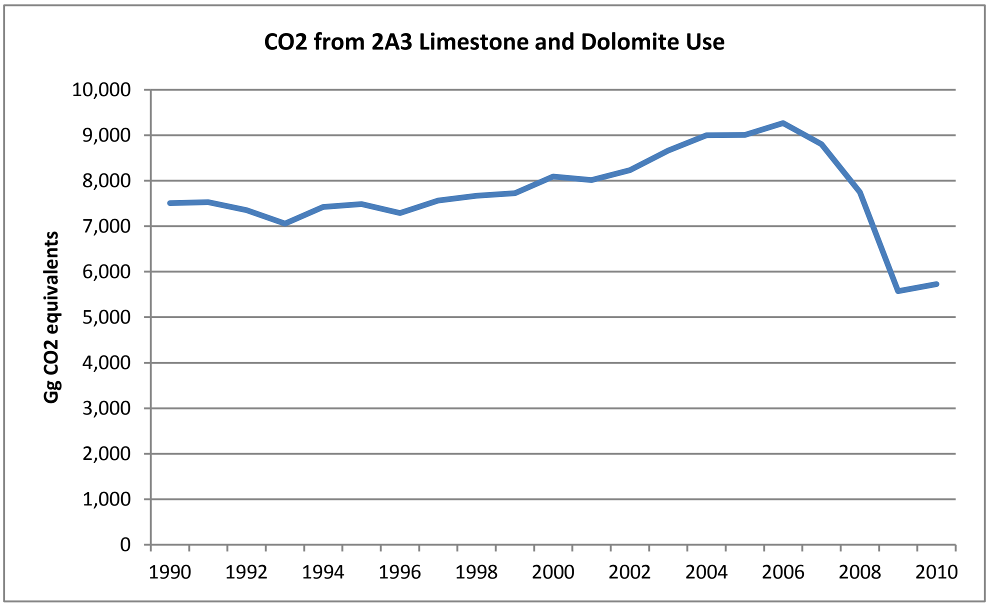
Member State	Review findings and responses related to 2A2 Lime Production	
	Comment UNFCCC report of the review of the 2011 submission	**Status in 2012 submission**
Austria	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2010/AUT). Review report (Centralized review 2011) not yet available.	No follow-up necessary
Belgium	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/BEL).	No follow-up necessary
Denmark	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/DNK).	No follow-up necessary
Finland	The ERT recommends that Finland explore the use of plant-specific data for the five plants for which an IEF is currently used, and use interpolation or other ways of ensuring time-series consistency. (FCCC/ARR/2011/FIN)	Average EFs derived from plant-specific data are used.
France	No recommendation for improvement of this source category in Review Report (FCCC/ARR/2010/FRA). Review report (Centralized review 2011) not yet available.	No follow-up necessary
Germany	No recommendation for improvement of this source category in Review Report (FCCC/ARR/2010/DEU). Review report (Centralized review 2011) not yet available.	No follow-up necessary
Greece	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/GRC)	No follow-up necessary
Ireland	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2010/IRE). Review report (Centralized review 2011) not yet available.	No follow-up necessary
Italy	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2010/ITA). Review report (Centralized review 2011) not yet available.	No follow-up necessary
Luxembourg	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/LUX).	No follow-up necessary
Netherlands	The category lime production is reported as "IE" (included elsewhere) in CRF table 2(I).A-G for the entire time series, in addition in the CRF table it is stated that the only known lime production is in the sugar industry and is accounted for under the category food and drink. However, in the Netherlands, there is paper industry and this industry could regenerate lime from waste materials. During the review week, the ERT was not able to clarify whether the paper producers in the Netherlands produce lime. This causes a lack of transparency and, if this source exists, could lead to an underestimation of emissions. Therefore, during the review week, the ERT recommended that the Netherlands: collect relevant information to demonstrate whether lime production occurs in paper industry in the Netherlands; and if lime production does occur, collect the data to estimate these emissions for the complete time series in accordance with the IPCC good practice guidance and report this in the CRF tables as well as provide supporting documentation for the reported figures. (FCCC/ARR/2012/NLD,para 91, 92)	In response to the list of potential problems and further questions raised by the ERT during the review, the Netherlands demonstrated that there are no emissions of lime production in the paper industry. In the Netherlands, paper and cardboard are mainly produced from recycled fibres, while new pulp is mainly imported from abroad. The production of wood pulp is minimal and amounts to only a few per cent of total production. In the Netherlands, pulp production only takes place by mechanical or thermo-mechanical processes. The kraft (sulphate) pulping process, the only source for CO2 emissions (originating from biomass), is not used in the Netherlands.
Portugal	Portugal has made considerable efforts to improve the AD used for emission estimates for lime production for the years 2001–2007, based on surveys by INE. However, AD for 2008 were estimated again using a simple linear forecast. The ERT recommends that Portugal make efforts to continue using the statistical data for the most recent year or obtain plant-specific data and report its emission estimates accordingly in its next annual submission. Review report (Centralized review 2011) not yet available.	Plant-specific data collected under the EU ETS was used consistently for recent years.
Spain	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2010/ESP). Review report (in-country review 2011) not yet available.	No follow-up necessary
Sweden	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2010/SWE). Review report (Centralized review 2011) not yet available.	No follow-up necessary
UK	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/GBR).	No follow-up necessary

Source: NIR 2012, UNFCCC inventory review reports, as published at UNFCCC: http://unfccc.int/national_reports/annex_i_ghg_inventories/inventory_review_reports/items/5687.php

4.2.1.3 2A3 Limestone and Dolomite Use

CO_2 emissions from 2A3 Limestone and Dolomite Use account for 0.15 % of total GHG emissions in 2010. Between 1990 and 2006, CO_2 emissions from this source increased by 24 % in the EU-15 and decreased by 23 % until 2010 (Figure 4.5). In 2010, Italy was responsible for 27 %, the UK for 16 % and France for 16 % of the emissions from this source. Emissions from this source category increased in seven MS in the period 1990 to 2010 (Austria, Denmark, Finland, Ireland, the Netherlands, Portugal and Sweden), whereas in five Member States emissions decreased during that time period. In absolute terms, the decrease in emissions was larger than the increase, with the largest absolute reduction in Italy.

Figure 4.5 2A3 Limestone and Dolomite Use: EU-15 CO_2 emissions



The increase of CO_2 emissions by 6 % in 1993-1994 was dominated by the increase of emissions in the Netherlands, the UK, Spain and Finland. The increase of emissions was mainly due to changes of activity (Netherlands, the UK). Reverse emissions trends and thus offsetting the increases of emissions to some extent could be found for Italy and Greece for that period.

CO_2 emissions decreased by 23 % in EU-15 during 2009-2010. Italy (the country's share in EU change of emissions 2009-2010 was -39 %) and Spain (the country's share in EU change of emissions 2009-2010 was -50 %) were the main contributors to this reduction. The decrease of CO_2 emissions in Spain in that time is mainly due to decrease of brick and tiles production as a consequence of the impact of the economic recession. Additionally, there was a decrease in the carbonates content in the clay used for brick and tiles manufacturing. For Italy, the emissions reduction is related to a decrease in carbonates input to brick, tiles, ceramics, pulp and paper production at country level equal to 30 % during 2008 and 2009. Between 2009 and 2010 emissions increased slightly in the EU-15 due to a better economic situation. In those MS that are still strongly hit by the financial crisis (Ireland, Italy, Spain, Portugal) emissions kept decreasing in this period while all other MS showed slightly raising emissions.

Table 4.10 2A3 Limestone and Dolomite Use: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)		
Austria	203	222	294	5.1%	72	32%	91	45%	T1	D,PS
Belgium	IE	18	16	-	-	-	-	-	T3	CS,PS
Denmark	14	38	46	0.8%	8	20%	32	233%	CS,T1	CS,D
Finland	88	132	251	4.4%	118	90%	163	185%	T2	CS
France	1,345	716	923	16.1%	207	29%	-423	-31%	T2, T3	PS
Germany	IE	IE	IE	-	-	-	-	-	NA	NA
Greece	583	431	458	8.0%	26	6%	-125	-21%	CS,T1	CS,D
Ireland	0	2	1	0.0%	-1	-33%	1	583%	T2	PS
Italy	2,540	1,651	1,558	27.2%	-93	-6%	-982	-39%	T2	CS,D,PS
Luxembourg	IE	IE	IE	-	-	-	-	-	NA	NA
Netherlands	481	501	574	10.0%	74	15%	93	19%	CS	D
Portugal	33	123	57	1.0%	-66	-54%	24	71%	D	D
Spain	1,005	671	499	8.7%	-172	-26%	-506	-50%	D	D, PS
Sweden	90	104	135	2.4%	31	29%	45	49%	CS	D
United Kingdom	1,125	963	921	16.1%	-42	-4%	-205	-18%	T2	CS,D
EU-15	**7,508**	**5,572**	**5,731**	**100.0%**	**159**	**3%**	**-1,777**	**-24%**		

Belgium reports emissions in the source category 2A7.
Germany reports emissions in the source categories where limestone and dolomite is used (1A1a, 2A1, 2A2, 2A4, 2A7, 2C1).
Luxembourg reports emissions in the source category 2A1 and 2A7.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.11 provides information on methods applied, activity data, emission factors for CO_2 emissions from 2A3 Limestone and Dolomite Use for 1990 to 2010. The table shows that almost all MS use limestone and dolomite consumption as activity data for calculating CO_2 emissions. In 2010 the EU-15 IEF is 0.45 t CO_2/t of limestone and dolomite consumption. The implied emission factors per tonne of limestone and dolomite consumption vary between 0.38 t CO_2/t for France and 0.68 t CO_2/t for the UK. Different EFs arise from the occurrence and the allocation of different activities under 2.A.3. Neither 1996 IPCC Guidelines for Greenhouse Gas inventories nor IPCC Good Practice Guidance (2000) clearly define a lower or higher tier method. The use of plant-specific data reported and verified under the EU ETS by Member States can be considered as equivalent to a Tier 2 or Tier 3 method. Table 4.121 suggests that 36 % of the EU-15 emissions are estimated using higher tier methodologies;

Table 4.11 **2A3 Limestone and Dolomite Use: Information on methods applied, activity data, emission factors for CO_2 emissions**

Member State	Method applied	Emission factor	1990				2010			
			Activity data		Implied emission factor (t/t)	CO_2 emissions (Gg)	Activity data		Implied emission factor (t/t)	CO_2 emissions (Gg)
			Description	(kt)			Description	(kt)		
Austria	T1	D,PS	Limestone and Dolomite Use	462	0.44	203	Limestone and Dolomite Use	676	0.43	294
Belgium	T3	CS,PS	Limestone and Dolomite Use	IE	IE	IE	Limestone and Dolomite Use	35	0.44	16
Denmark	CS,T1	CS,D	Limestone and Dolomite Use	42	0.33	14	Limestone and Dolomite Use	102	0.45	46
Finland	T2	CS	Limestone and Dolomite Use	206	0.43	88	Limestone and Dolomite Use	583	0.43	251
France	T2, T3	PS	Limestone and Dolomite Use	3809	0.35	1345	Limestone and Dolomite Use	2413	0.38	923
Germany	NA	NA	Limestone and Dolomite Use	IE	IE	IE	Limestone and Dolomite Use	IE	IE	IE
Greece	CS,T1	CS,D	Limestone Consumption	1249	0.47	583	Limestone Consumption	1017	0.45	458
Ireland	T2	PS	Limestone Consumption	0.3	0.44	0.2	Limestone Consumption	2	0.43	1
Italy	T2	CS,D,PS	Carbonates input to brick, tiles, ceramic production	5773	0.44	2540	Carbonates input to brick, tiles, ceramic production	3540	0.44	1558
Netherlands	CS	D	Limestone and Dolomite Use	1093	0.44	481	Limestone and Dolomite Use	1312	0.44	574
Portugal	D	D	Limestone consumption	74	0.45	33	Limestone consumption	124	0.46	57
Spain	D	D, PS	Limestone and Dolomite Use	2285	0.44	1005	Limestone and Dolomite Use	1162	0.43	499
Sweden	CS	D	Limestone and Dolomite Use	194	0.47	90	Limestone and Dolomite Use	294	0.46	135
UK	T2	CS,D	Limestone and Dolomite Use	2689	0.42	1125	Limestone and Dolomite Use	1347	0.68	921
EU15			**EU15**	**17,877**	**0.42**	**7,508**	**EU15**	**12,608**	**0.45**	**5,731**

Belgium reports emissions in the source category 2A7.
Germany reports emissions in the source categories where limestone and dolomite is used (1A1a, 2A1, 2A2, 2A4, 2A7, 2C1).
Abbreviations explained in the Chapter 'Units and abbreviations'.

A considerable increase of IEFs during 1990 and 2010 in the inventory submission 2012 could be observed for Denmark and the UK and the IEF shows some variations for France, whereas no significant increase or decrease of the IEF (> 0.02 t/t) occurred for any other MS that time period. Explanations for the development of the implied emission factors are given in the following overview:

Implied Emission Factor Limestone and Dolomite Use, France

The comparable low IEF (2009) is due to the fact that the French IEF is related to sinter production. In France, source category 2A3 includes CO_2 emissions from the decarbonization in the production of enamel, the use of carbon for desulfurization on some industrial sites, the use of limestone to neutralize acidic effluents and the use as a raw material in the agglomeration of ore, thus the global IEF for 2A3 is presently a mixture based on consumption of lime on the one hand, and sinter production on the other. Emissions associated with the use of limestone in sinter production however represent the largest part of 2A3 emissions, and the overall IEF for 2A3 is extremely close to the related specific IEF based on sinter production.

To answer to a recommendation raised during the EU Centralized Review in 2010, additional information explanations of the methods, activity data and emission factor used for estimating CO_2 emissions from limestone and dolomite use in France is provided in the following:

- Concerning the production of enamel, domestic production has been known since 2004 and is assumed to be identical for the period 1990-2003. Emissions are derived from annual statements since 1999. An average factor is applied to the period 1990-1998.
- Regarding emissions from desulfurization, the amounts of carbon products used are known through annual statements for recent years and were extrapolated from the emissions for some intermediate years or correspond to the known average emissions for years where no information was available. Emissions are known since 1999. Before that date, an emission factor of 440 kg CO_2 / t limestone has been used.
- On the neutralization of acidic effluent, the amount of limestone used are known through annual statements for recent years and were extrapolated from the emissions for some intermediate years or correspond to the known average emissions for years where no information was available. Emissions are known since 1997. Before that date, an emission factor of 418 kg CO_2 / t product has been used.
- The quantity of limestone used as a raw material in the agglomeration of ore is precisely known since 2000 through the French association of Steel (FFA, Fédération Française de l'Acier) and direct contact with the only operator not included in the FFA. Before that date, the amounts used are extrapolated from the production of agglomerates which is known and emissions are calculated from the stoichiometric ratio of limestone.

Implied Emission Factor Limestone and Dolomite Use, Denmark

The increase of the IEF is caused by the consideration of the occurrence and relevance of different activities included in this category: The activity data comprises the consumption of carbonates for production of mineral wool, consumption of CaCO3 for wet flue gas cleaning at waste incineration plants and combined heat and power plants. In the production of stonewool a number of raw materials contributing to CO_2 emission are used: bottom ash from coal-fired CHP, stonewool binder, stonewool waste, limestone, and dolomite. Activity data for production of mineral wool is not reported due to confidentiality reasons, therefore the total emissions are divided by the other activities only resulting in the increasing IEF. EU-ETS data for some years (1998-2002) combined with energy consumption has been used for extrapolation of the CO_2 emission from 1990-1997 and interpolation from 2003-2005. For wet flue gas cleaning at combined heat and power plants statistics on gypsum production has been used for calculation of CO_2 emission from 1990-2005; from 2006 onwards consumption of limestone has been used. Waste incineration plants: statistics on gypsum production has been used for calculation of CO_2 emission from 1990-2010. For wet flue gas cleaning at waste incineration plants produced amount of gypsum has been used as activity data for the period 1990-2010. The change in applied statistics explain the increasing IEF from 2005 to 2006. Regarding fluegas cleaning at combined heat and power stations, Denmark investigates to use statistics concerning consumption of limestone at waste incineration plants for the next inventory submission.

Implied Emission Factor Limestone and Dolomite Use, UK

The comparable high IEF (2010) is due to the inclusion of CO_2 emissions from gypsum produced in the flue gas desulphurisation process. The activity data does not reflect this particular process, and therefore the IEF is higher than might otherwise be expected. The increase of the IEF is caused by including CO_2 emissions from gypsum produced in the flue gas desulphurisation process but excluding this item in its activity rate.

CO_2 emissions occur when limestone and/or dolomite is used in wet flue gas desulphurization (FGD) of flue gases in power generation. With its report of the review of the initial report of the European Union, the ERT recommends that the EU encourage member States which do not mention this category in their NIR to report where this category is included (FCCC/IRR/2007/EC, para 68). In response to the recommendation by the ERT, Table 4.11 provides an overview about the reporting of this category.

Table 4.13 provides a more detailed overview on methods used in EU-15 Member States and the coverage of this source category.

Table 4.12 2A3 Limestone and Dolomite Use: Information of wet flue gas desulphurization provided by Member States

Limestone and dolomite use		
Member State	**FGD included**	**Further information on wet flue gas desulphurization**
Austria	2.A.3	In this category CO2 emissions from decarbonising of limestone in the iron and steel industry, limestone use for desulphurization and in chemical industry are considered. Activity data for limestone used for desulphurization were taken from a national report on desulphurization technologies in Austria. The time series was constructed with the help of plant specific SO2 emission declarations from the annual steam boiler database. [NIR 2012]
Belgium	2.A.3	After receiving the ETS-data and consultation of these ETS-data the emissions due to the use of limestone in pollution control were completed for the 2012 submission in the category 2A3 and accounts for +/- 10-15 kton of CO2 (from 1999 on). [NIR 2012]
Denmark	2.A.3	The CO2 emission from consumption of limestone for flue gas cleaning has been estimated from statistics on generation of gypsum (wet flue gas cleaning processes) and the stoichiometric relations between gypsum and release of CO2. Statistics on the generation of gypsum from power plants are compiled by Energinet.dk (2008). However, for 2006 - 2010 information on consumption of CaCO3 at the relevant power plants has been compiled (from environmental reports) and used in the calculation of CO2- emission from flue gas cleaning. [NIR 2012]
Finland	2.A.3	Limestone and dolomite use comprises the use in the production of tile, steel, calcium chloride, phosphates, mineral wool and in the wastewater handling and in the energy industry for sulphur dioxide control. [NIR 2012, p. 146]
France	2.A.3	The category of limestone and dolomite use (2A3) includes the following sub-sectors: [...] the use of carbonates for the desuplphurization of industrial stires (3 heat plants and 4 power plants) and the use as neutralizer for acidic substances (une chemical plant). [NIR 2012, p. 125]
Germany	1.A.1.a	Flue gas emissions are reported under 1A1a instead of 2A3. Limestone is used for the refining of sugar as well as for wet flue gas cleaning at power plants and waste incineration plants. CO2 emissions from flue-gas desulphurisation are included in 1.A.1.a Limestone use in flue-gas desulphurisation in public power stations. In the inventory, these CO2 emissions were assigned to emissions from use of solid fuels, because such use is the reason for operation of the flue-gas desulphurisation systems and for the systems' CO2 emissions. For calculating the volume of gypsum in years 2008 and 2009 the volume of gypsum was used as preliminary input value. [NIR 2012]
Greece	2.A.3	The operation of flue gas desulphurization systems in Greece started in 2000. The estimation of emissions is based on data collected during the formulation of the NAP for the period 2005 – 2007. For years 2005-2010 data from verified installation ETS reports were used. The emission factor used (0.44 t CO2 / t limestone) derives from the stoichiometry of the reaction. [NIR 2012]
Ireland	2.A.3	The CO2 emissions reported under this category refer to those emissions associated with the use of limestone (CaCO3) for flue gas desulphurisation and limestone used in the manufacture of bricks and tiles. Limestone has been used to capture the sulphur emitted from peat burning in one electricity generating station since 2001 and in a second such plant since 2007. The CO2 emissions estimates are taken from ETS returns. They are estimated on the basis of limestone quantity used by the companies and an emission factor of 0.44 t CO2/t limestone, which is the stoichiometric ratio of CO2 to CaCO3. [NI+C16R 2012]
Italy	2.A.3	CO2 emissions deriving from the treatment of flue gases have been accounted for the whole time series from 2011 submission. [NIR 2012]
Luxembourg		Not ocurring. [NIR 2012]
Netherlands	2.A.3	The CO2 emissions from this source category are based on consumption figures for limestone use – derived from plaster production figures – for flue gas desulphurisation (FGD) with a wet process by coal-fired power plants and for apparent dolomite consumption (mostly used for road construction). [NIR 2012]
Portugal	1..A.1.a	CO2 emissions from wet flue gas desulfurization are estimated for large point sources in the sector of public electricity and heat production. Since there is no CRF category specific for desulfurization, total CO2 emissions from this abatement system were included together with combustion emissions. [NIR 2012]
Spain	2.A.3	Category 2A3 includes emissions from the decarbonization of carbonates consumed for bricks and tiles as well asfor the desulphurization of flue gas of power plants. Emissions from desulfurization are estimated based on specific questionnaires on the consumption of limestone for the desulphurization process that are sent to power stations in which such a technique for reducing emissions is used. [NIR 2012]
Sweden	2.A.3	Activity data and CO2 emissions from the use of limestone and dolomite within facilities producing glass and mineral wool, iron pellets and chemical products, and also use of limestone and dolomite for flue gas purification in energy producing facilities are reported in CRF category 2A3. The calculations are made by applying the IPCC Guidelines default emission factors for limestone and dolomite. [NIR 2012]
UK	2.A.3	Limestone is also used in flue-gas desulphurisation (FGD) plant used to abate SO2 emissions from combustion processes. The limestone reacts with the SO2 present in flue gases, being converted to gypsum, with CO2 being evolved. Emissions are calculated using emission factors of 120 t carbon/kt limestone and 130 t carbon/kt dolomite, in the case of glass processes involving calcination, and 69 t carbon/kt gypsum produced in the case of FGD processes. [NIR 2012]

Source: NIR 2012.

Table 4.13 **2A3 Limestone and Dolomite Use: Summary of methodological information provided by Member States**

Limestone and dolomite use	
Member State	**Methodology comment**
Austria	Emissions were estimated using the methodology and the IPCC default EF for the years 1990-2004. AD for limestone used in blast furnaces for the years 1998 to 2002 was reported directly by the plant operator of the two integrated iron and steel production sites that operate blast furnaces. For the years before and after AD was estimated using the average ratio of limestone used per ton of pig iron produced of the years 1998-2002. For 2005-2010 verified CO2 emissions and activity data, reported under the ETS, were used for the inventory. These data cover limestone use in the iron and steel and chemical industry. The use of limestone in chemical industry is included in the inventory since 2005. AD for limestone used for desulphurization were taken from a national report on desulphurization technologies in Austria. For calculation of CO2 emissions the IPCC default emission factors of 440 kg CO2/t limestone and 477 kg CO2/t dolomite were used. Since 2005 ETS background data provided more detailed information on the actual carbon content of the limestone and dolomite used. Therefore, the IEFs since 2005 are slightly different to the IPCC default values. [NIR 2012]
Belgium	reported as IE until 2011: Also in the iron and steel sector (category 2C), more specifically during the sinter production, limestone and dolomite is used. The emissions are not allocated to the sector 2A3 'mineral products/limestone and dolomite use' but are allocated to this sector 2C. After receiving the ETS-data and consultation of these ETS-data emissions from desulphurization of flue gas were included in the 2012 submissions under limestone and dolomite consumption from 1999 onwards.[NIR 2012 and EU QA/QC]
Denmark	The reprted emissions include the use of limestone and dolomite for fluegas cleaning as well as for the production of stonewool. No activity data is reported for production of stonewool. This means that the IEF varies with the ratio: fluegas cleaning/stonewool production. A detailed description of stonewool production will be included in the next NIR. In the production of stonewool a number of raw materials contributing to CO2 emission are used: bottom ash from coal-fired CHP, stonewool binder, stonewool waste, limestone, and dolomite. The shares of the different CO2 sources will be analysed and a new classification (CRF code) will be considered. Regarding fluegas cleaning: CHP: statistics on gypsum production has been used for calculation of CO2 emission from 1990-2005; from 2006- consumption of limestone has been used. Waste incineration plants: statistics on gypsum production has been used for calculation of CO2 emission from 1990-2010. The change in applied statistics explain the increasing IEF from 2005 to 2006. From next year appplication of statistics concerning consumption of limestone at waste incineration plants will be investigated and implemented if possible. [EU QA/QC 2012]
Finland	Emissions from limestone and dolomite use are calculated by multiplying emission factors with activity data. Activity data are collected mainly directly from the industry but industrial statistics have also been used to calculate emissions at the beginning of the time series. Emission factors are based on the IPCC's default factors. The consumption of limestone and dolomite has been used as AD when calculating emissions from lime stone and dolomite use. Activity data for 2010 are collected directly from individual companies and the EU-ETS data. Most of the data for the earlier years have been received from individual companies, EU ETS and a small part has been estimated using industrial statistics. [NIR 2012]
France	The reported emissions in this category include the following subsectors: : - decarbonization in the production of enamel production (3 plants in France), - the use for desulphurization for flue gas cleaning (2 heat plants and 4 power plants), - the use of limestone to neutralize acidic substances (one chemical plant), - the use of limestone as primary material and additive (which ceased after the year 2008). Activity data and EFs are derived from plant-specific reporting. [NIR 2012]
Germany	Limestone consumption is reported in the sectors that use limestone and in 2A7 Other. [NIR 2012]
Greece	Estimate includes limestone use in steel, aluminium, magnesia, ceramics production and SO2 scrubbing. AD and plant-specific EF from operators under EU ETS are used. [NIR 2012]
Ireland	The CO2 emissions reported under this category refer to those emissions associated with the use of limestone for flue gas desulphurisation, and since 2006, limestone used by a single tile manufacturer. The CO2 emissions estimates are taken from ETS returns. They are estimated on the basis of limestone quantity used by the companies and an emission factor of 0.44 t CO2/t limestone, which is the stoichiometric ratio of CO2 to CaCO3. [NIR 2012]
Italy	CO2 emissions from limestone and dolomite use are related to the use of limestone and dolomite in bricks, tiles and ceramic production, paper production and also in the treatment of flue gases from power plants. CO2 emissions from paper production were accounted for the whole time series as requested by the 2010 review report. CO2 emissions deriving from the treatment of flue gases have been accounted for the whole time series from the 2011 submission. In the CRFs the total amount of limestone and dolomite used in these processes is reported, as activity data, and it has been estimated on the basis of the average content of CaCO3 in the different products. Detailed production activity data and emission factors have been supplied in the framework of the European emissions trading scheme and relevant data are annually provided by the Italian bricks and tiles industrial association and by the Italian ceramic industrial associations (ANDIL, 2000; ANDIL, several years; ASSOPIASTRELLE, several years; ASSOPIASTRELLE, 2004). [NIR 2012]
Luxembourg	Limestone consumption reported under 2.A.1 and 2.A.7. [NIR 2012]
Netherlands	Environmental reports are used for emission data. To calculate the CO2 emissions from the limestone use in the Iron- and steel production the amount of limestone stone reported in the annual environmental reports of Tata Steel (Corus) are used. Data on the consumption of limestone and dolomite are based on statistical information obtained from Statistics Netherlands. Limestone EF = 0.440 t/t (IPCC default) Dolomite use EF= 0.477 t/t (IPCC default). [NIR 2012]

Limestone and dolomite use	
Member State	**Methodology comment**
Portugal	CO_2 emissions are estimated from the quantification of carbon in original raw materials, and making a mass balance for the quantities of CO_2 that are liberated in the conversion process. Carbon content of materials consumed in Portugal was set from molecular stoichiometry. The consumption of sodium carbonate in the paper and pulp industry was determined from the statistical information from INE from 1990 to 2010. Fertilizer production data was also available from INE database from 1990 to 2010. The ceramic industry, more particularly the brick and tile industry and the pavement industry, consumes limestone, dolomite and the carbonates of sodium and barium, and all these substances were considered to result in decarbonisation. For this industry sector, although the consumption of carbonate bearing materials is not known for the whole period, a consumption factor was developed based on the information received under the European Emission Trading Scheme (EU-ETS), and production of construction ceramics and pavement ceramics, which is available from INE's industry surveys IAIT and IAPI, was used to obtain the full time series.[NIR 2012]
Spain	Includes emissions from dolomite and lime use in bricks and tiles production and from flue gas desulphurization in power plants. AD for bricks and tiles are based on data from the industrial association (HISPALYT) and from plant-specific data from power plants. Data on desulphurization are derived from questionnaires directly send by the power plants. An EF based on the stechiometric relation was used for bricks and tiles production. Plant-specific parameters for the EF are available for the emissions from desulphurization in power plants. Lime and dolomite use in iron and steel industry is included in source category 2C1 and emissions from glass production under 2A7. [NIR 2012]
Sweden	Activity data and CO_2 emissions from the use of limestone and dolomite within facilities producing glass and mineral wool, iron pellets and chemical products, and also use of limestone and dolomite for flue gas purification in energy producing facilities are reported in CRF 2A3. The calculations are made by applying the IPCC Guidelines default emission factors for limestone and dolomite. Data on the use of limestone and dolomite have been acquired from environ-mental reports, the ETS and through direct contacts with the companies. Sweden has chosen to not include in 2.A.3 (but in corresponding categories): · CO_2 emissions from the use of limestone and dolomite in primary and secondary production of steel (2.C.1.1, 2.C.1.2), · CO_2 emissions from the use of limestone and dolomite in other metal production (2.C.5), · CO_2 emissions from the use of limestone and dolomite in production of clay based products (2.A.7) and · CO_2 emissions from the use of limestone and dolomite in glass production (2.A.7.1). [NIR 2012]
UK	Data on the usage of limestone and dolomite for steel production are available from the Iron & Steel Statistics Bureau (2010). Gypsum produced in FGD plant is available from the British Geological Survey (2010), with some gaps in the records for 2009-2010 (for example, data are given for four of the five plant in 2010). These gaps are filled either by assuming that gypsum production is the same as in another year for which data are given, or by using Pollution Inventory data on emissions of 'chemical' carbon dioxide (i.e. carbon dioxide from chemical processes rather than 'thermal' carbon dioxide from combustion). Corus UK Ltd has provided analytical data for the carbon content of limestone and dolomite used at their steelworks (Corus, 2005), and these have been used to generate emission factors of 111 t carbon/kt limestone and 123 t carbon/kt dolomite for sintering and basic oxygen furnaces. An emission factor of 69 t carbon/kt gypsum produced is used in the case of FGD processes, based on the stoichiometry of the chemical reaction, and assuming that all of the carbon dioxide is released to atmosphere. [NIR 2012]

Source: NIR 2012.

Table 4.14 summarizes the recommendations from the 2010 and 2011 UNFCCC inventory reviews in relation to the category 2A3 Limestone and Dolomite Use.

Table 4.14 2A3 Limestone and Dolomite Use: Findings of the 2010 and 2011 UNFCCC inventory reviews in relation to CO_2 emissions and responses in 2011 inventory submissions

Member State	Review findings and responses related to 2A3 Limestone and Dolomite Use	
	Comment UNFCCC report of the review of the 2011 submission	**Status in 2012 submission**
Austria	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2010/AUT). Review report (Centralized review 2011) not yet available.	No follow-up necessary
Belgium	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/BEL).	No follow-up necessary
Denmark	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/DNK).	No follow-up necessary
Finland	For limestone and dolomite use Finland applies correction factors to the IPCC default EFs to account for impurities. While the percentages of impurities assumed by Finland seem reasonable in comparison with available international literature, the ERT recommends that Finland include in its next annual submission more information verifying the assumptions it made in establishing the correction factors. The correction factors vary between 0.93 and 0.97 according to the NIR. No key category. (FCCC/ARR/2011/FIN)	In response to questions raised during the review, Finland stated that if the plant-specific correction factors were available they were used in the inventory, and in other cases a correction factor of 0.97 was used. Furthermore, Finland informed the ERT that a master thesis from Helsinki University of Technology was used as reference; however, the thesis is written in Finnish. Finland also stated that plant-specific information cannot be included in the NIR for reasons of confidentiality.
France	No recommendation for improvement of this source category in Review Report (FCCC/ARR/2010/FRA). Review report (Centralized review 2011) not yet available.	No follow-up necessary
Germany	The ERT reiterates the recommendation of previous reviews that Germany should report the CO2 emissions from limestone and dolomite use as a whole, in line with IPCC good practice guidance. Review report (Centralized review 2011) not yet available.	The ERT recommendation is considered to result in less transparent emissions and in particular contradicts recommendations for the EU NIR to improve harmonized reporting of MS.
Greece	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/GRC)	No follow-up necessary
Ireland	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2010/IRE). Review report (Centralized review 2011) not yet available.	No follow-up necessary
Italy	Italy recalculated the emissions from this category to account for the emissions from paper production. However, the ERT noted that recalculations have only been performed for the period 2000–2008. The ERT recommends that Italy apply the recalculation also to the earlier years of the time series (1990–1999) to ensure consistency across the entire time series and the completeness of the coverage of the emission estimate. Review report (Centralized review 2011) not yet available.	CO2 emissions from paper production were accounted for the entire time series.
Luxembourg	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/LUX).	No follow-up necessary
Netherlands	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/NLD).	No follow-up necessary
Portugal	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2010/PRT). Review report (Centralized review 2011) not yet available.	No follow-up necessary
Spain	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2010/ESP). Review report (In-country review 2011) not yet available.	No follow-up necessary
Sweden	The ERT recommends that Sweden consider reallocating CO2 emissions from limestone and dolomite use in glass production to the limestone and dolomite use category. Review report (Centralized review 2011)	The ERT recommendation is considered to result in less transparent emissions and in particular contradicts recommendations for the EU NIR to improve harmonized reporting of MS.
UK	The ERT recommends that the United Kingdom update the AD value used and improve the comparability of the IEF with other reporting Parties for the next submission. (ARR 2011), para 69)	The United Kingdom explained that this is because the estimated emissions include emissions from flue gas desulphurization at power stations, but the gypsum produced is excluded from the AD.

Source: NIR 2012, UNFCCC inventory review reports, as published at UNFCCC: http://unfccc.int/national_reports/annex_i_ghg_inventories/inventory_review_reports/items/5687.php

4.2.1.4 2A7 Other Mineral Products

Table 4.15 provides an overview about the emission sources reported in the category 2A7 Other Mineral Products in 2009 as well as total emissions in this category. Following respective recommendations from the UNFCCC review of the EU inventory, several attempts were made to harmonize the allocation of emissions in a more transparent way across MS. 1996 IPCC Guidelines recommend to “inventory all other uses of limestone and dolomite which produce CO_2 emissions”, including glass manufacture and to allocate emissions from soda ash use in glass manufacture under 2A4. However, it is considered as a significant increase in transparency if all MS would report CO_2 emissions from glass production in a separate category under 2A7 which is an emission source in most MS. If a harmonized subcategory for emissions from glass production is reported by MS, this would allow a comparison of IEFs across countries for glass production as well as quality checks with EU ETS data. IEFs for a multitude of different activities reported under 2A3 are not really comparable due to the different nature of processes allocated under this category. Respective guidance was provided to MS, however UNFCCC ERTs to individual MS recommended to report different emission sources under 2A3 instead of a more transparent and comparable separation under 2A7 Other Glass production. In our view the recommendation of the 1996 IPCC Guidelines to “inventory all other uses of limestone and dolomite which produce CO_2 emissions” is not contradicting a separation under 2A7 ‘other mineral products’ if such allocation enhances the transparency and comparability across Parties. In 2012 all 15 MS reported CO_2 emissions from glass production as a separate category under 2A7. . In addition, several MS separate emissions from bricks and tiles production in this category (Austria, Denmark, France, Germany, Ireland, Spain, UK).

Germany is the largest contributor to this category with 21 %, followed by Spain (18 %) in 2010.

Table 4.15 2A7 Other Mineral Products: Emission sources reported for the year 2010

Member State	2.A.7 Other Mineral Products	CO_2 emissions [Gg]	CH_4 emissions [Gg]	N_2O emissions [Gg]	Total emissions [Gg CO2 equivalents]	Share in EU-15 total
Austria	Glass production, sinter production, bricks and tiles (decarbonizing)	435	NA	NA	435	8%
Belgium	Glass Production, ceramics	363	NA,NO	NA,NO	363	7%
Denmark	Glass Production, Yellow bricks. Expanded clay	31	IE,NA	IE,NA	31	1%
Finland	Glass production	1	NO	NO	1	0%
France	Glass Production, Brick and Tile Production	698	NA	NA	698	13%
Germany	Glass Production, Ceramics, Bricks and Tiles (decarbonizing)	1070	NA	NA	1,070	21%
Greece	Glass Production	15	NA,NO	NA,NO	15	0%
Ireland	Glas production, Bricks and Tiles (decarbonizing)	0	NO	NO	0	0%
Italy	Glass production	559	NA	NA	559	11%
Luxembourg	Glass production	61	NO	NO	61	1%
Netherlands	Glass production	232	NO	NO	232	4%
Portugal	Glass Production	214	NO	NO	214	4%
Spain	Glass production, Magnesite production, Porous Tiles, Non-porous Tiles	937	NA	NA	937	18%
Sweden	Glass production, Light expanded clay aggregate, Glass and mineral wool production	64	NA	NA	64	1%
UK	Fletton Brick Production	531	0	NE	536	10%
EU-15 Total		**5,212**	**0**	**0**	**5,218**	**100%**

Abbreviations explained in the Chapter ‘Units and abbreviations’.

Table 4.16 provides information on the contribution of Member States to EU recalculations in CO_2 from 2A Mineral products for 1990 and 2008 and main explanations for the largest recalculations in absolute terms.

Table 4.16 **2A Mineral products: Contribution of MS to EU recalculations in CO_2 for 1990 and 2009 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)**

	1990		2009		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	0	0.0	-3	-0.1	Revised activity data on soda ash production and glass production
Belgium	7	0.1	87	1.9	Emissions from carbonate use for flue gas desulphurization are included.
Denmark	0	0.0	0	0.0	
Finland	5	0.4	46	5.3	Impurities of lime are not included in the calculation, emission factor changed. A new plant was founded and emissions added.
France	7	0.0	-2	0.0	1990 : Ajout des émissions de 1960 à 2004 de CO2 pour la désulfuration liée à l'électricité
Germany	47	0.2	58	0.3	Revised activity data of soda ash use for glass production
Greece	33	0.5	10	0.2	Emissions from additional sources were included in the resubmission in 2011 and in the 2012 inventory submission. In addition, recalculations have been performed in
Ireland	0	0.0	0	0.0	
Italy	38	0.2	96	0.5	- Update of EF for cement; update of CO2 average emission factor for glass production on the basis of ETS figures
Luxembourg	0	0.0	0	0.0	
Netherlands	249	27.0	232	22.2	2A3, Limestone and Dolomite Use: reallocation from 2C1
Portugal	13	0.4	91	2.4	1) Revision of Lime Production (2A2) activity data for the period 1990-2010 (minor double counting).
Spain	0	0.0	-41	-0.3	2A3: Revision of CO2 emissions for the dolomite used as desulphurization technique in a power plant, that was omitted in the previous inventory edition. Revision of dolomite consumption as desulphurization technique in a power plant, that was
Sweden	0	0.0	0	0.0	
UK	15	0.1	-383	-6.6	The emission factor for lime production has been revised to reflect the mixture of limestone and dolomite used.
EU-15	**415**	**0.4**	**191**	**0.2**	

4.2.2 Chemical industry (CRF Source Category 2B) (EU-15)

Chemical industry includes the following key categories: CO_2 from 2B1 Ammonia Production, N_2O from 2B2 Nitric Acid Production and from 2B3 Adipic Acid Production and CO_2 and N_2O from 2B5 Other Chemical Industry.

Source category 2B1 Ammonia Production covers CO_2 emissions that occur during the production of ammonia, a chemical used as a feedstock for the production of several chemicals. In most instances, anhydrous ammonia is produced by catalytic steam reforming of natural gas (mostly CH_4) or other fossil fuels. CO_2 at plants using this process is released primarily during regeneration of the CO_2 scrubbing solution, with additional but relatively minor emissions resulting from condensate stripping. Source category 2B2 Nitric Acid Production accounts for N_2O emitted as a by-product of the high temperature catalytic oxidation of ammonia (NH_3) in the production of nitric acid. Adipic Acid Production (2B3) also emits N_2O as a by-product when a cyclohexanone/cyclohexanol mixture is oxidized by nitric acid.

Table 4.17 summarises information on Member States' emissions from chemical industry in 1990 and 2010 for total GHG, CO_2 and N_2O. Between 1990 and 2010, CO_2 emission from 2B Chemical Industry increased by 6 %. The absolute increase in CO_2 emissions was largest in Germany and Belgium; the absolute reductions were largest in Italy, France and Ireland. Between 1990 and 2010, N_2O emission from 2B Chemical Industry decreased by 87 %. The absolute decreases in N_2O emissions were largest in UK, France and Germany.

Table 4.17 2B Chemical Industry: Member States' contributions total GHG and CO_2 and N_2O emissions

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2010 (Gg CO_2 equivalents)	CO2 emissions in 1990 (Gg)	CO2 emissions in 2010 (Gg)	N_2O emissions in 1990 (Gg CO2 equivalents)	CO2 emissions in 2010 (Gg CO2 equivalents)
Austria	1,509	689	583	608	912	63
Belgium	4,588	5,758	645	3,155	3,943	2,596
Denmark	1,044	2	1	2	1,043	NA,NO
Finland	1,806	947	150	780	1,656	167
France	28,196	3,944	3,566	1,686	24,552	2,180
Germany	35,496	20,028	13,076	16,281	22,420	3,747
Greece	1,350	1,091	240	663	1,109	428
Ireland	2,026	NO	990	NO	1,035	NO
Italy	9,982	2,317	3,254	1,663	6,676	647
Luxembourg	NO	NO	NO	NO	NO	NO
Netherlands	11,095	5,119	3,744	3,882	7,096	982
Portugal	1,159	415	633	109	518	296
Spain	3,637	1,280	796	731	2,800	504
Sweden	969	458	126	131	835	319
United Kingdom	27,805	4,338	2,994	2,948	24,641	1,317
EU-15	**130,661**	**46,387**	**30,798**	**32,638**	**99,237**	**13,247**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.18 provides information on the contribution of Member States to EU recalculations in CO_2 from 2B Chemical industry for 1990 and 2009 and main explanations for the largest recalculations in absolute terms.

Table 4.18 2B Chemical Industry: Contribution of MS to EU recalculations of CO_2 emissions for 1990 and 2009 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2009		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	-3	-0.4	-6	-1.0	Plant specific data on the use of natural gas
Belgium	0	0.0	586	31.5	- During the 2012 submission the emissions of CO2 from the ammonia production in the Flemish region are revised from 2007 on. The company involved detected some errors in the calculation sheets. - During the 2012 submission some missing process emissions of CO2 in the category 2B5 in the Flemish region were added from 2005 on. The emissions of more
Denmark	0	0.0	0	0.0	
Finland	25	19.6	43	6.3	The indirect CO2 emissions from NMVOC emissions from chemical industry for the 2009 were updated. The recalculation was done due to corrected 2009 NMVOC emission data of a single plant in the VAHTI system. In addition CO2 emissions from the production of Phosphoric Acid were included in the inventory for the first time. Emissions of new hydrogen plant were included for 2009 and 2010, Emissions from
France	-1	0.0	0	0.0	
Germany	0	0.0	0	0.0	
Greece	0	0.0	266	0.0	CO2 emissions from Ammonia Production were corrected and resubmitted in September 2011. Emissions from Hydrogen Production have been reallocated from
Ireland	0	0.0	0	0.0	
Italy	0	0.0	0	0.0	
Luxembourg	0	0.0	0	0.0	
Netherlands	0	0.0	0	0.0	
Portugal	0	0.0	0	0.0	
Spain	0	0.0	0	0.0	
Sweden	8	7.0	43	73.7	2B4.2, Calcium Carbide: Revised national statistics regarding import and export of calcium carbide 2B5, Other inorganic chemical prod: CO2 emissions from two
UK	110	3.8	49	1.8	CO2 recovery is no longer subtracted from the emissions total. This is because it is not clear if the storage is permanent and to ensure compliance with the IPCC
EU-15	**138**	**0.5**	**980**	**3.3**	

Table 4.19 provides information on the contribution of Member States to EU recalculations in N_2O from 2B Chemical Industry for 1990 and 2009 and main explanations for the largest recalculations in absolute terms.

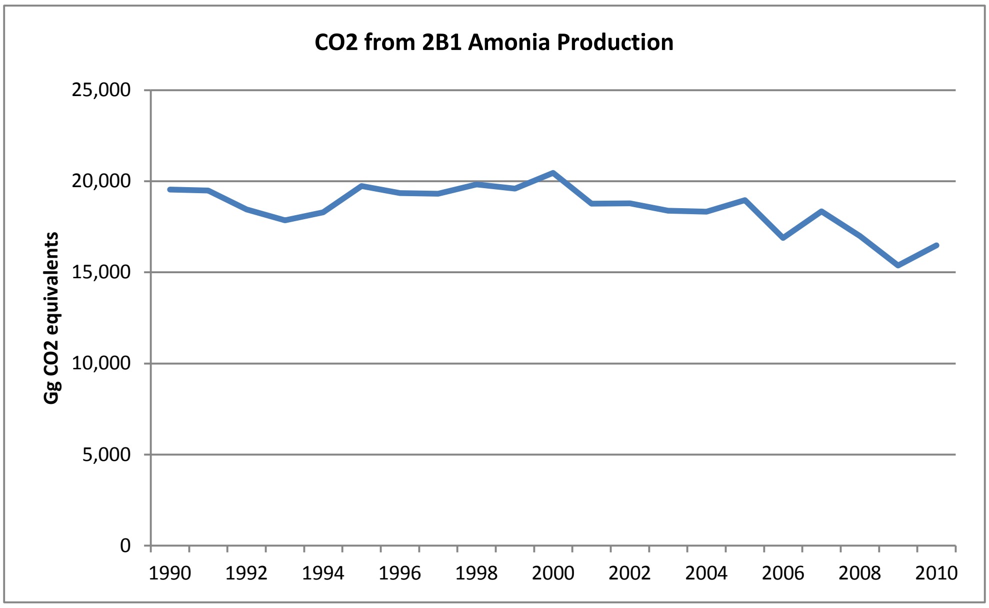
Table 4.19 2B-Chemical Industry: Contribution of MS to EU recalculations of N_2O emissions for 1990 and 2009 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2009		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	0	0.0	0	0.0	
Belgium	0	0.0	0	0.0	
Denmark	0	0.0	0	0.0	
Finland	0	0.0	0	0.0	
France	0	0.0	0	0.0	
Germany	0	0.0	0	0.0	
Greece	0	0.0	0	0.0	
Ireland	0	0.0	0	0.0	
Italy	0	0.0	0	0.0	
Luxembourg	0	0.0	0	0.0	
Netherlands	0	0.0	46	4.3	For 2009 a difference was found between the emission figures for N2O emissions from 2B2, nitric acid production, from the AER (which was used for the NIR 2011) and the verified emis-sions in the emission reports under EU-ETS. This error (+45.5 Gg CO2-
Portugal	-49	-8.6	166	131.5	Nitric Acid Production (2B2) new estimates: Data available at facility level
Spain	0	0.0	0	0.0	
Sweden	0	0.0	0	0.0	
UK	0	0.0	0	0.0	
EU-15	**-49**	**0.0**	**212**	**0.9**	

4.2.2.1 2B1 Ammonia Production

CO_2 emissions from 2B1 Ammonia Production account for 0.4 % of total EU-15 GHG emissions in 2010. Between 1990 and 2010, CO_2 emissions from this source decreased by 16 % (Figure 4.6). Germany, the Netherlands and France are responsible for 73 % of these emissions in the EU-15. Italy, Ireland and France had large reductions in absolute terms between 1990 and 2010. The reasons for these reductions were a change to low emitting technology in France and production decreases in the other two countries. The largest growth in emissions had Germany, followed by Belgium.

Figure 4.6 2B1 Ammonia Production: EU-15 CO_2 emissions



The raise of CO_2 emissions by 10 % in 1993-1995 was dominated by the increase of emissions in Belgium, Germany, Portugal and the Netherlands, whereas Italy showed a reverse trend in CO_2 emissions. The emissions in Belgium increased noticeably from 1993 to 1994 because new production installations started in the Flemish region. For Germany, production decreased during 1991-1993 due to closure of production sites in Eastern Germany, whereas in 1995 the market had stabilized again. The contribution to the EU-15 emission change 1993-1994 was dominated by activity data rather than implied emission factors.

The decrease in EU-15 CO_2 emissions by 10 % in 2006, which was followed by an increase of emissions by 9 % was mainly caused by France and the UK.. National statistics in France show a drop in production for 2006.

The largest reduction in CO_2 emissions in 2008-2009 could be observed for Portugal, as the only fertilizer industrial plant manufacturing ammonia has stopped its activity in 2009; the ammonia production has been relocated to India. CO_2 emissions in Germany (country's share in change of EU-15 emissions in 2009 is 35 %), the UK (country's share: 19 %) and Italy (country's share: 11 %) decreased considerably in absolute terms during 2008 and 2009. These reductions were mainly due to a drop in ammonia production that could be observed for nearly all Member States, but with highest rates among EU-15 MS for the UK (-28 %), Italy (-21 %) and Germany (-8 %) . Despite the decrease in the French production rate, France increased its CO_2 emissions from Ammonia production in the period 2008 to 2009, which was caused by a non-optimal process caused by a drop of production due to the economic crisis. Between 2009 and 2010, CO_2 emissions increased again in all EU-15 MS except France due to a consolidation of the economy. The emission reduction in France is due to the fact that one plant does no longer produce hydrogen, but buys hydrogen from an adjascent ammonia production plant and is therefore no longer emitted, due to a reduced ammonia production and a slight decrease of the EF because of an improvement of the catalysts.

Germany – representing the highest share of CO_2 emissions from Ammonia Production –estimated these emissions based on plant-specific information (Tier 3 approach) and thus improved the accuracy of estimates for this category, as recommended by the ERT (FCCC/ARR/2009/EC, para 50).

Table 4.20 2B1 Ammonia Production: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)		
Austria	514	480	538	3.3%	58	12%	24	5%	CS	CS,PS
Belgium	420	808	1,015	6.2%	207	26%	594	141%	T3	D,PS
Denmark	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	44	NO	NO	-	-	-	-44	-100%	NA	NA
France	3,033	2,155	1,439	8.7%	-717	-33%	-1,594	-53%	T2	PS
Germany	5,745	6,845	7,437	45.1%	592	9%	1,692	29%	T3	PS
Greece	240	188	301	1.8%	113	60%	61	-	T1a	CS
Ireland	990	NO	NO	-	-	-	-990	-100%	NA	NA
Italy	2,765	695	959	5.8%	265	38%	-1,805	-65%	T2	PS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	3,096	2,857	3,156	19.1%	300	10%	60	2%	T1b	CS
Portugal	569	NO	NO	-	0	-	-569	-100%	NA	NA
Spain	709	510	661	4.0%	151	30%	-47	-7%	D	PS
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom	1,431	849	978	5.9%	130	15%	-453	-32%	T1	CS
EU-15	**19,557**	**15,386**	**16,485**	**100.0%**	**1,099**	**7%**	**-3,072**	**-16%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.20 shows information on methods applied, activity data, emission factors for CO_2 emissions from 2B1 Ammonia Production for 1990 to 2010. The table shows that all MS (except for Ireland and the UK) report Ammonia Production as activity data. The implied emission factors per tonne of ammonia produced for 2010 vary between 1.09 t CO_2/t ammonia for Austria and 2.38 t CO_2/t ammonia for Germany (excluding the UK). In 2010 the EU-15 IEF (excluding the Netherlands, Portugal and the UK) is 1.85 t CO_2/t of ammonia produced. The table also suggests that about 63 % of EU-15 emissions are estimated with higher Tier methods.

Table 4.21 **2B1 Ammonia Production: Information on methods applied, activity data, emission factors for CO_2 emissions**

			1990				2010			
Member State	Method applied	Emission factor	Activity data: Description	Activity data: (kt)	Implied emission factor (t/t)	CO_2 emissions (Gg)	Activity data: Description	Activity data: (kt)	Implied emission factor (t/t)	CO_2 emissions (Gg)
Austria	CS	CS,PS	Ammonia Production	461	1.12	514	Ammonia Production	495	1.09	538
Belgium	T3	D,PS	Ammonia Production	360	1.17	420	Ammonia Production	904	1.12	1015
Finland	NA	NA	Ammonia Production	28	1.55	44	Ammonia Production	NO	NO	NO
France	T2	PS	Ammonia Production	1928	1.57	3033	Ammonia Production	956	1.50	1439
Germany	T3	PS	Ammonia Production	2705	2.12	5745	Ammonia Production	3128	2.38	7437
Greece	T1a	CS	Ammonia Production	313	0.77	240	Ammonia Production	159	1.89	301
Ireland	NA	NA	Natural Gas Feedstocks	430	2.30	990	Natural Gas Feedstocks	NO	NO	NO
Italy	T2	PS	Ammonia Production	1455	1.90	2765	Ammonia Production	505	1.90	959
Netherlands	T1b	CS	Ammonia Production	C	C	3096	Ammonia Production	C	C	3156
Portugal	NA	NA	Ammonia Production	C	C	569	Ammonia Production	C	NO	NO
Spain	D	PS	Ammonia Production	573	1.24	709	Ammonia Production	526	1.26	661
UK	T1	CS	Natural gas consumption PJ net	45	31.98	1431	Natural gas consumption PJ net	26	36.94	978
EU15			**EU15 w/o IE, NL, PT and UK (69%)**	**7823**	**1.72**	**13470**	**EU15 w/o NL, PT and UK (76%)**	**6674**	**1.85**	**12350**

Abbreviations explained in the Chapter 'Units and abbreviations'.

The implied emission factor for 2010 was lower than in 1990 for Austria, Belgium and France whereas the IEF increased for all other EU-15 MS during that period. Explanations for the development of the implied emission factors and for outliers in IEFs are given in the following overview:

Implied Emission Factor Ammonia Production, Austria

Emissions are calculated by natural gas non-energy use from the energy balance. The split in energy and non-energy use made by the operator might not always be consistent. In 1992 a high factor of natural gas/ammonia produced (0.5 t/t) was used, whereas in 2002 this factor was lower (0.41 t/t). The reason for the comparably low EF is i) the relatively low EF for CO_2 from natural gas (55.4 t/TJ) consistent with the energy sector, and ii) carbon bound in melamine that is not reported as CO_2.

Implied Emission Factor Ammonia Production, France

One plant stopped production in 2009. The sites reduced their specific emissions since 1990 due to improved efficiencies of catalysts. This was in particular the case for one site with 40% of the production for which the EF decreased from 2 kg CO_2 /t NH_3 produced to 1.5 kg CO_2/ t NH_3 in 2010. Deviating values occur for specific years, such as for 2009 when thehe IEF increased by 14% during 2008 and 2009 due to a non-optimal process which is caused by a drop of production.

Implied Emission Factor Ammonia Production, Germany

The growth of German IEF during 1992 and 1993 of 14% contributed most to the overall increase of the IEF during 1990 and 2009 (17%). The underlying reason is a gap in the emissions reported to the UBA from 1990 to 1992. Since its resubmission in 2010 and to correspond to recommendations from the In Country Review in 2010, Germany adds the CO_2 captured for other uses to total CO_2 emissions from 2B1. This results in an IEF results of 2.38 t CO_2/t NH_3 in 2010.

Implied Emission Factor Ammonia Production, Greece

The Greek IEF increased especially during the years 1990-1993 and 1998-2001 which is due to the different fuels used in the two plants operating in Greece. The first plant has been operating since 1990, with an interruption between 1994-1997 using natural gas provided by the Public Gas Company SA (DEPA) since 1998. During 1990-1993 natural gas has been provided by the Kavala Oil Corporation. Imported natural gas was introduced to the Greek energy system by DEPA in 1996. Until 1996 natural gas consumption in Greece corresponded to small amounts of domestic natural gas explored by the company Kavala Oil. The second plant has been operating since 1990 up to 1999 with intervals. This plant used lignite as feedstock until 1991, and liquid fuels until its closure.

During the Centralized Review of the Greek inventory in 2010, Greece recalculated and resubmitted all its estimates of CO_2 emissions from ammonia production reported under the industrial processes sector and the part that was allocated to the energy sector. The MS also used, for calculating its resubmitted estimates, updated AD compiled in consultation with external data providers, in order to have more accurate data on the natural gas used as feedstock for ammonia production. Thus, to correspond to recommendations raised during the EU Centralized Review in 2010, time-series consistency for ammonia production was improved.

Implied Emission Factor Ammonia Production, UK

The IEF of the UK (2010) is not comparable with other IEFs, because it is based on the activity data which is natural gas consumption in PJ for this source and not on ammonia production as for other MS.

Table 4.21 provides a more detailed overview of the methodologies and data sources used by Member States for this source category as reported in the NIR 2011.

Table 4.22 2B1 Ammonia Production: Summary of methodological information provided by Member States

Member State	Methodology comment
Austria	AD since 1990 and CH_4 emission data from 1994 onwards were reported directly by the only ammonia producer in Austria and thus represent plant specific data. The composition of the synthesis gas is measured regularly at the only ammonia producer in Austria. CO_2 emissions are calculated from the natural gas input with a standard emission factor (55.4 t/TJ). Until submission 2011 non-energy use data was taken from the national energy balance. In 2011 however, plant specific data on the use of natural gas (1990 – 2010) became available.In this methodology it is assumed that all natural gas is transformed to CO_2 and emitted at once. But, according to information from the producer, there are also CH_4 emissions during start-ups of the ammonia production. Therefore this CH_4 has to be subtracted from total CO_2 to avoid double counting. Furthermore, CO_2 and CH_4 emissions from urea production are reported, that both derive directly from ammonia. These emissions are reported under urea production – where they occur – and are also subtracted from total CO_2 emissions from ammonia production to avoid double counting of emissions. Account was taken for the carbon bound in the melamine production. [NIR 2012]
Belgium	In Flanders the emissions of CO_2 originating from the production of ammonia are obtained as a result of the yearly surveys carried out by the chemical federation in cooperation with the Vito. The estimation of the emissions is based on the consumption of natural gas. The part of the CO_2 (recovery part) is already taken into account. In the Walloon region, the amount of natural gas used in the process is given directly by the plant. The CO_2 process emissions are calculated based on this amount of natural gas. 100% per cent of the carbon content of the natural gas is presumed to be emitted and the default IPCC emission factor for CO_2 for natural gas (55,8 kton CO_2/PJ) is used. [NIR 2012]
Denmark	Not occuring. [NIR 2012]
Finland	The tier 1 IPCC methodology was applied. CO_2 emissions from ammonia production are calculated by multiplying the amount of produced ammonia with the emission factor. Activity data have been received directly from the company and the emission factor is the default factor from the IPCC.All ammonia currently used in Finland is imported. In 1990-1992 small amounts (4 - 30 Gg per year) were produced using mainly peat and heavy oil as feedstock for the needed hydrogen. From 1993 on there has been no ammonia production in Finland [NIR 2012]
France	There are currently for ammonia producing plants in France. Emissions, activity data and EFs are obtained directly from plants, CS EF calculated on this basis. [NIR 2012]
Germany	Tier 3 methodology has been applied since the 2011 submission. Companies report all information to Industrieverband Agrar (IVA) where data is aggregated and forwarded to UBA. [NIR 2012]
Greece	CO_2 emissions have been estimated using Tier 1a methodoloy. AD concerning fuel consumption for the years 1998-2009 have been provided by the plant using natural gas and by DEPA. Data for 2010 are plant specific and provided by the sole plant operating in Greece. National ammonia production for the whole time-series has been provided by the El Stat and for the years 1998-2010 by the one plant still operating in Greece. [NIR 2012]
Ireland	Carbon dioxide emissions from ammonia production are estimated from the natural gas feedstocks to the plant as indicated in the national energy balance provided by SEI. In accordance with the 1996 IPCC guidelines, it is assumed that no feedstock carbon is sequestered in urea and the emission factor is 54.94 kg CO_2/TJ, the value for indigenous natural gas, which equates to 2.3 tonne CO_2/tonne natural gas. Ammonia production was closed in 2003.[NIR 2012]
Italy	Ammonia production data are published in the international industrial statistical yearbooks (UN, several years), national statistical yearbooks (ISTAT, several years) and from 2002 they have been checked with information reported in the national EPER/E-PRTR registry. Recovered CO_2 has been investigated with the cooperation of the operators and the resulting information has been used to revise the whole CO_2 emission time series and the emission factors in this submission. The analysis has allowed to understand that CO_2 emissions recovered from ammonia production are used to produce urea and technical gases. According to IPCC Guidelines this CO_2 recovered should be accounted for emission and included in the estimate. Differently from the previous submissions the resulting average CO_2 emission factors are found to be higher than the IPCC defaults.For the years 2002-2007, the average emission factors result also from data reported by the plants in the national EPER/E-PRTR and they account for the recovered CO_2 data too. As for 2008 the average emission factor is 1.86 t CO_2/t ammonia production, whilst for 2009 the implied emission factor is 1.96 t CO_2/t ammonia production. while in 2010 the implied emission factor is 1.89 t CO_2/t ammonia production.[NIR 2012]
Luxembourg	Not occuring.[NIR 2012]
Netherlands	A method equivalent to IPCC Tier 1b has been applied. The amount of natural gas used as feedstock and a country-specific emission factor are used to estimate CO_2 emissions. Activity data on use of natural gas are obtained from Statistics Netherlands (CBS). Although ammonia and urea production data are considered confidential, international statistics such as UN, IFA and USGS do report production data for the Netherlands. A country-specific CO_2 emission factor is used. This emission factor is based on a 17% fraction of the carbon in the gas-feedstock not being oxidised during the ammonia manufacture and was calculated from the carbon contained in the urea produced. [NIR 2012]
Portugal	In 2008 only one fertilizer industrial plant manufactures ammonia in Portugal, using Vacuum Residual Fuel Oil (VRF) as source of hydrogen (feedstock). Total production of ammonia in Portugal is available from the only existing facility for the period 1990-2008. In 2009, this plant has stopped activity and the ammonia production has been relocated to India. The quantity of VRF that was used was set from data collected at the only industrial plant in Portugal for a limited number of years – 1990 till 1994 – and a strong linear relation between feedstock consumption and ammonia production could be established from available data [NIR 2012]
Spain	From 4 plants in 1990, only 2 plants still exist in 2010. In one plant that existed from 1990 to 1996, the production process was based on direct synthesis of ammonia in closed circuits with pure hydrogen and N which did not produce CO_2 emissions. Production data and country-specific EF from some plants and IPCC default factors and production statistics for the other plants. In 2009 only two plants were producing ammnia. Plant specific data (production of ammonia, consumption of natural gas and refinery gas, CO_2 produced, directly emitted, sold) is available. Emission factors are in the range 1.009-1.294 kg CO_2/tonne ammonia when using natural gas as input and in the range 1.420-1.430 kg CO_2/tonne ammonia when using naphtha / gas refinery as input. [NIR 2012]

Ammonia Production	
Member State	**Methodology comment**
Sweden	There is an annual production of about 5 Gg of ammonia in Sweden, according to UN statistics . This ammonia is however not intentionally produced, but is a by-product in one chemical industry producing various chelates and chelating agents, such as EDTA, DTPA and NTA . Emissions from this industry are included in CRF code 2B5 Other. Ammonia production, 2B1, is thus reported as NO in the CRF-tables. [NIR 2012]
UK	Emissions of CO2 from feedstock use of natural gas are calculated by combining reported data on CO2 produced, emitted and sold by the various ammonia processes. Where data are not available, they have been calculated from other data such as plant capacity or natural gas consumption. The ammonia plant utilising hydrogen by-product from acetic acid manufacture does not need to be included since there are no process emissions of CO2. A method change has been implemented in the 1990-2010 inventory cycle regarding emissions of CO2 from ammonia production where the CO2 is subsequently used as a feedstock in other production process. It is no longer assumed that the CO2 sold by one ammonia plant in the UK was used as a feedstock in methanol production, and was not emitted to atmosphere. UK estimates of CO2 emissions from ammonia manufacture have been revised to include the CO2 sold by that one ammonia production plant, increasing the sector emissions. The use of natural gas as a feedstock is calculated by combining: a) Natural gas equivalent to the CO2 emitted from ammonia manufacture; and b) Natural gas usage of the acetic acid plant, available from the process operator. [NIR 2012]

Source: NIR 2012.

Table 4.23 summarizes the recommendations from the 2010 and 2011 UNFCCC inventory reviews in relation to the category 2B1 Ammonia Production.

Table 4.23 2B1 Ammonia Production: Findings of the 2010 and 2011 UNFCCC inventory reviews in relation to CO_2 emissions and responses in 2012 inventory submissions

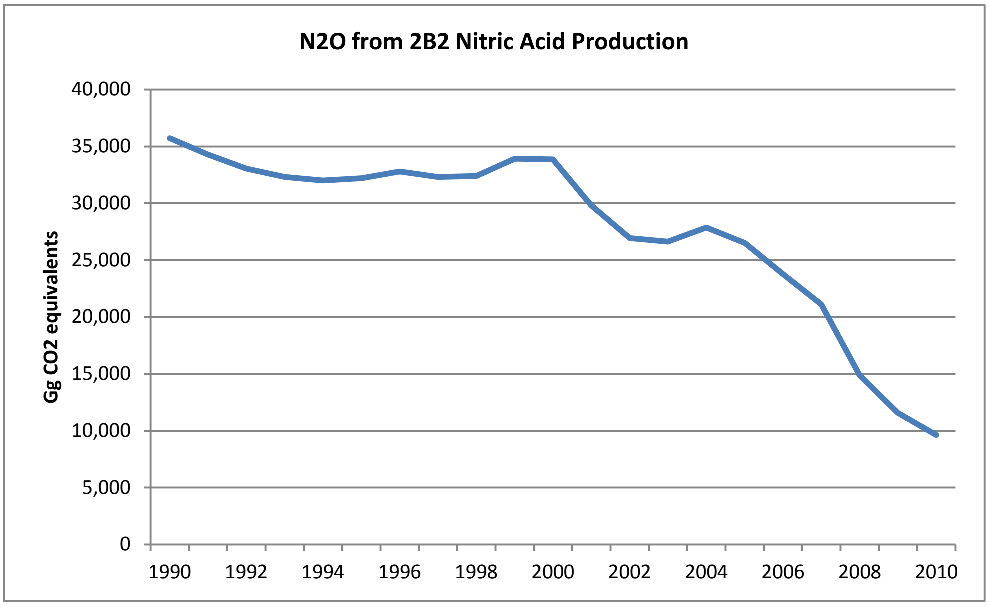
Member State	Review findings and responses in relation to 2B1 Ammonia Production	
	Comment UNFCCC report of the review of the 2010 or 2011 submission	Status in 2012 submission
Austria	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2010/AUT). Review report (Centralized review 2011) not yet available.	No follow-up necessary
Belgium	According to the information contained in the NIR, Belgium has used plant-specific data and IPCC default values to determine the CO2 EFs for ammonia production processes in the Flemish and Walloon Regions, which has resulted in a uniform EF of 55.8 t CO2/TJ. In response to questions raised by the ERT during the review, the Party confirmed that a methane oxidation rate of 99.5 per cent was used for the Flemish Region (similarly to the combustion efficiency) rather than a plant measurement. The ERT reiterates the recommendation from the previous review report that Belgium provide clearer information in the NIR on the methodology used, including justification for the oxidation factor applied. The ERT further recommends that Belgium develop plant-specific EFs for this key category and further update the description in the NIR on the development of the EFs for the next annual submission. (FCCC/ARR/2011/BEL, para 59)	The following clarification was provided in the NIR: The fraction means that a part of the imported CH4 of the natural gas is not converted to CO2 because of losses to CO, methanol and not-converted CH4. The company involved uses the standard factor of 0,995 (similar to the oxidation factor of gases when calculating the combustion emissions). During the 2012 submission the company involved in the Flemish region did revise their emissions of CO2 from 2007 on. [NIR 2012, p.97, 98]
Denmark	NO	No follow-up necessary
Finland	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/FIN)	No follow-up necessary
France	No recommendation for improvement of this source category in Review Report (FCCC/ARR/2010/FRA). Review report (Centralized review 2011) not yet available.	No follow-up necessary
Germany	No recommendation for improvement of this source category in Review Report (FCCC/ARR/2010/DEU). Review report (Centralized review 2011) not yet available.	No follow-up necessary
Greece	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/GRC)	No follow-up necessary
Ireland	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2010/IRE). Review report (Centralized review 2011) not yet available.	No follow-up necessary
Italy	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2010/ITA). Review report (Centralized review 2011) not yet available.	No follow-up necessary
Luxembourg	NO	No follow-up necessary
Netherlands	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/NLD).	No follow-up necessary
Portugal	AD for 2008 were estimated using a simple linear forecast. During the review, the ERT was informed that Portugal plans to obtain AD directly from the plant. The ERT welcomes this planned improvement and recommends that Portugal report its emission estimates accordingly in its next annual submission. Review report (Centralized review 2011) not yet available.	Ammonia Production in Portugal has stopped.
Spain	The ERT concluded that the revised estimate has resulted in greater consistency in the time series, but recommends that the Party explain why the IEF used is lower than the IPCC default EF, and enhance QC procedures to ensure that the emissions and IEF are not underestimated, in its future annual submissions. Review report (In-country review 2011) not yet available.	No information provided in the NIR
Sweden	NO	No follow-up necessary
UK	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/GBR).	No follow-up necessary

Source: NIR 2012, UNFCCC inventory review reports, as published at UNFCCC: http://unfccc.int/national_reports/annex_i_ghg_inventories/inventory_review_reports/items/5687.php

4.2.2.2 2B2 Nitric Acid Production

N_2O emissions from 2B2 Nitric acid production account for 0.3 % of total EU-15 GHG emissions in 2010. Between 1990 and 2010, N_2O emissions from this source decreased by 73 % (Table 4.23). Germany (32%), Belgium (19 %), UK (14%) and France (12%) account for 77 % of EU-15 emissions. All Member States had reductions from this source between 1990 and 2010. The Netherlands and France had the greatest reductions in absolute terms, due to the implementation of technical measures at all Dutch nitric acid plants in the third quarter of 2007 and due to the improvement of the process and catalyst efficiency in France. Production stopped in Denmark (middle of 2004) and Ireland (in 2002 due to the liquidation of Irish Fertilizer Industries).

Figure 4.7 2B2 Nitric acid production: EU-15 N_2O emissions



The decrease in N_2O emissions by 12 % in 2000-2001 and further 10 % 2001-2002 was dominated by the drop in emissions in France, UK and the Netherlands. The decrease of N_2O emissions of minus 11 % during 2006 and 2007 was dominated by Belgium (contributing with 27 % to the EU-15 emission change), the Netherlands (contributing with 48 % to the EU-15 emission change due to technical measures that have been implemented at all nitric acid plants in the third quarter of 2007) and France (contributing with 10 % to EU-15 emission change due to improved catalyst efficiency). The N_2O emissions further decreased significantly by minus 30 % between 2007 and 2008 and by minus 23 % during 2008 and 2009. Emissions reductions in 2009 were achieved especially in Germany, Finland and France. In Finland all existing Finnish nitric acid plants have started to use special catalyst to decrease emissions during 2009 whereas in Germany and France further implementation of reduction techniques and improvement of the process efficiency led to a continuation of the trend in emissions since 2007. This trend of declining N_2O emissions continued between 2009 and 2010 for Austria, Finland, France, Italy and Spain. Only Belgium, Greece and the UK reported emission increases in this period.

Table 4.24 2B2 Nitric acid production: Member States' contributions to N_2O emissions

Member State	N_2O emissions (Gg CO_2			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)		
Austria	912	165	63	0.7%	-102	-62%	-849	-93%	CS	PS
Belgium	3,562	1,470	1,865	19.4%	395	27%	-1,697	-48%	T3	PS
Denmark	1,043	NO	NO	-	-	-	-1,043	-100%	NA	NA
Finland	1,656	793	167	1.7%	-626	-79%	-1,489	-90%	T2	PS
France	6,570	1,991	1,191	12.4%	-800	-40%	-5,379	-82%	T2	PS
Germany	3,384	3,309	3,030	31.5%	-279	-8%	-354	-10%	T3	PS
Greece	1,109	367	428	4.4%	61	17%	-681	-61%	D	D
Ireland	1,035	NO	NO	-	-	-	-1,035	-100%	NA	NA
Italy	2,086	382	157	1.6%	-225	-59%	-1,929	-92%	T2	D,PS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	6,330	493	301	3.1%	-191	-39%	-6,028	-95%	T2	PS
Portugal	518	292	296	3.1%	4	1%	-222	-43%	D	PS
Spain	2,800	895	504	5.2%	-391	-44%	-2,296	-82%	T3	PS
Sweden	814	305	312	3.2%	7	2%	-502	-62%	T2	PS
United Kingdom	3,904	1,107	1,317	13.7%	210	19%	-2,587	-66%	CS	CS
EU-15	**35,723**	**11,569**	**9,632**	**100.0%**	**-1,937**	**-17%**	**-26,091**	**-73%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.25 shows information on methods applied, activity data, emission factors for N_2O emissions from 2B2 Nitric Acid Production for 1990 to 2010. The table shows that all MS report Nitric Acid Production as activity data; for some MS this information is confidential (Netherlands and Portugal). The implied emission factors per tonne of nitric acid produced vary for 2010 between 0.0004 t N_2O/t of nitric acid produced for Austria and 0.0070 t N_2O/t of nitric acid produced for Greece. The EU-15 IEF (excluding Netherlands and Portugal) is 0.0027 t N_2O/t of nitric acid produced. The decrease of the EU-15 IEF during 1990 and 2010 is mainly due to the implementation of improved abatement technologies in the different MS and the closure of older plants in some MS. The table also suggests that about 96 % of EU-15 emissions are estimated with higher tier methods for 2009.

Table 4.25 2B2 Nitric Acid Production: Information on methods applied, activity data, emission factors for N_2O emissions

Member State	Method applied	Emission factor	1990 Activity data Description	1990 Activity data (kt)	1990 Implied emission factor (t/t)	1990 N_2O emissions (Gg)	2010 Activity data Description	2010 Activity data (kt)	2010 Implied emission factor (t/t)	2010 N_2O emissions (Gg)
Austria	CS	PS	Nitric Acid Production	530	0.0056	2.9	Nitric Acid Production	548	0.0004	0.2
Belgium	T3	PS	Nitric Acid Production	1436	0.0080	11.5	Nitric Acid Production	2043	0.0029	6.0
Denmark	NA	NA	Nitric Acid Production	450	0.0075	3.4	Nitric Acid Production	NO	NO	NO
Finland	T2	PS	Nitric acid production medium pressure plants	549	0.0097	5.3	Nitric acid production medium pressure plants	566	0.0009	0.5
France	T2	PS	Nitric Acid Production	3200	0.0066	21.2	Nitric Acid Production	2362	0.0016	3.8
Germany	T3	PS	Nitric Acid Production	1698	0.0064	10.9	Nitric Acid Production	2513	0.0039	9.8
Greece	D	D	Nitric Acid Production	511	0.0070	3.6	Nitric Acid Production	197	0.0070	1.4
Ireland	NA	NA	Nitric Acid Production	339	0.0099	3.3	Nitric Acid Production	NO	NO	NO
Italy	T2	D,PS	Nitric Acid Production	1037	0.0065	6.7	Nitric Acid Production	417	0.0012	0.5
Netherlands	T2	PS	Nitric Acid Production	C	C	20.4	Nitric Acid Production	C	C	1.0
Portugal	D	PS	Nitric Acid Production	C	C	1.7	Nitric Acid Production	C	C	1.0
Spain	T3	PS	Nitric Acid Production	1329	0.0068	9.0	Nitric Acid Production	659	0.0025	1.6
Sweden	T2	PS	Nitric Acid Production	374	0.0070	2.6	Nitric Acid Production	257	0.0039	1.0
UK	CS	CS	Nitric Acid Production	2408	0.0052	12.6	Nitric Acid Production	1210	0.0035	4.2
EU15			**EU15 w/o NL and PT (81%)**	**13,861**	**0.0067**	**93**	**EU15 w/o NL and PT (95%)**	**10,772**	**0.0027**	**29**

Abbreviations explained in the Chapter 'Units and abbreviations'.

The implied emission factors for 2010 are significantly lower than in 1990 for all MS except for Greece. Explanations for the development of the implied emission factors are therefore given in the following overview. Besides implementing abatement measures, also the closure of older plants in Belgium, Denmark, Ireland, Italy and Sweden resulted in reduced emissions.

Implied Emission Factor, Belgium

The decrease in IEF was due to further introduction of catalysts in the different installations in the Flemish region.

Implied Emission Factor, Austria

Comparable low IEF could be explained with the installation of a N_2O decomposition facility in 2004. The additional decrease of IEF 2008-2009 was due to the introduction of a new catalyst into the nitric acid plant in May 2009.

Implied Emission Factor, France

IEF is calculated with activities and N_2O emissions reported under the E-PRTR. Between 2007 and 2008, reported N_2O emissions decreased due to improved processes and catalyst efficiency. In 2009 one older plant producing nitric acid was closed.

Implied Emission Factor, Finland

The decrease of the IEF after 2008 is due to the first joint implementation project in Finnish territory. This project aims on cutting down N_2O emissions of nitric acid plants and was started in 2009. A new N_2O abatement technology - a pelleted catalyst - was installed directly in the ammonia oxidation reactor underneath the ammonia oxidation catalyst (Pt-Rh) in all the three existing nitric acid plants.

Implied Emission Factor, Germany

A new plant started production that was build with the best available technology in 2002 and thus IEF significantly decreased from 2002 onwards. An additional decrease of the IEF is due the use of reduction techniques from 2006 onwards.

Implied Emission Factor, Spain

Emissions were derived from information about production, emission abatement techniques and plant specific EFs. Emissions thus follow the implementation of the techniques. Relevant information was provided by plant operators with questionnaires. For those plants that are no longer in operation, emission estimates were made by applying an emission factor of 7 kg N_2O / t nitric acid, as originally published by the Business Federation of the Chemical Industry in Spain (FEIQUE). Thus for early 1990ies IEF was higher than in recent years.

Table 4.26 provides a more detailed overview on methodologies and data sources used in EU-15 Member States for the estimation of emissions from Nitric Acid Production.

Table 4.26 2B2 Nitric Acid Production: Summary of methodological information provided by Member States

Nitric Acid Production	
Member State	**Methodology comment**
Austria	Following the IPCC Guidelines plant specific measurement data was collected. Activity and emission data of N2O emissions was obtained directly from the plant operator. Since 1998, emissions are measured continuously. Based on the analysed emission data of 1998 and due to the fact that the production technology has not changed between 1990 and 1998 emission factors per ton of product were calculated for the used technologies. With these estimates of plant specific emission factors and the production volume of the individual plants the total emission of N2O per year was calculated. [NIR 2012]
Belgium	The N_2O emissions from the production of nitric acid are estimated in Flanders until 2002 by using an emission factor of 8 kg N_2O/ton HNO_3 from CITEPA. The three plants involved in Flanders agreed with this factor of 8 kg N_2O/ton HNO_3 since 1990 and give their nitric acid production figures each year. Since 2000 only one plant is still involved in this sector. From 2003 on lower emission factors in this plant are reported, based on monitoring results (approx. 5.6 kg N_2O/ton HNO_3). The use of catalysts reduces these emissions. A further reduction of these emissions will be obtained in the future because of the extension of the use of catalysts in the different installations involved. From 2003 on a more or less stabilization in production occur, with the exception of the year 2009 due to the economic crisis. From 2006 a further decrease in emissions occurs contrary to the increase in production. As a result the emission factors decreases to 3 and even to 1 kg N2O/ton HNO3.
	In the Walloon region, there is only one producer of nitric acid (one plant with 3 installations). Each year, this plant provides the N2O emissions based on their production and on monitoring. The global emission factor used is 6,3 kg/t in 2009. For the time being , there is only one installation with an abatement technology (SCR) installed in 1996. However, this installation did not lead to a decrease in the N2O emissions because of the strong increase of the production since 1996. No emission factors and N2O emissions are presented by regions as there is only one company by region and the activity data are confidential. [NIR 2012]

Nitric Acid Production	
Member State	**Methodology comment**
Denmark	The N2O emission from the production of nitric acid/fertiliser is based on measurement for 2002. For the previous years, the N2O emission has been estimated from annual production statistics from the company and an emission factor of 7.5 kg N2O/tonne nitric acid, based on the 2002 emission measured. The production of nitric acid ceased in the middle of 2004. [NIR 2012]
Finland	Statistics Finland co-operates with the nitric acid manufacturers to produce the annual emission estimates. For emissions in 1990–2004 the procedure was as follows: the manufacturers provided the activity data and emission factors, and Statistics Finland carried out the calculations using an agreed methodology that corresponds to the IPCC Good Practice Guidance equation 3.9. Starting from the inventory year 2005 both emissions and activity data have been received from the Vahti system. Currently it is the specific emission factors rather than emissions that are calculated by the inventory unit. Since 2009 all existing nitric acid plants have been equipped with automatic systems according to EU standards to measure the project key parameters. The plant-specific project emission factor representing the average N2O emissions per tonne of nitric acid over the respective verification period is derived by dividing the total mass of N2O emissions by the total output of 100% concentrated nitric acid for that period. [NIR 2012]
France	Legislation in 1998 fixed a maximum emission factor of 7 kg/t HNO3 for new and existing plants. L'UNIFA reprted emissions for each plant for the years 1990, 1998 ,and 2001.For the year inbetween, only a global balance for all plants was provided. These data were compared with data reported in environmental declarations of industry. Since 2002 annual plant-specific data is available and good practice guidance for the estimation was adopted by AFNOR . [NIR 2012]
Germany	Tier 3 methodology has been applied since the 2011 submission. Companies report all information to Industrieverband Agrar (IVA) where data is aggregated and forwarded to UBA. [NIR 2012]
Greece	Estimates are based on activity data from El.Stat and the individual industrial units for 1990-2010 and average IPCC default EF (IPCC GPG 2000). Actually in the recent years there is only one unit producing nitric acid in Greece therefore, data are sent directly to the inventory team by the unit. No N2O abatement technologies are used. [NIR 2012]
Ireland	Nitric acid production ceased in 2002 with the liquidation of Irish Fertilizer Industries. For the years 1990-1995, the inventory agency received direct correspondence from the plant operator specifying the quantities of nitric acid produced and the company"s estimates of N2O emitted during the production process. The emissions were estimated from nitrogen loading and the type of catalyst used in the process. [NIR 2012]
Italy	With regard to nitric acid production (2B2), production figures at national level are published in the national statistical yearbooks (ISTAT, several years), while at plant level they have been collected from industry (Norsk Hydro, several years; Yara, several years; Radici Chimica, several years). In 1990 there were seven production plants in Italy; three of them closed between 1992 and 1995, and another one closed in 2004. The N2O average emission factors are calculated from 1990 on the basis of the emission factors provided by the existing production plants in the national EPER/EPRTR registry, applied for the whole time series, and default IPCC emission factors for low and medium pressure plants attributed to the plants, now closed, where it was not possible to collect detailed information. The implied emission factor varies year by year depending on the production levels of the different plants and it is equal to 6.49 and 7.07 kg N2O/Mg nitric acid production, in 1990 and in 2007 respectively. In 2008, the implementation of catalyst N2O abatement technology in one of the major production plants, and specifically in one unit of that plant, has led to a significant decrease in total N2O emissions from nitric acid production, consequently a relevant reduction in the IEF can be observed too (YARA, several years): the implied emission factor for 2008 is in fact 2.29 kg N2O/Mg nitric acid production (the abatement rate in one plant was 82% so far), while the implied emission factor for 2009 is 2.94 kg N2O/Mg nitric acid production, while for 2010 the implied emission factor is 1.21 kg N2O/Mg nitric acid production. The relevant decrease is due to the installation of the abatment technology in the other unit of the same producing facility (Radici Chimica, 2011).[NIR 2012]
Luxembourg	Not occuring. [NIR 2012]
Netherlands	Activity data are confidential. An IPCC Tier 2 method is used to estimate N2O emissions. The emission factors are based on plant-specific measured data which are confidential. The emissions are based on data reported by the nitric acid manufacturing industry and are included in the emission reports under EU ETS and the national Pollutant Release and Transfer Register (PRTR). [NIR 2012]
Portugal	Only three industrial plants did produced nitric acid in Portugal between 1990 and 2010. EFS were estimated based on monitoring data from the facilities and are confidential. Activity Data is obtained directly from the facilities. One of the plants was shutdown during year 2010 and replaced by a new facility.[NIR 2012]
Spain	Plant-specific production data for the years 1990 and 2008. Plant-specific AD for the entire time series from industrial association FEIQUE (the Business Federation of the Chemical Industry in Spain) and MITYC differentiation production types and processes. CS EF from plant-specific questionnaires are used taking into account technologies installed . [NIR 2011]
Sweden	Activity data, such as the produced amount of nitric acid, has been obtained from the facilities and from official statistics. Emission estimates of N2O have been reported in the companies' environmental reports or have been provided by the facilities directly. Emission data are not available for all facilities for 1991-1993. Since two plants have been shut down, it is no longer possible to acquire this information. Calculations have therefore been made based on production statistics and an assumed emission factor. [NIR 2012]
UK	Estimates are based on PS data as well as calculated using nitric acid production data and production capacities. Across the 1990-2010 time-series, the availability of emissions and production data for UK Nitric Acid (NA) plant is inconsistent, and hence a range of methodologies have had to be used to provide estimates and derive emission factors for this sector. Emissions partly provided directly by operators, site specific EF and default EFs. [NIR 2012]

Source: NIR 2012.

Table 4.27 summarizes the recommendations from the 2010 and 2012 UNFCCC inventory reviews in relation to the category 2B2 Nitric Acid Production.

Table 4.27 2B2 Nitric Acid Production: Findings of the 2010 and 2011 UNFCCC inventory reviews in relation to N_2O emissions and responses in 2012 inventory submissions

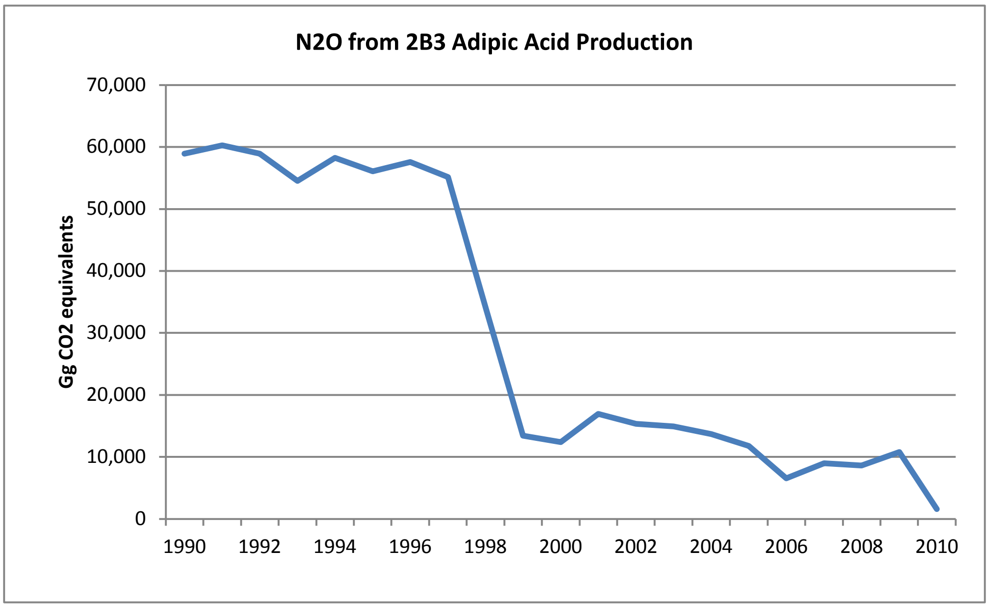
Member State	Review findings and responses related to 2B2 Nitric Acid Production	
	Comment UNFCCC report of the review of the 2011 submission	**Status in 2012 submission**
Austria	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2010/AUT). Review report (Centralized review 2011) not yet available.	No follow-up necessary
Belgium	N2O emissions from nitric acid production declined by 58.7 per cent for 2009 compared to the base year level and the inter-annual change between 2005 and 2006 was as high as 32.2 per cent. Following the recommendation from the previous review report, Belgium has provided an explanation for the inter-annual changes in the NIR, which the ERT found was not sufficient to explain the trend. During the review, the Party clarified that the decline was mainly due to strengthened abatement measures adopted in the Flemish Region where four dual-pressure process plants have been installed with a selective catalytic reduction process, and one single-pressure process plant has been installed with a non-selective catalytic reduction process. The ERT recommends that Belgium include this explanation in the NIR of its next annual submission, in order to improve transparency. (FCCC/ARR/2011/BEL, para 60)	Further explanation on the use of abatement technologies and the EFs were incorporated in the NIR. [NIR 2012, p.98]
Denmark	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/DNK).	No follow-up necessary
Finland	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/FIN)	No follow-up necessary
France	The evolution of the aggregated IEF for all plants is consistently presented in table 43 in the NIR and in the CRF tables, showing that the IEF decreased between 1990 (6.62 kg/t HNO3 100%) and 2008 (3.55 kg/t HNO3 100%). The ERT recommends that France report on the process technology used for each plant and the emissions aggregated by the two groups of plants, with and without N2O destruction technology, in order to increase transparency in its next annual submission. The ERT considers that France is not reporting information on how it calculates the country-specific EFs and the trend in a transparent manner. Review report (Centralized review 2011) not yet available.	Reporting of two groups of plants, with and without process technology, was not implemented.
Germany	No recommendation for improvement of this source category in Review Report (FCCC/ARR/2010/DEU). Review report (Centralized review 2011) not yet available.	No follow-up necessary
Greece	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/GRC)	No follow-up necessary
Ireland	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2010/IRE). Review report (Centralized review 2011) not yet available.	No follow-up necessary
Italy	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2010/ITA). Review report (Centralized review 2011) not yet available.	No follow-up necessary
Luxembourg	NO	No follow-up necessary
Netherlands	The Netherlands uses a plant-specific EF of 7.4 kg N2O/t nitric acid to estimate emissions for the period 1990–1998. The plant-specific EF is based on measurements taken in 1998 and 1999. From 1999 onwards, the emission estimates are based on measurements taken annually. The results of the measurements taken in 1998 and 1999 which have been used to determine the country-specific EF for the period 1990–1998 could not be provided to the ERT by the Netherlands as they had not been archived correctly. Therefore, the emissions for the period 1990–1999 and the time-series consistency could not be assessed by the ERT. The ERT recommends that the Netherlands retrieve the results of the 1998 and 1999 measurements in order to demonstrate time-series consistency in its next annual submission and that the Netherlands archive all such results properly and, when necessary, make them available for ERTs in the future. (FCCC/ARR/2011/NLD, para 79)	Not yet adressed. [NIR 2012]
Portugal	Nitric acid is produced in three industrial plants in Portugal. For all years, the AD and EFs are reported as confidential for this category. During the review, the ERT was informed that the country-specific EF used in emission estimates is based on monitored data from one of the three existing production units for 2001 and that the EF was assumed to be similar for the other units. The ERT recommends that Portugal derive country-specific EFs that are appropriate for all production units, and report on them in its next annual submission. Review report (Centralized review 2011) not yet available.	Portugal started obtaining AD directly from the facilities and derived plant specific EFs based on monitoring data. [NIR 2012, p.9-3]
Spain	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2010/ESP). Review report (in-country review 2011) not yet available.	No follow-up necessary
Sweden	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2010/SWE). Review report (Centralized review 2011) not yet available.	No follow-up necessary
UK	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/GBR).	No follow-up necessary

Source: NIR 2011, UNFCCC inventory review reports, as published at UNFCCC: http://unfccc.int/national_reports/annex_i_ghg_inventories/inventory_review_reports/items/5687.php

4.2.2.3 2B3 Adipic Acid Production

N_2O emissions from 2B3 Adipic Acid Production account for 0.04 % of total EU-15 GHG emissions in 2010. Between 1990 and 2010, N_2O emissions from this source decreased by 97 % (Figure 4.8). Only France, Germany, Italy and the UK produce adipic acid and all four countries were able to decrease emissions from this source category significantly due to the retrofitting of installations with abatement technologies.

Figure 4.8 2B3 Adipic Acid Production: EU-15 N_2O emissions



During 1997 and 1999, N_2O emissions for EU-15 decreased significantly by 76 %. The country's share in this change of emission trend was 43 % for Germany ,31 % for France and 28 % for the UK, whereas Italy increased its emissions during that time period and reduced its emissions significantly during 2005 and 2006 (-77%).

In Germany decomposition takes place nearly completely. At the end of 1997, both producers have put a catalytic reactor system into operation that, in constant operation, achieves an N_2O-decomposition rate of 96-98 %. A N_2O abatement system was fitted to the single plant that produces adipic acid in 1998. The abatement system is a thermal oxidation unit and is reported by the operators to be 99.99 % efficient at N_2O destruction. The only plant that produces adipic acid in France installed an abatement technique in 1998.

The decrease of N_2O emissions in Italy between 2005 and 2006 is the result of the application of the best available technique to reduce emission in the only existing adipic acid production plant. The technology has been applied in trial for a few months both in 2004 and in 2005. The technology of catalytic decomposition of N_2O was fully operational from December 2005 onwards and reduced N_2O emissions and IEF significantly (Table 4.28).

The increase of N_2O emissions between 2000 and 2001 and between 2006 and 2007 was dominated by the raise of emissions in Germany due to damaged abatement systems. During 2008 and 2009

German N_2O emissions increased by 56 % because the exhaust air cleaning system of one producer in Germany was not working for a longer period of time. In 2008-2009, the largest reduction of emissions could be found for the UK. The UK's only remaining adipic acid plant closed during early 2009 - therefore emissions are much lower than in previous years. The emission will be zero for 2010.

Table 4.28 2B3 Adipic Acid Production: Member States' contributions to N_2O emissions

Member State	N_2O emissions (Gg CO_2			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)		
Austria	NO	NO	NO	-	-	-	-	-	NA	NA
Belgium	NO	NO	NO	-	-	-	-	-	NA	NA
Denmark	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	NO	NO	NO	-	-	-	-	-	NA	NA
France	14,806	1,415	380	24.0%	-1,034	-73%	-14,425	-97%	T2	PS
Germany	18,805	8,570	716	45.1%	-7,854	-92%	-18,088	-96%	T3	PS
Greece	NO	NO	NO	-	-	-	-	-	NA	NA
Ireland	NO	NO	NO	-	-	-	-	-	NA	NA
Italy	4,579	748	490	30.9%	-258	-34%	-4,089	-89%	T2	D,PS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	NO	NO	NO	-	-	-	-	-	NA	NA
Portugal	NO	NO	NO	-	-	-	-	-	NA	NA
Spain	NA	NA	NA	-	-	-	-	-	NA	NA
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom	20,737	71	NO	0.0%	-71	-100%	-20,737	-100%	NA	NA
EU-15	**58,927**	**10,804**	**1,587**	**100.0%**	**-9,217**	**-85%**	**-57,340**	**-97%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.29 shows information on methods applied, activity data, emission factors for N_2O emissions from 2B3 Adipic Acid Production for 1990 to 2010. The table shows that in 2010 adipic acid was produced in four MS only. All four MS use adipic acid production as activity data but the information is confidential in France, Germany and the UK. The implied emission factors per tonne of adipic acid produced is only provided by Italy with 0.3 t/t for 1990 and 0.02 t/t for 2010. The table suggests that in 2010 100 % of EU-15 emissions are estimated with higher Tier methods.

Table 4.29 2B3 Adipic Acid Production: Information on methods applied, activity data, emission factors for N_2O emissions

Member State	Method applied	Emission factor	1990 Activity data Description	1990 Activity data (kt)	1990 Implied emission factor (t/t)	1990 N_2O emissions (Gg)	2010 Activity data Description	2010 Activity data (kt)	2010 Implied emission factor (t/t)	2010 N_2O emissions (Gg)
France	T2	PS	Adipic acid production	C	C	47.8	Adipic acid production	C	C	1.2
Germany	T3	PS	Adipic acid production	C	C	60.7	Adipic acid production	C	C	2.3
Italy	T2	D,PS	Adipic acid production	49	0.30	14.8	Adipic acid production	85	0.02	1.6
UK	NA	NA	Adipic acid production	C	C	66.9	Adipic acid production	NO	C	NO
EU15			**EU15**			**190**	**EU15**			**5**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.30 provides a more detailed overview on methodologies and data sources used in EU-15 Member States for the estimation of emissions from adipic acid production.

Table 4.30 2B3 Adipic Acid Production: Summary of methodological information provided by Member States

Adipic Acid Production	
Member State	**Methodology comment**
France	There is only one production site in France. Emissions are based on plant-specific data. Good practice guidance for the emissions measurement and estimation at plant level have been developed and approved by AFNOR. Since 1998 an abatement system is installed that destroys N2O using absorption which is synthesizing nitirc acid. The plant is equiped with a catylytic treatment of NOx before the exhaust is emitted in the atmosphere. In regular situations emissions are continuously measured, in irregular situations, emissions are estimated based on a material balance [NIR 2012]
Germany	Until around the mid-1990s, producers provided data only on amounts produced. The IPCC default emission factors have been used to calculate nitrous oxide emissions for that period. For the subsequent period, in addition to reporting their production figures, producers also confidentially reported their N2O emissions, along with necessary background information. This fact is highly significant with regard to the precision of the reported data; without data on technically unavoidable N2O production, and – especially – without information as to the operating period of the relevant decomposition facilities, estimates of the reduction in nitrous oxide emissions would have been so imprecise that it would have been necessary to continue using the default EF. [NIR 2012]
Italy	Italian production figures and emission estimates for adipic acid have been provided by the process operator (Radici Chimica, several years); for the whole time series. N2O emissions from adipic acid production (2B3) have been estimated using the default IPCC emission factor equal to 0.30 kg N2O/kg adipic acid produced, from 1990 to 2003. The abatement system is generally run together with the adipic acid production process. In 2004, the N2O catalytic decomposition abatement technology has been tested so that the value of emission factor has been reduced taking into account the efficiency and the time, one month, that the technology operated. From the end of 2005 the abatement technology is fully operational; the average emission factor in 2006 is equal to 0.05 kg N2O/kg adipic acid produced and the abatement system had been operating continuously for 9 months; since 2007 the average emission factor has been 0.03 kg N2O/kg adipic acid produced and the operating time of the abatement system was 11 months. Improving the efficiency in operation, the technology system it is expected to reach 95% of abatement rate in the future with respect to the default emission factor 300 kg/t adipic acid produced. Thus, both for the period 1990-2005 and from 2006 onwards the estimates are provided according to the GPG (default EF has been used when no abatement system was operational; abatement rates have been considered in estimating emission values since 2006). The operator reports also under EPER/E-PRTR both adipic acid production and the N2O emissions related to this production; adipic production and N2O emissions have been also reported by the operator to the national competent authoritiy for the ETS (because the facility will join the ETS system in 2013) together with additional information such as abatement rates and operating times. Based on this informationfrom the national PRTR EFs are calculated for the plant and compared to those resulting from the formula included in the following box (referred to the IPCC default EFs for adipic acid production, abatement rate and operating time of the abatement technology).[NIR 2012]
UK	Production data and emission estimates have been estimated based on data provided by the process operator (Invista, 2010). The emission estimates are based on the use of plant-specific emission factors for unabated flue gases, which were determined through a series of measurements on the plant, combined with plant production data and data on the proportion of flue gases that are unabated. In 1998 an N2O abatement system was fitted to the plant. The abatement system is a thermal oxidation unit and is reported by the operators to be 99.99% efficient at N2O destruction. In 2004 it was operational 92.6 % of the time (when compared to plant operation). Variation in the extent to which this abatement plant is operational, account for the large variations in emission factors for the adipic acid plant since 1999. [NIR 2012]

Source: NIR 2012

Table 4.31 summarizes the recommendations from the 2010 and 2011 UNFCCC inventory reviews in relation to the category 2B3 Adipic Acid Production.

Table 4.31 2B3 Adipic Acid Production: Findings of the 2010 and 2011 UNFCCC inventory reviews in relation to N_2O emissions and responses in 2012 inventory submissions

Member State	Review findings and responses related to 2B3 Adipic Acid Production	
	Comment UNFCCC report of the review of the 2010 submission	**Status in 2012 submission**
Austria	NO	No follow-up necessary
Belgium	NO	No follow-up necessary
Denmark	NO	No follow-up necessary
Finland	NO	No follow-up necessary
France	No recommendation for improvement of this source category in Review Report (FCCC/ARR/2010/FRA). Review report (Centralized review 2011) not yet available.	No follow-up necessary
Germany	No recommendation for improvement of this source category in Review Report (FCCC/ARR/2010/DEU). Review report (Centralized review 2011) not yet available.	No follow-up necessary
Greece	NO	No follow-up necessary
Ireland	NO	No follow-up necessary
Italy	The ERT recommends that Italy further improve transparency by correcting the formula that is reported in the NIR and explaining how this formula is used to check EFs provided by the production plant, and include a description of the emission estimation methodology applied by the production plant that was used by Italy for its 2010 annual submission. Review report (Centralized review 2011) not yet available.	NIR explains formula in detail and how it isused to check the emission estimates.
Luxembourg	NO	No follow-up necessary
Netherlands	NO	No follow-up necessary
Portugal	NO	No follow-up necessary
Spain	NO	No follow-up necessary
Sweden	NO	No follow-up necessary
UK	NO	No follow-up necessary

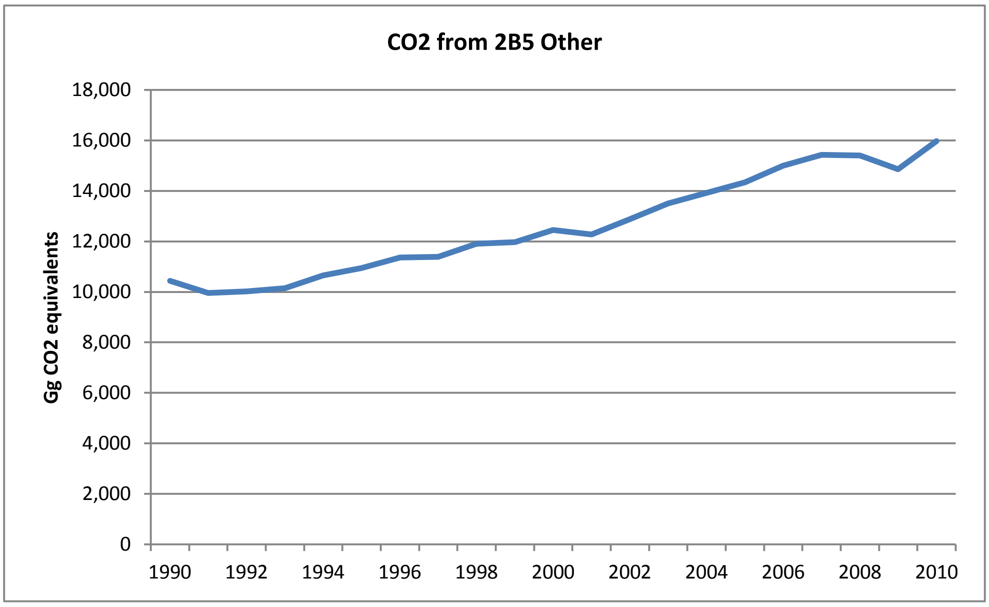
Source: NIR 2012, UNFCCC inventory review reports, as published at UNFCCC: http://unfccc.int/national_reports/annex_i_ghg_inventories/inventory_review_reports/items/5687.php

The ERT identified that the NIR does not include a section on 2B4 Carbide Production (FCCC/ARR/2008/EC, para 55). This is due to the fact that carbide production is not a key source in the sector 2 Industrial processes. An overview of Member States' methodologies, emission factors, quality estimates and emission trends is only provided in this report if identified with the key category analysis at EU-15 level.

In response to a recommendation raised during the EU Centralized Review in 2010, information on the trend of EU-15 CO_2 emissions from Carbide Production that was provided during the review is given in this NIR: The EU-15 CO_2 emissions trend from carbide production is mainly influenced by Germany and France. In Germany, emissions dropped by 79 % in 1991 compared to 1990. During the reunification period, calcium carbide production took place primarily in former East Germany. Shortly after reunification, production discontinued in former East Germany, while only one producer remained in former West Germany. In the period 1990 to 2008, this producer cut production by about half. In France, carbide production occurred in one plant up to 2003, and since 2003 there has been no carbide production in that MS any more.

CO_2 emissions from 2B5 Other account for 0.42 % of total EU-15 GHG emissions in 2010. Between 1990 and 2010, CO_2 emissions from this source increased by 53 % (Table 4.32). Germany is responsible for 55 % of these emissions in the EU-15, followed by Belgium (13 %) and the UK (12 %). Germany had the largest growth of emissions in absolute terms due to the increased production of methanol in the past and a new producer for carbon black. Additionally emissions of the conversion loss increased with further development of the production. Belgium, Finland and the UK also show an increase of emissions.

Figure 4.9 2B5 Other: EU-15 CO_2 emissions



The noticeable increase of CO_2 emissions in Finland 2006-2007 was caused by a new plant for hydrogen production. The British CO_2 emissions increased steadily during 1990 and 2008 due to the emissions from the breakdown of organic chemicals contained in household consumer products (detergents) subsequent to the release to sewer. The activity data used to calculate emissions are extrapolated from data for a single year using household numbers and population as proxy statistics, both of which have increased every year of the time series.

During 2008 and 2009 the reduction of CO_2 emission in relative terms was largest in Austria, where reported emissions are based on plant specific measurements for fertilizer production. In addition to a decline in the rate production of -17 % in that period, CO_2 emissions also depend on the kind of fertilizers being produced which changed over time. Germany had the largest emission reduction in absolute terms. The downward trend in emissions occurred since 2007 and is due to a decline in the production of carbon black and methanol. The Italian emissions – showing the second largest reduction in absolute terms during 2008 and 2009 – declined by 20 % due to a decrease in carbon black production of -21 %.

The emissions in France declined between 2009 and 2010 due to the closure of a site that produced carbon black in 2009.

For an overview of sources included in the source 2B5 see Table 4.34.

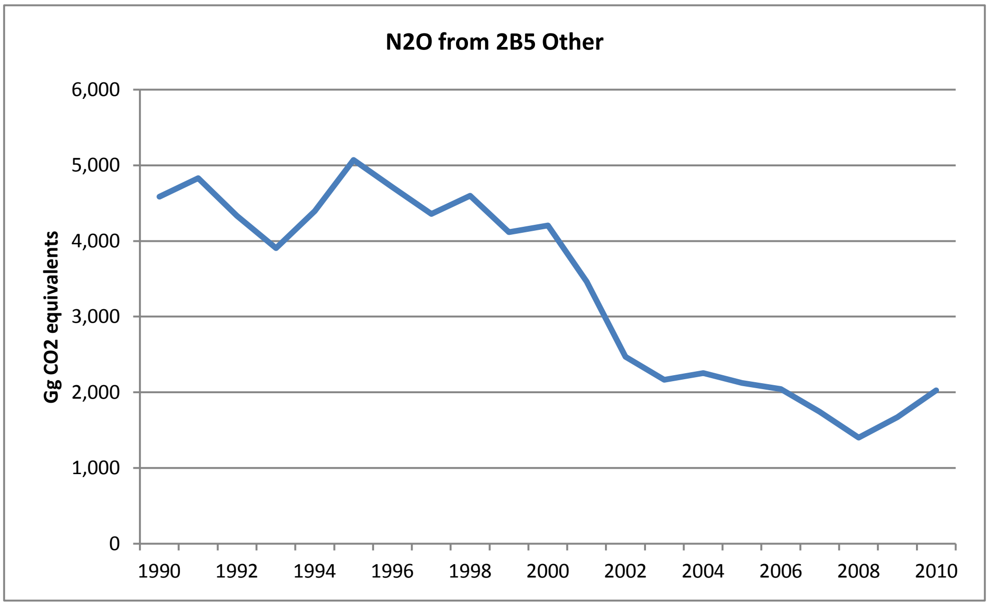
Table 4.32 2B5 Other: Member States' contributions to CO_2 emissions

Member State	CO2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)		
Austria	31	17	27	0.2%	10	61%	-4	-13%	T3	PS
Belgium	224	1,637	2,140	13.4%	504	31%	1,916	855%	T3	PS
Denmark	1	2	2	0.0%	0	0%	1	165%	CS	D
Finland	106	728	780	4.9%	52	7%	674	637%	CS,T2	CS,D,PS
France	366	229	230	1.4%	1	1%	-136	-37%	T2	PS
Germany	6,888	8,750	8,827	55.3%	77	1%	1,939	28%	CS,T2	CS,D
Greece	IA,NE,NO	266	362	2.3%	96	36%	362	-	T1	CS
Ireland	NO	NO	NO	-	-	-	0	-100%	NA	NA
Italy	475	481	702	4.4%	221	46%	227	48%	D,T2	PS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	649	651	725	4.4%	74	11%	77	12%	CS,T1	CS,D,PS
Portugal	63	92	109	0.7%	16	18%	45	71%	D	CS
Spain	NA	NA	NA	-	-	-	-	-	NA	NA
Sweden	72	88	99	0.6%	11	12%	27	38%	CS	PS
United Kingdom	1,563	1,915	1,970	12.3%	54	3%	407	26%	CS	CS,OTH
EU-15	**10,438**	**14,856**	**15,973**	**100.0%**	**1,117**	**8%**	**5,536**	**53%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

N_2O emissions from 2B5 Other account for 0.05 % of total EU-15 GHG emissions in 2010. Between 1990 and 2010, N_2O emissions from this source decreased by 56 % (Table 4.33). The Netherlands, Belgium and France are responsible for almost all of these emissions in the EU-15. Emissions decreased especially in France – besides the Netherlands – and had the largest influence on the reductions in the EU-15, whereas Belgium and Portugal increased their N_2O emissions in the period 1990 to 2010.

Figure 4.10 **2B5 Other: EU-15 N_2O emissions**



N_2O emissions in France decreased strongly between 1998 and 2003 and again from 2005 onwards. The first decline in emissions can be explained by the closing of one of the two sites which produced glyoxylic acid until 2001 and the installation of an abatement technique for the other site in 1998. The second decrease is due to the efficiency improvement of the abatement technique for glyoxylic acid production and by the decrease of the production of PTTB and industrial and medical N_2O. During 2008 and 2009, N_2O emissions again increased, which is caused by an increase of Uranium tetrafluoride production which emits N_2O, and by an increase of glyoxilic acid production. From 2009 to 2010 N_2O emissions increased again by 21%. This increase is on the one hand due to the increase of industrial and pharmaceutical production of N_2O (and consequently N_2O emissions). Secondly, it is due to the modification of N_2O measurements for UF4 production. Before 2010, N_2O measurements were done annually and extrapolated so as to determine N_2O emissions for the whole year whereas since 2010, the N_2O emissions are measured on a continuous basis.

In response to the recommendations by the ERT (FCCC/ARR/2009/EC, para 53), additional explanations of the trends or inter-annual fluctuations of N_2O emissions are given. For the Netherlands, N_2O emissions derive from the production of caprolactam; these emissions decreased by 48 % during 2004 and 2008. During the period 1990 to 2004, the Dutch emissions are based on production-indexes; as a result of an increasing production level the emissions increased, too. A better process control and a lower production level resulted in an emission reduction during 2004 and 2008. Plant-specific N_2O emission factors are used for caprolactam production. Emission factors as well as activity data on caprolactam production are confidential. Only emissions are reported by the companies.

N_2O emissions in Belgium increased during 1990 and 2010, especially during 2003 and 2007. Emissions of N_2O originate mainly from the production of caprolactam. Only one company is involved in Belgium in the Flemish region and since 1997 this company offers each year the results of the monitoring carried out. N_2O emissions increased again by 31% between 2009 and 2010 in the Flemish region due to strong increase of production of caprolactam in that period.

In Italy, N_2O emissions from caprolactam production have been estimated and emissions arise from only one producing plant, which closed in 2003.

Table 4.33 2B5 Other: Member States' contributions to N_2O emissions

Member State	N_2O emissions (Gg CO_2			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)		
Austria	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Belgium	381	559	731	36.1%	173	31%	350	92%	T3	PS
Denmark	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Finland	NO	NO	NO	-	-	-	-	-	NA	NA
France	3,176	503	609	30.0%	106	21%	-2,567	-81%	T2	PS
Germany	231	IE,NA,NO	IE,NA,NO	-	-	-	-231	-100%	NA	NA
Greece	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Ireland	NO	NO	NO	-	-	-	-	-	NA	NA
Italy	11	NA,NO	NA,NO	-	-	-	-11	-100%	NA	NA
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	766	603	681	33.6%	78	13%	-85	-11%	T2	PS
Portugal	0.03	0.0	0.1	0.0%	0	20%	0	87%	D	CR,OTH
Spain	NA	NA	NA	-	-	-	-	-	NA	NA
Sweden	22	7	7	0.3%	-1	-7%	-15	-69%	CS	PS
United Kingdom	NO	NO	NO	-	-	-	-	-	NA	NA
EU-15	**4,587**	**1,672**	**2,028**	**100.0%**	**356**	**21%**	**-2,559**	**-56%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.34 provides an overview of all sources reported under 2B5 Other Chemical Production by EU-15 Member States for the year 2010. The largest contributor to the total EU-15 emissions is Germany. Emissions of CO_2 in Germany are dominated by the production of carbon black and methanol as well as catalytic burning and conversion loss. Country specific emission factors are based on a study from 2006 and activity data on national statistics. In the UK CO_2 emissions are due to carbon from non-energy use of products.

For Belgium, the reporting covers the following activities:

(1) the emissions of CO_2 originate from the production of 1,2 dichloromethane and vinychloride in the Walloon region. The CO_2 emissions decreases between 2008 and 2010 as the production of anhydride maleique and phtalique was stopped in 2009 in the Walloon region. The emissions are estimated by the chemical industry;

(2) the emissions of N_2O originate mainly from the production of caprolactam. Only one company is involved in Belgium in the Flemish region and since 1997 this company offers each year the results of the monitoring carried out

(3) other process CO_2 emissions are reported by the chemical industry in Flanders (for example production of ethylene oxide, production of acrylic acid from propene, production of cyclohexanone from cyclo-hexane, production of paraxylene/meta-xylene, the emissions of CO_2 of flaring in the chemical industry etc). These CO_2 emissions result from surveys in the chemical sector in Flanders.

(4) some small process emissions of N_2O (maximum 25 kton CO_2 eq) and CH_4 (maximum of 11 kton CO_2 eq) mainly in the chemical industry in the Flemish region.

During the centralized review of the 2009 annual submission of the European Union, the ERT recommended EU to improve the completeness of its inventory by providing emission estimates for categories that have not currently been estimated, e.g. CH_4 from chemical industries such as the production of ethylene and dichloroethylene (FCCC/ARR/2009/EC, para 45). For these emissions only France reported 'NE' and in response to the recommendations by the ERT during the centralized review of the 2007 and 2008 greenhouse gas (GHG) inventory submissions of France (FCCC/ARR/2008/FRA), the Member State provided estimates of CH_4 from the production of ethylene and dichloroethylene with its 2010 greenhouse gas (GHG) inventory submission that was included in the European GHG inventory, thus improving the completeness for this source categories, independent from the fact that no methodologies are provided for these sources in 1996 IPCC Guidelines

Table 4.34 2B5 Other: Overview of sources reported under this source category for 2010

Member State	2.B.5 Other Chemical Industry	CO_2 emissions [Gg]	CH_4 emissions [Gg]	N_2O emissions [Gg]	Total emissions [Gg CO2 equivalents]	Share in EU-15 Total
Austria	Ethylene, Other chemical industry, CO2 from nitric acid production	26.9	0.8	NA,NO	43.6	0.2%
Belgium	Caprolactam Production, Other chemical production	2,140.2	0.3	2.4	2,878.5	15.6%
Denmark	Catalysts/Fertilizers, Pesticides and Sulphuric acid	2.1	NA,NO	NA,NO	2.1	0.0%
Finland	Hydrogen, chemicals production	780.1	NO	NO	780.1	4.2%
France	Ethylene, Styrene, Glyoxylic acid production, Anhydrid Phtalic Production, Other chemical production	230.4	3.7	2.0	917.1	5.0%
Germany	Carbon Black, Methanol, Caprolactam, Catalytic Burning, Conversion loss, N-Dodecandiacid	8,826.9	0.0	C,IE,NA,NO	8,827.3	47.7%
Greece	Organic chemicals production	362.1	NA,NO	NA,NO	362.1	2.0%
Ireland		NO	NO	NO	-	-
Italy	Carbon Black, Ethylene, Dichloroethylene, Styrene, Titanium Dioxide Production, Propylene, Caprolactam	701.8	0.3	NA,NO	708.7	3.8%
Luxembourg		NO	NO	NO	-	-
Netherlands	Carbon Black, Ethylene, Styrene, Methanol, Graphite, Caprolactam, Other chemical industry, Carbon electrodes, Ethene oxide production	725.3	11.5	2.2	1,648.7	8.9%
Portugal	Carbon Black, Ethylene, Ammonium sulphate, Monomer and polymer production, Production of explosives	108.6	0.5	0.0	119.1	0.6%
Spain	Carbon Black, Ethylene, Styrene	NA	2.0	NA	42.3	0.2%
Sweden	Pharmaceutical industry, Other inorganic chemical production, Other organic chemical production, Base chemicals for plastic industry	99.1	0.4	0.0	114.3	0.6%
UK	Ethylene, Methanol, Chemical Industry (All), Carbon from NEU products	1,969.8	3.5	NO	2,043.3	11.1%
EU-15 Total		**15,973**	**23**	**7**	**18,487**	**100.0%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

In response to the recommendation by the ERT in its review report, the methodologies for the largest emission sources in this category are provided (FCCC/ARR/2008/EC, para 53). Table 4.35 gives an overview on methodologies and data sources used all Member States which estimate CO_2 and N_2O emissions from other chemical production.

Table 4.35 2B5 Other Chemical Production: Summary of methodological information provided by Member States

Other Production	
Member State	**Methodology comment**
Austria	Production of Fertilizers and Urea: No IPCC methodology is available for these sources. Data for urea production were directly reported by the Austrian producer of urea and thus represent plant-specific data. The CH4 emissions are calculated from the ammonia input in the urea production process and the methane content of the ammonia. CH4 emissions from the production of urea were reported for the years 2002–2010. For the years before no data is available; therefore the implied emission factor for the year 2002 was used for all years. CO2 emissions are reported by the operator since 1995. The IEF from this year was applied to calculate emissions from the previous years. Data for fertilizer production for 1990 to 1994 were taken from national statistics (STATISTIK AUSTRIA), for 1995 to 2009 production data were reported directly by the main producer of fertilizers in Austria. CH4 emissions from the production of fertilizers were reported for the years 2002–2010; these data became available due to a measurement programme for CH4 at the plant starting in 2002. Before no data is available; therefore the IEF for the year 2002 was used for all years. [NIR 2012]
	Ethylene Production: Emissions were estimated using the IPCC default methodology. Activity data are the capacity of the only ethylene producing plant in Austria and amount to 350 000 t Ethylene per year until 2005. In 2006 the capacity of the ethylene plant was expanded to 500 000 t. The IPCC default emission factor of 1 g CH4/kg Ethylene production was used to calculate the emissions that amount to 350 tonnes CH4 until 2005 and 500 tonnes CH4 since 2006.[NIR 2012]
Belgium	The emissions of N2O originate mainly from the production of caprolactam. Only one company is involved in Belgium in the Flemish region and since 1997 this company offers each year the results of the monitoring carried out. This company estimated the emissions of the previous years from 1990 on as accurate as possible. No emission factors and emissions of N2O are presented in this report because only one company is involved in Belgium. [NIR 2012]
	Other process CO2 emissions are reported by the chemical industry in Flanders (for example production of ethylene oxide, production of acrylic acid from propene, production of cyclohexanone from cyclo-hexane, production of paraxylene/meta-xylene, the emissions of CO2 of flaring in the chemical industry etc). These CO2 emissions result from surveys in the chemical sector in Flanders. [NIR 2012]
	The emissions of CO2 originate from the production of 1,2 dichloromethane, vinychloride and anhydride maleique and phtalique in the Walloon region. The emissions are estimated by the chemical industry. [NIR 2012]

Other Production	
Member State	**Methodology comment**
Denmark	The CO2 emission from the production of catalysts/fertilisers is based on information in an environmental report from the company (Haldor Topsøe, 2011), combined with personal communication. In the environmental report, the company has estimated the amount of CO2 from the process and the amount from energy conversion. Based on information from the company, the emission of CO2 has been calculated from the composition of raw materials used in the production (for the years 1990 and 1996-2004). For 2005 to 2010 the EF is assumed to be the same as in 2004 based on the same activity (produced amount). For the years 1991-1995, the production, as well as the CO2 emission, has been assumed to remain the same as in 1990. [NIR 2012]
Finland	Activity or emission data for hydrogen production have been received directly from companies, a minor part of earlier years' data having been estimated. There are no default emission factors for hydrogen production in the IPCC Guidelines, for which reason the stoichiometric ratio of chemical reactions is used. [NIR 2012]
France	For the chemical sector, emissions are generally determined by a bottom up approach based on data provided through the annual reports of pollutant releases and supplemented by information from the industry. [NIR 2012]
	Fertilizer: National production data for fertilizers are known from the Union of Industry for Fertilization or from national statistics SESSI. Default factors are used for most pollutants. Since 2003, annual statements of releases are used to determine emission factor. [NIR 2012]
	Uranium tetrafluoride: Emissions data is taken directly from annual statements of pollutant emissions since 1990 and emissions are derived from continuous measurements since the 2012 submission. [NIR 2012]
Germany	Carbon Black: Estimation of CO2 emissions is based on IPCC default CO2-EFs from IPCC-Guidelines 2006 and AD, which were provided by the Federal Statistical Office. [NIR 2012]
Greece	Organic chemicals: Default emission factors (IPCC Guidelines) are used. Activity data (production of ethylene and 1,2 dichloro-ethane) are confidential and provided by the ElStat. The available data cover the period 1990 – 2007, whereas the ethylene and 1,2 dichloro-ethane production has ceased in 1998 and 2000 respectively. CO2 emission from hydrogen production are reallocated to this category in the present submission. Data are provided by DEPA for the whole time-series and by the verified EU ETS reports of the refineries for years 2005-2010. [NIR 2012]
Italy	Caprolactam: N2O emissions from caprolactam have been estimated on the basis of information supplied by the only plant present in Italy, production activity data published by ISTAT (ISTAT, several years), and production and emission data reported in the national EPER/E-PRTR registry. The average emission factor is equal to 0.3 kg N2O/Mg caprolactam production. The plant closed in 2003. [NIR 2012]
	Carbon Black: CO2 and CH4 emissions from carbon black production process have been estimated on the basis of information supplied by the Italian production plants in the framework of the national EPER/EPRTR registry and the European emissions trading scheme. In 1996 a change in the production technology in the existing plants caused a reduction of CH4, NMVOC, NOx, SOx and PM10 emissions. In 2005, the CO2 implied emission factor is 2.55 t CO2/t carbon black production, in 2008 it is equal to 2.59 t CO2/t carbon black production, in 2009 the IEF is 2.49 t CO2/t carbon black production, while in 2010 the IEF is 3.06 t CO2/t carbon black production.. [NIR 2012]
	Calcium Carbide: CO2 emissions from calcium carbide production process have been estimated on the basis of the activity data provided by the sole Italian producer and referred to the years from 1990 to 1995 when the production stopped. The default IPCC CO2 emission factor (IPCC, 2006) has been used to estimate the emissions. [NIR 2012]
Netherlands	Caprolactam production: Plant-specific N2O emission factors are used for Caprolactam production (confidential). [NIR 2012]
	Industrial gases: CO2 emissions are estimated based on use of fuels (mainly natural gas) as chemical feedstock. An oxidation fraction of 20% is assumed, based on reported data in environmental reports from the relevant facilities. [NIR 2012]
	Carbon electrodes: CO2 emissions are estimated based on fuel use (mainly petroleum coke and coke). A small oxidation fraction – 5% – is assumed, based on reported data in the environmental reports.[NIR 2012]
	Activated carbon: CO2 emissions are estimated on the basis of the production data for Norit and by applying an emission factor of 1 t/t Norit. The emission factor is derived from the carbon losses from peat uses reported in the environmental reports. As peat consumption is not included in the national energy statistics, the production data since 1990 have been estimated based on an extrapolation of production level of 33 Tg reported in 2002. This is considered to be justified because this source contributes relatively little to the national inventory of greenhouse gases. [NIR 2012]
	Ethylene oxide: CO2 emissions are estimated based on capacity data by using a default capacity utilisation rate of 86% and applying an emission factor of 0.45 t/t ethylene oxide. [NIR 2012]
Portugal	The major organic chemical plant in Portugal is BOREALIS unit, a petrochemical unit. The basic process in this unit is Ethylene production by Thermal Steam Cracking of petroleum feedstock. A specific and detailed inventory survey was made for BOREALIS Petrochemical Plant in Sines unit in 1993-1994. Emissions estimated for this period where used to determine plant-specific process emission factors that were used to estimate emissions for all time series from 1990 to 2001 and using ethylene production as activity rate indicator. For BOREALIS Petrochemical Plant in Sines - produced quantities are available from 1990 to 1997 and were forecasted thereafter. [NIR 2012]
	The second chemical industry LPS is the sole Carbon Black plant in Portugal. In the case of carbon black, where CO2 emissions result from liberation of carbon in tail gas to atmosphere, emissions were estimated using a simple mass balance. Production of carbon black and explosives is available from 1990 to 2010 from INE Statistical Database (IAIT and IAPI surveys). Emissions from flares and flue gas combustor where included in the emission factors. Statistical information for all emissions sources other than Sines industrial Plants were obtained from the National Statistical Institute (INE). [NIR 2012]
Sweden	This sub-category includes various chemical industries, such as sulphuric acid production, the pharmaceutical industry, production of base chemicals for plastic industry, various organic and inorganic chemical productions and other non specified chemical production, which are not covered elsewhere. The primary information on emissions of CO2, CH4, N2O, NOX, CO, NMVOC and SO2 is as reported by the companies in their environmental reports. In the IPCC Guidelines, methods for estimating CH4 emissions for several chemical products are presented and conse-quently the CRF Reporter is divided on those products (2B5.1-5). Since several plants in Sweden produce several chemicals products each but report emissions aggregated by plant, it is not possible to report emissions in accordance with the suggested split in the CRF Reporter. In Sweden there is one company producing carbon black. CH4 emissions are included from 1990 and onwards based on production data from the company"s environmental reports and IPCC Guidelines default EF (11 g CH4/kg production). [NIR 2012]
UK	CO2 emissions can occur direct from chemical processes, and estimates are made in the case of production of ammonia (see Section 4.9). It is possible that other chemical processes also result in direct CO2 emissions but none have been identified. Chemical processes can result indirectly in emissions if wastes from the process are subsequently used as fuels and emission estimates for this type of source have been included in the inventory. [NIR 2012]
	Methane emissions are reported separately for production of ethylene and production of methanol, these chemicals being suggested as sources by the IPCC Guidelines for National Greenhouse Gas Inventories. Ethylene was manufactured on four sites at the end of 2009 while the only methanol plant closed in 2001. [NIR 2012]

Source: NIR 2011
Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.36 summarizes the recommendations from the 2010 and 2011 UNFCCC inventory reviews in relation to the category 2B5 Other Chemical Production.

Table 4.36 **2B5 Other Chemical Production: Findings of the 2010 and 2011 UNFCCC inventory reviews in relation to CO_2 emissions and responses in 2012 inventory submissions**

Member State	Review findings and responses related to 2B5 Other	
	Comment UNFCCC report of the review of the 2011 submission	**Status in 2012 submission**
Austria	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2010/AUT). Review report (Centralized review 2011) not yet available.	No follow-up necessary
Belgium	Belgium has reported emission estimates for some categories without providing AD that are either confidential or impossible to attribute to one specific activity under the category other (chemical industry). The ERT commends the Party for this effort, which has improved the completeness of the emission estimates, and recommends that Belgium include information on the coverage of the category in the documentation box of CRF table 2(I)A-G and try to attribute these emissions to specific activities, where applicable, by as, for the next annual submission, in order to improve the transparency of its reporting. (FCCC/ARR/2011/BEL, para 61)	Not yet adressed. [NIR, CRF 2012]
Denmark	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/DNK).	No follow-up necessary
Finland	For the production of hydrogen under other (chemical industry) Finland applies a correction factor to the stoichiometric factors to account for the incompleteness of the chemical reactions. During the review, the ERT enquired about the use of pressure swing adsorption (PSA) units and whether the off-gas from the PSA containing unreacted CH4 and CO is recycled to the fired reformer as fuel and provided further information. In response, Finland informed the ERT that there are five hydrogen production plants in Finland and all plants produce hydrogen with steam-reforming and the produced hydrogen is refined in PSA units. The ERT recommends that Finland include the information provided to the ERT in the next annual submission. (FCCC/ARR/2011/FIN, para 53) The recycling and combustion of off-gases could potentially result in a double counting of emissions. During the review, Finland informed the ERT that in its opinion emissions are not double counted and that the off-gas emissions reported in the energy sector are corrected taking the emissions reported under hydrogen production into account. The ERT recommends that Finland ensure that there is no double counting of emissions and improve the description of this in its next annual submission. (FCCC/ARR/2011/FIN, para 54)	In response, Finland informed the ERT that there are five hydrogen production plants in Finland and all plants produce hydrogen with steam-reforming and the produced hydrogen is refined in PSA units. Furthermore, Finland explained that when off-gases are used only for preheating of processes, the correction factor has been applied; if off-gases are recycled and combusted no correction factor has been used. Finland also informed the ERT that the combusted off-gas emissions are included in the energy sector and emissions are calculated using the composition of the offgas to determine the EF. During the review, Finland informed the ERT that in its opinion emissions are not double counted and that the off-gas emissions reported in the energy sector are corrected taking the emissions reported under hydrogen production into account. [NIR 2012, p.165, 166, 398]
France	No recommendation for improvement of this source category in Review Report (FCCC/ARR/2010/FRA). Review report (Centralized review 2011) not yet available.	No follow-up necessary
Germany	No recommendation for improvement of this source category in Review Report (FCCC/ARR/2010/DEU). Review report (Centralized review 2011) not yet available.	No follow-up necessary
Greece	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/GRC)	No follow-up necessary
Ireland	NO	No follow-up necessary
Italy	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2010/ITA). Review report (Centralized review 2011) not yet available.	No follow-up necessary
Luxembourg	NO	No follow-up necessary
Netherlands	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/NLD).	No follow-up necessary
Portugal	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2010/PRT). Review report (Centralized review 2011) not yet available.	No follow-up necessary
Spain	NA	No follow-up necessary
Sweden	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2010/SWE). Review report (Centralized review 2011) not yet available.	No follow-up necessary
UK	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/GBR).	No follow-up necessary

Source: NIR 2012, UNFCCC inventory review reports, as published at UNFCCC:
http://unfccc.int/national_reports/annex_i_ghg_inventories/inventory_review_reports/items/5687.php
Abbreviations explained in the Chapter 'Units and abbreviations'.

4.2.3 Metal production (CRF Source Category 2C) (EU-15)

This source category includes the following key sources: CO_2 from 2C1 Iron and Steel Production, PFC from 2C3 Aluminium Production.

Table 4.37 summarises information by Member State on total GHG emissions, CO_2, SF_6 and PFC emissions from Metal Production. Between 1990 and 2010, CO_2 emission from 2C Metal Production decreased by 35 %. The absolute decrease was largest in Germany, Italy and the Netherlands.

Table 4.37 2C Metal Production: Member States' contributions to total GHG, CO_2, PFC and SF_6 emissions

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2010 (Gg CO_2 equivalents)	CO2 emissions in 1990 (Gg)	CO2 emissions in 2010 (Gg)	PFC emissions in 1990 (Gg CO2 equivalents)	PFC emissions in 2010 (Gg CO2 equivalents)	SF_6 emissions in 1990 (Gg CO2 equivalents)	SF6 emissions in 2010 (Gg CO2 equivalents)
Austria	4,786	5,480	3,725	5,480	1,050	NO	253	0
Belgium	2,451	1,101	2,451	1,088	NO	NO	NO	NO
Denmark	30	0	28	NA,NO	NO	NO	31	NO
Finland	1,941	2,417	1,936	2,408	NO	NO	NO	C,NO
France	7,444	3,501	4,377	3,444	3,032	46	809	242
Germany	26,682	18,925	24,153	18,764	2,489	135	189	107
Greece	1,104	894	940	860	163	34	NA,NO	NA,NO
Ireland	0	0	NO	NO	NO	NO	NO	NO
Italy	5,608	1,597	3,878	1,465	1,673	85	NA,NO	17
Luxembourg	985	134	985	134	NA,NO	NA,NO	NA,NO	NA,NO
Netherlands	4,907	1,055	2,661	998	2,246	58	NO	NO
Portugal	16	18	16	18	NE	NO	NE	NO
Spain	4,291	3,463	3,386	3,377	883	70	NA	NA
Sweden	3,457	3,293	3,078	3,135	377	156	24	34
United Kingdom	3,687	1,898	2,309	1,747	1,333	113	426	130
EU-15	**67,388**	**43,775**	**53,923**	**42,918**	**13,247**	**697**	**1,732**	**531**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.38 provides information on the contribution of Member States to EU recalculations in CO_2 from 2C Metal production for 1990 and 2009 and main explanations for the largest recalculations in absolute terms.

Table 4.38 **2C Metal Production: Contribution of MS to EU recalculations in CO_2 for 1990 and 2009 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)**

	1990		2009		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	0	0.0	168	3.8	Pig iron: Revised share of coke used in blast furnaces for 'non energy use' (consistent with revised energy balance).
Belgium	16	0.7	0	0.0	A recalculation of emissions in the electric arc furnaces sector took place during the 2012 submission in the Walloon region in response to the review process.
Denmark	0	0.0	0	0.0	
Finland	0	0.0	4	0.2	Change due to updated NMVOC emissions of a single plant at the VAHTI system.
France	0	0.0	-501	-15.0	2C1: Correction des consommations énergie et matière avec bilan 2009 actualisé
Germany	0	0.0	1,790	14.8	Activity data: new statistical data available
Greece	-7	-0.7	-2	-0.3	2C3: country-specific mathodology was used.
Ireland	0	0.0	0	0.0	
Italy	0	0.0	0	0.0	
Luxembourg	0	0.0	0	0.0	
Netherlands	-248	-8.5	-202	-15.8	2C1.5, Other/Limestone uses: reallocation to 2A3
Portugal	-3	-14.4	-3	-12.5	
Spain	0	0.0	-31	-1.2	Revision of CO2 emissions estimate as a result of the corresponding revision of carbon balance in intregrated iron and steel plants. The latter is in turn a consequence of the revision of estimates for collieries in such plants according to ERT suggestions
Sweden	3	0.1	1	0.1	2C1.1, steel: CO2 emissions from one facility have been corrected for 2008 and 2009. Carbon bound in product and scrubber sludges are excluded 2C1.2, pig iron: Updated activity data 2C1.3, sinter: CO2 from the use of organic binders as well as from the use of
UK	0	0.0	61	5.1	Revision to national energy statistics
EU-15	**-238**	**-0.4**	**1,284**	**4.1**	

Table 4.39 provides information on the contribution of Member States to EU recalculations in PFC from 2C Metal Production for 1990 and 2009 and main explanations for the largest recalculations in absolute terms.

Table 4.39 **2C Metal Production: Contribution of MS to EU recalculations in PFC for 1990 and 2009 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)**

	1990		2009		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	0	0.0	0	0.0	
Belgium	0	0.0	0	0.0	
Denmark	0	0.0	0	0.0	
Finland	0	0.0	0	0.0	
France	0	0.0	0.5	1.7	Correction des émissions de CF4 et C2F6 pour 2 sites suite aux données fournies par l'exploitant
Germany	0	0.0	-69	-28.1	In the previous submission the value of 2008 was used for 2009; now the value was calculated based on actual data.
Greece	-100	-38.0	-14	-37.7	Error in working files was removed.
Ireland	0	0.0	0	0.0	
Italy	0	0.0	0	0.0	
Luxembourg	0	0.0	0	0.0	
Netherlands	0	0.0	0	0.0	
Portugal	0	0.0	0	0.0	
Spain	0	0.0	0	0.0	
Sweden	0	0.0	0	0.0	
UK	0	0.0	0	0.0	
EU-15	**-100**	**-0.7**	**-83**	**-12.2**	

4.2.3.1 Iron and steel production

This source category includes emissions from the iron and steel industry. Crude iron is produced by the reduction of iron oxide ores mostly in blast furnaces, generally using the carbon in coke or charcoal (sometimes supplemented with coal or oil) as both the fuel and reductant. In most iron furnaces, the process is aided by the use of carbonate fluxes (limestone). Additional emissions occur as the limestone or dolomite flux gives off CO_2 during reduction of pig iron in the blast furnace, but this source category is covered as emissions from limestone use. Carbon plays the dual role of fuel and reductant. Member states use different methods for the allocation of emissions that are described in Table 4.42

CO_2 emissions from 2C1 Iron and Steel Production account for 1% of total EU-15 GHG emissions (w/o LULUCF) in 2010. Germany is responsible for 48% of these emissions in the EU-15. Germany had the largest decreases in absolute terms between 1990 and 2010 while increases were encountered in Austria, Finland, Sweden and to a lesser extent also in Greece and Portugal. Between 1990 and 2010 emissions are fluctuating. The emission trend follows mainly the emissions from Germany that are fluctuating due to varying production figures. Overall, between 1990 and 2010, CO_2 emissions from this source decreased by 19 % (Table 4.40), however, emissions from this source category increased by 31% between 2009 and 2010 following the recovery of the industry after the economic recession in 2009.

Figure 11.12 2C1 Iron and Steel Production: EU-15 CO_2 emissions

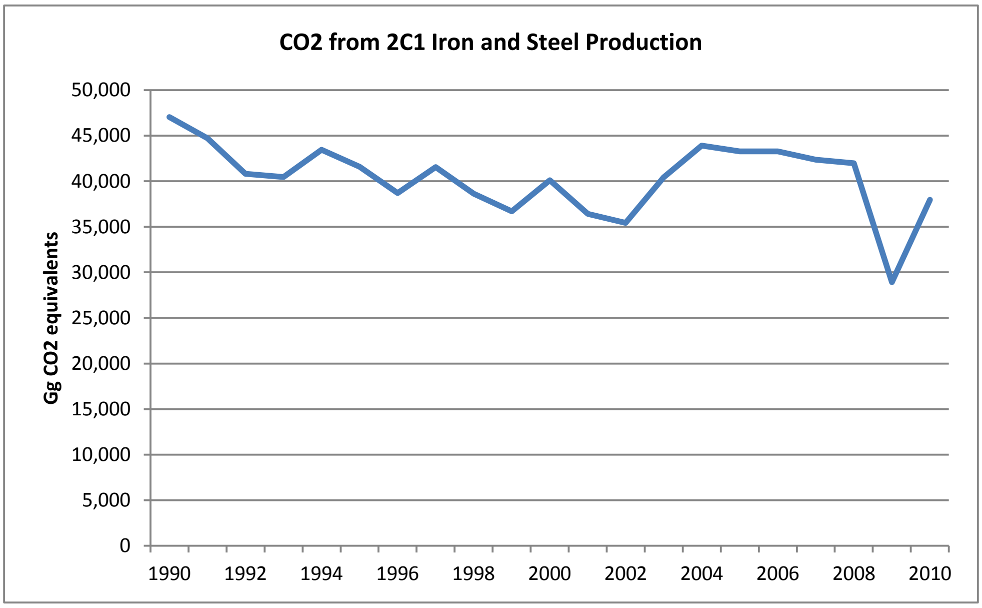


Table 4.40 **2C1 Iron and Steel Production: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor**

Member State	CO2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)		
Austria	3,546	4,579	5,460	14.4%	881	19%	1,914	54%	CS,T2	D,PS
Belgium	2,451	938	1,088	2.9%	150	16%	-1,362	-56%	CS,D,T3	PS
Denmark	28	NA,NO	NA,NO	-	-	-	-28	-100%	NA	NA
Finland	1,935	1,945	2,408	6.3%	463	24%	473	24%	CS,T1,T2,T3	CS,D
France	3,151	2,113	2,541	6.7%	427	20%	-610	-19%	T2	CS
Germany	22,712	13,464	18,208	48.0%	4,744	35%	-4,504	-20%	T2	CS
Greece	93	137	116	0.3%	-21	-16%	23	25%	CS	PS
Ireland	NO	NO	NO	-	-	-	-	-	NA	NA
Italy	3,124	901	1,139	3.0%	238	26%	-1,986	-64%	D,T2	CR,CS,PS
Luxembourg	985	129	134	0.4%	5	4%	-851	-86%	CS,T2	CS
Netherlands	2,267	836	687	1.8%	-149	-18%	-1,580	-70%	T2	CS
Portugal	16	18	18	0.0%	0	-2%	2	11%	T2	PS
Spain	2,428	1,653	2,002	5.3%	350	21%	-426	-18%	T2	CS,PS
Sweden	2,465	1,336	2,701	7.1%	1,365	102%	236	10%	CS,T2	PS
United Kingdom	1,859	864	1,461	3.8%	597	69%	-398	-21%	T3	CS
EU-15	**47,059**	**28,912**	**37,961**	**100.0%**	**9,049**	**31%**	**-9,098**	**-19%**		

Table 4.41 shows information on activity data, emission factors for CO_2 emissions from 2C1 Iron and Steel Production for 1990 and 2010. For 2C1 Iron and Steel Production it is not useful to give an average IEF for the EU-15 because the allocation of emissions (the split between process and combustion related emissions for pig iron production, which is the most important sub category) is differing between MS. The table and the method descriptions included in Table 4.42 suggest that for 2010 more than 90% of the reported emissions are estimated using higher tier methods.

Table 4.41 2C1 Iron and Steel Production: Information on activity data, emission factors for CO_2 emissions

Member State	1990				2010			
	Activity data		Implied emission factor (t/t)	CO2 emissions (Gg)	Activity data		Implied emission factor (t/t)	CO2 emissions (Gg)
	Description	(kt)			Description	(kt)		
Austria	**Iron and steel production**		**0.26**	**3546**	**Iron and steel production**	**0**	**0.32**	**5460**
	Steel Production [kt]	3921	0.12	484	Steel Production [kt]	6570	0.12	792
	Iron Production [kt]	3444	0.88	3043	Iron Production [kt]	5644	0.82	4622
	Sinter Production [kt]	4384	NA	NA	Sinter Production [kt]	3528	NA	NA
	Coke Production [kt]	1725	NA	NA	Coke Production [kt]	1391	NA	NA
	Other			20	Other	0	0.00	47
Belgium	**Iron and steel production**		**0.06**	**2451**	**Iron and steel production**	**0**	**0.05**	**1088**
	Steel	11570	0.09	1037	Steel	8133	0.03	213
	Pig Iron	9415	0.11	1033	Pig Iron	4688	0.17	783
	Sinter	13735	0.03	381	Sinter	6898	0.01	86
	Coke	4542			Coke	1957	IE	IE
	Other				Other	0	0.00	6
Denmark	**Iron and steel production**		**0.05**	**28**	**Iron and steel production**	**0**	**NA,NO**	**NA,NO**
	Steel	614	0.05	28	Steel	NO	NO	NO
	Pig Iron	NO	NO	NO	Pig Iron	NO	NO	NO
	Sinter	NO	NO	NO	Sinter	NO	NO	NO
	Coke	NO	NO	NO	Coke	NO	NO	NO
	Other			NA	Other	0	0.00	NA
Finland	**Iron and steel production**		**0.58**	**1935**	**Iron and steel production**	**0**	**0.49**	**2408**
	Produced steel	2861	0.68	1931	Produced steel	4040	0.60	2405
	Pig Iron	IE	IE	IE	Pig Iron	IE	IE	IE
	Sinter	IE	IE	IE	Sinter	IE	IE	IE
	Produced coke	487	0.001	1	Produced coke	828	0.001	1
	Other			3	Other	0	0.00	2
France	**Iron and steel production**		**0.10**	**3151**	**Iron and steel production**	**0**	**0.10**	**2541**
	Steel: kt Production	19073	0.09	1639	Steel: kt Production	15989	0.07	1182
	Pig Iron: kt Production	14088	0.09	1210	Pig Iron: kt Production	10066	0.11	1087
	Sinter: kt Production	IE	IE	IE	Sinter: kt Production	IE	IE	IE
	Coke: kt Production	IE	IE	IE	Coke: kt Production	IE	IE	IE
	Other			302	Other	0	0.00	272
	2.C.1.5.1 Rolling mills, blast furnace charging	16848	0.02	302	2.C.1.5.1 Rolling mills, blast furnace charging	15989	0.02	272

	1990				2010			
Member State	Activity data		Implied emission factor (t/t)	CO2 emissions (Gg)	Activity data		Implied emission factor (t/t)	CO2 emissions (Gg)
	Description	(kt)			Description	(kt)		
Germany	**Iron and steel production**		**0.19**	**22712**	**Iron and steel production**	**0**	**0.25**	**18208**
	Steel	87878	0.26	22712	Steel	43830	0.42	18208
	Pig Iron	32263	IE	IE	Pig Iron	28560	IE	IE
	Sinter	IE	IE	IE	Sinter	IE	IE	IE
	Coke	IE	IE	IE	Coke	IE	IE	IE
	Other			NO	Other	0	0.00	NO
Greece	**Iron and steel production**		**0.09**	**93**	**Iron and steel production**	**0**	**0.06**	**116**
	steel production in EAF	999	0.09	93	steel production in EAF	1824	0.06	116
	Pig Iron	NO	NO	NO	Pig Iron	NO	NO	NO
	Sinter	NO	NO	NO	Sinter	NO	NO	NO
	Coke	NO	NO	NO	Coke	NO	NO	NO
	Other			NO	Other	0	0.00	NO
Ireland	**Iron and steel production**		**NO**	**NO**	**Iron and steel production**	**0**	**NO**	**NO**
	Steel	NO	NO	NO	Steel	NO	NO	NO
	Pig Iron	NO	NO	NO	Pig Iron	NO	NO	NO
	Sinter	NO	NO	NO	Sinter	NO	NO	NO
	Coke	NO	NO	NO	Coke	NO	NO	NO
	Other			NO	Other	0	0.00	NO
Italy	**Iron and steel production**		**0.05**	**3124**	**Iron and steel production**	**0**	**0.02**	**1139**
	Steel: Production	25467	0.05	1346	Steel: Production	25750	0.02	600
	Pig Iron: Production	11852	0.15	1778	Pig Iron: Production	8555	0.06	539
	Sinter: Production	13577	NA	NA	Sinter: Production	9084	NA	NA
	Coke: Production	6356	NA	NA	Coke: Production	4110	NA	NA
	Other			NA	Other	0	0.00	NA
Luxembourg	**Iron and steel production**		**0.09**	**985**	**Iron and steel production**	**0**	**0.05**	**134**
	steel production	3506	0.12	404	steel production	2634	0.05	134
	pig iron production	2645	0.08	200	pig iron production	NO	NO	NO
	sinter production	4804	0.08	380	sinter production	NO	NO	NO
	coke production in non-integrated plants	NO	NO	NO	coke production in non-integrated plants	NO	NO	NO
	Other			NA	Other	0	0.00	NA

Member State	1990				2010			
	Activity data		Implied emission factor (t/t)	CO2 emissions (Gg)	Activity data		Implied emission factor (t/t)	CO2 emissions (Gg)
	Description	(kt)			Description	(kt)		
Netherlands	**Iron and steel production**		**0.44**	**2267**	**Iron and steel production**	**0**	**0.10**	**687**
	Crude steel production	5162	0.01	43	Crude steel production	6679	0.00	22
	Pig Iron	NO	NO	NO	Pig Iron	NO	NO	NO
	Sinter	NO	NA	NA	Sinter	NO	NA	NA
	See 1B1b	IE	IE	IE	See 1B1b	IE	IE	IE
	Other			2224	Other	0	0.00	665
	Limestone equiv. use	IE	IE	IE	Limestone equiv. use	IE	IE	IE
	Carbon loss	12	190.21	2224	Carbon loss	17	38.10	665
Portugal	**Iron and steel production**		**0.01**	**16**	**Iron and steel production**	**0**	**0.01**	**18**
	Steel	1247	0.01	14	Steel	2082	0.01	18
	Pig Iron	IE	IE	IE	Pig Iron	IE	IE	IE
	Sinter	IE	IE	IE	Sinter	IE	IE	IE
	Coke	230	0.01	2	Coke	IE	NO	NO
	Other			NO	Other	0	0.00	NO
Spain	**Iron and steel production**		**0.18**	**2428**	**Iron and steel production**	**0**	**0.12**	**2002**
	Steel production	13163	0.07	979	Steel production	16217	0.06	928
	Pig iron production	C	C	246	Pig iron production	C	C	430
	Sinter production	C	C	538	Sinter production	C	C	324
	Coke production	IE	IE	IE	Coke production	IE	IE	IE
	Other			666	Other	0	0.00	320
Sweden	**Iron and steel production**		**0.16**	**2465**	**Iron and steel production**	**0**	**0.10**	**2701**
	Production of secondary steel	1743	0.09	156	Production of secondary steel	1517	0.12	178
	Production of primary iron	2845	0.81	2306	Production of primary iron	3570	0.71	2517
	Sinter	10977	0.00	3	Sinter	22133	0.00	5
	Coke	IE	IE	IE	Coke	IE	IE	IE
	Other			NA	Other	0	0.00	NA
UK	**Iron and steel production**		**0.08**	**1859**	**Iron and steel production**	**0**	**0.12**	**1461**
	Steel Production (EAF)	4546	0.01	37	Steel Production (EAF)	2411	0.01	18
	Iron Production (blast furnace)	12463	IE	IE	Iron Production (blast furnace)	7233	IE	IE
	Sinter	NA	IE	IE	Sinter	NA	IE	IE
	Coke consumed in blast furnaces	5180	IE	IE	Coke consumed in blast furnaces	2979	IE	IE
	Other			1822	Other	0	0.00	1443
	Blast furnace gas flared (PJ)	7	275.67	1805	Blast furnace gas flared (PJ)	5	298.28	1434
	Steel Production (OC)	13169	0.00	17	Steel Production (OC)	7323	0.00	9

According to the IPCC methodology, processes including auto-producers - power and heat production facilities located in iron and steel plants excluding heating of coke ovens (where usually coke oven gas is combusted) and fuel combustion (gaseous fuels and coke) in sinter plants (agglomeration of iron ores) should be taken into account in 1A2a; while processes including consumption of carbonaceous reducing agents, especially in blast furnaces, oxidation of carbon contained in a pig iron or scrap and the burning off carbonaceous electrodes should be taken into account in 2C1. Additionally, emissions coming from limestone and dolomite use in iron and steel plants should be included under 2A3 and Emissions coming from heating of coke ovens should be reported under 1A1c.

However, some EU-15 Member States do not keep this boundary for different reasons (local traditions used in history and in this context an attempt to keep consistency in data series). E. g. some Member States report emission from blast furnace gas and from converter gas under 1A2a instead of under 2C1, because they interpret it as emissions from energy supply.

Thus, for an overview of EU-15 total emissions it seems to be more convenient to take into account all emissions covered by the combined category 1A2a + 2C1. Resulting emissions for the EU-15 Member States in the combined category 1A2a + 2C1 are given in Table 4.42.

Table 4.42 CO_2 Emissions of EU-15 Member States in 1A2a and 2C1 Iron and Steel

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Share 2C1
	1A2a	2C1	Combined		
Austria	5,835	5,460	11,295	8.0%	48%
Belgium	6,097	1,088	7,186	5.1%	15%
Denmark	88	NA,NO	88	0.1%	0%
Finland	2,994	2,408	5,402	3.8%	45%
France	12,262	2,541	14,803	10.5%	17%
Germany	34,269	18,208	52,477	37.2%	35%
Greece	159	116	275	0.2%	42%
Ireland	2	NO	2	0.0%	NA
Italy	14,092	1,139	15,231	10.8%	7%
Luxembourg	457	134	590	0.4%	23%
Netherlands	4,398	687	5,085	3.6%	14%
Portugal	156	18	174	0.1%	10%
Spain	6,763	2,002	8,765	6.2%	23%
Sweden	1,773	2,701	4,474	3.2%	60%
United Kingdom	13,750	1,461	15,210	10.8%	10%
EU-15	**103,096**	**37,961**	**141,057**	**100.0%**	**27%**

It is obvious, that the ratio 2C1 / (1A2a + 2C1) entitled as "Share 2C1" differs significantly for individual Member States. Therefore, boundary between 1A2a and 2C1 is not uniformly interpreted in individual Member States. The seven Member States that are significant CO_2 emitters from iron and steel production (accounting together for 90% of EU-15) allocate emissions in the following ways:

- **Germany**: About 35 % of emissions is reported under 2C1. To calculate process specific emissions the Tier 2 approach is used (using a carbon / tonne pig iron factor for the ideal blast furnace process) and emissions are subtracted from total emissions calculated by the total fuel input to obtain energy related emissions. Process emissions include furthermore electrode combustion in the electric steel production. Emissions from carbonates used in metal production are reported in sector 2C1 instead of 2A3.

- **United Kingdom:** Major share of emissions (90 %) is reported under 1A2a. Emissions from pig iron, sinter and coke production are allocated in 1A2a (or 1A1) instead of 2C1.
- **France:** Major share of emissions (83 %) is reported under 1A2a. In the CRF tables it is specified that emissions from sinter are reported under 1A2a and emissions from coke are included in 1B1b.
- **Italy:** Major share of emissions (93 %) is reported under 1A2a. CO_2 emissions due to the consumption of coke, coal or other reducing agents used in the iron and steel industry have been accounted for as fuel consumption and reported in the energy sector. In the sector 2C1 emissions are reported from: the carbonates used in the sinter plant and in basic oxygen furnaces to remove impurities and to the steel and pig iron scraps, instead of sector 2A3; and graphite electrodes consumed in electric arc furnaces.
- **Austria:** About half of emissions (48 %) are reported under 2C1. Process specific emissions are calculated according to the IPCC good practice guidance Tier 2 approach (using a fix percentage of coke used as reducing agent); these emissions are subtracted from total CO_2 emissions reported by the company. The remaining emissions are reported in the energy sector as emissions due to combustion in category 1A2a Iron and Steel. Emissions from sinter and coke production are included in 1A2a. Emissions from limestone and dolomite use are reported under 2A3. Process emissions include furthermore electrode combustion in the electric steel production.
- **Belgium:** Major share of emissions (85 %) is reported under 1A2a. Emissions from coke are included in the energy sector. Emissions from carbonates used in metal production are reported in sector 2C1 instead of 2A3.
- **Spain:** About three quarters of emissions (77 %) is reported under 1A2a. Emissions from coke are included in the energy sector.

Table 4.43 summarises information by Member State on methods used for estimating CO_2 emission from 2C1 Iron and Steel Production.

Table 4.43 2C1 Iron and Steel Production: Information on activity data and methods used for CO_2 emissions for 1990 and 2010

Member states	Description of methods
Austria	Total CO_2 emissions from the two main integrated iron and steel production sites in Austria were reported directly by industry until 2002. They are calculated by applying a very detailed mass balance approach for carbon. For the years 2003 and 2004 total CO_2 emissions were not reported by industry, thus they were estimated using information from the national energy balance and from the years before. For 2005 and 2006 verified CO_2 emissions, reported under the EU ETS, were taken for the inventory. These data cover CO_2 emissions from pig iron and basic oxygen furnace steel. Process specific emissions are calculated by the Umweltbundesamt according to the IPCC good practice guidance; these emissions are subtracted from total CO_2 emissions reported by the company. The remaining emissions are reported in the energy sector as emissions due to combustion in category 1 A 2 a Iron and Steel. CO_2 emissions from pig iron production were calculated following closely the IPCC GPG guidelines Tier 2 approach, applying the default emission factor of table 3.6 of the IPCC GPG. CO_2 emissions from steel production (which corresponds to steel production at the two integrated sites operating basic oxygen furnaces) were calculated following the IPCC GPG guidelines Tier 2 approach. CO_2 emissions from electric steel production were estimated using a country specific methodology. For 2005- 2010 CO_2 emissions from non-carbonatious ore and other additives were taken into account additionally. This information became available from background data reported under the ETS. Again it has to be stressed that this additional accounting does not affect total CO_2 emissions, but only improves the accuracy of the split made between process and combustion specific emissions.
Belgium	During the 2011 submission the emissions of CO_2 in the iron and steel sector are completely revised in the Flemish region and based on the ETS-methodology instead of C-balance-approach in previous emissions. One company produces rust-free steel. The process emissions in this company are rather small and calculated on the basis of the production of fluid steel on one side. An emission factor of 1.11 – 1.17 %C is still used, being the C-amount blown off in the convertor. On the other hand, the consumption of electrodes is also taken into account. The sum of both emissions of CO_2 are total process emissions in this company. In the second company that produces steel in the Flemish region, process emissions are originating from (1) production of fluid pig iron, (2) amount of lime used directly in the sinter factory to fix the alkalinity of the slags

Member states	Description of methods
	and (3) the amount of lime used (indirectly) in the grinded mixture (mixture of ores, recovery products, MgCO3, CaCO3, …) in the sinter factory as well. The process emissions in the iron and steel sector are allocated in this category 2C, the energy emissions are included in category 1A2a. Emissions of production of coke are separately put in category 1A1c.In the Walloon region, iron is produced through the reduction of iron oxides (ore) with metallurgical coke (as the reducing agent) in a blast furnace to produce pig iron. Steel is made from pig iron and/or scrap steel using electric arc or basic oxygen furnace. The emission estimates in this sub-sector include also emissions from the production of steel in basic oxygen type furnaces but not the emissions from the combustion of the fuel. Until 2004, the emission factors in the basic oxygen furnace steel plant are used as indicated in table 4.5.2.The plants approved these emission factors. Until 2002, 100 % of the CO_2 in the pig iron produced in the blast furnace has been estimated to be emitted in the basic oxygen furnace due to the lack of data's (purchased pig iron, C in steel produced, C in steel scrap). Since 2005, CO_2 emissions have been obtained directly by the obliged reporting of the plants under the emission trading scheme. In 2010 recalculation of emissions in the electrical arc furnaces sector by using plant specific data in the Walloon region led to a change of emission factors.
Denmark	The CO_2 emission from the consumption of metallurgical coke at steelworks has been estimated from the annual production of steel sheets and steel bars combined with the consumption of metallurgical coke per produced amount (Stålvalseværket, 2002). The carbon source is assumed to be coke and all the carbon is assumed to be converted to CO_2 as the carbon content in the products is assumed to be the same as in the iron scrap. The emission factor (3.6 tonnes CO_2/ton metallurgical coke) is based on values in the IPCC-guideline (IPCC (1997), vol. 3, p. 2.26). Emissions of CO_2 for 1990-1991 and for 1993 have been determined with extrapolation and interpolation, respectively.
Finland	The calculation method of CO_2 emission from iron and steel industry is country specific. Both fuel based emissions and process emissions are calculated in connection with the ILMARI calculation system (see chapter 3.2 Emissions from fuel combustion) using plant/process level (bottom-up) data. The methodology is slightly plant-specific, because all plants are different from each other. The main common feature for all plants is, that fuel-based emissions for each installation are calculated in ILMARI system from the use of fuels, excluding coke and heavy bottom oil used in blast furnaces, and subtracted from total CO_2 emissions (described below). Fuel-based emissions are allocated to CRF 1A 2a and CRF1A 1c (coke ovens) The rest of emissions are allocated to process emissions in CRF 2C 1 (and CRF 2.A 1 in the case of lime kilns). Total CO_2 emissions for each installation (coke oven, sinter plant, blast furnace, lime kiln, steel converter, rolling mills, power plants/boilers) in each plant are mostly taken from VAHTI database. These emissions are basically calculated by plant operators using carbon inputs (fuel inputs and reducing materials) and they are reported by installations separately. From 2005 on, all four iron and steel plants in Finland report to the ETS. Starting from 2007 submission, the total CO_2 emissions for GHG inventory have been taken from the ETS data, although the split between process and fuel-based emissions has been done in the same way as in the previous years' calculation. Recalculation in 2010 submission: coke consumption time series data were updated
France	Country specific based on carbon mass balance approach Data sources: Annual pollutant emission reports; French Steel Association.
Germany	The total process-related emissions to be reported under 2.C.1 consist of the following: 1. The CO_2 emissions resulting from use of reducing agents in primary steel production, where the relevant top gas and converter gas is not used in other source categories and thus reported under other categories as CO_2 emissions 2. The CO_2 emissions from limestone inputs in pig iron production, and 3. The CO_2 emissions from electrode consumption in electrical steel production
Greece	Steel production in Greece is based on the use of electric arc furnaces (EAF). There are no integrated iron and steel plants for primary production as no units for primary production of iron exist, but there are several iron and steel foundries. The methodology used for the estimation of emissions is based on tracked carbon oxidation throughout the production processes in electric arc furnace operation.
Ireland	NO
Italy	CO_2 emissions from iron and steel production refer to the carbonates used in sinter plants, in blast furnaces and in steel making plants to remove impurities; they are also related to the steel and pig iron scraps, and graphite electrodes consumed in electric arc furnaces. Basic information for this sector derives from different sources in the period 1990-2010. Activity data are supplied by official statistics published in the national statistics yearbook (ISTAT, several years) and by the sectoral industrial association (FEDERACCIAI, several years).For the integrated plants, emission and production data have been communicated by the two largest plants for the years 1990-1995 in the framework of the CORINAIR emission inventory, distinguished by sinter, blast furnace and BOF, and by combustion and processes emissions. From 2000 CO_2 emissions and production data have been supplied by all the plants in the framework of the ETS scheme, for the years 2000-2004 disaggregated for sinter, blast furnace and BOF plants, from 2005 specifying carbonates and fuels consumption and related CO_2 emissions. For 2002-2006 data have also been supplied by all the four integrated iron and steel plants in the framework of the European EPER/E-PRTR registry not distinguished for combustion and processes. Qualitative information and documentation available on the plants allowed reconstructing their history including closures

Member states	Description of methods
	or modifications of part of the plants; additional qualitative information regarding the plants collected and checked for other environmental issues or directly asked to the plant permitted to individuate the main driving of the emission trends for pig iron and steel productions. Time series of carbonates used in basic oxygen furnaces have been reconstructed on the basis of the above mentioned information resulting in no emissions in the last years. Indeed, as regards the largest Italian producer of pig iron and steel, lime production has increased significantly from 2000 to 2008 by about 250,000 over 410,000 tonnes and the amount introduced in basic oxygen furnaces was, in 2004, about 490,000 tonnes (ILVA, 2006). In 2009 lime production, for the same plant, is equal to 216,000 tonnes but also steel production has sharply decreased; in 2010 lime production is 306,930 tonnes. Emissions from lime production in steel making industries are reported in 1A2 Manufacturing Industries and Construction. Concerning the electric arc furnaces, additional information on the consumption of scraps, pig iron, graphite and electrodes and their average carbon content has been supplied together with the steel production by industry for a typical plant in 2004 (FEDERACCIAI, 2004) and checked with other sectoral study (APAT, 2003). On the basis of these figures an average emission factor has been calculated.CO_2 emissions due to the consumption of coke, coal or other reducing agents used in the iron and steel industry have been accounted for as fuel consumption and reported in the energy sector, including fuel consumption of derived gases. Implied emission factors for steel production reduced from 0.053 to 0.023 t CO_2/t steel production, from 1990 to 2010, due to the reduction in the basic oxygen furnaces. In 2010 recalculations followed an update of pig iron production data and rolling mills activity data.
Luxembourg	Sinter Plant (SP): The emissions in 1990 are calculated from the mass of carbon in the ore. It is therefore a country specific methodology. The data were collected directly from the operator. Blast furnace (BF) and basic oxygen furnace steel production (BOF): The 2000 IPCC-GPG Tier 2 methodology is applied for calculating the emissions in 1990. The emissions from iron production in BF and from steel production in BOF are calculated separately based on a carbon balance over the production processes. Electric arc furnace steel production (EAF): The 2000 IPCC-GPG Tier 2 methodology has been applied for calculating the emissions from the year 2004 onward. The emissions are calculated based on a carbon balance over the production process. [NIR 2008]
Netherlands	CO_2 emissions are estimated using a Tier 2 IPCC method and country-specific carbon contents of the fuels. Carbon losses are calculated from coke and coal input used as reducing agent in blast and oxygen furnaces, including other carbon sources such as limestone and the carbon contents in the iron ore (corrected for the fraction that ultimately remains in the steel produced). Only the net carbon losses are reported in category 2C1. The carbon contained in the blast furnace gas and oxygen furnace gas produced as by-products and subsequently used as fuels for energy purposes is subtracted from the carbon balance and is included in the Energy sector (1A1a and 1A2a, see Sections 3.2.2 and 3.2.3).
Portugal	Emissions are simply calculated from multiplication of activity levels by a suitable emission factor. To avoid double counting, carbon dioxide emissions in coquerie and blast furnace, from oxidation of the carbon that was used as a reducing agent were not estimated from steel or coke production data but simply from use of coke derivative fuels (coke gas and blast furnace gas) in all combustion equipments. Methodology to estimate emissions from combustion of coke gas and blast furnace gas were already discussed in chapter 3.2A – Energy Industries and emissions are included in source sector 1A.2 - manufacturing industries and construction - and 1A.1.c.1 - Manufacture of Solid Fuels. Emissions factors for production process where set mostly from CORINAIR/EMEP also with contributions from IPCC96 and US-EPA AP42. The CO_2 emission factors for Electric Arc Furnace, and that were used for each one of the two iron and steel plants that are included in the European Union Emission Trading Scheme (EU-ETS), were determined from consumption of carbon bearing materials in these units: limestone, calcium carbide and coke for years 2002 and 2003. It was assumed that the same carbon content exists in both scrap and final steel produced in EAF furnaces and consequently no additional emissions are estimated apart from carbon in additives. Scrap use for the period 2005-2010 was obtained from EU-ETS data.
Spain	La estimación de las emisiones de CO_2 en los procesos de fabricación de sínter, arrabio y acero se ha realizado utilizando el método de nivel 2 de IPCC según el cual se rastrea el carbono a través del proceso de producción, evitándose de esta manera la contabilidad por partida doble de las emisiones. La elección de este método ha sido posible debido a que se ha podido disponer de balances de masa de carbono en las materias de entrada y salida correspondientes para cada uno de los procesos encuadrados dentro de esta categoría, tal y como se describe más adelante en este mismo apartado, con distinción entre las tecnologías utilizadas en la fabricación de acero (acerías eléctricas vs acerías de oxígeno básico), dadas las diferencias sustanciales en cuanto a la tecnología y las materias primas utilizadas. En cuanto a las antorchas, la estimación de las emisiones de CO_2 se basa en el contenido de carbono de cada gas incinerado y en los factores de oxidación, tal y como se detalla más adelante en este mismo epígrafe. Incorporación a la categoría 2C1 de la estimación de las emisiones originadas en antorchas en coquerías (2010).
Sweden	Process emissions arising from reducing agents in the primary steel works and secondary iron and steel works are reported in CRF 2C1. As the plants also generate emissions from fuel combustion (CRF 1A1c and CRF 1A2a) and fugitive emissions (CRF 1B1c), the text in this section is closely connected to the text in the corresponding section in the energy chapter. In the Swedish inventory, emissions from primary iron and steel production and secondary steel production are reported separately and fed into the CRF Reporter under 2C1.2 Pig iron and 2C1.1 Steel, respectively. This enables process emissions from the two integrated iron and steel production plants in Sweden to be reported together (2C1.2 Pig iron), and thus not introducing further sources of

Member states	Description of methods
	uncertainty due to additional data handling. Steel: The reported CO_2 emissions include emissions from reducing agents such as coke, coal and electrodes in electric arc furnaces in secondary steel plants. Reported CO_2 emissions also include emissions from the use of limestone and dolomite in secondary steel industry. In most cases data from the Swedish inquiry for the Swedish national allocation plan (NAP) for the EU emissions trading scheme could be used for the years 1998-2002. Data for remaining years (1990-1997 and 2003-2004) has been collected directly from the plants. From 2005, the equivalent data are acquired from the ETS, environmental reports and through contacts with the companies. Data in the ETS also includes information on other sources for process-related CO_2 emissions as well as information concerning carbon bound in products, slag, etc., Reported CO_2 emissions are for all facilities except the one which closed down in 2004 based on data in the ETS, and reported CO_2 emissions can therefore be classified to follow the Good Practice Guidance method Tier 2. According to the ETS guidelines, reported emissions shall be based on all carbon input to and carbon output from the process. For the remaining facility plant specific methods are applied Iron powder: In Sweden there is one producer of iron ore based iron powder. The emissions of CO_2 are calculated by using the Good Practice Guidance method Tier 2. The method includes plant specific activity data on emissions from carbon-containing input materials such as coke and anthracite and also specific carbon-contents of output iron and rest products for all years. Pig iron: The recommended Tier 2 methodaccording to the IPCC Guidelines is applied: calculations of CO_2 emissions are based on carbon mass-balances in order to reduce the risk of double counting or omitting CO_2 emissions. The carbon contents of external input materials such as coking coal, coke, injection coal, limestone, etc., are balanced against final output materials; coke86, pig iron86, steel, tar, sludge, slag, etc. The remaining carbon contents are accounted for as CO_2 emissions.
United Kingdom	The methodology for the prediction of carbon dioxide emissions from fuel combustion, fuel transformation, and processes at integrated steelworks is based on a detailed carbon balance (this methodology is described in more detail within the section on CRF sector 1A2a).Carbon emissions from electric arc furnaces are calculated using an emission factor provided by Corus (2005) The use of updated data in the carbon balance leads to an increase in the emission factor generated for blast furnace gas and, thus, an increase in emissions for 2C1 (2010)

Source: NIR 2012 unless stated otherwise

Table 4.44 summarizes the recommendations from the latest UNFCCC review of the inventory report in relation to the category 2C1 Iron and Steel Production. The overview shows that most recommendations could be implemented.

Table 4.44 2C1 Iron and Steel Production : Findings of the latest UNFCCC review of the inventory report in relation to CO_2 emissions and responses in 2011 inventory submissions

Member State	Review findings and responses related to 2.C.1 Iron and Steel Production	
	Comment in the latest UNFCCC review report	**Status in 2012 submission**
Austria	No 2011 review report available at the time of the compilation of this NIR Review report 2010: Between 2005 and 2008 the CO_2 IEF for electric arc furnaces varies between 72 kg/t steel and 82 kg/t steel, thus being considerably higher than the average value used for the period 1990–2004. The ERT recommends that Austria validate the consistency of the time series and provide explanations for the high variation in the CO_2 IEF in its next annual submission.	Resolved (NIR 2012 p. 189ff.)
Belgium	No 2011 review report available at the time of the compilation of this NIR	A recalculation of emissions in the electric arc furnaces sector took place during the 2012 submission in the Walloon region in response to the review process. (BE NIR 2012, p.97)
Denmark	No recommendation for improvement for this source category in the latest review report.	No follow-up necessary
Finland	The ERT also noted that Finland reported that some streams of carbon stored had not been taken into account. Finland stated that EU ETS data found these streams to be very small, with an overall cumulative effect on emissions of less than 1 per cent of the plant's total emissions. Failing to take account of carbon stored is not consistent with the IPCC good practice guidance. Finland has responded to the recommendation stating that the resources needed to perform such a task would outweigh the gain in accuracy. The ERT notes that the approach currently taken by Finland is conservative, ensuring that all carbon is accounted for. From the information provided in the NIR and the responses from Finland during the review, it is evident that the resources needed to implement this would	No follow-up necessary

Member State	Review findings and responses related to 2.C.1 Iron and Steel Production	
	Comment in the latest UNFCCC review report	**Status in 2012 submission**
	outweigh the gain in accuracy. Furthermore, it could jeopardize resources for other key categories and the change in the estimate of emissions would fall far below the uncertainty of the emission estimate. Therefore, the ERT considers that the approach taken by Finland is appropriate.	
France	No recommendation for improvement for this source category in the latest review report.	No follow-up necessary
Germany	No 2011 review report available at the time of the compilation of this NIR	
Greece	No recommendation for improvement for this source category in the latest review report.	No follow-up necessary
Ireland	No 2011 review report available at the time of the compilation of this NIR	
Italy	No 2011 review report available at the time of the compilation of this NIR	
Luxembourg	The ERT recommends that Luxembourg include a carbon mass balance for the entire time series and more information on the country-specific methodology in order to increase transparency in the NIR of its next annual submission.	Partly solved; follow-up is necessary
Netherlands	The ERT agrees with the carbon mass balance and its carbon flows presented by the Netherlands and recommends that the Party include this carbon mass balance in its next annual submission.	No follow-up necessary Recalculation in response to the review: These differences are the result of an error correction we made during the analysis of the carbon flows.
Portugal	No 2011 review report available at the time of the compilation of this NIR	
Spain	No 2011 review report available at the time of the compilation of this NIR	
Sweden	No 2011 review report available at the time of the compilation of this NIR	
UK	No recommendation for improvement for this source category in the latest review report.	No follow-up necessary

Sources: Review Report 2011 unless stated otherwise; NIR 2012 unless stated otherwise

4.2.3.2 Aluminium production and magnesium foundries

This category includes PFC and SF_6 emissions from aluminum production and magnesium foundries. Two PFCs, tetrafluoromethane (CF4), and hexafluoroethane (C2F6) are known to be emitted from the process of primary aluminum smelting. These PFCs are formed during the phenomenon known as the anode effect (AE), when the aluminum oxide concentration in the reduction cell electrolyte is low. In the magnesium industry, SF_6 is used as a cover gas in foundries to prevent oxidation of molten magnesium. It is assumed that all SF_6 used as cover gas is emitted to the atmosphere.

Table 4.45 summarizes information by Member State on emission trends for the key source PFCs from 2C3 Aluminium Production. PFC emissions from 2C3 Aluminium production account for 0.01 % of total EU-15 GHG emissions (w/o LULUCF) in 2010. Between 1990 and 2010, PFC emissions from this source decreased by 95 % (Table 4.45). Germany, Italy, UK and Sweden are responsible for 70 % of these emissions in the EU-15. All Member States reduced their emissions from this source between 1990 and 2010. France, Germany and the Netherlands had the largest decreases in absolute terms, in Austria, aluminium production ended in 1992. The decreasing trend of PFC emissions from this key source between 1990 and 2010 is due to production stop (AT, 90-92) or decline (DE, ES) and due to process improvements (FR, DE, ES, NL). The peak in 2002 is due to technological changes and not well optimized operations (NL, FR). The small increase in 2010 reflects the recovery of the industry after the economic crisis in 2009.

Figure 13.14 2C3 Aluminium Production: EU-15 PFC emissions

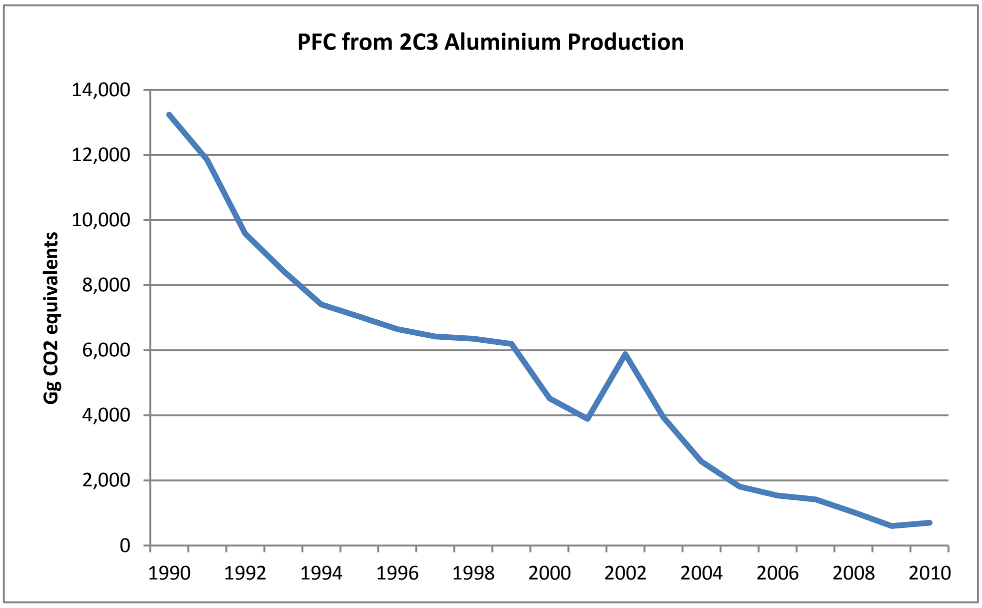


Table 4.45 2C3 Aluminium Production: Member States' contributions to PFC emissions and information on method applied, activity data and emission factor

Member State	PFC emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO2 equivalent	(%)	(Gg CO2 equivalents)	(%)		
Austria	1,050	NO	NO	-	-	-	-1,050	-100%	NA	NA
Belgium	NO	NO	NO	-	-	-	-	-	NA	NA
Denmark	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	NO	NO	NO	-	-	-	-	-	NA	NA
France	3,032	29	46	6.5%	16	56%	-2,986	-98%		
Germany	2,489	178	135	19.3%	-43	-24%	-2,355	-95%	T3	CS
Greece	163	23	34	4.9%	11	50%	-130	-79%	T3	PS
Ireland	NO	NO	NO	-	-	-	-	-	NA	NA
Italy	1,673	146	85	12.2%	-60	-42%	-1,588	-95%	T2	PS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	2,246	43	58	8.3%	15	35%	-2,189	-97%	T2	PS
Portugal	NE	NO	NO	-	-	-	-	-	NA	NA
Spain	883	82	70	10.1%	-12	-14%	-812	-92%	T2	PS
Sweden	377	33	156	22.4%	123	367%	-220	-58%	T2	D
United Kingdom	1,333	61	113	16.2%	53	87%	-1,220	-92%	CS	CS,PS
EU-15	**13,247**	**594**	**697**	**100.0%**	**103**	**17%**	**-12,550**	**-95%**		

Table 4.46 shows information on activity data and emission factors for PFC emissions from 2C Metal Production for 1990 to 2010. The table shows that in 2010 aluminium production was reported by all MS as activity data; for some MS this information is confidential. The implied emission factors for CF4 per tonne of aluminium produced vary for 2010 between 0.03 kg/t for Greece and 0.21 kg/t for Sweden. The EU-15 IEF (excluding Greece, France and Spain) is 0.07 kg/t. The implied emission factors for C2F6 per tonne of aluminium produced vary for 2009 between less than 0.004 kg/t and 0.01 kg/t. The EU-15 IEF (excluding Greece, France and Spain) is 0.09 kg/t. The table suggests that for 2010 all reported emissions are estimated using higher tier methods (based on plant specific data). For 1990 Italy used a T1 approach to estimate emissions. The EU-15 IEFs generally decrease due to reduced durations and frequencies of the anode effects.

Table 4.46 2C Metal Production: Information on methods applied, activity data, emission factors for PFC emissions

Member State	Method applied	Emission factor	Gas	1990				2010			
				Activity data		Implied emission factor (kg/t)	Emissions (t)	Activity data		Implied emission factor (kg/t)	Emissions (t)
				Description	(kt)			Description	(kt)		
Austria	NA	NA	CF_4	Aluminium production	88	1.56	137	Aluminium production	NO	NO	NO
			C_2F_6	Aluminium production	88	0.19	17	Aluminium production	NO	NO	NO
France			CF_4	Aluminium production	C	C	369	Aluminium production	C	C	6
			C_2F_6	Aluminium production	C	C	69	Aluminium production	C	C	0
Germany	T3	CS	CF_4	Aluminium production	740	0.45	336	Aluminium production	403	0.04	18
			C_2F_6	Aluminium production	740	0.05	34	Aluminium production	403	0.01	2
Greece	T3	PS	CF_4	Aluminium production	150	0.14	21	Aluminium production	130	0.03	4
			C_2F_6	Aluminium production	150	0.02	3	Aluminium production	130	0.00	1
Italy	T2	PS	CF_4	Aluminium production	232	0.86	198	Aluminium production	130	0.09	11
			C_2F_6	Aluminium production	232	0.18	42	Aluminium production	130	0.01	1
Netherlands	T2	PS	CF_4	Aluminium production	272	1.02	277	Aluminium production	215	0.04	8
			C_2F_6	Aluminium production	272	0.18	48	Aluminium production	215	0.00	1
Spain	T2	PS	CF_4	Aluminium production	C	C	122	Aluminium production	C	C	10
			C_2F_6	Aluminium production	C	C	10	Aluminium production	C	C	1
Sweden	T2	D	CF_4	Aluminium production	96	0.56	54	Aluminium production	96	0.21	20
			C_2F_6	Aluminium production	96	0.03	3	Aluminium production	96	0.03	3
UK	CS	CS,PS	CF_4	Aluminium production	290	0.60	174	Aluminium production	186	0.08	15
			C_2F_6	Aluminium production	290	0.08	22	Aluminium production	186	0.01	2
EU-15			**CF_4**	**EU-15 w/o FR, GR; ES (97%)**	**1718**	**0.68**	**1176**	**EU-15 w/o FR, GR; ES (78%)**	**1029**	**0.07**	**72**
			C_2F_6	**EU-15 w/o FR,GR, ES (98%)**	**1718**	**0.10**	**165**	**EU-15 w/o FR,GR, ES (83%)**	**1029**	**0.01**	**9**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.47 provides key information on methods used for 2C3 by the EU15 Member States.

Table 4.47 2C3 Aluminium Production: Description of national methods used for estimating PFC emissions

Member States	Description of methods
Austria	PFC emissions were estimated using the IPCC Tier 3b methodology. The specific CF4 emissions (and C2F6 emissions respectively) of the anode effect were calculated by applying the following formula (BARBER 1996), (GIBBS & JACOBS 1996), (TABERAUX 1996): kg CF4/tAl = (1.7 x AE/pot/day x F x AEmin)/CE For the aluminium production in Austria the rate of C2F6 is about 8% and the current efficiency (CE) about 85.4%. Activity data were taken from national statistics (1990 to 1992). Primary aluminium production in Austria was terminated in 1992.
Belgium	NO
Denmark	NO
Finland	NO
France	Deux types de technologies sont employées sur les sites, la plus ancienne, dénommée SWPB correspondant à une alimentation mécanisée sur les côtés des cuves, et la plus récente, dénommée PFPB correspondant à une alimentation ponctuelle automatique au centre de la cuve. Emission declarations from plants are used that follow a tier 2 approach.
Germany	The production figures for the year 2009 were taken from the aluminium-industry monitoring report for the year 2009 [GDA, 2009]. Emission data is available for PFC emissions from primary aluminium foundries, thanks to a voluntary commitment on the part of the aluminium industry. Since 1997, the aluminium industry has reported annually on the development of PFC emissions from this sector. The measurement data is not published, but it is made available to the Federal Environmental Agency. The measurements conducted in all German smelters in the years 1996 and 2001 form the basis for calculation of CF4 emissions. In this context, specific CF4 emission factors per anode effect were calculated, in keeping with the technology used. The number of anode effects is recorded and documented in the smelters. The total CF4 emissions were calculated by multiplying the total anode effects for the year by the specific CF4 emissions per anode effect determined in 2001. The total emission factor for CF4 is obtained by adding the CF4 emissions of the smelters and then dividing the sum by the total aluminium production of the smelters. C2F6 and CF4 occur in a constant ratio of about 1:10. The above-described method was applied to the entire time series, and the emissions for the years 1990 to 1996 were filled in via recalculations.
Greece	PFC emissions estimates are based on anode effect performance by calculating the anode effect overvoltage statistic (Overvoltage method). This methodology concerns measurements and recordings that are being

Member States	Description of methods
	performed concerning the parameters of the equation used for the CF4 emission's calculation, namely the overvoltage and the aluminium production process current efficiency. The estimations are provided directly by the plant to the inventory team. For 2010 PFCs emissions have been recalculated following the detection of an error in the passing of information from the working files to the CRF Reporter
Ireland	NO
Italy	For the estimation of PFC emissions from aluminium production, both IPCC Tier 1 and Tier 2 methods are used. These emissions, specifically CF4 and C2F6, have been calculated on the basis of information provided by national statistics (ENIRISORSE, several years; ASSOMET, several years) and the national primary aluminium producer (ALCOA, several years),, with reference to the document drawn up by the International Aluminium Institute (IAI, 2003) and the IPCC Good Practice Guidance (IPCC, 2000). Tier 1 method has been used to calculate PFC emissions related to the entire period 1990-1999. The emission factors for CF4 and C2F6 were provided by the main national producer (ALCOA, 2004) based on the IAI document (IAI, 2003). PFC emissions for the period from the year 2000 result from the more accurate IPCC Tier 2 method, based on default technology specific slope factors and facility specific anode effect minutes. The EFs for PFCs were then calculated by ALCOA as weighted arithmetic mean values of EFs for the different technologies (IAI, 2003), the weights representing the technologies implemented.
Luxembourg	NO
Netherlands	PFC emissions from primary aluminium production reported by the two facilities are based on the IPCC Tier 2 method for the complete period 1990-2008. Emission factors are plant specific and are based on measured data.
Portugal	NO
Spain	Para el cálculo de las emisiones de PFC, se ha optado por utilizar el método de nivel 2 referido en la Guía de Buenas Prácticas 2000 IPCC en el epígrafe 3.3 (ecuación 3.10 y Box 3.3 "Tabereaux approach"). Para la aplicación de la fórmula anterior se han utilizado los valores por defecto de la variable "pendiente" (slope = 1,698 (p/CE)) de la Guía de Buenas Prácticas 2000 IPCC (epígrafe 3.3.1, tabla 3.9), y de la información sobre las variables "AEF" y "AED" facilitadas por las plantas productoras mediante un cuestionario específico diseñado al efecto, distinguiendo por planta y series el método de fabricación seguido (ánodos precocidos picado lateral o central y proceso Söderberg de agujas verticales). Dentro de cada serie se recibe información del número de efectos ánodos por cuba y día y de la duración en minutes del efecto ánodo.
Sweden	Tier 2: Activity data used for the PFC emission calculations, anode effects in min/oven day and production statistics, were provided by the company, and specified for the Prebaked and Söderberg processes.
United Kingdom	The estimates were based on actual emissions data provided by the aluminium-smelting sector. There are two main aluminium smelting operators in the UK. One operator uses a Tier 2 methodology Smelter-specific relationship between emissions and operating parameters based on default technology-based slope and over-voltage coefficients, using the default factors for the CWPB (Centre Worked Prebaked) plant. The other operator uses a Tier 3b methodology (as outlined in the IPCC guidance) Smelter-specific relationship between emissions and operating parameters based on field measurements. Emissions estimates were based on input parameters, including frequency and duration of anode effects, and number of cells operating. Emission factors were then used to derive the type of PFC produced. All emissions occur during manufacturing. These emissions were provided directly by the operators.

Source: NIR 2012 unless stated otherwise

Table 4.48 summarizes the recommendations from the latest UNFCCC review of the inventory report in relation to the category 2C3 Aluminium Production. The overview shows that few recommendations were made, and some could be implemented.

Table 4.48 2C3 Aluminium Production: Findings of the latest UNFCCC review of the inventory report in relation to PFC emissions and responses in 2011 inventory submissions

Member State	Review findings and responses related to 2.C.3 Aluminium Production	
	Comment in the latest UNFCCC review report	**Status in 2012 submission**
Austria	No 2011 review report available at the time of the compilation of this NIR	
Belgium	No 2011 review report available at the time of the compilation of this NIR	
Denmark	No recommendation for improvement for this source category in the latest review report.	No follow-up necessary
Finland	No recommendation for improvement for this source category in the latest review report.	No follow-up necessary
France	No 2011 review report available at the time of the compilation of this NIR	
Germany	No 2011 review report available at the time of the compilation of this NIR	

Member State	Review findings and responses related to 2.C.3 Aluminium Production	
	Comment in the latest UNFCCC review report	**Status in 2012 submission**
Greece	The ERT asks Greece to provide AD for aluminium production	Resolved, reasons for not including data in inventory given. Plant specific data which are not updated each year
Ireland	No 2011 review report available at the time of the compilation of this NIR	
Italy	No 2011 review report available at the time of the compilation of this NIR	
Luxembourg	No 2011 review report available at the time of the compilation of this NIR	
Netherlands	During the review, the ERT recommended that the Netherlands provide revised estimates for this category using the CO_2 EF of 1.45 t CO_2/t aluminium for 2007–2009.	Resolved, during the review, the Netherlands agreed that this is an error.
Portugal	No 2011 review report available at the time of the compilation of this NIR	
Spain	No 2011 review report available at the time of the compilation of this NIR	
Sweden	No 2011 review report available at the time of the compilation of this NIR	
UK	No recommendation for improvement for this source category in the latest review report.	No follow-up necessary

Sources: Review Report 2011 unless stated otherwise; NIR 2012 unless stated otherwise

Table 4.49 summarise information by Member State on emission trends and methodologies for the source category SF_6 from 2C Metal Production.

Table 4.49 2C-Aluminium and Magnesium Foundries: Description of national methods used for estimating SF_6 emissions

Member states	Description of methods
Austria	Emissions were estimated following the IPCC methodology using annual consumption data of SF_6. Information about the amount of SF_6 used was obtained directly from the aluminium and mag-nesium producers in Austria and thus represents plant-specific data (for verification data was checked against data from SF_6 suppliers). Actual emissions of SF_6 equal potential emissions and correspond to the annual consumption of SF_6 for magnesium casting, by two companies that used SF_6 as fire-extinguishing cover gas until 2006. SF_6 has not been used in magnesium casting since 2006. From the six secondary aluminium smelters only one stated the use of SF_6 as a cleaning gas from 2006 onwards. For these recent years an EF of 1.5% of SF_6 consumed was applied. This EF is based on measurements in a German aluminium plant that have shown significant destruction of SF_6 (decomposition into sulphur and fluorine) during the process. From 1990 to 2010 the emissions decreased by nearly 100%. This decreasing trend is explained by technological advances and the replacement of SF_6 by other substances used for surface protection
Belgium	NO
Denmark	The emission of SF_6 has been decreasing in recent years due to the fact that activities under Magnesium Foundry no longer exist
Finland	Direct reporting method, Tier 1a. Tier 1b is not applicable to this category because all SF_6 used is imported in bulk. Emissions from this source are not reported separately due to confidentiality (Included in 2 F).
France	Les émissions de SF_6 sont déterminées par bilan matière à partir de l'estimation des consommations annuelles et de certaines informations communiquées par les industriels. Les quantités consommées sont considérées totalement relarguées à l'atmosphère.
Germany	Aluminium production: All of the SF_6 used in Germany to purify molten aluminium is emitted completely upon use (consumption = emission; EF = 1). The practice of assuming the equivalence between consumption (AR) and emissions conforms to the IPCC method (IPCC, 1996a: 2.34). SF_6 consumption was determined via direct surveys, regarding sales, of the few providers of the SF_6-containing gas mixture. The survey for the report year 2000 revealed that the gas mixture has no longer been sold since 2000. For the report year 2002, a first survey of gas providers' SF_6 sales figures was carried out, and these figures were compared with data obtained from a first survey of amounts consumed by industry. This made it possible to identify SF_6 users, in the area of aluminium casting, who use pure SF_6. Since 2007, data on the sale of SF_6 gas are obtained from the central bureau of statistics. Magnesium production: Until 2006, SF_6-input quantities have been determined via direct surveys of foundries' annual consumption levels. In 2006, thusly determined input data were cross-checked for the first time against

Member states	Description of methods
	sales quantities as determined via surveys of gas sellers in this sector. The described procedure has been applied to all report years other than 1996 and 1999, for which lacking yearly data was obtained via interpolation. Good agreement was found, and thus since then, data on gas sales are obtained from the central bureau of statistics. In 2010 emission factors and respectively emissions were concretised due to plant specific measurements
Greece	NO
Ireland	NO
Italy	For SF_6 used in magnesium foundries, according to the IPCC Guidelines (IPCC, 1997), emissions are estimated from consumption data made available by the company (Magnesium products of Italy, several years), assuming that all SF_6 used is emitted. In 2007, SF_6 has been used partially, replaced in November by HFC 125, due to the enforcement of fluorinated gases regulation (EC, 2006). This regulation allows for the use of SF_6 in annual amounts less than 850 kg starting from 1 January 2008, that's why in 2008 SF_6 was still reported together with HFC125 emissions. HFC125 emissions have been reported in the CRF sector 2G OTHER.
Luxembourg	NO
Netherlands	NO
Portugal	NO
Spain	NO
Sweden	The total annual amount of SF_6 used in the magnesium foundries is reported as emissions, according to the IPCC Guidelines and Good Practice Guidance. Data is obtained from companies using SF_6. In Sweden, no SF_6 is used in aluminum foundries (CRF 2C4.1) as far as known, and thus reported as not occurring (NO).
United Kingdom	For magnesium alloy production, emissions from 1998-2008 were estimated based on the emission data reported by the company to the UK's Pollution Inventory. These data are considered reasonably robust whilst earlier data (pre-1998) are estimated based on consultation with the manufacturer. In 2004, for the first time, one of the main industry users has implemented a cover gas system using HFC134a as a cover gas for some of its production capacity. There has not been a complete switch to HFC 134a, although the operator is considering this on an ongoing basis depending on suitability for the different alloys produced. In addition to having a significantly lower GWP than SF_6 (and thus reducing emissions on a CO_2 equivalent basis), use of HFC134a is further advantageous in that a significant fraction of it is destroyed by the high process temperatures thus reducing the fraction of gas emitted as a fugitive emission. It is assumed 90% of the used HFC cover gas is destroyed in the process (CSIRO 2005). In 2008, for the first time, emissions of HFCs have been reported in the Pollution Inventory, and therefore this figure has been used for 2008. Note that actual emissions of SF_6 for this sector are reported for practical reasons under 2C5 'Other metal production'. This is because the CRF Reporter does not allow reporting of HFC emissions under the 2C4 sector category. No emissions of SF_6 are currently reported by any of the aluminium foundries in the Pollution Inventory. Emissions from the use of SF_6 in the UK are therefore reported as Not Occurring.

4.2.3.3 Other metal production

Table 4.50 provides an overview of all sources reported under 2C5 Other Metal Production by EU-15 Member States for the year 2010. Four Member States report emissions from silicium, magnesium or non-ferrous metals: the largest contributor to emissions is Sweden with 38.6 %.

Table 4.50 2C5 Other: Overview of sources reported under this source category for 2010

Member State	2.C.5 Other Metal Production	CO_2 emissions [Gg]	CH_4 emissions [Gg]	N_2O emissions [Gg]	HFC emissions [Gg CO_2 equivalents]	PFC emissions [Gg CO_2 equivalents]	SF_6 emissions [Gg]	Total emissions [Gg CO2 equivalents]	Share in EU-15 Total
Austria	NA, NO	NA	NA	NA	NA,NO	NA,NO	NO	-	0.0%
Belgium	NA	NO	NO	NO	NA,NO	NA,NO	NO	-	0.0%
Denmark	NA, NO	NO	NO	NO	NA,NO	NA,NO	NO	-	0.0%
Finland	Non-ferrous metals	0.3	NO	NO	NA,NO	NA,NO	NO	0.3	0.1%
France	NA	NA	NA	NA	NA	NA	NA	-	0.0%
Germany	Magnesium production	NA,NO	NA,NO	NA,NO	C,NA,NO	NA,NO	IE,NA,NO	-	0.0%
Greece	NA, NO	NO	NO	NA	NA,NO	NA,NO	NA	-	0.0%
Ireland	NA, NO	NO	NO	NO	NA,NO	NA,NO	NO	-	0.0%
Italy	Magnesium Foundries	NA	NA	NA	NA	NA	NA	-	0.0%
Luxembourg	NA	NA	NA	NA	NA	NA	NA	-	0.0%
Netherlands	NA, NO	NO	NO	NO	NA,NO	NA,NO	NO	-	0.0%
Portugal	NA, NO	NO	NO	NO	NA,NO	NA,NO	NO	-	0.0%
Spain	Silicium production	163.1	NA	NA	NA	NA	NA	163	32.6%
Sweden	Non-ferrous metals	192.9	NE,NO	NA,NO	NA,NO	NA,NO	NA,NO	193	38.6%
UK	Non-ferrous metals	NO	NO	NO	13.6	NA,NO	0.0054	143.7	28.7%
EU-15 Total		**356**	**0**	**0**	**14**	**0**	**0.0054**	**500**	**100.0%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

4.2.4 Production of halocarbons and SF_6 (CRF Source Category 2E) (EU-15)

Emissions related to the production of halocarbons as well as SF_6 are reported under this source category. This includes chemical by-products of processes related to the production of these substances that may be released into the atmosphere as well as fugitive emissions of the chemicals that occur during the production and distribution of the chemical.

Table 4.51 summarise information by Member State on emission trends for the key source HFCs from 2E Production of Halocarbons and SF_6.

Table 4.51 2E Production of Halocarbons and SF_6: Member States' contributions to total GHG and HFC emissions

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2010 (Gg CO_2 equivalents)	HFC emissions in 1990 (Gg CO_2 equivalents)	HFC emissions in 2010 (Gg CO_2 equivalents)
Austria	NA, NO	NA,NO	NA	NA
Belgium	3,313	77	NO	NA,NO
Denmark	0	0	NO	NA,NO
Finland	0	0	NA,NO	NA,NO
France	4,691	178	3,635	167
Germany	4,529	256	4,409	166
Greece	935	0	935	NA,NO
Ireland	NA, NO	NA, NO	NA,NO	NA,NO
Italy	1,284	1,144	351	NA,NO
Luxembourg	0	0	NA,NO	NA,NO
Netherlands	4,432	480	4,432	480
Portugal	NE, NO	NE, NO	NE,NO	NA,NO
Spain	2,403	881	2,403	881
Sweden	0	0	NO	NA,NO
United Kingdom	11,385	120	11,374	82
EU-15	**32,971**	**3,136**	**27,539**	**1,775**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.52 provides information on the contribution of Member States to EU recalculations in HFC from 2E Production of Halocarbons for 1990 and 2009 and main explanations for the largest recalculations in absolute terms.

Table 4.52 2E Production of Halocarbons and SF_6: Contribution of MS to EU recalculations in HFC for 1990 and 2009 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2009		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	0	0.0	0	0.0	
Belgium	0	0.0	0	0.0	
Denmark	0	0.0	0	0.0	
Finland	0	0.0	0	0.0	
France	0	0.0	3	1.1	Une très légère modification de la spéciation des HFC totaux déclarés par les industriels suite à de nouvelles données a été effectuée.
Germany	80	1.9	0	0.0	Error correction
Greece	0	0.0	0	0.0	
Ireland	0	0.0	0	0.0	
Italy	0	0.0	0	0.0	
Luxembourg	0	0.0	0	0.0	
Netherlands	0	0.0	0	0.0	
Portugal	0	0.0	0	0.0	
Spain	0	0.0	-38	-7.9	The estimation of HFC-23 emissions estimate in the production of HCFC-22 has been revised in accordance with the new information provided by the only plant that
Sweden	0	0.0	0	0.0	
UK	0	0.0	-11	-10.3	Correction. Projected value previously used.
EU-15	**80**	**0.3**	**-46**	**-2.5**	

HFC emissions from 2E1 By-Product Emissions account for 0.02 % of total EU-15 GHG emissions (w/o LULUCF) in 2010. In 2010 France, the Netherlands and Spain together account for about 92 % of these emissions in the EU-15. Between 1990 and 2010, HFC emissions from this source decreased by 95 % (Table 4.53). The initial increase of emissions from 1990 to 1997 by 54 % is due to increased production in UK, Spain, Greece and the Netherlands. Since 1997 emissions decreased in nearly all Member States strongly; in UK due to the installation of thermal oxider pollution abatement equipments; in the Netherlands due to the installation of a thermal afterburner; in Spain due to the installation of a condensation equipment; and in Greece due to production stop in 2006. In contrast to the trend described above, emissions in France decreased already between 1990 and 1997 due to the installation of a thermal afterburner and remained stable since then.

Figure 15.16 2E1 By-Product Emissions: EU-15 HFC emissions

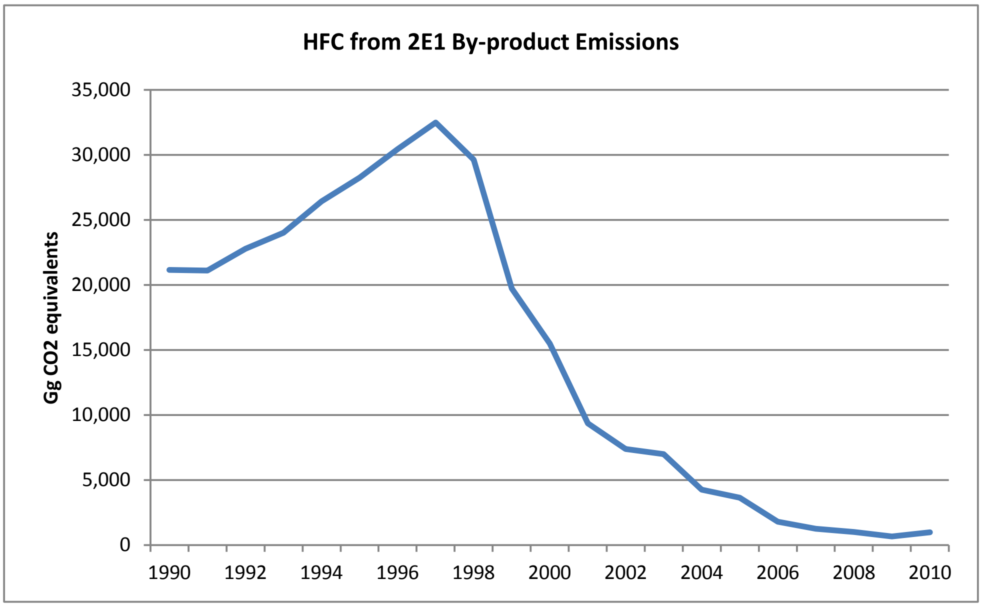


Table 4.53 2E1 By-Product Emissions: Member States' contributions to HFC emissions and information on method applied, activity data and emission factor

Member State	HFC (Gg CO_2 equivalents)			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)		
Austria	NA	NA	NA	-	-	-	-	-	NA	NA
Belgium	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Denmark	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Finland	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
France	1,663	157	110	11.2%	-47	-30%	-1,553	-93%	T2	PS
Germany	C,NA	C,NA	C,NA	-	-	-	-	-	NA	NA
Greece	935	NA,NO	NA,NO	-	-	-	-935	-100%	NA	NA
Ireland	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Italy	351	NA,NO	NA,NO	-	-	-	-351	-100%	NA	NA
Luxembourg	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Netherlands	4,432	154	391	40.0%	237	154%	-4,041	-91%	T2	PS
Portugal	NE,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Spain	2,403	247	395	40.4%	148	60%	-2,008	-84%	T2	PS
Sweden	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
United Kingdom	11,374	94	82	8.3%	-12	-13%	-11,292	-99%	T2	PS
EU-15	**21,158**	**651**	**977**	**100.0%**	**326**	**50%**	**-20,180**	**-95%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.54 shows information on methods used for HFC emissions from 2E1 By-Product Emissions for 1990 and 2010. For 2E1 By-Product Emissions it is not possible to give an average IEF for the EU-15 because for most countries activity data is confidential. Except for Greece, all reported emissions are estimated with higher Tier methods. This means that for the latest inventory year (2010) all reported emissions are estimated using higher tier methods (based on plant specific data).

Table 4.54 2E1 By-Product Emissions: Description of national methods used for estimating HFC emissions and abatements applied

Member States	Description of methods
Austria	NO
Belgium	NO

Member States	Description of methods
Denmark	NO
Finland	NO
France	Il existe un site en France, producteur de HCFC-22, émetteur de HFC-23. Les émissions ont été réduites de façon importante depuis 1992 après l'introduction d'un incinérateur. Les émissions sont déterminées à partir d'une approche bottum-up à partir des données communiquées directement par les sites industriels conformément aux déclarations faites aux DRIRE/DREAL. Parmi les activités de la chimie du nucléaire, la réalisation d'électrolyses de HF occasionnent des émissions de fluor. Ces émissions sont neutralisées par des pots à soufre pour transformer le fluor en sous-produit SF_6 (neutre chimiquement). Ce procédé a été modifié fin 2006 afin de recycler le fluor : les émissions de SF_6 sont ainsi évitées. Les émissions sont communiquées annuellement par le site. Les HFC sont distingués en fonction de leur composition et de leur provenance (i.e. « sous-produit » ou émission « directe »). Ces émissions sont communiquées par les contacts avec les sites concernés et les déclarations annuelles des rejets. Les émissions ont été considérablement réduites depuis 1990 suite à l'installation d'unités de traitement des produits fluorés par oxydation thermique dans les différentes usines. Seules les émissions résiduelles subsistent. De même que pour les HFC, les PFC sont distingués en fonction de leur origine.
Germany	Since 1995 emissions have been calculated (via mass balance) on the basis of the amount of H-CFC-22 produced, of annual measurements of HFC-23 concentrations in the facility's waste gas, of amounts of HFC-23 sold and of the amounts of HFC-23 delivered to the cracking facility; for the 1995 report year, emissions reduction measures (cracking facility) have been taken into account, as of the middle of the year, for the first production facility. Since produced quantities of H-CFC are not reported, no emission factor can be determined and compared with the IPCC standard emission factor. The producer reports only emissions of HFC-23. These are reported in aggregated form, together with emissions from the CRF sub - source category 2.E.2, since they are confidential. In 1995, in Frankfurt, a CFC cracking plant went into operation that cracks, at high temperature, excess HFC-23 produced during production of H-CFC-22 and that recovers hydrofluoric acid; i.e. no significant emissions are produced. HFC-23 produced at the second German production facility is captured in large amounts at the production system itself; the substance is then sold as a refrigerant or – following further distillative purification – as an etching gas for the semiconductor industry. The HCFC-22 production was terminated in mid 2010. From 2011 there are no emissions from HFC-23.
Greece	According to the IPCC Good Practice Guidance, the analytical methodology (Tier 2) should be applied for the calculation of HFC-23 emissions from HCFC-22 production, as it constitutes a key source. This methodology is based on the collection and elaboration of on site measurement data. However, due to the lack of such data, calculation of emissions is based on production statistics and a reference emission factor. It should be noticed that data on the production of HCFC-22 are confidential and therefore are not presented in the current report. The reference emission factor used is suggested by the IPCC GPG. HFC-23 emissions from HCFC-22 manufacture do not occur since 2006, since the plant manufacturing HCFC-22 has stopped operating since.
Ireland	NO
Italy	For source category "By-product emissions", the IPCC Tier 2 method is used, based on plant-level data communicated by the national producer (Solvay, several years). Also for source category "Fugitive emissions", emission estimates are based on plant- level data communicated by the national producer (Solvay, several years). [NIR 2011] In 2010 the operator has provided the time series for the activity data from 2002 (HCFC22 and TFM). Recalculation of the whole Total F-gas emissions time series for category 2E has occurred, because CF4 emissions as a by product of HCFC22 production process have been accounted.
Luxembourg	NO
Netherlands	Production of HCFC-22(2E1): To comply with the IPCC Good Practice Guidance (IPCC, 2001) an IPCC Tier 2 method is used to estimate emission of this source category. HFC-23 emissions are calculated using both (measured) data on the mass flow of HFC23 produced in the process and a destruction factor to estimate the reduction of this HFC 23 flow by the thermal afterburner. Handling activities (HFCs) (2E3): Tier 1 country-specific methodologies are used to estimate the handling emissions of HFCs. The estimations are based on emissions data reported by the manufacturing and sales companies.
Portugal	NO
Spain	The information on HFC-23 emissions is based on the estimates made by the centres themselves, complemented for the years 1990-1998 by a default emission factor. Therefore, the estimation methodology applied in this case is a combination of Tier 1 and Tier 2 in the IPCC's terminology. No se presenta aquí la información sobre variables de actividad y parámetros de proceso por ser de carácter confidencial al corresponder actualmente la propiedad de las plantas únicamente a dos empresas. Cabe asimismo mencionar que en una de las plantas existe un descenso de la emisión a partir del año 2001 debido a la construcción y puesta en servicio de una instalación para disminuir la emisión de HFC-23 mediante su compresión, condensación, licuación y almacenamiento. El HFC-23 licuado se carga en cisternas y se envía a un gestor exterior para su tratamiento. Nuevos calculus: Los nuevos cálculos en esta actividad han estado motivados por la revisión de las cifra de emisión de HFC-23 correspondiente al año 2009 de acuerdo con la información actualizada facilitada por la única planta fabricante de HCFC-22 en dicho año.
Sweden	NO

Member States	Description of methods
United Kingdom	Within the model, manufacturing emissions from UK production of HFCs, PFCs and HFC 23 (by-product of HCFC 22 manufacture) are estimated from reported data from the respective manufacturers. Manufacturers have reported both production and emissions data, but only for certain years, and for a different range of years for different manufacturers.Therefore the emissions model is based on implied emission factors, and production estimates are used to calculate emissions in those years for which reported data was not available. Two of the three manufacturers were members of the UK greenhouse gas Emissions Trading Schemes. As a requirement of participation in the scheme, their reported emissions are verified annually via external and independent auditors. All three now report their emissions to the Environment Agency's Pollution Inventory and these reported emissions have been used to calculate total emissions in later years for two of the operating plant, where full speciated emissions data were provided by one of the operators for most of the time series. There is a significant decrease in HFC emissions in 1998/1999. This step-change in emissions is due to the installation of thermal oxider pollution abatement equipment at one of the UK manufacturing sites. Fugitive HFC emissions from both an HCFC22 plant and HFC manufacturing plant (run by the same operator) are treated using the same thermal oxidiser unit. Emissions also decrease in 2004, reflecting the installation of a thermal oxider at the second of the UK's HCFC22 manufacturing sites. This was installed in late 2003, and became fully operational in 2004. Emissions from the production of HCFC-22 are reported under 2E1.2 and are combined with fugitive emissions from HFC and manufacture, to protect commercial confidential data.

Source: NIR 2012 unless stated otherwise

Table 4.19 provides an overview of Member States' contributions to HFC emissions from sector 2E2, Fugitive Emissions. Only 3 Member States report emissions from this sector. Spain accounts for 68.6 % of all emissions, Germany for 23.4 %, and France for 8 %.

Table 4.55 2E2 Fugitive Emissions: Member States' contributions to HFC emissions

Member State	HFC (Gg CO_2 equivalents)			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010	
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)
Austria	NA	NA	NA	-	-	-	-	-
Belgium	NO	NA,NO	NA,NO	-	-	-	-	-
Denmark	NO	NA,NO	NA,NO	-	-	-	-	-
Finland	NA,NO	NA,NO	NA,NO	-	-	-	-	-
France	1,972	91	57	8.0%	-34	-38%	-1,915	-97%
Germany	4,409	746	166	23.4%	-580	-78%	-4,243	-96%
Greece	NO	NA,NO	NA,NO	-	-	-	-	-
Ireland	NO	NA,NO	NA,NO	-	-	-	-	-
Italy	NO	NA,NO	NA,NO	-	-	-	-	-
Luxembourg	NO	NA,NO	NA,NO	-	-	-	-	-
Netherlands	NO	NA,NO	NA,NO	-	-	-	-	-
Portugal	NE	NA,NO	NA,NO	-	-	-	-	-
Spain	NA	197	486	68.6%	288	146%	486	-
Sweden	NO	NA,NO	NA,NO	-	-	-	-	-
United Kingdom	NA	NA	NA	-	-	-	-	-
EU-15	**6,381**	**1,034**	**708**	**100.0%**	**-326**	**-32%**	**-5,673**	**-89%**

Table 4.56 shows that only one Member State reports GHG emissions under 2E3 Other for the year 2010. The Netherlands include HFC emissions from handling activities, like repackage HFCs from large units (e.g. containers) into smaller units (e.g. Cylinders).

Table 4.56 2E3 Other: Overview of sources reported under this source category for 2009

Member State	2.E.3 Other	HFC emissions [Gg CO_2 equivalents]	PFC emissions [Gg CO_2 equivalents]	SF_6 emissions [Gg]	Total emissions [Gg CO2 equivalents]	Share in EU-15 Total	Information from NIR-2008
Austria	NA	NA	NA	NA	-	0.0%	
Belgium	Other non-specified	NA,NO	NA,NO	NO	-	0.0%	
Denmark	Other non-specified	NA,NO	NA,NO	NO	-	0.0%	
Finland	Other non-specified	NA,NO	NA,NO	NO	-	0.0%	
France	Other non-specified	NA,NO	NA,NO	NA	-	0.0%	
Germany	Other non-specified	NA,NO	NA,NO	NO	-	0.0%	Includes confidential HFC emissions from 2E1 and 2E2
Greece	Other non-specified	NA,NO	NA,NO	NO	-	0.0%	
Ireland	Other non-specified	NA,NO	NA,NO	NO	-	0.0%	
Italy	NA	NA	NA	NA	-	0.0%	
Luxembourg	NA	NA	NA	NA	-	-	
Netherlands	Not specific attributable due to Confidential Bussiness Information	89.7	NA,NO	NO	89.7	100.0%	2E3 Handling activities: emissions of HFCs. There is one company in the Netherlands that repackage HFCs from large units (e.g. containers) into smaller units (e.g. Cylinders) and in addition trading with HFCs. Besides this company there are a lot of companies in the Netherlands which are importing small units with FCs and sell them in the trading areas.
Portugal	Other non-specified	NA,NO	NA,NO	NO	-	0.0%	
Spain	NA	NA	NA	NA	-	0.0%	
Sweden	Other non-specified	NA,NO	NA,NO	NO	-	0.0%	
UK	Other non-specified	NA	NA	NA	-	0.0%	
EU-15 Total		**90**	**0**	**-**	**90**	**100.0%**	

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.57 summarizes the recommendations from the latest UNFCCC review of the inventory report in relation to the category 2E Production of Halocarbons.

Table 4.57 2E Production of Halocarbons and SF_6: Findings of the latest UNFCCC review of the inventory report and responses in 2011 inventory submissions

Member State	Review findings and responses related to 2.E. Production of halocarbons and SF_6	
	Comment in the latest UNFCCC review report	**Status in 2012 submission**
Austria	No 2011 review report available at the time of the compilation of this NIR	
Belgium	No recommendation for improvement for this source category in the latest review report.	No follow-up necessary
Denmark	No recommendation for improvement for this source category in the latest review report.	No follow-up necessary
Finland	No recommendation for improvement for this source category in the latest review report.	No follow-up necessary
France	No 2011 review report available at the time of the compilation of this NIR	
Germany	No 2011 review report available at the time of the compilation of this NIR	
Greece	No recommendation for improvement for this source category in the latest review report.	No follow-up necessary
Ireland	No 2011 review report available at the time of the compilation of this NIR	
Italy	No 2011 review report available at the time of the compilation of this NIR	
Luxembourg	No recommendation for improvement for this source category in the latest review report.	No follow-up necessary
Netherlands	The ERT recommends that the Netherlands explore ways to allow the reporting of sufficient data to the Dutch inventory experts, in order to	Not resolved.

Member State	Review findings and responses related to 2.E. Production of halocarbons and SF_6	
	Comment in the latest UNFCCC review report	Status in 2012 submission
	ensure completeness, consistency and adequate QC of the emission estimates, while maintaining the confidentiality of the data.	
Portugal	No 2011 review report available at the time of the compilation of this NIR	
Spain	No 2011 review report available at the time of the compilation of this NIR	
Sweden	No 2011 review report available at the time of the compilation of this NIR	
UK	The ERT recommends that the United Kingdom correct the errors, improve QC for the sector and appropriately report these emissions in the CRF tables for its next annual submission. In response to questions raised by the ERT during the review, the United Kingdom responded that the reference to the energy sector is an error that will be corrected in its next annual submission and the missing value in table 2(II).E is a technical mistake and the relevant emissions are included in the total.	No follow-up necessary.

Sources: Review Report 2011 unless stated otherwise; NIR 2012 unless stated otherwise

4.2.5 Consumption of halocarbons and SF_6 (CRF Source Category 2F) (EU-15)

Emissions related to the consumption of Halocarbons (HFCs, PFCs) and Sulphur Hexafluoride (SF_6) are reported under this source category. These substances are serving as alternatives to ozone depleting substances (ODS) that are being phased out under the Montreal Protocol. The main applications for Halocarbons include refrigeration and air conditioning, fire suppression and explosion protection, aerosols, solvent cleaning, and foam blowing, as well as some other applications. Primary uses of SF_6 include gas insulated switch gear and circuit breakers, fire suppression and explosion protection, and other applications.

Table 4.58 summarises information by Member State on emission trends of total GHG emissions and for the two key sources (HFCs and SF_6) from 2F Consumption of Halocarbons and SF_6.

Table 4.58 **2F Consumption of Halocarbons and SF_6: Member States' contributions to total GHG, HFC and SF_6 emissions**

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2010 (Gg CO_2 equivalents)	HFC emissions in 1990 (Gg CO_2 equivalents)	HFC emissions in 2010 (Gg CO_2 equivalents)	SF_6 emissions in 1990 (Gg CO_2 equivalents)	SF6 emissions in 2010 (Gg CO_2 equivalents)
Austria	296	1,575	26	1,161	241	345
Belgium	103	1,915	NO	1,803	103	105
Denmark	13	851	NA,NE,NO	800	13	38
Finland	94	1,196	0	1,164	94	31
France	1,514	17,391	102	16,742	1,070	323
Germany	4,511	14,472	40	11,245	4,333	3,053
Greece	3	3,632	NA,NO	3,558	3	6
Ireland	37	635	1	563	36	35
Italy	213	9,211	NO	8,754	213	356
Luxembourg	13	74	12	66	1	7
Netherlands	237	2,137	NO	1,802	218	184
Portugal	0	1,239	NE	1,232	NE	7
Spain	67	7,858	NA	7,264	67	361
Sweden	88	890	4	849	84	39
United Kingdom	674	14,767	12	14,139	604	559
EU-15	**7,863**	**77,843**	**197**	**71,142**	**7,081**	**5,448**

Abbreviations explained in the Chapter 'Units and abbreviations'.

HFC emissions from 2F Consumption of Halocarbons and SF_6 account for about 2 % of total EU-15 GHG emissions (w/O LULUCF) in 2010. HFC emissions in 2001 were 99 times higher than in 1990. The main reason for this is the phase-out of ozone-depleting substances such as chlorofluorocarbons under the Montreal Protocol and the replacement of these substances with HFCs (mainly in refrigeration, air conditioning, foam production and as aerosol propellants). France, Germany, UK, Spain and Italy had the most significant absolute increases from this source between 1990 and 2010.

SF_6 emissions from 2F Consumption of Halocarbons and SF_6 account for 0.15 % of total EU-15 GHG emissions (w/o LULUCF) in 2010. Between 1990 and 2010, SF_6 emissions from this source decreased by 23 %. Germany, France, Italy, UK, Austria and Spain are responsible for 85 % of total EU-15 emissions (w/o LULUCF) from this source. In absolute terms, Germany had also the most significant decreases from this source between 1990 and 2010.

Table 4.59 provides information on the contribution of Member States to EU recalculations in HFC from 2F Consumption of Halocarbons for 1990 and 2009 and main explanations for the largest recalculations in absolute terms.

Table 4.59 2F Consumption of halocarbons: Contribution of MS to EU recalculations in HFC for 1990 and 2009 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2009		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	0	0.0	1	0.1	Update regarding life time of equipment; reviewed activity data for mobile air conditioning available
Belgium	-443	-100.0	-32	-1.8	The main changes made to the inventory data for the period 1995-2009 are the following: - The data for the years 1990-1994 have been revised. As the base year for the Kyoto protocol is 1995, there is a lack of data for these years, and a simplified approach had been used, consisting, wherever data are not available, in considering that they are equal to those of 1995. This has been improved by setting activity variables and emissions to zero for the years for which it is known that the gases were not yet used. In practice, this has led to put zero for all HFCs for the years 1990 and 1991, and in a few cases for later years. This concerns both actual and potential emissions. - The emissions from household refrigerators (both compressors and foams) have been revised for the entire time period since 1995. - Refrigerants R422D and R427A, which have recently started to penetrate the market, have now been taken into account for "installations", which has led to changes in emissions HFC 32, HFC 125, HFC 134a and HFC 143a for 2008 and 2009. - Disposal emissions of HFC134a have been introduced for Refrigeration 'Installations' in 2009. - The non fugitive emissions of the chemical industry in 2009 have been corrected.
Denmark	0	0.0	0	0.0	
Finland	0	0.0	0	0.0	
France	-4	-3.9	-590	-3.9	- 2F1: Modif ication des données de l'EMP avec mises à jour de données statistiques et productions + correction des émissions f in de vie qui étaient surestimées par double-compte. - 2F2: Modif ication de la méthodologie -> les émissions de HFC des mousses OCF sont maintenant attribuées à la banque et non à la charge. - 2F4: Modif ication des données d'émissions d'un site qui a comptabilisé 2 fois les pertes matières ce qui a majoré sa déclaration d'émisisons.
Germany	0	0.0	7	0.1	- 2F1: Number of produced and registered refrigeration trucks have been changed. - 2F9: Error corrections.
Greece	0	0.0	787	30.6	Mobile Air-Conditioning, HFC-134a: - Updated data provided by Association of Motor Vehicle Importers Representatives. - The percentage of HFCs penetration in the new equipment has been taken into account. - Emission factors: use of updated default value (GPG).
Ireland	1	88.7	20	4.0	2F1: - Decomissioning of A/C systems assuming 12 year vehicle lifespan & introduction of A/C in 1993 - Revised activity data submitted to inventory agency - Revised penetration rate of vehicles with air conditioning 2F2: Revised GDP estimate used in conjunction with global sales data from AFEAS 2F3: Revised product life and disposal factors 2F4: - Revised estimate of HFC species ratio used in aerosols - Revised activity data submitted by manufacturer to the inventory agency
Italy	0	0.0	-9	-0.1	- Update of activity data from operators of mobile air conditioning - Update of import export data reported by operators
Luxembourg	-2	-11.3	-0.2	-0.4	Detailed data is now provided in the corresponding subcategory, previously emmissions were only reported in the summary tables.
Netherlands	0	0.0	-21	-1.2	Improved activity data
Portugal	0	0.0	40	3.6	- The number of households (domestic refrigeration) was updated for the period 2001-2010 based on INE timeseries. - In hypermarkets, AD has been revised for the period 1990-2010. - Data on the opening date and total area of each shopping center (Industrial Stationary Air Conditioning) has been revised based on APCC timeseries. - Amounts of sold metered dose inhalers charged with F-gases have been revised for the period 2008-2010.
Spain	0	0.0	-103	-1.5	Commercial Refrigeration, HFC-134a: - Revision of the coefficient of losses in medium/large air-conditioning equipment, after having detected an error in this parameter in the previous inventory edition. Mobile Air-Conditioning, HFC-134a: - Revision of the amount filled in new manufactured products at three car production plants. - Revision of the emission factor after updating the mobile air-conditioning system emission rate parameter in accordance with the updated values of the IPCC 2000 Good Practice Guidance.
Sweden	0	8.0	-63	-6.8	Update of the data from the Products Register from the Swedish Chemicals Agency. Correction of formulas. Information on heat pumps was updated
UK	0	0.0	3,043	28.3	The refrigeration and air conditioning model has been re built to utilise bottom up data across all categories. All parameters have been reviewed and revised.
EU-15	**-447**	**-69.4**	**3,080**	**4.8**	

Table 4.60 provides information on the contribution of Member States to EU recalculations in SF_6 from 2F Consumption of Halocarbons for 1990 and 2009 and main explanations for the largest recalculations in absolute terms.

Table 4.60 **2F Consumption of halocarbons and SF_6: Contribution of MS to EU recalculations in SF_6 for 1990 and 2009 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)**

	1990		2009		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	0	0.0	0	0.0	
Belgium	0	0.0	0	0.0	
Denmark	0	0.0	-0.4	-1.1	A calculation error has been identified in calculation of stock in double glaze windows for the year 1998. Correction of the error results in changes in the stock in the following and therefore changes in the emission from
Finland	0	0.0	0	0.0	
France	0	0.0	-20	-6.1	2F8: Correction d'une erreur en 2009
Germany	0	0.0	7	0.2	2F9: Error corrections.
Greece	0	0.0	0.2	4.8	Updated data from Public Power Company, Distribution department,
Ireland	0	0.3	-27	-41.4	2F7: Revised activity data submitted by semiconducture manufacturers to the inventory agency 2F9: Revised UK estimates of SF6 from sporting goods which are used in
Italy	0	0.0	0	0.0	
Luxembourg	0	0.0	-0.4	-5.4	2F8: Corrected double counting of one type of installation
Netherlands	1	0.4	-5	-2.7	New improved data; error correction
Portugal	0	0.0	-1	-17.8	Electric equipment AD timeseries have been revised for the period 2007-2010.
Spain	0	0.0	0	0.0	
Sweden	0	0.0	-2	-3.4	2F8: updated information from the Swedish producer of gas-insulated switchgear
UK	0	0.0	0	0.0	
EU-15	**1**	**0.0**	**-49**	**-0.9**	

Table 4.61 shows the sub-categories of HFC emissions from 2F Consumption of Halocarbons and SF_6 by Member State. It shows that 2F1 Refrigeration and Air Conditioning Equipment is by far the largest sub-category accounting for 79 % of HFC emissions in this source category; 2F4 Aerosols/Metered Dose Inhalers and 2F3 Fire Extinguishers account for 13% and 4 % respectively.

Table 4.61 **2F Consumption of Halocarbons and SF_6: Member States' sub-categories of HFC emissions for 2010 (Gg CO_2 equivalents)**

Member State	Consumption of Halocarbons and SF_6	Refrigeration and Air Conditioning Equipment	Foam Blowing	Fire Extinguishers	Aerosols/ Metered Dose Inhalers	Solvents	Other applications using ODS substitutes	Semiconductor Manufacture	Electrical Equipment	Other (please specify)
Austria	**1,161**	1,098	31	10	20	NO	NO	2	NO	NA,NO
Belgium	**1,803**	1,616	103	12	70	NO	NO	2	NO	NA,NO
Denmark	**800**	692	87	NO	17	NO	NO	NO	NO	4
Finland	**1,164**	1,090	8	C,NO	63	NO	NO	C,NA,NO	NO	3
France	**16,742**	10,850	209	130	5,164	379	NO	9	NO	NA,NO
Germany	**11,245**	10,086	670	24	457	C,NO	NO	9	NO	NA,NO
Greece	**3,558**	3,421	33	41	63	NA,NO	NO	NO	NO	NA,NO
Ireland	**563**	375	27	63	94	NO	NO	3	NO	NA,NO
Italy	**8,754**	7,696	496	160	393	NO	NO	8	NO	NA,NO
Luxembourg	**66**	62	2	NO	2	NO	NO	NO	NA	NA,NO
Netherlands	**1,802**	1,578	IE	IE,NO	IE	IE,NO	NO	NO	NO	224
Portugal	**1,232**	1,171	48	6	7	NO	NO	NO	NO	NA,NO
Spain	**7,264**	5,123	68	1,974	100	NA	NA	NA	NA	NA
Sweden	**849**	784	32	6	27	NO	NO	NO	NA	NA,NO
UK	**14,139**	10,834	299	204	2,690	107	NA	IE	IE	6
EU-15	**71,142**	**56,476**	**2,112**	**2,630**	**9,166**	**486**	**0**	**34**	**0**	**238**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.62 shows MS contribution to EU-15 HFC emissions from the two most important sub-sources 2F1 and 2F4.

Table 4.62 **2F1 Refrigeration and Air conditioning: Member States' contributions to HFC emissions and information on method applied, activity data and emission factor**

Member State	HFC (Gg CO_2 equivalents)			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)		
Austria	2	995	1,098	1.9%	103	10%	1,096	62303%	CS	CS
Belgium	NO	1,593	1,616	2.9%	23	1%	1,616	-	T2	CS,D,PS
Denmark	NA,NE	683	692	1.2%	9	1%	692	-	CS	CS
Finland	0	799	1,090	1.9%	291	36%	1,090	8649182%	T2	D
France	79	10,130	10,850	19.2%	720	7%	10,771	-		
Germany	NA,NO	9,984	10,086	17.9%	102	1%	10,086	-	T2	CS,D
Greece	NO	3,216	3,421	6.1%	206	6%	3,421	-	T2	D
Ireland	IE,NO	338	375	0.7%	37	11%	375	-	T1,T3	CS
Italy	NO	7,136	7,696	13.6%	560	8%	7,696	-	T2	CS
Luxembourg	0	61	62	0.1%	1	2%	62	2396580%	CS	CS
Netherlands	NO	1,528	1,578	2.8%	50	3%	1,578	-	T2	CS
Portugal	NE	1,091	1,171	2.1%	80	7%	1,171	-		
Spain	NA	4,648	5,123	9.1%	475	10%	5,123	-	T1,T2	D
Sweden	3	798	784	1.4%	-13	-2%	782	27393%	CS,T2	CS,D
UK	NO	10,403	10,834	19.2%	431	4%	10,834	-	T3	CS
EU-15	**84**	**53,403**	**56,476**	**100.0%**	**3,074**	**6%**	**56,392**	**67444%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

In 2010, HFC emissions from 2F1 were about 675 times higher than in 1990 (Figure 17.18). France, Germany, Italy and the UK are responsible for 70% of total EU-15 emissions from this source. Between 2009 and 2010 EU-15 emissions increased by 6 %. The largest increase of HFC emissions from 2F1 between these years was in Finland. Sweden reported decreasing emissions from this source in the latest years.

Figure 17.18 **2F1 Refrigeration and Air conditioning: EU-15 HFC emissions**

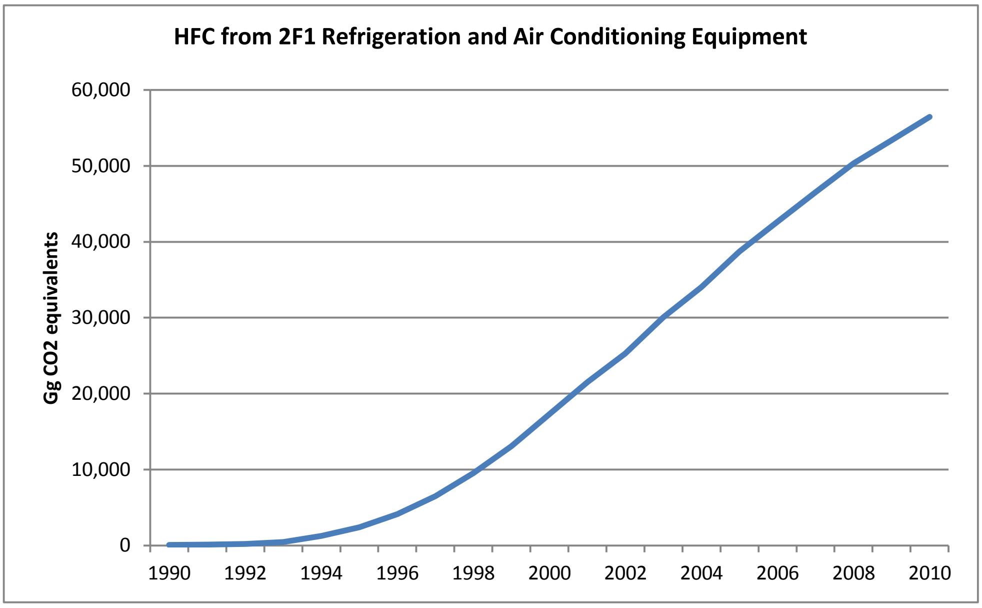


Table 4.63 **2F3 Fire extinguishers: Member States' contributions to HFC emissions and information on method applied, activity data and emission factor**

Member State	HFC (Gg CO_2 equivalents)			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)		
Austria	NO	10	10	0.4%	0	-2%	10	-	CS	CS
Belgium	NO	12	12	0.5%	0	3%	12	-	T2	CS
Denmark	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	NO	C,NO	C,NO	-	-	-	-	-	NA	NA
France	NO	128	130	5.0%	2	2%	130	-		
Germany	NO	14	24	0.3%	10	75%	24	-	CS	CS,D
Greece	NA,NO	39	41	0.4%	2	6%	41	-	CS	D
Ireland	0	55	63	2.4%	8	14%	63	28697%	T3	CS
Italy	NO	146	160	6.1%	14	10%	160	-	T2	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	NO	IE,NO	IE,NO	-	-	-	-	-	NA	NA
Portugal	NE	4	6	0.2%	2	69%	6	-		
Spain	NA	1,921	1,974	75.1%	52	3%	1,974	-	T1,T2	D
Sweden	NA	6	6	0.2%	0	0%	6	-	CS	CS
UK	NO	202	204	7.7%	2	1%	204	-	T2	CS
EU-15	**0**	**2,536**	**2,630**	**100.0%**	**94**	**4%**	**2,630**	**1203328%**		

In 2010, HFC emissions from 2F3 Table 4.63 increased by 4% compared to 2009 – and by 1 203 328% compared to 1990. The biggest contributors to this sector are Spain (75.1%), UK (7.7%), and Italy (6.1%), those three countries account for 88.9% of the share in EU15 emissions in this sector. Only Austria reported a decrease in emissions (-2%) compared to 2009.

Table 4.64 2F4 Aerosols/ Metered Dose Inhalers: Member States' contributions to HFC emissions and information on method applied, activity data and emission factor

Member State	HFC (Gg CO_2 equivalents)			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)		
Austria	22	19	20	0.2%	0	2%	-2	-11%		
Belgium	NO	68	70	0.8%	2	3%	70	-	T1,T2	D
Denmark	NA,NE,NO	18	17	0.2%	-1	-6%	17	-	CS	CS
Finland	NA,NO	80	63	0.7%	-17	-21%	63	-	T2	D
France	NO	3,389	5,164	56.3%	1,776	52%	5,164	-		
Germany	C,NO	456	457	5.0%	1	0%	457	-	CS,T2	CS,D
Greece	NO	65	63	0.7%	-2	-4%	63	-	T2	D
Ireland	1	98	94	1.0%	-4	-4%	94	15089%	T1,T2	CS
Italy	NO	398	393	4.3%	-4	-1%	393	-	T2	CS
Luxembourg	NA,NO	2	2	0.0%	0	-3%	2	-	CS	CS
Netherlands	NO	IE	IE	-	-	-	-	-	NA	NA
Portugal	NE	7	7	0.1%	0	1%	7	-		
Spain	NA	144	100	1.1%	-44	-31%	100	-	D	D
Sweden	1	25	27	0.3%	2	6%	26	1968%	CS,T2	D
UK	12	2,784	2,690	29.3%	-94	-3%	2,678	22658%	T2	CS
EU-15	**36**	**7,552**	**9,166**	**100.0%**	**1,613**	**21%**	**9,130**	**25423%**		

In 2010, HFC emissions from 2F4 were more than 255 times higher than in 1990 (Figure 19.20). France and UK are responsible for 85.7 % of total EU-15 emissions from this source. Between 2009 and 2010 EU-15 emissions increased by 21 %. The relative decrease between these years was largest in Spain and Finland, the biggest increase was reported in France (Table 4.66).

Figure 19.20 2F4 Aerosols/Metered Dose Inhalers: EU-15 HFC emissions

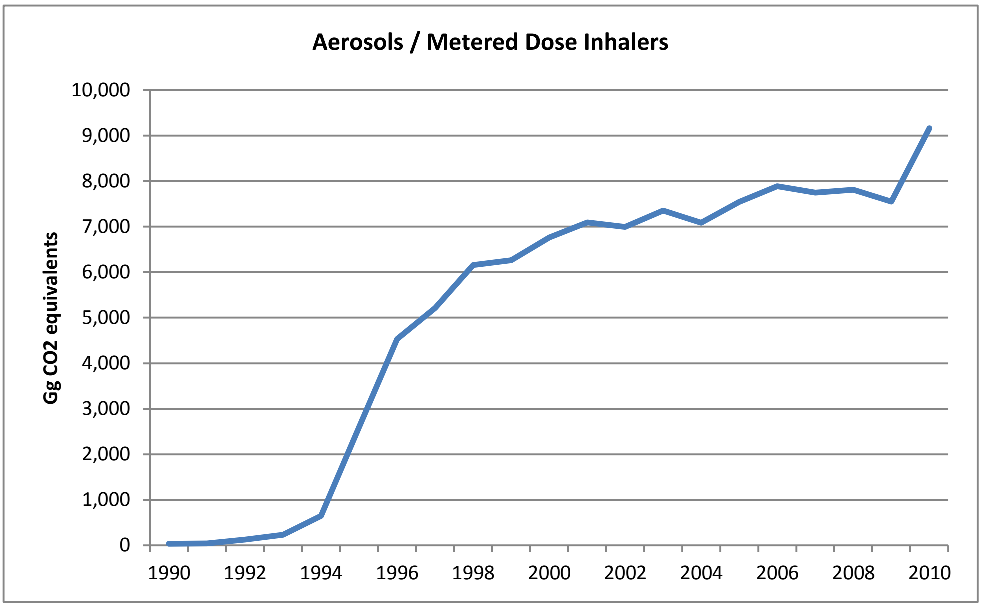


Table 4.65 provide descriptions on methods used for estimating HFC, PFC and SF_6 emissions from 2F Consumption of Halocarbons and SF_6.

Table 4.65 2F Consumption of halocarbons and SF_6: General description of national methods used for estimating emissions

Member States	Description of methods
Austria	A study was contracted out to determine the consumption data and emissions from 1990–2000 for all uses of FCs (UMWELTBUNDESAMT 2001b). In this study, bottom up data for consumption per sector were compared with top-down data from importers and retailers of FCs as well as with data from the national statistics (import/export statistics). The sub-category 2.F.2 Foam blowing was re-evaluated in a new contracted study (OBERNOSTERER et al 2004). Austrian estimates of emissions from the sources 2.F.4 Aerosols and 2.F.5 solvents are based on a European evaluation of emissions from this sector (HARNISCH & SCHWARZ 2003), subsequently disaggregated to provide a top-down Austrian estimate. For the years 2000-2008 a second study (LEISEWITZ & SCHWARZ 2010) was contracted in order to conduct a complete survey of all F-gas uses and emission sources. In this study equally a combined bottom-up top-down approach was used. Data about consumption of HFC, PFC and SF_6 were determined from the following sources: data from national statistics data from associations of industry direct information from importers and end users Since 2004 there is also a reporting obligation under the Austrian FC-regulation for users of FCs in the following applications: refrigeration and air-conditioning, foam blowing, semiconductor manufacture, electrical equipment, fire extinguishers and aerosols. Emissions for all subcategories were estimated using a country specific methodology, emission factors are based on information of experts from the respective industries. For most sources emissions are calculated from annual stocks using emission factors. Due to an update of information regarding life time of equipment in the mobile air conditioning sector, some emissions from disposal starting in 2009 were updated in 2010, which led to minor recalculations of emissions in that sector. Also, some reviewed activity data for mobile air conditioning became available, which also led to minor recalculations for 2009.
Belgium	Emissions of fluorinated greenhouse gases are mainly estimated on the basis of the consumption of the different substances for each application, the consumption of products containing such substances, figures on external trade in substances or products containing substances, as well as on emission modelling by application and assumptions on leakage rates. Regarding HFC emissions- Activity variables for the period 1990-1994 have been assigned the value 'NO' for the years for which the relevant gases are known not to have been available on the market. - Activity data for household refrigerators have been revised for the entire time period since 1995. - Refrigerant mixtures R422D and R427A, which have recently started to penetrate the market, have now been taken into account for 'installations', which has led to changes in emissions of HFC32, HFC125, HFC134a and HFC 143a for 2008 and 2009. - Disposal emissions of FHC134a have been introduced for 'installations' in 2009. - Recovery figures for 2009 have been revised, which influences the potential emissions. - the emissions from the use of technical aerosols have been revised for 2007 and 2008. In 2010: - 'PFC emissions of refrigeration have been taken into account. - The non fugitive emissions of the chemical industry in 2009 have been corrected.
Denmark	The data for emissions of HFCs, PFCs, and SF_6 has been obtained in continuation on work on inventories for previous years. The determination includes the quantification and determination of any import and export of HFCs, PFCs, and SF_6 contained in products and substances in stock form. This is in accordance with the IPCC-guideline (IPCC (1997), vol. 3, p. 2.43ff) as well as the relevant decision trees from the IPCC Good Practice Guidance (GPG, IPCC (2000) p. 3.53ff). For the Danish inventories of F-gases basically a Tier 2 bottom up approach is used. As for verification using import/export data a Tier 2 top down approach is applied. In an annex to the F-gas inventory report 2008 (DEPA, 2010), there is a specification of the approach applied for each sub-source category. The following sources of information have been used: Importers, agency enterprises, wholesalers, and suppliers Consuming enterprises, and trade and industry associations Recycling enterprises and chemical waste recycling plants Statistics Denmark Danish Refrigeration Installers' Environmental Scheme (KMO) Previous evaluations of HFCs, PFCs, and SF_6 Suppliers and/or producers provide consumption data of F-gases. Emission factors are primarily defaults from GPG, which are assessed to be applicable in a national context. In an annex to the F-gas inventory report 2010 (Poulsen & Werge, 2012)), there is a specification of the approach applied for each subsource category
Finland	Detailed sector-specific approach. Emissions from each category are quantified using 2 or 3 different methods given in IPCC GPG (2000).
France	IPCC Tier 2

Member States	Description of methods
Germany	Detailed CS approach (Tier 2).
Greece	In order to obtain a reliable estimation of F-gases emissions, collection of detailed data for all activities mentioned above (e.g. number of refrigerators, type and amount of refrigerant used by each market label, substitutions of refrigerants that took place the late years etc.) is required. The availability of official data in Greece is limited and, therefore, the estimations presented hereafter involve the application of country specific methodologies. In order to resolve any remaining completeness issues, and given the fact that there has not been any opposite indication for the use of the PFCs in Fire Extinguishers and f-gases in Solvent Uses up to now, in September 2010 Greece has decided to use information from inventories of neighbouring countries. To this end, the inventory of Italy has been used, on the grounds that the climatic and socio-economic conditions between Greece and Italy are quite similar.
Ireland	Emission calculation based on special studies by sub-contractors. The compilation of emission estimates for HFC's, PFC's and SF_6 for this submission was reviewed externally leading to data revision/recalculations up to 2009 (as described in the NIR 2012 section 4.6)
Italy	Methodology used is IPCC Tier 2a, except for SF_6 emissions from electrical equipment (2F7), where it is IPCC Tier 3c. The IPCC Tier 1a method has been used to calculate potential emissions, using production, import, export and destruction data provided by the national producer (Solvay, several years; ST Microelectronics, several years; MICRON, several years). As regard PFC potential emissions, since no production occurs in Italy, export has been reasonably assumed negligible, whereas import correspond to consumption of PFCs by semiconductor manufacturers, that use these substances. Regarding HFCs there was an update of import export data reported by operators (refer to NIR 2012 section 4.7.2
Luxembourg	A re-evaluation of the emission sources and the emissions of HFCs, PFCs and SF_6, taking into account the 2000 IPCC-GPG Guidelines as well as country specific considerations has been done in the previous submission. [NIR 2012, Chapter 4.7]
Netherlands	To comply with the IPCC Good Practice Guidance (IPCC, 2001) IPCC Tier 2 methods are used to estimate emissions of the sub-sources Stationary refrigeration, Mobile airconditioning, Aerosols, Foams and Semiconductor manufacturing. The country-specific method for the source Electrical equipment is equivalent to the IPCC Tier 3 method and the country-specific methods for the sources Sound-proof windows and Electron microscopes are equivalent to IPCC Tier 2 methods. For 2007 and 2008 the country-specific method for the source Electrical equipment is equivalent to the IPCC Tier 3b method and from 2009 onwards to the IPCC Tier 3a method.
Portugal	For those sources with sufficient available data, actual emissions where estimated with a Tier 2 (advanced or actual method) approach which is considered Good Practice in accordance with GPG. This approach allows the quantification of emissions in the year in which they actually occurred accounting for the time lag between consumption and emissions. On the contrary, the Tier 1, or potential approach, allocates emissions in the year that the chemical is sold into a particular end-user. As a general rule, bottom-up methodologies were used, and thus overall methodology should be classified as Tier 2a. This approach departs from the knowledge of the number of equipments using Fluorinated compounds and estimates emissions to atmosphere from charge (amount of chemical used in the equipment), service life, emission rate during the various periods of the equipment life and possible recovery of emissions. Whenever possible emission estimates include: - assembly emissions - when equipment is first filled76; - operation emissions - occurring during equipment lifetime or usage and resulting mainly from leaks; - disposal emissions - the remaining charge that is released to the atmosphere at end of equipment life and where the remaining charge is neither recycled or destroyed. Due to update of AD time series were revised (NIR 2012 section 4.3.5.3)
Spain	No general description, see sub-category specific descriptions Nuevos calculos (NIR 2012): • En los equipos de refrigeración y aire acondicionado del sector automoción (categoría 2F2) se ha revisado el coeficiente de pérdida en funcionamiento para adaptarlo al valor promedio de los propuestos en la Tabla 3.23 de la Guía de Buenas Prácticas 2000 de IPCC. En ediciones previas del inventario se utilizaba un coeficiente del 20%, habiendo sido modificado a 15% (valor central del rango propuesto en la citada tabla, entre 10% y 20%) • En los equipos de refrigeración y aire acondicionado del sector comercial (categoría 2F2), se ha corregido un error en el algoritmo de estimación de las emisiones de HFC-134a al haber aplicado a los equipos medios/ grandes fabricados en años anteriores al considerado el porcentaje de pérdidas de los equipos individualizados • Se ha incorporado la estimación de las emisiones en fabricación de aerosoles de acuerdo con las recomendaciones del equipo revisor de la SCMNUCC.
Sweden	In estimating the actual emissions, as far as possible, a Tier 2 approach has been used. A model is used for calculating the actual emissions. Changes in accumulated amounts each year resulting from additional amounts of HFC, PFC and SF_6 imported and used within the country, as well as the decline in accumulated stock caused by exports or emissions from operating systems, have been taken into consideration. Potential emissions: Data on bulk imports and exports are obtained from the Products register hosted by the Swedish Chemicals Inspectorate, which did not register these substances until 1995. Estimates of potential emissions for imports and exports were, however, made for all years in the time series, 1990-2004 in a special study in 2005. The method of estimating potential emissions for 2005 was made accordingly. A SMED study carried out in 2011 (Gustafsson T. 201. Fluorinated Greenhouse Gases in Sweden. Review of Methodology and Estimated Emissions Reported to the UNFCCC and the EU monitoring Mechanism) led to recalculation of emissions
United Kingdom	No general description, see sub-category specific descriptions

Source: NIR 2012 unless stated otherwise

Table 4.66 provide descriptions on methods used for estimating HFC emissions from 2F1 Refrigeration and Air-Conditioning Equipment.

Table 4.66 2F1 Refrigeration and Air-conditioning equipment: Description of national methods used for estimating HFC emissions

Member States	Description of methods
Austria	See also General description of national methods used for estimating emissions from Consumption of halocarbons and SF_6. Refrigeration and Air Conditioning: Consumption data was obtained directly from the most important importers, retailers and service companies of refrigerants. The stocks of the different subcategories were estimated using information from the most important refrigerant retailers/ importers and experts from the refrigeration branch. A detailed model was used to calculate emissions from passenger cars. This includes figures on new registered cars, MAC quota and the average charge. The stocks were calculated accordingly.
Belgium	For the refrigeration sector, emissions have been estimated separately for the following source categories: industrial and commercial installations, household refrigerators, air conditioning of private cars, air conditioning of buses and coaches, and refrigerated transport. In accordance with the IPCC guidelines, the assembly emissions, the operation emissions and the disposal emissions are being determined separately. The assembly emissions are calculated as a function of the estimated amount charged into new systems and the percentage assembly losses, the operation emissions as a function of the amount stocked in existing systems and assumptions on annual leakage rates, and the disposal emissions in function of the amount in systems at time of disposal and the estimated recovered fraction. An annual inquiry is made on the consumption of the major F-gas containing product manufacturers, among which the 4 car manufacturers. These data are used for calculating the potential emissions as well as the assembly emissions. Industrial and commercial "installations" represent all on-site assembled systems for industrial & commercial refrigeration as well as stationary air-conditioning applications, which is the largest single source of F-gas emissions. The consumption and emission of refrigerants are modelled on the basis of an annual inquiry among refrigerant distributors on their national supply by refrigerant mixture, as well as on assumptions on average loss rates, from which the estimated supply for refilling vehicles is subtracted. No distinction is made between industrial refrigeration, commercial refrigeration and air conditioning installations, as it is not possible to disaggregate the consumption data between these sub-sectors, because of the presence of intermediary wholesalers, and the fact that no inventory of installations is available. The refrigerant consumption and emissions of the transportation sector are estimated by modelling the evolution of the vehicle stock, on the basis of the number of new vehicle registrations and of the percentage of new vehicles equipped with air conditioning., by category of vehicles (cars, buses and coaches). The emissions from refrigerated transport are calculated on the basis of the annual number of new registrations of refrigerated trucks and trailers by gross / net weight categories, the average quantity of refrigerant (by type of refrigerant) contained in each vehicle (by vehicle category) and emission factors taken from the literature.
Denmark	See General description of national methods used for estimating emissions from Consumption of halocarbons and SF_6. In case of commercial refrigerants and Mobile Air Condition (MAC), national emission factors are defined and used. Import/export data for sub-source categories where import/export is relevant (MAC, fridge/freezers for household) are quantified on estimates from import/export statistics of products + default values of the amount of gas in the product. The estimates are transparent and described in the annex to the report referred to above. applied. In an annex to the F-gas inventory report 2010 (Poulsen & Werge, 2012)), there is a specification of the approach applied for each subsource category. Detailed information on the amount of HFCs used for refilling of mobile A/C has been available for 2009 and 2010, and therefore, a new approach has been implemented in the calculation of emissions. HFCs for mobile A/C are only used for refilling, and therefore the amount used for mobile A/C is assumed to be the same as the amount emitted during use (Poulsen & Werge,2012):Consumption of HFC for MAC = refilled stock = emission
Finland	Refrigeration and air conditioning (CRF 2.F.1) Top-down Tier 2, Tier 1a, Tier 1b The Tier 2 top-down method is used for all sources in this category, both stationary and mobile. Data are not collected for separate subcategories because such statistics are either not available or the preparation of such statistics would entail a very high reporting burden on companies. There is also some evidence that simpler questionnaires lead to better response activity. HFC-23 emissions from this source are not reported separately due to confidentiality.
France	IPCC Tier 2. Les émissions de HFC sont déterminées à l'aide du modèle « RIEP » développé par l'Ecole des Mines de Paris qui utilise une méthode de rang 2 du GIEC avancée.
Germany	IPCC Tier 2a. This category is divided into the sub-categories of household refrigeration, commercial refrigeration, transport refrigeration, industrial refrigeration, stationary air-conditioning systems and room air-conditioners, and mobile air-conditioning systems. In Germany, the leading pure-HFC refrigerants are HFC-134a and the mixtures 404A and 507A. For calculation of HFC emissions from the sub-categories of refrigeration and stationary airconditioning systems, individual data are collected, or refrigerant models used. Any refrigerant models used are described in connection with the relevant method. The emission factors used are the result of surveys of experts. The emission factors for waste disposal are the standard values from the IPCC Guidelines of 1996. For some sub - source

Member States	Description of methods
	categories, disposal emissions occurred for the first time in 2003.
Greece	Refrigeration and air-conditioning: F-gases emissions are estimated according to the Tier 2a methodology described in the IPCC Good Practice Guidance. It is a bottom-up approach based on detailed equipment data and emission factors representing various types of leakage per equipment category. It should be noted that the application of the Tier 1 methodology (calculation of potential emissions based on imports, exports and domestic consumption of each gas) and Tier 2b is not possible, as the available information is not reported in the way required by these methodologies. Total emissions are calculated as the sum of assembly emissions, operation emissions that include annual leakage from equipment stock in use as well as servicing emissions and disposal emissions that include the amount of refrigerant released from scrapped systems. Currently (2012) changes to the data collection progress are made.
Ireland	In terms of stationary refrigeration data on the quantities of industrial gases supplied to the refrigeration sector is obtained from chemical suppliers and manufacturers of refrigeration units. Sales data is provided for a range of HFCs and blends corresponding to the individual HFC species. A bottom-up approach is not feasible for estimating actual emissions from stationary refrigeration and air conditioning in Ireland due to the lack of data available on equipment types and HFC sales data into equipment sub-categories. Therefore emissions are estimated using a top-down approach based on reported sales data and information on market shares, which are applied to calculate estimates of total HFC sales into the Irish stationary refrigeration and air-conditioning sectors. Emissions of HFCs from sub-category 2.IIA.F.1.6 Mobile Air-Conditioning are estimated using a Tier 3b bottom-up analysis which utilises national vehicle fleet statistics from the Department of the Environment, Heritage and Local Government and assumed rates of airconditioning unit penetration in the national vehicle fleet. The methodology used takes account of vehicle lifetime, the percentage of vehicles having HFC in their air-conditioning systems, average charge per unit, product manufacturing emissions, effective lifetime leakage rates (incorporating emissions from normal operating losses and accidental releases arising from collision damage) and decommissioning losses. HFC emissions from Mobile Air Conditioning (2F1) have been revised for 2005-2009. This is due in part to the use of a revised disposal factor of 10 per cent for end of life vehicles (AEA, 2011). In addition the assumed penetration of air conditioning units containing HFC's in vehicles is now assumed to reach 90 per cent by 2010 (AEA, 2011). The result of this recalculation is an increase in HFC emissions from Mobile Air Conditioning of 2.7 per cent in 2009. HFC emissions from Refrigeration and Air Conditioning (2F1) have been revised for 2009 due to the provision of revised manufacturing loss emissions by one of the installations that provide information to the inventory agency. The result of this recalculation is a reduction of 13.7 per cent in HFC emissions from Refrigeration and Air Conditioning in 2009. Revisions were also made for the sectors 2F2, 2F3, 2F4 between 1990 and 2009 (2012 NIR section 4.6)
Italy	Refrigeration and air-conditioning: IPCC Tier 2a Basic data and have been supplied by industry: specifically, for the mobile air conditioning equipment the national motor company and the agent's union of foreign motor-cars vehicles have provided the yearly consumptions; for the other air conditioning equipment the producer supply detailed table of consumption data by gas. Losses rates have been checked with industry and they are distinguished by domestic equipment, small and large commercial equipment, industrial chillers, mobile air conditioning equipment. Refrigeration activities, such as commercial, transport, industrial and other stationary, are all reported under domestic refrigeration because no detailed information is available to split consumptions and emissions in the different sectors. Anyway appropriate losses rates have been applied for each gas taking in account the equipment where refrigerants are generally used. Therefore implied product life factors, especially for HFC 134a, result from the weighted average of different losses rates, from 0.7% for domestic refrigeration to 10% for large chillers. HFCs - update of import export data reported by operators (NIR 2012 section 4.7.2)
Luxembourg	Emissions from industrial and commercial installations have been calculated on the basis of a life-cylce approach and on the basis of an inquiry among the refrigerant distributors on their national supply by refrigerant mixture on the year 2006. The evolution in time of the total supply by refrigerant has been assumed to be the same as in Belgium. No distinction has been made between industrial refrigeration, commercial refrigeration and air conditioning installations, as it was not possible to disaggregate the consumption data between these sub-sectors because of the presence of intermediary wholesalers. The emissions are calculated on the basis of the assumption of 3% assembly losses, the annual losses (10.0% in 2010), the average equipment lifetime of 20 years and an end-of-life recovery rate of 50%. Emissions from domestic refrigeration have been estimated to be negligible. In fact, HFCs are very rarely used in domestic refrigeration. Furtheron there are very low quantities (< 100 g) used in these applications and the systems are always hermetically sealed. Moreover Luxembourg has a very efficient recycling technology for domestic refrigeration equipments (Superfreonskescht). Emissions from the manufacturing of refrigerators are based on figures provided by the only manufacturer and are very small (below 0.1 kt CO_2-eq "actual"). Emissions from cars have been calculated on the basis of a life-cylce approach and on the basis of the evolution of the national car fleet. Assumptions have been taken for the percentage of new cars equipped with air conditioning (96% in 2010), the average quantity of HFC 134a in a new car (0.61 kg in 2010), the percentage of annual losses (6.9% regular losses and 1.9% accidentally losses in 2010) and the annual refilling rate (3% in 2010). Moreover it is assumed that there is no dismantling of end-of-life cars in Luxembourg since all old cars are exported. Emissions from buses have been calculated on the basis of a life-cylce approach and on the basis of the evolution of the national bus fleet. Assumptions have been taken for the percentage of new buses equipped with air

Member States	Description of methods
	conditioning (100% in 2010), the average quantity of HFC 134a in a new bus (10.6 kg in 2010) and the percentage of annual losses (15% in 2010). Moreover it is assumed that there is no dismantling of end-of-life buses in Luxembourg since all old buses are exported. Emissions from transport refrigeration are calculated on the basis of the emissions reported by Germany (Schwarz, 2009) expressed per capita with the relative population in Luxembourg.
Netherlands	See General description of national methods used for estimating emissions from Consumption of halocarbons and SF_6.To comply with the IPCC Good Practice Guidance (IPCC, 2001) IPCC Tier 2 methods are used to estimate emissions of the sub-sources Stationary Refrigeration and Mobile air conditioning
Portugal	CFC, HCFC and F-Gases emissions from operation and disposal of Domestic Refrigeration Equipments, Commercial Refrigeration (non domestic Refrigeration Equipments), transport refrigeration equipments, Stationary and Industrial Air conditioning equipments and Mobile Air Conditioning were estimated using the bottom-up approach (Tier 2a or actual method) as proposed in chapter 3.7.4 of the GPG. F-Gases emissions for each particular compound were estimated from total Refrigeration Fluid emissions and considering the percentage of F-Gas use in total Refrigeration Fluid use in each year. The stock of domestic refrigeration equipments was estimated from the number of households and from the percentage of households with refrigeration equipments, available for years 1990, 1995 and 2000, according to an unpublished report from INE.From year 2000 onward the percentage of equipments per household was forecasted by APA based on gross domestic product behaviour. The number of households refers to INE-Family Survey. There are no available national statistics concerning the number and dimension of non-domestic refrigeration equipments used in commerce, industry, tourism, services and institutional activities. A survey to Hotels, Hostels and Camping Parks was conducted with the support of “Turismo de Portugal, ip” and “AHP – Associação da Hotelaria de Portugal”, in order to obtain real data concerning the number and dimension of non-domestic refrigeration equipments. Data pertaining to other commerce and services activities was estimated with the technical support of APIRAC, Importers and DGE (Enterprise and Industry General Directorate). Calculations for Hypermarkets were made separately. Estimates for Road Transportation and Railways were made separately. The number of light vehicles with MAC was estimated from the total number of light vehicles sold each year, using the same information used to establish the time series of car sales and fleet in chapter 1A3, and the percentage of new cars sold with MAC at each yearwas estimated according to data provided by manufacturers.
Spain	Para estos sectores se ha contado con información suministrada para algunos años por las asociaciones empresariales del frío y climatización y, por lo que respecta a su uso en la industria de automoción, con información obtenida vía cuestionario a las plantas de fabricación de automóviles. Para los equipos estacionarios de refrigeración y climatización, el equipo de trabajo del inventario ha extendido las tasas de variación interanual para completar los últimos años de la serie al no haberse podido disponer de otra información en esta edición del inventario. La información para el desglose según tamaños (pequeños o stand-alone y medios/grandes) de los equipos de refrigeración comercial, se ha tomado de un estudio sectorial sobre equipamiento de las superficies comerciales, clasificadas según tipología y tamaño, y que contenía datos sobre metros lineales de equipos de refrigeración. Los factores de emisión son, por lo que respecta a la producción nacional de automóviles, datos derivados de la información de cuestionarios a las plantas fabricantes, y para los demás sub-sectores se han tomado de las guías de IPCC.
Sweden	See also General description of national methods used for estimating emissions from Consumption of halocarbons and SF_6. Refrigeration and air conditioning equipment: Input data for the calculation of actual emissions consists of information from various sources. For heat pumps, air conditioning, mobile air conditioning, refrigeration and freezing equipment, the equipment producers and importers were contacted and have provided information of varying quality. Estimates have been checked with trade associations (KYS and SVEP) and with experts at the Swedish EPA (Ujfalusi, Bernekorn, Björsell). The information on refrigerant-related imported amounts of fluorinated gases from the Products register is compared to calculations made in the model, based on assumptions and information from other sources. A SMED study carried out in 2011 (Gustafsson T. 201. Fluorinated Greenhouse Gases in Sweden. Review of Methodology and Estimated Emissions Reported to the UNFCCC and the EU monitoring Mechanism) was based on contacts with the Swedish road vehicles manufacturers. Several factors were modified for MAC for 2010 onwards to be more in line with the present status of the Swedish road vehicle fleet.
United Kingdom	The calculation methodology within the model is considered to provide a relatively conservative approach to the estimation of emissions.The bank of fluid is estimated by considering the consumption of fluid in each sector, together with corrections for imports, exports, disposal and emissions.Once the size of the bank in a given year is known, the emission can be estimated by application of a suitable emission factor.Emissions are also estimated from the production stage of the equipment and during disposal.The methodology corresponds to the IPCC Tier 2 -'bottom-up'- approach.Data are available on the speciation of the fluids used in these applications; hence estimates were made of the global warming potential of each fluid category. Emissions from the domestic refrigeration sector were estimated based on a bottom-up approach using UK stock estimates of refrigerators, fridge-freezers, chest-freezers and upright freezers from the UK Market Transformation Programme (MTP, 2002). For the commercial and industrial refrigeration sub-sectors, emission estimates are now based on refrigerant fluid sales data, from the British Refrigeration Association. This allowed the previous estimates within the model to be verified against real data, and adjusted accordingly. Emissions of HFCs from mobile air conditioning systems were also derived based on a bottom-up analysis using UK vehicle statistics obtained from the UK Society of Motor Manufacturers and Traders, and emission factors determined in

Member States	Description of methods
	consultation with a range of stakeholders. A full account of the assumptions and data used to derive emission estimates for the MAC sub-sector is in AEAT (2004) and AEA (2008). The previous version of the refrigeration/air conditioning inventory model developed by AEA (2010) was updated by ICF International in the summer/autumn of 2011 based on revised industry input and a more transparent, robust Tier 2 modelling approach.

Source: NIR 2012 unless stated otherwise

Table 4.67 provides an overview of all sources reported under 2F9 Other by EU-15 Member States for the year 2010. The largest contributor to emissions is Germany with 60.2 %. Most Member States report emissions from double glaze windows in this source category.

Table 4.67 2F9 Other: Overview of sources reported under this source category for 2010

Member State	2.F.9 Other	HFC emissions [Gg CO_2 equivalents]	PFC emissions [Gg CO_2 equivalents]	SF_6 emissions [Gg]	Total emissions [Gg CO_2 equivalents]	Share in EU-15 Total
Austria	Double glaze windows, Research and other use	NA,NO	NA,NO	0.0102	244.7	5.9%
Belgium	Double glaze windows	NA,NO	NA,NO	0.0038	90.4	2.2%
Denmark	Double glaze windows, Laboratories, Fibre optics	4.2	6.3	0.0010	34.2	0.8%
Finland	Grouped confidential data	3.5	0.7	0.0010	27.4	0.7%
France	Shoes application, Closed application, Open application	NA,NO	192.5	NO	192.5	4.6%
Germany	Car Tyres, Shoes, Trace gas, Double glaze windows, Coating, AWACS maintenance, Optical Glass Fibre, Solar Technology, Welding	NA,NO	0.2	0.1043	2,492.2	60.2%
Greece	NA,NO	NA,NO	NA,NO	NO	-	0.0%
Ireland	Medical Applications, Tracer in Leak Detection, Double glaze windows, Sporting goods	NA,NO	NA,NO	0.0001	3.4	0.1%
Italy	NA,NO	NA,NO	NA,NO	NO	-	0.0%
Luxembourg	Noise reduction windows	NA,NO	NA,NO	0.0003	6.2	0.1%
Netherlands	No specific allocation due to confidentiality of data	224.5	NA,NO	0.0077	408.6	9.9%
Portugal	NA,NO	NA,NO	NA,NO	NO	-	0.0%
Spain	NA	NA	NA	NA	-	0.0%
Sweden	Shoes, Double glaze windows	NA,NO	NA,NO	0.0003	7.7	0.2%
UK	Semiconductors, Electrical and production of trainers, One Component Foams, Gibraltar F Gas Emissions	6.3	68.5	0.0234	634.1	15.3%
EU-15 Total		**238**	**268**	**0.1521**	**4,141**	**100.0%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.68 summarise information by Member State on emission trends, methodologies, emission factors and activity data for the key source SF_6 from 2F9 Other sources of SF_6. The emission trend is mainly driven by the emission trend in Germany.

Figure 21.22 2F9 Other: EU-15 SF_6 emissions

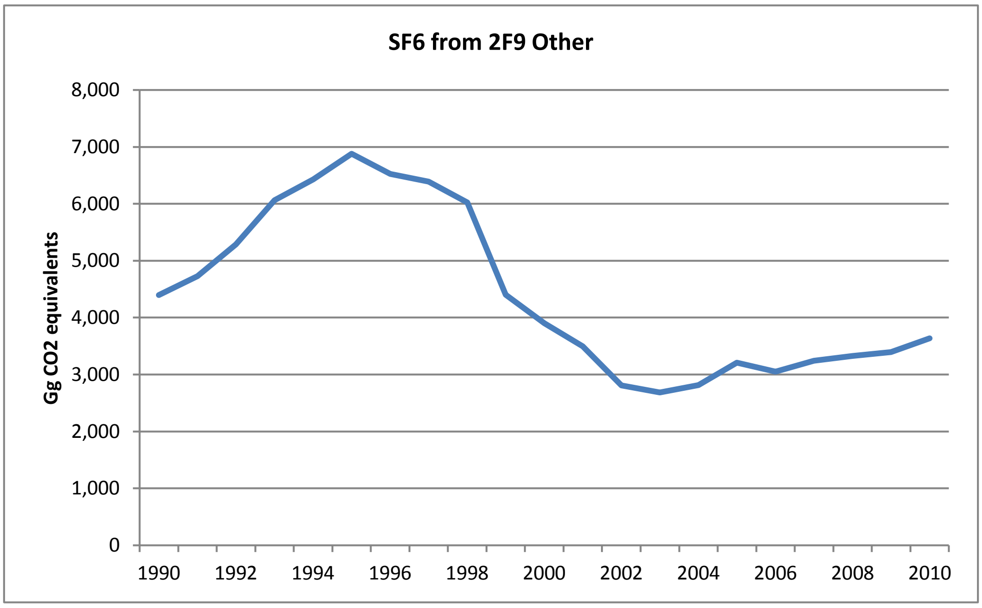


Table 4.68 2F9 Other: Member States' contributions to SF_6 emissions and information on method applied, activity data and emission factor

Member State	SF6 emissions (Gg CO2 equivalents)			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010	
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)
Austria	127	247	245	6.7%	-2	-1%	118	93%
Belgium	84	83	90	2.5%	7	8%	7	8%
Denmark	12	22	24	0.7%	2	9%	12	98%
Finland	8	29	23	0.6%	-5	-19%	15	194%
France	118	NO	NO	-	-	-	-118	-
Germany	3,211	2,244	2,492	68.6%	248	11%	-719	-22%
Greece	NO	NO	NO	-	-	-	-	-
Ireland	14	3	3	0.1%	0	1%	-10	-75%
Italy	NO	NO	NO	-	-	-	-	-
Luxembourg	1	6	6	0.2%	0	7%	6	976%
Netherlands	218	170	184	5.1%	14	8%	-34	-16%
Portugal	NE	NO	NO	-	-	-	-	-
Spain	NA	NA	NA	-	-	-	-	-
Sweden	2	8	8	0.2%	0	0%	5	211%
United Kingdom	604	583	559	15.4%	-24	-4%	-45	-7%
EU-15	**4,397**	**3,395**	**3,635**	**100.0%**	**239**	**7%**	**-763**	**-17%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.69 provide descriptions on methods used for estimating SF_6 emissions from 2F Consumption of Halocarbons and SF_6.

Table 4.69 2F6-2F9 Consumption of halocarbons and SF_6: Description of national methods used for estimating SF_6 emissions

Member States	Description of methods
Austria	Semiconductors: All consumption data and data about actual emissions from semiconductor manufacture are based on direct information from industry. Because of the confidentiality claimed for consumption data in this industry emissions are reported in the CRF only for the sum of HFC and PFC. Emissions are calculated according to the formula presented below: Emissions = Consumption*(1-emission control technology) * efficiency factor * uptime Typical ranges of these parameters are: for emission control technology 0.01 – 0.95, for efficiency factor 0.75-0.95, and for uptime 0.9. The emission control technology applied is high temperature combustion and elution of HF with typical efficiencies of 65-95% for latest years.. Electrical Equipment: Information on SF_6 stocks in electrical equipment in 2003-2007 was obtained from energy suppliers and industrial facilities. The EFop of HV- and MV-GIS correspond to the default emission factors of the IPCC GL 2006 with 0.7% (HV) and 0.1% (MV) per year, respectively. Manufacturing emissions from first filling were estimated to 1% according to reported data, the EFdisp is assumed to equal 2%. Noise insulating windows: Activity data were estimated based upon information from experts from industry. Approximately one-third of the total amount of SF_6 used for filling of the double glass windows is released during assembly. For the stock of gas remaining inside the window (bank), an annual leakage rate of 1 percent is assumed. At the end of the lifetime, about 75% of the initial stock remains and is lost by disposal. As of 2003, the Austrian F-gas regulation stopped by legal prohibition the usage of SF_6 as filling gas for soundproof glazing.. Emissions at disposal became relevant in 2005, because the average life time is estimated to be 25 years and the first SF_6 filled windows were introduced in Austria in 1980. They are calculated by assuming that the remaining quantity of SF_6 in windows produced in 1980 is emitted this year. Tyres: SF_6 used as filling gas for tyres was supplied by only one SF_6 importer, who reported on the amount of SF_6 sold to the Austrian tyre and automotive trade. Due to the Austrian F-gas regulation this use has been legally prohibited. According to IPCC GL 2006 it is assumed that SF_6 completely emits from car tyres with their disposal three years after filling. Filling emissions are regarded to be insignificant. Consumption of SF_6 and disposal emissions three years later are identical. Shoes: Shoes with F-gas cusions are not manufactured in Austria but imported. As no import data for Austria are available, 10% of the German market were taken for estimation, due to the comparability of the market and the size of the country. Operating emissions during the use of the footwear are not considered. The lifetime of shoes is estimated to be 3 years. At disposal, 100% of the initial filling is released to the atmosphere (i.e. EFdisp= 100%). Emissions of year 3 are treated to be equal to the amount of F-gas in sport shoes put on the market the year n-3. Research: Manufacturers and operators provided the number of devices operating in Austria. Data on filling volume and refilling have been collected from the institutions and companies operating the equipment, from manufacturers and from service companies. The annual F-gas consumption (first filling of new products) is very small (order of kg) and reached about 400 kg only during one year. The stock is for all years below 1 t. The implied EF is in the order of 6%, but there is a wide difference between the several types of equipment.
Belgium	The SF_6 emissions originating from the production and the stock of soundproof double-glazing are calculated from the SF_6 consumption data, which have been obtained from the main manufacturers. The stock of SF_6 contained in existing glazing in Belgium is evaluated on the basis of a balance between production, import and export of this glazing , as well as emissions from the stock, over the years. From information obtained from the double glazing producers we assessed a specific export rate for each of them. The import of acoustic double glazing was estimated to be around 10% of the Belgian consumption. The emission rate of glazing from the bank is assumed to be 1% /year, as previously. The emission from production of acoustic double glazing is assumed to be 33% of the SF_6 consumption. The disposal emissions are based on an assumed unique lifetime of 25 years. SF_6 emissons from the electricity sector are based on stock and emission factor data obtained from the SYNERGRID association.
Denmark	See also General description of national methods used for estimating emissions from Consumption of halocarbons and SF_6.
Finland	Electrical equipment (CRF 2.F. 8) Tier 3c (country-level mass-balance), Tier 1b Tier 1a estimates can not be calculated for this source because of lack of historical data. Tier 1b estimates have been calculated, however, based on survey and emissions data, cf. section 3.1 of Oinonen (2003). Running shoes (CRF 2.F. 9) Method for adiabatic property applications, Tier 1b Tier 1a is not applicable to this category because all SF_6 used is imported not in bulk, but in products (i.e. shoes). Emissions from this source are not reported separately due to confidentiality. The emissions from running shoes ended in 2007.
France	IPCC Tier 2. Fabrication de semi-conducteurs (2F7) : Les émissions de PFC, HFC-23 et SF_6 sont calculées selon la méthode de rang 2c du GIEC à partir des consommations de gaz déclarées par les sites. Equipements électriques (2F8) : La méthode de calcul distingue les émissions à la charge des équipements à l'usine selon les quantités déclarées par les industriels à leur syndicat et les émissions du parc installé estimées par EDF qui distingue les fuites à l'usage, la maintenance et la fin de vie.
Germany	Semiconductor manufacture: The emissions cannot be determined solely on the basis of input quantities (sales by gas vendors), because the difference between consumption and emissions depends on a number of factors, including only partial chemical transformation in plasma reactors and the effects of downstream exhaust-gas-

Member States	Description of methods
	scrubbing systems. Furthermore, a residue of approximately 10 % per gas bottle must be taken into account as non-consumption. During the etching process, only about 15 % of the added CF4 react chemically. The emission factor, an inverse reaction quota, thus amounts to 85 % of the CF4 consumption. Electrical equipment: The emissions figures are based largely on a mass balance. Increasingly, they are also being combined with emission factors for sub-areas in which the technical measurement limits for mass-balancing have been reached or in which mass-balancing would necessitate unreasonably high costs. The methods used are based on the new "2006 IPCC Guidelines for National Greenhouse Gas Inventories; Volume 3", Chapter 8. For further information, the reader is referred to "Tier 3, Hybrid Life-Cycle Approach" in sub-chapter 8.2. Noise insulating windows: The EF production is 33 %, with respect to new annual consumption. The emission factor Euse of 1 % with respect to the average SF_6 stocks that have accumulated since 1975 and that are in place in year n. Disposal losses are incurred at the end of windows' service lifetimes (utilization periods), or an average of 25 years after being filled. Tyres and Shoes: The emissions are calculated using equation 3.23 of IPCC-GPG (2000).
Greece	Electrical equipment The available information is not sufficient in order to apply the methodologies suggested by the IPCC Good Practice Guidance. In the context of the present inventory emissions are estimated on the basis of information provided by PPC regarding losses in the transmission and in the distribution system. The data provided cover the period 1995 – 2008. Emissions estimates are being performed on the basis of the quantity of SF_6 consumed during the year, by the Directorate of Strategy and Planning of the PPC. Emissions for the period 1990 – 1994 are estimated (by the inventory team) by mean of a linear extrapolation.
Ireland	Semiconductor manufacture: There are two main semiconductor manufacturers in Ireland, both of which provide data on the annual use and estimated emissions of HFCs, PFCs and SF_6 in their plants over the full time series 1990-2008 Electrical equipment: The Electricity Supply Board (ESB) is the owner of both the high and low voltage distribution systems and the owner and operator of the medium and lower voltage distribution systems in Ireland. The company has supplied an estimate of SF_6 emissions from their equipment using a Tier 1 approach based on an analysis of opening and closing stocks of SF_6. Other Emission Sources (2.F.9): This category includes emissions of SF_6 from minor uses within Ireland including emissions from double glazed windows, medical applications, sporting goods and as a gas-air tracer in leak detection. SF_6 emissions from Semiconductor Manufacture (2F7) have been revised for 2009 as a result of revised data supplied to the inventory agency by one of the installations in the this sector. Emissions of SF_6 from Semiconductor Manufacture for 2009 are reduced by 50.7 per cent as a result of this recalculation. SF_6 emissions from Windows/Soundproofing (2F7) have been revised for the timeseries 1990-2009. Double glazed windows were first introduced in Ireland in 1978, thus there is a bank of SF_6 in windows manufactured and installed prior to 1990 which will contribute to the emissions from leakage in the period 1990-2009. The net effect of this recalculation is an increase in SF_6 emissions for the sector of 25.4 per cent and 50.3 per cent in 1990 and 2009, respectively. Emissions of SF_6 from Sporting Goods (2F7) have been revised for 1998-2009 as a result of revised estimates submitted by the UK to the UNFCCC. UK emission estimates for this sector are used in conjunction with population estimates for the UK and Ireland to develop emission estimates for Ireland. Emissions of SF_6 from sporting goods in 2009 are reduced by 71.4 per cent as a result of this recalculation.
Italy	SF_6 emissions from electrical equipment have been estimated according to the IPCC Tier 2a approach from 1990 to 1994, and IPCC Tier 3c from 1995. SF_6 leaks from installed equipment have been estimated on the basis of the total amount of sulphur hexafluoride accumulated and average leakage rates; leakage data published in environmental reports have also been used for major electricity producers (ANIE, several years). Additional data on SF_6 used in high voltage gas insulated transmission lines have been supplied by the main energy distribution companies.
Luxembourg	F7 – Electrical Equipment - A country specific methodology is applied: Emissions= EF● AR The activity rate (AR) is based on the installed capacity with the total nameplate capacity from the largest operator (CREOS) in Luxembourg (80% coverage). The yearly emissions are assumed to vary between 0.1 and 0.9% depending on the type of switchgear according to the EF's applied in Germany.
Netherlands	See General description of national methods used for estimating emissions from Consumption of halocarbons and SF_6.
Portugal	SF_6 emissions from electrical equipment: different estimates methodologies for electricity distribution at: (a) Very High Voltage (>110 kV): a methodology based on "Correspondent States Principle" was used (b) distribution at Low (≤1 kV), Medium (>1 kV and ≤45 kV) and High Voltage (>45 kV and ≤110 kV): estimated with a tier T3b, based on data provided by "EDP Distribuição", excluding the details in life-cycle and using a country-specific emission factor. Separate estimates were made for Gas Circuit Breakers; Outdoor Gas Insulated Switchgears; Gas Insulated Switchgears; High and Medium Voltage Sectioning Posts;
Spain	Tier 2. Category 2F8 includes the SF_6 emissions from electrical equipment. In the case of Spain, this is the only source generating emissions of this gas. De una forma general, las emisiones se pueden generar en cada uno de los siguientes puntos del ciclo de vida de los equipos eléctricos que incorporan SF_6 como aislante: 1) En la fase de fabricación del equipo (lo que incluye las operaciones de prueba y la carga de los equipos).

Member States	Description of methods
	2) Durante la instalación en el lugar de funcionamiento del equipo. 3) Durante la fase de funcionamiento del equipo. 4) En la retirada de funcionamiento del equipo. Estos cuatro puntos o fases del ciclo vida que dan origen a las emisiones se corresponden con los respectivos cuatro términos que figuran en el segundo miembro de la ecuación siguiente, y que es la trascripción de la Ecuación 3.16 de la Guía de Buenas Prácticas de IPCC correspondiente al método de nivel 2a, que es el que se ha adoptado para la estimación de las emisiones de esta actividad: ET = EF + EI + EO + ERdonde: ET = Emisiones totales; EF = Emisiones en fabricación; EI = Emisiones en instalación; EO = Emisiones en operación de los equipos; ER = Emisiones en la retirada de los equipos
Sweden	Semiconductor manufacture: Information concerning the annually used amounts of various fluorinated substances has been provided by the company, and as far as possible been compared to information from the Products register at the Swedish Chemicals Agency. Emissions are calculated by using the IPCC Good practice Guidance Tier 1 method. Electrical equipment: The SF_6 emissions from production have decreased in later years due to measures taken at the production facility. These estimates, obtained from industry, are of medium to high quality, with better quality in later years. For the early 1990s, assumptions on the emitted amounts of SF_6 from GIS manufacture were made in cooperation with industry. Industry has also provided information concerning the used amount of SF_6 for GIS manufacture, as well as the share of products that are exported from the country, which exceeds 90 % of the production. Emissions from installed amounts of SF_6 for insulation purposes in operating systems have previously contributed less to the actual annual emissions. In 2001- 2002, a questionnaire was sent out to power companies from the trade association Swedenergy102 (Svensk Energi) asking for the installed amounts of SF_6 in operating equipment, and the replaced amounts of SF_6 during service. The results showed an installed accumulated amount of approximately 80 Mg and an annual leakage rate of 0.6 % (equals the amount replaced from the questionnaire) and these were used as input data in the inventory. For later years, data on replaced amounts of SF_6 in operating systems results in a calculated annual leakage rate of 0.5 % (Swedenergy and power distribution companies). For jogging shoes, a more or less rough estimate has been made. It has not been possible to obtain any national data, so a Norwegian estimate was scaled to the Swedish population. According to the results from a study performed in early 2004 a phasing out of SF_6 and replacement with PFC-218 was started in 2003. Manufacturers of windows have provided data on the amount of SF_6 used in the manufacture of barrier gas windows. The manufacturers have also provided estimates of the share of SF_6 emitted in production. These estimates vary considerably between manufacturers, from 5-50%. Calculating a weighted average of the emission factor at production results in a national figure in the order of 30%, which is in line with the point estimate of 33% given in the IPCC Good Practice Guidance.
United Kingdom	Emissions of SF_6 from semiconductor manufacturing and from electrical equipment are combined with emissions from training shoes in source category 2F8b for reasons of commercial confidentiality. SF_6 emission from electrical transmission and distribution were based on industry data from BEAMA (for equipment manufacturers) and the Electricity Association (for electricity transmission and distribution), who provided emission estimates based on Tier 3b, but only for recent years. Tier 3a estimates were available for the electricity distribution and transmission industry for 1995. In order to estimate a historical time series and projections, these emission estimates together with fluid bank estimates provided by the utilities were extrapolated using the March study methodology (March, 1999).This involved estimating leakage factors based on the collected data and using the March model to estimate the time series. Emissions prior to 1995 used the March SF_6 consumption data to extrapolate backwards to 1990 from the 1995 estimates. Emissions of PFC and SF_6 emissions from electronics are based on data supplied by UK MEAC – the UK Microelectronics Environmental Advisory Committee.UK MEAC gave total PFC consumption for the UK electronics sector based on purchases of PFCs as reported by individual companies. Emissions were then calculated using the IPCC Tier 1 methodology, which subtracts the amount of gas left in the shipping container (10%), the amount converted to other products (between 20% and 80% depending on the gas) and the amount removed by abatement (currently assumed to be zero).Emissions for previous years were extrapolated backwards assuming an annual 15% growth in the production of semiconductors in the UK up until 1999.

Source: NIR 2012 unless stated otherwise

Table 4.70 summarizes the recommendations from the latest UNFCCC review of the inventory report in relation to the category 2F Consumption of Halocarbons. The overview shows that some recommendations have been implemented.

Table 4.70 2F Consumption of halocarbons and SF_6: Findings of the latest UNFCCC review of the inventory report and responses in 2011 inventory submissions

Member State	Review findings and responses related to 2.F. Consumption of halocarbons and SF_6	
	Comment in the latest UNFCCC review report	Status in 2012 submission
Austria	No 2011 review report available at the time of the compilation of this NIR	

Member State	Review findings and responses related to 2.F. Consumption of halocarbons and SF_6	
	Comment in the latest UNFCCC review report	Status in 2012 submission
Belgium	The ERT highlighted this issue as a potential problem during the review and recommended that Belgium provide estimates of HFC emissions from commercial refrigeration equipment by applying the default data provided in the IPCC good practice guidance. The ERT recommends that Belgium include this information in the NIR of the next annual submission and revise the notation key used in CRF table 2(II) accordingly. The ERT recommends that the Party justify, in the next annual submission, the applicability of the EFs to the whole time series and make appropriate updates in order to maintain time-series consistency, supported by appropriate documentation in the NIR.	Resolved, BE NIR 2012, p.97 Resolved, BE NIR 2012, p.110 Not resolved.
Denmark	However, the ERT recommends that Denmark be more transparent and provide the rationale for this determination in the NIR of its next annual submission. The ERT welcomes the improvements in the estimates for the later years of the time series and recommends that the Party recalculate the full time series for the next annual submission, if additional errors are identified through the intended QC process. The ERT reiterates these recommendations: with respect to QA/QC, the ERT continues to recommend that Denmark develop QA/QC procedures for the F-gas emission calculations; While, regarding transparency, the ERT reiterates previous recommendations that the Party improve the documentation of methods and assumptions for the F-gas model in the NIR, recognizing that not all model documentation needs to be included for transparency.	Described in NIR 2012 (general methodology) improved in 2012 NIR Not resolved Partly resolved in 2012 NIR Improved in 2012 NIR
Finland	The ERT recommends that the improvement of the time-series consistency for SF_6 emissions from electrical equipment be implemented, as planned by Finland for its 2013 annual submission The ERT recommends that Finland, in the next annual submission, include information on the status of the effort to ensure time-series consistency, with a view to implementing it in the 2013 annual submission. Improve the time-series consistency of the estimates of SF_6 emissions from electrical equipment	Not resolved Not resolved Not resolved
France	No 2011 review report available at the time of the compilation of this NIR	
Germany	No 2011 review report available at the time of the compilation of this NIR.	
Greece	HFC emissions from foam blowing are estimated with reference only to emissions from hard foam production. In response to a question raised by the ERT during the review on imported foams containing HFCs, the Party explained that the national foam market is mainly covered by the products produced in Greece. Furthermore, the Party informed the ERT that, among the companies producing foams, only one company reports on the import of extruded polystyrene foams and emissions from these products have already been taken into account in the Party's calculations. The other companies' production is concentrated only on the import of products that do not contain HFCs. The ERT notes that the information on HFC emissions from imported foams is not reflected in the NIR and recommends that Greece include a transparent explanation on the assumptions, methodologies, AD and EFs used to estimate HFC emissions from foam blowing in the next annual submission. The ERT also notes that the import of foams containing HFCs can be	Not resolved Not resolved Not resolved

Member State	Review findings and responses related to 2.F. Consumption of halocarbons and SF_6	
	Comment in the latest UNFCCC review report	**Status in 2012 submission**
	covered not only by companies producing foams and recommends that the Party further investigate the import of HFC-containing foam products in Greece for the next annual submission. Emissions of SF_6 from electrical equipment are reported in CRF table 2(II), but there are no further details provided in CRF table 2(II).F. The ERT noted that, although there is no manufacturer of switchgear equipment in Greece, there are emissions from installation losses for high-voltage switchgear used in the country, which should preferably be reported under emissions from manufacturing. The ERT recommends that Greece complete its reporting of these emissions in CRF table 2(II).F in order to improve transparency.	
Ireland	No 2011 review report available at the time of the compilation of this NIR	
	The ERT noted that Ireland is not presenting transparent information on the time series of AD and EFs for each category separately as appropriate. The ERT considers that the aggregated approach adopted by Ireland impairs transparency, and recommends that the Party increase the level of disaggregation of the information in its next annual submission by providing additional information for this sector.	Not resolved
	The ERT noted that in CRF table 2(II).F the Party appears to have inconsistently used the notation key for included elsewhere ("IE") and the notation key "NA" to report AD and the corresponding estimates of emissions of HFCs from refrigeration and airconditioning equipment: estimated emissions from manufacturing and from disposal for commercial refrigeration are reported as "IE" and included under "stock", and AD are reported as "NA". The Party explained to the ERT during the review that the use of a bottom-up approach is not appropriate for estimating actual emissions from stationary refrigeration and air conditioning in Ireland, owing to the lack of data available on equipment types and sales of HFCs for each equipment subcategory. Emissions are therefore estimated using a top-down approach based on reported sales data and information on market shares. These are used to allocate the estimates of total HFC sales between stationary refrigeration and air conditioning. Therefore, Ireland is not in a position to provide AD but only estimates of actual emissions from stocks. The ERT recommends that Ireland investigate this matter further for its next annual submission and improve the transparency of its reporting by reviewing its use of the notation keys for this category.	Not resolved – no changes to CRF in 2012 submission
	The ERT also recommends that the Party provide more information on the share of new vehicles equipped with air conditioning (the NIR states that 75 per cent of new or imported vehicles are equipped with air conditioning) and the average filling amount (0.8 kg for private cars and 1.2 kg for commercial vehicles) of new vehicles that were used to estimate emissions for this category.	Not resolved
Italy	No 2011 review report available at the time of the compilation of this NIR.	
Luxembourg	The ERT recommends that Luxembourg provide a description of the trend in the NIR and maintain the time-series consistency of these categories in accordance with the IPCC good practice guidance.	Not resolved
	The ERT reiterates the recommendation from the previous review report that Luxembourg make efforts to collect and use country-specific data in the calculation of HFC emissions for the entire time series.	Not resolved
	ERT recommends that Luxembourg provide this information in the NIR and in the relevant CRF tables in its next annual submission.	Resolved
	The ERT recommends that Luxembourg make efforts to collect and use country-specific data in the calculation of HFC emissions for the entire time series.	Not resolved
Netherlands	The ERT recommends that the Netherlands calculate potential emissions of all ODS substitutes according to the tier 1 method contained in the IPCC good practice guidance. This calculation method will contribute to the completeness of the inventory and to the transparency and comparability of the emissions.	Not resolved
	The ERT recommends that the Netherlands report the SF_6 emissions under semiconductor manufacture instead of under the sub-category other for	Not resolved

Member State	Review findings and responses related to 2.F. Consumption of halocarbons and SF_6	
	Comment in the latest UNFCCC review report	Status in 2012 submission
	transparency reasons. Correctly estimate emissions from all ODS substitutes (HFCs, PFCs and SF_6 from aerosols and metered dose inhalers; solvent uses; foam; stationary refrigeration; mobile air conditioning; fire protection; and other applications.) If a tier 1 method is required then the IPCC tier 1 method should be correctly implemented;	Not resolved
Portugal	No 2011 review report available at the time of the compilation of this NIR.	
Spain	No 2011 review report available at the time of the compilation of this NIR.	
Sweden	No 2011 review report available at the time of the compilation of this NIR.	
UK	The ERT recommends that the United Kingdom enhance the transparency and comparability of its reporting by including a table with EFs (product manufacturing factors, product life factors (PLFs) and disposal loss factors) by application over time in its next annual submission. In addition, the ERT recommends that the United Kingdom check the model used for calculating emissions from refrigeration and the AD, emissions and PLFs reported in the CRF sectoral background data table 2(II).F for refrigeration, and correct them if necessary.	improved in 2012 NIR

Sources: Review Report 2011 unless stated otherwise; NIR 2012 unless stated otherwise

4.2.6 Other (CRF Source Category 2G) (EU-15)

Table 4.71 shows that only three Member States reports GHG emissions under 2G Other for the year 2009. The Netherlands include CO_2, CH_4 and N_2O emissions from fireworks and candles, degassing drinking water from groundwater and process emissions in other economic sectors; Germany reports due to confidentiality reasons aggregated SF_6 emissions from shoes, AWACS maintenance and welding; and Denmark include CO_2 emissions from lubricants in this category.

Table 4.71 2G Other: Overview of sources reported under this source category for 2009

Member State	2.G Other	CO_2 emissions [Gg]	CH_4 emissions [Gg]	N_2O emissions [Gg]	HFC emissions [Gg CO_2 equivalents]	PFC emissions [Gg CO_2 equivalents]	SF_6 emissions [Gg]	Total emissions [Gg CO2 equivalents]	Share in EU-15 Total
Austria	NA	NA	NA	NA	NA	NA	NA	-	0.0%
Belgium	NA,NE	NA	NA	NA	NA	NA	NA	-	0.0%
Denmark	Lubricants	33.2	NA	NA	NA	NA	NA	33.2	5.7%
Finland	NA	NA	NA	NA	NA	NA	NA	-	0.0%
France	NA,NO	NO	NO	NO	NA,NO	NO	NO	-	0.0%
Germany	Other non-specified Confidential SF6-emissions of the use in AWACs, Sport shoes and for Welding are reported in "Unspecified mix of HFCs" to keep confidentiality of these data.	NO	NO	NO	186.2	IE,NA,NO	IE	186	32.2%
Greece	NA,NO	NO	NO	NO	NA,NO	NO	NO	-	0.0%
Ireland	NA,NO	NO	NO	NO	NA,NO	NA,NO	NO	-	0.0%
Italy	NA	NA	NA	NA	1.7	NA,NO	NO	1.7	0.3%
Luxembourg	NA	NA	NA	NA	NA	NA	NA	-	0.0%
Netherlands	Fireworks and candles, Degassing drinkwater from groundwater, Process emissions in other economic sectors	310.1	1.7	0.04	NA,NO	NA,NO	NO	357	61.8%
Portugal	NA,NO	NO	NO	NO	NA,NO	NA,NO	NO	-	0.0%
Spain	NA	NA	NA	NA	NA	NA	NA	-	0.0%
Sweden	NA	NO	NO	NO	NA,NO	NA,NO	NO	-	0.0%
UK	NA	NA	NA	NA	NA	NA	NA	-	0.0%
EU-15 Total		**343**	**2**	**0**	**188**	**0**	**-**	**578**	**100.0%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

4.3 Methodological issues and uncertainties (EU-15)

The previous section presented for each EU-15 key source in CRF Sector 2 an overview of the Member States' contributions to the key source in terms of level and trend, information on methodologies, emission factors, completeness and qualitative uncertainty estimates. Detailed information on national methods and circumstances is available in the Member States' national inventory reports.

Table 4.72 shows the total EU-15 uncertainty estimates for the sector 'Industrial processes' and the uncertainty estimates for the relevant gases of each source category. The highest level uncertainty was estimated for CH_4 from 2A (83 %) and the lowest for N20 from 2A (0 %). With regard to trend HFC from 2F shows the highest uncertainty estimates, CO_2 and N_2O from 2A and CO_2 from 2C the lowest. For a description of the Tier 1 uncertainty analysis carried out for the EU-15 see Chapter 1.7.

Table 4.72 Sector 2 Industrial processes: Uncertainty estimates for the EU-15

Source category	Gas	Emissions 1990	Emissions 2010	Emission trends 1990-2010	Level uncertainty estimates based on MS uncertainty estimates	Trend uncertainty estimates based on MS uncertainty estimates
2.A Mineral Products	CO_2	109,221	89,417	-18%	3%	0.0%
2.A Mineral Products	CH_4	24	7	-71%	83%	0.8%
2.A Mineral Products	N_2O	0	0		0%	0.0%
2.B Chemical Industry	CO_2	31,324	32,674	4%	7%	0.0%
2.B Chemical Industry	CH_4	186	100	-46%	24%	0.1%
2.B Chemical Industry	N_2O	99,006	13,247	-87%	26%	0.1%
2.C Metal Production	CO_2	52,260	41,486	-21%	5%	0.0%
2.C Metal Production	CH_4	135	91	-33%	34%	0.2%
2.C Metal Production	N_2O	39	24	-38%	75%	0.2%
2.C Metal Production	HFC	0	0		0%	
2.C Metal Production	PFC	6,716	468	-93%	15%	0.1%
2.C Metal Production	SF_6	474	159	-67%	26%	0.1%
2.D Other Production	CO_2	5	2	-63%	18%	0.1%
2.D Other Production	CH_4	5	6	25%	21%	0.1%
2.D Other Production	N_2O	66	83	25%	21%	0.1%
2.E Production of Halocarbons and SF_6	CO_2	0	0		0%	0.0%
2.E Production of Halocarbons and SF_6	CH_4	0	0		0%	0.0%
2.E Production of Halocarbons and SF_6	N_2O	0	0		0%	0.0%
2.E Production of Halocarbons and SF_6	HFC	11,695	876	-93%	15%	0.1%
2.E Production of Halocarbons and SF_6	PFC	1,753	77	-96%	32%	0.2%
2.E Production of Halocarbons and SF_6	SF_6	1,846	90	-95%	10%	0.2%
2.F Consumption of Halocarbons and SF_6	CO_2	0	0		0%	0.0%

2.F Consumption of Halocarbons and SF_6	CH_4	0	0		0%	0.0%
2.F Consumption of Halocarbons and SF_6	N_2O	0	0		0%	0.0%
2.F Consumption of Halocarbons and SF_6	HFC	3,782	57,231	1413%	39%	2.7%
2.F Consumption of Halocarbons and SF_6	PFC	385	772	101%	25%	0.3%
2.F Consumption of Halocarbons and SF_6	SF_6	7,758	3,977	-49%	8%	0.0%
2.G Other	CO_2	354	372	5%	19%	0.0%
2.G Other	CH_4	297	291	-2%	51%	0.0%
2.G Other	N_2O	3	11	273%	71%	1.9%
2 (werhe no subsector data were submitted)	*all*	*19,780*	*18,600*	-6%	*16%*	*2%*
Total - 2	**all**	**347,115**	**260,061**	-25%	**8.8%**	**3.9%**

Note: *Emissions are in Gg CO_2 equivalents; trend uncertainty is presented as percentage points; the sum of the source category emissions may not be the total sector emissions because uncertainty estimates are not available for all source categories; uncertainty estimates for Portugal are not included.*

4.4 Sector-specific quality assurance and quality control (EU-15)

There are two main activities for improving the quality of GHG emissions from industrial processes: (1) Before and during the compilation of the EU GHG inventory several checks are made of the Member States data in particular for time series consistency of emissions and implied emission factors, comparisons of implied emission factors across Member States and checks of internal consistency. (2) In the second half of the year the EU internal review is carried out for selected source categories. In 2006 the following source categories have been reviewed by Member States experts: 2A Mineral Products, 2B Chemical Industry, 2C Iron and Steel Production and Fluorinated Gases, 2E Production of Halocarbons and SF_6 and 2F Consumption of Halocarbons and SF_6. In 2008, completeness and allocation issues have been reviewed by Member States experts for all source categories in Industrial Processes.

For the inventory 2005 for the first time plant-specific data was available from the EU Emission Trading Scheme (EU ETS). This information has been used by EU Member States for quality checks and as input for calculating total CO_2 emissions for the sectors Energy and Industrial Processes in this report (see Section 1.4.2).

4.5 Sector-specific recalculations (EU-15)

Table 4.73shows that in the industrial processes sector the largest recalculations in absolute terms were made for CO_2 and HFCs in 1990 and 2009.

Table 4.73 Sector 2 Industrial processes: Recalculations of total GHG emissions and recalculations of GHG emissions for 1990 and 2009 by gas (Gg CO_2 equivalents) and percentage)

1990	CO_2		CH_4		N_2O		HFCs		PFCs		SF_6	
	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent
Total emissions and removals	65,596	2.1%	-15,455	-3.4%	-3,212	-0.8%	-224	-0.8%	499	3.0%	-142	-1.3%
Industrial Processes	315	0.2%	-76	-8.6%	-49	0.0%	-224	-0.8%	499	3.0%	-142	-1.3%
2009												
Total emissions and removals	94,276	3.4%	-5,030	-1.6%	-2,289	-0.8%	3,203	4.9%	795	40.8%	-219	-3.6%
Industrial Processes	2,455	1.6%	6	1.1%	214	0.9%	3,203	4.9%	795	40.8%	-219	-3.6%

Table 4.74 provides an overview of Member States' contributions to EU-15 recalculations.

Table 4.74 Sector 2 Industrial processes: Contribution of Member States to EU-15 recalculations for 1990 and 2009 by gas (difference between latest submission and previous submission Gg of CO_2 equivalents)

	1990						2009					
	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
Austria	-3	0	0	0	0	0	159	0	0	1	0	0
Belgium	23	0	0	-443	0	0	672	3	0	-32	-9	0
Denmark	0	0	0	NA,NE,NO	NA,NE,NO	0	0	0	0	0	0	0
Finland	29	0	0	0	0	0	93	0	0	0	0	0
France	6	-76	0	-4	0	0	-503	4	0	-587	0	-20
Germany	47	0	0	224	-80	-143	1,848	0	2	176	-73	-163
Greece	27	0	0	0	-100	0	273	0	0	787	34	0
Ireland	0	0	0	1	0	0	0	0	0	20	0	-27
Italy	38	0	0	0	679	0	96	-1	0	-9	845	0
Luxembourg	0	0	0	-2	NA,NO	0	0	0	0	0	0	0
Netherlands	1	0	0	0	0	1	29	-1	46	-21	0	-5
Portugal	11	0	-49	NE,NO	NE	0	89	0	166	40	0	-1
Spain	0	0	0	0	0	0	-72	0	0	-141	0	0
Sweden	11	0	0	0	0	0	44	0	0	-63	0	-2
UK	124	0	0	0	0	0	-273	0	0	3,032	-3	0
EU-15	**315**	**-76**	**-49**	**-224**	**499**	**-142**	**2,455**	**6**	**214**	**3,203**	**795**	**-219**

5 Solvent and other product use (CRF Sector 3)

This chapter provides sections on emission trends, methods and on recalculations in CRF Sector 3 Solvent and Other Product Use. In response to the UNFCCC review findings this report for the second time includes more detailed descriptions of methods used by Member States.

The use of solvents manufactured using fossil fuels as feedstock can lead to evaporative emissions of various non-methane volatile organic compounds (NMVOC), which are subsequently further oxidised in the atmosphere. Fossil fuels used as solvent are notably white spirit and kerosene (paraffin oil). White spirit is used as an extraction solvent, as a cleaning solvent, as a degreasing solvent and as a solvent in aerosols, paints, wood preservatives, lacquers, varnishes and asphalt products. White spirit is the most widely used solvent in the paint industry.

A comprehensive methodology for estimating NMVOC emission for all sources is provided neither in the IPCC guidelines nor in the EMEP/EEA Air pollutant emission inventory guidebook 2009. The current methodology for estimating NMVOC from solvents determinates comparability between countries, shows lack in transparency and uncertainty quantification.28

The EMEP/EEA Air pollutant emission inventory guidebook 2009 is structured according to the Nomenclature for Reporting (NFR), which is the reporting format of the Guidelines for Reporting Emission Data under the Convention on Long-range Transboundary Air Pollution (LRTAP). This nomenclature closely resembles the IPCC source nomenclature developed for reporting under the UN Framework Climate Change Convention. Cross-referencing to the Selected Nomenclature for reporting of Air Pollutants (SNAP) 97 developed by the EEA's European Topic Centre (ETC/AE) is presented in the following overview.

CRF	SNAP	Description	CRF	SNAP	Description
3 A	0601	Paint application	3 B	0602	Degreasing, dry cleaning and electronics
	060101	Paint application: manufacture of automobiles		060201	Metal degreasing
	060102	Paint application: car repairing		060202	Dry cleaning
	060103	Paint application: construction and buildings		060203	Electronic components manufacturing
	060104	Paint application: domestic use (except 060107)		060204	Other industrial cleaning
	060105	Paint application: coil coating	3 D	0604	Other use of solvents and related activities
	060106	Paint application: boat building		060401	Glass wool enduction
	060107	Paint application: wood		060402	Mineral wool enduction
	060108	Other industrial paint application		060403	Printing industry
	060109	Other non industrial paint application		060404	Fat, edible and non edible oil extraction
3 C	0603	Chemical products manufacturing or processing		060405	Application of glues and adhesives
	060301	Polyester processing		060406	Preservation of wood

28 See http://www.tfeip-secretariat.org/MeetingReport_CI_Workshop_17Feb2010_final.pdf

	060302	Polyvinylchloride processing		060407	Underseal treatment and conservation of vehicles
	060303	Polyurethane processing		060408	Domestic solvent use (other than paint applicat.)
	060304	Polystyrene foam processing		060409	Vehicles dewaxing
	060305	Rubber processing		060411	Domestic use of pharmaceutical products
	060306	Pharmaceutical products manufacturing		060412	Other (preservation of seeds,...)
	060307	Paints manufacturing		0605	Use of HFC, N_2O, NH_3, PFC and SF_6
	060308	Inks manufacturing		060501	Anaesthesia
	060309	Glues manufacturing		060505	Fire extinguishers
	060310	Asphalt blowing		060506	Aerosol cans
	060311	Adhesive, magnetic tapes, films &photographs		060508	Other
	060312	Textile finishing	NOT included in this sector		
	060313	Leather tanning	2 F 1	060502	Refrigeration and air conditioning equipments
	060314	Other	2 G	060503	Refrigeration and air conditioning equipments using other products than halocarbons
			2 F 2	060504	Foam blowing (except 060304)
			2 F 6	060507	Electrical equipments (except 060203)

5.1 Overview of sector (EU-15)

CRF Sector 3 Solvent and Other Product Use contributes 0.19 % to the total EU-15 GHG emissions in 2010 (Table 5.4). The EU-15 Member states jointly achieved an emissions reduction of about 33 % from 13.5 Tg in 1990 to 9.6 Tg in 2010 (Figure 5.1 and Table 5.1).

As it is shown in Table 5.1 and Figure 5.2, in the period 1990 to 2010 an emission reduction in this sector could be achieved by

- Germany (2 594 Gg CO_2eq; -57 %);
- France (840 Gg CO_2eq; -41 %);
- The Netherlands (371 Gg CO_2eq; -68 %);
- Italy (797 Gg CO_2eq; -32 %);
- Austria, Finland, Denmark, Sweden, Luxembourg, Ireland and Portugal (together 449 Gg CO_2eq; -29 %).

The Member State with the high increase in emissions in this sector is Spain with 1129.2 Gg CO_2eq (+62 %) from 1990 to 2010. The GHG emission of the Member States Belgium and Greece increased slightly (together 8.4 Gg CO_2eq; 1.6 %) in the same period.

Figure 5.1 **Sector 3 Solvent and Other Product Use: EU-15 GHG emissions for 1990–2010 in CO_2 equivalents (Tg)**

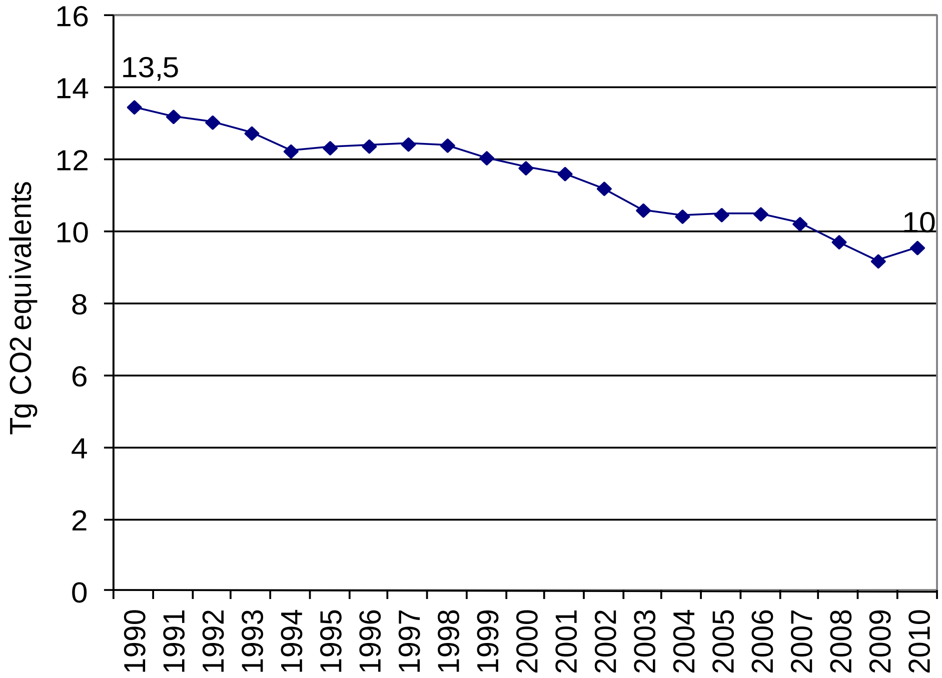
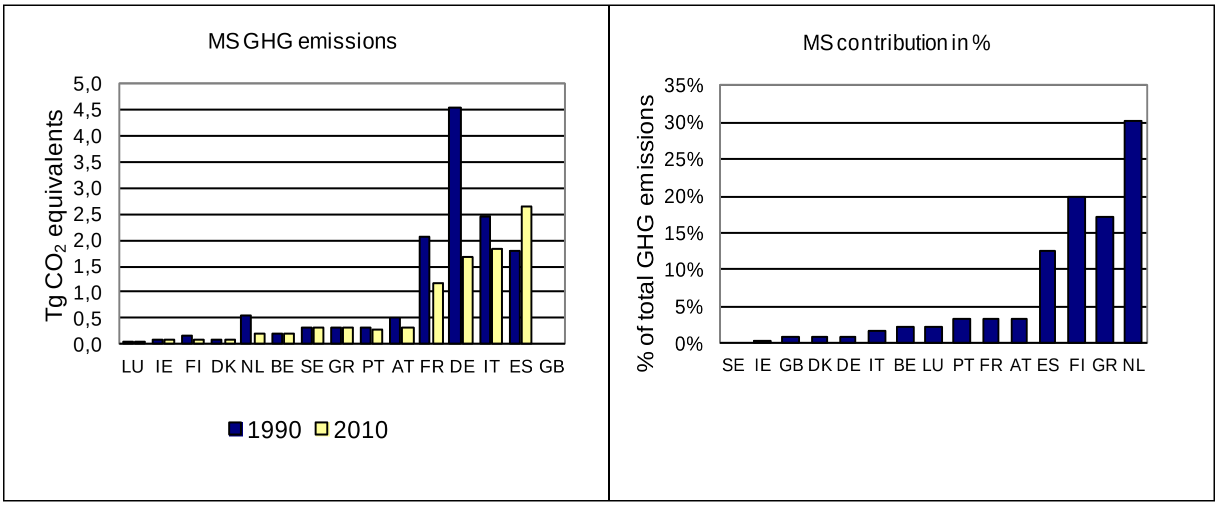


Figure 5.2 **Sector 3 Solvent and Other Product Use: GHG emissions of EU-15 MS for 1990 and 2010 as well as Member States' contributions to GHG emissions for 2010 in percentage**



In 2010, the emissions decreased by 5 % compared to 2009 (Table 5.1). In this period the highest emission reduction in absolute terms was achieved by Italy (-156 Gg CO_2eq; -8,6 %), Portugal (-44.2 Gg CO_2eq; -16,2 %) and Netherlands (-32.9 Gg CO_2eq; -16,2 %). The emissions increased in the Member States Austria (28 Gg CO_2eq; 9.3 %), France (39.4 Gg CO_2eq; 3.3 %), Germany (257 Gg CO_2eq; 15.26 %) and Spain (289 Gg CO_2eq; 10.9 %). In Finland and Greece a slight increase compared to 2009 could be noted (together 40 Gg CO_2eq).

As it is shown in Table 5.1 the Member States Spain, France, Germany and Italy are jointly responsible for 80 % of the total EU-15 GHG emissions in this sector in 2010. The remaining 20 % of GHG emissions of this sector emanate in 2010 from all other EU-15 Member States.

Table 5.1 Sector 3 Solvent and Other Product Use: Member States' contributions to GHG emissions

Member State	Greenhouse gas emissions (Gg CO2 equivalents)			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010	
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)
Austria	512	299	327	3,4%	28,0	9,3%	-184,7	-36%
Belgium	213	214	214	2,2%	0,0	0,0%	0,6	0%
Denmark	93	82	76	0,8%	-5,9	-7,2%	-16,9	-18%
Finland	178	72	73	0,8%	1,2	1,6%	-104,9	-59%
France	2.065	1.185	1.224	12,6%	39,4	3,3%	-840,6	-41%
Germany	4.539	1.688	1.944	20,0%	256,6	15,2%	-2.594,1	-57%
Greece	308	316	316	3,2%	0,6	0,2%	7,8	3%
Ireland	80	72	72	0,7%	-0,2	-0,3%	-8,4	-11%
Italy	2.455	1.815	1.658	17,0%	-156,4	-8,6%	-796,8	-32%
Luxembourg	24	16	14	0,1%	-1,8	-11,0%	-9,6	-40%
Netherlands	541	203	170	1,8%	-32,9	-16,2%	-370,7	-68%
Portugal	332	272	228	2,3%	-44,2	-16,2%	-103,9	-31%
Spain	1.809	2.650	2.938	30,2%	288,6	10,9%	1.129,2	62%
Sweden	332	311	311	3,2%	0,0	0,0%	-21,4	-6%
United Kingdom	NE	NE	0	0,0%	0,0	-	0,0	-
EU-15	**13.482**	**10.233**	**9.728**	**100,0%**	**-504**	**-4,9%**	**-3.753,93**	**-28%**

This sector does not contain a key source.

In the Sector 3 Solvent and Other Product Use in addition to CO_2 emission NMVOC and N_2O emission are identified. The most important GHG from Solvent and Other Product Use is CO_2. In 2010 the CO_2 emissions have a share of 0.19 % of the 'Total EU-15 CO_2 Emissions and Removals' and a share of 0.15 % of the 'Total EU-15 GHG emissions' (Table 5.2). In 2010 the N_2O emissions have a share of 1.38 % of the 'Total EU-15 N_2O emissions' and a share of 0.10 % of the 'Total EU-15 GHG emissions' (Table 5.3).

Table 5.2 Sector 3 Solvent and Other Product Use: EU-15 CO_2 emissions as well as their share

	Unit	1990	2010
CO2 emission in 'Solvent and Other Product Use'	[Gg]	8.748	5.854
Total GHG emission in 'Solvent and Other Product Use'	[Gg CO_2 eq]	13.482	9.568,0
Share of CO2 emission in Total GHG in 'Solvent and Other Product Use'		*65%*	*61%*
Total National CO2 Emissions and Removals (excluding net CO2 from LULUCF)	[Gg]	3.362.190	3.147.314
Share of CO2 emission from 'Solvent and Other Product Use' in Total CO2 Emissions and Removals		*0,26%*	*0,19%*
Total National GHG Emissions and Removals (without LULUCF)	[Gg CO_2 eq]	4.249.291	3.795.944
Share of CO2 emission from 'Solvent and Other Product Use' in Total GHG Emissions and Removals (without LULUCF)		*0,21%*	*0,15%*

Table 5.3 **Sector 3 Solvent and Other Product Use: EU-15 N_2O emissions as well as their share**

	Unit	1990	2010
N2O emission in 'Solvent and Other Product Use'	[Gg]	15,3	12,0
Total GHG emission in 'Solvent and Other Product Use'	[Gg CO_2 eq]	13.482	9.568
Share of N2O emission in Total GHG in 'Solvent and Other Product Use'		*35%*	*39%*
Total National N2O Emissions	[Gg]	1.289	867
Share of N2O emission from 'Solvent and Other Product Use' in Total National N2O Emissions		*1,18%*	*1,38%*
Total National GHG Emissions and Removals (without LULUCF)	[Gg CO_2 eq]	4.249.291	3.795.944
Share of N2O emission from 'Solvent and Other Product Use' in Total GHG Emissions and Removals (without LULUCF)		*0,11%*	*0,10%*

Table 5.4 **Sector 3 Solvent and Other Product Use: EU-15 GHG emissions as well as their share**

	Unit	1990	2010
GHG emission in 'Solvent and Other Product Use'	[Gg CO_2 eq]	13.482	9.568
Total National GHG Emissions and Removals (without LULUCF)	[Gg CO_2 eq]	4.249.291	3.795.944
Share of GHG emission from 'Solvent and Other Product Use' in Total GHG Emissions and Removals (without LULUCF)		*0,32%*	*0,25%*

In Table 5.5 the emission of CO_2, N_2O and NMVOC as well as the Total GHG emission for the EU-15 and for all EU-15 Member States are listed as recommended in IRR 2007 (para 78).

Table 5.5 **Sector 3 Solvent and Other Product Use: EU-15 emissions of CO_2, N_2O, NMVOC and GHG**

		CO_2	N_2O	NMVOC	Total emissions		CO_2	N_2O	NMVOC	Total emissions
		Gg			Gg CO_2 eq		Gg			Gg CO_2 eq
AT	A. Paint Application	55,30		20,80	55,30	B. Degreasing and Dry Cleaning	26,91	NA	10,18	26,91
BE		NA		16,37	NA		NA	NA	3,64	NA
DK		7,96		3,11	7,96		0,00	NA	0,00	0,00
FI		22,67		10,30	22,67		0,88	NO	0,40	0,88
FR		464,10		148,91	464,10		18,28	NA	5,86	18,28
DE		572,86		260,39	572,86		82,47	NO	37,49	82,47
GR		35,63		11,43	35,63		8,91	NA	2,86	8,91
IE		19,20		6,16	19,20		3,67	NA	1,18	3,67
IT		468,68		150,36	468,68		63,20	NA	20,28	63,20
LU		2,22		1,01	2,22		2,68	NA	0,90	2,68
NL		51,48		17,72	51,48		1,96	NO	3,42	1,96
PT		56,90		18,26	56,90		7,92	NO	2,54	7,92
ES		446,37		143,22	446,37		80,90	NA	25,96	80,90
SE		30,91		11,19	30,91		0,15	NA	0,13	0,15
GB		NE		76,19	NE		NE	NE	28,19	NE
EU15		2.234,30		895,43	2.234,30		297,93	0,00	143,02	297,93
AT	C. Chemical Products, Manufacture and Processin	11,86		6,29	11,86	D. Other	82,82	0,48	36,82	***233,05***
BE		NA		3,53	NA		NA	0,69	21,02	***213,97***
DK		12,31		4,96	12,31		41,98	0,05	18,71	***56,14***
FI		6,21		2,82	6,21		15,78	0,09	7,17	***43,67***
FR		96,13		30,84	96,13		558,95	0,28	179,34	***645,96***
DE		123,24		56,02	123,24		804,69	1,17	365,77	***1165,91***
GR		NA		IE	NA		117,10	0,50	40,03	***271,63***
IE		7,89		2,53	7,89		40,83	NA,NE	13,10	***40,83***
IT		NA		77,19	NA		499,90	2,02	160,38	***1126,34***
LU		1,22		0,47	1,22		3,34	0,02	1,55	***8,21***
NL		NA		IE	NA		74,87	0,14	35,70	***117,04***
PT		62,42		20,03	62,42		78,18	0,07	25,09	***100,76***
ES		NA		96,07	NA		510,50	6,13	163,80	***2410,93***
SE		1,08		0,42	1,08		170,46	0,35	75,69	***278,96***
GB		NE		11,77	NE		NE	NE,NO	229,39	***0,00***
EU15		322,37		312,94	322,37		2.999,42	11,98	1.373,57	***6713,43***
AT	*Total Solvent and Other Product Use*	*176,89*	0,48	*74,09*	*327,12*					
BE		*NA*	0,69	*44,56*	*213,97*					
DK		*62,26*	0,05	*26,78*	*76,42*					
FI		*45,53*	0,09	*20,69*	*73,43*					
FR		*1.137,46*	0,28	*364,96*	*1.224,46*					
DE		*1.583,27*	1,17	*719,67*	*1.944,49*					
GR		*161,64*	0,50	*54,32*	*316,17*					
IE		*71,59*	NA,NE	*22,97*	*71,59*					
IT		*1.031,78*	2,02	*408,21*	*1.658,22*					
LU		*9,47*	0,02	*3,93*	*14,34*					
NL		*128,31*	0,14	*56,84*	*170,48*					
PT		*205,43*	0,07	*65,91*	*228,00*					
ES		*1.037,78*	6,13	*429,04*	*2.938,21*					
SE		*202,61*	0,35	*87,44*	*311,11*					
GB		*NE*	NE,NO	*345,54*	*0,00*					
EU15		*5.854,01*	11,98	*2.724,95*	*9.568,02*					

5.2 Methodological issues and uncertainties (EU-15)

This sector does not contain any key source. An overview information on methodologies used by the Member States is given in Table 5.6. For estimation the emission in this sector the methodologies used by the Member States are very different and based on:

- Methodology provided by IPPC Guidelines and CORINAIR Guidebook;
- Bottom up and top down approach / consumption-based emissions estimating;
- Chemical approach
- mass balance for single substances or groups of substances
- plant specific surveys / expert judgment.

No additional overview information on qualitative uncertainty estimates is provided. Altogether it can be noted that very high uncertainties are reported because of lack of information and rough assumptions.

Table 5.6 Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions

Austria (NIR AT 2012)

GHG & pollutant: CO_2, NMVOC, N_2O **GHG Key Category:** CO_2 **Completeness: yes** **Uncertainties: CO_2: 11 %, N_2O: 20 %**

Time series consistency: yes **Sector specific QA/QC and verification**: provided **Recalculation: yes Planned improvements: no**

Methodology (CO_2 emissions):

CO_2 emissions from solvent use were calculated from NMVOC emissions of this sector. As a first step the quantity of solvents used and the solvent emissions were calculated. To determine the quantity of solvents used in Austria in the various applications, a bottom up and a top down approach were combined. The top down approach provided total quantities of solvents used in Austria. The share of the solvents used for the different applications and the solvent emission factors have been calculated on the basis of the bottom up approach. By linking the results of bottom up and top down approach, quantities of solvents annually used and solvent emissions for the different applications were obtained. emission estimates only based on the top-down approach overestimate emissions because a large amount of solvent substances is used for “non-solvent-applications”. “Non-solvent application” are applications where substances usually are used as feed stock in chemical, pharmaceutical or petrochemical industry (e.g. production of MTBE58, ETBE59, formaldehyde, polyester, biodiesel, pharmaceuticals etc.) and where therefore no emissions from “solvent use” arise. However, there might be emissions from the use of the produced products, such as MTBE and ETBE which is used as fuel additive and finally combusted, these emissions for example are considered in the transport sector. Additionally the comparison of the top-down and the bottom-up approach helped to identify several quantitatively important applications like windscreens wiper fluids, antifreeze, moonlighting, hospitals, deicing agents of aeroplanes, tourism, cement-respectively pulp industry, which were not considered in the top-down approach.

Activity:

The top-down approach is based on (A) import-export statistics, (B) production statistics on solvents in Austria, (C) survey on non-solvent-applications in companies, and regularly questionnaires (D) survey on the solvent content in products and preparations at producers & retailers. The bottom up approach is based on an extensive survey on the use of solvents in the year 2000 and 2008. In this survey data about the solvent content of paints, cleaning agents etc. and on solvents used (both substances and substance categories) like acetone or alcohols were collected. Information about the type of application of the solvents was gathered, divided into the three categories ‘final application’, ‘cleaner’ and ‘product preparation‘ as well as the actual type of waste gas treatment, which was divided into the categories ‘open application‘, ‘waste gas collection‘ and ‘waste gas treatment‘.

Emission factor:

For every category of application and waste gas treatment an emission factor was estimated to calculate solvent emissions in the year 2000. In a second step a survey in 1800 households was made for estimating the domestic solvent use. Also, solvent use in the context of moonlighting besides commercial work and do-it-yourself was calculated.

Methodology, Activity & Emission factor (N_2O Emissions):

N_2O Emissions in CRF 3: 3 D 1 Use of N_2O for anaesthesia and 3 D 3 Use of N_2O in aerosol cans: A specific methodology for these activities has not been prepared yet. 100 % of N_2O used for anaesthesia/ aerosol cans is released into atmosphere, which means that activity data = emission (1.00 Mg N_2O / Mg product use)

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions

Belgium (NIR BE 2012)

GHG & pollutant: NMVOC, N_2O **GHG Key Category**: no **Completeness: yes** **Uncertainties: N_2O: AD: 3 %, EF: 100%**

Time series consistency: yes **Sector specific QA/QC and verification:** not provided **Recalculation: yes Planned improvements: yes**

Methodology (CO_2 emissions):

In Belgium the emissions of NMVOC in the source category 'Solvent and other product use' include paint application (building industry, households and road markings), production of medicines, paints, inks and glues, domestic use of other products (incl. glues and adhesives), coating processes in general (incl. assembly of automobiles), printing industry, wood conservation, treatment of rubber, recuperation of solvents, extraction of oil, cleaning and degreasing and dry cleaning. No estimation of the CO_2 equivalent emissions of the solvent consumption is carried out in Belgium. The greenhouse gas emissions in this category 3 are related in Belgium to the use of N_2O as anaesthetics.

The regions in Belgium are using comparable methodologies to estimate the emissions of solvent and other product use in their region.

The emissions of NMVOC in Flanders are estimated by using the results of a study started by the University of Gent in 1998 and continued by the Flemish Environment Agency (VMM). In Wallonia, the calculation is based on a methodology established by Econotec.

In the Brussels region, the emissions are calculated by using the results of research projects.

Because of the less importance of these emissions in the greenhouse gas story, only a general view of how these emissions are calculated in Belgium is given below.

- Emissions of category 3A (NMVOC emissions for Paint Application: building industry, households and road markings) as well as some of category 3D (other domestic use, wood coating, wood conservation, recovery of solvents, treatment of rubber, coating of synthetic material and paper) are estimated based on production figures that are given by the specific industry or professional federations. The emission factors used are mainly the solvent content of the product.

- The remaining emissions of categories 3A (assembly of automobiles, other coating processes), 3C (production of paints, inks and glues) and 3D (extraction of oil seeds, textile coating and printing industry) are estimated based on information gathered in the industrial databases mainly originating from the yearly reporting obligations of the industrial companies.

- The emission calculation for the emission of N_2O from anaesthesia (3D) is based on the number of hospital beds in Belgium and the average consumption of anaesthetics per bed. The emission factor is 10,3 kg N_2O/bed/year. This factor was determined by inquiries carried out in 1995 by the independent consultant agency Econotec.

It has been assumed that all of the nitrous oxide used for anaesthetics will eventually be released to the atmosphere. The number of beds used for the emissions calculations was obtained from the DGASS (General Directorate for Health and Social Action) and from the Health Public Federal Service.

- There is no estimation carried out in Belgium of the CO_2 equivalents calculated out of the emissions of NMVOC of the solvent consumption because of the unreliability of this factors proposed in literature.

Methodology, Activity & Emission factor (N_2O Emissions):

The activity data is the number of hospital beds, which is well known. As no default emission factor is available by EMEP/EEA nor by the IPCC Guidelines, a national specific emission factor has been estimated through surveys in hospitals. The uncertainty on this emission factor is considered high.

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Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions

Denmark (NIR DK 2012)

GHG & pollutant: CO_2, NMVOC, N_2O **GHG Key Category:** no **Completness: yes** **Time series consistency: yes**
Sectorspecific QA/QC and verification: yes **Recalculation:** yes **Planned improvements: yes**

Uncertainties: Tier 2 uncertainty analysis: Total emission uncertainty (2010): NMVOC -14%, +17%; CO_2 -14%, +17%), Trend uncertainty 1990–2010: NMVOC -3.2%, +3.7%; CO_2-eqv. -4.0%; +4.6%

Methodology (CO_2 emissions):

Until 2002 the Danish solvent emission inventory was based on questionnaires, which were sent to selected industries and sectors requiring information on solvent use. In 2003 it was decided to implement a method that is more complete, accurate and transparent with respect to including the total amount of used solvent, attributing emissions to industrial sectors and households and establishing a reliable model that is readily updated on an annual basis. Emission modelling of solvents can basically be done in two ways: 1) By estimating the amount of (pure) solvents consumed, or 2) By estimating the amount of solvent containing products consumed, taking account of their solvent content (EMEP/CORINAIR, 2004). In 1) all relevant solvents must be estimated, or at least those together representing more than 90 % of the total pollutant emission, and in 2) all relevant source categories must be inventoried or at least those together contributing more than 90 % of the total pollutant emission. A simple approach is to use a per capita emission for each category, whereas a detailed approach is to get all relevant consumption data (EMEP/CORINAIR, 2004). The detailed method 1) is used in the Danish emission inventory for solvent use, thus representing a chemicals approach, where each pollutant is estimated separately. The sum of emissions of all estimated pollutants used as solvents equals the pollutant emission from solvent use. Method 2) is used for determining emissions from fireworks, tobacco and charcoal for barbeques included in 3D Other Use.
NMVOC is the most abundant chemical group in relation to Solvent and Other Product Use. Additionally there is also some use and/or emissions of NO2 and CO_2. The definitions of solvents and VOC that are used in the Danish inventory (Nielsen et al., 2010) are as defined in the solvent directive (Directive 1999/13/EC) of the EU legislation: "Organic solvent shall mean any VOC which is used alone or in combination with other agents, and without undergoing a chemical change, to dissolve raw materials, products or waste materials, or is used as a cleaning agent to dissolve contaminants, or as a dissolver, or as a dispersion medium, or as a viscosity adjuster, or as a surface tension adjuster, or a plasticiser, or as a preservative". VOCs are defined as follows: "Volatile organic compound shall mean any organic compound having at 293.15 K a vapour pressure of 0.01 kPa or more, or having a corresponding volatility under the particular condition of use". This implies that some NMVOCs, e.g. ethylenglycol, that have vapour pressures just around 0.01 kPa at 20 °C, may only be defined as VOCs at use conditions with higher temperature. However, use conditions under elevated temperature are typically found in industrial uses. Here the capture of solvent fumes is often efficient, thus resulting in small emissions (communication with industries). The Danish list of NMVOCs comprises approx. 30 pollutants or pollutant groups representing more than 95 % of the total emission from solvent use. CO_2 conversion factors, where all carbon in a carboncontaining pollutants molecule, is converted to CO_2, are provided.
Activity

For each pollutant or product a mass balance is formulated:
Consumption = (production + import) – (export + destruction/disposal + hold-up)
Data concerning production, import and export amounts of solvents and solvent containing products are collected from StatBank DK (2011), which contains detailed statistical information. Manufacturing and trading industries are committed to reporting production and trade figures to the Danish Customs & Tax Authorities in accordance with the Combined Nomenclature. Import and export figures are available on a monthly basis from 1990 to present and contain trade information from approx. 200 countries worldwide. Production figures are reported quarterly as "industrial commodity statistics by commodity group and unit" from 1990 to present. Destruction and disposal of solvents lower the pollutant emissions. In principle this amount must be estimated for each pollutant in all industrial activities and for all uses of pollutant containing products. At present the solvent inventory only considers destruction and disposal for a limited number of pollutants. For some pollutants it is inherent in the emission factor, and for others the reduction is specifically calculated from information obtained from the industry or literature. Hold-up is the difference in the amount in stock in the beginning and at the end of the year of the inventory. No information on solvents in stock has been obtained from industries. Furthermore, the inventory spans over several years so there will be an offset in the use and production, import and export balance over time. In some industries the solvents are consumed in the process, e.g. in the graphics and plastic industry, whereas in the production of paints and lacquers the solvents are still present in the final product. These products can either

be exported or used in the country. In order not to double count consumption amounts of pollutants it is important to keep track of total solvent use, solvents not used in products and use of solvent containing products. Furthermore some pollutants may be represented as individual pollutants and also in chemical groups, e.g. “o-xylene”, “mixture of xylenes” and “xylene”. Some pollutants are better inventoried as a group rather than individual pollutants, due to missing information on use or emission for the individual pollutants. The Danish inventory considers single pollutants, with a few exceptions. Activity data for pollutants are thus primarily calculated from Equation 1 with input from StatBank DK (2011). When StatBank (2011) holds no information on production, import and export or when more reliable information is available from industries, scientific reports or expert judgements the data can be adjusted or even replaced.

Emission factor

For each pollutant the emission is calculated by multiplying the consumption with the fraction emitted (emission factor), according to:

Emission = consumption * emission factor

The present Danish method uses emission factors that represent specific industrial activities, such as processing of polystyrene, dry cleaning etc. or that represent use categories, such as paints and detergents. Some pollutants have been assigned emission factors according to their water solubility. Higher hydrophobicity yields higher emission factors, since a lower amount ends in waste water, e.g. ethanol (hydrophilic) and turpentine (hydrophobic). Emission factors for solvents are categorised in four groups in ascending order: (1) Lowest emission factors in the chemical industry, e.g. lacquer and paint manufacturing, due to emission reducing abatement techniques and destruction of solvent containing waste, (2) Other industrial uses, e.g. graphic industry, have higher emission factors, (3) Non-industrial use, e.g. auto repair and construction, have even higher emission factors, (4) Diffuse use of solvent containing products, e.g. painting, where practically all the pollutant present in the products will be released during or after use. For a given pollutant the consumed amount can thus be attributed with two or more emission factors; one emission factor representing the emissions occurring at a production or processing plant and one emission factor representing the emissions during use of a solvent containing product. If the chemical is used in more processes and/or is present in several products more emission factors are assigned to the respective chemical amounts. Emission factors can be defined from surveys of specific industrial activities or as aggregated factors from industrial branches or sectors. Furthermore, emission factors may be characteristic for the use pattern of certain products. The emission factors used in the Danish inventory also rely on the work done in the joint Nordic project (Fauser et al., 2009).

Methodology, Activity & Emission factor (N_2O Emissions):

Five companies sell N_2O in Denmark and only one company produces N_2O. N_2O is primarily used in anaesthesia by dentists, veterinarians and in hospitals and in minor use as propellant in spray cans, use in laboratories, racing cars and in the production of electronics. Due to confidentiality no data on produced amount are available and thus the emissions related to N_2O production are unknown. An emission factor of 1 is assumed for all uses, which equals the sold amount to the emitted amount. Sold amounts are obtained from the respective companies and the produced amount is estimated from communication with the company. Total sold and estimated produced N_2O for sale in Denmark, which equals the emissions. The emissions, activity data and emission factors for N_2O and CO_2 from the use of fireworks, tobacco and charcoal for barbeques (BBQ) other product uses are included in 3D Other Use. Activity data are gathered from Statbank (2011). Emission factors for use of fireworks, tobacco and charcoal for barbeques (BBQ) are found from literature studies: CO_2 Mg/Mg 0.043 Netherlands National Water Board (2008), N_2O kg/Mg 1.935.

Finland (NIR FI 2011)

GHG & pollutant: CO_2, NMVOC, N_2O **GHG Key Category:** no **Completeness: yes** **Time series consistency: yes**

Sector specific QA/QC and verification: yes **Recalculation: no** **Planned improvements: no**

Overall uncertainty: NMVOC: -30% - +30%, N_2O:-34%-+39%

Methodology (CO_2 emissions):

3.A – 3.D.: Indirect CO_2 emissions from solvents and other product use have been calculated from NMVOC emissions for the time series 1990-2008. Indirect CO_2 emissions were calculated using the equation below. It was assumed that the average carbon content is 60% by mass for all categories under the sector of solvents and other products use according to the 2006 IPCC Guidelines. As described in the Guidelines, the used fossil carbon content fraction of NMVOC is based on limited published national analyses of speciation profile.

EmissionsCO_2 = EmissionsNMVOC ∗ Percent carbon in NMVOCs by mass * 44 /12

Paint application is the biggest source of NMVOC emissions of this sector. Emissions have been calculated from the use of paint and varnish in industry and households. Most Finnish paint producers or importers are members of the Association of Finnish Paint Industry and the use of paint is calculated in the Association using amount and solvent content of sold paint and varnish. The rest of emissions from use of paint and varnish have been estimated using a questionnaire sent to non-members of this association and emission data from the VAHTI system (detailed information in Annex 2). Detailed data of these calculations are included in the report to the UNECE: Air pollutant emissions in Finland 1990-2008, Informative Inventory Report (Finnish Environment Institute, 2010)

Degreasing and dry cleaning is a minor source of NMVOCs. Chlorinated organic solvents are used in the metal and electronics industries to clean surfaces of different components and in dry cleaners and emissions are based on import statistics of pure chlorinated solvents, amount of products containing chlorinated organic solvents and amounts of solvent waste processed in the hazardous waste treatment plant.

The NMVOC emissions are also emitted from the use of solvents in different industrial processes. In Finland there are these kinds of processes in the pharmaceutical industry, leather industry, plastic industry, textile industry, rubber conversion and manufacture of paints and inks. The emissions are foremost from the emission data of the VAHTI system. Questionnaires are also sent to companies in the textile, plastic and paint industry in which they report either the amount of used solvent or the emissions of their production processes.

Methodology (N_2O Emissions):

The N_2O emissions are calculated by Statistics Finland. The country-specific calculation method is consistent with a Tier 2 method. In the estimation of the N_2O emissions sales data are obtained from the companies delivering N_2O for medical use and other applications in Finland. For the years 1990 to 1999 the emissions have been assumed constant based on activity data obtained for the years 1990 and 1998. Since 2000 annual and more precise data have been received from the companies. The emission estimation is based on the assumption that all used N_2O is emitted to the atmosphere in the same year it is produced or imported to Finland. A very small part of emissions is estimated due to non-response.

Activity

For the estimation of N_2O emissions production or importation data are obtained from companies for the years 1990, 1998 and all years starting from 2000. In 2008 one company reported that they have continued to export and that has been also taken into account in the calculations.

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions

France (NIR FR 2012)

GHG & pollutant: NMVOC, N_2O **GHG Key Category:** no **Completness: yes Uncertainty: 3A: 54%, 3D: 102%**

Time series consistency: yes **Sectorspecific QA/QC and verification:** not provided **Recalulation: yes Planned improvements: yes**

Methodology (CO_2 emissions):

Les émissions de CO_2 traduisent la transformation du carbone contenu dans les émissions de COVNM en CO_2 ultime. Cette conversion se fait sur la base d'un contenu moyen en carbone de 85%.

3A Approche méthodologique:

Activity: Mix top-down (provenant des statistiques du secteur) et bottum-up lorsque les informations par usine sont disponibles

Facteurs d'émission: Estimés au niveau national en concertation avec la profession dans le cas general. Recalculés partir des facteurs d'émission spécifiques chaque installation si ceux-ci sont disponibles

3B Approche méthodologique

Activité: Estimation des consommations totales de solvants

Facteurs d'émission: Pour le dégraissage des métaux, directement déduits des émissions de COVNM. Pour le nettoyage à sec, estimés à partir des données des industriels

3C Approche méthodologique

Activité: Traitement des statistiques de consommation au niveau national ou bottom-up suivant les secteurs.

Facteurs d'émission: Spécifiques aux secteurs. Valeurs nationales par défaut ou spécifiques chaque installation si elles sont disponibles

3C Approche méthodologique

Activité: Traitement des statistiques de consommation au niveau national ou bottom-up suivant les secteurs Population pour l'utilisation domestique de solvants et de produits pharmaceutiques

Facteurs d'émission: Spécifiques aux secteurs. Valeurs nationales par défaut ou informations par installation lorsqu'elles sont disponibles

Methodology, Activity & Emission factor (N_2O Emissions):

Le N_2O est également, du fait de son usage comme gaz analgésique, émis par ce secteur.

The emission calculation for the emission of N_2O from anaesthesia (3D) is based on the number of population and the use of N20 from anaesthesia in Europe.

Germany (NIR DE 2012)

GHG & pollutant: CO_2, NMVOC, N_2O **GHG Key Category: no** **Completeness:** yes **Uncertainty: CO_2 7.9 %; N_2O AD 19.1%, EF 0.6%**

Time series consistency: yes **Sector specific QA/QC and verification:** yes **Recalculation: yes Planned improvements: no**

Methodology (CO_2 emissions):

NMVOC emissions are calculated in keeping with a product-consumption-oriented approach. In this approach, the NMVOC input quantities allocated to these source categories, via solvents or solvent-containing products, are determined and then the relevant NMVOC emissions (for each source category) are calculated from those quantities via specific EFs. This method is explicitly listed, under "consumption-based emissions estimating", as one of two methods that are to be used for emissions calculation for this source category. Use of this method is possible only with valid input figures – differentiated by source categories – in the following areas:

1. Quantities of VOC-containing (pre-) products and agents used in the report year,
2. The VOC concentrations in these products (substances and preparations),
3. The relevant application and emission conditions (or the resulting specific EF).

To take account of the highly diverse structures throughout the sub-categories 3A – 3D, these input figures are determined on the level of 37 differentiated source categories, and the calculated NMVOC emissions are then aggregated. The product/substance quantities used are determined at the product-group level with the help of production and foreign-trade statistics. Where possible, the so-determined domestic-consumption quantities are then further verified via cross-checking with industry statistics.

The values used for the average VOC concentrations of the input substances, and the EFs used, are based on experts' assessments (expert opinions and industry dialog) relative to the various source categories and source-category areas. Not all of the necessary basic statistical data required for calculation of NMVOC emissions for the most current relevant year are available in final form; as a result, the data deter-mined for the previous year are used as an initial basis for a forecast for the current report. The forecast for NMVOC emissions from solvent use for the relevant most current year is calculated on the basis of specific activity trends. As soon as the relevant basic statistical data are available for the relevant most current year, in their final form, the inventory data for NMVOC emissions from solvent use will be recalculated.

Since 1990, so the data, NMVOC emissions from use of solvents and solvent-containing products have decreased by nearly 42 %. The main emissions reductions have been achieved in the years since 1999. This successful reduction has occurred especially as a result of regulatory provisions such as the 31st Ordinance on the execution of the Federal Immissions Control Act, the 2nd such ordinance (and the TA Luft. The German "Blauer Engel" ("Blue Angel") environmental quality seal, which is used to certify a range of products, including low-solvent paints, lacquers and glues, has also played an important role in this development.

While product sales increased in some areas – even over periods of several years –thereby adding to emissions, the above-described measures offset this trend. These successes, which have occurred especially in recent years, are reflected in the updated emissions calculations – which, thanks to methods optimisation, now feature greater differentiation of VOC concentrations and EFs.

For the 2012 report, indirect CO_2 emissions from NMVOC have been calculated. The following relationship was used for pertinent conversion: EMindirect CO_2 = EMNMVOC * molar mass CO_2 / molar mass C * 60%

Methodology, Activity & Emission factor (N_2O Emissions):

Anaesthesia

The 1990 figure for N_2O emissions from medical applications is based on an extrapolation of a statistical plant survey conducted in 1990 in the territory of the former GDR. At the time, it was ascertained that one plant for the production of N_2O for narcotic purposes had existed in the former GDR. Also at the time in question, the plant had not yet been operational for long (it was constructed in 1988). The annual production capacity was approximately 1,200 t. Research indicated that there were no exports or imports of this substance, and thus it was assumed that all of the substance was used for domestic consumption. Via the per-capita emissions calculated from this for the former GDR, and assuming identical conditions, N_2O emissions of 6,200 t were estimated, as a rough approximation, for Germany in 1990. The N_2O figure for 2001 was obtained via a written memorandum, dating from 2002, of the Industriegaseverband e.V. (IGV) industrial-gas association. That figure was tied to a range of 3,000 ~ 3,500 t/a. The mean value from that range (3,250 t/a) was then used for generation of an N_2O-emissions time series. Since 2005, the Industriegaseverband (IGV) industrial-gas association has carried out surveys of N_2O sales for all applications in Germany. In addition, the IGV has made the data from those surveys available to the Federal Environment Agency for reporting purposes. In 2010, the IGV entered into a voluntary agreement, with the Federal Ministry of Economics and Technology (BMWi), regarding annual provision of N_2O-sales data for purposes of emissions reporting. The gaps in the data relative to uses in anaesthesia are closed via interpolation and extrapolation. The pertinent emission factor is 100%.

Whipped-cream aerosol cans

Use of N_2O in aerosol cans for whipped cream, in Germany, has to be carefully differentiated. In Germany, there is one maker of aerosol cans for whipped cream. That maker also fills the cans in Germany. In emissions calculations, it is assumed, on the basis of the abovedescribed research, that that company accounts for a share of about 3 % of the laughing-gas sales of the IGV industrial-gas association. The majority of the companies who deal with such aerosol cans has them filled abroad and then imports them into Germany. The relevant sales of such companies are thus not included in the data of the IGV industrial-gas association. The MIV dairy-industry association has reported to the Federal Environment Agency the results of a one-time survey that showed that 50.2 million units of whipped-cream aerosol cans were sold in 2008. At the same time, the MIV association reported that the units involved vary in size, and that it is not possible to break the figures down by can sizes. Internet research showed that pressurized cartridges for this area are sold in Germany: cartridges with 8g of N_2O, for 0.5l cans, and cartridges with 16g of N_2O, for 1.0l cans. Comparison calculations have shown that 8g of N_2O is a safe approximation, for purposes of calculation, for the amount of laughing gas contained per sold unit (whipped-cream aerosol can). That, in turn, leads to an input figure of 401.6 t N_2O for whipped-cream aerosol cans in 2008 in Germany. Since no pertinent data are available for the years prior to 2008, that value
is assumed to be constant. The emission factor for whipped-cream aerosol cans is assumed to be 100%.

Semiconductor manufacturing

On a one-time basis, the German Electrical and Electronic Manufacturers' Association (ZVEI) has provided information on quantities of laughing gas sold in the years 1990, 1995, 2000, 2001 and 2008. Values between those points are obtained via interpolation. In addition, the ZVEI estimated the emission factor for 2008 to be about 40 %, in keeping with conversion of laughing gas within the pertinent process and with downstream treatment processes. The ZVEI was unable to provide any figures for 1990. But since it can be assumed that levels of waste-gas treatment in 1990 were not nearly as high as they were in 2008, an emission factor of 100 % is used as a conservative estimate for 1990. The emission factor for the period between 1990 and 2008 was obtained via interpolation.

Explosives

In 2003, a total of 59 kt of explosives was produced in Germany. Of that figure, 13 kt were exported abroad, and 5.8 kt were imported into Germany. Those figures, in turn, yield a figure of 51.8 kt for the amount of explosives used in Germany. Of that amount, ANFO accounts for a share of 60 %, emulsion explosives account for 25 % and dynamite explosives account for 15 %. ANFO explosives consist of 94 % ammonium nitrate and 6 % fuels. The corresponding relationship for emulsion explosives is 80 % to 20 %; for dynamite explosives, it is 50 % to 50 %. At present, nitrous oxide amounts in detonation clouds are not determined, while amounts of NO and NO2 are determined. Normally, N_2O formation plays a significant role only in explosives that contain ammonium nitrate (AN). That said, no precise analyses of detonation clouds of ANFO explosives have been carried out. For this reason, it must be assumed that the N_2O concentrations formed upon detonation of ANFO are similar, with regard to AN content, to those formed upon detonation of amatols and ammonites, for which analyses have been carried out that support relevant estimates. The following result has been obtained: upon detonation, amatoles and ammonites form about 0.1 mole N_2O per mole of ammonium nitrate (AN). According to the Federal Office for Material Research and Testing (BAM), levels of explosives use in Germany remained constant from 1990 to 2005. The emission factor for use of explosives is 0.1036 kg N_2O/t explosives. That emission factor was determined, via measurement, by the BAM in February 2010. As a result, the emission factor has been corrected downward, considerably, with respect to the Submission 2010.

Greece (NIR GR 2012)

GHG & pollutant: CO_2, NMVOC, N_2O **GHG Key Category**: no **Completeness: no** **Uncertainty: CO_2 300%**

Time series consistency: yes **Sector specific QA/QC and verification:** not provided **Recalculation: no** **Planned improvements: yes**

Methodology (NMVOC, CO_2 emissions):

The calculation of NMVOC emissions requires a very detailed analysis of the use of solvents and other products containing volatile organic compounds. There are two basic approaches for the estimation of emissions from Solvent and Other Product Use, which depend on the availability of data on the activities producing emissions and the emission factors.

- Production-based. In cases that solvent or coating use is associated with centralised industrial production activities (e.g. automobile and ship production), it is generally possible to develop NMVOC emission factors based on unit of product output. Next, annual emissions are estimated on the basis of production data.

- C onsumption-based. In many applications of paints, solvents and similar products, the end uses are too small-scale, diverse, and dispersed to be tracked directly. Therefore, emission estimates are generally based on total consumption (i.e. sales) of the solvents, paints, etc. Used in these applications. The assumption is that once these products are sold to end users, they are applied and emissions generate relatively rapidly. Emission factors developed on the basis of this assumption can then be applied to data from sales for the specific solvent or paint products.

The application of both approaches needs detailed activity data, concerning either e.g. the amount of pure solvent consumed or the amount of solvent containing products consumed. The availability of such activity data in Greece is limited and as a result the default CORINAIR methodology is applied for the estimation of NMVOC emissions. It should be mentioned that evaporative emissions of GHG arising from other types of product use (e.g. N_2O emissions from medical use), are not estimated since appropriate methodologies have not been developed yet. Carbon dioxide emissions are calculated from NMVOC emissions, assuming that the carbon content of NMVOC is 85%.

Paint application: Data availability concerning the use of products containing solvents for "Vehicle manufacture and Vehicle refinishing" is limited and as a result the respective emissions are not estimated. Emissions from "Domestic use and construction" are estimated on the basis of population figures and default emission factors from CORINAIR (0.5 kg / capita).

Metal Degreasing and Dry Cleaning: Emission estimates are given only for the dry cleaning sector. These estimates are based on population figures and default emission factors from CORINAIR (0.25 kg /capita) that is applicable to all types of dry cleaning equipment.

Other Use of Solvents and Related Activities:

The emission factors used for some of the activities defined in CORINAIR and for which it was possible to obtain the corresponding activity data from the National Statistical Service of Greece, are: (a) Production and processing of PVC: 40 kg / t of product produced or processed. (b) Production of pharmaceutical products: 14 g /capita. (c) Ink production: 30 kg / t of product. (d) Glue production, applied emission factor: 20 kg /t of product (e) For the wood preservation: 24 kg / t of wood preserved (f) For fat edible and non edible oil extraction: 14 kg NMVOC/ t of seed processed (g) For domestic solvent use (except paint application): 2.6 kg NMVOC/capita/year.

In the case of **printing industry**, the estimation of emissions was based on the consumption of ink. Printing ink is mostly used for the publishing of newspapers, books and various leaflets. According to the estimations of one publishing organisation, the amount of ink used for the printing of a daily newspaper is approximately 3.7 g of ink. The quantity of ink used for printing books etc. Was calculated by subtracting the total quantity used for the newspapers from the total ink consumed. The emission factor applied (260 kg / t ink) is the average of emission factors for newspaper printing (54 kg /t ink) and for books and other leaflets printing (132-800 kg / t ink).

Methodology, Activity & Emission factor (N_2O Emissions):

For source categories 3D1 and 3D3, neither national activity data nor IPCC methodology are available for the estimation of N_2O emissions. The inventory team in order to provide emissions for these source categories proceeded as follows:
1. The inventory team started by investigating the NIRs and ERT audit reports of other Annex I parties, as concerns the estimation of emissions for the 3D1 and 3D3 source categories. 2. The ratio of N_2O emissions per population (ktN_2O/1000s capita) for a cluster of Annex I parties was computed. Four European countries were selected: Italy and Spain (which have similarities with Greece as concerns climate etc), Austria and Netherlands (in order to be conservative in the estimation of emissions). 3. The mean value of the above mentioned ratios was calculated. 4. By using the population of Greece as a driver (activity data) and the above calculated ratio as "Emission factor", the emissions for the whole time series 1990-2010 of the 3D1 and 3D3 were estimated.

Ireland (NIR IE 2012)

GHG & pollutant: CO_2, NMVOC **GHG Key Category:** no **Completness: yes** **Uncertainty: CO_2: 30 %**

Time series consistency:yes **Sector specific QA/QC and verification:** yes **Recalulation:yes** **Planned improvements: no**

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions

Methodology (CO_2 emissions):

CTC (2005) developed a bottom-up approach was developed for estimating NMVOCs from activities that are subject to IPPC licensing in the four source categories (3.A Paint Application, 3.B Degreasing and Dry Cleaning, 3.C Chemical Products and 3.D Other Solvent Uses). Relevant data on emissions and solvent use were extracted from their electronic or paper Annual Environmental Reports (AERs) or Pollution Emissions Registers (PERs). Where such information was not available, European PERs were assessed.

Top-down methods were used for activities (i.e. the use of paints and the use of domestic solvents) that are not covered by the IPPC licensing system. For these activities, Irish statistics such as vehicle stock, population and housing stock were used.

Input, usage and emissions data for each individual activity is collated into IPPC and non-IPPC spread sheets. Emissions are estimated by applying EMEP/CORINAIR methods, using default, UK and literature emission factors and general guidance as appropriate. Interpolation and extrapolation are used to elaborate a time series were no annual specific data is available. These are combined with Irish statistics for the number of vehicles, population, housing stock and a range of other activity data. In some instances activity data is currently not available in Ireland and where this occurs emission estimates are undertaken using Irish and UK population statistics and UK emission data. In other instances, emissions are estimated using GDP as a surrogate activity data.

Activity data

The activity data used for computing estimates of CO_2 emissions in Solvent and Other Product Use are the mass emissions of NMVOC determined for the relevant source categories (3.A Paint Application, 3.B Degreasing and Dry Cleaning, 3.C Chemical Products and 3.D Other Solvent Uses). The Irish data used for this purpose are the NMVOC emissions which are compiled according to the CORINAIR methodology for reporting to the UNECE under the Convention on Long Range Transboundary Air Pollution (CLRTAP) (UNECE, 1999) and the National Emissions Ceilings Directive (EP and CEU, 2001).

Emission factor

The CO_2 emissions are derived by assuming that 85 percent of the mass emissions of NMVOC in the four categories is converted to CO_2.

Italy (NIR IT 2012)

GHG & pollutant: CO_2, NMVOC, N_2O **GHG Key Category:** yes **Completeness:** yes

Uncertainty: CO_2: 58% - AD 30%, EF 50%; N_2O: 51% - AD 50%, EF 10%

Time series consistency: yes **Sectorspecific QA/QC and verification:** provided **Recalulation: yes Planned improvements: yes**

Methodology, Activity data & Emission factor (CO_2 emissions):

Emissions of NMVOC from solvent use have been estimated according to the methodology reported in the EMEP/CORINAIR guidebook, applying both national and international emission factors (Vetrella, 1994; EMEP/CORINAIR, 2007). Country specific emission factors provided by several accredited sources have been used extensively, together with data from the national EPER Registry; in particular, for paint application (Offredi, several years; FIAT, several years), solvent use in dry cleaning (ENEA/USLRMA, 1995), solvent use in textile finishing and in the tanning industries (TECHNE, 1998; Regione Toscana, 2001; Regione Campania, 2005; GIADA 2006). Basic information from industry on percentage reduction of solvent content in paints and other products has been applied to EMEP/CORINAIR emission factors in order to evaluate the reduction in emissions during the considered period. Emissions from domestic solvent use have been calculated using a detailed methodology, based on VOC content per type of consumer product.

As regards household and car care products, information on VOC content and activity data has been supplied by the Sectoral Association of the Italian Federation of the Chemical Industry (Assocasa, several years) and by the Italian Association of Aerosol Producers (AIA). As regards cosmetics and toiletries, basic data have been supplied by the Italian Association of Aerosol Producers too (AIA) and by the national Institute of Statistics and industrial associations (ISTAT; UNIPRO, several years); emission factors time series have been reconstructed on the basis of the information provided by the European Commission (EC, 2002). The conversion of NMVOC emissions into CO_2 emissions has been carried out considering that carbon content is equal to 85% as indicated by the European Environmental Agency for the CORINAIR project (EEA, 1997), except for CO_2 emissions from the 3C sub-sector which are not calculated to avoid double-counting. These emissions are, in fact, already accounted for in sectors 1A2c and 2B.

Methodology, Activity data & Emission factor (N_2O emissions):

Emissions of N_2O have been estimated taking into account information available by industrial associations. Specifically, the manufacturers and distributors association of N_2O products has supplied data on the use of N_2O for anaesthesia from 1994 to 2009 (Assogastecnici, several years). For previous years, data have been estimated by the number of surgical beds published by national statistics (ISTAT, several years [a]).

Moreover, the Italian Association of Aerosol Producers (AIA, several years) has provided data on the annual production of aerosol cans. It is assumed that all N_2O used will eventually be released to the atmosphere, therefore the emission factor for anaesthesia is equal to 1

Mg N_2O/Mg product use, while the emission factor used for aerosol cans is 0.025 Mg N_2O/Mg product use, because the N_2O content in aerosol cans is assumed to be 2.5% on average (Co.Da.P., 2005).

For the estimation of N_2O emissions from explosives, data on the annual consumption of explosives have been obtained by a specific study on the sector (Folchi and Zordan, 2004); as stated in the document, this figure is believed to be constant for all the time series with a variation within a range 140 of 30%. As for the emission factor, the estimated N_2O emissions represent the theoretically maximum emittable amount; in fact, no figures are available on the amount of N_2O emissions actually emitted upon detonations and the value of 3,400 Mg N_2O/Mg explosive use is provided by a German reference (Benndford, 1999) which corresponds to the assumption of 68 g N_2O per kg ammonium nitrate. N_2O emissions have been calculated multiplying activity data, total quantity of N_2O used for anaesthesia, total aerosol cans and explosives, by the related emission factors.

Luxembourg (NIR LU 2011)

GHG & pollutant: CO_2, NMVOC, N_2O **GHG Key Category:** no **Completness: yes** **Uncertainty: yes**

Time series consistency:yes **Sectorspecific QA/QC and verification:** not provided **Recalulation: yes** **Planned improvements: yes**

Methodology, Activity data & Emission factor (CO_2 emissions):

The total amount of NMVOC emissions from solvents and other product use has been taken as a basis to calculate resulting CO_2 emissions. The following VOC emission estimates from this source categroy were done for 1990. Part of these data are based on estimations of various solvent application activities in Luxembourg as they were at the beginning of the 1990ies. In some sub-sectors, no statistical data on consumption of solvent containing products were available. Therefore part of the estimations are based on typical consumption estimates of products containing solvents for the neighbour countries of Luxembourg and/or for Europe. An update of these estimations of VOC emissions from solvents could lead to an improvement of the emission data.

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions

Netherlands (NIR NL 2011)

GHG & pollutant: CO_2, NMVOC, N_2O **GHG Key Category:** no **Completness: yes Uncertainty:CO_2: 27 %, N_2O: 50%**

Time series consistency: yes Sectorspecific QA/QC and verification: not provided **Recalulation: yes Planned improvements: no**

Methodology (CO_2 emissions):

Country-specific carbon contents of the NMVOC emissions from 3A, 3B and 3D are used to calculate indirect CO_2 emissions. The monitoring of NMVOC emissions from these sources differs per source. Most of the emissions are reported by branch organizations (e.g. paints, detergents and cosmetics). The indirect CO_2 emissions from NMVOC are calculated from the average carbon contents of the NMVOC in the solvents: C-content NMVOC 3A: 0.72, 3B: 0.16 3D: 0.69. The carbon content of degreasing and dry cleaning is very low due to the high share of chlorinated solvents (mainly tetrachloroethylene used for dry cleaning). The emissions are then calculated as follows:

CO_2 (in Gg) = Σ{NMVOC emission in subcategory i (in Gg) x C-fraction subcategory i} x 44/12.

The fraction of organic carbon (i.e. of natural origin) in the NMVOC emissions is assumed to be negligible.

Activity data

Consumption data and NMVOC contents of products are mainly provided by trade associations, such as the VVVF (for paints), the NCV (for cosmetics) and the NVZ (for detergents). The consumption of almost all solvent-containing products has increased since 1990. However, the general NMVOC content of products (especially paints) has decreased over the past years, resulting in a steady decline in NMVOC emissions since 1990. Due to the increased sales of hairspray and deodorant sprays NMVOC emissions have increased slightly in recent years.It is assumed that the NMVOC contents of these products have remained stable.

Emission factors

It is assumed that all NMVOC in the product is emitted (with the exception of some cleaning products and methylated spirit, which are partly broken down in sewerage treatment plants after use, or used as fuel in BBQs or fondue sets (methylated spirit). The carbon contents of NMVOC emissions are documented in a monitoring protocol.

Methodology (N_2O emissions):

Country-specific methodologies are used for the N_2O sources in Sector 3. Since the emissions in this source category are from non-key sources for N_2O, the present methodology complies with the IPCC Good Practice Guidance (IPCC, 2001).

Activity data: The major hospital supplier of N_2O for anesthetic use reports the consumption data of anesthetic gas in the Netherlands annually. The Dutch Association of Aerosol Producers (NAV) reports data on the annual sales of N_2O-containing spray cans. Missing years are then extrapolated on the basis of this data. Domestic sales of cream in aerosol cans have shown a strong increase since 2000. The increase is reflected in the increased emissions in these years.

Emission factors

The emission factor used for N_2O in anesthesia is 1 kg/kg. Sales and consumption of N_2O for anesthesia are assumed to be equal each year. The emission factor for N_2O from aerosol cans is estimated to be 7.6 g/can (based on data provided by one producer), and is assumed to be constant over time.

Portugal (NIR PT 2011)

GHG & pollutant: CO_2,NMVOC, N_2O **GHG Key Category:** 3A, 3B 3D **Completness: yes Uncertainty: 3A: 262%; 3B: 100% %; 3C 141%; 3D: 408% Time series consistency: yes Sectorspecific QA/QC and verification: not provided Recalulation: no**

Planned improvements: yes

Methodology, Activity data & Emission factor (CO_2 emissions):

NMVOC emissions estimates must be converted in CO_2 emissions whenever the carbon that is present in organic compounds has fossil fue origin (originated from feed-stocks from petroleum, coal or natural gas), and being assumed that NMVOC compounds are fully oxidized in air to carbon dioxide contributing thence to the atmospheric pool. Therefore, in general terms in except for the cases where a specific methodology is presented, emission of ultimate CO_2 were calculated assuming that 85 percent of the mass emissions of NMVOC is carbon and it is converted to carbon dioxide in the atmosphere. All solvents are assumed to have fossil origin and hence all ultimate CO_2 emissions are included in the inventory as CO_2e. With UCO_2=44/12 * NMVOC*0.85, where UCO_2-Ultimate CO_2 (ton/yr); NMVOC-emissions of NMVOC (ton/yr).

Paint Application (CRF 3A): NMVOC emissions from use of coating materials are estimated in a simple manner using the following formulation: EmiNMVOC(a,p,y) =ΣaΣp[EF(p) * CoatingCONS(a,p,y)] * 10-3; where EmiNMVOC(y) – NMVOC emissions resulting from use/application of coating substances during year y; CoatingCONS(a,p,y) – Use of coating substance p in economic activity a during year y; EF(p) – NMVOV EF (solvent content) resulting from application of substance; For specific sectors were more detailed activity data and emissions factores were available a product base methodology was used. This is the case for: (a) Cars manufacturing; (b) Truck cabin coating; (c) Leather finishing. The product based methodology can be described as following: EmiNMVOC(p,y) = ΣaΣp [EF(p) * CoatingCONS(a,p,y)] * 10-3 Where EmiNMVOC(p,y) – NMVOC emissions resulting the production of product p during year y (t/yr); Product(p,y) – Production units of product p during year y (cars/yr, truck cabins/yr, kg leather/yr); EF(p) – NMVOV emission factor for production of product p (kg/car, kg/truck cabin, kg/kg leather) p – product (cars, truck cabin, leather). Emission factors were taken from EMEP/CORINAIR guidebook 2009. Control strategies were obtained from GAINS model developed by IIASA. Default emission factors and abatment technologies were obtained from EMEP/CORINAIR, then the control strategy suggested by IIASA was applied in the following manner.

Activity data: The available and reliable information concerning the use of paints is restricted to a small number of activities in Portugal. From IAIT and IAPI industrial surveys, compiled by national statistics, it is only possible to determine consumption of paint in industrial activities, but the remaining, and larger part of consumption, is not known. Therefore total consume of paint and varnish in Portugal had first to be estimated from internal production, importation and exportation according to: TotalCons(y)=Production(y)+Imports(y)–Exports(y); Where: TotalCons(y)- Consumed paint and varnish of type p in year y; Production(y) - National Produced paint and varnish of type p in year y; Imports(y) - Imported paint and varnish of type p in year y; Exports(y) - Exported paint and varnish of type p in year y.

Degreasing and dry cleaning (CRF 3B): Assuming that all solvents consumed during degreasing and dry-cleaning evaporate, NMVOC emission will be equal to the amount of solvents used. If it is considered that annual consumption of solvents in an economic activity is used to replenish the quantity of solvent that was lost, then annual NMVOC emissions may be estimated from the annual consumption of solvent. This methodology overcomes the need of being aware of the portion of solvent that is recovered. In the case of the dry-cleaning activity it was assumed that either the solvent is lost directly to atmosphere, or if it is conveyed to water or retained in clothes, but it will eventually reach atmosphere by evaporation. For the dry cleaning sector other methodologies, based on quantities of washed cloths, are recommended by several sources (USEPA, 1981; EMEP/CORINAIR). However, in Portugal there is no sufficient information to use this other approach. CO_2 emissions are derived by assuming that 85 percent of the mass emissions of NMVOC is carbon: UCO_2 = NMVOC * 0.85 * (44/12) where: UCO_2 - Ultimate CO_2 (ton); NMVOC - Global emissions of NMVOC (ton).Activity Data Statistical information concerning total solvent use, from the National Statistics Institute (INE), was used to estimate VOC emissions. Consumption of solvents was based on consumption of volatile organic materials in the metal and plastic industries, from IAIT statistical survey. There is no available statistical information concerning consumption of solvents and other materials in dry-cleaning activity, because this activity is not included under IAIT and IAPI industrial surveys. Therefore, it was assumed that all PER (Tetra-chloro-ethylene) consumed in Portugal is used in dry-cleaning activity and that all PER used is imported (no national production). Annual apparent consumption was estimated from INE's statistical databases on external trade from 1990 to 2009 and assumed as equal to solvent use

Chemical products, manufacture and processing (CRF 3C): Emissions were estimated by the use of emission factors that are multiplied by the quantity of material produced: EmiNMVOC = EF * ActivityRate * 10^{-3} where EmiNMVOC - annual emission of NMVOC (ton/yr); ActivityRate - Indicator of activity in the production process. Quantity of product produced per year as a general rule for this emission source sector (ton/yr); EF - emission factor (kg/ ton); It was assumed that NMVOC result mostly from solvents with fossil origin, therefore contributing fully to ultimate carbon dioxide emissions. Ultimate carbon dioxide emissions are calculated assuming that emitted VOC have on average 85% of carbon: $EmiCO_2$ = EmiNMVOC * 0.85 * (44 / 12)

Other use of solvents and related activities (CRF 3D):

Use of N_2O for Anaesthesia (3.D.1) The N_2O consumed in Portugal is primarily for medical use as anaesthesia. The new 2006 guidelines propose that emissions be estimated from supply "It is good practice to estimate N_2O emissions from data of quantity of N_2O supplied that are obtained from manufacturers and distributors of N_2O products”. There will be a time delay between manufacture, delivery and use but this is probably small in the case of medical applications because hospitals normally receive frequent deliveries to avoid maintaining large stocks. Therefore, it is reasonable to assume that the N_2O products supplied will be used in one year. Emission Factors: It is assumed that none of the administered N_2O is chemically changed by the body, and all is returned to the atmosphere. It is reasonable to assume an emission factor of 1.0 Activity Data: Consumption of N_2O emissions are calculated from statistics obtained from INE (1990 to 2009).

Fire Extinguishers (3.D.2), N_2O from Aerosol Cans (3.D.3) and Other Use of N_2O (3.D.4) are included under 3D1 as well.

Other (3.D.5) Emissions from printing industry was estimated according with Tier 1 methodologly from EMEP/CORINAIR Guidebook. EmiNMVOC(y) = EF(i) * INKCONS(y) x 10^{-3} where EmiNMVOC(y) – NMVOC emissions resulting from printing activities during year y (t/yr); InkCONS(y) – Use of printing ink during year y (t/yr); EF(i) – NMVOC emission factor (solvent content) for ink use (g/kg ink). Ultimate CO_2 emissions are calculated assuming that 85 percent of the mass emissions of NMVOC is carbon and it is converted to carbon dioxide in the atmosphere. All solvents are assumed to have fossil origin and hence all ultimate CO_2 emissions are included in the inventory. UCO_2 = NMVOC * 0.85 * (44 / 12) where: UCO_2 - Ultimate CO_2 (ton/yr); NMVOC - Global emissions of NMVOC (ton/yr). The emission factor used for printing activities was obtained from EMEP/CORINAIR guidebook. The same emission factor was used for year 1990 to 2010. Consumption of inks in printing industry according to printing product is available from the INE’s statistical database

Edible and non edible oil extraction Emissions of NMVOC were estimated considering that the annual hexane consumption by the industrial plant, hexane make-up, is due to losses to the air, and hence: EmiNMVOC(y) = MakeUpSolvents(y) where: EmiNMVOC(y) - Emissions of NMVOC (ton/yr); MakeUpSolvents(y) - annual consumption of solvent in edible and non-edible oil industry, to replenish losses (ton/yr). Ultimate CO_2 emissions are calculated assuming that 85 percent of the mass emissions of NMVOC is carbon and is converted to carbon dioxide in the atmosphere. All solvents are assumed to have fossil origin and hence all ultimate CO_2 emissions are included in the inventory. UCO_2 = NMVOC * 0.85 * (44 / 12) where: UCO_2 - Ultimate CO_2 (ton/yr); NMVOC - Global emissions of NMVOC (ton/yr). The national emission factor for NMVOC was calculated as the ratio of the amount of solvents consumed during manufacture processes to the quantities of edible and non edible oil manufactured. However, from the available data from INE, this emission factor could be only estimated from IAIT industrial survey, i.e. from 1989 to 1991, because solvent consumption is not available from IAPI survey. Statistical information used in actual calculations of annual emission factor are presented in Table 5.52, together with the average emission factor in 1989- 1991, value that was used to estimate annual NMVOC emissions for the whole covered period. Oil refining data was available from INE’s industrial surveys: IAIT for 1990 and 1991 and IAPI thereafter until 2000. Production of olive oil by mechanical pressure does not cause NMVOC emissions.

Industrial application of glues and adhesives NMVOC = ConsNat x FENat + Imp x FEimp where: NMVOC = Global emissions of NMVOC (ton); ConsNat = Domestic consumption of glues and adhesives produced in Portugal (ton) FENat = Emission factor for glues and adhesives produced in Portugal (kg NMVOC/ton Ink) Imp = Imported glues and adhesives (ton) FEimp = Emission factor associated with the use of imported glues and adhesives. ConsNat = ProdNat - Exp where: ConsNat = Consumed glues and adhesives produced in Portugal (ton) ProdNat = National production of glues and adhesives (ton) Exp = Exported glues and adhesives (ton). To estimate the emission factor applied for the use of national glues and adhesives, the ratio of the amount of solvents consumed during manufacture processes with the amount of glues and adhesives manufactured was computed, and an average emission factor obtained. The emission factor for VOC emission from the manufacture of glue and adhesives was subtracted from this value to obtain the emission factors for use of national produced glue and adhesives.

Wood Preservation EmiNMVOC (y) = Consumption(y) * FEConsumption where: EmiNMVOC(y) - Emissions of NMVOC associated to consumption of wood preservation products (ton) Consumption(y) - Consumption of wood preservation products (ton) FEConsumption - Emission factor associated to the consumption of wood preservation products. CORINAIR90 Emission Factor Handbook proposes three emission factors for VOC emission from wood preservation, depending on the type of product used. The emission factor is 100 kg/ton of product applied for creosote; 900 kg/ton for solvent based products and 0 for water based products. The available data do not discriminate the share of the several types of preservation products, therefore, it was assumed that the main product used in Portugal is creosote. Activity Data were obtained from National Statistics Institute (INE)

Domestic solvent use including fungicides This secotr addresses emissions from the use of solvent containing products by the public in their homes. This sector does not include the use of decorative paints which is covered by source category 3.A. Paint Application. NMVOC's are used in a large number of products sold for use by the public. These include: - Cosmetics and toiletries; Products for the maintenance or improvement of personal appearance, health or hygiene. - Household products; Products used to maintain or improve the appearance of household durables. - Construction/Do-It-Yourself; Products used to improve the appearance or the structure of buildings such as adhesives and paint remover. - Car care products; Products used for improving the appearance of vehicles to maintain vehicles or winter products such as antifreeze. Pesticides such as garden herbicides and insecticides and household insecticide sprays may be considered as consumer products. Most agrochemicals, however, are produced for agricultural use and fall outside the scope of this section. Emission from this sector were calculated using a Tier 1 approach. This approaches uses a single emission factor expressed on a person basis which was multiplied by the population to derive emissions from domestic solvent use. NMVOCi = Population i x EF_{NMVOC} where: NMVOCi - Emissions of NMVOC, Population i – inhabitants in year i; EF_{NMVOC} - Emission factor associated with the use of domestic products containing solvents [kg/person/year] Emission Factors Emission factor for NMVOC was obtained from EMEP/CORINAIR Guidebook, 2009. This default emission factor has been derived from an assessment of the emission factors presented in GAINS model developed by IIASA. Activity data were obtained from National Statistics Institute (INE).

Spain (NIR ES 2012)

GHG & pollutant: CO_2,NMVOC, N_2O **GHG Key Category:** no **Completeness: yes** **Uncertainty:CO_2: 25 %**

Time series consistency: yes **Sector specific QA/QC and verification:** yes **Recalculation: yes** **Planned improvements: yes**

Methodology, Activity data & Emission factor (CO_2 emissions):

Para los COVNM, la metodología aplicada para la estimación de las emisiones es esencialmente la de EMEP/CORINAIR, complementada con aportaciones y consultas realizadas con IIASA y EGTEI2. Como especificidades cabe destacar que, para algunas fuentes emisoras de especial relevancia, la información se ha recabado y procesado a nivel de planta individualizada (caso de las plantas de fabricación de automóviles). Para las restantes fuentes emisoras, la información sobre las variables de actividad procede en su inmensa mayoría de las

asociaciones empresariales correspondientes, entre las que cabe destacar las siguientes: Asociación Española de Fabricantes de Pinturas y Tintas de Imprimir (ASEFAPI); Federación Empresarial de la Industria Química Española (FEIQUE); Confederación Española de Empresarios de Plástico (ANAIP); Asociación Técnica del Poliuretano Aplicado (ATEPA); Asociación Nacional de Poliestireno Expandido (ANAPE); Asociación de la Industria del Poliuretano Rígido (IPUR); Consorcio Nacional de Industriales del Caucho (COFACO); Asociación Nacional de Empresas para el Fomento de las Oleaginosas y su Extracción (AFOEX); Asociación Nacional de Empresas de Protección de la Madera (ANEPROMA). Asimismo, se ha utilizado en el caso de algunas actividades información de estadísticas generales, tales como la población del Instituto Nacional de Estadística (INE), la Encuesta Industrial (INE) o la publicación "La Industria Química en España" del Ministerio de Industria, Turismo y Comercio (MITYC).

En cuanto a los factores de emisión, la metodología utilizada trata de cuantificar el contenido de COVNM en los disolventes y otros productos que contienen estas sustancias. En su caso, se incorporan los coeficientes reductores correspondientes a las distintas técnicas de aplicación y de abatimiento de las emisiones resultantes. En particular, y para el caso de aplicación de pinturas, es especialmente relevante la diferenciación entre los distintos tipos de pinturas (al agua, al disolvente, etc.). En la medida que se dispone de información de la evolución de estas técnicas en el tiempo, los factores aparecen anualizados.

Especial mención merece el caso de las fábricas de automóviles, para las cuales se ha realizado un tratamiento individualizado en cada planta, recabando la información sobre cantidades de concentrado y disolvente utilizadas y sus contenidos en COV en las distintas fases de las líneas de pintado del proceso productivo, así como de los procesos de recuperación y eliminación implantados en cada centro, de manera que la emisión se estima por balance de masas.

Una vez que se han determinado las emisiones inmediatas de COVNM su conversión a CO_2 final se realiza utilizando el siguiente algoritmo: Emisión CO_2 = Emisión COVNM · 0,85 · 44/12; donde 0,85 es el coeficiente para pasar la masa de COVNM a masa de carbono, y 44/12 para expresar la masa de carbono en masa de CO_2.

Methodology, Activity data & Emission factor (N_2O emissions):

Por lo que al N_2O se refiere, las emisiones consideradas en el inventario se circunscriben, tal y como se ha mencionado anteriormente, al uso de este gas con fines anestésicos. El óxido nitroso, con su característica de mayor solubilidad en grasas que en el agua, es transportado en forma gaseosa por la sangre hasta el sistema nervioso central a través de los líquidos contenidos en este último, donde se produce un estado de complete inconsciencia o narcosis. Como muchos otros productos anestésicos volátiles, el N_2O sale del organismo sin experimentar cambios, es decir, es refractario al catabolismo de los procesos biológicos. Debido a esta propiedad la emisión de N_2O se considera igual al consumo que de dicho gas se hace para este uso. Dicho consumo se ha estimado a partir de la información facilitada por el Ministerio de Sanidad y Política Social para los años 2000-2010, habiéndose estimado los consumos correspondientes a los años 1990-1999 mediante procedimientos de extrapolación, utilizando como información complementaria los datos suministrados para dicho periodo por una de las grandes empresas del sector.

Sweden (NIR SE 2012)

GHG & pollutant: CO_2,NMVOC, N_2O **GHG Key Category:** no **Completness: yes** **Uncertainty: CO_2 25 %**

Time series consistency: yes **Sectorspecific QA/QC and verification**: no **Recalulation: yes** **Planned improvements: no**

Paint application (CRF 3.A) All activity data from 1995 has been obtained from the Products register at the Swedish Chemicals Agency. Emissions from 1988 are taken from a time series that was compiled in a special study concerning NMVOC emissions, carried out by SMED in 2002. The emissions for 1990-1994 have been interpolated based on the information from the late 1980´s and known data for 1995.

Degreasing and Dry cleaning (CRF 3.B) All activity data from 1995 has been obtained from the Products Register at the Swedish Chemicals Agency. Emission data for 1988 is based on reported quantities of tetrachloroethylene from the Swedish Chemicals Agency. After 1995 also other substances for degreasing and dry cleaning are included. Of the total amount of NMVOC used within CRF 3B these “non tetrachloretylene” substances contribute approximately 30%. As not only tetrachloroethylene is included in the time series after 1995, the NMVOC emissions reported 1988 is recalculated using a correction factor based on the proportion of other NMVOCs of the total NMVOC for 1995 (tetrachloroethylene plus 30 %). Emissions between 1990 and 1994 have been interpolated based on the information from the late 1980´s and known data for 1995. The solvents used within CRF 3B includes a lower carbon share compared to the solvents used in the other sub-codes within CRF 3.

Chemical products, Manufacture and Processing (CRF 3.C) The category includes emissions from car manufacturing, paint industry and from rubber industry. Emissions from car manufacturing contribute by approximately 50%, paint industry by 30 % and rubber industry by 20 % of the reported emissions in CRF 3C. Emission data for car manufacturing has been compiled from environ-mental reports for 1990 and data for 1991-1994 has been interpolated. For paint industry emission data for 1990-1994 has been taken from the old time series given in a special study concerning NMVOC emissions, carried out by SMED in 2002. Emission data for the rubber industry is known for 1988118 and data for 1990-1994 have been interpolated based on the information from the late 1980´s and known data for 1995.

Other (CRF 3.D) Solvents used in printing industry, for preservation of wood, in leather industry and in textile industry have been estimated separately. The code also includes solvents used by other industries not reported separately, and also solvents for domestic use. The printing industry contributes by 8 %, preservation of wood 1 %, leather and textile industry < 1 % and general solvent use 90 % of the total reported emissions in CRF 3D. Emission data for 1988 is known for most industries included in CRF 3D and in most cases the emissions for 1990-1994 have been interpolated based on information from the late 1980´s and known data for 1995.

There are two companies in Sweden selling N_2O in gas cylinders. Information on sold amounts was obtained from one of the companies (1990 - 1991) and from the Products Register at the Swedish Chemicals Agency (1992 - 2008). The time series of use of N_2O in Sweden are reported in Other use of N_2O (3D4) since no back-ground data is available to separate between the source categories Use of N_2O for Anaesthesia (3D1) and N_2O from Aerosol cans (3D3). Consequently CRF codes 3D1 and 3D3 are both reported as IE. Activity data for the latest year, 2009, is not yet official and hence Sweden has chosen to report data from 2008 also for 2009. Data for 2009 will be updated in the next submission.

United Kingdom (NIR GB 2012)

GHG & pollutant: NMVOC **GHG Key Category**: no **Completness: no** **Uncertainty: no**

Time series consistency: yes **Sectorspecific QA/QC and verification:** not provided **Recalulation: yes** **Planned improvements: yes**

Paint Application (3A): Emission estimates for most types of coatings are based on annual consumption data and emission factors provided by the British Coatings Federation (BCF, 2011). Emission estimates for drum coatings, metal packaging and OEM coatings are estimated instead using a combination of consumption data and emission factors and estimates made on a plant by plant basis using information supplied by the Metal Packaging Manufacturers Association (MPMA, 2000) and the regulators of individual sites.

Degreasing and Dry cleaning (CRF 3.B) Emission estimates for surface cleaning processes are based on estimates of annual consumption and emission factors. Consumption estimates are based on data from UK industry sources and UK and European trade associations, together with some published data. Some extrapolation of data is necessary, using Index of Output data produced annually by the Office for National Statistics (ONS, 2010), although this is not expected to introduce significant uncertainty into the estimates. Emission factors assume that all hydrocarbon and oxygenated solvent is emitted, while emission factors for chlorinated solvents are lower, reflecting the fact that some solvent is sent for disposal rather than emitted.Emission estimates for dry cleaning are based on estimates of solvent consumption by the sector. Industry-sourced data are available for some years and estimates for the remaining years are based on a model of the sector, which takes account of changes in the UK population and the numbers of machines of different types and with different emission levels.Emission estimates for leather degreasing are based on a single estimate of solvent use extrapolated to all years using the Index of Output for the leather industry, which is produced annually by the ONS.

Chemical products, Manufacture and Processing (CRF 3.C) Emission estimates for coating of film, leather, and textiles as well as estimates for tyre manufacture are based on plant-by-plant emission estimates, made on the basis of information available from regulators. Emissions from coating manufacture are calculated from the solvent contained in coatings produced in the UK, by assuming that an additional 2.5% of solvent was lost during manufacture. Emissions from the manufacture of rubber goods other than tyres are based on solvent consumption estimates provided by the British Rubber Manufacturers Association (BRMA, 2001), which are extrapolated to other years on the basis of the Index of Output figures for the rubber industry which are published each year by the ONS.

Other (CRF 3.D) Emission estimates are based on one of three approaches: 1) Estimates are made based on activity data and emission factors supplied by industry sources (printing processes, consumer products, wood preservation); 2)Estimates are made for each process in a sector based on information provided by regulators or process operators (seed oil extraction, pressure sensitive tapes, paper coating); 3)Estimates are based on estimates of solvent consumption supplied by industry sources (adhesives, aerosols, agrochemicals, miscellaneous solvent use).

5.3 Sector-specific quality assurance and quality control (EU-15)

There are no sector-specific QA/QC procedures for this sector.

5.4 Sector-specific recalculations (EU-15)

Table 5.7 shows that in the solvent sector recalculations were made for CO_2 and N_2O.

Table 5.7 Sector 3 Solvent and Other Product Use: Recalculations of total GHG emissions and recalculations of GHG emission for 1990 and 2009 by gas (GgCO_2-equivalents and %)

1990	CO_2		CH_4		N_2O		HFCs		PFCs		SF_6	
		percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent
Total emissions and removals	65,596	2.1%	-15,455	-3.4%	-3,212	-0.8%	-224	-0.8%	499	3.0%	-142	-1.3%
Solvent and other product use	-55	-0.6%	0	0.0%	0	0.0%	NO	NO	NO	NO	NO	NO
2009												
Total emissions and removals	94,276	3.4%	-5,030	-1.6%	-2,289	-0.8%	3,203	4.9%	795	40.8%	-219	-3.6%
Solvent and other product use	-142	-2.5%	0	0.0%	-11	-0.3%	NO	NO	NO	NO	NO	NO

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 5.8 provides an overview of Member States' contributions to EU-15 recalculations. Denmark and Portugal had recalculations for 1990; France, Germany, Italy, Portugal, Spain and Sweden had recalculations for 2009.

Table 5.8 Sector 3 Solvent and Other Product Use: Contribution of Member States to EU-15 recalculations for 1990 and 2009 by gas (difference between latest submission and previous submission Gg of CO_2 equivalents)

	1990						2009					
	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
Austria	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
Belgium	NA	0	0	NO	NO	NO	NA	0	0	NO	NO	NO
Denmark	-43	0	0	NO	NO	NO	0	0	-19	NO	NO	NO
Finland	0	0	0	NO	NO	NO	2	0	0	NO	NO	NO
France	2	0	0	NO	NO	NO	-23	0	0	NO	NO	NO
Germany	0	0	0	NO	NO	NO	-160	0	0	NO	NO	NO
Greece	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
Ireland	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
Italy	0	0	0	NO	NO	NO	-60	0	13	NO	NO	NO
Luxembourg	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
Netherlands	0	0	0	NO	NO	NO	8	0	0	NO	NO	NO
Portugal	-15	0	0	NO	NO	NO	-15	0	-11	NO	NO	NO
Spain	0	0	0	NO	NO	NO	75	0	21	NO	NO	NO
Sweden	0	0	0	NO	NO	NO	30	0	-15	NO	NO	NO
UK	NE	0	0	NO	NO	NO	NE	0	0	NO	NO	NO
EU-15	**-55**	**0**	**0**	**NO**	**NO**	**NO**	**-142**	**0**	**-11**	**NO**	**NO**	**NO**

6 Agriculture (CRF Sector 4)

Half the European Union's land is farmed. This fact alone highlights the importance of farming for the EU's natural environment. Farming and nature exercise a profound influence over each other. Farming has contributed over the centuries to creating and maintaining a variety of valuable semi-natural habitats. Today these shape the majority of the EU's landscapes and are home to many of the EU's richest wildlife. Farming also supports a diverse rural community that is not only a fundamental asset of European culture, but also plays an essential role in maintaining the environment in a healthy state[29].

The links between the richness of the natural environment and farming practices are complex. While many valuable habitats in Europe are maintained by extensive farming, and a wide range of wild species rely on this for their survival, agricultural practices can also have an adverse impact on natural resources. Pollution of soil, water and air, fragmentation of habitats and loss of wildlife can be the result of inappropriate agricultural practices and land use.

Agriculture in Europe is determined by the Common Agriculural Policy (CAP) of the European Union. The CAP dates from 1957, and its foundations are entrenched in the Treaty of Rome. Initially, the emphasis of the CAP was to increase agricultural productivity, partly for food security reasons, but also to ensure that the EU had a viable agricultural sector and that consumers had a stable supply of affordable food (Gay et al., 2005). With the MacSharry reform of 1992 several steps were taken by the EU to shift CAP subsidies away from price and market support towards direct support for farmers. This was further pursued with the Agenda 2000 reform, as signified by the shift in focus towards the maintenance and enhancement of the rural environment and the growing recognition of agriculture as a multifunctional activity. In environmental terms, the focus is on

- less-favoured areas and areas with environmental restrictions, and
- on agricultural production methods designed to protect the environment and to maintain the countryside.

However price support and income payments, together with milk quotas, remained the dominant support measures. The 2003 CAP reform made further progress in the direction initiated by the Agenda 2000 reform, by aiming to make European agriculture more market oriented and giving a stronger focus to environmental protection. With the CAP reform, cross-compliance became an obligatory element of the CAP. Cross-compliance establishes a link between the granting of income support to the farmers and the compliance by the beneficiary with specified requirements of public interest (Oenema, 2008). These are given in

- “Statutory management requirements” (SMR, (Annex III of Regulation (EC) No 1782/2003) which are set in 19 community legislative acts on environment, food safety, animal health and welfare, as well as
- the obligation to maintaining land in good agricultural and environmental conditions (GAECs) and maintaining permanent pasture at level at 1.5.2004. Definitions of GAEC are specified at national or regional level and should warrant appropriate soil protection, ensure a minimum level of maintenance of soil organic matter and soil structure and avoid the deterioration of habitats.

[29] http://europa.eu.int/comm/agriculture/envir/index_en.htm

An important driver of GHG emissions from agriculture were the milk quota. For example in the Netherlands, total milk production is determined mainly by EU policy on milk quota, which remained unchanged. Therefore, the effect of increasek milk production per cow needed to be counteracted by decreasing the animal number of adult dairy cattle.

The *Nitrates Directive* (Council Directive 91/676/EEC) is the SMR with the largest impact on greenhouse gas emissions from agriculture. The directive aims at reducing and preventing water pollution caused by nitrates from agricultural sources with the goal that nitrate concentrations in groundwater will not exceed 50 mg NO_3 L^{-1} and listing codes of good practice (Annex II A) to be implemented by the farmers on a voluntary basis. Nitrate vulnerable zones must be designated on the basis of monitoring results which indicate that the groundwater and surface waters in these zones are or could be affected by nitrate pollution from agriculture. The action program must contain mandatory measures relating to: (i) periods when application of animal manure and fertilizers is prohibited; (ii) capacity of and facilities for storage of animal manure; and (iii) limits to the amounts of animal manure and fertilizers applied to land.

This affected emissions in most countries, for example in Belgium, manure Action Plans (based on the Nitrate directive) in Flanders affected NH_3 volatilization from manure application. The first action plan in 1991 regulated the reduced in which manure can be spread and foresees low-emission techniques for the application of manure on land. The MAP2bis in 2000 focuses on the reduction of the manure surplus and manure processing in order to reduce the NH_3 emissions from manure application on land. Other MAP's followed.

In Denmark, the environmental policy has introduced a series of measures to prevent loss of nitrogen from agricultural soil to the aquatic environment. The measures include improvements to the utilisation of nitrogen in manure, a ban on manure application during autumn and winter, increasing area with winter-green fields to catch nitrogen, a maximum number of animals per hectare and maximum nitrogen application rates for agricultural crops. All farmers are obliged to do N-mineral acounting a a farm and field level with the N-excretaion data from FAS (Faculty of Agriucltural Sciences). The N figures also include the quantities of mineral fertilisers bought and sold. Suppliers of mineral fertilisers are required to report all N sales to commmercial farmers to the Plant Directorate. An active environmental policy has brought about a decrease in the N-excretion, a decrease of emission per produced animal, because of more efficient feeding. As a result of increasing requirements to reduce the nitrogen loss to the environment, the consumption of nitrogen in synthetic fertiliser has more than halved from 1990 to 2007.

In the Netherlands, manure and fertilizer policy influences livestock numbers. Especially young cattle, pigs and poultry numbers decreased by the introduction of measures like buying up part of the so-called pig and poultyr production rights (ceilings for total animal numbers) by the government and lowering the maximum nutrient application standards for manure and fertilizer.

However, greater compliance to standards and requirements for animal welfare and the housing of animals may contribute to increasing emissions (so-called pollution swapping).

Beside the environmentally-targeted directives, also the so-called first pillar of the CAP (dealing with market support in contrast to pillar two covering rural development measures) had a strong impact on the greenhouse gas emissions from agriculture in Europe, namely through the milk quota system, which lead to a strong reduction of animal numbers in the dairy sector to compensate for the increasing animal performance during the last decades.

Other important policies affecting greenhouse gas emissions from agriculture, particularly by addressing the abatement of air pollution through the control of NO_x and NH_3 emissions include, under others,

- the 1999 *Gothenburg Protocol* under the *Convention on Long Range Transboundary Air Pollution (CLRTAP)* to 'Abate Acidification, Eutrophication and Ground-level Ozone', which entered into force on 22 June 2006;
- the National Emission Ceilings Directive (NEC - Directive 2001/81/EC), which sets upper limits for each Member State for the total emissions in 2010 of the four pollutants responsible for acidification, eutrophication and ground-level ozone pollution;
- the *Integrated Pollution Prevention and Control* (IPPC) Directive, which was established in 1996 (http://ec.europa.eu/environment/ippc/index.htm), and aims at minimizing pollution from point sources, i. e., intensive animal production facilities (pig and poultry farms, with > 2000 fattening pigs; >750 sows; or > 40,000 head of poultry). These are required under the directive to apply control techniques for preventing NH_3 emissions according to Best Available Technology (BAT).

Structural changes are caused also by the general development of countries. For example, in Finland, the membership in the EU resulted in changes in the economic structure followed by an increase in the average farm size and a decrease in the number of small farms (Pipatti 2001), causing also a decrease in the livestock numbers for most animal types. Swedish agriculture has undergone radical structural changes and rationalisations over the past 50 years. One fifth of the Swedish arable land cultivated in the 1950s is no longer farmed. Closures have mainly affected smallholdings and those remaining are growing larger. In 1999, some 31,000 agricultural holdings were livestock farms, 14,000 were purely crop husbandry farms, and only 5,000 were a combination of the two. Livestock farmers predominately engage in milk production and the main crops grown in Sweden are grain and fodder crops.101 The decrease of agricultural land area has continued since Sweden joined the European Union in 1995 and the acreages of land for hay and silage has increased. Organic farming has increased from 3 % of the arable land area in 1995 to 17 % in 2007.

6.1 Overview over the sector

Figure 6.1 EU-15 GHG emissions for 1990–2010 from CRF Sector 4: 'Agriculture' in CO_2 equivalents (Tg)

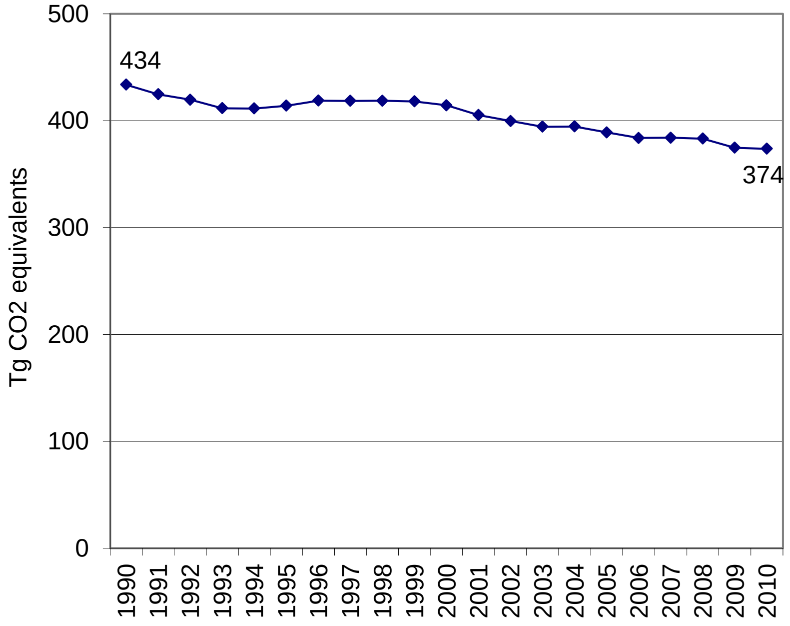
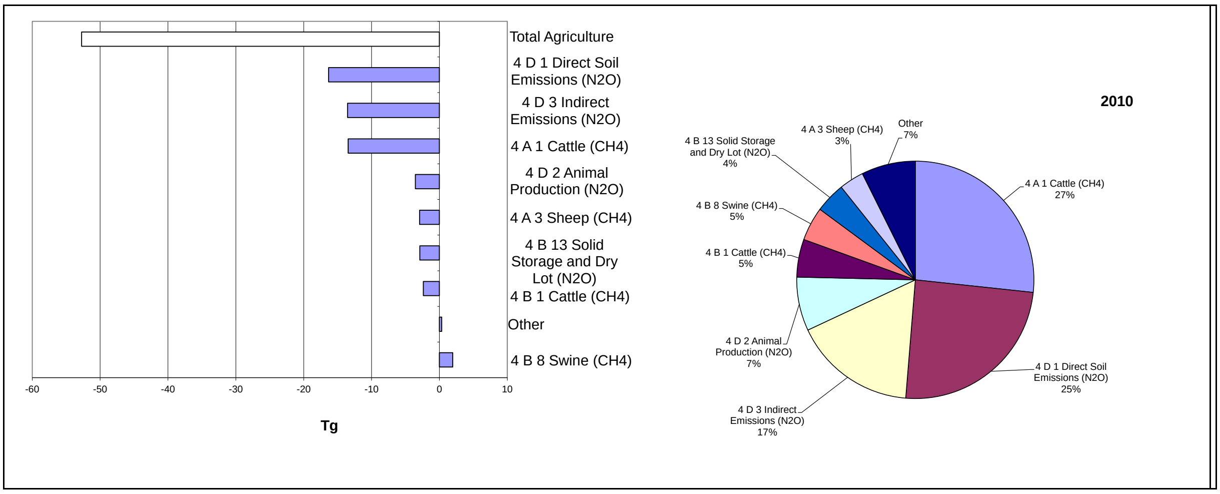


Figure 6.2 shows that large reductions occurred in the largest key sources N_2O from 4.D.1: 'Direct soil emissions', 4.D.3: 'Indirect emissions' and CH_4 from 4.A.1: 'Cattle'. The main reasons for this are decreasing use of fertiliser and manure and declining cattle numbers in most Member States.

Figure 6.2 Absolute change of GHG emissions by large key source categories 1990–2010 in CO_2 equivalents (Tg) in CRF Sector 4: 'Agriculture' and share of largest key source categories in 2010



6.2 Source Categories

Table 6.1 shows total GHG and CH_4 emissions by Member State from 4A Enteric Fermentation. Between 1990 and 2010, CH_4 emission from 4A Enteric fermentation decreased by 12 %. The absolute decrease was largest in Germany, the absolute increase was largest in Spain.

Table 6.1 **4A Enteric Fermentation: Member States' contributions to total GHG and CH_4 emissions**

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2010 (Gg CO_2 equivalents)	CH_4 emissions in 1990 (Gg CO_2 equivalents)	CH4 emissions in 2010 (Gg CO_2 equivalents)
Austria	3,753	3,257	3,753	3,257
Belgium	4,140	3,555	4,140	3,555
Denmark	3,247	2,856	3,247	2,856
Finland	1,933	1,604	1,933	1,604
France	30,472	28,459	30,472	28,459
Germany	26,672	20,278	26,672	20,278
Greece	3,246	3,224	3,246	3,224
Ireland	9,574	8,496	9,574	8,496
Italy	12,278	10,732	12,278	10,732
Luxembourg	261	252	261	252
Netherlands	7,653	6,649	7,653	6,649
Portugal	2,664	2,766	2,664	2,766
Spain	11,568	12,377	11,568	12,377
Sweden	3,070	2,713	3,070	2,713
United Kingdom	18,457	15,202	18,457	15,202
EU-15	**138,989**	**122,420**	**138,989**	**122,420**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Enteric fermentation from cattle is the largest single source of CH_4 emissions in the EU-15 accounting for 2,7 % of total GHG emissions in 2010. Between 1990 and 2010, CH_4 emissions from enteric fermentation from cattle declined by 11 % in the EU-15 (Table 6.2). In 2010, the emissions were at the level of 2009. The main driving force of CH_4 emissions from enteric fermentation is the number of cattle, which was 17 % below 1990 levels in 2010. The Member States with most emissions from this source were France and Germany (together 44,3 %). All Member States except Spain, Portugal and Greece reduced CH_4 emissions from enteric fermentation of cattle between 1990 and 2010.

Table 6.2 **4A1 Cattle: Member States' contributions to CH_4 emissions and information on method applied and emission factor**

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)		
Austria	3,551	3,056	3,045	3.0%	-11	0%	-506	-14%	T1,T2	CS,D
Belgium	3,887	3,285	3,305	3.2%	20	1%	-582	-15%	T2	CS,D
Denmark	2,929	2,405	2,442	2.4%	37	2%	-488	-17%	T2	CS
Finland	1,011	770	778	0.8%	8	1%	-234	-23%	T2	CS
France	27,560	26,137	26,071	25.5%	-65	0%	-1,488	-5%	T3	CS
Germany	25,342	19,317	19,193	18.8%	-124	-1%	-6,149	-24%	CS,T2	CS
Greece	929	936	941	0.9%	5	1%	12	1%	T2	CS,D
Ireland	8,485	8,076	7,865	7.7%	-212	-3%	-620	-7%	CS,T2	CS
Italy	10,138	8,635	8,332	8.1%	-303	-4%	-1,806	-18%	T2	CS
Luxembourg	257	240	245	0.2%	5	2%	-12	-5%	T2	CS
Netherlands	6,783	5,831	5,870	5.7%	39	1%	-913	-13%	T2	CS
Portugal	1,814	2,157	2,152	2.1%	-5	0%	337	19%	T2	CS
Spain	6,473	7,867	7,940	7.8%	73	1%	1,467	23%	CS,T2	CS,D
Sweden	2,698	2,345	2,329	2.3%	-16	-1%	-369	-14%	CS	CS
United Kingdom	13,727	11,671	11,826	11.6%	155	1%	-1,901	-14%	T2	CS,D
EU-15	**115,585**	**102,726**	**102,332**	**100.0%**	**-394**	**0%**	**-13,253**	**-11%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

6.2.1 Entric fermentation (CRF Source Category 4A) (EU-15)

Enteric fermentation from sheep is the fifth largest single source of CH_4 emissions in the EU-15 and accounts for 0.34 % of total GHG emissions in 2010. Between 1990 and 2010, CH_4 emissions from enteric fermentation of sheep declined by 22 % in the EU-15 (Table 6.3). In 2010, the emissions were 3 % lower compared to 2009. The main driving force of CH_4 emissions from enteric fermentation is the number of sheep, which was 25 % below 1990 levels in 2010. The Member States with most emissions from this source were Spain and the United Kingdom (50,5 %). Most Member States reduced CH_4 emissions from enteric fermentation of sheep.

Table 6.3 **4A3 Sheep: Member States' contributions to CH_4 emissions and information on method applied and emission factor**

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)		
Austria	52	58	60	0.5%	2	4%	8	16%	T1	D
Belgium	32	18	17	0.1%	-1	-6%	-15	-46%	T1	D
Denmark	33	42	40	0.3%	-2	-4%	7	21%	T2	D,CS
Finland	15	21	22	0.2%	1	7%	7	50%	T2	CS
France	2,170	1,590	1,586	12.3%	-3	0%	-584	-27%	T3	CS
Germany	549	395	351	2.7%	-44	-11%	-198	-36%	T1	D
Greece	1,656	1,685	1,680	13.0%	-5	0%	24	1%	T2	CS,D
Ireland	1,032	589	557	4.3%	-32	-5%	-476	-46%	T1	D
Italy	1,468	1,346	1,327	10.3%	-19	-1%	-141	-10%	T1	D
Luxembourg	1	1	2	0.0%	0	3%	0	25%	T1	D
Netherlands	286	188	190	1.5%	2	1%	-96	-34%	T1	D
Portugal	579	474	453	3.5%	-21	-5%	-127	-22%	T2	CS
Spain	4,269	3,656	3,422	26.5%	-234	-6%	-847	-20%	T2, CS	D, CS
Sweden	68	91	95	0.7%	4	5%	27	39%	T1	D
United Kingdom	4,396	3,160	3,102	24.0%	-58	-2%	-1,294	-29%	T1	CS
EU-15	**16,608**	**13,313**	**12,904**	**100.0%**	**-409**	**-3%**	**-3,704**	**-22%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

6.2.2 Manure management (CRF Source Category 4B) (EU-15)

Table 6.4 shows total GHG, CH_4 and N_2O emissions by Member State from 4B Manure Management. Between 1990 and 2010, CH_4 and N_2O emissions from 4B Manure Management decreased by 0,2 % and 13 % respectively.

Table 6.4 **4B Manure Management: Member States' contributions to total GHG emissions, CH_4 and N_2O emissions**

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2010 (Gg CO_2 equivalents)	CH_4 emissions in 1990 (Gg CO_2 equivalents)	CH4 emissions in 2010 (Gg CO_2 equivalents)	N_2O emissions in 1990 (Gg CO2 equivalents)	N2O emissions in 2010 (Gg CO2 equivalents)
Austria	1,367	1,256	431	331	935	925
Belgium	2,690	2,443	1,728	1,658	962	786
Denmark	1,593	1,709	993	1,288	600	421
Finland	734	728	247	300	487	429
France	18,798	18,708	12,262	13,593	6,535	5,115
Germany	8,895	7,841	6,325	5,573	2,570	2,268
Greece	679	610	337	315	342	296
Ireland	2,789	2,576	2,354	2,134	435	442
Italy	7,383	6,268	3,462	2,567	3,921	3,701
Luxembourg	121	123	80	97	41	26
Netherlands	4,207	3,886	3,034	2,881	1,173	1,004
Portugal	1,709	1,364	1,184	1,065	526	299
Spain	6,191	8,023	3,930	5,407	2,260	2,617
Sweden	966	755	233	295	733	460
United Kingdom	5,515	4,320	3,555	2,654	1,960	1,666
EU-15	**63,637**	**60,612**	**40,156**	**40,156**	**23,481**	**20,455**

Abbreviations explained in the Chapter 'Units and abbreviations'.

CH_4 emissions from 4B1 Cattle account for 0.52 % of total EU-15 GHG emissions in 2010. Between 1990 and 2010, CH_4 emissions from this source decreased by 4 % (Table 6.5). Germany and France are responsible for 49.5 % of the total EU-15 emissions from this source. Seven Member States had reductions between 1990 and 2010. In absolute terms, Ireland, Germany and Italy had the most significant decreases from this source.

Table 6.5 4B1 Cattle: Member States' contributions to CH_4 emissions and information on method applied and emission factor

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)		
Austria	283	230	229	1.2%	-1	0%	-54	-19%	T1,T2	CS,D
Belgium	337	279	283	1.4%	4	1%	-54	-16%	T2	CS,D
Denmark	519	589	596	3.0%	7	1%	77	15%	CS,T2	CS
Finland	71	90	91	0.5%	1	1%	20	27%	T2	CS
France	7,681	8,315	8,265	41.8%	-50	-1%	583	8%	T2	D
Germany	4,088	3,522	3,508	17.7%	-14	0%	-580	-14%	T2	D
Greece	48	45	45	0.2%	0	0%	-2	-5%	T2	CS,D
Ireland	1,888	1,648	1,591	8.0%	-57	-3%	-297	-16%	T2	CS
Italy	1,636	1,079	908	4.6%	-171	-16%	-728	-45%	T2	CS
Luxembourg	47	60	61	0.3%	1	2%	14	29%	T2	CS
Netherlands	1,574	1,693	1,715	8.7%	22	1%	141	9%	T2	CS
Portugal	47	76	77	0.4%	0	1%	30	64%	T2	CS
Spain	473	418	411	2.1%	-6	-2%	-62	-13%	CS,T2	CS,D
Sweden	141	209	210	1.1%	1	0%	68	48%	T2	CS
United Kingdom	1,755	1,720	1,778	9.0%	59	3%	23	1%	T2	CS,D
EU-15	**20,589**	**19,972**	**19,768**	**100.0%**	**-205**	**-1%**	**-821**	**-4%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

CH_4 emissions from 4B8 Swine account for 0.46 % of total EU-15 GHG emissions in 2010. Between 1990 and 2010, CH_4 emissions from this source increased by 5 % (Table 6.6). France and Spain are responsible for 53,6 % of the total EU-15 emissions from this source. In absolute terms, Spain had the most significant increases from this source.

Table 6.6 **4B8 Swine: Member States' contributions to CH_4 emissions and information on method applied and emission factor**

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)		
Austria	123	78	77	0.4%	-1	-1%	-46	-37%	T1	D
Belgium	1,369	1,312	1,344	7.6%	31	2%	-25	-2%	T2	CS,D
Denmark	423	595	607	3.4%	12	2%	185	44%	CS,T2	CS
Finland	IE	IE	IE	-	-	-	-	-	NA	NA
France	3,832	4,681	4,627	26.3%	-54	-1%	795	21%	T2	D
Germany	2,118	2,021	1,933	11.0%	-88	-4%	-185	-9%	T2	CS
Greece	146	129	129	0.7%	-1	-1%	-18	-12%	T1	D
Ireland	332	389	406	2.3%	18	5%	74	22%	T2	D
Italy	1,432	1,292	1,151	6.5%	-140	-11%	-281	-20%	T2	CS
Luxembourg	31	33	34	0.2%	1	4%	3	11%	T1	D
Netherlands	1,140	1,126	1,063	6.0%	-63	-6%	-77	-7%	T2	CS
Portugal	1,088	874	867	4.9%	-8	-1%	-221	-20%	T2	CS
Spain	3,264	4,992	4,811	27.3%	-181	-4%	1,548	47%	T2, CS	D, CS
Sweden	57	45	45	0.3%	-1	-1%	-12	-22%	T2	CS
United Kingdom	1,496	546	516	2.9%	-30	-6%	-981	-66%	T2	CS,D
EU-15	**16,852**	**18,114**	**17,611**	**100.0%**	**-504**	**-3%**	**759**	**5%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

N_2O emissions from 4B13 Solid Storage and Dry Lot account for 0.4 % of total EU-15 GHG emissions in 2010. Between 1990 and 2010, N_2O emissions from this source decreased by 19 % (Table 6.7). Italy and France are responsible for 51.5 % of the total EU-15 emissions from this source.All counties but Ireland and Spain decreased their emissionsbetween 1990-2010. In absolute terms, France had the most significant decrease from this source.

Table 6.7 **4B13 Solid Storage and Dry Lot: Member States' contributions to N_2O emissions and information on method applied and emission factor**

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)		
Austria	750	682	681	4.3%	-1	0%	-69	-9%	T1	D
Belgium	894	718	727	4.6%	9	1%	-167	-19%	T1	D
Denmark	314	93	88	0.6%	-4	-5%	-225	-72%	CS,D	D
Finland	423	334	342	2.2%	8	2%	-82	-19%	D	D
France	6,386	4,948	4,937	31.1%	-12	0%	-1,450	-23%	T2	D
Germany	1,179	951	947	6.0%	-4	0%	-232	-20%	T1,T2	D
Greece	322	276	277	1.7%	0	0%	-45	-14%	D	D
Ireland	371	397	379	2.4%	-18	-5%	8	2%	T1	D
Italy	3,728	3,351	3,248	20.4%	-102	-3%	-480	-13%	T2	D,CS
Luxembourg	40	23	23	0.1%	0	1%	-17	-42%	T1	D
Netherlands	937	838	844	5.3%	6	1%	-93	-10%	T2	D
Portugal	509	287	278	1.8%	-8	-3%	-230	-45%	D	D
Spain	1,537	1,513	1,629	10.3%	116	8%	92	6%	D, T2, CS	D
Sweden	654	325	329	2.1%	4	1%	-325	-50%	T1,T2	CS,D
United Kingdom	1,550	1,169	1,155	7.3%	-13	-1%	-395	-25%	T1	D
EU-15	**19,595**	**15,905**	**15,885**	**100.0%**	**-19**	**0%**	**-3,710**	**-19%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

N_2O emissions from 4B14 Other account for 0.06 % of total EU-15 GHG emissions in 2010. Between 1990 and 2010, N_2O emissions from this source increased by 55 % (Table 6.8). Spain and the UK are responsible for about 60% of the total EU-15 emissions from this source.

Table 6.8 4B14 Other: Member States' contributions to N_2O emissions

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010	
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)
Austria	152	218	217	8.8%	-1	-1%	65	43%
Belgium	57	48	49	2.0%	1	3%	-9	-15%
Denmark	192	255	258	10.5%	3	1%	66	34%
Finland	44	68	68	2.8%	1	1%	24	55%
France	NA	NA	NA	-	-	-	-	-
Germany	NO	NO	NO	-	-	-	-	-
Greece	13	13	13	0.5%	0	0%	0	3%
Ireland	NO	NO	NO	-	-	-	-	-
Italy	NO	304	300	12.2%	-4	-1%	300	-
Luxembourg	0.02	0.31	0.32	0.01%	0	1%	0	1206%
Netherlands	NO	NO	NO	-	-	-	-	-
Portugal	NO	NO	NO	-	-	-	-	-
Spain	715	958	983	40.1%	25	3%	268	38%
Sweden	64	106	107	4.4%	2	2%	44	69%
United Kingdom	343	463	455	18.6%	-8	-2%	113	33%
EU-15	**1,579**	**2,432**	**2,451**	**100.0%**	**18**	**1%**	**872**	**55%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

6.2.3 Agricultural soils (CRF Source Category 4D) (EU-15)

N_2O emissions from this source category account for 5 % of total GHG emissions. Table 6.9 shows total GHG and N_2O emissions by Member State for N_2O from 4D Agricultural Soils. N_2O emissions from this source decreased by 18 % between 1990 and 2010. All EU-15 Member States decreased emissions.

Table 6.9 **4D Agricultural Soils: Member States' contributions to total GHG and N_2O emissions**

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2010 (Gg CO_2 equivalents)	N_2O emissions in 1990 (Gg CO_2 equivalents)	N2O emissions in 2010 (Gg CO_2 equivalents)
Austria	3,437	2,939	3,430	2,929
Belgium	5,026	4,044	5,026	4,044
Denmark	7,620	4,951	7,620	4,951
Finland	3,948	3,548	3,948	3,548
France	54,594	46,565	54,594	46,565
Germany	47,644	39,360	47,644	39,360
Greece	7,452	5,288	7,452	5,288
Ireland	7,272	6,838	7,272	6,838
Italy	19,482	15,159	19,482	15,159
Luxembourg	364	316	364	316
Netherlands	10,670	6,089	10,670	6,089
Portugal	3,461	2,958	3,461	2,958
Spain	18,997	18,844	18,997	18,844
Sweden	5,028	4,405	5,028	4,405
United Kingdom	32,825	26,386	32,825	26,386
EU-15	**227,819**	**187,689**	**227,812**	**187,680**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 6.10 provides information on emission trends and information on methods applied and emissions factor of the key source from 4D1 Direct soil emissions by Member State. Direct N_2O emissions from agricultural soils is the largest source category of N_2O emissions and accounts for 2.5 % of total EU-15 GHG emissions in 2010. Direct N_2O emissions from agricultural soils occur from the application of mineral nitrogen fertilisers and organic nitrogen from animal manure. Between 1990 and 2010, emissions declined by 17 % in the EU-15. The Member States with most emissions from this source were France and Germany. All Member States reduced N_2O emissions from agricultural soils.

The main driving force of direct N_2O emissions from agricultural soils is the use of nitrogen fertiliser and animal manure, which were 28 % and 11 % below 1990 levels in 2010, respectively. N_2O emissions from agricultural land can be decreased by overall efficiency improvements of nitrogen uptake by crops, which should lead to lower fertiliser consumption on agricultural land. The decrease of fertiliser use is partly due to the effects of the 1992 reform of the common agricultural policy and the resulting shift from production-based support mechanisms to direct area payments in arable production. This has tended to lead to an optimisation and overall reduction in fertiliser use. In addition, reduction in fertiliser use is also due to directives such as the nitrate directive and to the extensification measures included in the agro-environment programmes (EC, 2001).

Table 6.10 **4D1 Direct soil emissions: Member States' contributions to N_2O emissions and information on method applied and emission factor**

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)		
Austria	1,909	1,822	1,738	1.8%	-84	-5%	-171	-9%	T1	D
Belgium	2,786	2,384	2,380	2.5%	-4	0%	-406	-15%	T1a	CS,D
Denmark	4,401	3,125	3,051	3.2%	-74	-2%	-1,351	-31%	CS,D,T1b	D
Finland	2,999	2,657	2,749	2.9%	92	3%	-249	-8%	T1	CS,D
France	24,675	20,968	20,667	21.9%	-302	-1%	-4,009	-16%	CR,T1,T2	CS,D
Germany	29,161	25,217	24,757	26.3%	-460	-2%	-4,404	-15%	CR,T1,T2	CR,D
Greece	2,761	1,381	1,591	1.7%	210	15%	-1,170	-42%	T1,T1a,T1b	CS,D
Ireland	3,025	2,566	2,878	3.1%	312	12%	-146	-5%	T1a,T1b	D
Italy	9,606	7,364	7,236	7.7%	-129	-2%	-2,370	-25%	CS,T1	CS,D
Luxembourg	163	139	137	0.1%	-2	-1%	-26	-16%	T1a,T1b	D
Netherlands	4,137	3,359	3,286	3.5%	-73	-2%	-851	-21%	T1b,T2	CS
Portugal	1,440	1,036	1,035	1.1%	0	0%	-405	-28%	T1a	D
Spain	9,697	8,294	9,276	9.8%	982	12%	-420	-4%	CS,T1a,T1b	D
Sweden	2,792	2,378	2,482	2.6%	104	4%	-310	-11%	CS,T1a,T1b	CS,D
United Kingdom	13,774	10,918	11,021	11.7%	103	1%	-2,753	-20%	T1,T1a	D
EU-15	**113,326**	**93,608**	**94,285**	**100.0%**	**676**	**0.7%**	**-19,042**	**-17%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

N_2O emissions from 4D2 Pasture, Range and Paddock Manure account for 0.7 % of total EU-15 GHG emissions in 2010. Between 1990 and 2010, N_2O emissions from this source decreased by 15 % (Table 6.11). France and the United Kingdom are responsible for 51 % of the total EU-15 emissions from this source. The Netherlands had the greatest reduction in absolute terms while Spain had the largest increases.

Table 6.11 **4D2 Pasture, Range and Paddock Manure: Member States' contributions to N_2O emissions and information on method applied and emission factor**

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)		
Austria	169	95	95	0.3%	1	1%	-73	-43%	T2	D
Belgium	992	780	780	2.8%	0	0%	-211	-21%	T1a	D
Denmark	311	203	197	0.7%	-6	-3%	-114	-37%	CS,D	D
Finland	182	175	179	0.6%	4	2%	-3	-2%	D	D
France	9,718	8,981	8,929	31.8%	-52	-1%	-789	-8%	T2	D
Germany	2,020	1,358	1,334	4.8%	-23	-2%	-685	-34%	CR	CR
Greece	1,821	1,771	1,760	6.3%	-11	-1%	-61	-3%	D	D
Ireland	2,868	2,709	2,636	9.4%	-73	-3%	-233	-8%	T1a	D
Italy	1,736	1,556	1,544	5.5%	-11	-1%	-192	-11%	T1	CS,D
Luxembourg	59	57	58	0.2%	1	2%	-1	-2%	T1	D
Netherlands	3,150	1,300	1,307	4.7%	7	1%	-1,843	-59%	T1b	CS
Portugal	687	826	821	2.9%	-5	-1%	133	19%	T1a	D
Spain	2,273	2,585	2,495	8.9%	-90	-3%	222	10%	`1a, T1b, CS	D
Sweden	386	404	406	1.4%	3	1%	21	5%	T2	CS
United Kingdom	6,613	5,539	5,532	19.7%	-8	0%	-1,082	-16%	T2	CS
EU-15	**32,985**	**28,339**	**28,075**	**100.0%**	**-264**	**-1%**	**-4,910**	**-15%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

N_2O emissions from 4D3 Indirect Emissions account for 1.7 % of total EU-15 GHG emissions in 2010. Between 1990 and 2010, N_2O emissions from this source decreased by 20 % (Table 6.12). France, the UK, Spain, Germany and Italy are responsible for 85,7 % of the total EU-15 emissions from this source.

Table 6.12 4D3 Indirect Emissions: Member States' contributions to N_2O emissions and information on method applied and emission factor

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)		
Austria	1,352	1,180	1,096	1.7%	-84	-7%	-256	-19%	T1a,T1b	D
Belgium	1,248	886	883	1.4%	-3	0%	-365	-29%	T1a	CS,D
Denmark	2,907	1,693	1,703	2.7%	11	1%	-1,204	-41%	CS,D,T1b	D
Finland	767	581	620	1.0%	39	7%	-147	-19%	T1	D
France	20,201	17,172	16,969	26.4%	-203	-1%	-3,231	-16%	T1	D
Germany	16,463	13,626	13,268	20.7%	-358	-3%	-3,195	-19%	CR,D,T1	CR,D
Greece	2,869	1,785	1,937	3.0%	152	9%	-932	-32%	T1a	CS,D
Ireland	1,379	1,277	1,324	2.1%	46	4%	-56	-4%	T1b	CS
Italy	8,140	6,582	6,379	9.9%	-203	-3%	-1,761	-22%	T1	CS,D
Luxembourg	142	120	121	0.2%	1	1%	-21	-15%	T1b	D
Netherlands	3,358	1,502	1,491	2.3%	-11	-1%	-1,867	-56%	T1,T3	D
Portugal	1,333	1,104	1,102	1.7%	-2	0%	-231	-17%	T1a	D
Spain	7,027	6,465	7,072	11.0%	606	9%	44	1%	CS,T1a,T1b	D
Sweden	1,132	829	830	1.3%	1	0%	-302	-27%	CS,T1	D
United Kingdom	12,178	9,188	9,411	14.7%	223	2%	-2,767	-23%	T1	D
EU-15	**80,498**	**63,992**	**64,207**	**100.0%**	**215**	**0%**	**-16,291**	**-20%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

6.3 Methodological issues and uncertainty

All Member States consider their greenhouse gas inventories in the agricultural sector for complete for those categories that are reported to occur in the countries. For categories 4.A, 4.B (both methane and nitrous oxide) and 4.D (nitrous oxide) emissions in all relevant sub-categories are considered (CRF Tables 7s2). CH_4 emissions from rice fields are reported for France, Greece, Italy, Portugal and Spain.

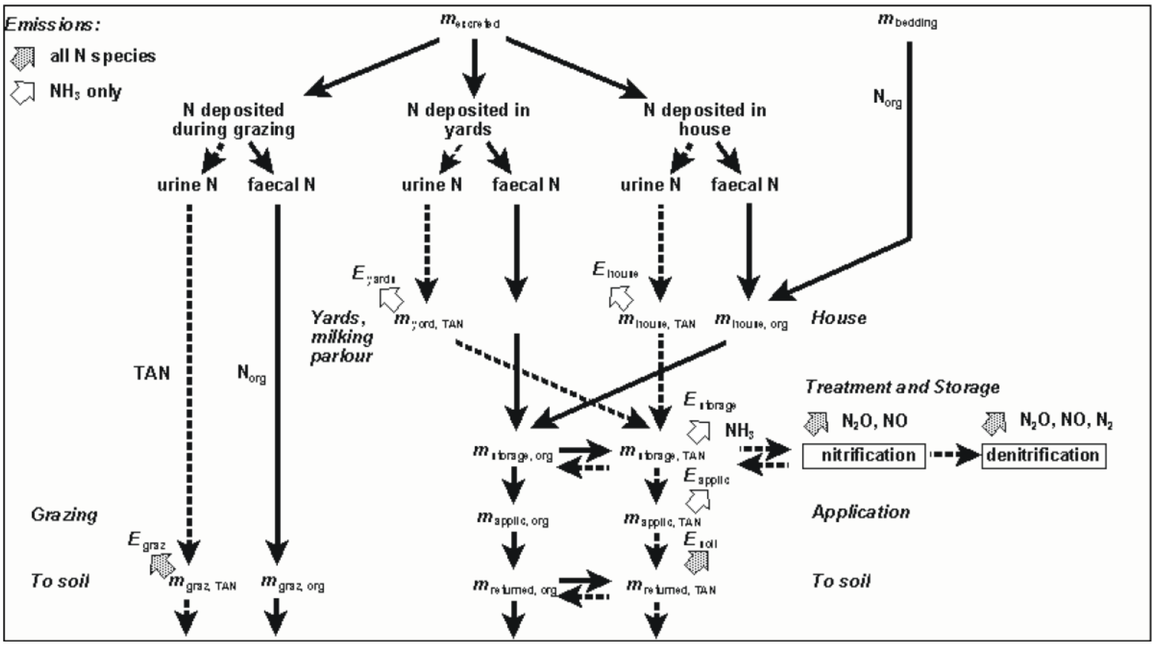
Many countries recognise that in the agriculture sector the emissions from the different categories are inherently linked and are best estimated in a comprehensive model that covers not only greenhouse gases (CH_4 and N_2O) in a consistent manner, but also ammonia. Estimations of ammonia emissions are required for reporting under the Convention on Long-Range Transboundary Air Pollution and are needed to estimate indirect N_2O emissions. Hence, some countries have developed comprehensive models covering consistently different source categories and different gases.

- Germany: GAS-EM (GASeous Emissions) calculates consistently the emissions from the agriucltural sector (Dämmgen et al., 2007). Figure 6.3 shows the flow of nitrogen in manure management systems tracking all fluxes and N-transformation processes in a mass-conservative mode.
- Denmark: DIEMA (Danish Integrated Emission Model for Agriculture) covers emissions of

greenhouse gases, ammonia and particulate matter (Mikkelsen et al., 2005). DIEMA operates with 30 different livestock categories (animal type, weight class, age), which are subdivided by stable and manure type to around 100 combinations. Information is obtained for each class and aggregated to the reported animal categories (Mikkelsen et al., 2005)

- Finland uses a nitrogen mass flow model (except for N-fixing, crop residue and sewage sludge) accounts for nitrogen losses as ammonia and nitrous oxide emissions during manure management in animal houses, during storage and application; the calculation method was developed in order to avoid double-counting.

Figure 6.3 **Flow of nitrogen in manure management systems (Dämmgen et al., 2007)**



6.3.1 *Enteric Fermentation (CRF source category 4.A)*

Source category description

Methane is produced in herbivores as a by-product of enteric fermentation, a digestive process by which carbohydrates are broken down by micro-organisms into simple molecules for absorption into the bloodstream. The amount of methane that is released depends on the type of digestive tract, age, and weight of the animal, and the quality and quantity of the feed consumed. Ruminant livestock (e.g., cattle, sheep) are major sources of methane with moderate amounts produced from non-ruminant livestock (e.g., pigs, horses). The ruminant gut structure fosters extensive enteric fermentation of their diet. Generally, higher feed intake induces also higher methane emission, but the extent of methane production may also be affected by the composition of the diet. Feed intake is positively related to animal size, growth rate, and production (e.g., milk production, wool growth, or pregnancy).

CH_4 emissions in the source category Enteric Fermentation stem for 10 Member States to over 85% from the sub-category “Cattle”. Substantial emissions from the sub-category “Sheep” (up to 52% of emissions in category 4.A. for Greece) are reported by Greece, Italy, Portugal, Spain, and United Kingdom. Emissions accounting for more than 5% of the emissions in this category are further reported by for the sub-category “Goats” (Greece, 17%) and for the sub-category “Swine” (Belgium,Denmark, Netherlands, with a maximum of 10%).

An overview of the CH_4 emissions, animal population and the corresponding implied emission factors for CH_4 emissions from enteric fermentation for the most important categories cattle and sheep (key source at EC-level) and also goats and swine are given in Table 6.13. Data are given for 2010 as the last inventory year and the base year 1990. The table shows that there is a general trend of decreasing animal numbers which are partly compensated by higher emissions per head due to intensification of livestock production in Europe.

Table 6.13: Total CH_4 emissions in category 4A and implied Emission Factor at EU-15 level for the years 1990 and 2010

1990[1)]	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine
CH_4 emissions [Gg CH_4]	2588	2916	791	75	138
Animal population [1000 heads]	26211	65016	114738	12730	113536
Implied EF (kg CH_4/head/yr)	99	45	6.9	5.9	1.2

2010	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine
CH_4 emissions [Gg CH_4]	2110	2763	614	68	140
Animal population [1000 heads]	17525	58515	85533	11561	118221
Implied EF (kg CH_4/head/yr)	120	48	7.2	5.9	1.2

2010 value in percent of 1990	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine
CH4 emissions [Gg CH4]	81%	95%	78%	91%	102%
Animal population [1000 heads]	67%	90%	75%	91%	104%
Implied EF (kg CH4/head/yr)	122%	105%	104%	100%	98%

Information source: CRF for 1990 and 2010, submitted in 2012

Methodological Issues

CH_4 emissions from enteric fermentation is a key source category for cattle and sheep. For cattle, this is also true for all member states. Accordingly, Member States have used Tier 2 methodology for calculating enteric CH_4 emissions, as shown in Table 6.14. In addition to the methodology applied by the Member States for calculating CH_4 emissions, the table indicates also the total emissions in the category “enteric fermentation”, the contribution of the animal types considered (dairy and non-dairy cattle and sheep) to the total emissions, and whether the emissions from the animal class are belonging to the key source categories in the different Member States.

The table indicates also the Tier level of the source category and of the emission estimates for the animal types considered. For this purpose we compare the implied emission factor for dairy cattle, non-dairy cattle and sheep with the IPCC default values for Western Europe of 100 kg CH_4 head^{-1} year-1, 48 kg CH_4 head^{-1} year-1 and 8 kg CH_4 head^{-1} year-1, respectively. For a detailed description on the methodology used to estimate the “Tier-level” for the EC, see Section 6.4.1. Greece uses the default values of Eastern European countries of 56 kg CH_4 head^{-1} year-1 for non-dairy cattle. A value of 56 kg CH_4 head^{-1} year-1 was also used by Austria for non-dairy cattle, however, according to the national inventory report it was derived on the basis of a Tier 2 calculation. For cattle, all emissions are calculated with the help of country-specific data, while for sheep still 28% of the emissions are estimated with a Tier 1 approach. The Tier levels for goats, swine, and reindeer are included in .

Sheep is no key source category for most countries, even though several Member States did not report disaggregated key source categories for category 4A. However, considerable emissions from this category with more than 10% of total emissions in this category are reported by 5 countries. Therefore, most countries are applying Tier 1 methodology. Those Member States where sheep emissions are belonging to the key source categories have indeed developed a Tier 2 approach. In the case of the United Kingdom, where the default value was used, but it is adjusted for lambs, considering also the lifetime of lambs. Thus we assigned a Tier level of 1.5.

On EU-15 level, 97% of the CH_4 emissions in category 4.A have been estimated with a Tier 2 approach. Overall, a Tier level between Tier 1.6 and Tier 2.0 can be derived for the source category 'enteric fermenation' with a Tier level of Tier 1.96 for EU-15. This estimate includes also the Tier level for goat (Tier 1.3), swine (Tier 1.6) and reindeer (estimated by Finland and Sweden with national emission factors). The thus aggregated Tier level accounts for 98% of the emissions in category 4A and has been complemented with 'other emissions' assuming that these are estimated with a Tier 1 approach giving overall a quality of Tier 1.93.

Table 6.14: Total emissions, contribution of the main sub-categories to CH_4 emissions in category 4A, methodology applied and key source assessment by Member States for the sub-categories dairy cattle, non-dairy cattle and sheep.

Member State	Total		Dairy Cattle		Non-dairy cattle		Cattle	Sheep	
	Gg CO_2-eq	b	a	b	a	b	c	a	b
Austria	3,257	Tier 1.9	40%	Tier 2.0	54%	Tier 2.0	y	2%	Tier 1.0
Belgium	3,555	Tier 1.9	35%	Tier 2.0	58%	Tier 2.0	y	0%	Tier 1.0
Denmark	2,856	Tier 2.0	56%	Tier 2.0	29%	Tier 2.0	y	1%	Tier 2.0
Finland	1,604	Tier 1.9	48%	Tier 2.0	40%	Tier 2.0	y	1%	Tier 1.0
France	28,459	Tier 2.0	33%	Tier 2.0	59%	Tier 2.0	y	6%	Tier 2.0
Germany	20,278	Tier 2.0	54%	Tier 2.0	41%	Tier 2.0	y	2%	Tier 1.0
Greece	3,224	Tier 1.6	11%	Tier 2.0	19%	Tier 1.0	y	52%	Tier 2.0
Ireland	8,496	Tier 2.0	29%	Tier 2.0	63%	Tier 2.0	y	7%	Tier 2.0
Italy	10,732	Tier 1.8	41%	Tier 2.0	37%	Tier 2.0	y	12%	Tier 1.0
Luxembourg	252	Tier 2.0	41%	Tier 2.0	56%	Tier 2.0	y	1%	Tier 1.0
Netherlands	6,649	Tier 1.9	60%	Tier 2.0	28%	Tier 2.0	y	3%	Tier 1.0
Portugal	2,766	Tier 2.0	27%	Tier 2.0	51%	Tier 2.0	y	16%	Tier 2.0
Spain	12,377	Tier 2.0	15%	Tier 2.0	49%	Tier 2.0	y	28%	Tier 2.0
Sweden	2,713	Tier 1.9	36%	Tier 2.0	50%	Tier 2.0	y	3%	Tier 1.0
United Kingdom	15,202	Tier 1.9	28%	Tier 2.0	49%	Tier 2.0	y	20%	Tier 1.5
EU-15	**122,420**	**Tier 1.93**	**36%**	**Tier 2.0**	**47%**	**Tier 2.0**	**y**	**11%**	**Tier 1.7**
EU-15: Tier 1	3%		0%		0%			28%	
EU-15: Tier 2	97%		100%		100%			72%	

a Contribution to CH_4 emissions from enteric fermentation
b Tier 1: default methodology; Tier 2: country-specific methodology
c Source category is key in the Member State's inventory (y/n). nr: not reported. Assessment for total cattle.

Details on the applied methodologies for the estimation of CH_4 emissions from enteric fermentation are given in Table 6.15.

Table 6.15: Methodology used by Member States for calculating CH_4 emissions in category 4A

Member State	Methodology

Member State	Methodology
Austria	**IPCC Tier 1 for Swine, Sheep, Goats, Horses and Other Animals (Deer). For Cattle Tier 2. For the calculation of emissions from category Poultry the IPCC Tier 2 method with Swiss emission factors (Gross Energy Intake, Methane Conversion Rate) was use.**
Belgium	**Tier 2 approach is in both regions (harmonized), Flanders and Wallonia for key-source animal types. CH_4 emissions from enteric fermentation from the other, non key source, animal categories (sheep, goats, swine, horses and mules and asses) are estimated using the Tier 1 methodology.**
Denmark	**The emissions from the agricultural sector are calculated in a comprehensive agricultural model complex called DIEMA (Danish Integrated Emission Model for Agriculture) (Mikkelsen, 2006; Mikkelsen and Gyldenkærne 2006). The implied emission factors for all animal categories are based on the Tier 2 approach. The category Non-Dairy Cattle includes Calves, Heifer, Bulls and Suckler Cows and the implied emission factor is a weighted average of these different subcategories. Data given for Non-Dairy Cattle covers data for heifer older than ½ year. The category Swine includes the subcategories Sows, Piglets and Slaughtering Pigs. The feed intake for sows and piglets has increased while the feed intake for slaughtering pigs has decreased as a result of improved fodder efficacy.**
Finland	**Tier 1 for Horses, Swine, Goats and Fur animal (Norway EFs). Tier 2 method for Cattle. CH_4 emissions from enteric fermentation of Reindeer have been calculated by estimating the GE on the basis of literature (McDonald, 1988) by using national data for estimating dry matter intake and its composition (hay and lichen) and calculating the respective emission factor. The same methodology has been used for estimating GE and EF for Sheep. Cattle's are not used for work in Finland. Piglets are included in the category 'sows with piglets'.**
France	**Emissions from Dairy Cattle are calculated using an equation developed at INRA (Tier 2+). Tier 1 other animal types.**
Germany	**Tier 2 for dairy and non-dairy cattle and swine. Tier 1 for other animals .**
Greece	**Dairy cattle and non-dairy cattle: Tier 2. Sheep: Tier 2 methodology. Livestock sub-categories are characterised based on the age of animals, their sex, weight, feeding situation and on the various management systems of animals. Other animal categories: Tier 1.**
Ireland	**Cattle: Tier 2. For Dairy cows and Suckler Cows, the country was divided into three regions: (1) south and east, (2) west and midlands, and (3) north west, coinciding with regions used for implementing the Nitrates Directive based on slurry storage requirements of local planning authorities. In the approach outlined by O'Mara (2006), the daily energy requirement of cows in each region is calculated by month or part thereof based on maintenance requirements, milk yield and composition, requirements for foetal growth and gain or loss of bodyweight (INRA, 1989). Given data for liveweight and liveweight gain, energy requirements of animals were estimated during the winter housing periods and grazing seasons of the animal's lifetime using the INRAtion computer programme, version 3.0. This programme is devised by the French research organisation INRA, and is based on the net energy system for Cattle. Other animals: Tier 1 Methodology, EFs IPCC default.**
Italy	**The Tier 2 IPCC GPG approach has been followed for Dairy, Non-Dairy and Buffalo. Country-specific emission factor suggested by the Research Centre on Animal Production for rabbits have been use. A Tier 1 approach, with IPCC default emission factors, has been used to estimate methane emissions from swine, sheep, goats, horses, mules and asses.**
Luxembourg	**The IPCC Tier 1 method has been applied to all farm animal categories with the exception of cattle for which a Tier 2 method has been used (option B).**
Netherlands	**Cattle: Tier 2, calculated annually for several subcategories of dairy, non-dairy and young cattle. The calculation of the methane production via enteric fermentation by dairy cows is performed using dynamic modelling (Tier 3; Smink, 2005), employing the model of Mills et al. (2001), including updates (Bannink et al., 2005a,b). This model is based on the rumen model of Dijkstra et al. (1992). It has been developed for dairy cows and is therefore not suitable for all cattle categories. The model calculates the gross energy intake and methane production per cow per year on the basis of data on the share of feed components (grass silage, maize silage, wet by-products and concentrates) and their chemical nutrient composition (sugars, NDF, etc). All relevant documents concerning methodology, emission factors and activity data are published on the website www.greenhousegases.nl.**
Portugal	**Tier 2 for all animal types, with an enhanced characterization of livestock, with subdivision per age, sex and management conditions for most animal types. Milk yield was estimated dividing the annual production of milk cow over the number of cows in production101, both of which are published by the National Statistical Institute (INE). Three different cattle types were considered: (1) Imported breeds; (2) Traditional breeds on pasture; (3) Traditional breeds on range. The methodology used by the French I.N.R.A. (INRA, 1984) was used to estimate feed intake for each swine sub-class.**
Spain	**Cattle and Sheep: Tier 2. Swine: Tier 3; Other animal categories: Tier 1. For cattle and sheep, national literature on the main animal breed present in Spain are used. Animal characterization is obtained according to UPV (2006). Milk production are not sufficiently disaggregated model calculations are used to obtain milk production for the different breeds. Digestibility is calculated from feed composition. For swine a Tier 3 methodology has been developed (MARM, 2010) on the basis of the feed and energy requirement balances defining a typical feed composition.**
Sweden	**Significant Cattle subgroups: national emission factor (Tier 1). Reindeer: according to Tier 2 methodology using a Finnish value of gross energy requirements. Other animal categories: Tier 1.**

Member State	Methodology
United Kingdom	**The national methodology for Dairy Cows, Beef Cows and Other Cattle.** **Tier 2 method for dairy and beef cows, lambs and deer. Tier 1 for other animal types.**

Activity Data

Animal population of dairy and non-dairy cattle, sheep, goat, swine, and poultry in 2010 are given in Table 6.16. The characterization of the livestock population across the background tables 4.A, 4.B(a), and 4.B(b) is done in a consistent way by all Member States and will therefore be discussed only here. Luxembourg and Netherlands have chosen to use the option B for the classification of cattle. In order to allow the calculation of an EC implied emission factor for the categories listed under option A, these numbers were "converted" using the following rule: Mature Dairy Cattle → Dairy Cattle; Mature Non-dairy Cattle + Young Cattle → Non-dairy cattle.

Other animal types with population data reported in Table4.A are reindeers (Finland, Sweden), deer (Austria, Denmark, Luxembourg, and UK), fur farming (Finland, Denmark), rabbits (Italy, Luxembourg, and Portugal), and other poultry (Denmark).

Some information on the source of the animal numbers for the different Member States is given in Table 6.17.

Table 6.16: Animal population [1000 heads] in

Member State 2010	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine	Poultry
Austria	533	1,481	358	72	3,134	13,027
Belgium	467	2,178	103	31	6,606	32,479
Denmark	568	1,003	111	16	13,173	18,731
Finland	289	636	126	5	1,367	9,587
France	3,733	15,876	7,975	1,354	14,522	254,913
Germany	4,183	8,626	2,089	150	22,244	128,900
Greece	135	515	8,832	5,155	875	29,079
Ireland	1,060	5,448	4,315	10	1,509	16,248
Italy	1,746	4,086	7,900	983	9,321	198,347
Luxembourg[1)]	83	315	9	5	84	90
Netherlands[1)]	2,957	4,993	1,130	353	12,255	103,371
Portugal	255	1,228	2,384	426	1,938	32,897
Spain	841	5,333	18,552	2,904	25,203	159,706
Sweden	348	1,189	565	6	1,520	16,403
United Kingdom	1,847	8,262	31,086	93	4,468	163,842
EU-15	19,045	61,169	85,533	11,561	118,221	1,177,619

Information source: CRF for 1990 and 2010, submitted in 2012

[1)] Numbers for cattle have been calculated using the figure given under option B.

Table 6.17: Information on the source of animal population data

Member State	Activity Data
Austria	**The Austrian official statistics (Statistic Austria, 2006) provides national data of annual livestock numbers on a very detailed level. In 1998-2002 swine numbers were fluctuating due to a high elasticity to market prices. The animal numbers of Young Swine were not taken into account because the emission factors for Breeding Sows already includes nursery and growing pigs (Schechtner 1991). Information about the extent of organic farming in Austria was provided in the Austrian INVEKOS database (Kirner and Schneeberger, 1999). From 2004 onwards INVEKOS data of organic cattle population as reported in the so called 'Green**

Member State	Activity Data
	Reports' of the ministery of agriculture (BMLFUW 2007) was used.
Belgium	**The National Institute of Statistics (NIS) publishes land-use and the livestock figures yearly (NIS, 2006 http://www.statbel.fgov.be/downloads/cah2006m_fr.xls). All agricultural businesses have to fill in a form each year about the situation at 1 may of that year and sent it to the NIS. In Flanders, livestock figures from 2000 on are obtained by the Manure Bank of the Flemish Land Agency. Further details on the agricultural census methodology and QA/QC issues can be found on the NIS website (www.statbel.fgov.be). Mules and Asses are included in the category Horses. "Other" includes Horses, Mules and Asses, Goats and Rabbits.**
Denmark	**Livestock production is primarily based on the agricultural census from Statistics Denmark. The emission from slaughter pigs and poultry is based on slaughter data. Approximate numbers of horses, goats and sheep on small farms are added to the number in the Agricultural Statistics, in agreement with the Danish Agricultural Advisory Centre (DAAC), as Statistics Denmark does not include farms less than 5 hectares. Animal numbers of sheep, goats, ostriches and deer are based on the Central House animal farm Register (CHR). Pheasant numbers are based on expert judgemet from NERI and the pheasant breeding association.**
Finland	**The number of cattle, sheep, swine, poultry and goats was received from the Matilda-database maintained by the Information Centre of the Ministry of Agriculture and Forestry (http://www.mmmtike.fi/en/) as well as from the Yearbook of Farm Statistics published annually by the Ministry of Agriculture and Forestry. The number of animals describes the number of animals in 1st of May (cattle, swine, poultry) and it has been reported consistently over the time series. Cattle category has been divided into the following sub-categories: Dairy cows, Suckler cows, Bulls, Heifers and Calves for which separate emission factors have been calculated. Animal numbers are harmonized with the Nitrogen mass flow model used by the Finnish Environment Institute.**
France	**Agricultural statistics are issued by the ministry of agriculture (SCEES/AGRESTE). Activity data is a one year average. Heifers are included in Other Cattle, but heifers more than 2 years old (40% of the total heifer livestock) are considered as Dairy cattle.**
Germany	**Animal types are disaggregated, if significant differences exist between emission factors. For example, dairy cattle are grouped into sub-categories in each district on the basis of animal performance and feeding indicators. Other cattle include calves, heifers, bulls (beef), suckler cowws and mature males. Sows and suckling pigs are calculated separately, as well as sheep and lambs, and the results are aggregated and IEFs covering both sub-categories are reported. The category 'poultry' is differentiated into the sub-categories laying hens, broilers, pullets, geese and ducks and turkey hens and cocks. A complete animal census at the "Kreise" level is available for every second year in the official agricultural statistics with the exception of goats, mules and asses, and buffalo. For the other years, animal numbers are available at the "Länder" level. The number of horses is taken from the official statistics, but are probably too low, they are partly corrected (Daemmgen, 2006). Numbers for sheep have to be corrected for some years. Calculation methods and elaboration of activity data are detailed in Daemmgen et al. (2007). Individual cattle are registered since 2008 in a specific data base (HIT). As no threshold exist, this lead to higher animal numbers.Information on feeding and stable types are taken from the agricultural model 'RAUMIS' available at vTI (Regionalisiertes Agrar- und UmweltInformationsSystems fuer Deutschland). The model is based on national statistics at district level, description of standard production methods from KTBL, information from the ministry for agriculture and results from surveys. Data gaps are filled by expert knowledge.**
Greece	**Data on animal population, agricultural production and cultivated areas used for the emissions calculation were provided by the NSSG. Data on animal population 2007 are provisional estimations. Animal population except Sheep, is a 3-year average. Because of the analytic methodology used for Sheep, data on disaggrated population are the actual reported in the Statistics for each year. Milk yield derives from data of the annual Agricultural Statistics.**
Ireland	**Because of the importance of agriculture in the country, Ireland has very extensive and up-to-date statistical data on all aspects of the sector, compiled and published by the Central Statistics Office. The Irish cattle herd is now characterised by 11 principal animal categories for which annual census data are published by CSO. The number of Cows in each category given by CSO statistics was allocated to the regions using CMMS reports published by the Department of Agriculture and Food (DAF, 2007). The most important parameter is liveweight gain as it directly affects the energy requirement and thus feed intake. There is little statistical information on the liveweight gain of the different types of Cattle in the Irish Cattle herd, but the weight of carcasses of all slaughtered cattle is recorded by the Department of Agriculture and Food.**
Italy	**Livestock data are collected from the National Institute of Statistics (ISTAT) and are based on specific national surveys, such as the 'milk production' and the 'farm structure and production' surveys, and from a general agricultural census carried out every 10 years. The last Farm was carried out at the end of 2005, surveying about 1.38 million agricultural holdings of an economic size of at least 1 European Size Unit. Since 2006 submission, results from the MeditAIRaneo project have been included in the preparation of the emission inventory.**
Luxembourg	**The activity data are the livestock data reported in the national statistics.**
Netherlands	**Activity data for the animal population are based on the annual agricultural survey performed by Statistics Netherlands (CBS). Data can be found on the website www.cbs.nl and in background documents (Van der Hoek and Van Schijndel, 2006; Van Schijndel and Van der Sluis, 2008). For cattle three categories are distinguished: Dairy cattle: adult female cows (for milk production); Non-dairy cattle: adult cows (for meat production); Young cattle showing a mix of different age categories (for breeding and meat production).**

Member State	Activity Data
Portugal	**Activity data are 3-years average except for last year. Annual livestock numbers were available from the statistical databases of the National Statistics Institute (INE) for Cattle, Swine, Sheep, Goats, Horses, Mules and Donkeys, dissagregated per region, age and sex. The number of Rabbits, Hens, Broilers, Turkeys, Ducks, Geese and Guinea-fowl, is only available for 1999 – from the national agriculture census that is done every ten years.**
Sweden	**The Farm Register provides the main basis for agricultural statistics in Sweden. The Register is administered by the Swedish Board of Agriculture and Statistics Sweden and provides annual information on the total number of animals of different categories on Swedish farms. The information on livestock refers to the situation prevailing in mid-June of that year and thus is considered to be equivalent to a one-year average. Mink and foxes are minor contributors to greenhouse gas emissions and are not included in the inventory due to a lack of well-founded emission factors. The number of slaughter chickens (mean number of chickens kept during the year) is provided by the Swedish Poultry Meat Association.**
United Kingdom	**The animal population data are collected in an annual census (Defra). Animal weights based on slaughter weights (Defra). Pre-1995 is corrected home killed slaughter weights (UK livestock Slaughter Statistics, Defra, SERAD, WAG and DARDNI and their predecessors, 1995 and onwards are weights from the over 30 months scheme (courtesy of Rural Payments Agency). In using the animal population data, it is assumed that the reported numbers of animals are alive for that whole year. The exception is the treatment of sheep where it is normal practice to slaughter lambs and other non-breeding sheep after 6 to 9 months. Hence it is assumed that breeding sheep are alive the whole year but that lambs and other non-breeding sheep are only alive 6 months of a given year (based on Smith and Frost, 2000).**

Emission Factors and other parameters

Considerable variation is found in the IEF for dairy and non-dairy cattle with values between 103 kg CH_4 head^{-1} yr^{-1} (Spain) and 139 kg CH_4 head^{-1} yr^{-1} (Portugal) for dairy cattle, and 36 kg CH_4 head^{-1} yr^{-1} (Netherlands2)) and 60 kg CH_4 head^{-1} yr^{-1} (Finland) for non-dairy cattle. The difference can mainly be explained by the different levels of intensity for dairy production. The IEF for the EU-15 Member States and the CH_4 conversion factors used are given in Table 6.18. For EU-15, the implied emission factor in 2010 was 120 kg CH_4 head^{-1} yr^{-1} for dairy cattle.

For non-dairy cattle, the low IEF reported by Netherlands (36 kg CH_4 head^{-1} yr^{-1} in 2010) is explained by the fact that the Netherlands has a considerable population of white veal calves. Because of the low roughage intake MCF is 4% instead of 6% for these animals. This results in a lower average methane conversion rate for total cattle. In Denmark, the IEF is 40 kg CH_4 head^{-1} yr^{-1} in 2010. The IEF for non-dairy cattle is lower compared with the default value, this is due to lower weight and lower feed intake and a higher digestibility of feed.. Also in Germany the IEF is lower than IPCC default which is due to large share of cattle with low EF. The level of IEF seems to be comparable to that given by a number of other countries (comparison based on 2007 submissions, including Option B). Further, the low IEF is consistent with a low animal weight for non-dairy cattle in Germany.

The IEF for sheep and goats used in Denmark (Tier 2 methodology) is with 17.2 kg CH_4 head^{-1} yr^{-1} and 13.1 kg CH_4 head^{-1} yr^{-1} considerably higher than the IPCC default values and the numbers used in other Member States. This is explaind by the Danish normative data, which operate with sheep including lamb and goats including kids. The emissions of lamb and kids are therefore included in the numbers for sheep and goats, respectively. On the other hand, the IEF for sheep for UK is with 4.8 kg CH_4 head^{-1} yr^{-1} the lowest from EU and is similar to the IEF for developing countries according to the IPCC 2006 GL. The emission factor was fixed by Tier 1 with the assumption that IEF for lambs is 40% of that for adult sheep (breeding sheep are alive the whole year but that lambs and other non-breeding sheep are only alive 6 months of a given year) In Germany, the IEFfor goats is based on the assumption of all-round grazing, which is not the case. Emissions are calculated with realistic management system frequency distributions.

For horses, Germany makes a distinction for large and small horses, whereby the IEF for large horses was taken from IPCC (2006) and the IEF for small horses used was smaller with 12 kg head^{-1} yr^{-1}. The overall IEF for horses is thus smaller then the IPCC value.

The CH_4 conversion factor is IPCC default for most Member States.

More detailed information on the development of the emission factors for category 4A is given in Table 6.19.

Table 6.18: Implied Emission factors for CH_4 emissions from enteric fermentation and CH_4 conversion factors used in Member State's inventory

Member State	Implied EF (kg CH_4/head/yr) [1]					CH4 conversion (%) [1]				
2010	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine
Austria	116	56	8.0	5.0	1.5	6.0	6.0	6.0	5.0	0.6
Belgium	126	45	8.0	5.0	1.5	6.0	6.0	NE	NE	NE
Denmark	134	40	17.2	13.1	1.1	6.0	6.0	6.0	5.0	0.6
Finland[1]	128	60	8.4	5.0	1.5	6.0	6.0	NA	NA	NA
France	119	50	9.5	11.8	0.9	NA	NA	NA	NA	NA
Germany	124	46	8.0	5.0	1.2	6.0	6.2	6.0	5.0	0.6
Greece	120	56	9.1	5.0	1.5	6.0	6.0	6.6	NE	NE
Ireland	112	47	6.1	5.0	1.1	6.5	6.5	7.0	NE	NE
Italy	120	46	8.0	5.0	1.5	6.0	4.4	NA	NA	NA
Luxembourg[2]	120	43	8.0	5.0	1.5	6.0	6.0	6.0	5.0	0.6
Netherlands[2]	129	36	8.0	5.0	1.5	5.9	5.9	NE	NE	NE
Portugal	139	55	9.0	7.6	1.4	6.0	5.9	6.0	5.0	0.6
Spain	103	55	8.8	5.0	0.9	5.5	5.3	6.6	NA	82.1
Sweden	132	55	8.0	5.0	1.5	6.2	7.0	6.0	5.0	0.6
United Kingdom	111	43	4.8	5.0	1.5	6.0	6.0	NE	NE	NE
EU-15	120	47.7	7.2	5.9	1.2	6.0	5.9	6.6	5.0	31.1

Information source: CRF for 1990 and 2010, submitted in 2012. Abbreviations explained in the Chapter 'Units and abbreviations'.

[1] Finland reports non-dairy cattle under "other" in the following categories: bulls, cows, heifers, and calves. The IEF has been calculated as a weighted average. [2] The IEF for Luxembourg and the Netherlands has been calculated as a weighted average has been calculated using the values given under option B (mature non-dairy and young cattle).

Table 6.19: Member State's background information for CH_4 emissions in category 4.A. Emission Factor and other parameters

Member State	Emission Factor and other parameters
Austria	**Country specific emission factors for cattle calculated from the specific gross energy intake and the methane conversion rate (IPCC for "all other cattle" because there are few if any feedlot cattle with a high-energy diet). Austrian energy intake data were recalculated by from the Agricultural Research and Education Centre (AREC) Raumberg-Gumpenstein (Poetsch et al. 2005, Gruber and Poetsch, 2006). The time series of average milk yields per dairy cow was taken from national statistics, milk yield of suckling cows is from Hausler (2009). For the period from 1990 to 2007 a constant average milk yield of 3 000 kg kg was applied, resulting in a Gross Energy Intake of 235.3 MJ per suckling cow and day. For the calculation of emissions from poultry the IPCC Tier 2 method with Swiss emission factors (Gross Energy Intake, Methane Conversion Rate) was used. The animal category Other livestock corresponds to deer with default EF used for sheep.**
Belgium	**The average animal weight and weight gain originate in Flanders from the Department Agriculture and Fishery and in Wallonia from average weights published by the federal finance department. In Flanders, data for feed digestibility (DE%) originate from a report [http://www.rivm.nl/bibliotheek/rapporten/680125001.html] from the Netherlands, a neighbouring country with comparable feeding situations. In both regions a methane conversion rate (Ym) of 6% is used to calculate the emission factor for each cattle type. The emission factors for all categories with exception for dairy cows stay constant over the entire time series. For dairy cows the emission factor increases with increasing milk production.**

Member State	Emission Factor and other parameters
Denmark	**Feed consumption for all animal categories is based on the Danish normative figures. The estimation of the national values of Ym is based on model "Karoline" developed by FAS based on average feeding plan for 20% of all dairy cows in Denmark obtained from the Danish Agricultural Advisory Centre DAAC (Danfær, A. 2005). New investigations from FAS have shown a change in fodder practice from use of sugar beets to use of maize. Research showed that sugar beets as feeding stuff is resulting in a higher methane conversion rate than the default values. Enteric CH_4 emissions are, in general, lower than the IPCC default values due to the professional way farms are managed in Denmark. For goats and horses new subcategories are introduced in 2007 and therefore the IEF differs from the other years. For sheep the IEF is constant.**
Finland	**IPCC gives no default emission factor for reindeer, thus it has been calculated by using national methodology for estimating gross energy intake of reindeer from the basis of their forage. The same equation has been used for sheep also. Emission factors for cattle are updated annually. EF´s for other animal groups will be updated if more national data will become available. Average daily weight gain for cattle was estimated to remain constant.**
France	**The EF for Dairy Cattle, is depending to the milk production. Emissions factors are used for enteric fermentation from a study published in 2008 by the French National Institute of Agronomy. These emission factors are based on parameters equivalent to Ym and GE, but these parameters are not directly available in the study.**
Germany	**The calculation of the EF for Dairy Cattle is based on milk production, animal weight (derived from nation data on milk production and milk quality), and animal feed. Feeding composition (mixed grass/maize/feed concentrates and grass/concentrates) and their characterization is available for each district. Feed digestibility is estimated as function of feed composition and productivity. For milk-feed calves it has been considered that they do not belong to the ruminant animals.**
Greece	**The average milk production for domestic and in flock and for nomadic sheep is 0.48 kg/day and 0.43 kg/day respectively.**
Ireland	**The Tier 2 emission factors for the 11 animal categories was initially carried out for the 2006 herd and then repeated for 1990 and 2005. The study and analysis underlying the new emission factors is available (O'Mara, 2006). Emission factors for the Beef cattle categories were determined by calculating lifetime emissions for the animal and by partitioning between the first, second and third years of the animal's life.**
Italy	**Data to calculate the emission factor from dairy and non-dairy cattle are national (ISTAT, Centro Ricerche Produzioni Animali, Reggio Emilia - CRPA). This information has been discussed in a specific working group in the framework of the MidetAlRaneo project (CRPA, 2006; CRPA, 2005). The emission factor for buffalo has been calculated by Condor et al. (2006). The emission factor for rabbits is national.**
Luxembourg	**For the Tier 1 method, default GE are usually provided in the IPCC Guidelines. For the Tier 2 method, GE is the combination of various feed intake – or net energy – estimates relating to maintenance, activity, growth, etc. of the animals.**
Netherlands	**The emission factors for three cattle types are calculated annually (e.g. adult dairy, adult non-dairy and young cattle, respectively). Swine, sheep, goat and horses: default.**
Portugal	**For the emission factor for Rabbit, the default EF for Horse has been downscaled to the average weight of a rabbit according to the scaling equation in IPCC GPG. Default EF for Horses, Mules and Asses, due to the unavailability of a more detailed livestock characterization and specific characterization of national populations. In accordance with the unavailability of emissions factors in IPCC96 for broilers, laying hens, turkeys, ducks, geese, guinea fowl and other poultry, emissions from these classes were not estimated and were assumed as negligible.**
Spain	
Sweden	**A national methodology based on feed energy requirements expressed as metabolisable energy is used in the Swedish inventory to estimate emission factors for dairy cows, beef cows and other cattle. The calculations for dairy cows were revised some years ago. The emission factors for other cattle groups were also reevaluated, using the same methodology. The initial step in estimating emission factors for cattle according to the Swedish method is enhanced characterisation of feed intake estimates (Tier 2 methodology). The energy requirements for maintenance, growth, lactation and pregnancy are estimated, but expressed as metabolisable energy (MJ/day) instead of as net energy. The metabolisable energy requirement is then recalculated to digestible energy. A lactation period of 305 days and a non-lactating period of 60 days was used (Bertilsson, 2002; Nieminen, 1998). The default values in the IPCC Guidelines are used for the less significant animal groups. Reindeer: according to IPCC GPG (Tier 2) using a Finnish value of gross energy requirements.**
United Kingdom	**Apart from cattle, lambs and deer, the methane emission factors are IPCC Tier 1 defaults. The emission factor for Lambs is assumed to be 40% of that for adult Sheep (Sneath, 1997). The exception is the treatment of sheep where it is normal practice to slaughter lambs and other non-breeding sheep after 6 to 9 months. In the inventory the dairy cows weights are slaughter weight data provided by Sarah Thompson, Defra. The digestibility value (74%) was derived from calculations (Bruce Cottrill, pers. comm.) based on typical diets for cows over a dry and lactating period, combining forage and concentrates with the digestibilities of the gross energy for various feeds according to MAFF (1990).**

Milk productivity is one of the most important factors determining the level of CH_4 emissions from dairy cattle. Several countries have reported milk productivity, which are reproduced in Table 6.20

and Table 6.21 beside information on feed intake, animal weight, and feed digestibility. The data show clearly that a strong intensification of cattle husbandry occurred, with increases in the milk yield ranging from 27% (Ireland) to 109% (Spain). This is thus more than the increase in the CH_4 emission factor. The increased production was only partly achieved by increased energy intake (up to a maximum of 46%, but some countries report also a stable feed intake), and partly by an improved feed efficiency. This is expressed in the feed digestibility, which for some countries increased by up to 6%, however it must be kept in mind that most countries do not estimate a time-varying feed digestibility (only 4 do, compared to 14 countries which report a time-dependent milk productivity). Higher feed digestibility reduces the portion of carbon intake that is transformed to methane in ruminants. As the feed intake increase is smaller than the increase in milk productivity (for EU15 the numbers are 24% and 48%, respectively), the feed quality and consequently also the feed digestibility increase most probably in more countries. This suggests that these countries tend to overestimate the increase in methane emissions from enteric fermentation of dairy cattle. Calculating the average for those countries which have reported data, the milk yield was higher by 11% than the default value for Western Europe (11.5 kg/day) in 1990, and increased to a level which was 64% above IPCC default in 2010. Even though feed digestibility for dairy cattle was not separately estimated for each year by all countries, the level is 18% to 19% above IPCC default (60%) digestibility.

Table 6.20: **Additional background information for calculating CH_4 emissions from enteric fermentation from dairy cattle**

Member State	Dairy Cattle				Member State	Dairy Cattle			
2010	Feed Intake[1)]	Animal Weight (kg)	Milk prod.[1)]	Feed Digest. (%)	**1990**	Feed Intake[1)]	Animal Weight (kg)	Milk prod.[1)]	Feed Digest. (%)
Austria	295	700	17	70	Austria	247	700	10	66
Belgium	321	600	20	75	Belgium	253	600	11	75
Denmark	345	570	23	71	Denmark	278	550	17	71
Finland	325	645	22	70	Finland	250	520	16	70
France	NA	NA	18	NA	France	NA	NA	13	NA
Germany	315	647	19	74	Germany	257	608	13	73
Greece	304	600	15	60	Greece	224	600	7	60
Ireland	244	535	15	NE	Ireland	222	535	11	NE
Italy	305	603	19	65	Italy	240	603	12	65
Luxembourg[2)]	305	650	20	70	Luxembourg[2)]	247	650	13	70
Netherlands[2)]	333	NE	NE	NE	Netherlands[2)]	280	NE	NE	NE
Portugal	353	NE	21	60	Portugal	241	NE	12	60
Spain	286	648	21	71	Spain	200	642	10	71
Sweden	326	600	24	69	Sweden	276	600	19	69
United Kingdom	283	653	20	74	United Kingdom	226	572	14	74
EU-15	306	627	19	71	EU-15	246	599	13	71

Information source: CRF for 1990 and 2010, submitted in 2012. Abbreviations explained in the Chapter 'Units and abbreviations'. 1) Unit for feed intake: MJ/head/yr; unit for Milk productivity: kg/day/head.

Table 6.21: **Additional background information for calculating CH_4 emissions from enteric fermentation from non-dairy cattle**

Member State 2010	Non-dairy Cattle Feed Intake[1)]	Animal Weight (kg)	Milk prod.[1)]	Feed Digest. (%)
Austria	143	425	NO	73
Belgium	112	410	NE	76
Denmark	130	320	NO	71
Finland	123	NA	NA	70
France	NA	NA	NA	NA
Germany	109	330	NE	73
Greece	141	420	NO	60
Ireland	129	349	8	NE
Italy	139	381	NA	NA
Luxembourg[2)]	108	360	NA	64
Netherlands[2)]	91	NE	NE	NE
Portugal	142	412	3	62
Spain	154	470	1	70
Sw eden	181	NE	NE	69
United Kingdom	128	500	5	65
EU-15	128	406	5	69

Member State 1990	Non-dairy Cattle Feed Intake[1)]	Animal Weight (kg)	Milk prod.[1)]	Feed Digest. (%)
Austria	123	364	NO	74
Belgium	104	381	NE	76
Denmark	107	290	NO	71
Finland	103	NA	NA	70
France	NA	NA	NA	NA
Germany	102	300	NE	73
Greece	136	382	NO	60
Ireland	132	349	8	NE
Italy	141	376	NA	NA
Luxembourg[2)]	104	322	NA	64
Netherlands[2)]	98	NE	NE	NE
Portugal	130	355	2	62
Spain	155	460	1	69
Sw eden	181	NE	NE	69
United Kingdom	128	500	5	65
EU-15	122	379	5	70

Information source: CRF for 1990 and 2010, submitted in 2012. Abbreviations explained in the Chapter 'Units and abbreviations'. 1) Unit for feed intake: MJ/head/yr; unit for Milk productivity: kg/day/head. 2) Numbers calculated as a w eighted average has been calculated using the values given under option B (mature non-dairy and young cattle).

Trends

Animal population. Regarding animal numbers, some major changes occurred since 1990. In all countries, the numbers of cattle and sheep are considerably reduced, on the average by 32% for dairy cattle and 10% for non-dairy cattle, and by 25% for sheep. An increase in the number of cattle has only been observed in the category of non-dairy cattle in Greece (7%), Sweden (4%), Portugal (25%) and Spain (54%). Largest decrease of the number of dairy cattle occurred in Spain (2010 at 52% of the 1990 level). For non-dairy cattle, largest decrease occurred in Germany (2010 at 66%).

The picture is a little bit different for the categories Goats and Swine, as some countries have encountered a significant increase of the populations, for example the goat population in Belgium in 2010 has increased by 254% respective to the population in 1990; in the Netherlands this figure amounts to 480%. However, due to a decrease of the goat number in other countries with a high population (mainly Spain with 2,904,000 heads in 2010), the goat population at EU15 level was rather stable (2010 at 91% of 1990-level).

The swine population was increasing especially in Denmark (39%), Spain (54%), and Ireland (24%), but this was balanced from reductions in other countries. Poultry numbers saw a slight increase of 12% in EU15; only Austria and Luxembourg reported CH_4 emissions from enteric fermentation of poultry.

The trend in animal numbers is to a large extend influenced by EU policy such as suckler cow premia, milk quota, but also environmental legislation linked to agricultural policy through cross-compliance and the rural development. Animal development is also determined by epidemies such as the avian flu (reducing e. g. the number of poultry in the Netherlands in 2003), the BSE crisis between 2001 and 2003, to name just the most important. Further examples for driving forces of the observed trends are given in Table 6.22 below.

Implied emission factor. At the aggregated level for EU-15, the implied emission factor for dairy cattle increase from 98.8 kg CH_4 head^{-1} yr^{-1} to 120 kg CH_4 head^{-1} yr^{-1} while at the same time the animal number of dairy cattle decreased by 32%, resulting in a decrease of European CH_4 emissions from enteric fermentation in the category of dairy cattle by Dairy Cattle.

Changing IEFs, however, are not necessarily due to a changing (assumed) productivity of non-dairy cattle sub-categories, but can rather be the consequence of a different composition of non-dairy cattle (e. g. ratio of heifers to young cattle) with different implied emission factor. Nevertheless, the IEF for non-dairy cattle was more stable that that for dairy cattle and changed only by 5% between 1990 and 2010 from 45.5 kg CH_4 head^{-1} yr^{-1} to 47.7 kg CH_4 head^{-1} yr^{-1}.

For sheep, the implied emission factors changed since 1990 in 6 countries, but stayed close to the 1990-value for EU15. Only Finland and Portugal saw a substantial increase of the IEF for sheep by 23% and 7%, respectively.

Figure 6.4 through Figure 6.13 show the trend in the activity data for the key source in the category of enteric fermentation as well as the trend of one important indicator for animal productivity, the average daily gross energy intake for dairy and non-dairy cattle and sheep. The trend of the populations of swine, goat, and poultry are included as well. Table 6.22 gives additional information on the trend in category 4A as reported in the national inventory reports.

Table 6.22: Member State's background information on the trend for CH_4 emissions in category 4.A.

Member State	Trend in category 4A
Austria	**Up to the early 1990ies Austrian dairy husbandry was determined by traditional Austrian green feeding and traditional Austrian races. From the mid 1990ies onwards milk production has been intensified: diets with higher energy concentration were fed and the share of high yield breeds (e.g. Holstein Friesian) in dairy farming was increased.**
Belgium	**In Belgium, there is the trend of disappearance of small businesses, also reinforced by the BSE crises. Additionally in Flanders, this partly can be explained due to the subsidized cut down of the number of Cattle. This affected only swine in 2001 and 2002, but in 2003 also bovine animals and poultry. Nevertheless the land area used for agricultural purposes remained identical during this period. In 2005 Wallonia has 55% of the land used for agriculture, but 67% of agricultural businesses are situated in Flanders. The land area used for farming is on average 19 ha per farm in the Flemish region and 47 ha per farm in the Walloon region.**
Denmark	**The increase in the IEF for dairy cattle from 1990-2007 is the result of increasing feed consumption due to rising milk yields. On average, the milk yield has increased from 6200 litre per cow per year in 1990 to approximately 8600 litre per cow per year in 2007 (Statistics Denmark). The interannual increase of methane IEF for non-dairy cattle in 2008/2009 is 7%. This is due to an increase in the number of heifers >½ year, which have a relatively high EF.**
Finland	**The IEF for sheep is calculated annually on the basis of forage consumption and the number of animals (lambs and ewes separately). Thus, next to the relative numbers of lambs and ewes, changes in the diet are reflected in the IEF, which lead to an inter-annual fluctuation of the emissions.**
Ireland	**Increased beef population is explained by the earlier finishing time for male beef cattle since the BSE crisis that affected agriculture during the 1990s.. 2010 was a particularily good year for Irish agriculture. Milk yield per cow increased by 8% from 4946 kg milk per cow to 5322 kg per cow. As a consequence, the IEF of methane EF dairy cattle increased between 2009 and 2010 by 3%.**
Germany	**The reduction of animal numbers since 1990, and in particular between 1990 and 1991 is a consequence of the German unification causing a change in consumer behavior. At the same time, animal performance (calculated for cattle and swine) increased.**
Netherlands	**Decreases in emissions from cattle the decrease in numbers is mainly explained by an increase in milk production per dairy cow combined with an unchanged total milk production. Milk production per cow increased significantly since 1990, a development which has resulted from both genetic changes in cattle (due to breeding programmes) and the change in amount and composition of feed intake. Total milk production in the Netherlands is determined mainly by EU policy on milk quota. Milk quota remained unchanged in the same period. In order to comply with the unchanged milk quota, animal numbers of (dairy) cattle had to decrease to counteract the effect of increased milk production per cow. The numbers of young (dairy) cattle follow the same trends as those of adult female cattle – namely, a decrease. (Van Schijndel and Van der Sluis, 2008). Goat numbers increased by a factor 5 and horse numbers nearly**

Member State	Trend in category 4A
	doubled in this period. The increase in the number of goats might be explained as an effect of the milk quota for **The increased number of swine in 1997 was a direct result of the outbreak of classical swine fever in that year. In areas where this disease was present, the transportation of pigs, sows and piglets to the slaughterhouse was not allowed, so the animals had to remain on the pig farms for a relatively long period (accumulation of pigs).**
Portugal	**Data from National Statistics show a decrease in net stripped weight per animal from 2007 to 2008 causing an inter-annual decrease in emission factor for sheep by 5%.**

Figure 6.4: Trend of activity data (population) for dairy cattle.

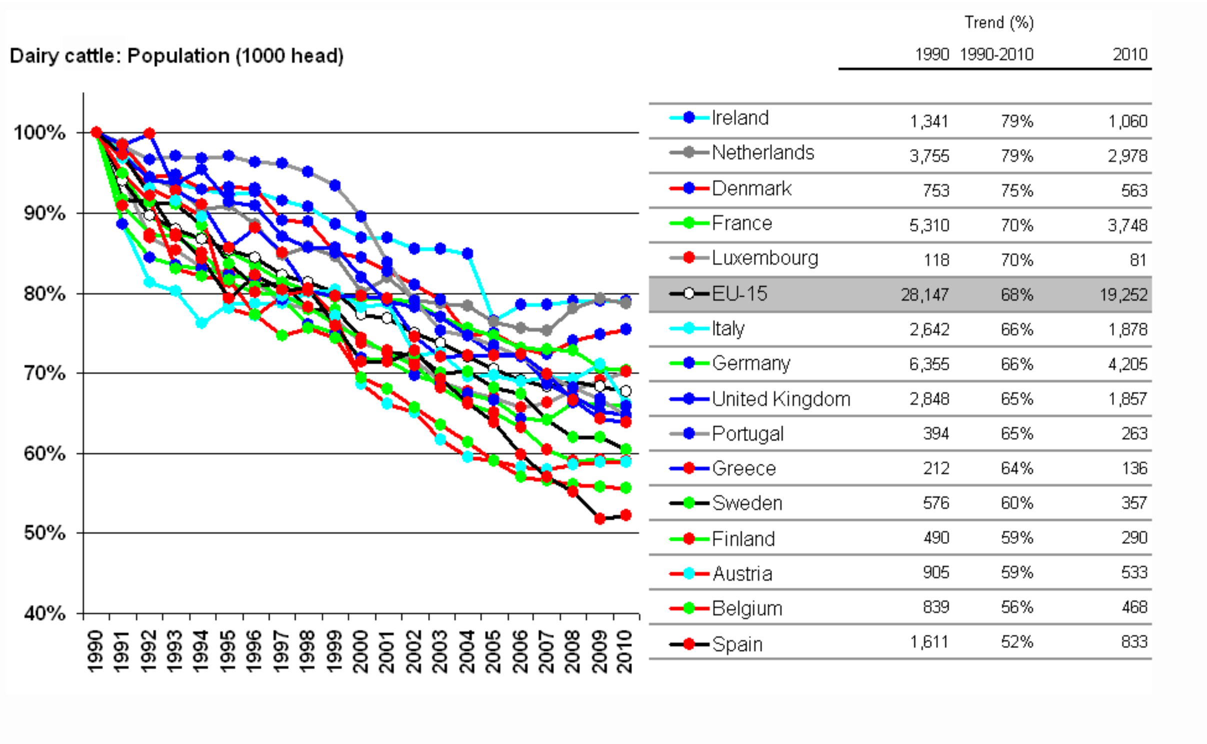
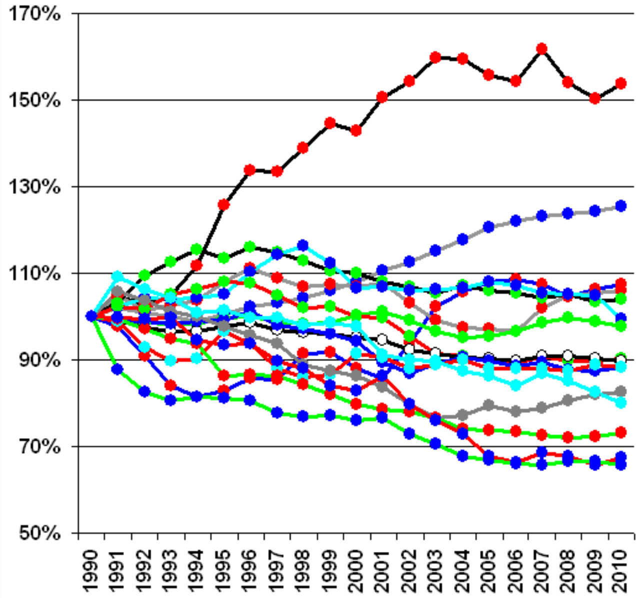


Figure 6.5: Trend of activity data (population) for non-dairy cattle.

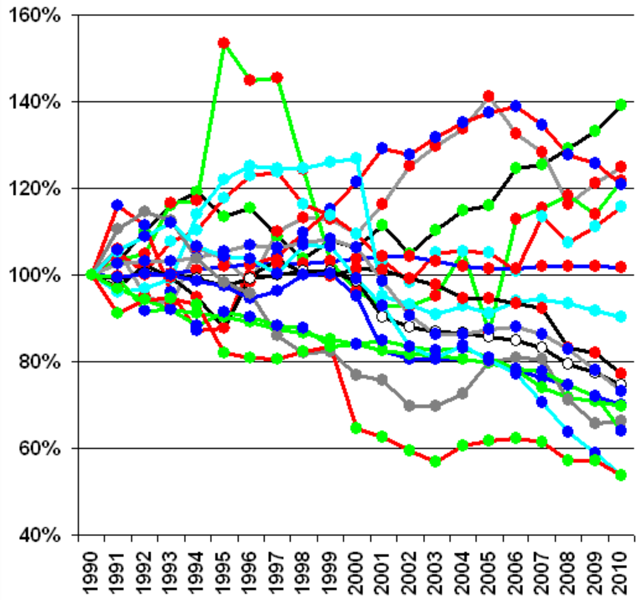
Non-dairy cattle: Population (1000 head)



	1990	Trend (%) 1990-2010	2010
Spain	3,469	154%	5,215
Portugal	978	125%	1,215
Greece	479	107%	509
Luxembourg	186	106%	196
Sweden	1,142	104%	1,182
Ireland	5,481	99%	5,753
France	16,227	98%	16,059
Belgium	2,410	90%	2,164
EU-15	68,223	90%	61,596
United Kingdom	9,344	88%	8,169
Austria	1,679	88%	1,493
Netherlands	3,168	82%	2,602
Italy	5,110	80%	4,224
Finland	870	73%	628
Denmark	1,486	67%	977
Germany	13,133	66%	8,739

Figure 6.6: Trend of activity data (population) for sheep

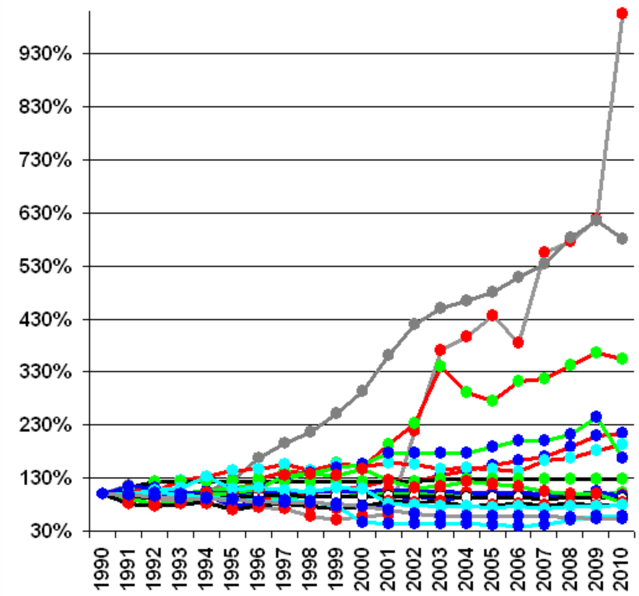
Sheep: Population (1000 head)



	1990	Trend (%) 1990-2010	2010
Sweden	406	139%	540
Luxembourg	7	125%	9
Finland	103	122%	118
Denmark	92	121%	116
Austria	310	116%	345
Greece	8,692	102%	8,854
Italy	8,739	90%	8,013
Spain	24,037	77%	19,718
EU-15	114,738	75%	88,690
Portugal	3,262	73%	2,543
United Kingdom	44,469	70%	32,038
France	11,439	70%	8,093
Netherlands	1,702	66%	1,117
Germany	3,266	64%	2,350
Ireland	8,021	54%	4,727
Belgium	192	54%	110

Figure 6.7: Trend of activity data (population) for goats

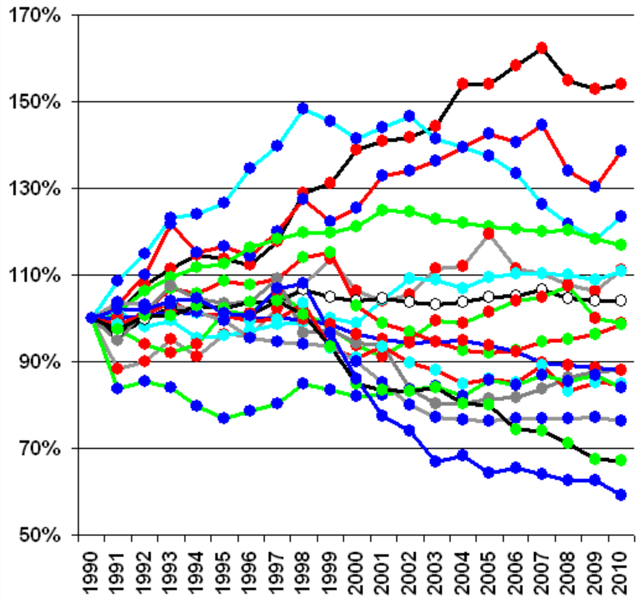
Goats: Population (1000 head)



	1990	Trend (%) 1990-2010	2010
Luxembourg	1	1005%	3
Netherlands	61	580%	374
Belgium	9	354%	32
Denmark	7	213%	16
Austria	37	192%	68
Germany	90	167%	220
Sweden	4	128%	6
France	1,329	102%	1,329
Greece	5,339	97%	5,215
United Kingdom	98	95%	101
EU-15	12,730	91%	11,707
Finland	6	83%	6
Spain	3,663	79%	2,934
Italy	1,259	78%	961
Ireland	17	58%	10
Portugal	810	53%	432

Figure 6.8: Trend of activity data (population) for swine

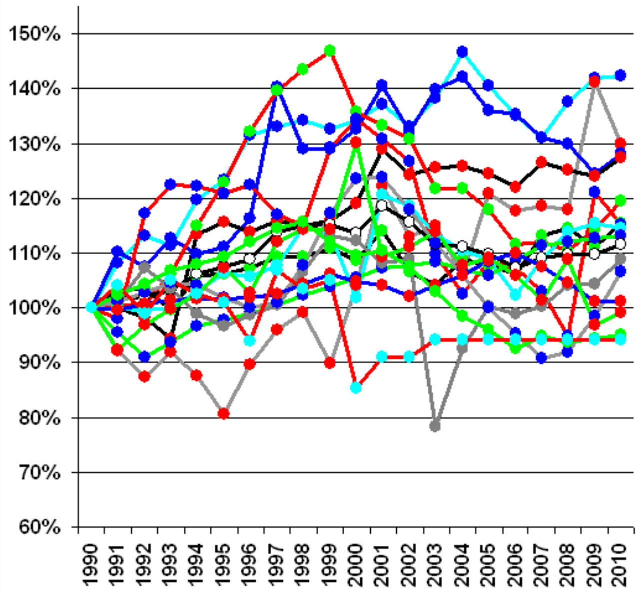
Swine: Population (1000 head)



	1990	Trend (%) 1990-2010	2010
Spain	16,371	154%	25,046
Denmark	9,497	139%	12,369
Ireland	1,222	124%	1,444
France	12,435	117%	14,719
Luxembourg	75	111%	80
Italy	8,407	111%	9,157
EU-15	113,536	104%	118,087
Finland	1,381	99%	1,381
Belgium	6,700	99%	6,454
Netherlands	13,915	88%	12,186
Greece	994	88%	880
Austria	3,688	85%	3,137
Germany	26,502	84%	23,021
Portugal	2,535	76%	1,959
Sweden	2,264	67%	1,529
United Kingdom	7,548	59%	4,724

Figure 6.9: Trend of activity data (population) for poultry

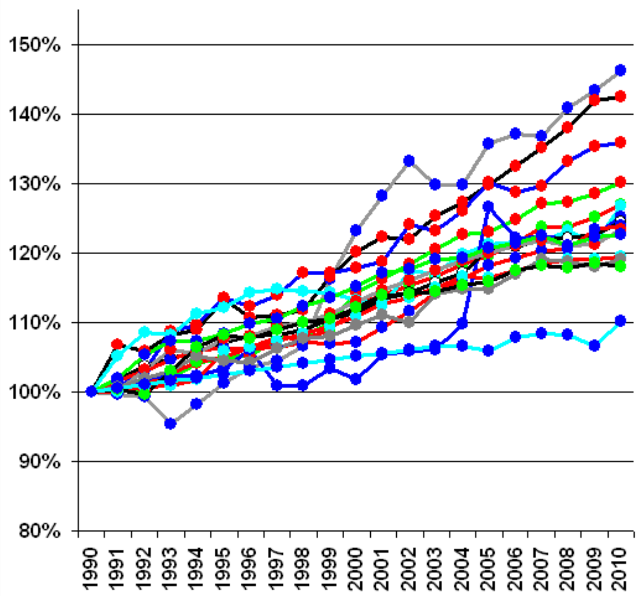
Poultry: Population (1000 head)



	1990	Trend (%) 1990-2010	2010
Ireland	11,413	142%	16,198
Luxembourg	69	130%	97
United Kingdom	127,952	128%	159,288
Spain	125,292	127%	155,465
Belgium	27,167	120%	31,018
Sweden	14,222	115%	15,812
Denmark	16,249	115%	19,676
Italy	173,342	114%	199,925
Germany	113,879	113%	128,221
EU-15	1,055,627	112%	1,159,855
Netherlands	94,902	109%	99,076
Portugal	30,891	106%	30,417
Greece	28,747	101%	29,110
Finland	9,663	99%	9,369
France	268,020	95%	253,156
Austria	13,821	94%	13,027

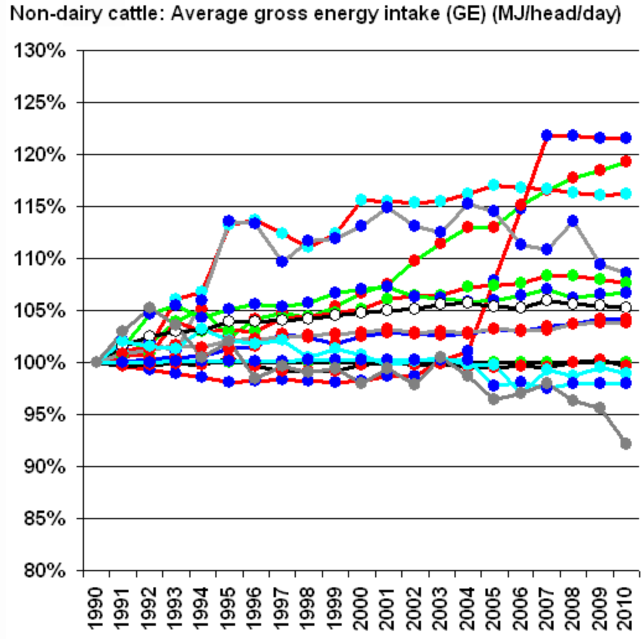
Figure 6.10:. Trend of activity data (gross energy intake) for dairy cattle.

Dairy cattle: Average gross energy intake (GE) (MJ/head/day)



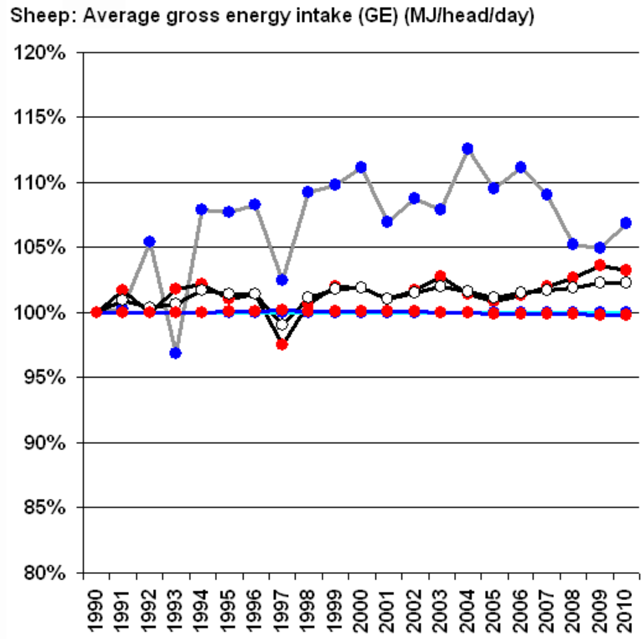
	1990	Trend (%) 1990-2010	2010
Portugal	241	146%	346
Spain	200	142%	284
Greece	224	136%	303
Finland	250	130%	321
Belgium	253	127%	317
Italy	240	127%	292
United Kingdom	226	125%	277
EU-15	246	124%	302
Denmark	278	124%	343
Luxembourg	247	123%	300
Germany	257	123%	314
Austria	247	119%	294
Netherlands	280	119%	330
Sweden	276	118%	327
Ireland	222	110%	237
France			

Figure 6.11: Trend of activity data (gross energy intake) for non-dairy cattle.



	1990	Trend (%) 1990-2010	2010
Denmark	107	122%	130
Finland	103	119%	122
Austria	123	116%	143
Portugal	130	109%	143
Belgium	104	108%	112
Germany	102	107%	109
EU-15	122	105%	129
Greece	136	104%	141
Luxembourg	104	104%	108
United Kingdom	128	100%	128
Sweden	181	100%	181
Spain	155	100%	155
Italy	141	99%	140
Ireland	132	98%	129
Netherlands	98	92%	94
France			

Figure 6.12: Trend of activity data (gross energy intake) for sheep



	1990	Trend (%) 1990-2010	2010
Portugal	21	107%	23
Spain	19	103%	20
EU-15	20	102%	20
Denmark	44	100%	44
Austria	20	100%	20
Germany	20	100%	20
Luxembourg	20	100%	20
Sweden	20	100%	20
Ireland	20	100%	20
Greece	21	100%	21
Finland			
Belgium			
United Kingdom			
Italy			
Netherlands			
France			

Figure 6.13: Trend of activity data (milk productivity) for dairy cattle

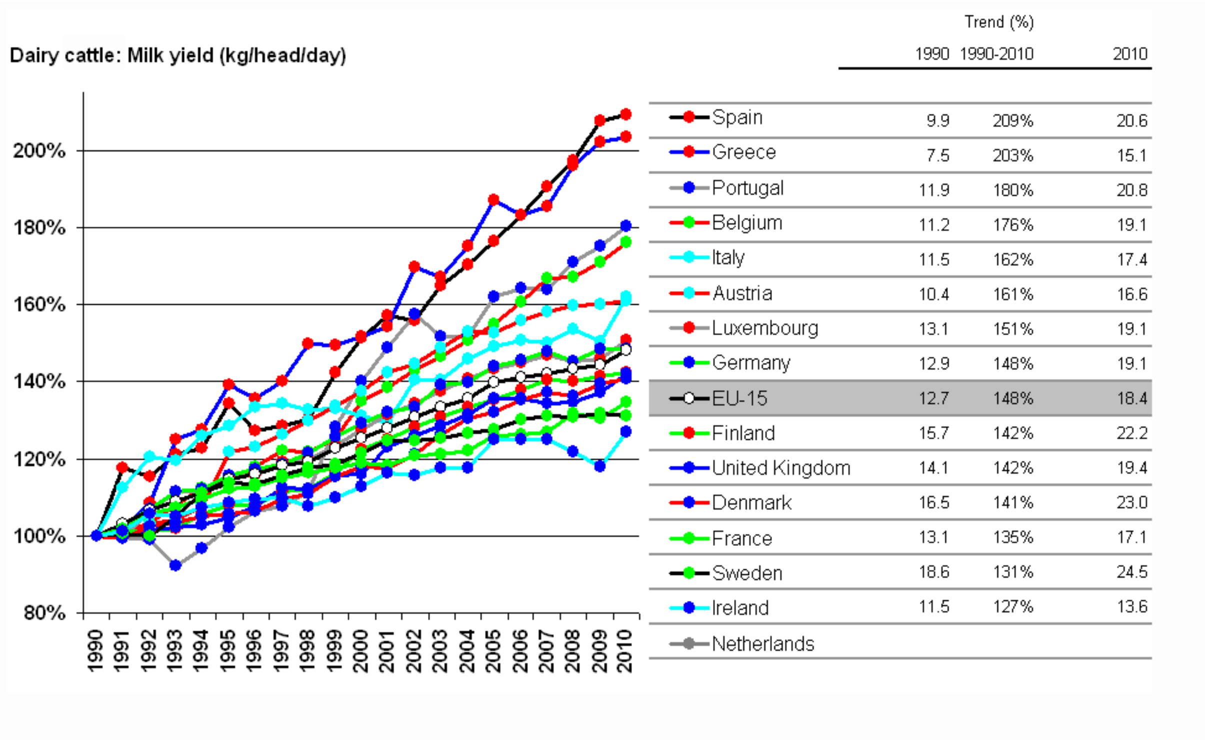


Figure 6.14: Trend of livestock characterisation: animal mass for dairy cattle

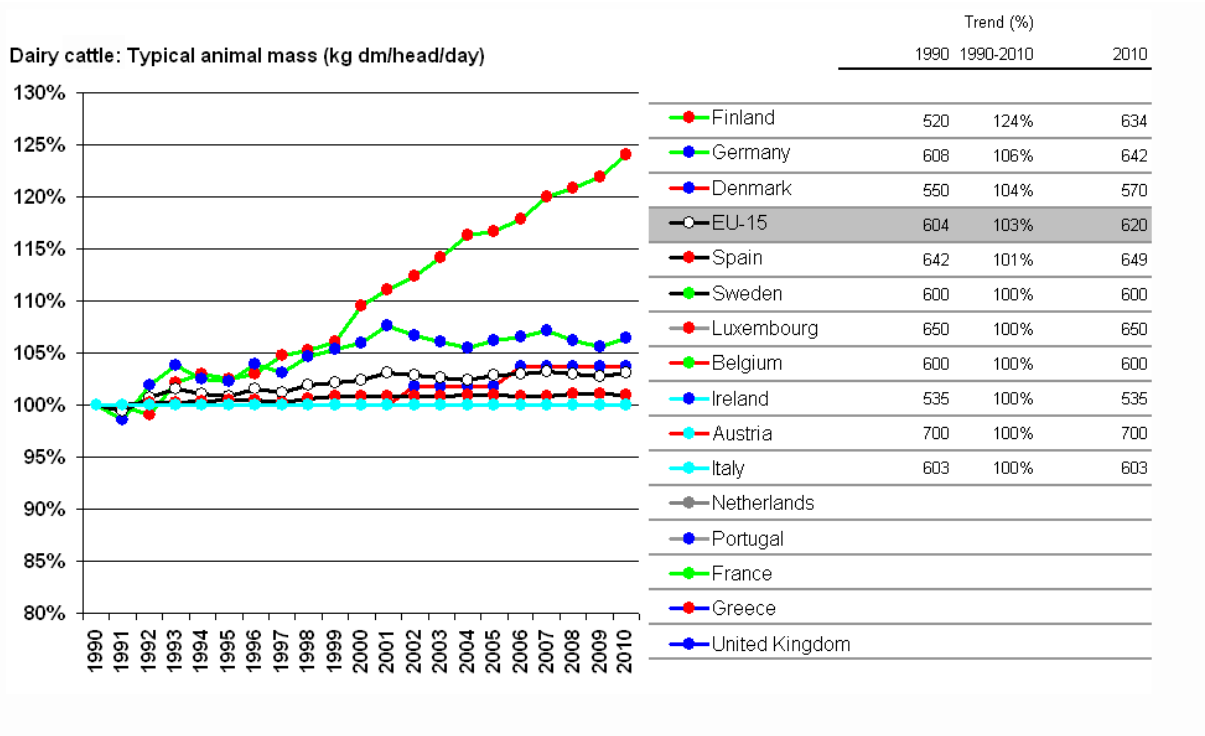


Figure 6.15: Trend of livestock characterisation: animal mass for non-dairy cattle

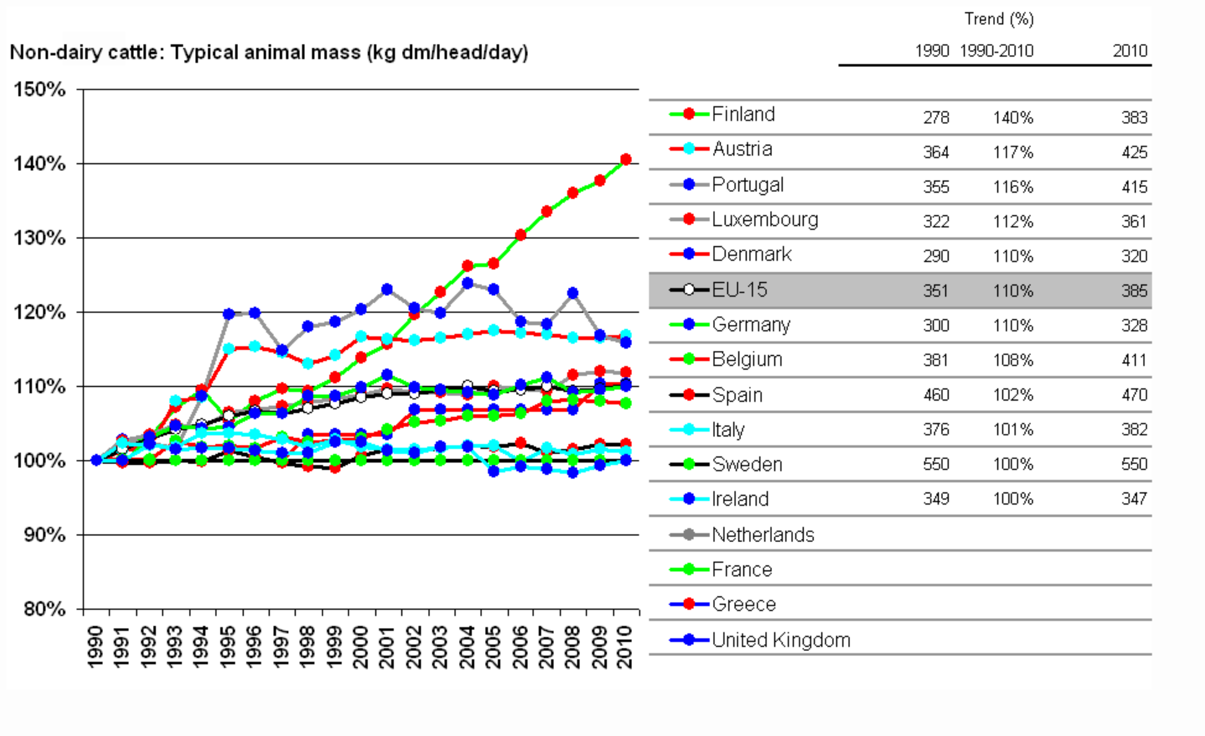
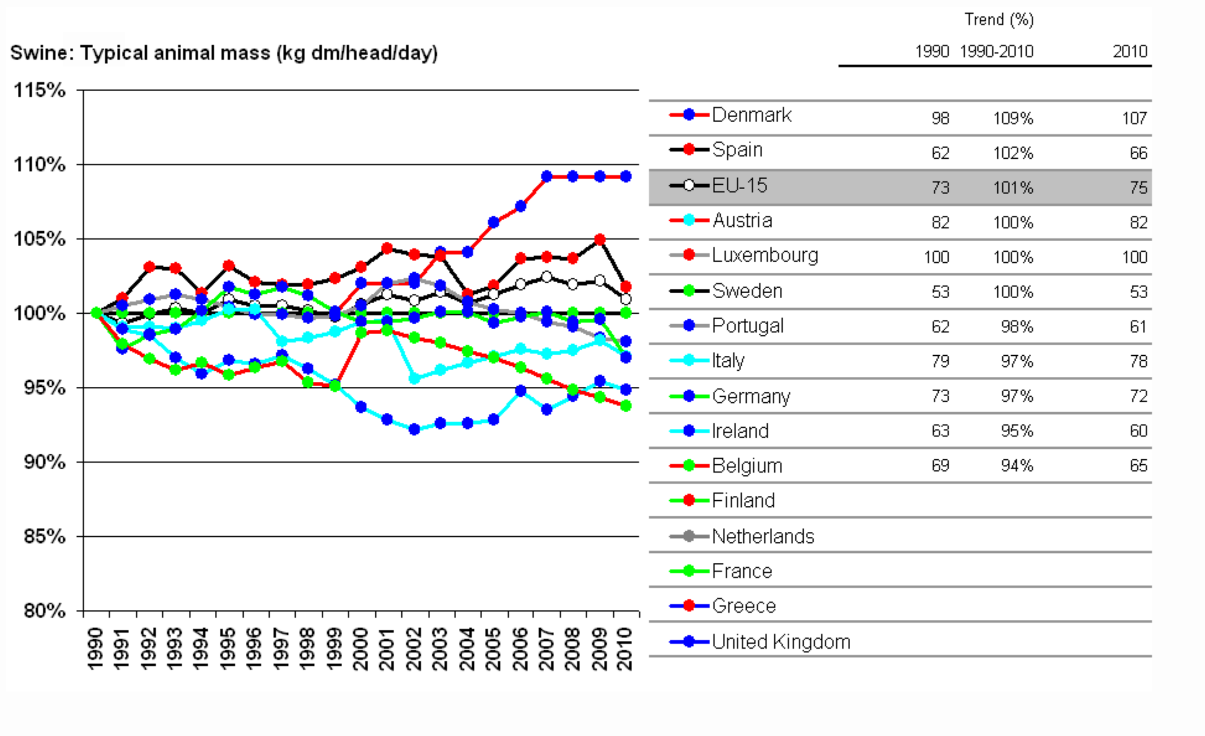


Figure 6.16: Trend of livestock characterisation: animal mass for swine



Uncertainty and time series consistency

CH_4 emissions from enteric fermentation belong to the source categories in agriculture, which are less uncertain. Animal numbers are assumed to be correct with a maximum uncertainty of 10% (with the exception of Portugal), and also the emission factor, which is calculated to a large extent with the Tier 2 methodology, is estimated to be known with a precision better than 20% for most countries, with 40% being the highest uncertainty estimate (Belgium and France) for cattle and 50% (Portugal) for other animal types. One exception is the high uncertainty assigned to some animal types (mules and asses, poultry and rabbit) in Portugal. The absence of statistic numbers for poultry, the need to estimate a time-series based on surrogate drivers, and the prevalence of dispersed animals in small farms, naturally causes higher uncertainty values for these animals. Finally, animals that are usually not considered as meat, such as equines, are less controlled and numbers tend to be known with less rigour.

The contribution of enteric fermentation to the overall inventory uncertainty is generally 1% or less, only France, Sweden and Ireland report a contribution of 2.2%, 0.5%, and 1.6% to the total inventory uncertainty, respectively.

An overview of the uncertainty estimates for activity data and emission factors are given in Table 6.23 and Table 6.24. An overview of uncertainty estimates for agriculture at country and EU15 levels will be given in 6.4.2. Note that some countries (Finland) are using Tier 2 methodology for combining uncertainty estimates in agriculture at a much finer level of disaggregation and thus do not report AD and EF uncertainty estimates separately. Instead, due the combined uncertainty estimate is reported also in the cells for the EF uncertainty and the AD uncertainty is set to zero.

Table 6.25 compiles some background information on the estimates of the uncertainty of the values used as activity data and emission factors to estimate CH_4 emissions from enteric fermentation.

Table 6.23: Relative uncertainty estimates for activity data in category 4A

Member State 2010	Total	Cattle	Dairy Cattle	Non-Dairy Cattle	Buffalo	Sheep	Goats	Camels and Llamas	Horses	Mules and Asses	Swine	Poultry	Other
Austria		10.0											
Belgium	5.0												
Denmark	2.0												
Finland													
France	5.0												
Germany			6.0	3.7	7.6								
Greece	5.0												
Ireland			1.0	1.0									1.0
Italy	20.0												
Luxembourg	2.0												
Netherlands			5.0	5.0							5.0		5.0
Portugal	7.2												
Spain	3.0												
Sweden	2.2												
United Kingdom	0.1												

Table 6.24: Relative uncertainty estimates for implied emission factors in category 4A

Member State 2010	Total	Cattle	Dairy Cattle	Non-Dairy Cattle	Buffalo	Sheep	Goats	Camels and Llamas	Horses	Mules and Asses	Swine	Poultry	Other
Austria		20.0											
Belgium	20.0												
Denmark	20.0												
Finland	32.0												
France	40.0												
Germany			40.0	24.7	26.2								
Greece	30.0												
Ireland			15.0	15.0									30.0
Italy	20.0												
Luxembourg	20.0												
Netherlands			15.0	20.0							50.0		30.0
Portugal	11.9												
Spain	10.0												
Sweden	11.2												
United Kingdom	20.0												

Table 6.25: Member State's background information for the uncertainty estimates in category 4.A

Member State	Background information to uncertainy estimates
Austria	Activity Data: **Animal numbers, in accordance to WINIWARTER & ORTHOFER (2000) were estimated at 10% uncertainty and considered statistically independent.** Emission Factor: **Uncertainties of emission factors for CH_4 emissions of enteric fermentation, according to AMON et al. (2002) were considered 20% for cattle and sheep (representing ruminants) and 30% for all other animals. EFs are correlated. Uncertainties of CH_4 emissions from Enteric Fermentation were estimated with a "Monte Carlo" simulation. Assuming a normal probability distribution, the calculated standard deviation is 4%. This indicates there is a 95% probability that CH_4 emissions are between +/- 2 standard deviations. Uncertainties considered are Gross Energy Intake, Methane Conversion Factor, Livestock, Share of oragnic farming, emission factor. The emission factors for the Tier 2 method are determined by the uncertainty of the gross energy intake and the CH_4 conversion rate.**
Belgium	Activity Data: **The only activity data here is the national livestock census. The uncertainty is judged small taken into account the features of the monitoring (census twice a year, individual earmarks and registration for all bovines, …),.** Emission Factor: **The emission factors are mainly the IPCC default values, using Tier 1 methodology. Consequently, the IPCC uncertainty estimate of 40% is used for the emission factor.**
Denmark	Activity Data: **Due to the large number of farms included in the norm figures, the arithmetic mean can be assumed as a very good estimate,with a low uncertainty. All cattle have theyr own ID-number (ear tags) and, thencd, the uncertainty in this number is almost non-existent. The Danish Plant Directorate, as the controlling authority, performs analysis of feed sold to farmers. Onaverage, 1600 to 2000 samples are analysed everly ear. Uncertainty in the data is seen as negligible. The combined effect of low uncertainty in actual animal numbers, feed ocnsumption and excretion rates gives a very low uncertainty in the activity data. The major uncertainty, therefore, relates to the emission factors.**
Finland	Activity Data: **Uncertainty estimates of animal numbers were based on knowledge on the reliability and coverage of data collection. Cattle has individual earmarks that enable very accurate assessment of animal numbers (uncertainty of ±3%), but uncertainty in animal numbers for other species in farms is higher (±5%). The uncertainty in animal numbers is estimated to be the highest for reindeer (±10%).** Emission Factor: **IPCC default uncertainties for emission factors were used excluding reindeer, for which the national emission factor has been used. The uncertainty in the Tier 2 method for evaluating emissions from enteric fermentation of cattle was assessed by estimating uncertainty in each calculation parameter (except coefficients, whose importance was expected to be minor) and combining uncertainties using Monte Carlo simulation. Uncertainty in CH_4 emissions from enteric fermentation of domestic livestock were estimated at -20% to +30% in 2007.**
Germany	Activity Data: **The uncertainties in the animal head counts in each class (with the exception of horses) are on the order of less than 6 % (DÄMMGEN, 2005). For the new Länder, herd sizes and their regional distribution for the years 1990 and 1991 were calculated using the RAUMIS model (HENRICHSMEYER et al., 1996), which provides regional data for agricultural production and products. As the data sources do not vary with the years, the time series is considered to be basically consistent. Derivation of the corrections is described in DÄMMGEN (2005).** Emission Factor: **The uncertainties in the methane emission factors are on the order of 30 % (EMEP, 2000: Chapter B1040-6). The primary sources of inaccuracy in these figures include the methane conversion factor (for cattle, 0.06 ± 0.005, i.e. 10 %, cf. IPCC, 2006) and the actual federation composition, especially**

Member State	Background information to uncertainy estimates
	that for cattle.
Luxembourg	Activity Data: **Animal numbers' uncertainty is estimated between 2% (for cattle, which are extremely well covered due to their inclusion in a register) and 10% for animals distributed over many small farms (sheep, horses, chicken).**
	Emission Factor: **The uncertainty in CH_4 emission factors for livestock categories (sheep, goats, horses) is reported to be ±20%.**
Netherlands	Activity Data: **For cattle, uncertainty in animal numbers 5% (Olivier et al.,2009),**
	Emission Factor: **For cattle, uncertainty in emission factor 15% (Bannink, 2009).The uncertainty in the emission factor for swine and other animals is estimated to be 50% and 30%, respectively (Olivier et al.,2009)**

The following issues related to time-series consistency are identified for population data:

- *Austria*

  The FAO agricultural data base provides worldwide harmonized data (FAO Agr. Statistical System 2001). In the case of Austria, these data come from the national statistical system (Statistik Austria). However, there are inconsistencies between these two data sets. Analysis shows that there is often a time gap of one year between the two data sets.

- *Denmark*

  Agricultural Statistics, in agreement with the Danish Agricultural Advisory Centre (DAAC), as Statistics Denmark does not include farms less than 5 hectares. Statistics Denmark is the source for the database kept by FAO (Food and Agriculture Organization of the United Nations). This explains why the number of sheep, goats and horses in FAO and the Danish emission inventory disagree. The largest difference is found for horses. Improvements to the documentation of number of horses, sheep and goats on small farms, in cooperation with DAAC, are planned for the 2010 reporting. Since the year 2007, a decision was taken to improving methodology in estimation of animal number to add number of sheep, goats and horses on small farms less than 5 ha.

- *Germany*

  There is some inconsistency in the time series of animal numbers in Germany due to the modification of the ""Agrarstatistikgesetzes"" with a rupture between 1998 and 1999. This applies particularly to sheep and horses, for both animal categories an approach for correction has been developed and applied (Daemmgen, 2006).

  Buffalo: Buffalo have been kept in Germany since 1996. In 1990, their population was zero. They are therefore not reported for the whole time series"

- *Sweden*

  The time series in the agricultural sector in Sweden are calculated consistently but the data needed are not always available for every year covered by the inventory. In cases where statistics are not produced annually, interpolation and extrapolation are necessary tools for the imputation of estimates. Methane from enteric fermentation may be a bit more certain with an error of about 30 %.

- *United Kingdom, AD general*

  In the United Kingdom, the time-series consistency of these activity data is very good due to the continuity in data provided. There is an increase in slaughter weight from 2004 (238kg) to 2005 (343kg). This increase was a result of the lifting of the Over Thirty Month rule, which is a measure to control the exposure of humans to the disease BSE.

With regard to time series consistency for the IEF for CH_4 emissions from enteric fermentation:

- *Sweden*

  The time series in the agricultural sector in Sweden are calculated consistently but the data needed are not always available for every year covered by the inventory. In cases where statistics are not produced annually, interpolation and extrapolation are necessary tools for the imputation of estimates. Methane from enteric fermentation may be a bit more certain with an error of about 30 %.

6.3.2 Manure Management CH_4 (CRF source category 4.B(a))

Source category description

During storage and management of manure, CH_4 can be produced and emitted to the atmosphere. In accordance with the IPCC guidelines, the term 'manure' is used collectively to include both dung and urine (i.e., the solids and the liquids) produced by livestock. Source category 4.B(a) excludes emissions that originate from burning of manure. The decomposition of manure generates CH_4 under anaerobic conditions (i.e., in the absence of oxygen). These conditions occur most readily when large numbers of animals are managed in a confined area (e.g., dairy farms, beef feedlots, and swine and poultry farms), and where manure is disposed of in liquid-based systems. If manure is managed or treated in liquid systems, it decomposes anaerobically and can produce a significant quantity of CH_4. The temperature and the retention time of the storage unit greatly affect the amount of methane produced.

Table 6.26 shows that at the European level, swine and cattle contribute more or less equally to CH_4 emissions from manure management (49% and 44% of total emissions in category 4B(a), respectively). For cattle, the contributions of non-dairy cattle are prevailing with percentages of total emissions in this category amounting to 23% and 26%, respectively. The highest contribution of cattle to CH_4 emissions from manure management are observed in Ireland (75%) and the United Kingdom (67%); the lowest in Portugal and Spain, where cattle contribute with only 8%. This is compensated with the emissions from swine manure with 89% of the total CH_4 from manure management. As also for enteric fermentation, significant emissions from sheep and goat occur in Greece with 15% and 6.2% of total CH_4 from manure management, respectively. Greece has also the highest contribution of poultry to CH_4 emissions from manure management with 23%.

At the EU-15 level, CH_4 emissions from manure management have decreased for cattle and sheep, but have increased for swine, which is mainly due to an intensification of swine production resulting in a higher IEF. Emissions from goats and poultry remained more or less stable.

Table 6.26: Total CH_4 emissions in category 4B(a) and implied Emission Factor at EU-15 level for the years 1990 and 2010

	Dairy Cattle	Non-dairy cattle	Swine
	1990		
Total Emissions of CH_4 [Gg CH_4]	535	445	802
Total Population [1000 heads]	26211	65016	113536
Implied Emission Factor [kg CH_4 / head / year]	20.4	6.9	7.2

	Dairy Cattle	Non-dairy cattle	Swine
	2010		
Total Emissions of CH_4 [Gg CH_4]	496	446	839
Total Population [1000 heads]	17525	58515	118221
Implied Emission Factor [kg CH_4 / head / year]	28.3	7.7	7.2

	Dairy Cattle	Non-dairy cattle	Swine
	2010 value in percent of 1990		
Total Emissions of CH_4 [Gg CH_4]	93%	100%	105%
Total Population [1000 heads]	67%	90%	104%
Implied Emission Factor [kg CH_4 / head / year]	139%	111%	100%

Source of information: CRF Table4s1 and 4.B(a) for 1990 and 2010, submitted in 2012
Dairy cattle includes Mature Dairy cattle, Non-dairy cattle includes Mature Non-Dairy Cattle and Young Cattle

Methodological Issues

Methods

CH_4 emissions from manure management are a key source category for cattle and swine at EU-15 level. This is true also for many Member States. Table 6.27 shows the total emissions in category 4.B(a), how this is composed and the methodology used for calculating the emissions for cattle and swine by Member States. Also, it is reports whether the source category is a key source category for the Member States.

The method for calculation of CH_4 emissions from manure management implies the need to estimate for each animal category the excretion of volatile organic solids (VS) and a maximum methane producing capacity (B_0); furthermore, for each animal category and manure management system, a methane conversion factor must be determined, which is dependent on the climate region. Each country must determine the fractions of the manure managed in all AWMS-climate region combinations. A weighted average of the methane conversion factor over all occurring climate regions must then be calculated for each animal waste management system. The IPCC *Guidelines* list default values for all these parameters. In Table 6.27, we report also the Tier that has been used by the Member States to estimate CH_4 emissions from manure management according to the approach described in section 6.4.1 (see Table 6.84 through Table 6.87).In the case of CH_4 emissions from manure management, a Tier 2 approach was assigned according to the “median-rule” with the weighting factors 0.75, 0.13, and 0.13 for VS, B_0, or MCF, respectively (see Section 0 for details). For the methane conversion factor, we calculated the default value by using the allocation to the different climate regions reported by the countries and multiplying with the respective IPCC value. For the Netherlands, no background data are given, so the level of the method could not be calculated. However, according to the NIR of the Netherlands, a country-specific Tier 2 method has been applied.

Overall, the quality of the emission estimates in category 4B(a) range between Tier 1.2 and Tier 2.0 with a Tier level for EU-15 of Tier 1.6 (corresponding to 63% of the emissions being calculated with country-specific data). This relatively low quality for this source category is due to the fact that countries with a high number of animals have intermediate quality (Tier 1.5, e.g. because no country-specific estimation of VS has been done).

Some additional information on the methodological approaches for some Member States is given in Table 6.28.

Table 6.27: Total emissions and contribution of the main sub-categories to CH_4 emissions in category 4B(a), methodology applied and key source assessment by Member States for the sub-categories dairy cattle, non-dairy cattle and swine.

	Total		Dairy Cattle		Non-dairy cattle		Cattle	Swine	
	Gg CO_2-eq	b	a	b	a	b	c	a	b
Austria	331	Tier 1.8	30%	Tier 1.9	39%	Tier 1.9	y	23%	Tier 1.9
Belgium	1,658	Tier 1.9	10%	Tier 1.9	7%	Tier 1.9	y	81%	Tier 1.9
Denmark	1,288	Tier 1.9	31%	Tier 1.9	16%	Tier 1.9	y	47%	Tier 1.9
Finland	300	Tier 1.6	30%	Tier 1.9	15%	Tier 1.9	y	36%	Tier 1.2
France	13,593	Tier 1.2	25%	Tier 1.2	36%	Tier 1.2	y	34%	Tier 1.2
Germany	5,573	Tier 1.9	42%	Tier 1.9	21%	Tier 2.0	y	35%	Tier 1.9
Greece	315	Tier 1.3	9%	Tier 1.9	6%	Tier 1.9	y	41%	Tier 1.2
Ireland	2,134	Tier 1.8	22%	Tier 1.8	53%	Tier 1.8	y	19%	Tier 1.9
Italy	2,567	Tier 1.8	16%	Tier 2.0	19%	Tier 2.0	y	45%	Tier 2.0
Luxembourg	97	Tier 1.8	33%	Tier 1.8	30%	Tier 1.8	y	35%	Tier 1.8
Netherlands	2,881	Tier 2.0	46%	Tier 2.0	14%	Tier 2.0	y	37%	Tier 2.0
Portugal	1,065	Tier 1.9	4%	Tier 1.9	3%	Tier 1.8	y	81%	Tier 1.9
Spain	5,407	Tier 1.8	5%	Tier 1.8	2%	Tier 1.8	y	89%	Tier 1.8
Sweden	295	Tier 1.9	21%	Tier 1.9	50%	Tier 1.9	y	15%	Tier 1.9
United Kingdom	2,654	Tier 1.6	49%	Tier 1.8	18%	Tier 1.9	y	19%	Tier 1.0
EU-15	**40,156**	**Tier 1.6**	**26%**	**Tier 1.7**	**23%**	**Tier 1.5**	**y**	**44%**	**Tier 1.7**
EU-15: Tier 1	37%		34%		47%			33%	
EU-15: Tier 2	63%		66%		53%			67%	

a Contribution to CH_4 emissions from manure management
b Tier 1: default methodology; Tier 2: country-specific methodology
c Source category is key in the Member State's inventory (y/n)

Table 6.28: Member State's background information for the calculation of CH_4 emissions in category 4.B(a)

Member State	Methods
Austria	**Cattle and swine: Tier 2 (key sources); Sheep, Goats, Horses and Other Soliped, Chicken, Other Poultry and Other animals: Tier 1.**
Belgium	**Tier 2 methodology is used for both cattle and swine in Flanders and for cattle alone in Wallonia since the 2009 submission. Wallonia may use this Tier 2 as well, but swine is not a key source in Wallonia and only grows 5 % of the total Belgian swine. EF used in de current methodology are close to the IPCC value. Because of the availability of detailed statistics on livestock composition in Flanders, including data on e.g. slaughter weights, a more extended variant of the IPCC methodology has been applied. Accounting for the fact that the weight of the cattle over the whole lifetime is not the same as the slaughter weight, the weight is integrated from birth to slaughtering. A study performed by the Flemish Institute for Technological Research (Vito), indicates that CH_4 emissions during manure processing are negligible.**
Denmark	**The emissions from the agricultural sector are calculated in a comprehensive agricultural model complex called DIEMA (Danish Integrated Emission Model for Agriculture, Mikkelsen, 2006). The IPCC Tier 2 approaches are used for the estimation of the CH_4 emission from manure management. The amount of manure is calculated for each combination of livestock subcategory and stable type. The estimation is based on national data for feed consumption (Poulsen et al. 2001) and standards for ash content and digestibility. A significant share of cattle and pig slurry are treated in biogas plants (DEA 2010). Treated slurry in biogas plants has a lower emission of both CH_4 and N_2O. No description on how to include biogas treated slurry in the inventories is provided in the IPCC guidelines. Therefore, the Danish inventory uses data based on a Danish study (Sommer et al., 2001). CH_4 emissions from treated slurry are reduced by 25% (cattle) or 40% (pig) versus the emissions from un-treated slurry.**
Finland	**Methane emissions from manure management are calculated in the same generic way as emissions from enteric fermentation, i.e. by multiplying the number of the animals in each category with the emission factor for each category. In Finland the Tier 2 method is used for all animal categories. The**

Member State	Methods
	national emission factor for each cattle subcategory has been calculated by using the IPCC Tier 2 methodology.
France	**Tier 1+.**
Germany	**Tier 2 for dairy cattle, non-dairy cattle and swine. Tier 2 is used also for most poultry sub-categories. The IPCC 2006 Guidelines were applied and Tier 1b (advance) methodology was used for key source categories. The values for VS and MCF are updated (Daemmgen et al., 2008). The emission factors represent the general situation in Germany. Calculations are done at the district level.**
Greece	**Dairy cattle, non-dairy cattle and sheep: Tier 2. Other animals: Tier 1.**
Ireland	**The analysis of the feeding regime for cattle (O' Mara, 2006) included a full evaluation of the organic matter content of the feeds applicable to the 11 categories that characterise the national herd, which facilitates the estimation of their respective levels of organic matter excretion.**
Italy	**IPCC Tier 2 approach has been used for estimating CH_4 EFs for manure management from cattle, buffalo and swine. For estimating slurry and solid manure EFs and the specific conversion factor, a detailed methodology (Method 1) has been applied at a regional basis (cattle and buffalo categories). Then, a simplified methodology, for estimating EFs time series, has been followed (Method 2). Since the 2006 submission, a reduction of CH_4 emissions because of biogas production has been considered.**
Luxembourg	**Tier 1 method has been applied to estimate methane emissions from manure management – i.e. for all animal categories except cattle. Population and methane emission growths are exactly the same as in enteric fermentation. What distinguishes one tier from the other is the fact that, for cattle, the average gross energy intake – as a component of the volatile solid daily excretion – is not a default value but, rather, the value obtained when estimating enteric fermentation methane related emissions with a Tier 2 method.**
Netherlands	**Tier 2 approach is used based on country specific data on animal manure production per animal, on manure characteristics (like organic matter (OM) content) and (liquid) manure storage conditions.**
Portugal	**All animal types: Tier 2. Emission factors by animal type and climatic conditions.Emissions factors for each animal type were established according to the tier 2 methodology, which considers the use of country specific information concerning the quantity of manure produce per animal and the share of each Manure Management System that is used for each animal type.**
Spain	**Tier 3 for swine and poultry; Tier 2 for cattle; Tier 1 for other animal categories.VS is estimated according to IPCC for cattle, and a national methodology for swine and poultry. Smooth temperature functions for the MCF for swine, poultry and cattle are used (modification accepted by IPCC). It has been calculated by interpolating IPCC default factors for the three climatic regions (with mid-point mean annual temperature of 10, 20, and 28°C) using the formula: MCF(T)=MCF(10°C) + b (10-T)^m, where b and m are parameters that vary with animal waste management system.**
Sweden	**Tier 2 for Cattle and Swine, Tier 1 methodology is used for other animal groups.**
United Kingdom	**Tier 2.**

Activity Data

Table 6.29 and Table 6.30 summarize the allocation of the produced manure over the animal wastes management systems 'liquid systems', 'solid storage and dry lot' and 'pasture, range and paddock' for the animal categories dairy and non-dairy cattle and swine in 2010 and 1990, respectively. The table shows, that in all countries more manure is managed in liquid systems for swine than for cattle, whereby in Italy, Ireland and the Netherlands, 100% of the swine manure is managed in liquid systems. Only in the UK more manure is managed in solid than in liquid systems. In the category cattle, generally more manure is managed in liquid systems for dairy cattle than for non-dairy cattle, expressed in relative numbers, with the exception of Italy and France.

Substantial changes in the allocation of manure to manure management systems are reported for Sweden, Germany, Finland, and Denmark, however, with different signs of the direction of the changes. For example, liquid systems were more frequently used to manage manure from dairy cattle in Sweden (from 23% in 1990 to 58% in 2010).

Table 6.29: Member State's Allocation of Animal Waste Management Systems over liquid systems, solid storage and dry lot, and pasture range and paddock in 2010

Member State	Dairy Cattle - Allocation of AWMS (%)				Non-Dairy Cattle - Allocation of AWMS (%)				Swine - Allocation of AWMS (%)			
2010	Liquid system[1)]	Daily Spread	Solid storage and dry lot	Pasture range paddock	Liquid system[1)]	Daily Spread	Solid storage and dry lot	Pasture range paddock	Liquid system[1)]	Daily Spread	Solid storage and dry lot	Pasture range paddock
Austria	32%		49%	3%	23%		44%	5%	81%	NO	4%	NO
Belgium	12%	NO	25%	43%	4%	NO	38%	45%	6%	3%	6%	NO
Denmark	87%		3%	5%	30%		1%	29%	97%		3%	0%
Finland	46%	NO	27%	26%	NO	NO	NO	NO	72%	NO	23%	
France	26%	NO	27%	47%	25%	NO	28%	47%	93%	NO	6%	1%
Germany	74%	NO	16%	10%	43%	NO	38%	19%	92%	NO	8%	NO
Greece		2%	90%	8%		3%	62%	33%	90%		10%	
Ireland	29%	NO	2%	69%	31%	NO	11%	58%	100%	NO	NO	NO
Italy	38%	NO	57%	5%	56%	NO	42%	3%	100%	NO	NA	NA
Luxembourg	34%	NO	16%	45%	26%	NO	19%	50%	90%	NO	5%	NO
Netherlands	90%			10%	75%		2%	23%	100%			
Portugal	20%	NO	50%	30%	14%	NO	NO	86%	92%	NO	2%	6%
Spain	15%	25%	60%	NO	NO	NO	35%	65%	NO	NO	NO	NO
Sweden	58%	NO	16%	25%	18%	NO	20%	46%	85%	NO	12%	NO
United Kingdom	38%	13%	4%	45%	4%	14%	21%	62%	24%	26%	38%	12%
EU15	47%	3%	23%	26%	26%	2%	27%	43%	67%	1%	5%	1%

Source of information: CRF 4.B(a) for 2010, submitted in 2012. Abbreviations explained in the Chapter 'Units and abbreviations'.

1) Anaerobic lagoon + Liquid system. Missing fraction belong to the category 'Other'

Table 6.30: Member State's Allocation of Animal Waste Management Systems over liquid systems, solid storage and dry lot, and pasture range and paddock in 1990

Member State	Dairy Cattle - Allocation of AWMS (%)				Non-Dairy Cattle - Allocation of AWMS (%)				Swine - Allocation of AWMS (%)			
1990	Liquid system[1)]	Daily Spread	Solid storage and dry lot	Pasture range paddock	Liquid system[1)]	Daily Spread	Solid storage and dry lot	Pasture range paddock	Liquid system[1)]	Daily Spread	Solid storage and dry lot	Pasture range paddock
Austria	33%		49%	11%	24%		46%	9%	69%	NO	9%	NO
Belgium	10%	NO	27%	43%	3%	NO	37%	45%	3%	3%	6%	NO
Denmark	70%		13%	15%	36%		3%	28%	89%		11%	NO
Finland	23%	NO	51%	25%	NO	NO	NO	NO	44%	NO	51%	0%
France	19%	NO	33%	48%	19%	NO	35%	45%	82%	NO	16%	1%
Germany	55%	NO	27%	18%	60%	NO	25%	15%	80%	NO	20%	NO
Greece		2%	90%	8%		3%	62%	33%	90%		10%	
Ireland	32%	NO	2%	66%	29%	NO	11%	60%	100%	NO	NO	NO
Italy	38%	NO	57%	5%	58%	NO	40%	2%	100%	NO	NA	NA
Luxembourg	23%	NO	32%	45%	19%	NO	31%	50%	90%	NO	5%	NO
Netherlands	70%			30%	66%		2%	32%	100%			
Portugal	35%	NO	35%	30%	NO	NO	28%	72%	95%	NO	3%	2%
Spain	15%	25%	60%	NO	NO	NO	31%	69%	NO	NO	NO	NO
Sweden	23%	NO	52%	25%	17%	NO	32%	42%	44%	NO	52%	NO
United Kingdom	30%	17%	7%	45%	3%	14%	22%	62%	43%	28%	27%	2%
EU15	37%	3%	30%	29%	30%	2%	27%	39%	66%	2%	12%	0%

Source of information: CRF 4.B(a) for 2010, submitted in 2012. Abbreviations explained in the Chapter 'Units and abbreviations'.

1) Anaerobic lagoon + Liquid system. Anaerobic lagoon contributes significantly only in Portugal.

For some countries, background information on in addition to what is reported inTable 6.30 on the activity data used for the estimation of CH_4 emissions from manure management is given in the respective National Inventory Reports and is listed in Table 6.31.

Table 6.31: Member State's background information on the allocation to animal waste management systems used for the calculation of CH_4 and N_2O emissions in category 4.B(a)

Member State	Activity data
Austria	**AWMS distribution was taken from the research project "Animal husbandry and manure management systems in Austria" (Amon et al. 2007) which was a a comprehensive survey on the agricultural practice**

Member State	Activity data
	in Austria. As a result of TIHALO, for 2005 new representative data on animal husbandry and manure management systems all over Austria is available. Firstly, a questionnaire was developed to assess animal housing, manure storage and manure application on typical Austrian farms. In November 2005, the questionnaire was sent to 5 000 Austrian farms. The statistical sampling plan was set up with the assistance of the Statistics Austria to guarantee the selection of a representative sample of Austrian farms. A questionnaire return of about 40% had to be achieved to receive representative data on animal husbandry and manure management systems in Austria. The returned questionnaires were manually fed into a data template by the Statistics Austria. On the basis of this template, a data base was created that contained the questionnaire information. Anonymity of the farms that supplied data is guaranteed. The data base was checked for representativeness and plausibility. For the year 1990 AWMS data based on (Konrad 1995) is available. The AWMS data from 2005-2008 were derived by linear extrapolation. From 2008 onwards the AWMS distribution is held constant in order to prevent implausible trends by the end of the commitment period. It is not planned to have another survey before the end of the commitment period. In the 2008 inventory, the following new systems have been taken into account: yard, deep litter, composting, aerobic treatment and anaerobic digester; these AWMS have been summarised under "Other". Manure management systems are distinguished for Dairy Cattle, Suckling Cows and Cattle 1–2 years in "summer situation" and "winter situation". For poultry and horses in addition the treatment of manure in anaerobic digesters is been considered. The amount of manure treated in anaerobic digersters is obtained on data from the the Austrian Energy Regulator E-Control (E-CONTROL 2011) on the basis of reports from biogas plants operators.
Belgium	**In Wallonia, the allocation of animals to AWMS comes from the NIS agricultural census of 1992 and 1996, where those data were published by animal type. Those data are not collected yearly by the NIS given their slow pace of change; an update would be desirable.**
Denmark	**From 2006, all farmers have to report which stable type they are using to the Danish Plant Directorate. These information are now included in the inventory and are in overall consonant with the expert judgement from DAAC. At present, there exist no official statistics concerning the distribution of animals according to stable type. The distribution is, therefore, based on an expert judgement from the Danish Agricultural Advisory Centre (DAAC). Approximately 90-95% of Danish farmers are members of DAAC and DAAC regularly collects statistical data from the farmers on different issues, as well as making recommendations with regard to farm buildings.**
Finland	**Distribution over animal systems (slurry, solid storate, pasture) is country-specific from literature (MKL, 1993; Seppänen and Matinlassi, 1998) and expert judgement. Anaerobic lagoons and daily spread not used in Finland.**
France	**Surveys on the distribution of national animal housing systems have been carried out in 1994, 2001, and 2008 and allow thus to cover the evolution of the systems in time. Distribution of manure over AWMS takes into account the time the animal spent within the housing and outside (pasture or yard) as well as the share of solid and liquid systems. As only days which were spent entirely in the housing systems were counted, 4 hours/day during the grazing period were added for dairy cattle to account for time they spent in the housings. Distribution over AWMS is interpolated between the years 1994, 2001 and 2008 and has been kept constant after 2008.**
Ireland	**The allocation to animal waste management system is based on the farm facilities survey. The same values are used for all years. The bulk of animal wastes in housing are managed in liquid storage systems. New information obtained from a national farm facilities survey (Hyde et al., 2008).**
Luxembourg	**The allocation of AWMS for dry lot is included in solid storage.**
Netherlands	**Specified data on manure management are based on statistical information on management systems; these data are documented in Van Schijndel and Van der Sluis, 2008.**
Portugal	**Livestock numbers per animal type were available at Concelho level from two detailed agriculture surveys: RGA89 and RGA99. Livestock numbers in each Concelho area were allocated to each climate region, for year 1999, according to the land are percentage, and always assuming an homogeneous distribution of animals in the Concelho territorial area. Number of animals were summed at each Administrative Region (Região). Livestock population in each climate region and by Região was estimated annually from total livestock population in Região and considering the constant share and, finally, the total national livestock population for each region was calculated.**
Sweden	**Information on waste management systems is collected from the survveys publishes in the biannual statistical report on the use of fertilisers and animal manure in agriculture (Statistics Sweden, MI 30-series). Three manure management systems are considered apart form grazing animals: liquid systems (including semi-liquid manure), solid storage and deep litter (sometimes categorised as "other" in the national inventory). National estimates of stable periods are collected from the statistical report on use of fertilisers and animal manure in agriculture (Statistics Sweden, MI 30-series). This information has been available biannually since 1997. Before 1997, the data are extrapolated to 1990. Since dairy cows are often stabled at night, the data on stable periods for this animal category is combined with an assumption that 38% of its manure was produced in the stable during the grazing period (caclulated according to the STANK model, Swedish Board of Agriculture, 2005)**
United Kingdom	**The distribution to AWMS was revised in 2000 for cattle and poultry. Data on 'no significant storage capacity' of farmyard manure were allocated. This could have a large effect on emissions because it amounted to around 50% of manure and the 'Daily spread (DS)' category has an emission factor of zero, compared to 0.02 for the 'Solid storage and dry lot (SSD)' category. There was a revision (in 2002) of the allocation of manure to the different management systems based on new data.Data for waste management systems for swine and poultry are from a survey. For other animal types the values are from expert judgement (UPV 2006).**

Emission Factors and other parameters

The implied emission factors for CH_4 emissions from manure management vary substantially among the Member States, as shown in Table 6.32. The range of the implied emission factors for dairy cattle, non-dairy cattle and swine covers about one order of magnitude, which is more than the range proposed in the IPCC *Guidelines* for different climate regions (for dairy cattle in Western Europe, for example, an emission factor of 14 kg CH_4 head^{-1} y^{-1} is proposed for cool climate regions and a factor of 81kg CH_4 head^{-1} y^{-1} of warm climate regions), but less than the ratio of the methane conversion factors of liquid (39% - 72%) and solid (1% – 2%) manure.

As mentioned above, the two most important factors influencing the amount of CH_4 emitted from manure management systems are the climate region and if solid or liquid systems are dominating. We have already discussed the large range of systems used in the EU-15 Member States. The other two factors, the excretion rate of volatile solids and the methane producing potential, are not significantly influencing the order of magnitude.

The ratio of the highest and the smallest IEF used by the Member States is 6 for dairy cattle, and 13 for non-dairy cattle and 20, 21, and 18 for sheep, goats and swine, respectively. The highest IEF for dairy cattle is used by France with 42.6 kg CH_4/head/year and the smallest by Portugal with 7.8 kg CH_4/head/year.

For dairy cattle, the low IEF used in Portugal is explained by the fact that part of dairy cattle is managed in "Fossas" (Pits)", which corresponds best to the IPCC class "Pit storage below animal confinements". The storage time is very short, less than one month. Therefore, Portugal set the MCF to zero. In 2006 guidelines the MCF is revised to 3%, but no clear distinction is made between pits and liquid/slurry system. A more detailed assessment would require a country-specific study. Germany uses higher CH_4-IEF for dairy cattle then neighbouring countries. This might partly be caused by the use of MCF values from IPCC (2006), while most countries use data from IPCC (1996). Value of IEF for CH_4 emissions is among the highest among EU27. The only national values used are those for the breakdown of manure by systems (liquid, daily spread). It is based on an expert judgment. That might, perhaps, be the reason for the high IEFs for CH_4. Not satisfactory explained.

A very low IEF has been used for non-dairy cattle by Spain. Spain uses a Tier 2 approach. Gross energy is calculted using tier 2 methodology of enteric fermentation whilst percentages of manure management systems are taken from national references. The dominant systems for non-dairy cattle are solid storage and pasture, both of which have very a low MCF at 10ºC. The reason for high IEF used by France are high values for the MCF. This is due to the climate region, which is "temperate" in the metropolitan territory and "warm" in DOM and COM.

Table 6.32: Implied Emission factors for CH_4 emissions from manure management used in Member State's inventory 2010

Member State	Implied EF (kg CH_4/head/yr)				
2010	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine
Austria	9.0	4.1	0.19	0.12	1.2
Belgium	16.7	2.6	0.63	0.76	9.7
Denmark	33.2	9.5	2.82	2.45	2.2
Finland1)	15.0	3.3	0.19	0.12	3.7
France	43.1	14.6	0.28	0.18	15.2
Germany	26.4	6.5	0.27	0.22	4.1
Greece	9.6	1.7	0.25	0.18	7.0
Ireland	20.7	9.9	0.16	0.12	12.8
Italy	11.2	5.8	0.22	0.15	5.9
Luxembourg	37.3	8.7	0.19	0.12	19.5
Netherlands	42.6	7.5	0.16	0.37	4.1
Portugal	7.8	1.3	1.84	1.70	21.3
Spain	15.9	1.2	0.22	0.16	9.1
Sweden	8.5	5.9	0.19	0.12	1.4
United Kingdom	33.8	2.7	0.14	0.12	5.5
EU-15	28.3	7.7	0.25	0.24	7.2

Source of information: CRF 4.B(a) for 2010, submitted in 2012 Abbreviations explained in the Chapter 'Units and abbreviations'.

1) Finland reports non-dairy cattle under "other" in the following categories: bulls, cows, heifers, and calves. Swine is reported under "other" in the categories: fattening pigs, sows with piglets and weaned pigs. The IEFs have been calculated as a weighted average. The IEF for the Netherlands and Luxembourg has been calculated as a weighted average has been calculated using the values given under option B (mature non-dairy and young cattle).

The parameter of interest are the allocation of manure to climate regions (Table 6.33) and methane conversion factor used (Table 6.34). Most of Europe falls into the cool climate region with average annual temperatures below 15°C. Accordingly, most countries are allocating 100% of the animal population to the cool climate region, with Italy and Portugal allocating a part of the population into the temperate region (for dairy cattle for example 8% and 60%, respectively) and only Greece allocating 100% of the animals to the temperate climate region. France assumes 0.1% of the dairy cattle and 0.9% of the non-dairy cattle in the warm climate region, which is due to the extra-territorial regions; the remaining manure is allocated to the temperate climate region. The distribution of the animals over the climate regions is somewhat different for different animal types; in Portugal, for example, the portion of animals living in the temperate region increases from dairy cattle over non-dairy cattle to swine.

For the categories dairy cattle, non-dairy cattle and swine, only in few cases is the allocation of animal population to climate regions reported to be dynamic. However, in Portugal, for example, a general shift of livestock production to warmer climate regions has been observed increasing the percentage of manure managed in the temperate region by 8%, 18%, and 5% for dairy cattle, non-dairy cattle, and swine, respectively.

The potential methane producing factor is IPCC default or close to IPCC default for most countries (Table 6.35); the amount of volatile organic solid excreted per animal (Table 6.36) and year varies across the countries on the basis of the animal characterization with a ratio of highest to lowest average VS excretion rate between 2.4 (Dairy Cattle) and 3.8 (Goats).

Table 6.33: Member State's allocation of dairy cattle, non-dairy cattle and swine to the climate regions "cool", "temperate" and "warm" in 2010

Member State	Dairy Cattle - Allocation by climate region[1)]			Non-Dairy Cattle - Allocation by climate region[1)]			Swine - Allocation by climate region[1)]		
2010	Cool (%)	Temperate (%)	Warm (%)	Cool (%)	Temperate (%)	Warm (%)	Cool (%)	Temperate (%)	Warm (%)
Austria	100%	NO	NO	100%	NO	NO	100%	NO	NO
Belgium	100%	NO	NO	100%	NO	NO	100%	NO	NO
Denmark	100%			100%			100%		
Finland	100%	NO	NO	NO	NO	NO	100%	NO	NO
France	NO	100%	0.1%	NO	99%	0.9%	NO	99%	1.0%
Germany	100%	NO	NO	100%	NO	NO	100%	NO	NO
Greece		100%			100%			100%	
Ireland	100%	NO	NO	100%	NO	NO	100%	NO	NO
Italy	92%	8%	NO	87%	13%	NO	97%	3%	NO
Luxembourg	100%	NA	NA	100%	NA	NA	100%	NA	NA
Netherlands	100%			100%			100%		
Portugal	40%	60%	NO	24%	76%	NO	17%	83%	NO
Spain	88%	12%		70%	30%		71%	29%	
Sweden	100%	NO	NO	100%	NO	NO	100%	NO	NO
United Kingdom[1)]	100%			100%			100%		
EU-15	76%	24%	0%	66%	33%	0%	79%	21%	0%

Source of information: CRF 4.B(a) for 2010, submitted in 2012. Abbreviations explained in the Chapter 'Units and abbreviations'.

[1)] The portion lacking for 100% are reported as daily spread (only UK) and 'other'.

Table 6.34: Member State's Methane Conversion Factor used for dairy cattle, non-dairy cattle and swine for the different animal waste management systems in 2010

Member State	Dairy Cattle - Methane Conversion Factor (%) [1)]				Non-dairy Cattle - Methane Conversion Factor (%) [1)]				Swine - Methane Conversion Factor (%) [1)]			
2010	Anaerobic lagoon	Liquid system	Solid storage and dry lot	Pasture range paddock	Anaerobic lagoon	Liquid system	Solid storage and dry lot	Pasture range paddock	Anaerobic lagoon	Liquid system	Solid storage and dry lot	Pasture range paddock
Austria	NA	9%	1.00%	1.00%	NA	8%	1.00%	1.00%	NA	3%	1.00%	1.00%
Belgium	NO	19%	2.00%	1.00%	NO	19%	2.00%	1.00%	NO	19%	2.00%	NO
Denmark	NO				NO				NO			
Finland	NA	10%	1.00%	1.00%	NA	10%	1.00%	1.00%	NA	10%	1.00%	1.00%
France	NO	59%	1.75%	1.75%	NO	59%	1.75%	1.75%	NO	59%	1.75%	1.75%
Germany	NO	13%	2.00%	1.00%	NO	13%	2.00%	1.00%	NO	16%	2.00%	1.00%
Greece												
Ireland	NA	39%	1.00%	1.00%	NA	39%	1.00%	1.00%	NA	39%	NA	NA
Italy	NO	16%	3.00%	1.25%	NO	16%	3.00%	1.25%	NO	26%	NA	NA
Luxembourg	NA	39%	1.00%	1.00%	NA	39%	1.00%	1.00%	NA	39%	1.00%	NA
Netherlands												
Portugal	42%	NA	1.25%	1.25%	NA	NA	1.25%	1.25%	42%	NA	1.25%	1.25%
Spain	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sweden[2)]	NO	10%	1.00%	1.00%	NO	10%	1.00%	1.00%	NO	10%	1.00%	NO
United Kingdom	N/A	39%	1.00%	1.00%		39%	1.00%	1.00%	NA	NA	NA	NA
EU15	42%	43%	1.96%	1.50%	NA	45%	1.82%	1.50%	42%	42%	1.76%	1.50%

Source of information: CRF 4.B(a) for 2010, submitted in 2012. Abbreviations explained in the Chapter 'Units and abbreviations'.

[1)] Anaerobic lagoon + Liquid system. [2)] Values reported by Sweden have been multiplied with a factor of 100.

Table 6.35: Member State's methane producing potential for emissions from manure management for the main animal types in 2010

Member State 2010	CH4 producing potential (Bo) (CH4 m3/kg VS)				
	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine
Austria	0.24	0.17	0.19	0.17	0.45
Belgium	0.24	0.17	0.19	0.17	0.45
Denmark	0.24	0.17	0.19	0.17	0.45
Finland	0.24	0.17	0.19	0.17	0.45
France	0.24	0.17	0.19	0.17	0.45
Germany	0.24	0.18	0.19	0.18	0.45
Greece	0.24	0.17	0.19	NE	NE
Ireland	0.24	0.24	0.19	0.17	0.45
Italy	0.14	0.13	0.19	0.17	0.46
Luxembourg	0.24	0.17	0.19	0.17	0.45
Netherlands	0.25	0.25	0.25	0.25	0.34
Portugal	0.24	0.17	0.19	0.17	0.45
Spain	0.24	0.17	NA	NA	0.45
Sweden	0.24	0.17	0.20	0.20	0.45
United Kingdom	0.24	0.15	0.19	0.17	0.45
EU-15	0.23	0.18	0.19	0.18	0.44

Source of information: CRF 4.B(a) for 2010, submitted in 2012. Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 6.36: Member State's volatile solid excretion from managed manure for the main animal types in 2010

Member State 2010	VS excretion (kg dm/head/day)				
	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine
Austria	4.2	1.9	0.4	0.3	0.3
Belgium	4.0	1.4	0.5	0.5	0.5
Denmark	6.2	2.8	1.1	1.1	0.2
Finland	4.9	1.9	0.4	0.3	0.5
France	5.1	2.7	0.4	0.3	0.5
Germany	4.0	1.5	0.4	0.3	0.3
Greece	6.6	2.8	0.4	NE	NE
Ireland	3.0	1.3	0.4	0.3	0.3
Italy	6.4	2.8	0.4	0.3	0.3
Luxembourg	4.5	1.9	0.4	0.3	0.5
Netherlands	4.6	1.1	0.5	0.6	0.2
Portugal	7.0	2.7	0.5	0.4	0.5
Spain	4.1	2.4	NA	NA	0.3
Sweden	5.3	1.5	0.4	0.3	0.3
United Kingdom	3.7	2.3	0.4	0.3	0.5
EU-15	4.6	2.2	0.4	0.3	0.3

Source of information: CRF 4.B(a) for 2010, submitted in 2012 Abbreviations explained in the Chapter 'Units and abbreviations'.

Some additional background information on the factors and parameters used by the Member States is given in Table 6.37.

Table 6.37: Member State's background information on the emission factors and other parameters used for the calculation of CH_4 emissions in category 4.B(a)

Member State	Emission Factors and other parameters
Austria	**The default MCF values for 'cool climate regions' were used. For liquid systems a national value is used based on measurements; these values are considerably lower than IPCC default values. For yard (which is not included in the GPG2000, the MCF of pasture, range and paddock has bee taken. For deep litter the MCF of the 2006 IPCC Guidelines (17%) has been taken because the MCF of the GPG 2000 (39%) is not applicable to Austria's cold climate conditions. Austrian measurements showed that CH_4 emissions from farmyard manure were always lower than CH_4 emissions from liquid manure. It would contradict latest scientific results to apply a higher MCF to deep litter systems than to liquid manure systems. In the IPCC guidelines the default MCF for deep litter systems equals the default MCF for liquid systems. Hence, for Austria the chosen MCF of 17% (IPCC 2006) is a conservative estimate. Austrian specific values for dairy cows were calculated in dependency of annual milk yields and corresponding feed intake data (gross energy intake, feed digestibility, ash content). MCF for liquid systems are obtained from peer reviewed publications (AMON et al. 2002a, 2006, 2007a) based on a three-year measurement campaign on emissions from manure stores. Following the results of a Germam study (FNR, 2010), CH_4 losses of biogas plants are about 1-2% of the gas produced under cold climate conditions. Following these results and expert judgement, the MCF was set to 2% for manure treated in anaerobic digesters.** **For the calculation of VS excretion of suckling cows an average milk yield of 3 000 kg was applied. Austrian specific values on VS excretion for all other cattle categories were calculated from typical Austrian diets under organic and conventional management. As no major changes in diets of Non-Dairy Cattle occurred, methane emissions from manure management of Non-Dairy Cattle are calculated with a constant gross energy intake and thus constant VS excretion rate for the whole time series for swine. From Manure Management for Sheep, Goats, Horses, Poultry and Other Livestock / Deer are estimated with Tier 1 approach.**
Belgium	**Emission factors for each animal category have been developed by Siterem 2001. Those factors take into account the type and volume of manure produced during the time spent in stables, its density and carbon content, and its carbon volatilisation ratio. The resulting EF are comparable to the default IPCC for cool climate.**
Denmark	**The IEF for sheep and goats includes lambs and kids, which corresponds the Danish normative data. This explains why the Danish IEF is nearly twice as high as the IPCC default value. Swine: typical animal mass is based on slaughter pigs. Old-style tethering systems with solid manure have been replaced by loose housing with slurry-based systems. For non-dairy cattle, the opposite development has taken place. An increasing proportion of bull-calves are raised in stables with deep litter, where the MCF is lower than for liquid manure. The methane emission from liquid systems is very sensitive to temperatureeffects. Basically most of the manure is stored in Denmark under cold conditions (<5-10 degrees) .The CH_4 formation practically stops at 4°C and therefore there are no plausible arguments that 39% of total CH_4 capacity should be released under Danish conditions. Danish studies confirm this assumption (Husted, 1994 and Sommer et al., 2000). Furthermore, investigations based on measurements in Canada, which conditions are similar to Denmark, support this value (Massé et al., 2003). Support of this value is also found from a Swedish review (Dustan, 2002), taking both the cold climate and the fact that the slurry containers usually have a surface cover, in to account and which also argues for a liquid MCF at 10 %. Considering the agricultural conditions in Denmark and the present scientific knowledge as described above a MCF of 10 % for liquid/slurry is more appropriate under the Danish conditions. The Danish decision of using a MCF of 10 % is as demonstrated above backed by several scientific papers as well as both the revised 1996 IPCC Guidelines and the IPCC 2006 Guidelines. Therefore Denmark intends to continue using a MCF value of 10 % until scientific knowledge become available.**
Finland	**Cattle: National values for digestible energy (DE %), fraction of animal´s manure managed annually in each manure management system (MS), average milk production and animal weight. For Reindeer it is assumed that all manure is deposited on pastures and for fur animals it is assumed that all manure is managed as solid. For fur animals, VSi value is based on expert judgement being 0.17 kg/head/day.**
France	**IPCC EFs, only some specific national conditions were considered.**
Germany	**According to the calculation at district level, IEF are varying with time and space due to differences in AWMS distribution and climate. No national data for the methane producing potential exist and IPCC (2006) default values are used. IPCC 2006 is used as it allows for a better description of emissions from storage allowing consistent mass flow calculations. In addition, it provides temperature-dependent methane conversion factors. For goats, the IEF is based on the assumption of all-round grazing, which is not the case. Emissions are calculated with realistic management system frequency distributions. Emissions from buffalo are calculated on the basis of 100% formation of natural crusts.**
Greece	
Ireland	**New information obtained from a national farm facilities survey (Hyde et al., 2008) and the work on emission factors for enteric fermentation in cattle is the basis of the CH_4 emission factors for manure management. The emission factors for manure management are derived using the quantified organic matter excretion as volatile solids (VS), a BO (the methane production potential of animal waste), the allocation to animal waste management system based on the farm facilities survey and the corresponding values of MCF (methane conversion factor) given for the cool climate zone.**

Member State	Emission Factors and other parameters
Italy	**The detailed calculation includes a monthly regional emission factor as an exponential function from the monthly average regional temperature for slurry and the average regional monthly storage temperature for solid manure (Husted, 1993; Husted, 1994). The storage temperature is by itself an exponential function of the regional temperature. A specific conversion factor has then been estimated to correlate methane emissions and volatile solid production (15.32 g CH_4 kg-1 VS for slurry and 4.80 g CH_4 kg-1 VS for solid manure). These factors have then been used to calculate the aggregated methane emissions. The methane producing potential B_0 has been calculated for reporting purposes only. Swine. National emission data from experimental research at the Research Centre on Animal Production (CRPA, 1996).**
Luxembourg	**For cattle, the IEF has been calculated by combining the country specific activity data, coefficients and parameters according to the Tier 2 methodology.**
Netherlands	**The Netherlands uses a country-specific emission factor for a specific animal category, which is expressed as amount of methane emitted per kg animal manure per year for all three manure management systems for every animal category on a Tier 2 level. These calculations are based on country-specific data on manure characteristics: organic matter (OM) and maximum methane-producing potential (B_0), manure management system conditions (storage temperature and period) for liquid manure systems, which determine the methane conversion factor (MCF). Country-specific data on manure characteristics (volatile solids and maximum methane producing potential). Country-specific data on manure management system conditions (storage temperature and period) are also taken into account for liquid manure systems. For the other manure systems (solid manure and manure produced in the meadow), IPCC default values for the methane conversion factor are used. The Netherlands uses a MCF of 1.5% for all animal categories; for manure production in the meadow, it uses the IPCC default MCF value.**
Portugal	**Emissions factors for each animal type were established according to the tier 2 methodology, which considers the use of country specific information concerning the quantity of manure produce per animal and the share of each Manure Management System that is used for each animal type.**
Spain	**VS is estimated according to IPCC for cattle, and a national methodology for swine and poultry. Smooth temperature functions for the MCF for swine, poultry and cattle are used (modification accepted by IPCC). It has been calculated by interpolating IPCC default factors for the three climatic regions (with mid-point mean annual temperature of 10, 20, and 28°C) using the formula: MCF(T)=MCF(10°C) + b (10-T)^m, where b and m are parameters that vary with animal waste management system.**
Sweden	**The B_0i and MCF factors used are the default values in the Good Practice Guidance, except for the MCF for liquid manure, where the value of 3.5 % is used. This value was developed by Rodhe et al. 2008 and is considered to be more appropriate for Swedish conditions.**
United Kingdom	**Apart from cattle, lambs and deer, IPCC Tier 1 defaults (IPCC, 1997) are used and do not change from year to year. The emission factors for lambs are assumed to be 40% of that for adult sheep. Emission factors for dairy cattle were calculated from the IPCC Tier 2 procedure. The waste factors used for beef and other cattle are now calculated from the IPCC Tier 2 procedure but do not vary from year to year.**

Trends

Shifts in emission factors are partly explained by the increasing milk yield for dairy cows and by changes in the use of manure management systems. For example, in Denmark, an increasing IEF for dairy cattle results from an increasing milk yield and a shift to liquid manure systems. For pigs, there has been a similar development with a move from solid manure to slurry-based systems. For non-dairy cattle, the opposite development has taken place; an increasing proportion of bull-calves is raised in stables with deep litter, where the MCF is lower than for liquid manure. A similar effect is seen for Finland. The fluctuations underlying the general increase in emissions in Finland are related to both changes in animal numbers, which is largely dependent on agricultural policy, as well as changes in the distribution of manure management systems used. Slurry-based systems increase methane emissions per animal tenfold compared to the solid storage or pasture. In the Netherlands, liquid manure systems were replaced for poultry by solid manure systems which explain the decreasing emissions for poultry.

Figure 6.17 through Figure 6.22 show the trend of the development of animal productivity in terms of volatile solid excretion for dairy and non-dairy cattle and swine, and the IEF for CH_4 emissions from manure management. These figures show how the different development of the animal sectors in the various countries affects the average characteristics at EU level. Spain is the country with the largest increase in the Swine population and also the country which estimates the highest estimated volatile solid excretion rate. Thus the trend observed at EU-15 level (steepest increase in volatile solid excretion) can entirely be explained by a shift of the weight towards Spanish conditions.

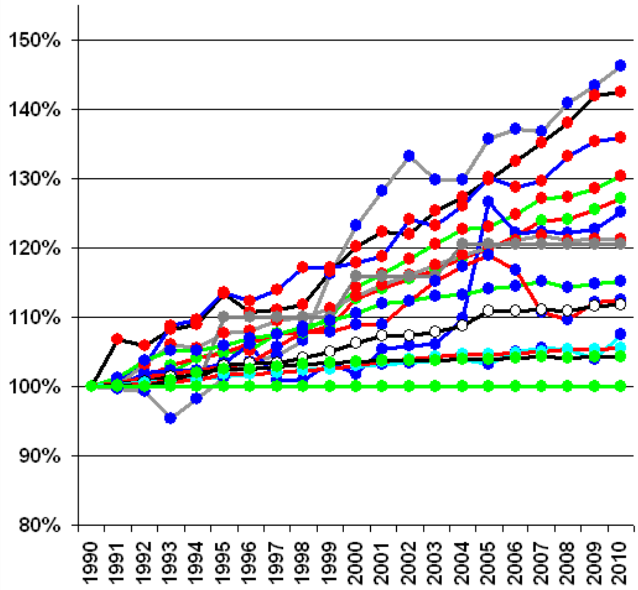
Table 6.38 gives additional information on the trend in category 4B(a) as reported in the national inventory reports.

Table 6.38: **Member State's background information on the trend for CH_4 emissions in category 4.A.**

Member State	Trend in category 4B(a)
Denmark	**The emission from manure management has increased due to a change towards greater use of slurry-based stable systems, which have a higher emission factor than systems with solid manure. By coincidence, the decrease and the increase almost balance each other out and the total CH_4 emission from 1990 to 2007 has decreased by 5%. For pigs, there has been a similar development as for dairy cattle with a move from solid manure to slurry-based systems. Updated stable type data for 2007 shows fewer animals on slurry systems than previous estimated by the expert judgement from the Danish Agricultural Advisory Centre. An increase of the EF for swine has been observed between 2007 and 2008 (6%). This is due to changes in the allocation between the subcategories sows, slaughter pigs and piglets. Looking at the time serie for EF similar changes is seen, for example between 1993 and 1994 (increase by 7%), 2000-2001 (decrease by 5%) and 2004-2005 (decrease by 6%).**
Finland	**Some inter-annual variation between the years can be noticed from the time series but overall there is an increase in the emissions since 1990. This is mainly caused by fluctuation in activity data between the years because of changes in animal numbers, for example, which is largely affected by agricultural policy and subsidies. Manure management is affected by the fluctuation in animal numbers as well as the proportion of manure managed in different manure management systems which vary depending on animal species. The number of animals kept in a slurry-based system is increasing.**
Ireland	**A decrease of the IEF for non-dairy catte between 2005 and 2006 (by 5%) is explained by the strong increase of recovery of biogas from the animal waste storage for energy purposes in 2006.**
Italy	**Strong increase in biogas recovery in 2006 affected significantly CH_4 emissions from manure management.**
Luxembourg	**Methane emissions from manure management are increased by more than 22% for the period 1990-2006. Animals who did contribute the most of these emissions are cattle, swine and chicken. Beside livestock population developments, the methane emission increase is mainly driven by the changes in the AWMS for cattle: the liquid system share in AWMS went from 23% to about 38% for dairy cattle and from 18.9% to 28.9% for non-dairy cattle. As liquid systems have the highest methane conversion factor, this explains why, despite a decreasing cattle population, related CH_4 emissions did rise over the period 1990-2006.**
Netherlands	**The interannual increase of methane emissions is 13% and methane IEF for dairy cattle in 2008/2009 is 11%. This is not due to shorter grazing periods but the result of a shift from day and night grazing towards during the daytime only. Methane emissions from the stable are far higher than during grazing thus explaining the difference.**
Spain	**The interannual increase of CH_4 emissions for Swine 2005/2006 by 11% is due to several factors: a) an increse of 5% in the numbers of animals that superimposes to an increase in the per animal weight, and b) to an increase of the annual average temperatures (based on annual meteorological - not climatic - data for temperature).**

Figure 6.17: Trend of volatile solid excretion for dairy cattle

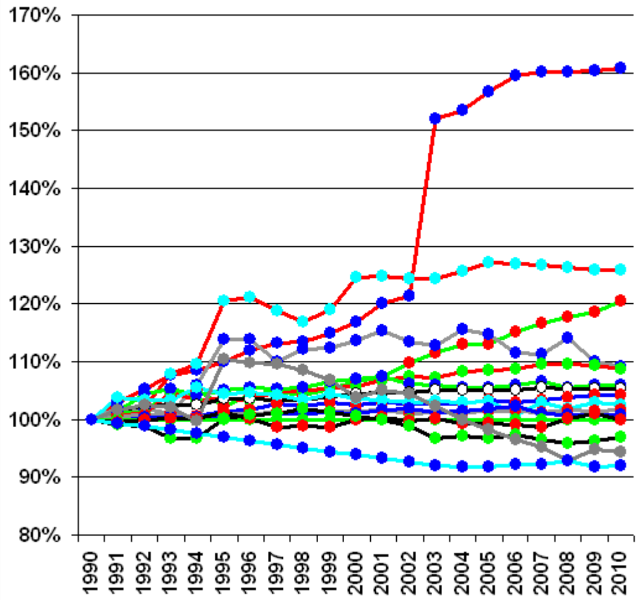
Dairy cattle: Volatide solid excretion (kg dm/head/year)



	1990	Trend (%) 1990-2010	2010
Portugal	4.8	146%	6.9
Spain	2.9	142%	4.1
Greece	4.9	136%	6.6
Finland	3.7	130%	4.8
Belgium	3.1	127%	3.9
United Kingdom	3.0	125%	3.7
Luxembourg	3.7	121%	4.5
Netherlands	3.8	121%	4.6
Germany	3.4	115%	4.0
Denmark	5.5	112%	6.2
EU-15	4.1	112%	4.6
Ireland	2.8	108%	2.9
Austria	4.0	105%	4.2
Sweden	5.1	104%	5.3
Italy	6.4	100%	6.4
France	5.1	100%	5.1

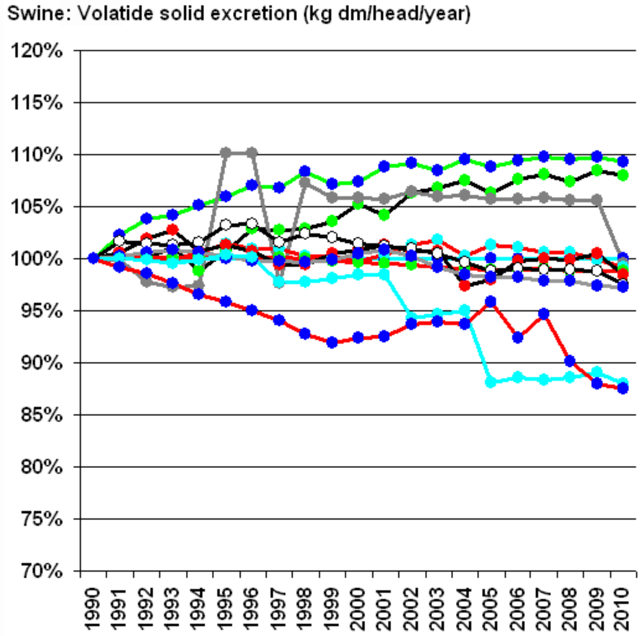
Figure 6.18: Trend of volatile solid excretion for non-dairy cattle

Non-dairy cattle: Volatide solid excretion (kg dm/head/year)



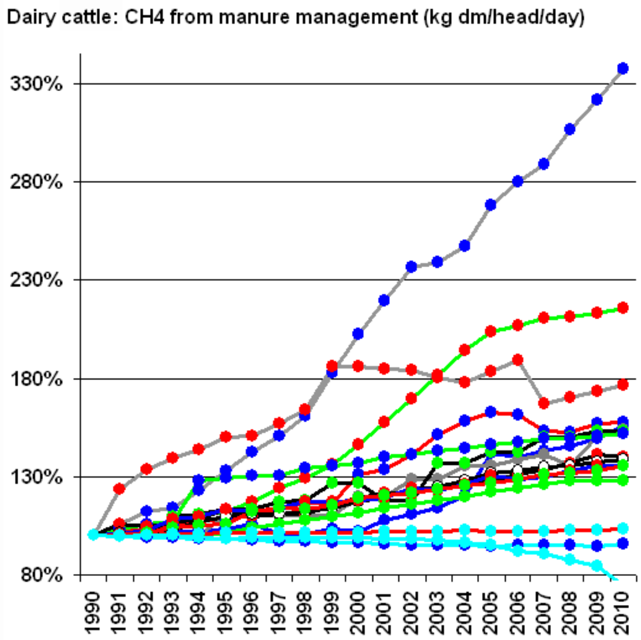
	1990	Trend (%) 1990-2010	2010
Denmark	1.7	161%	2.8
Austria	1.5	126%	1.9
Finland	1.5	121%	1.8
Portugal	2.5	109%	2.7
Belgium	1.2	109%	1.4
Germany	1.4	106%	1.5
EU-15	2.0	105%	2.2
Greece	2.7	104%	2.8
Italy	2.8	102%	2.8
Luxembourg	1.9	102%	1.9
United Kingdom	2.3	101%	2.3
France	2.7	100%	2.7
Spain	2.4	100%	2.4
Sweden	1.5	97%	1.4
Netherlands	1.2	94%	1.2
Ireland	1.4	92%	1.3

Figure 6.19: Trend of volatile solid excretion for swine



	1990	Trend (%) 1990-2010	2010
Germany	0.2	109%	0.3
Sweden	0.3	108%	0.3
Finland	0.5	100%	0.5
Luxembourg	0.5	100%	0.5
United Kingdom	0.5	100%	0.5
France	0.5	100%	0.5
Ireland	0.3	100%	0.3
Netherlands	0.2	99%	0.2
Austria	0.3	99%	0.3
Belgium	0.5	99%	0.5
Spain	0.3	98%	0.3
EU-15	0.3	98%	0.3
Portugal	0.5	97%	0.5
Italy	0.4	88%	0.3
Denmark	0.2	88%	0.2
Greece			

Figure 6.20: Trend of IEF for CH_4 emissions from category 4B(a) for dairy cattle



	1990	Trend (%) 1990-2010	2010
Portugal	2.3	338%	7.4
Finland	6.9	216%	14.8
Luxembourg	21.1	177%	36.7
Denmark	21.1	158%	33.1
United Kingdom	21.7	156%	32.4
Netherlands	27.7	154%	41.7
Sweden	5.6	153%	8.5
Germany	17.4	152%	26.2
Spain	11.4	140%	16.1
EU-15	20.4	139%	28.0
Greece	7.0	136%	9.5
Belgium	12.3	135%	16.4
France	33.8	128%	43.2
Austria	8.7	103%	9.0
Ireland	21.6	96%	20.4
Italy	15.0	75%	12.7

Figure 6.21: Trend of IEF for CH_4 emissions from category 4B(a) for non-dairy cattle

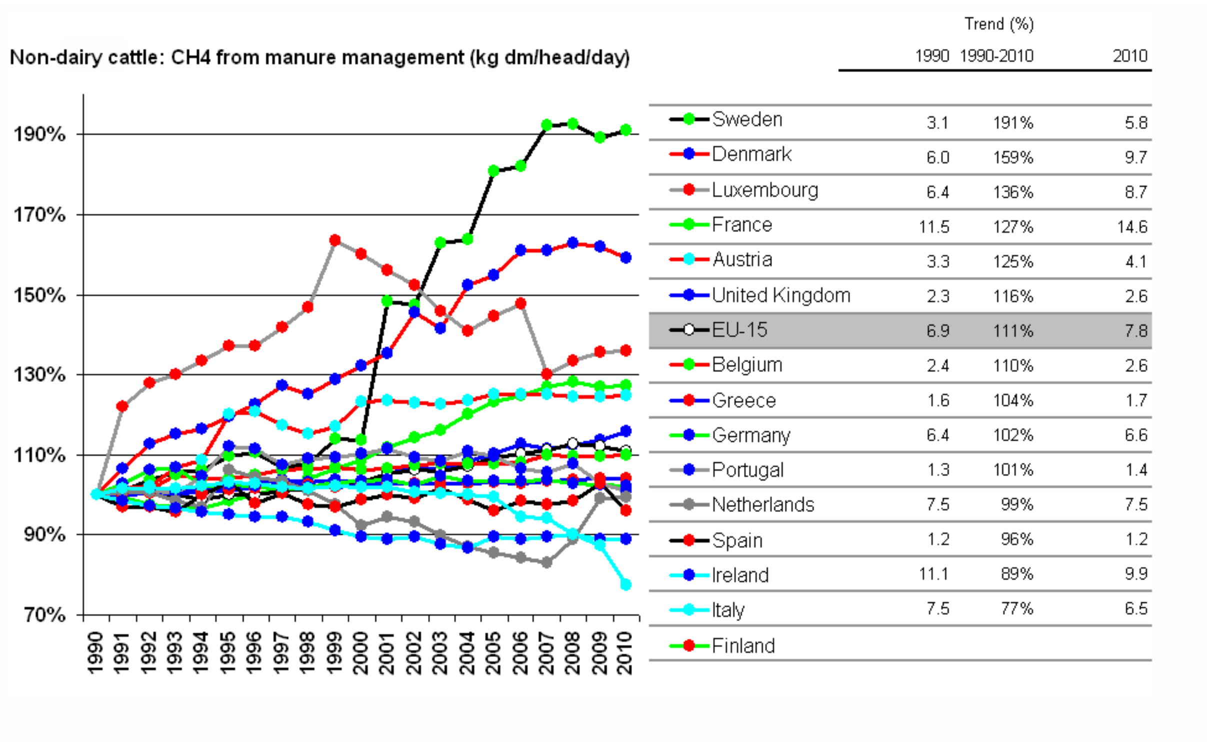
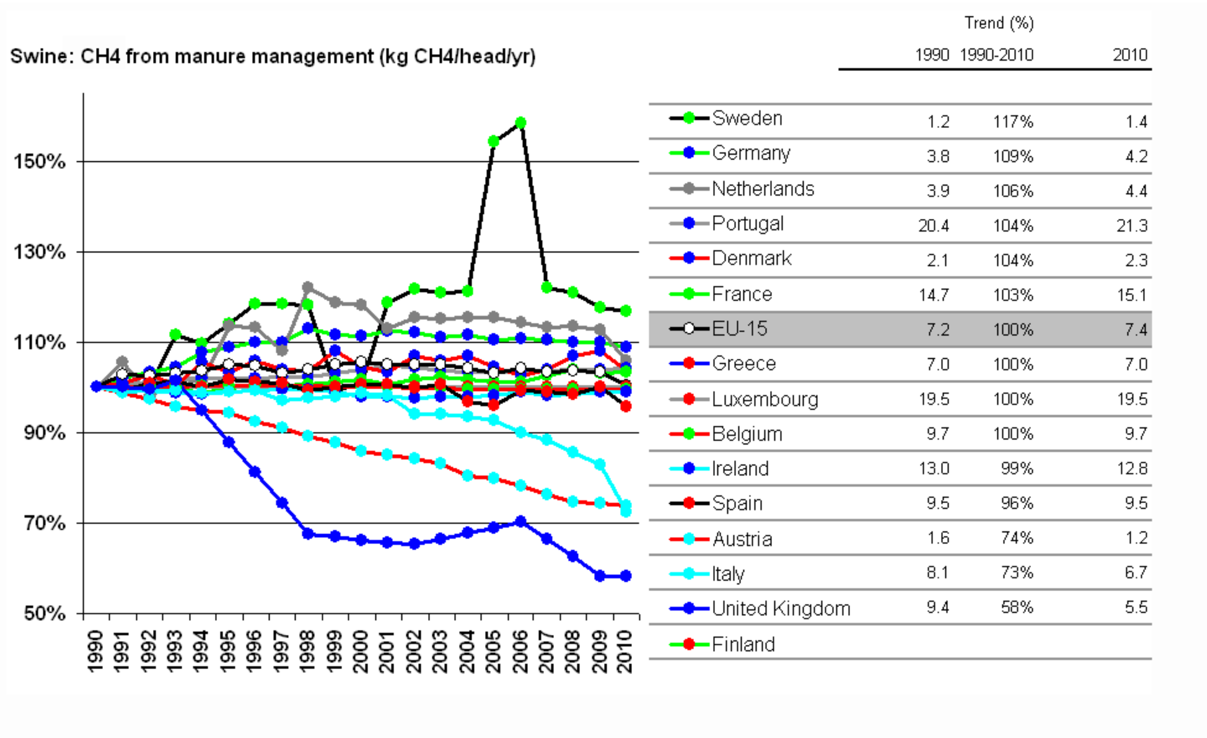


Figure 6.22: Trend of IEF for CH_4 emissions from category 4B(a) for swine



Uncertainty and time series consistency

As for enteric fermentation, the activity data in the category 4B(a) are considered to be relatively certain with uncertainty estimates around 10% for most countries. Highest uncertainty for the activity data are estimated by Italy (20%). Portugal assigns a high uncertainty to the population data of several animal types.

The uncertainty estimate for the emission factors is higher and ranges between 10% (Spain) and 100% (Italy).

An overview of the uncertainty estimates for activity data and emission factors are given in Table 6.39 and Table 6.40. An overview of uncertainty estimates for agriculture at country and EU15 levels will be given in 6.4.2

Table 6.41 compiles some background information on the estimates of the uncertainty of the values used as activity data and emission factors to estimate CH_4 emissions from manure management. The table lists only information on activity-data uncertainty that is not covered in category 4A.

Table 6.39: Relative uncertainty estimates for activity data in category 4B(a)

Member State 2010	Total	Cattle	Dairy Cattle	Non-Dairy Cattle	Buffalo	Sheep	Goats	Camels and Llamas	Horses	Mules and Asses	Swine	Poultry	Other
Austria		10.0											
Belgium	10.0												
Denmark	5.0												
Finland													
France	5.0												
Germany			6.0	3.6							7.6		8.3
Greece	5.0												
Ireland			1.0	1.0									1.0
Italy	20.0												
Luxembourg	2.0												
Netherlands		10.0									10.0	10.0	10.0
Portugal	9.3												
Spain	3.0												
Sweden	7.1												
United Kingdom	0.1												

Table 6.40: Relative uncertainty estimates for implied emission factors in category 4B(a)

Member State 2010	Total	Cattle	Dairy Cattle	Non-Dairy Cattle	Buffalo	Sheep	Goats	Camels and Llamas	Horses	Mules and Asses	Swine	Poultry	Other
Austria		50.0											
Belgium	40.0												
Denmark	20.0												
Finland	16.0												
France	50.0												
Germany			40.0	24.3							30.3		18.3
Greece	50.0												
Ireland			15.0	15.0									30.0
Italy	100.0												
Luxembourg	70.0												
Netherlands		100.0									100.0	100.0	100.0
Portugal	74.3												
Spain	10.0												
Sweden	17.7												
United Kingdom	30.0												

Table 6.41: Member State's background information for uncertainty estimates in category 4.B(a)

Member State	Background information to uncertainy estimates
Austria	Emission Factor: **Based on the identical animal numbers, uncertainties of emission factors for CH_4 from manure were assessed at 70% (AMON et al. 2002), and for N_2O emissions a lognormal distribution with a low at 50% and a high of 200% of the best estimate was chosen derived from IPCC, 2000.**
Belgium	Activity Data: **The activity data are the livestock census, but also the type of animal housing. The type of housing is more difficult to assess than the number of animals. Consequently the uncertainty on the activity data is estimated at 10 %.** Emission Factor: **The CH_4 emission factors are based on a regional-specific study. However, given that many assumptions were necessary to calculate these emission factors, the uncertainty on these emission factors is estimated to be similar to the uncertainty on enteric fermentation emission factor.**
Denmark	Emission Factor: **The emission factor for CH_4 from manure management is 10%. This figure may be underestimated and the uncertainty is, therefore, increased to 100 % until further investigations reveal new data.**
Finland	Emission Factor: **The uncertainty estimate of the CH_4 emission factor for manure management for all species (±30%) was based on uncertainty estimates of other countries, i.e. Norway, the Netherlands, the USA (Rypdal & Winiwarter 2001) and the UK (Charles et al. 1998), complemented with expert judgement.**
Germany	Emission Factor: **30 % for emission factors for CH_4 and NH_3. The errors for the other emission factors are not known. Figures for N_2O, NO and N2 are taken from IPCC (2006).**
Netherlands	Activity Data: **The uncertainty in the annual CH_4 and N_2O emissions from manure management from cattle and swine is estimated to be approximately 100%. The uncertainty in the amount of animal manure (10%) is based on a 5% uncertainty in animal numbers and a 5–10% uncertainty in excretion per animal. The resulting uncertainty of 7–11% was rounded off to 10%.** Emission Factor: **The uncertainty in the CH_4 emission factors for Manure management, based on the judgments of experts, is estimated to be 100% (Olivier et al.,2009). Of the three factors that together make up the emission factor (emission per amount of manure), MCF (Methane Conversion Factor) is the most uncertain. The factor captures for instance assumptions on temperature (temperature is important to the rate of methane production) on technology of manure systems (e.g., sometimes methane (biogas) is collected and used) and on the actual management (e.g. whether a tank is directly cleaned after its use). The microbiology of methane formation itself is relatively well known. Most of the uncertainty is created by the assumptions about 'average' manure manage-ment (Olsthoorn and Pielaat, 2003)**
Portugal	Activity Data: **Territorial units under each climate class could easily change as much as 30% in either direction, value that was assumed as representative of uncertainty for this factor.** Emission Factor: **Uncertainty for the quantity excreted, VS parameter, was set at 20%, considering the use of an enhanced livestock characterization. Uncertainty values vary from 10% for horses up to 22% for dairy cows. The uncertainty of the biogas density was assumed not to be determinant of the overall uncertainty value.**

The following issues for time-series consistency have been identified:

- *CH_4 Emissions – Dairy cattle, Non-Dairy cattle, Greece*

  The inter-annual decrease in methane emissions of dairy cattle in 2004/2005 is 22% and increase in 2005/2006 is 30%. The inter-annual increase in methane emissions of non-dairy cattle in 2004/2005 is 46% and decrease in 2005/2006 is 27%.

- *CH_4 Emissions – Dairy cattle, Non-Dairy cattle, Luxembourg*

  An unexpected interannual increasing of methane emissions in 2004-2005 is 412%.

- *Activity data, Sweden*

  Information on waste management systems is collected from the surveys published in the biannual statistical report on the use of fertilisers and animal manure in agriculture and the interpolated values are used for the intermediate years. National estimates of stable periods for cattle are collected from the statistical report on use of fertilisers and animal manure in agriculture. This information has been available biannually since 1997. Before 1997, the data are extrapolated to 1990.

6.3.3 Manure Management N_2O (CRF source category 4.B(b))

Source category description

During storage and management of manure, N_2O can be produced and emitted to the atmosphere. In accordance with the IPCC guidelines, the term 'manure' is used collectively to include both dung and urine (i.e., the solids and the liquids) produced by livestock. As for methane emissions, source category 4.B(b) excludes emissions that originate from burning of manure. Also excluded are emissions from manure deposited on pastures by grazing animals, which are reported under category 4.D2.

Direct N_2O emissions occur via combined nitrification and denitrification of nitrogen contained in the manure, and depend on the availability of nitrogen and carbon. As nitrification requires the presence of oxygen, N_2O emissions are favored by aerobic conditions, which are favored in solid manure storage and treatment systems. Denitrification is an anaerobic process and yields molecular nitrogen next to N_2O. Under conditions of reduced moisture, high nitrate concentrations and acidic medium, the emissions of N_2O relative to N_2 increase. Losses of other forms of nitrogen (NH_3, NO_x) are possible and will potentially lead to N_2O emissions once they re-deposit on the surface. These 'indirect' N_2O emissions are reported in source category 4.D3.

Generally, GHG emissions (in $CO_{2\text{-equivalent}}$s) from manure management are predominantly as CH_4 rather than as N_2O. At the EU-15 level, this ratio is at about a factor of 2.9, ranging from 0.5 (Austria) to 7.2 (Ireland). Values close or smaller to unity are found for example for Italy (1.0).

The differences of the ratio across the countries can partly be explained by the implied emission factor used for CH_4 emissions in the manure management category (see discussion above), and partly by the nitrogen excretion factors. Total nitrogen excretion by Member State and manure management system are given in Table 6.42.

Table 6.42 shows that the implied emission factors used for N_2O emission from manure management are IPCC default for all countries are close to the default value and that only small changes in the IEF occurred in the time between 1990 and 2010 with an 0% increase of the IEF for solid systems and of 1% for liquid systems.

Table 6.42: Total N_2O emissions in category 4B(b) and implied Emission Factor at EU-15 level for the years 1990 and 2010

	Anaerobic lagoon	Liquid systems	Solid storage and dry lots
	1990		
Total Emissions of N_2O [Gg N_2O-N]	0	7	63
Total Nitrogen excreted [Gg N]	20	2739	2460
Implied Emission Factor [kg N_2O-N / kg N]	0.10%	0.17%	1.64%

	Anaerobic lagoon	Liquid systems	Solid storage and dry lots
	2010		
Total Emissions of N_2O [Gg N_2O-N]	0	7	51
Total Nitrogen excreted [Gg N]	20	2492	1989
Implied Emission Factor [kg N_2O-N / kg N]	0.10%	0.17%	1.64%

	Anaerobic lagoon	Liquid systems	Solid storage and dry lots
	2010 value in percent of 1990		
Total Emissions of N2O [Gg N2O-N]	100%	92%	81%
Total Nitrogen excreted [Gg N]	100%	91%	81%
Implied Emission Factor [kg N2O-N / kg N]	100%	101%	100%

Methodological Issues

Methods

Emissions of nitrous oxide are much higher from solid storage systems than from liquid systems; the percentage of emissions from solid storage systems thus varies between 72% in Sweden and 93% in Portugal.

Table 6.43 shows the total emissions in category 4B(b), how this is composed and the methodology used for calculating the emissions for cattle and swine by Member States. The table shows also that 'solid storage' is a key category for all Member States. Activity Data are the excretion of nitrogen per animal and the distribution over the manure management systems. This is done by most Member States at a higher disaggregation level than categories that are reported in the CRF. The emission factor of N_2O per nitrogen managed in a certain manure management system is usually IPCC default.

The quality of the emission estimates is calculated from the Nex factor for the each manure management system (assigning Tier 1 or Tier 2 when comparing to IPCC default), combined with the MEAN-rule (Table 6.88 through Table 6.91) and then further combined with the Tier level of the emission factor for the manure storage system by using the MEDIAN rule with weighting factors for Nex and the IEF being 2/3 and 1/3.

As most countries use country-specific nitrogen excretion rates for most animals but use default emission factors, the Tier level of Tier 1.8 is assigned. The combined uncertainty of both solid, liquid, and other systems (12% of total emissions, for which a Tier 1 was assumed) range between Tier 1.1

and Tier 2.0. Nitrogen excretion is reported by animal type and not by manure management system in the CRF tables. To assign nevertheless a Tier level for the nitrogen excretion by manure management system, the allocation of animal waste to manure management systems from the calculation of CH_4 emissions from manure management is used. Netherland does not report nitrogen excretion rates and no allocation of animal waste to manure management systems could be done. However, according to the national inventory report, a Tier 2 approach can be assumed for the Nex values.

For EU-15, the overall Tier level is Tier 1.8 (82% of emissions estimated using country-specific information). This value is somewhat lower for solid systems (Tier 1.8) than for liquid systems (Tier 1.9). A compilation of national methodologies for the estimation of nitrogen excretion can be found in Table 21.31; most data are based on country-specific information. This is important if we assess the uncertainty of the EU15 emission estimate: given that nitrogen excretion is largely controlling N_2O emissions from manure management, the error of the estimates of the different countries can be assumed to be largely independent one from another. Only two countries are relying on IPCC default values, i.e. Greece using values reported for the Mediterranean region and France (for dairy cattle) using the value for Western Europe.

Additional background information on the methodology, if available, is summarised in Table 6.44.

Table 6.43: Total emissions and contribution of the main sub-categories to N_2O emissions in category 4B(b), methodology applied (EF) and key source assessment by Member States for the sub-categories solid storage and liquid systems

	Total		Solid Storage			Liquid Systems	
	Gg CO_2-eq	b	a	b	c	a	b
Austria	925	Tier 1.8	74%	Tier 1.7	y	3%	Tier 1.7
Belgium	786	Tier 1.7	93%	Tier 1.7	y	1%	Tier 1.7
Denmark	421	Tier 1.9	21%	Tier 1.7	y	18%	Tier 1.9
Finland	429	Tier 1.1	80%	Tier 1.6	y	4%	Tier 1.1
France	5,115	Tier 2.0	97%	Tier 2.0	y	3%	Tier 2.0
Germany	2,268	Tier 2.0	42%	Tier 2.0	y	58%	Tier 2.0
Greece	296	Tier 1.7	94%	Tier 1.4	y	2%	Tier 1.7
Ireland	442	Tier 1.7	86%	Tier 1.7	y	14%	Tier 1.7
Italy	3,701	Tier 1.7	88%	Tier 1.6	y	4%	Tier 1.7
Luxembourg	26	Tier 2.0	91%	Tier 2.0	y	8%	Tier 2.0
Netherlands	1,004	Tier 1.8	84%	Tier 2.0	y	16%	Tier 1.7
Portugal	296	Tier 1.7	93%	Tier 1.6	y	4%	Tier 1.7
Spain	2,617	Tier 1.6	62%	Tier 1.6	y	0%	Tier 1.6
Sw eden	460	Tier 1.7	72%	Tier 1.7	y	5%	Tier 1.7
United Kingdom	1,666	Tier 1.8	69%	Tier 1.7	y	3%	Tier 1.7
EU-15	**20,452**	**Tier 1.8**	**78%**	**Tier 1.8**	**y**	**10%**	**Tier 1.9**
EU-15: Tier 1	18%		20%			8%	
EU-15: Tier 2	82%		80%			92%	

a Contribution to N_2O emissions from manure management; b Quality level (between Tier 1 and Tier 2); c Source category is key in the Member State's inventory (y/n); nr: not reported

Table 6.44: Member State's background information on the methodology for estimating N_2O emissions in category 4.B(b)

Member State and reference	Methods
Austria	**For the estimation of N_2O emissions from manure management systems only a Tier 1 approach is available. Young swine from 20 to 50 kg are considered separately.**

Member State and reference	Methods
Denmark	**Emissions from manure management are calculated in with the model DIEMA (Danish Integrated Emission Model for Agriculture, Mikkelsen et al., 2006). Investigation indicates a lower N_2O emission from biogas treated slurry compared to untreated slurry (Sommer et al., 2001 and Sommer et al., 2004). The lower emission is a result of displacement in allocation between the fraction of degradable and non-degradable VS. Biogas treated slurry increase the fraction of non-degradable VS, which promote the oxygen content in soil. These conditions will reduce the potential risk for N_2O emission, because N_2O emission takes place in environments with out oxygen or with very low concentrations of oxygen (Sommer et al., 2001). In practice this effect of a lower N_2O emission will takes place in the manure applied on soil. However, it is chosen, in the inventory, to incorporate the lower N_2O-emission as a subtracting from the manure management emission. The biogas treatment is accomplished before the slurry is applied to soil. I**
Finland	**The nitrogen mass flow model takes into account the volatilisation of ammonia in each step of manure management (animal shelter, filling storage, storing) and the effect of possible abatement measures to volatilisation. This enables to calculate indirect nitrous oxide emissions from AWMS. Urine stored separately is a small adjustment to solid storage emissions (and has EF of liquid).**
Germany	**Calculation of N-excretion is based on the concept of nitrogen-flow in agriculture which considers all nitrogen losses including molecular nitrogen (EMEP, 2003; Daemmgen and Hutchings, 2005; Daemmgen et al., 2007). It considers a differentiation between organic nitrogen and easily decomposable nitrogen (total ammoniacal nitrogen, TAN). TAN is present in the uring of mammals, while poultry excrete uric acid nitrogen (UAN), which is considered as TAN in the calculations. In a first step, both the excretion of total nitrogen and of total ammoniacal nitrogen (TAN) is estimated. Simultaneous NO, N2 and N_2O emissions are calculated on the basis of total nitrogen, but are subtracted from the TAN pool only. Main drivers of the emissions are manure storage system and temperature. Emissions of all N-gases on pasture, range and paddock occur simultaneously, while volatilization in housing systems are subtracted from available TAN for the calculation of emissions from manure management systems. All calculations are done**
Greece	**Dairy cattle, non-dairy cattle and sheep: Tier 2. Other animals: Tier 1.**
Italy	**Tier 1 methodology and IPCC default emission factors were used for the management systems. For sheep and goat, a detailed analysis has been carried out with information from ASSONAPA, the National Association for Sheep Farming. For slurry and solid manure production parameters, specifically for the cattle and buffalo category, updated data have been incorporated, according to new country specific data available.**
Netherlands	**Activity data are collected in compliance with a Tier 2 method. The method used is fully in compliance with the IPCC Good Practice Guidance (IPCC, 2001). Ther N-flows from animal production are assessed by the National Emission Model for Ammonia (NEMA). Results include emissions of ammonia (NH_3), nitric oxide (NO), laughing gas (N_2O) and nitrogen gas (N2) from stable and storage.**
Sweden	**The methodology for estimating N_2O from manure management is in accordance with the IPCC Guidelines Tier 2 methodology; it is based on emission factors from the IPCC Guidelines in combination with national activity data.**
United Kingdom	**It is assumed that 20% of the total N emitted by livestock volatilises as NO_x and NH_3 and does not contribute to N_2O emissions. This is because in the absence of a more detailed split of NH_3 losses at the different stages of the manure handling process it has been assumed that NH_3 loss occurs prior to major N_2O losses. Emission estimates are made with 20% smaller Nex factors than those reported in the CRF. The methodology for estimating N_2O from manure management is in accordance with the IPCC Guidelines Tier 2 methodology; it is based on emission factors from the IPCC Guidelines in combination with national activity data.**

Activity Data

In EU-15, a total of 7,958 Gg N was managed in manure management systems or excreted on pasture range and paddock in 2010. The largest share of this manure-nitrogen was excreted by grazing animals, followed by manure managed in liquid and solid storage systems. Compared with 1990, this was a decrease of manure-nitrogen by 12%. The decreases were similar for the different manure management systems with a smallest decrease for liquid systems (-9%). The decrease of nitrogen was particularly pronounced in the Netherlands, where total nitrogen decreased by 29%. At the same time, the manure managed on solid storage systems increased by 5% indicating a strong shift from pasture to solid systems in the Netherlands. This is a consequence of the increase of the time period dairy cattle are kept indoors. Firstly this is done to increase cost-effectiveness of milk production and secondly to increase the efficiency of manure application as an effect of Dutch manure-policy.

The nitrogen managed in the various manure management systems in 2010 is given in Table 6.45. Background information on the allocation to manure management systems is given in Table 6.31. Nitrogen excretion data per head will be discussed below.

Table 6.45: Member State's nitrogen managed in the manure managed systems anaerobic lagoon, liquid systems, daily spread, and other systems, manure excreted on pasture range and paddock, and total nitrogen excreted in 2010

Member State 2010	Anaerobic lagoon	Liquid systems	Daily Spread	Solid storage and dry lot	Other	Pasture range paddock	Total
Austria		56		70	32	10	168
Belgium		19	2	75	86	80	262
Denmark		195		9	33	22	258
Finland		38		43	7	19	107
France		442		578		768	1,789
Germany		759		366		137	1,261
Greece		13	1	28	5	181	228
Ireland		130		39		271	439
Italy		314		333	31	159	837
Luxembourg		4		2	1	6	13
Netherlands		327		96		81	505
Portugal	20	22		29		84	155
Spain		10	17	167	301	306	802
Sweden		48		34	11	46	139
United Kingdom		115	140	119	54	568	995
EU-15	20	2,492	161	1,989	561	2,736	7,958

Information source: CRF Table 4.B(b) for 2010, submitted in 2012. Abbreviations explained in the Chapter 'Units and abbreviations'.

Emission Factors and other parameters

As most countries are using IPCC default values for the IEF or values that are close to it, these numbers apply also for the EC-N_2O inventory for manure management. An overview of the implied emission factors is given in Table 6.46.

Table 6.46: **Implied Emission factors for N_2O emissions from manure management used in Member State's inventory 2010**

Member State	Implied EF (kg N_2O-N / kg N)			
2010	Anaerobic lagoon	Liquid system	Solid storage and dry lot	Other
Austria	NO	0.10%	2.0%	1.4%
Belgium	NO	0.10%	2.0%	0.1%
Denmark	NO	0.08%	2.0%	1.6%
Finland	NO	0.10%	1.6%	2.0%
France	NA	0.08%	1.8%	NA
Germany	NO	0.36%	0.5%	NO
Greece	NA	0.10%	2.0%	0.5%
Ireland	NO	0.10%	2.0%	NO
Italy	NO	0.10%	2.0%	2.0%
Luxembourg	NO	0.10%	2.0%	0.1%
Netherlands	NO	0.10%	1.8%	NO
Portugal	0.10%	0.10%	2.0%	NO
Spain	NO	0.10%	2.0%	0.7%
Sw eden	NO	0.10%	2.0%	2.0%
United Kingdom	NO	0.10%	2.0%	1.7%
EU-15	0.10%	0.17%	1.6%	0.9%

Information source: CRF Table 4.B(b) for 2010, submitted in 2012
Abbreviations explained in the Chapter 'Units and abbreviations'.

An important parameter in the calculation of N_2O emissions from manure management is the nitrogen excretion rate per head and year, which is given in Table 6.47 for EU15-countries and the main animal types. The table shows a range by a factor of up to 3.3 between the highest and the lowest value used is found. For example, for dairy cattle, we have a range from about 70 kg N head^{-1} y^{-1} for Spain to 139 kg N head^{-1} y^{-1} for Denmark. Large ranges are found for non-dairy cattle with values between 42 (Sweden) and 67 kg N head^{-1} y^{-1} (United Kingdom) and sheep with values between 5.2 kg N head^{-1} y^{-1} (Spain) and 17.0 kg N head^{-1} y^{-1} (Luxembourg). In the German inventory, nitrogen in bedding material is considered when calculating N_2O emissions from solid manure. The IEF is therefore higher than each partial EF by management system.

Additional information on the development of the emission factor is available for some Member States and is summarized in Table 6.48. Additional background information on the calculation of nitrogen excretion rates are summarised in Table 6.49.

Table 6.47: Total Nitrogen excretion by AWMS [Gg N] for dairy and non-dairy cattle, sheep, swine, and poultry in 2010

Member State 2010	Dairy	Non-Dairy	Sheep	Sw ine	Poultry
Austria	97.4	46.7	13.1	9.5	0.5
Belgium	116.9	54.1	7.6	10.0	0.6
Denmark	138.6	43.1	17.0	7.6	0.6
Finland	128.7	51.7	10.0	IE	0.6
France	113.2	59.3	16.7	7.0	0.6
Germany	114.1	44.4	8.2	11.9	0.7
Greece	100.0	46.2	10.7	16.0	0.6
Ireland	101.9	48.8	6.9	8.6	0.4
Italy	116.0	49.8	16.2	11.7	0.5
Luxembourg	102.0	47.2	17.0	11.7	0.7
Netherlands	130.2	42.5	7.0	8.6	0.6
Portugal	117.4	50.8	8.0	9.3	0.6
Spain	67.6	52.2	5.2	9.1	0.5
Sw eden	126.0	42.0	6.3	9.1	0.4
United Kingdom	121.1	67.4	5.4	10.4	0.6
EU-15	114.0	51.4	8.2	9.4	0.6

Information source: CRF Table 4.B(b) for 2010, submitted in 2012
Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 6.48: Member State's background information on the emission factor for calculation of N_2O emissions in category 4.B(b)

Member State	Emission Factors
Denmark	**IEF for "Solid Storage and dry lot" is a weighted value: 0.005 for poultry manure without bedding and 0.02. Other manure default. Effects from biogas-treated slurry are included in the N_2O emissions.**
Germany	**N_2O - default (IPCC 2006). Emission factors for NO and N2 are taken in accordance to results in the UK (Jarvis and Pain, 1994) and are used also in the inventories of the UK, CH, and DK. They are derived from the N_2O-EF as follows: EF-N_2O = 10 EF-NO = 1/3 EF-N2. The IEF for solid manure solidconsiders also the nitrogen in the bedding material and is thus higher than reported default factors. The application of NH_3 and N_2O emission factors from IPCC1996 shows that they exceed the size of the TAN pools. For N_2O, IPCC 2006 partial emission factors were taken into account, as they can be assigned to the storage systems used in Germany (see also Amon et al., 2001). For cattle, these emission factors allow for a differentiation between slurry stored with and without a natural crust cover in particular. The mean N_2O emission factor is strongly depending on the emission factor chosen for solid storage. Here, the IPCC 1996 factor unduly extrapolates from the dry lot storage systems (0.02 kg kg-1 N_2O) to straw based systems used in Germany, see comment in IPCC 2006, Table 10.21 ("Judgement of IPCC Expert Group in combination with Amon et al. (2001), which shows emissions ranging from 0.0027 to 0.01 kg N_2O-N (kg N)-1."). In Germany the system of dry lot is not practised. Only the two straw based systems of solid storage (EF of 0.005 kg/kg) and deep litter (EF of 0.01 kg/kg) are used. Therefore, the IPCC1996 factor is not used. IPCC 2006 allows that partial emission factors can be assigned to the systems used in Germany. For cattle, these EFs allow for a differentiation between slurry stored with and without a natural crust cover in particular. EFs of 2006 have been shown to correspond with German conditions for slurry and solid manure (Freibauer, 2003).**
Italy	**Liquid system, solid storage and other management systems (chicken-dung drying process system since 1995 when it became widespread in poultry breeding) have been considered according to their significance and major application in Italy.**
Netherlands	**Emission factors for N_2O from Manure management represent the IPCC default values for liquid and solid systems.**
Sweden	**Default values from the IPCC Guidelines. IEFs may change over the years, depending on the relative size of the respective subgroups aggregated.**
United Kingdom	**The assigning of manure 'stored in house' manure to 'daily spread' is acceptable only if emissions from the housing phase are thought to be very small. For farmyard manure, storage capacity within the house or yard might comprise between 7 weeks - 12 months (poultry) or several months (cattle) (Smith, 2002, pers. comm.). Calculations were performed with the N_2O Inventory of Farmed Livestock to compare housing and storage phases (Sneath et al. 1997). For pigs and poultry, the emission factor for housing is the same as or greater than that of storage. It would therefore lead to significant underestimation to use the daily spread emission factor. The FYM in this case has therefore been re-allocated to SSD or 'other' as appropriate. For dairy and non-dairy cattle, the emission factor for the housing phase is around 10% of the storage phase, so the non-stored FYM**

Member State	Emission Factors
	has been split between SSD and DS to account for this.

Table 6.49: Member State's background information for the development of nitrogen excretion rates used in the calculation of N_2O emissions in category 4.B(b)

Member State	Nitrogen excretion rates
Austria	**N-excretion data are calculated following the guidelines of the European Commissions according to the requirements of the European Nitrate Directive based on feed rations which are estimated on the basis of field studies on representative grassland and dairy farm areas for cattle and take into consideration the daily gain of weight, nitrogen and energy uptake, efficiency, etc. Similar level of detail for pigs. (Gruber & Poetsch, 2005; Poetsch et al., 2005; Steinwidder & Guggenberger, 2003). Piglets are not considered in N-excretion data separately (included in sows). However, there are included in the population data, which gives rise to an inconsistency in the CRF table.**
Belgium	**N_2O emissions from manure storage are based on N excretion data estimated through local production factors. In Wallonia, emissions are calculated using the model developed by (Siterem, 2001) also used for CH_4 and NH_3 emissions. It includes emissions from animal husbandry, excreta deposited in buildings and collected as liuid slurry or solid manure, and application of mineral fertilizer and manure nitrogen to land. Such factors were first determined for the implementation of the CE Nitrates Directive 91/676 on http://www.nitrawal.be/pdf/arretenitrates_mb2.pdf, but were representing the nitrogen after deduction of the atmospheric losses, so new factors were calculated on this basis for the purposes of estimating atmospheric emissions. For Flanders, nitrogen excretion factors are from the Manure Bank of the Flamish Land Agency (www.vlm.be) and are based on the regional situation. The nitrogen excretion factors for cattle, horses, sheep, goats and rabbits are used as described in the Manure Action Plans (MAP2bis**
Denmark	**N-excretion (kg N/head/yr) is weighted values from the following categorisation: Non-dairy cattle: Calves, Bulls, Heifers and Suckling Cattle, Sheeps, Goats, Swine: Piglets, Slaugthering pigs, Fur animals, Poultry: Broilers, Hens, Ducks, etc. The variations in N-excretion in the time-series reflect changes in feed intake, fodder efficiency and allocation of subcategories. The Danish N-excretion levels are generally lower than IPCC default values. This is due to the highly skilled, professional and trained farmers in Denmark, with access to a highly competent advisory system.**
Finland	**Annual N excretion per animal for cattle, sheep, swine, horses, poultry and fur animals has been calculated by animal nutrition experts of MTT Agrifood Research Finland (Nousiainen, J. pers.comm.). Values for annual N excretion (Nex) are based on calculations on N intake-N retention for typical animal species in typical forage system. Annual nitrogen excretion per animal and in the case when animals are kept less than one year in farms (swine, poultry), replacement of animals with new ones has been taken account in the calculations. For reindeer, values for goats have been used. N-excretion for Fur animals is average of two sub-categories: Minks and Fitches and Fox and Racoon.**
France	**Country-specific excretion factors. For cattle, N-excretion is calculated on the basis of animal physiology, milk production, and feed consumption. While feed consumption of dairy cattle is known, it has been estimated for non-dairy cattle. For swine, N-excretion has been calculated from animal physiology data and the share of swine under phase-feeding. N-excretion factors for poultry are available for 78 animal types, which have been aggregated to the 10 animal types in the national statistics based on data obtained on the survey on animal housing systems from 2008. N-excretion for goats are from Schmideley et al. (2002). N-excretion is from expert judgement (Rosset).**
Germany	***Dairy cattle*: N-excretion factors are calculated on the basis of milk productivity, protein content of the milk, the weight, number of births and the composition of the rations. *Non-dairy cattle*: feed compisition, daily weight gain and live weight. *Swine and hens*: N-excretion is calculated on the basis of productivity (number of births or weight gain), the weight and the feed composition. For Dairy cattle and national data for other animals. Country-specific data for other animal categories. Values for the content of total ammoniacal nitrogan (TAN) were estimated for Cattle, Swine, Sheep, Horses, and Poultry. Other parameter required for the estimation of N_2O emission (the effective surface area, the ventilation conditions and the temperature during storage) are not available.**
Greece	**N excretion for dairy cattle value referring to West Europe countries was used taking into account that the dairy milk production in Greece has increased to levels similar to those of Western Europe. Moreover, for other cattle and buffalo N excretion values for dairy cattle referring to West Europe countries were used. For the rest of the animals N excretion value referring to Mediterranean countries was used. Finally, for the estimation of other cattle and sheep N excretion, the adjustment factors for young animals proposed by IPCC guidelines (Table 4.14, IPCC 1997) were used.**
Ireland	**For Cattle, the excretion rates are consistent with the nitrogen content of Cattle feeds and the quantities excreted by the animal, as analysed in conjunction with the determination of Tier 2 CH_4 emission factors for Cattle. The published nitrogen excretion rates are used along with the information on the allocation of animal manures to each applicable animal waste management system from the Farm Fatility Survey. The nitrogen excretion rates of 92.5 and 50 kg/N for Dairy Cattle and Other Cattle, respectively, taken from the REPS survey data are close to the upper end**

Member State	Nitrogen excretion rates
	of the range reported for typical Irish farming systems (Mulligan, 2002; Hynds, 1994). These findings indicate that Dairy Cows producing 4,200, 5,600 and 7,000 kg of milk per year in Ireland excrete 82, 89 and 96 kg N, respectively while excretion rates for beef cattle are highly variable and range from 27 kg N to 69 kg N per year depending on performance level and age. The IPCC default nitrogen excretion rates of 8, 12 and 0.6 kg are used for S
Italy	**Country-specific N-excretion data (Inter-regional nitrogen balance project results, CRPA, 2006; Xiccato et al., 2005). The nitrogen balance project involved Emilia Romagna, Lombardia, Piemonte and Veneto regions, where animal breeding is concentrated. The nitrogen balance methodology was followed, as suggested by IPCC. N-excretion rates are time-dependent for cattle, buffalo, and pigs.**
Luxembourg	**The nitrogen excretion per AWMS cannot be calculated since the nitrogen excretion per head of animal is not yet estimated for Luxembourg. The default factors suggested for Western Europe in the IPCC Guidelines have to be further investigated to decide whether or not they might be applied to Luxembourg's situation as regards manure management of animals.**
Netherlands	**Standard factors for manure production and manure N-excretion per animal per animal category and per manure management system are calculated by Netherlands Statistics and decided on by WUM (Working group for Uniform calculations on Manure- and minerals) annually, based on specific data such as milk yield. More specified data on manure management are based on statistical information on management systems and is documented (Van der Hoek, 2006). http://www.greenhousegases.nl/documents/4B_N_2O_manure.pdf**
Portugal	**Country-specific nitrogen excretion factors (Ministry of Agriuclture). The nitrogen excretion rates reflect the analysis results obtained in the Laboratory Rebelo da Silva, complement with international sources such as (Ryser, 1994) and data submitted by other countries. These rates are considered more representative of the national conditions than those that were formely submitted and which was set from information received from the Agriculture Ministry (Seixas, 2000). The nitrogen rates are presented in next table together with the default nitrogen excretion rates from IPCC for Western Europe. There is an acceptable agreement between country-specific values and IPCC defaults for all species other than Sheep, Goats and Equines.**
Spain	**National N-excretion factors for cattle, sheep, swine and poultry. For the other animal types IPCC facotr for the "Near East & Mediterranean" climate region and applying age-related correction factors.**
Sweden	**The Swedish Board of Agriculture publishes data on manure production from most of the aniumal subgroups included in the inventory. The given values are according to the STANK model, which is the official model for input/output accounting on farm level (Linder, 2001). They are a function e. g. of milk productivity for dairy cattle, age and number of production cycles for pigs etc.**
United Kingdom	**N excretion data from Cottrill and Smith (ADAS).**

Trends

The decreases in N_2O emissions of 13% (total; 8% in liquid systems and 19% for solid systems) are mainly due to decreases in nitrogen excretion. For liquid systems, the implied emission factor increases slightly by 1% (a decrease by 41%, 19% and 14% is estimated for Finland, Denmark and Netherlands, respectively, and an increase for Germany by 13%); so that the decrease in N_2O emissions is buffered. For solid systems, a change in the IEF between 1990 and 2010 has been reported for Finland (increase of 9%), Germany (increase of 2%), France (decrease of 1%) and the Netherlands (decrease of 5%).

Figure 6.20 through Figure 6.29 show the trend of the nitrogen excretion rate per head and the nitrogen managed in solid storage and dry lot systems. The trend in emissions is driven by animal numbers, animal performance (nitrogen excretion) and the distribution of manure over the manure management systems, which have been discussed above. The effect of the AWMS is contrary to that observed for the methane emissions.

The category “other“ animal waste management systems for Italy is reported for the years 1995 onwards only in the Italian inventory. This nitrogen excretion refers to poultry manure that is undergoing a drying-process. This system has been widely used from 1995 (CRPA, 2000).

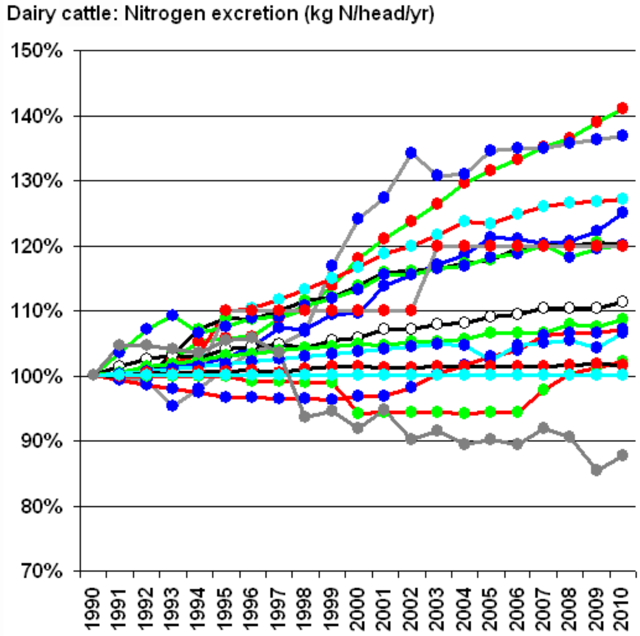
Nitrogen excretion for buffalo is reported for Germany (buffalo are occurring from 1996 onwards), Italy and Greece only. While Greece and Germany use a constant excretion factor of 70.0 and 82.0 kg N head^{-1} year-1, respectively, the N excretion of buffalo varies significantly in Italy with values between 92 and 107 kg N head^{-1} year-1. The N-excretion values result from the weighted average of cow buffalo and other buffaloes and the variability is due to the interannual variation of the proportion of the two livestock number as published by the National Institute of statistics. Cow buffaloes have a higher N excretion, comparable with dairy cows, because they are prevalently breeded for milk production (mozzarelle di bufala).

Table 6.50 gives additional information on the trend in category 4B(b) as reported in the national inventory reports.

Table 6.50: Member State's background information on the trend for N_2O emissions in category 4B(b).

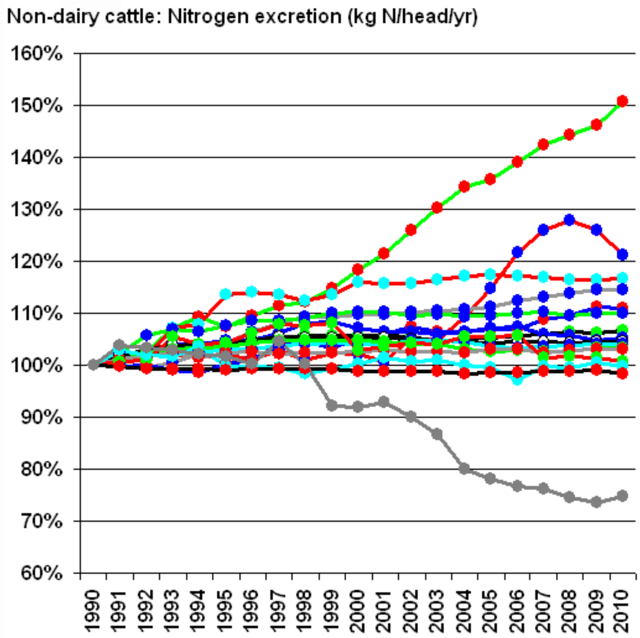
Member State	Trend in category 4B(b)
Austria	**Emissions of cattle dominate the trend. The reduction of diary cows is partly counterbalanced by an increase in emissions per animal (because of the increasing gross energy intake, milk production and N excretion of dairy cattle since 1990).**
Denmark	**This reduction in the total amount of nitrogen in manure despite the increasing production of pigs and poultry is particularly due to an improvement in fodder efficiency, especially for slaughter pigs. An increase of the EF for swine has been observed between 2007 and 2008 (6%). This is due to changes in the allocation between the subcategories sows, slaughter pigs and piglets. Looking at the time serie for EF similar changes is seen, for example between 1993 and 1994 (increase by 7%), 2000-2001 (decrease by 5%) and 2004-2005 (decrease by 6%).**
Finland	**The fluctuation in N_2O emissions is related to both changes in animal numbers, which is largely dependent on agricultural policy, as well as changes in the distribution of manure management systems used. Slurry-based systems increase methane emissions per animal tenfold compared to the solid storage or pasture.**
Italy	**N-excretion in the category Other has been not reported in 1990-1994. The chicken-dung drying process system has been widely used only since 1995 onwards.**
Netherlands	**The relatively large decrease in N_2O emissions of solid manure in 2003 is a direct result of the decrease in poultry animal manure. This decrease was due to the reduction in the number of poultry animals that followed the avian flu epidemic. In 2004 and 2005, N_2O emissions increased once again following the recovery of poultry animal numbers, while in 2006 the emission decreased as a consequence of lower poultry numbers. In 2007 emissions increased as a result of increasing animal population and higher N excretion per animal. The slightly increase N_2O emissions from manure management over the whole time series is explained by a higher IEF partly counteracted by a decrease in N excretion in the stable. The interannual decrease of N-excretion in 2008/2009 is 6%. Technical information on the composition of rations and their mineral content are taken into consideration, and therefore N-excretion can vary from year to year. In 2009 considerably more maize silage was available, filling in almost equal energy requirements replacing grass (which has more than double the N-content of maize).**
Sweden	**The N_2O emissions have decreased since 1990, mainly because of a change from solid manure management to slurry management in dairy and pork production. An increase in the production cycles per year from 2.5 to 3 for pigs for meat production causes an increase in the nitrogen excretion for swine in 2001-2002 by 16%.**

Figure 6.23: Trend of nitrogen excretion rates for dairy cattle



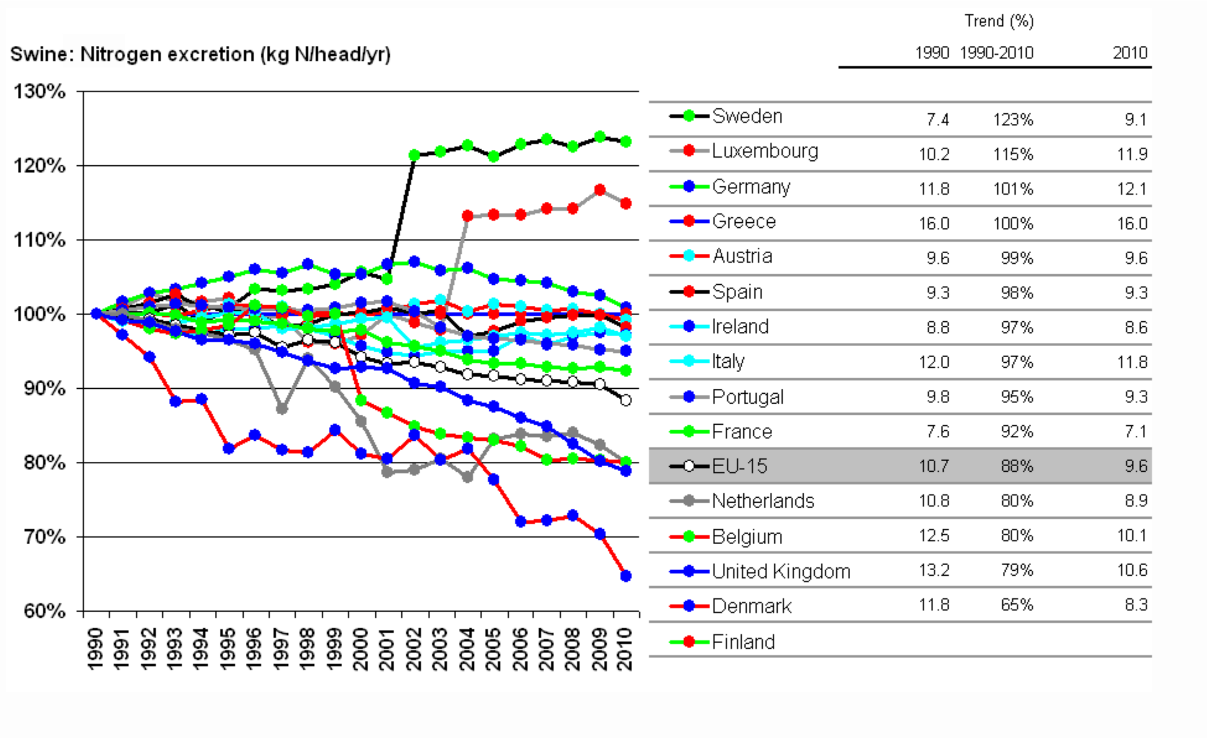
	1990	Trend (%) 1990-2010	2010
Finland	91.3	141%	126.9
Portugal	85.8	137%	116.9
Austria	76.6	127%	97.1
United Kingdom	96.9	125%	118.3
Sweden	104.9	120%	126.4
Germany	95.1	120%	113.7
Luxembourg	85.0	120%	102.0
EU-15	102.3	111%	112.9
France	104.2	109%	112.0
Denmark	129.5	107%	138.1
Ireland	95.5	107%	99.7
Belgium	114.5	102%	115.8
Spain	66.6	102%	67.7
Greece	100.0	100%	100.0
Italy	116.0	100%	116.0
Netherlands	148.5	88%	127.0

Figure 6.24: Trend of nitrogen excretion rates for non-dairy cattle:



	1990	Trend (%) 1990-2010	2010
Finland	34.3	151%	50.2
Denmark	35.6	121%	44.8
Austria	40.0	117%	46.6
Portugal	44.4	114%	50.8
Greece	41.7	111%	46.3
Germany	40.3	110%	44.3
Sweden	39.3	107%	41.7
United Kingdom	64.1	105%	67.2
EU-15	49.2	104%	51.5
Ireland	47.0	104%	48.9
France	57.4	103%	59.3
Luxembourg	45.8	103%	47.2
Belgium	53.7	101%	54.4
Italy	50.0	100%	50.2
Spain	53.1	98%	52.6
Netherlands	56.9	75%	41.8

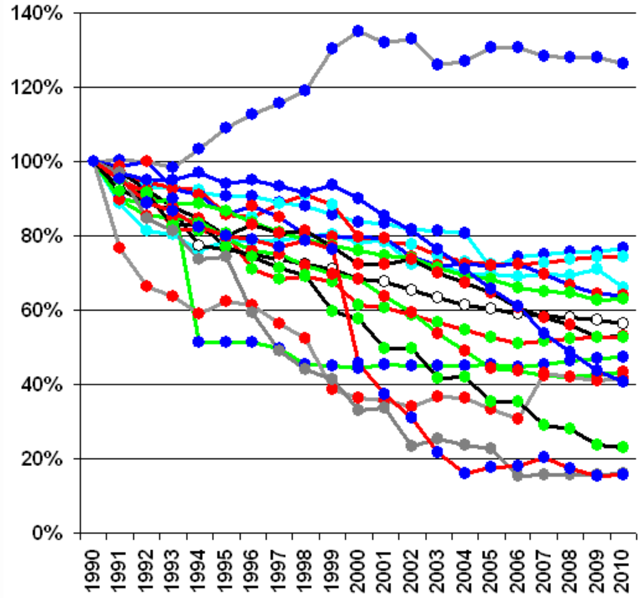
Figure 6.25: **Trend of nitrogen excretion rates for swine**



- Remark Sweden: Due to more intense swine production the nitrogen production for sows and pigs for meat production were updated in 2002.
- Remark Luxembourg: Nex is calculated as a population-weighted average of constant Nex values for 4 swine sub-categories: pigs < 20kg- pigs 20 to 50 kg- fattening pigs > 50 kg & breeding pigs. From 2004 onwards the two first sub-categories were changed to pigs < 10 kg & pigs 10 to 50 kg. Unfortunately the published table does not record these changes as a footnote but they are clearly visible in the series. Since this modification increases the Nex it was not corrected because it does not lead to an underestimation of the emissions for the `Kyoto` years.

Figure 6.26: **Trend of N managed in solid storage and dry lot, dairy cattle**

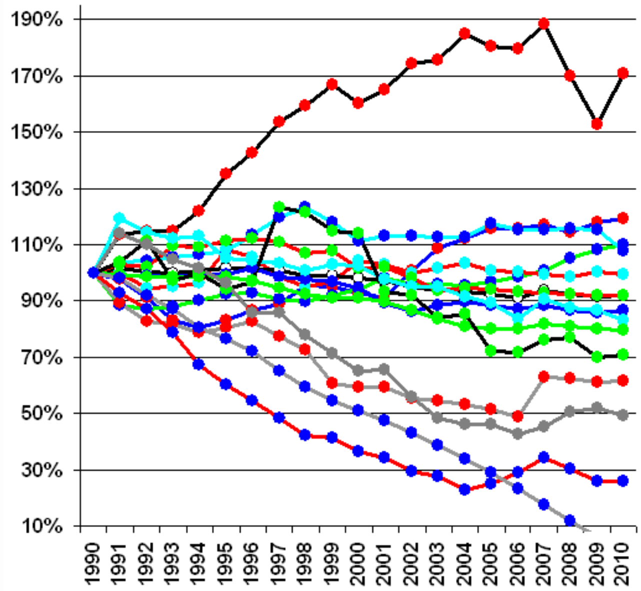
Dairy cattle: Nitrogen managed in solid storage systems (Gg N/yr)



	1990	Trend (%) 1990-2010	2010
Portugal	11.8	126%	15.2
Ireland	2.6	77%	2.0
Austria	34.3	74%	25.4
Italy	174.9	66%	124.4
Greece	19.1	64%	12.3
France	182.4	63%	114.3
EU-15	779.1	56%	447.5
Spain	64.3	53%	33.9
Belgium	25.9	53%	13.6
Germany	161.5	47%	75.9
Finland	22.9	43%	9.8
Luxembourg	1.6	42%	0.7
United Kingdom	19.7	41%	8.7
Sweden	31.4	23%	7.4
Netherlands	13.6	16%	2.1
Denmark	13.0	16%	2.0

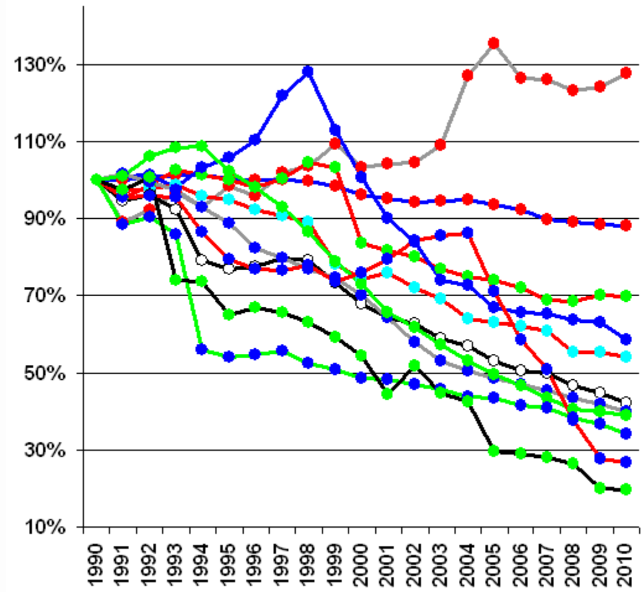
Figure 6.27: **Trend of N managed in solid storage and dry lot, non-dairy cattle**

Non-Dairy cattle: Nitrogen managed in solid storage systems (Gg N/yr)



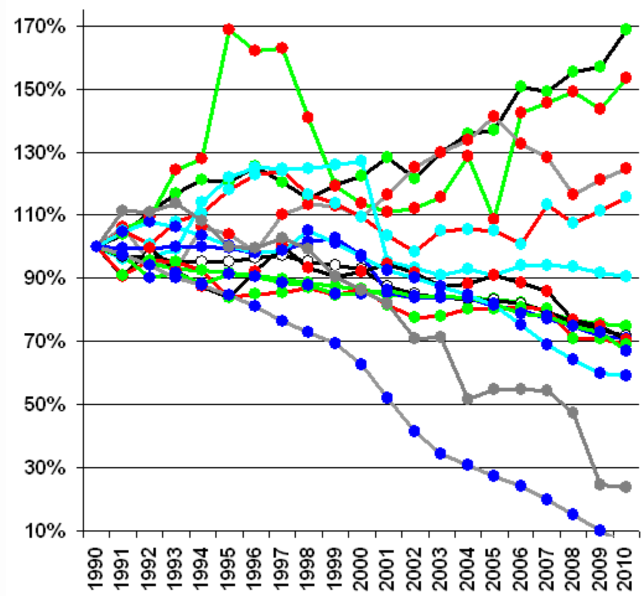
	1990	Trend (%) 1990-2010	2010
Spain	57.7	171%	88.1
Greece	12.4	119%	14.6
Germany	132.9	110%	143.9
Ireland	25.0	108%	28.8
Austria	29.8	100%	29.9
EU-15	890.5	92%	813.0
Belgium	48.2	92%	44.3
United Kingdom	98.3	87%	84.5
Italy	101.8	83%	88.3
France	328.9	80%	263.8
Sweden	15.0	71%	10.5
Luxembourg	2.3	62%	1.4
Netherlands	26.5	49%	13.7
Denmark	1.8	26%	0.5
Portugal	9.7	0%	0.6
Finland			

Figure 6.28: Trend of N managed in solid storage and dry lot, swine



	1990	Trend (%) 1990-2010	2010
Luxembourg	0.0	127%	0.0
Greece	1.6	88%	1.4
Belgium	5.4	70%	3.8
United Kingdom	30.9	59%	19.5
Austria	4.0	54%	2.2
EU-15	141.8	42%	63.2
Portugal	0.7	40%	0.3
France	15.5	39%	6.2
Germany	62.8	34%	23.1
Denmark	12.3	27%	3.4
Sweden	8.6	20%	1.7
Spain			
Ireland			
Italy			
Netherlands			
Finland			

Figure 6.29: Trend of N managed in solid storage and dry lot, sheep



	1990	Trend (%) 1990-2010	2010
Sweden	1.1	169%	1.7
Finland	0.1	153%	0.1
Luxembourg	0.0	125%	0.1
Austria	2.0	116%	2.3
Italy	14.2	90%	13.0
France	49.4	75%	37.3
EU-15	123.7	72%	91.0
United Kingdom	10.0	71%	7.2
Spain	22.1	71%	16.5
Belgium	0.3	69%	0.2
Germany	12.6	67%	9.1
Ireland	3.9	59%	2.3
Netherlands	3.1	24%	0.8
Portugal	5.1	6%	0.5
Greece			
Denmark			

Uncertainty and time series consistency

Activity data used for the estimation of N_2O emissions from manure management are generally analog to those used for the estimation of CH_4 emissions, and consequently also the uncertainty estimates are similar. The uncertainty of the emission factor is much higher than the uncertainty of the activity data, and only Germany has estimated an uncertainty lower than 50%. Generally an uncertainty of 100% is assumed, the United Kingdom assume high uncertainty with 414%.

Nevertheless, N_2O emissions from manure management are representing only a small fraction in most inventories, so that the contribution to the overall uncertainty remains in most cases small, i. e. 0.5% of total emissions or less. Only Austria and United Kingdom report a higher contribution of N_2O emissions from manure management to the overall uncertainty with 1.1% and 1.2% of total emissions, respectively.

An overview of the uncertainty estimates for activity data and emission factors are given in Table 6.51. An overview of uncertainty estimates for agriculture at country and EU15 levels will be given in 6.4

Table 6.52 compiles some background information on the estimates of the uncertainty of the values used as activity data and emission factors to estimate N_2O emissions from manure management.

Table 6.51: Relative uncertainty estimates for activity data and implied emission factors in category 4B(b)

Member State 2010	AD	IEF
Austria	10.0	100.0
Belgium	10.0	90.0
Denmark	22.4	50.0
Finland		82.0
France	5.0	50.0
Germany	5.1	63.2
Greece	50.0	100.0
Ireland	11.2	100.0
Italy	20.0	100.0
Luxembourg		
Netherlands	10.0	100.0
Portugal	36.3	93.3
Spain	16.0	100.0
Sw eden	15.1	37.7
United Kingdom	1.0	414.0

Table 6.52: Member State's background information for uncertainty estimates in category 4.B(b)

Member State	Background information to uncertainy estimates
Austria	Emission Factor: **Based on the identical animal numbers, uncertainties of emission factors for CH_4 from manure were assessed at 70% (AMON et al. 2002), and for N_2O emissions a lognormal distribution with a low at 50% and a high of 200% of the best estimate was chosen derived from IPCC, 2000.**
Belgium	Emission Factor: **The IPCC emission factors are used to calculate the emissions of N_2O. Consequently, the IPCC uncertainty in combination with information of the Finnish emission inventory, are used in the uncertainty calculation.**
Denmark	Activity Data: **The normative figures (Poulsen et al. 2001) are arithmetic means. Based on the feeding plans, the standard deviation in N-excretion rates between farms can be estimated to ±20 % for all animal types (Hanne D. Poulsen, FAS, pers. comm).**
Finland	Activity Data: **The amount of N excreted annually by the reindeer is very uncertain. Currently, because of lack of data, the value for goats has been used.** Emission Factor: **The uncertainty estimate for N_2O emissions from manure management used a negatively**

Member State	Background information to uncertainy estimates
	skewed distribution based on different studies (Amon et al., 2001; Huether, 1999). The uncertainty of the N_2O emission factor could probably be reduced by gathering more national data from gas flux measurements.
Portugal	Activity Data: **The uncertainty in N-excretion rate was set at 37.5 per cent, considering an intermediate situation between the uncertainty values recommended by GPG for default N-excretion rates (50 per cent) and the lower uncertainty when country-specific values are based on accurate national statistics (25 per cent).**
	Emission Factor: **The uncertainty in N_2O emission factors was set in accordance with the maximum values, 100 per cent for all MMS.**

6.3.4 Rice Cultivation

Source category description

Anaerobic decomposition of organic material in flooded rice fields produces methane (CH_4), which escapes to the atmosphere primarily by transport through the rice plants. The annual amount emitted from an area of rice acreage is a function of rice cultivar, number and duration of crops grown, soil type and temperature, water management practices, and the use of fertilisers and other organic and inorganic amendments.

Rice cultivation is occurring in five EU-15 countries: France, Greece, Italy, Portugal, and Spain. All countries but Italy are reporting rice production under a continuously flooding regime, while in Italy the practice of multiple aeration is predominant. In Italy rice paddies are flooded with 15-25 cm of water usually from April-May to August. During this field submersion time two or three water drainage periods, 2 to 4 days each, can happen in 85% of rice paddies, a clearly uninterrupted submersion in 13-14% and about one month delayed submersion in 1-2%.

At EU-15 level, the implied emission factors amounts to 22 g m^{-2} in 2010 for continuous flooded rice fields, which represents an increase in the implied emission factor by 20% since 1990 (see Table 6.53), which can be explained by the higher contribution of Portugal with an implied EF of 64.1 g CH_4 m^{-2} in 2010 compared to 31.9 g CH_4 m^{-2} in 1990 . Note that the implied emission factors for intermittently flooded field are stemming from the Italian inventory only. Here it is smaller than the emissions from continuously flooded fields. At the EU-15 level and with the given choices of emission factors by the different countries, however, the average emission from continuous flooded fields appears to be only half of those from single-aerated rice fields.

Table 6.53: **Total CH_4 emissions, area harvested and implied Emission Factor for category 4C at EU-15 level for 2010**

	Continuously Flooded	Intermittently flooded: single aeration	Intermittently flooded: multiple aeration
	1990		
Total Emissions of CH4 [Gg CH4]	29.7	0.6	74.5
Total Area harvested [10^9 m^2 y^{-1}]	1.64	0.02	2.13
Implied Emission Factor [g CH4 / m^2]	18	27	35

	Continuously Flooded	Intermittently flooded: single aeration	Intermittently flooded: multiple aeration
	2010		
Total Emissions of CH4 [Gg CH4]	43.8	15.7	58.8
Total Area harvested [10^9 m^2 y^{-1}]	2.03	0.65	1.82
Implied Emission Factor [g CH4 / m^2]	22	24	32

	Continuously Flooded	Intermittently flooded: single aeration	Intermittently flooded: multiple aeration
	2010 value in percent of 1990		
Total Emissions of CH4 [Gg CH4]	147%	2610%	79%
Total Area harvested [10^9 m^2 y^{-1}]	123%	2915%	86%
Implied Emission Factor [g CH4 / m^2]	120%	90%	92%

Methodological Issues

Methods

A summary of the methodologies used for the calculation of CH_4 emissions from rice cultivation is given in Table 6.54. More detailed data are given in the section on the emission factors.

Table 6.54: **Additional information in the methodology used for the calculation of CH_4 emissions in category 4.C in 2009**

Member State	Method
France	**Default EF, non key source, IPCC methodology. Statistic from the Ministry of Agriculture.**
Greece	**In order to estimate methane emissions from rice cultivation, the default methodology suggested by the IPCC Good Practice Guidance was followed. The cultivated areas provided by the NSSG and the default emission factor (20 g CH_4 / m^2) were used for the emissions calculation. Rice cultivated in Greece is grown in continuously flooded fields without the use of organic amendments and one cropping period is considered annually.**
Italy	**According to specific characteristics of rice cultivation in Italy, methane emissions from rice cultivation are estimated only for an irrigated regime, other categories suggested by IPCC (rainfed, deep water and "other") are not present. Methane emission factor has been adjusted with the following parameters: daily integrated emission factor for continuously flooded fields without organic fertilisers, scaling factor to account for the differences in water regime in the rice growing season (SFw), scaling factor to account for the differences in water regime in the preseason status (SFp) and scaling factor which varies for both types and amount of amendment applied (SFo) (Yan et al., 2005). Futher, the following national cirumstances are considered: cultivation period of rice (days) and annual harvested area under specific condictions. In Italy, rice is sown from mid-April to the end of May and harvested from mid-September to the end of October; the only practised system is the controlled flooding system, with variations in water regimes (Tossato and Regis, 2002; Mannini, 2004; Confalonieri and bocchi, 2005; Regione Emilia Romagna ,2005)** **In Italy, three types of rice cultivation are distinguished: Wet-seeded "classic" cultivation, Wet-seeded "red rice control" cultivation and dry-seeded with delayed flooding. The wet-seeded cultivation methods fall into the IPCC category of 'multiple aeration' while the dry-seeded cultivation method is intermittently aerated one once. A detailed description of the management is given in the national inventory report.**
Portugal	**Methane emissions from rice production were estimated following the GPG, but simplified**

Member State	Method
	because there are no appreciable differentiation in Portugal in what concerns water management regimes or any other conditions that are known to affect emissions from this source sector. A regional specific seasonally integrated emission factor for continuously flooded fields without organic amendments (Efc) of 31.9 g/m^2/yr was used, based on Schuetz (1989). Rice culture in Portugal is almost homogeneous, in what concerns hydrologic management regime and characterized by cultivation being done under irrigated continuous flooded areas (SFw is set to 1). Traditionally, stubbles and straw were burnt between crops, the use of rice straw as fodder or bedding is not significant (Portuguese Ministry of Agriculture). More recently the agricultural practices have changed. It became more common to left the straw on ground and incorporate it into soil by plowing. This is the only procedure allowed for rice cultivation subject to the "Techniques of Integrated Production and Protection"), which occupied about 60 per cent of rice paddies in 2004. A time series for the scaling factor reflecting organic amendments S0 was developed assuming that, in 1990, 100% of rice paddies were burnt and no organic amendments were added to soil. In 2008 the area subjected to burning was reduced to only about 33 per cent.
Spain	**The rice cultivation is not key source, EFs: IPCC default, methodology default.**

Activity Data

Italy is by far the largest producer of rice in Europe, with 2477 km^2 of rice cultivation, followed by Spain with an area of 1192 km^2 (2010 data). The other three countries have rice producing areas around 200 km^2, as shown in Table 6.55 for the rice cultivation practices continuously flooded, intermittently flooded with single aeration, and intermittently flooded with multiple aerations.

Table 6.55: Harvested Area Rice in the Member States in and 1990

Member State 2010	Harvested area [10^9 m^2]		
	Continuously Flooded	Intermittently flooded: single aeration	Intermittently flooded: multiple aeration
France	0.26	NO	NO
Greece	0.28	NO	NO
Italy	NO	0.65	1.82
Portugal	0.29	NO	NO
Spain	1.19	NO	NO
EU-15	2.03	0.65	1.82

Member State 1990	Harvested area [10^9 m^2]		
	Continuously Flooded	Intermittently flooded: single aeration	Intermittently flooded: multiple aeration
France	0.24	NO	NO
Greece	0.16	NO	NO
Italy	NO	0.02	2.13
Portugal	0.34	NO	NO
Spain	0.90	NO	NO
EU-15	1.64	0.02	2.13

Information source: CRF Table 4.C for 2010 and 1990, submitted in 2012
Abbreviations explained in the Chapter 'Units and abbreviations'.

Emission Factors and other parameters

A summary of the implied emission factors used by these countries is given in Table 6.56. France and Greece are using IPCC default emission factors presented in the IPCC *Good Practice Guidance*. This value is the arithmetic mean of the seasonally integrated emission factors presented in Table 4-13 of the IPCC *Guidelines*. In this Table, a value from Schuetz et al (1989) is also presented (36 g m^{-2}, range 17-54 g m^{-2}, representing a seasonally averaged emission factor). In Italy, a daily integrated emission factor for continuously flooded fields without organic fertiliser (Schuetz et al., 1989; Leip et al., 2002) have been adjusted to account for differences for three different cultivation types (see Table 6.54) Spain uses a seasonal emission factor of 12 g m^{-2}, which has been obtained from Table 4-9 of the IPCC *Guidelines* reporting a study carried out in Spain (Seiler et al., 1984); the value used by Portugal in 1990 and 2010 are the above-mentioned value of 36 g m^{-2} measured by Schuetz et al. (1989).

Table 6.56: Implied Emission factors for CH_4 emissions from rice cultivation used in Member State's inventory

Member State 2010	Implied EF (g $CH_4 \cdot m^{-2}$)		
	Continuously Flooded	Intermittently flooded: single aeration	Intermittently flooded: multiple aeration
France	20.00	NO	NO
Greece	20.00	NO	NO
Italy	NO	24.02	32.27
Portugal	64.1	NO	NO
Spain	12.00	NO	NO
EU-15	21.63	24.02	32.27

Member State 1990	Implied EF (g $CH_4 \cdot m^{-2}$)		
	Continuously Flooded	Intermittently flooded: single aeration	Intermittently flooded: multiple aeration
France	20.00	NO	NO
Greece	20.00	NO	NO
Italy	NO	26.84	34.92
Netherlands	NO	NO	NO
Portugal	31.9	NO	NO
Spain	12.00	NO	NO
EU-15	18.06	26.84	34.92

Information source: CRF Table 4.C for 2010 and 1990, submitted in 2012
Abbreviations explained in the Chapter 'Units and abbreviations'.

Trend

The trend in rice growing areas in these countries is divers: while in Italy, the area cultivated with rice fluctuated since 1990, its level was in 2010 was 15% larger than in 1990. The harvested area in Spain increased from 1990 to 2010 by 32%, but around 1993-1995 rice production was only half of the area in 1990; also Greece increased its rice production since 1990 by 70%. The trend was opposite in France with peaks in rice production during 1993-1995 and in 2010 the level was about 10% lower than in 1990. Finally, Portugal saw a decline in rice production by 14% since 1990.

There was a considerable increase in the implied emission factor used by Portugal from 31.9 g CH_4 m^{-2} yr^{-1} in 1990 to 64.1 g CH_4 m^{-2} yr^{-1} in 2010. The reason is the increase of organic amendment to rice paddies in this time period. In 1990 it can be assumed that 100% of the rice paddies were burned and no organic amendment was added to the soils. However, the "Techniques of Integrated Production and Protection" allow only incorporating the straw by ploughing. In 2004, 60% of the rice cultivation area was subject to these "Techniques"

Figure 6.30: Trend of continuous flooded rice cultivation – area harvested

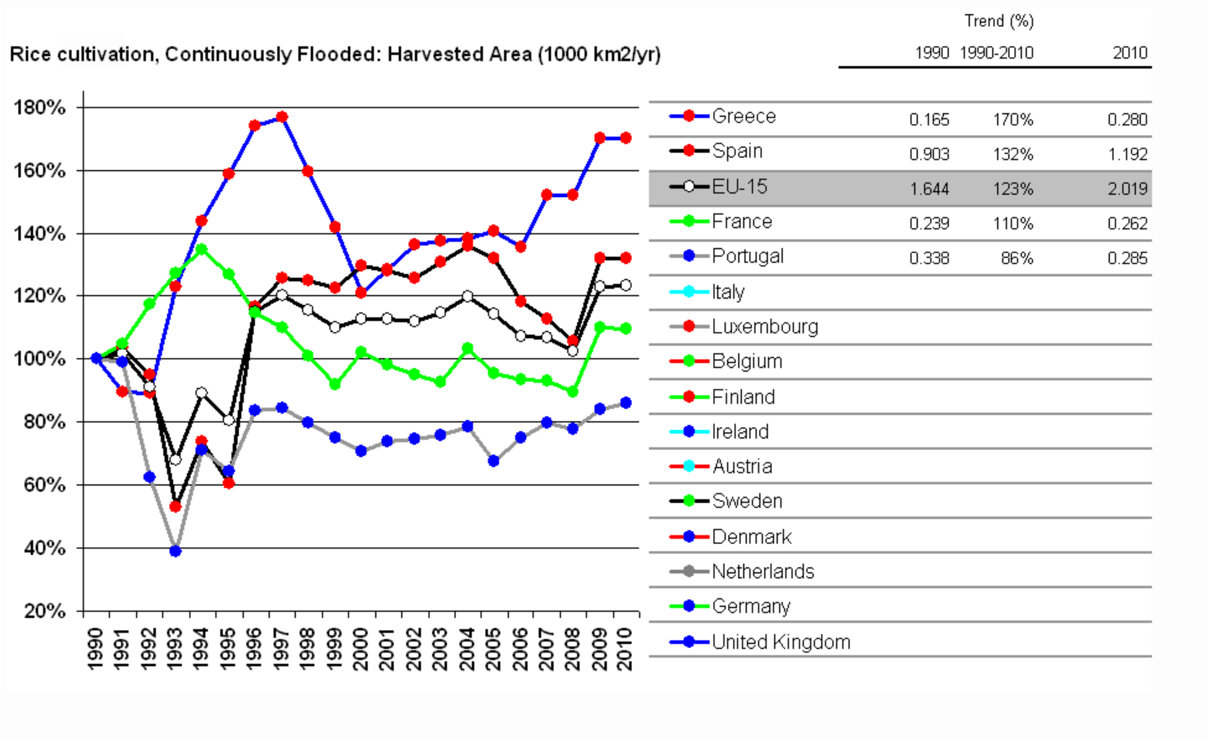


Figure 6.31: Trend of intermittently flooded (single aeration) rice cultivation – area harvested

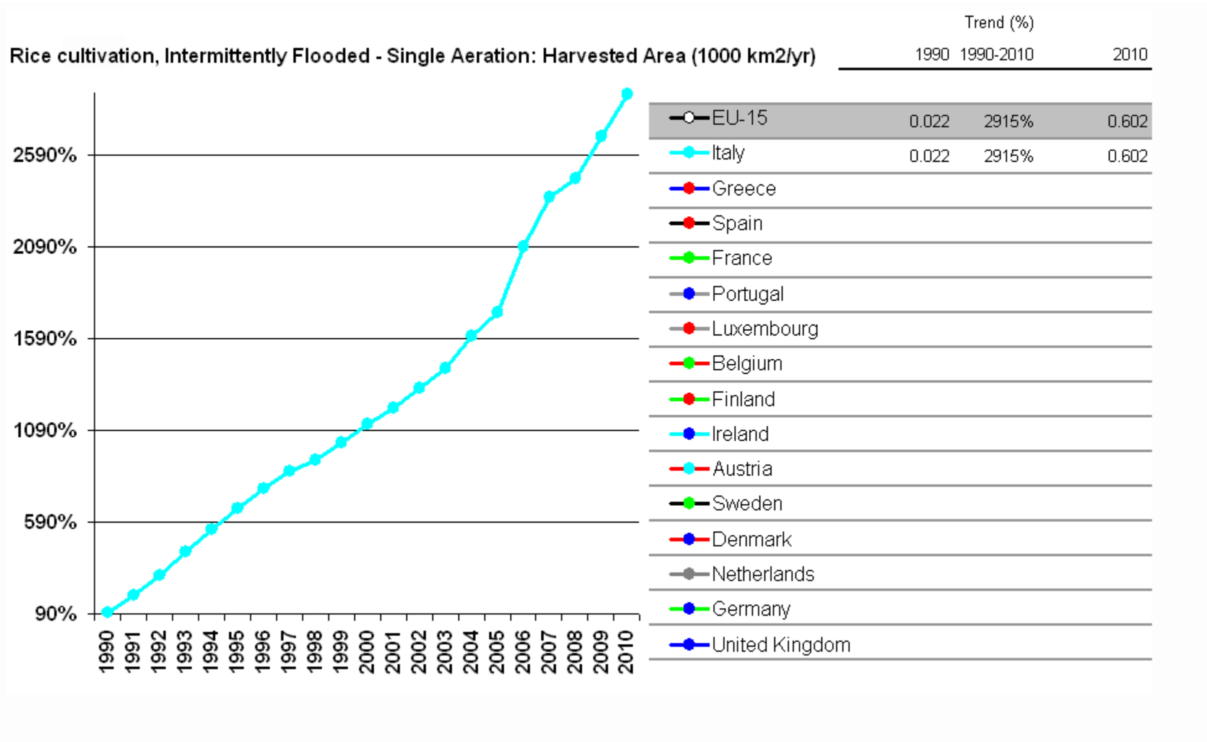


Figure 6.32: Trend of intermittently flooded (multiple aeration) rice cultivation – area harvested

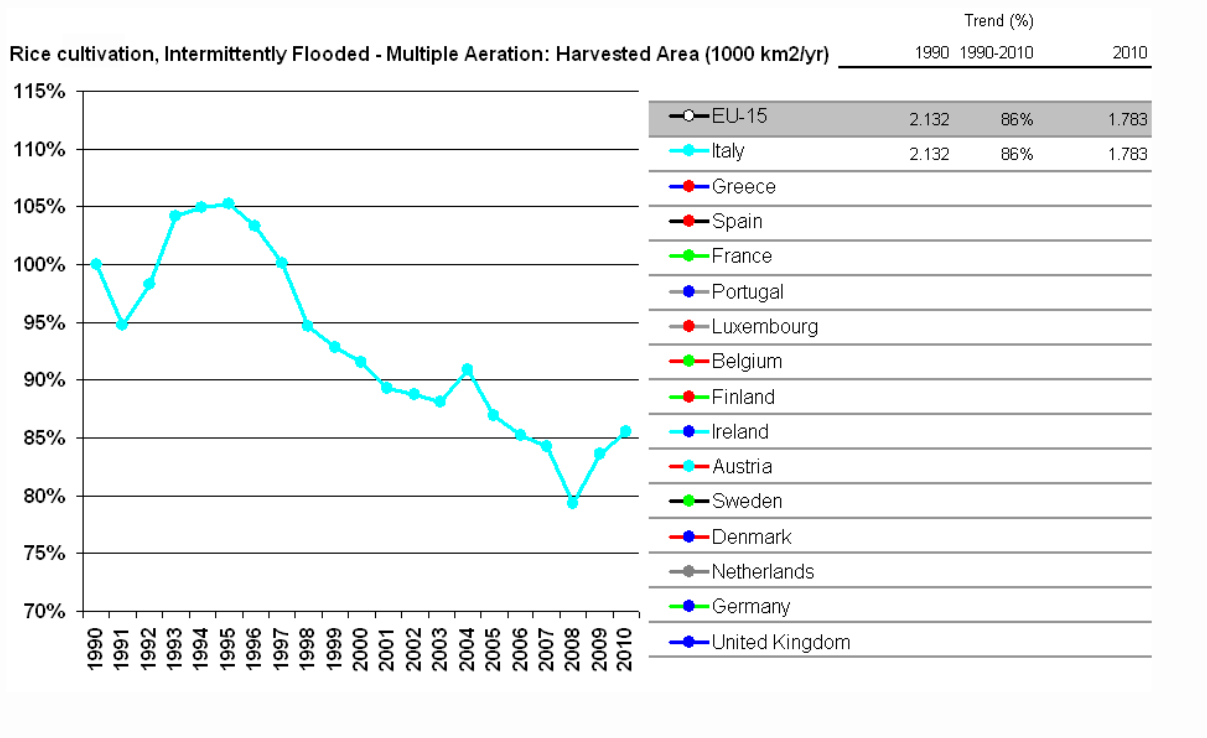


Figure 6.33: Trend of continuous flooded rice cultivation – implied emission factor

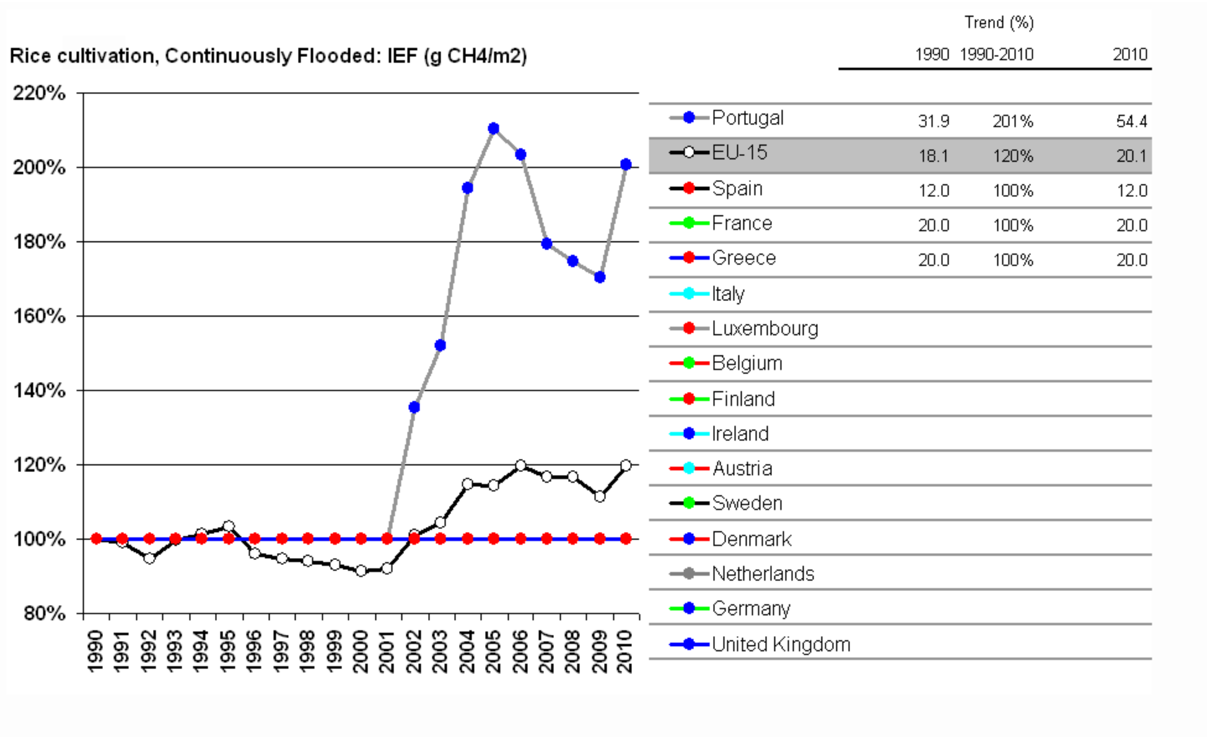


Figure 6.34: Trend of intermittently flooded (single aeration) rice cultivation – implied emission factor

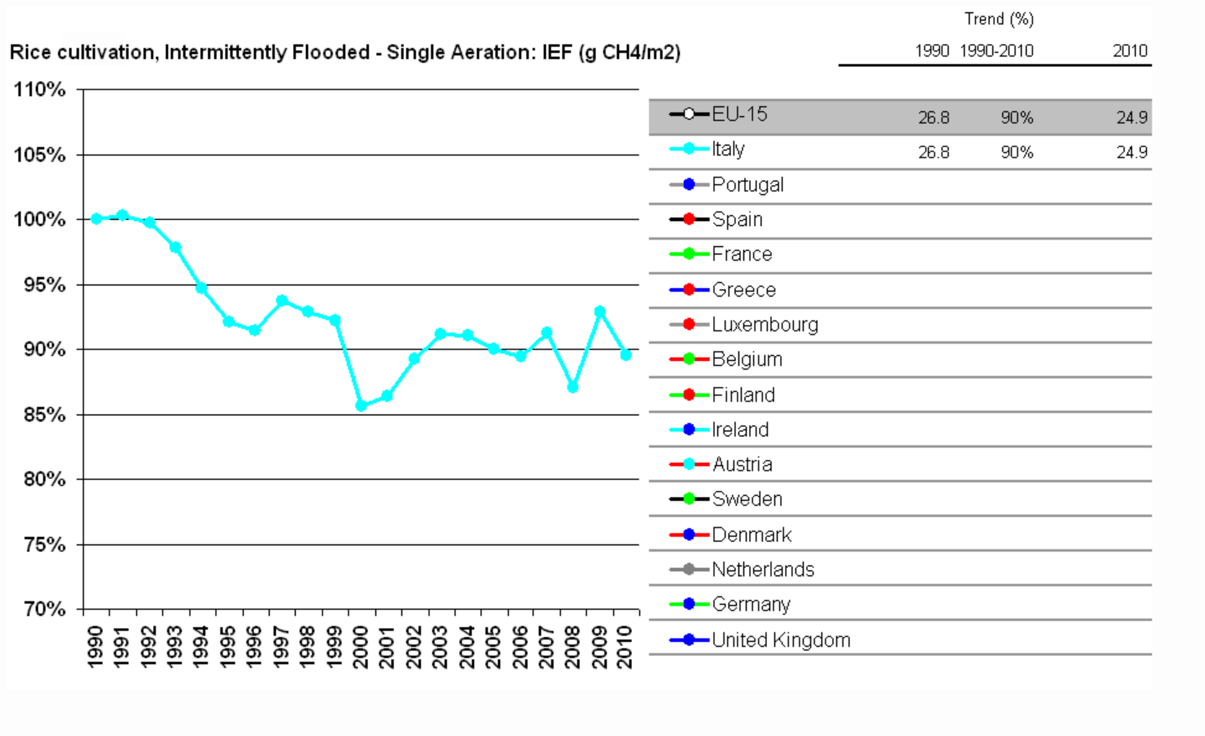
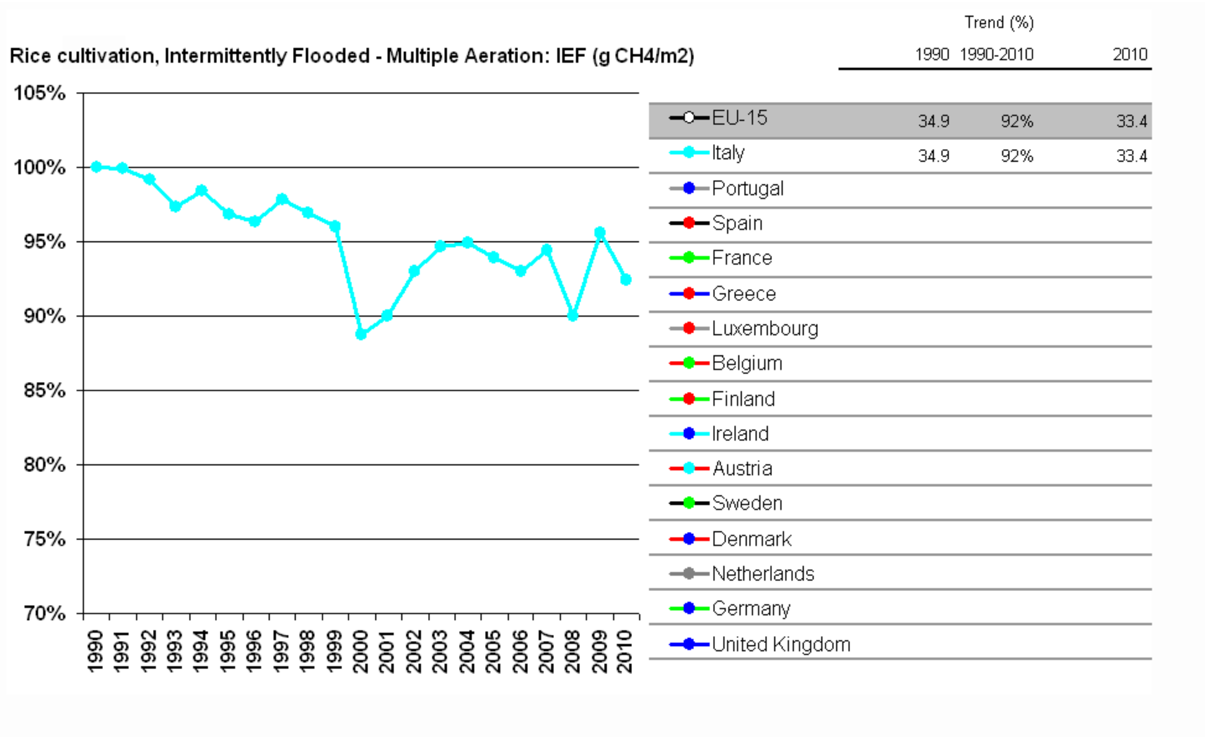


Figure 6.35: Trend of intermittently flooded (multiple aeration) rice cultivation – implied emission factor



Uncertainty and time series consistency

Uncertainty estimates for CH_4 emissions from rice cultivation are reported by three countries (Greece, Italy, and Portugal). The area used for the cultivation of rice is generally well known, only

Portugal reports an uncertainty of 35.7%. The uncertainty of the implied emission factor is 40%, Italy uses a national methodology and estimates an uncertainty of 20%. An overview of the estimates is given in Table 6.57.

Table 6.58 compiles some background information on the estimates of the uncertainty of the values used as activity data and emission factors to estimate CH_4 emissions from rice cultivation.

Table 6.57: Relative uncertainty estimates for activity data and implied emission factors in category 4C (data from 2007 submission)

Member State 2010	AD	IEF
Greece	2.0	40.0
Italy	3.0	20.0
Portugal	35.7	40.0

Table 6.58: Member State's background information for uncertainty estimates in category 4.C

Member State	Background information to uncertainy estimates
Italy	**Uncertainty of emissions from rice cultivation has been estimated equal to 20% as a combination of 3% and 20% for activity data and emissions factor, respectively.**
Portugal	**The uncertainty in the adjusted seasonally integrated emission factor was considered to be 40 per cent, according to the range proposed in table 4.22 of the GPG. For activity data, the standard deviation of inter-annual area under rice cultivation was considered, also 40 per cent.**

6.3.5 Agricultural Soils - N_2O (Source category 4.D)

Source category description

Nitrous oxide is produced naturally in soils through the processes of nitrification and denitrification. Nitrification is the aerobic microbial oxidation of ammonium to nitrate, and denitrification is the anaerobic microbial reduction of nitrate to nitrogen gas (N2). Nitrous oxide is a gaseous intermediate in the reaction sequence of denitrification and a by-product of nitrification that leaks from microbial cells into the soil and ultimately into the atmosphere. One of the main controlling factors in this reaction is the availability of inorganic N in the soil. Therefore, N_2O emissions are reported separately for the main anthropogenic input pathways of nitrogen to the soil, i.e., application of mineral fertilizer nitrogen or nitrogen contained in applied manure, biological nitrogen fixation and nitrogen returned to the soil by the process of mineraliztion of crop residues. Additionally, the emissions of N_2O from manure deposited by grazing animals on pasture, range and paddock are reported here. The emissions of N_2O that result from anthropogenic N inputs or N mineralisation occur through both a direct pathway (i.e., directly from the soils to which the N is added/released), and through two indirect pathways: (i) following volatilisation of NH_3 and NO_x from manure managegement and managed soils, and the subsequent redeposition of these gases and their products NH4 + and NO_3 - to soils and waters; and (ii) after leaching and runoff of N, mainly as NO_3 -, from managed soils.

For EU-15, emissions from all sub-categories in the category 4.D have decreased since 1990 (see Table 6.59). This was most significant for direct emissions from the application of synthetic fertiliser (-28%), followed by indirect emissions from leaching and run-off (-20%) and volatilisation of NH_3+NO_x

(-23%). In the latter two cases, the reduction of emissions can be explained by a reduction of nitrogen input, as the implied emission factor was not or only slightly (leaching) changing during the reporting period. The reduction of animal manure applied to soils more than counterbalanced the increase in the implied emission factor for animal wastes application so that emission decreased by 7%.

At the aggregated EU-15 level, the implied emission factor for N_2O emissions from the application of manure increased by 4%, caused by strong increase by 117% of the implied emission factor for this source in the Netherlands during 1990 to 2010. This increase is explained from a shift from surface spreading of manure to the incorporation of manure into the soil. In the inventory of the Netherlands, incorporation of manure into soils is accounted for with a higher emission factor of N_2O. Incorporation into the soil reduces NH_3 emissions.

The decrease in the input of nitrogen to agricultural soils was significant for all sub-categories and was 28% for synthetic fertilizer application, 11% for application of manure, 0% (on average) of the area of histosols cultivated and 13% of nitrogen excreted by grazing animals. This translated to a reduction of volatilized and re-deposited nitrogen by 23% and of the amount of nitrogen leached by 20%.

Table 6.59: Total N_2O emissions, Total Nitrogen input into agricultural soils and implied Emission Factor for category 4D at EU-15 level in 2010 and 1990 and relative changes

1990	Synthetic Fertilizer	Animal Wastes appl.	Cultiv. of Histosols[1)]	Animal Production	Atmospheric Deposition	Nitrogen Leaching and run-off
	Direct				Indirect	
Total Emissions of N_2O [Gg N_2O]	197	75	24	106	48	212
Total Nitrogen input [Gg N]	10407	4219	20161	3297	2912	5116
Implied Emission Factor [kg N_2O-N / kg N]	1.21%	1.14%	7.6	2.05%	1.04%	2.64%

2010	Synthetic Fertilizer	Animal Wastes appl.	Cultiv. of Histosols[1)]	Animal Production	Atmospheric Deposition	Nitrogen Leaching and run-off
	Direct				Indirect	
Total Emissions of N_2O [Gg N_2O]	143	70	24	91	37	170
Total Nitrogen input [Gg N]	7490	3756	20195	2872	2235	4072
Implied Emission Factor [kg N_2O-N / kg N]	1.21%	1.19%	7.7	2.01%	1.05%	2.66%

2010 value in percent of 1990	Synthetic Fertilizer	Animal Wastes appl.	Cultiv. of Histosols	Animal Production	Atmospheric Deposition	Nitrogen Leaching and run-off
	Direct				Indirect	
Total Emissions of N_2O	72%	93%	102%	85%	77%	80%
Total Nitrogen input	72%	89%	100%	87%	77%	80%
Implied Emission Factor	100%	104%	102%	98%	101%	101%

Source of information: Tables 4.D for 1990 and 2010, submitted in 2012

[1)] Histosols unit AD: km^2; Unit for IEF: kg N_2O-N/ha

Methodological Issues

Methods

Due to the large uncertainty associated with the emission factors in this category and the lack of well-established alternatives, most Member States rely on the IPCC default emission factors (see below). For other parameters used in the calculation of N_2O emissions from agricultural soils, however, many Member States use country-specific methodologies, linking the N_2O inventory with the CORINAIR NH_3 inventory or using simulation models. A more specific discussion of emission factors and parameters used is presented below.

Table 6.60 gives an overview of the total N_2O emissions in category 4D and the contribution of the main sub-categories. For direct N_2O emissions from the application of fertilizer and from emissions from animal production activity data are multiplied with the emission factor, which is for most countries the IPCC default factor. Thus, the vast majority of the emissions are calculated with the Tier 1 approach for the emission from synthetic fertilizer. However, emissions depend also the fraction of nitrogen that volatilises is subtracted from the applied nitrogen for the calculation of N_2O emissions and – for manure applied – also from the method that is used to estimate nitrogen excretion, which has already been discussed above. Additionally, nitrogen in crop residues and nitrogen fixed by biological nitrogen fixation might be estimated using country-specific data.

For each single sub-category we calculated a 'Tier-level' scoring between 1 and 2 according to the methodology (Table 6.92 through Table 6.95, for details see 0).

- The Tier level for direct N_2O emissions is calculated from the Tier level for emissions from mineral fertilizer input, manure application, crop residues and N-fixing crops on the basis of the MEAN rule. The Tier level for the estimation of N_2O emissions from mineral fertilizer is done by comparing the IEF with the IPCC default value. For emissions from manure applications, the Tier level of the nitrogen excretion rates estimated for N_2O emissions from manure management are combined with the Tier level of the IEF using the MEDIAN rule. The Tier level for N_2O emissions from crop residues and N-fixing crops are combined from the qulity level of the emission factor used and the Tier level of the N-input, which is done by expert judgement on the basis of the information contained in the national inventory reports (see Table 6.68 and Table 6.69). A "Tier 2" level has been assigned only if country-specific data have been used; the use of Tier 1b with default IPCC parameters counted as Tier 1 level. An analogue approach is followed to determine the Tier level for N_2O emissions from the cultivation of histosols.
- The Tier level of N_2O emissions from grazing animals is derived from the quality of N excretion factors, the implied emission factor, and a factor based on the information given in the national inventory report on the fraction of manure deposited to grazing land. The share of nitrogen that is deposited on pasture/range and paddock was only considered to be "Tier 2" if the estimate is based on a more is based on a more elaborate approach than purely the length of the grazing season.
- The Tier level for indirect N_2O emissions is a combination of the Tier levels for N_2O emissions from volatilised NH_3+NO_x and from leached/run-off nitrogen. In either case the Tier level is derived from the emission factor used and the respective fraction of nitrogen with weighing factors being 1/3 and 2/3. In the case of N-volatilization the Tier level of the amount of nitrogen is derived from both voliatilization of mineral nitrogen and manure nitrogen (MEAN rule), whereby the quality of the latter is obtained from $Frac_{GASM}$ and nitrogen excretion factors (equal weights) using the MEDIAN rule.

As a result, we estimate that a minimum of 42% of the emissions reported in category 4D are estimated with country-specific information. Highest quality was obtained for emissions from volatilised nitrogen (45%), which reflects the direct impact of the calculation of N-excretion rates and the fact that several countries link this calculation to the NH_3 inventory, where fertilizer-specific volatilisation fractions are given.

A summary of the main methodological issues, as presented in the respective national greenhouse gas inventory reports, is given in Table 6.61. Note however, that most information will be summarized in specific tables on the emission factors and parameters used.

Table 6.60: Total emissions and contribution of the main sub-categories to N_2O emissions in category 4D, methodology and key source assessment by Member States for the sub-categories direct emissions, animal production and indirect emissions for the year 2010.

	Total		Direct			Animal Production			Indirect			Volatilization		Leaching	
Member State	Gg CO_2-eq	b	a	b	c	a	b	c	a	b	c	a	b	a	b
Austria	2,929	Tier 1.3	59%	Tier 1.4	y	3%	Tier 1.4	y	37%	Tier 1.2	y	8%	Tier 1.6	29%	Tier 1.1
Belgium	4,044	Tier 1.4	59%	Tier 1.1	y	19%	Tier 1.4	y	22%	Tier 2.0	y	7%	Tier 2.0	15%	Tier 2.0
Denmark	4,951	Tier 1.6	62%	Tier 1.4	y	4%	Tier 1.4	y	34%	Tier 1.9	y	6%	Tier 1.6	29%	Tier 2.0
Finland	3,548	Tier 1.5	77%	Tier 1.5	y	5%	Tier 1.1	y	17%	Tier 1.5	y	4%	Tier 1.6	13%	Tier 1.5
France	46,565	Tier 1.3	44%	Tier 1.1	y	19%	Tier 1.7	y	36%	Tier 1.2	y	6%	Tier 1.0	31%	Tier 1.2
Germany	39,360	Tier 1.4	63%	Tier 1.4	y	3%	Tier 1.7	y	34%	Tier 1.3	y	6%	Tier 1.6	28%	Tier 1.2
Greece	5,288	Tier 1.2	30%	Tier 1.1	y	33%	Tier 1.4	y	37%	Tier 1.1	y	6%	Tier 1.0	30%	Tier 1.1
Ireland	6,838	Tier 1.3	42%	Tier 1.1	y	39%	Tier 1.4	y	19%	Tier 1.6	y	6%	Tier 1.6	13%	Tier 1.6
Italy	15,159	Tier 1.3	48%	Tier 1.3	y	10%	Tier 1.4	y	42%	Tier 1.2	y	10%	Tier 1.6	32%	Tier 1.1
Luxembourg	316	Tier 1.2	43%	Tier 1.2	y	18%	Tier 1.4	y	38%	Tier 1.2	y	6%	Tier 1.0	32%	Tier 1.2
Netherlands	6,089	Tier 1.9	54%	Tier 1.9	y	21%	Tier 1.7	y	24%	Tier 2.0	y	8%	Tier 2.0	17%	Tier 2.0
Portugal	2,958	Tier 1.4	35%	Tier 1.1	y	28%	Tier 1.4	y	37%	Tier 1.6	y	6%	Tier 1.6	31%	Tier 1.6
Spain	18,844	Tier 1.6	49%	Tier 1.8	y	13%	Tier 1.7	y	38%	Tier 1.2	y	5%	Tier 1.5	33%	Tier 1.1
Sweden	4,405	Tier 1.8	56%	Tier 1.8	y	9%	Tier 1.7	y	19%	Tier 1.7	y	4%	Tier 2.0	15%	Tier 1.6
United Kingdom	26,386	Tier 1.6	42%	Tier 1.7	y	21%	Tier 1.4	y	36%	Tier 1.6	y	6%	Tier 1.6	30%	Tier 1.6
EU-15	**187,680**	**Tier 1.4**	**50%**	**Tier 1.4**	**y**	**15%**	**Tier 1.6**	**y**	**34%**	**Tier 1.3**	**y**	**6%**	**Tier 1.5**	**28%**	**Tier 1.3**
EU-15: Tier 1	58%		57%			43%			68%			55%		70%	
EU-15: Tier 2	42%		43%			57%			32%			45%		30%	

a Contribution to N2O emissions from agricultural soils

b Tier 1: default methodology; Tier 2: country-specific methodology

c Source category is key in the Member State's inventory (y/n)

Table 6.61: Member State's background information for the calculation of N_2O emissions in category 4.D

Member State	Methods
Austria	**Emissions are estimated within an N-flow model fofr agriculture. The IPCC Tier 1a and – where applicable – Tier 1b with Austria specific consideration of nitrogen losses (NH_3-N, NO_x-N, N_2O-N). These losses are subtracted from the amount of mineral fertilizer N sales in the CRF table.**
Denmark	**The IPCC Tier 1a methodology is used to calculate the N_2O emission. Emissions of N_2O are closely related to the nitrogen balance (DIEMA). Indirect emissions from atmospheric deposition includes all emission sources of ammonia, i. e., livestock manure, use of synthetic fertilizer, crops, ammonia-treated straw used as feed, and sewage sludge and sludge from industrial production applied to agricultural soils.**
Finland	**Emissions are esteimated within a mass-flow approach in order to avoid double-counting. The nitrogen mass flow model (except for N-fixing, crop residue and sewage sludge) accounts for nitrogen losses as ammonia and nitrous oxide emissions during manure management in animal houses, during storage and application; for NH_3 volatilisation of pasture manure, urine and dung volatilisation are now taken into account separately; for synthetic fertilizers fertilizer type field type and placement fertilisation are considered; atmospheric deposition from manure is calculated from the ammonia volatilised during the whole management/application process.**
Germany	**Nitrogen emissions are calculated with the mass-flow approach, taking generally the simple methodology of the CORINAIR guidebook (EMEP, 2003). Application rates are dis-aggregated to the district level on the basis of the acreage of crops in the districts and fertilizer recommendations (LWK-WE, 2003). A national approach is used for calculating N_2O emissions from atmospheric deposition of NH_3+NO_x taking into consideration *total volatilization* fluxes of NH_3 and NO_x, including those from N-fixing crops, crop-residues, bedding material and imported manure.**
Ireland	**Direct Soil Emissions: calculated in a Tier 1 approach take into account the nitrogen inputs from all these sources, except that due to the cultivation of organic soils. For N_2O emissions from manure applilcation, also N_2O emissions during housing and storage is subtracted from the N-input.**
Italy	**IPCC default Tier 1 methodology.**

Member State	Methods
Luxembourg	**Nitrous oxide emissions from agricultural soils are estimated by using emission factors in relation with the mass of fertilizers used. For fallows (cultures without fertilizer use) an area-based emission factor is used in relation with the respective agricultural surface areas.**
Netherlands	**The IPCC Tier 1b/2 methodology is used to estimate direct N_2O emissions for two soil types (organic and inorganic soils) and to estimate direct N_2O emissions from animal production. The IPCC Tier 1 method is used to estimate indirect N_2O emissions. For emissions from crop residues and N-fixing crops, only crops from arable farming and horticulture in the full soil (not in tubs) are included. All relevant documents concerning methodology, emission factors and activity data are published on www.greenhousegases.nl. The LEI (Dutch agricultural economic institute) performs these calculations based on the methodology described in Van der Hoek et al. (2007). Ammonia emissions are published by CBS/Statline (website www.cbs.nl). About 80–85% of the manure N collected in the stable and in storage is applied to soils. A small portion of the manure N (approximately 1–4%) is exported; while approximately 13-15% is emitted as ammonia during storage.**
Portugal	**Manure managed as liquid systems and solid storage is fully applied to agricultural soil as a fertilizer, irrespective of the animal species considered, whereas only 80% of manure handled in anaerobic lagoons is placed in soil (Bicudo & Albuquerque, 1995). The remaining 20 per cent wastewater flow and nitrogen is rejected directly to water systems. This fraction, however, is included in the determination of N_2O indirect emissions from agricultural soils.The activity data for applied organic nitrogen is obtained after subtracing not only NH_3 and NO_x volatilization from housing and manure management systems, but also N_2O emissions in manure management systems.**
Spain	**The activity data for applied organic nitrogen is obtained after subtracing not only NH_3 and NO_x volatilization from housing and manure management systems, but also N_2O emissions in manure management systems.**
Sweden	**Background emissions from agricultural soils are reported both for organic and mineral soils in the Swedish inventory. For mineral soils, a national emission factor has been developed (Kasimir-Klemedtsson, 2001).**
United Kingdom	**Indirect emissions of N_2O from the atmospheric deposition of ammonia and NO_x are estimated according to the IPCC (1997) methodology but with corrections to avoid double counting N. The sources of ammonia and NO_x considered are synthetic fertiliser application and animal manures applied as fertiliser. The method used corrects for the N content of manures used as fuel but no longer for the N lost in the direct emission of N_2O from animal manures as previously.**

Activity Data

For the estimation of N_2O emissions from N-fixing crops and crop residues, most Member States use the amount of N input (in Gg N) as activity data in the CRF table; but some countries give the emission factor in kilogram of nitrogen emitted per kg of dry crop production (N-fixing crop or other crops, respectively). Therefore, the data given in Table 6.62 in the respective columns are not comparable.

Additional background information on the source of the data used in the Member States's inventories is given in Table 6.63.

Table 6.62: Member State's activity data to calculate direct and indirect N_2O emissions in category 4D

Member States 2010	Synthetic Fertilizer (Gg N)	Animal Wastes appl. (Gg N)	N-fixing crops (Gg N)	Crop residue (Gg N)	Cultiv. of Histosols (km^2)	Animal Production (Gg N)	Atmosph. Deposition (Gg N)	Nitrogen Leaching and run-off (Gg N)
	Direct						Indirect	
Austria	85	112	23	64	NO	10	49	70
Belgium	139	137	7	105	25	80	55	50
Denmark	187	190	39	52	418	20	59	150
Finland	151	61	1.0	24	3,223	18	29	39
France	1,875	694	319	487	NO	910	567	1,166
Germany	1,499	769	77	905	12,301	137	454	908
Greece	192	38	1	27	67	181	67	132
Ireland	352	109	1	11	NO	271	86	74
Italy	450	435	171	116	90	159	300	404
Luxembourg	13	6	0	3	NO	6	4	8
Netherlands	220	293	4	25	2,230	81	99	83
Portugal	99	44	2	25	NO	84	36	76
Spain	941	395	169	110	NO	306	186	506
Sweden	166	62	36	46	1,450	42	36	53
United Kingdom	1,121	412	36	411	392	568	205	352
EU-15	7,490	3,756	887	2,411	20,195	2,872	2,235	4,072

Source of information: Tables 4.D for 2010, submitted in 2012. Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 6.63: Member State's background information on the activity data used for the calculation of N_2O emissions in category 4.D

Member State	Activity data
Austria	**Mineral Fertilizer application detailed data about the use of different kind of fertilizers are available until 1994, because until then, a fertilizer tax („Düngemittelabgabe“) had been collected. Data about the total synthetic fertilizer consumption are available for amounts (but not for fertilizer types) from the statistical office (Statistic Austria) and from an agricultural marketing association (Agrarmarkt Austria, AMA). The yearly numbers of the legume cropping areas were taken from official statistics (BMLFUW 2007). Harvest data were taken from (BMLFUW) and the datapool of (Bundesanstat fuer Agrarwirtschaft). Agriculturally applied Sewage sludge data were taken from Water Quality Report, 2000 (Philippitsch, 2001), For 2001 to 2006 data from the National Austrian Waste Water Database operated by the Umweltbundesamt was used.** **The yearly numbers of the legume cropping areas were taken from official statistics (BMLFUW). Harvest data were taken from (BMLFUW) and the datapool of (Bundesanstalt fuer Agrarwirtschaft).**
Belgium	**In 2006 Wallonia has 55% of the land used for agriculture, but 67% of agricultural businesses are situated in Flanders.**
Denmark	**The amount of nitrogen (N) applied on soil by use of synthetic fertiliser is estimated from sale estimates by the Danish Plant Directorate, which is source to the FAO database. Data for crop yield is based on Statistics Denmark. For nitrogen content in the plants the data is taken from Danish feed stuff tables (Danish Agricultural Advisory Centre).**
Finland	**The amount of synthetic fertilisers sold annually has been received from the annual agricultural statistics of the Ministry of the Agriculture and Forestry. The amount of sewage sludge applied annually has been received from the VAHTI database of Finland's environmental administration. Area of cultivated organic soils are from MTT Agrifood Research Finland. Crop yields of cultivated plants have been received from agricultural statistics.**
France	**National statistics of fertilizer consumption are from UNIFA. Crop production statistics are obtained from the Ministry of agriculture (SCEES/ AGRESTE). For animal production, the difference between table 4.D and table 4B(b) is due to the oversea territories that are accounted separately in table 4D.**
Greece	**The data regarding the annual quantities of synthetic fertilizers consumed in the country derive from FAO. The data for the last two years result from extrapolation based on the trend of the last five years. Data on agricultural crop production used for the calculation of emissions was obtained from the annual national statistics of the NSSG.**
Ireland	**The annual statistics on nitrogen fertilizer use (Nfert) are obtained from the Department of Agriculture and Food.**
Italy	**Fertilizer application rates are from ISTAT.**

Member State	Activity data
Luxembourg	**AD from national statistical data (Statistical Yearbook, tables C.2100 and C.2104) and ASTA (Administration des Services Techniques de l'Agriculture)**
Portugal	**Apparent Consumption of Fertilizers in the Agriculture activity (ACFA) by a simple mass balance, from sales and international market information data not accounting for losses and stock changes. The data are compared to the more complete time-series that is available at FAO (http://faostat.fao.org), with sales information for "Nitrogenous Fertilizers" from 1961 up to 2002. However, and although its completeness, the Ministry of Agriculture and the National Statistical Institute, shown concerns about the origin of the information behind the final time series, and consider that it did not reflect clearly the situation that existed in Portugal in the period. Nevertheless, both series agree quite well near the base year, although the values in this series appear to be over-estimating the rate of decrease of synthetic fertilizers in Portugal.**
Spain	**Mineral fertilizer statistics are obtained from 'Anuario de Estadistica Agroalimentario' (MARM)**
Sweden	**Sales of fertilisers, recalculated into nitrogen quantities, are published annually by Statistics Sweden and the national estimates are considered to be accurate, according to the quality declaration in the statistical report. The fertiliser sales values are however a bit higher than the estimated use of fertilisers, which is estimated from telephone interviews with farmers. The difference can partly be explained by the use of fertiliser in other sectors such as in horticulture. Statistics on the use of sewage sludge have been published irregularly and in different reports, but a time series has been created through interpolation and the emissions are reported for the first time in the current submission of the GHG inventory. Estimated standard yields for different crops are published annually by the Swedish Board of Agriculture/Statistics Sweden and are a function of crop yields estimated by surveys conducted over the last 15 years.** **The area of arable land in the agricultural sector is taken from the National Forest Inventory to harminize the Swedish National Froest Inventory with the agricutlural sector.**
United Kingdom	**Annual consumption of synthetic fertilizer is estimated based on crop areas (Defra) and fertilizer application rates (BSFP, 2006). Crop production data are taken from Defra (2006).**

Emission Factors and other parameters

Table 6.64 and Table 6.65 give an overview of the emission factors and other parameters used for the calculation of N_2O emissions from agricultural soil in 2010. As discussed already above, emission factors are largely IPCC default, while other parameters are more frequently country-specific. Also, while the emission factors are static in the time series, some parameters are dynamically calculated on the basis of national input data, for example the mix of mineral fertilizer types with different volatilization fractions associated.

In the following, country-specific elements in the calculation of N_2O emissions from agricultural soils as reported in the National Inventory Reports are given in Table 6.67 for direct N_2O emissions from fertilizer application, Table 6.68 and Table 6.69 for N_2O emissions from N-fixing crops and crop residues, Table 6.70 for the N_2O emissions from animal production and Table 6.71 for N_2O emissions from cultivated histosols.

Furthermore, background information on the development of national parameters is given in Table 6.72 for $Frac_{GASF}$, Table 6.73 for $Frac_{GASM,}$ and Table 6.74 for $Frac_{LEACH}$.

Most Member States use the IPCC default emission factors for the calculation of N_2O emissions from the application of mineral and organic fertiliser. A differentiation between organic and inorganic fertiliser has been made by the Netherlands and Sweden.

The Swedish EF for synthetic fertiliser is lower than IPCC default and is based on a study on N_2O emissions in Sweden and other countries of northern Europe and in Canada (Kasimir-Klemedtsson, 2001), supported by a study in Norway suggesting a lower emission factor for emitted fertiliser N than the IPCC default value (Laegreid and Aastveit, 2002). The EF for applied manure is higher than

IPCC default and is a country specific EF derived from a literature study requested by the Swedish EPA (Klemedtsson, 2001).

The Netherlands distinguish between mineral fertiliser application on mineral soils and on organic soils, with the EFs being twice as high for the application on organic soils; for the application of manure, differentiation is made between surface spreading and incorporation of the fertiliser. As more nitrogen is locally available if the fertiliser is incorporated into the soil, this application system is assumed to result in higher emissions of N_2O in mineral soils. For organic soils, the same, higher, EF is applied for both application systems. An overview of the Dutch emission factors is given in Table 6.66. Additional background information on the emission factors used is given in Table 6.67.

All countries are reporting N_2O emissions from manure excreted by animals during grazing and the implied EF is the default factor of 2% N_2O-N per kg N excreted and year, except of the emission inventories of the Spain and the Netherlands and Sweden, which use an EF of 1.7% and 3.3%, respectively.

Table 6.64: Implied Emission Factors for the category 4D - N_2O emissions from agricultural soils in

Member States 2010	Synthetic Fertilizer	Animal Wastes appl.	N-fixing crops	Crop residue	Cultiv. of Histosols	Animal Production	Atmosph. Deposition	Nitrogen Leaching and run-off
	Direct						Indirect	
Austria	1.25%	1.25%	1.25%	1.25%	NO	2.0%	1.00%	2.50%
Belgium	1.25%	1.25%	1.25%	1.25%	8.0	2.0%	1.00%	2.50%
Denmark	1.25%	1.25%	1.25%	1.25%	8.0	2.0%	1.00%	1.94%
Finland	1.25%	1.25%	1.25%	1.25%	8.3	2.0%	1.00%	2.50%
France	1.25%	1.25%	1.25%	1.25%	NO	2.0%	1.00%	2.50%
Germany	1.25%	1.25%	1.25%	1.25%	8.0	2.0%	1.00%	2.50%
Greece	1.25%	1.25%	1.25%	1.25%	8.0	2.0%	1.00%	2.50%
Ireland	1.25%	1.25%	1.25%	1.25%	NO	2.0%	1.00%	2.50%
Italy	1.25%	1.25%	1.25%	1.25%	8.0	2.0%	1.00%	2.50%
Luxembourg	1.25%	1.25%	1.25%	1.25%	NO	2.0%	1.00%	2.50%
Netherlands	1.30%	0.87%	1.00%	1.00%	4.7	3.3%	1.00%	2.50%
Portugal	1.25%	1.25%	1.25%	1.25%	NO	2.0%	1.00%	2.50%
Spain	1.17%	1.01%	1.25%	1.25%	NO	1.7%	1.00%	2.50%
Sweden	0.8%	2.50%	1.25%	1.25%	8.0	2.0%	1.02%	2.50%
United Kingdom	1.12%	1.00%	1.25%	1.25%	8.0	2.0%	1.55%	4.59%
EU-15	1.21%	1.19%	1.25%	1.25%	7.7	2.0%	1.05%	2.66%

Source of information: Tables 4.D for 2010, submitted in 2012. Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 6.65: Relevant parameters for the calculation of N_2O emissions from agricultural soils in 2010

Member States	FracBURN	FracFUEL	FracGASF	FracGASM	FracGRAZ	FracLEACH	FracNCRBF	FracNCRO	FracR
Austria	0.31%		4.1%	27%	6%	30%	2.6%	0.9%	34%
Belgium	NO	NO	3.8%	21%	31%	12%	3.0%	1.5%	50%
Denmark	0.73%	NO	1.5%	19%	8%	33%	3.9%	1.7%	86%
Finland	0.20%	NA	1.5%	25%	18%	15%	4.2%	0.6%	45%
France	0.57%	NO	10.0%	20%	41%	30%	3.0%	0.8%	NA
Germany	NO	NO	4.4%	30%	11%	30%	4.3%	2.3%	63%
Greece	10%		10.0%	20%	79%	30%	1.4%	0.5%	52%
Ireland	NO	NO	2.9%	17%	62%	10%	1.4%	0.5%	NO
Italy	10%	NO	9.4%	29%	19%	30%	3.0%	1.5%	45%
Luxembourg	NO	NO	10.0%	20%	45%	30%	3.0%	1.5%	45%
Netherlands	NO	NO	5.2%	9%	16%	12%	NE	NE	NE
Portugal	4.5%	NO	5.7%	19%	54%	32%	2.2%	1.3%	71%
Spain	19.7%	NO	6.5%	20%	38%	30%	2.4%	0.5%	NA
Sweden	NO	NO	0.9%	33%	33%	20%	1.3%	1.0%	64%
United Kingdom		35.71%	10.0%	20%	57%	30%	3.0%	1.5%	52%
EU-15[1)]	NA	NA	5.7%	22%	35%	25%	2.8%	1.3%	55%

Source of information: Tables 4.D for 2010, submitted in 2012. Abbreviations explained in the Chapter 'Units and abbreviations'.
[1)] Arithmetic average over the MS that reported.

Direct emissions from application of fertiliser

Only few countries use country-specific emission factors to estimate N_2O emissions caused by the application of mineral fertilizer. The reason is the extreme high spatial and temporal variability of this emission source, which makes the generation of a robust database with observations, based on which national emission factors can be derived, extremely difficult. National methodologies are summarized in Table 6.67. Table 6.68 through Table 6.70 give additional information on the methodologies used to estimate N_2O emissions from crop residues, biological N-fixation, and animal production.

Table 6.66 shows the methodology used in the Netherlands in detail.

Table 6.66: N_2O emission factors for agricultural soils used in Netherlands' inventory (from the NL protocol for direct N_2O emissions; www.greenhousegases.nl)

Supply source	EF (kg N_2O–N per kg N supply) Mineral soil	Organic soil	Reference
Using fertiliser			
- ammonia-retaining (no nitrate)	0.005	0.01	2
- other types of fertiliser	0.01	0.02	1
Using animal manure			
- above-ground usage	0.01	0.02	1
- low-emission use	0.02	0.02	1
Grazing agricultural pets			
- faeces	0.01	0.01	1
- urine	0.02	0.02	1
Nitrogen fixation	0.01		1
Remaining crop residues	0.01		2
Agricultural use of histosols		0.02	2

references: 1= Kroeze, 1994; 2= Van der Hoek et al., 2005

Table 6.67: Member State's background information for the calculation of N_2O emissions from the application of fertilizer in category 4.D

Member State	Direct emissions from fertilizer application
Finland	**IPCC default with the exceptoin of emission factors for organic soils on grass and other crops which are based on national data (Monni et al. 2007) (cereals 11.08 kg N_2O-N ha^{-1} y^{-1}, grass 5.7 kg N_2O-N ha^{-1} y^{-1}).**
Germany	**Default emission factors. For emissions from leaching, default factor from IPCC 2006. The IPCC 1996 factor represents poor klnowledge available at the time. The new data set used for the development for the IPCC 2006 guidelines agrees with the German situation (Weymann et al., 2008).**
Netherlands	**Distinction is made between fertiliser type (ammonia-retaining-no nitrate fertiliser and other fertiliser), application to mineral or organic soils, and manure incorporation. The country specific emission factors for mineral soils are lower than IPCC defaults and for organic soils they are higher. A fixed distribution of the total amount of nitrogen in fertiliser and animal manure is used over the Netherlands areas of mineral and organic agricultural soils. For fertiliser use, 90% is attributed to mineral soils, and 10% to organic soils; for animal manures this is 87% and 13% respectively (Kroeze, 1994). For incorporation into soil also a higher emission factor than the IPCC default is used. A recent survey on N_2O emission factors for the field-scale application of animal manure (Kuikman et al., 2006) showed that on the basis of available data it was not possible to make an update of the N_2O emission factors applied in the past (Kroeze et al., 1994). Very few comparative trials between surface spreading and incorporation have been carried out in The Netherlands to date, resulting in very low emission rates for both techniques. Field-scale comparative experiments carried out in other countries show that, in most cases, N_2O emissions increased and seldom were lower in comparison with surface application. However, it was not possible to deduce long-term average N_2O emission factor from these findings and to translate these to the Dutch circumstances. Therefore, it was not possible to underpin an update of the N_2O emission factor for the application of animal manure. More research is needed in order to be able to take the specific circumstances of The Netherlands into account.**
Sweden	**National emission factor for direct emissions based on a study by (Klemedtsson, 2001). For nitrogen supply from fertilizers, a national emission factor, 0.8% N_2O-N of N-supply, is used. For nitrogen supply from manure, a national emission factor of 2.5% emissions of N-supply is used. The background emissions from the cultivation of mineral soils have also been included in the inventory with the national emission factor of 0.5 kg N_2O-N ha^{-1}. For other direct soil emissions, default values from the IPCC Guidelines are used. The background emissions from organic soils vary with different crops. They are considered to be higher from ploughed soils than from pasture or lay lands and the suggested emission factors are 1 and 6 kg N_2O-N ha^{-1}, respectively. The IPCC guidelines' default value is implemented in the inventory since a Swedish/Finnish research group concluded that not enough data exists to generate different emission factors for different management and soil types (Klemedsson et al., 1999).**

Table 6.68: Member State's background information for the calculation of N_2O emissions from crop residues in category 4.D

Member State	Direct emissions from crop residues
Austria	**Country-specific data for average crop residues/crop products ratio, dry matter fraction, N in crop residues (Goetz, 1998) and fraction of crop residues removed (Loehr 1990). Emissions from field burning have been calculated on a crop by crop basis.**
Belgium	**The dry matter content of the crops in Flanders are region specific.**
Denmark	**N_2O emissions from crop residues are calculated as the total above-ground amount of crop residues returned to soil. For cereals the aboveground residues are calculated as the amount of straw plus stubble and husks. The total amount of straw is given in the annual census and reduced with the amount used for feeding, bedding and biofuel in power plants. Straw for feeding and bedding is subtracted in the calculation because this amount of removed nitrogen returns to the soil via manure. Data for nitrogen content in stubble and husks are provided by the Danish Institute of Agricultural Sciences (Djurhuus,and Hansen, 2003). Burning of plant residues has been prohibited since 1990 and may only take place in connection with continuous cultivation of seed grass. It is assumed that the emissions are insignificant.**
Germany	**Germany makes use of statistically available nitrogen contents in crop residues. Factors used in the Tier 2 calculation for emissions from crop residues is given in (Daemmgen et al., 2007).**
Italy	**Country-specific methodology; N-content in crop residues calcualted using the protein content in dry matter, and dividing by the factor 6.25.**
Netherlands	**A fixed countryspecific value in kg N per hectare is used for the nitrogen content of the above-ground crop residues (Velthof and Kuikman, 2000). Country-specific values for removal of crop residues show that during the period 1990-2003, only grains and corn were removed (90%) from the fields (Van der Hoek et al., 2005).**
Portugal	**Crop residues not only annual crops were considered but also permanent crops, such as orchards and pastures. Crop residues are not used as combustible or building material in Portugal.**
Spain	**Regulations on burning of cereal residues vary between regions (zones A and B). Data are listed by year, crop category and zone.**
Sweden	**N-content in crop residues from cereals are based on national measurement data (Mattson, 2005). For other crops, a combination of national factors and IPCC default values was used (Swedish EPA/SMED, 2005).**
United	**Production data of crops are taken from Defra (2006a, 2006b). Field burning has ceased to be legal in the**

Member State	Direct emissions from crop residues
Kingdom	**UK since 1993, and none is assume to occur after this date. For years prior to 1993, field-burning data were taken from the annual MAFF Straw Disposal Survey (MAFF, 1995).**

Table 6.69: Member State's background information for the calculation of N_2O emissions from N-fixing crops in category 4.D

Member State	Direct emissions from N-fixing crops
Austria	**Values for biological fixation for peas, soja beans adn horse/field beans (120 kg N/ha) and clover-hey (160 kg N/ha) are country-specific (Goetz, 1998); these values are constant over the time series.**
Denmark	**The estimates for the amount of fixed nitrogen in crops are estimated by Danish Institute of Agricultural Science (Swedish Board of Agriculture, 2005) from literature (Kristensen, 2003; Høgh-Jensen et al, 1998; Kyllingsbæk, 2000). Emissions from clover-grass are included (not mentionen in IPCC). Area with grass and clover covered approx.17% of the total agricultural area and represent thus a significant part of N-fixing crops emissions.**
Finland	**Vegetables grown in the open have been included into the emission estimate of crop residues for the first time in 2005 submission. Vegetable yields have been received from literature (Yearbook of Farm Statistics, 2006). Values for the residue/product fraction, dry matter content and nitrogen fraction are IPCC with amendments where appropriate values were missing (turnip rape/rape; sugar beet; clover seed) or where more values based on expert judgement were used (N-fraction for peas of 3.5%; DM and residue/product fraction from sugar beet used for vegetables).**
Germany	**The quantity of N fixes by leguminous crops is estiamted on the basis of cultivated area and national average N-fixing rates of 250 kg N ha^{-1} (pulses), 300 kg N ha^{-1} (alfalfa), and 200 kg N ha^{-1} (mixed alfalfa, clover; improved grassland) (DÄMMGEN et al., 2007).**
Italy	**Country-specific methodology considering also legume forage. Nitrogen fixed per hectare is taken from Erdamn, 1959 in Giardini (1983).**
Netherlands	**Country-specific value for nitrogen fixation per hectare (Mineralen Boekhouding, 1993) (Lucerne: 422 kg N per hectare; Green peas (harvested dry) and field peas, marrowfat peas en grey peas, brown beans, peas (harvested green): 164 kg N per hectare; Field beans: 325 kg N per hectare; Stem beans (harvested green), scarlet runner-/salad-/common beans: 75 kg N per hectare; Broad beans: 164 kg N per hectare.**
Portugal	**N fixed by crops includes both annual crops and a permanent crop (carob tree, Ceratonia siliqua) production. Factors are IPCC defaults and from other sources (Jarrige, 1988; INRA, AFRC).**
Spain	**A literature review was made to obtain N-fixing data relevant for cultures grown in Spain. This resulted in a detailed list containing data on crop residue/yield fracion, dry matter, carbon and nitrogen content for more than 100 crop types.**
Sweden	**To estimate nitrogen fixation from the atmosphere, a model according to Høgh-Jensen has been used since submission 2006 The model covers fixation from root and stubble as well as trensmission to other plants. It has been adapted to Swedish conditions (Frankow-Lindberg, 2005). According to the model, the amount of fixed nitrogen is estimated as a part of the total amount of N in the plant's biomass, which varies depending on th ekind of leguminous plant, the age of the pasture, the number of harvests and, to some extent, the amount of fertiliser applied.**
United Kingdom	**The total nitrous oxide emission reported also includes a contribution from improved grass calculated using a fixation rate of 4 kg N/ha/year (Lord, 1997). Crop production data are taken from Defra (2006).**

Table 6.70: Member State's background information for the calculation of N_2O emissions from animal production in category 4.D

Member State	Grazing animals
Austria	**During the summer months, 14.1% of Austrian Dairy cows and Suckling cows are on alpine pastures 24 hours a day. 43.6 % are on pasture for 4 hours a day and 42.3 % stay in the housing for the whole year (Konrad, 1995).**
Belgium	**The nitrogen from grazing is estimated, taking into account the number of days in pasture and the nitrogen excreted by each animal category. Available nitrogen is the difference between the manure nitrogen content and the manure nitrogen volatilisation in NH_3 and NO form.**
Denmark	**$Frac_{GRAZ}$ is based on expert judgement (DAAC - Poulsen et al., 2001) assuming that 5%, on average, of the nitrogen from dairy cattle and heifers is excreted on grass.**
Finland	**The length of pasture season has been estimated as 130 days for suckler cows, 120 days for dairy cows, heifers, calves, shepp, goats and horses, 365 days for reindeer, and 0 for bulls, swine, poultry and fur animals.**
Germany	**Grazing animals: N input calculated with the mass-flow approach taking into consideration all relevant housing systems occurring in Germany and is based on the length of the grazing period, the average time per day spent grazing and in milking yards. The share of grazing varies with subcategory, region, and time.**

Member State	Grazing animals
Ireland	**The amount of organic nitrogen input concerned from the equations above, is large in Ireland due to the relatively short period that cattle remain in housing and the contribution from large *Sheep* populations, the majority of which are not housed.**
Netherlands	**National emission factor. A distinction is made between nitrogen in urine and in faeces. The distribution of nitrogen over faeces and urine depends on the nitrogen content in the meadow grass, and in turn this depends on the fertilisation level. For the period 1990-1999 a distribution of 30/70 was assumed, and for the period from 2000 onwards, a ratio of 35/65 is used (calculated on the basis of Valk et al., 2002).For the calculation of N_2O emissions, the nitrogen excreted is corrected for NH_3 volatilization.**
Portugal	**Emissions of N_2O due to the input of nitrogen to soils from pasture, range and paddock were estimated with a methodology similar to that used to estimate emissions of N_2O from Manure Management. The emission factor of N_2O for Pasture, Range and Paddock (EF3) was set at 0.02 kg N_2O-N/kg N which is the default IPCC96 emission factor.**
Sweden	**The fraction of manure deposited that volatilises as ammonia is model-based. A different fraction for manure deposited by grazing animals is used (FracGASG) then for manure applied to soils. FracGASG is time dependent. N_2O emissions from grazing animals are calculated after subtracting the nitrogen that volatilises as ammonia. Due to lack of data concerning reindeer, the nitrogen production by sheep is also applied to reindeer. Stable periods are obtained from Statistics Sweden per year and animal.**
United Kingdom	**The fraction of livestock N excreted and deposited onto soil during grazing is a country specific value of 0.52, much larger than the IPCC recommended value (0.23), based on country specific data.**

Direct emissions from the cultivation of histosols.

N_2O emissions from the cultivation of histosols reported as not occurring in Austria, France, and Spain, and as not estimated in Portugal. Also, no emissions from the cultivation of histosols are reported by Ireland, because tillage farming in Ireland is concentrated in the south-east of the country while the bulk of organic soils occur in the middle and western part of the country. Consequently, nitrogen inputs due to the cultivation of organic soils have been taken as negligible.

The cultivation of histosols represents the biggest share of emissions from agricultural soils in Finland (37%), Sweden (15%) and a substantial source for N_2O emissions in Germany (12% - almost as large as emission from application of manure) and the Netherlands (8%). The emission factor proposed in the IPCC GPG of 8 kg N_2O-N per hectare and year (IPCC, 2000) is used in most countries. Netherlands uses 4.7 kg N_2O-N ha^{-1}; national emission factors are further used in Denmark (8.0 kg N_2O-N ha^{-1}) and Finland (8.3 kg N_2O-N ha^{-1}).

On absolute terms, the estimated emissions of N_2O from the cultivation of histosols are largest for Germany (15.5 Gg N_2O), followed by Finland (4.2 Gg N_2O) and Sweden (1.8 Gg N_2O).

Table 6.71: Member State's background information for the calculation of N_2O emissions from the cultivation of histosols in category 4.D

Member State	Histosols
Belgium	**The area histosols is calculated on the basis of an intersection between the CORINE Land Cover Geodataset from 1990 and the Belgian 'Soilassociationmap'. The area is held constant for the entire time series. No histosol cultivation occurs in Wallonia, where the only recorded organic soils are part of a nature reserve.**
Denmark	**National IEF for histosols. N_2O emissions from histosols are based on the area with organic soils multiplied with a national emission factor for C, the C:N relationship for the organic matter in the histosols and an emission factor of 1.25 of the total amount of released N. Danish organic soils are defined as soils having >10% SOM in contradiction to the IPCC definition where organic soils has >20% SOM. For 1998 the distribution of the agricultural area between mineral soils and organic soils is subdivided into cropland and permanent grassland based on a GIS analysis. Set-a-side, grass in rotation and permanent grass is more common on organic soils than on mineral soils.**

Member State	Histosols
Finland	**The area of cultivated organic soils has been received from MTT Agrifood Research Finland and has been updated for the 2006 submission on the basis of (Myllys, 2004; Kähäri, 1987). The area of cultivated organic soils is poorly known in Finland. Current area estimate is based on the results of soil analysis. The emission factors for organic soils on grass and other crops are based on national data (Monni et al. 2007). The emission factors were calculated on the basis of published results on annual fluxes measured with flux chambers on five different peat fields.**
Germany	**Estimation of the are of cultivated histosols on the basis of an overlay of a land-use map and a soil map (Daemmgen et al., 2006). The area is considered proportional to the total cultivated area.**
Greece	**Data for the areas of organic soils derive from a relevant research conducted by the Soil Science Institute of Athens (SSIA, 2001).**
Ireland	**Not estimated. Tillage farming in Ireland is concentrated in the south-east of the country while the bulk of organic soils occur in the midlands and west. Consequently, nitrogen inputs due to the cultivation of organic soils can be taken as negligible.**
Italy	**Area of organic soils from the national soil map of the year 1961. These values have been verified with related data for Emilia Romagna region, where this type of soil is the most prevalent.**
Netherlands	**A fixed country-specific emission factor of 4.7 kg N_2O-N per hectare is used for this calculation. This value is based on an average mineralisation of around 235 kg N per hectare histosol (Kuikman et al., 2005). Using an emission factor of 0.02 (largely taken from Dutch research projects conducted in the first half of the 1990s and reported in Kroeze, 1994), the laughing gas emission of histosols amounts to 4.7 kg N_2O–N per hectare.**
Portugal	**Histosols represent at most a negligible emission quantity in Portugal, and they may be reported as not occurring for all practical purposes.**
Sweden	**The area of organic soils has only been estimated intermittently. The latest survey in 2009 concluded that approximately 5 % of the total area of arable land consists of organic soils (Berglund, Berglund & Sohlenius, 2009). That fraction has then been used for all years.**
United Kingdom	**The area of cultivated Histosols is assumed to be equal to that of eutric organic soils in the UK and is based on a FAO soil map figure supplied by SSLRC (now NSRI).**

Indirect emissions.

All Member States report indirect emissions of nitrous oxide induced by the atmospheric deposition of NH_3 and NO_x volatilised and nitrate leached to the groundwater using the default IPCC emission factors. Only Denmark uses a smaller emission factor for N_2O from nitrogen leached or run-off (1.94%).

Country-specific methodologies, however, are used by most Member States for the calculation of nitrogen volatilisation and nitrate leaching, with only 3 Member States using the IPCC default values for the volatilisation fractions of mineral and organic fertilizer ($Frac_{GASF}$ and $Frac_{GASM)}$, respectively, and 8 countries are using the default IPCC values for the leaching fraction ($Frac_{LEACH}$). The Netherlands reports the fractions as NE.

The latest edition of the EMEP/EEA Emission Inventory Guidebook (EMEP/EEA, 2009) gives in the section ‘4.D Crop production and agricultural soils’ the emission factors for NH_3 volatilization from mineral fertilizers if the Tier 2 ‘technology specific approach’ can be used (Table 3-2). The method considers soil pH and the mean spring temperature as factors influencing the magnitude of NH_3 volatilizations. For example, the application of ammonium nitrate on soils with a pH$\leq$7 and a mean spring temperature of 6ºC would lead to a NH_3 volatilization of 0.014 or 1.4%, which is considerably lower than the IPCC default factor. Volatilizations higher than the IPCC default factor of 10% are only achieved when using this methodology for the application of urea, nitrogen solutions at high temperatures, or ammonium sulphates or ammonium phosphates on soils with a high pH>7. Accordingly, the estimates volatilization fraction of NH_3 and NO_x from the application of mineral fertiliser is considered by all Member States to be lower as the IPCC default values (range of national factors 1.5% to 10%, with 4 countries using the default value of 10%).

In contract, most of the Member States with country-specific volatilisation rates for organic fertiliser are estimating larger losses of NH_3 + NO_x than proposed by the IPCC (range 21% to 33%) with 4 countries using the default $Frac_{GASM}$ of 20% and the lowest volatilization fraction used being 17.2%. The country-specific methodology for the estimation of NH_3 volatilization is in some cases based on the NH_3 inventory using the CORINAIR methodology thus differentiating between different kinds of synthetic fertilisers.

Also, model-based estimations for the fraction of nitrogen volatilised from applied animal wastes have been used. The fraction of nitrogen lost by leaching ranges from 12.4% to 33% with 8 countries using the default FracLEACH of 30% and 6 countries using a smaller value. They are in some cases based on a nitrogen-leaching model (e.g., Denmark, Sweden) and in some cases based on national studies (e.g., Finland, Ireland).

Table 6.72: Member State's background information on the fraction of NH_3 and NO_x volatilized from applied mineral fertilizer, $Frac_{GASF}$ for the calculation of N_2O emissions in category 4.D

Member State	$Frac_{GASF}$
Austria	**$Frac_{GASF}$ 2.3% for mineral fertilizers and 15.3% for urea fertilizers (CORINAIR).**
Belgium	**$Frac_{GASF}$ 2.3% in Wallonia (recommended by IIASA for different fertiliser types); in Flanders an average rate for NH_3 volatilisation is calculated by the model that estimates the NH_3 emissions from synthetic fertiliser as developed by ILVO. The rate for NO volatilisation in Flanders is 1.5%.**
Denmark	**The Danish value for the $Frac_{GASF}$ is an average of national estimates of NH_3 emissions from each fertilizer type (Sommer and Christensen, 1992; Sommer and Jensen, 1994; Sommer and Ersbøll, 1996) in accordance with the CLRTAP guidebook. This average is with 0.02 considerably lower than given in IPCC, i.e. 0.10. The major part of the Danish emission is related to the use of calcium ammonium nitrate and NPK fertiliser, where the emission factor is 0.02 kg NH_3-N/kg N. The low Danish $Frac_{GASF}$ is also probably due to a small consumption of urea (<1%), which has a high emission factor.**
Finland	**The country-specific $Frac_{GASF}$ value is based on the NH_3 emission factor given in the report by (ECETOC, 1994) for NPK fertilisers, which is 1% of the nitrogen content in the fertilisers. In Finland, about 90% of the fertilisers are NPK fertilizers. Urea is used only in small amounts. 80% of the nitrogen in synthetic fertilisers in Finland is applied using the placement method - placing the fertilizer approximately 7-8 cm below the soil surface (urea application is place on the surface). A conservative estimate of 50% surface application has been used. A project to measure ammonia emissions from fertilisation may lead to a revision of the $Frac_{GASF}$ values.**
Germany	**$Frac_{GASF}$ dynamically calculated using default emission factors for the application of mineral fertilizers (EMEP/CORINAIR, 2003). NH_3 emissions consider different fertilizer types, temperature during fertilizer application, and makes a distinction between arable and grassland. To this purpose, the total fertilizer application is distributed to grassland and arable land under the assumption that no preference for fertilizer types exists and under application of fertilizer application recommendations.**
Ireland	**The volatilization rates for Ireland are however determined from an elaborate new NH_3 inventory for agriculture and it is assumed that nitrogen lost as NO_X is negligible in comparison to NH_3.**
Netherlands	**Indirect N_2O emissions resulting from atmospheric deposition are estimated using country-specific data on ammonia emissions. The extent of the NO_x emission as a result of fertiliser and animal manure is estimated at 15% of the ammonia emission (De Vries et al., 2003). The supply source, deposits of NO_x as a result of using fertiliser and animal manure, is not (yet) included in the annual calculations under the framework of the Emission Registration, and is therefore not included when determining the nitrogen balance.**
Portugal	**Product specific volatilization rates from EMEP/CORINAIR (EEA,2003) were used for each nitrogen fertilizer type. The weighted average varies between 0.053 and 0.064 kg NH_3-N/kg N, and which are almost half the default value.**
Spain	**$Frac_{GASF}$ is calculated according to the EMEP/CORINAIR methodology.**
Sweden	**The proportions of emitted N-content of fertilisers sold in different years varie because of changes in the sold quantities of different types of fertilisers. Ammonia emission fractions after CORINAIR.**

Table 6.73: Member State's background information on the fraction of NH_3 and NO_x volatilized from applied manure, $Frac_{GASM}$ for the calculation of N_2O emissions in category 4.D

Member State	$Frac_{GASM}$
Austria	**The amount of manure left for spreading was calculated within source category 4B (Amon et al., 2002). With regard to a coprehensive treatment of the nitrogen budget, the emission inventory of N_2O is linked with the Austrian inventory of NH_3. This procedure enables the use of country specific data, which is more accurate than the use of the default value for $Frac_{GASM}$. Nitrogen left for spreading is calculated subtracting the following losses: N-excreted during grazing, NH_3-N losses from housing, NH_3-N losses during manure storage and N_2O-N losses from manure management. <u>NH_3 emissions from housing:</u> according to CORINAIR guidelines 1999 (Swiss or German default factors); <u>NH_3 emissions from manure management</u>: TAN content accroding to Schlechtner 1991 (cattle and pigs) + emissions factors default CORINAIR; other animals CORINAIR simple methodology; <u>NH_3 emissions during manure application</u>: CORINAIR default factors; <u>NO_X-emissions during manure application</u>: a conservative emission factor for NO_x-N of 1% was used (Fre**
Belgium	**In Wallonia and Flanders no animal manure is burned.In Flanders the animal manure nitrogen used as fertiliser is also corrected for the amount of manure transported outside Flanders or to a fertiliser processing company.**
Denmark	**The $Frac_{GASM}$ is estimated as the total N-excretion (N ab animal) minus the ammonia emission in stables, storage and application. They are based on national estimations and are calculated in the ammonia emission inventory. The $Frac_{GASM}$ has decreased since 1990 0.26 to 0.20. This is a result of an active strategy to improve the utilization of the nitrogen in manure. It is assumed that 1.9% of the N-input from sewage sludge or industrial sludge applied to soil volatilises as ammonia. An ammonia emission factor of 7% is used for all animal categories based on investigations from the Netherlands and the United Kingdom (Jarvis et al. 1989a, Jarvis et al., 1989b and Bussink 1994).**
Finland	**Value for $Frac_{GASM}$ has been obtained from the ammonia model of VTT Technical Research Centre of Finland (Savolainen, 1996). In the model, annual N excreted by each animal type has been distributed into different manure management systems typical for each animal group. Ammonia volatilisation during stable, storage and application were included with specific emission factor in each phase. $Frac_{GASM}$ is the proportion of total NH_3-N of the total N excreted. Emission factors for the amount of NH_3 volatilised in each phase has been taken from (ECETOC, 1994; Grönroos et al., 1998). References that support the values used are cited in the NIR. For grazing animals, an ammonia emission factor of 7% is used for all animal categories based on investigations from the Netherlands and the United Kingdom (Jarvis et al., 1989a; Jarvis et al., 1989b; Bussink 1994).**
Germany	**$Frac_{GASM}$ dynamically calculated using default emission factors for the application of organic fertilizers (EMEP/CORINAIR, 2003). Germany considers broadcasting,and for slurry additionally trailing hose and trailing shoe for slurry. Distinction is made between arable land and grassland. Incorporation timing is considered (< 1 h, < 4 h, < 6 h, < 12 h, < 24 h, and without incorporation). $Frac_{GASM}$ is calculated considering also the input of nitrogen with straw and imported manure. However, $Frac_{GASM}$ does not consider volatilizations or N-input from bedding material, leguminous crops, which are calculated separately for estimating total indirect N_2O emissions from volatilization.**
Ireland	**The volatilization rates for Ireland are however determined from an elaborate new NH_3 inventory for agriculture and it is assumed that nitrogen lost as NO_X is negligible in comparison to NH_3. In addition, $Frac_{GASM}$ is split into $Frac_{GASM}1$ and $Frac_{GASM}^2$ with $Frac_{GASM}1$ referring to NH_3-N losses from animal manures in housing, storage and landspreading and $Frac_{GASM}^2$ being the proportion of nitrogen excreted at pasture that is volatilised as NH_3.**
Italy	**$Frac_{GASM}$ country-specific**
Netherlands	**Indirect N_2O emissions resulting from atmospheric deposition are estimated using country-specific data on ammonia emissions (estimated at a tier 3 level; LEI-MAM).**
Portugal	**The use of emission factors of ammonia volatilisation from EMEP/UNECE results, therefore, in obtaining a value for $Frac_{GASM}$ that is different and slightly higher than the default value for $Frac_{GASM}$. The resultant implied $Frac_{GASM}$ oscilates between 0.22 to 0.23 kg N-NH_3 + N-NO_x/ kg of N excreted.**
Spain	**National $Frac_{GASM}$**
Sweden	**The estimates of the fraction of nitrogen supply in emitted as ammonium-N are model-based and take into account many factors that influence gas emissions. The methodology, based on data collected on the use of manure from telephone interviews with farmers, was developed in the early 1990s. Later, the methodology was extended to take into account more detailed information on the use of manure and manure storage. $Frac_{GASM}$ varies from year to year.**

Table 6.74: Member State's background information on the fraction of nitrogen input leached or run-off, $Frac_{LEACH}$ for the calculation of N_2O emissions in category 4.D

Member State	FracLEACH and EF5
Austria	**Default value applied to nitrogen inputs from synthetic fertilizer use, livestock excretion, and sewage sludge application.**
Belgium	**FracLEACH is estimated from local studies (Pauwelyn, 1997) and falls into the IPCC range (0.17 kg N / kg N available). In Flanders, the nitrogen leaching (N_2O model) comes from the SENTWA model (System for the Evaluation of Nutrient Transport to Water) that is yearly updated.**

Member State	FracLEACH and EF5
Denmark	**The calculation of N to the groundwater is based on two different models– SKEP/Daisy and N-LES (Børgesen & Grant, 2003) carried out by DJF and NERI. SKEP/DAISY is a dynamical crop growth model taking into account the growth factors, whereas N-LES is an empirical leaching model based on more than 1500 leaching studies performed in Denmark during the last 15 years. The models produce rather similar results for nitrogen leaching on a national basis (Waagepetersen et al., 2008). Data concerning the N-leaching to rivers and estuaries is based on data from NOVANA (National Monitoring program of the Water Environment and Nature) received from NERI the department of Freshwater Ecology. NOVANA is a monitoring program which includes monitoring of the ecologic, physic and chemical condition of water areas and transport of water and a range of substances, including N, to lakes and the sea (Wiberg-Larsen et al., 2010). These studies include measurements from 223 monitoring stations in all parts of Denmark and have been go**
Finland	**It is estimated that nitrogen leaching is less than IPCC default value in Finnish conditions (Rekolainen, 1993) value is 15% and this has been used in the inventory).**
Germany	
Ireland	**The expressions for N_2O indirect-dep and N_2O indirect-leach are slightly modified to be consistent with those for estimating direct emissions above and to account for the two separate volatilisation fractions $Frac_{GASM}$1 and $Frac_{GASM}^2$. Estimates of the nitrogen loads in Irish rivers reported under the OSPAR Convention (NEUT, 1999) suggest that approximately 10 percent of all applied nitrogen in Irish agriculture is lost through leaching. This level of leaching is also indicated by farm budget studies where the nitrogen runoff equivalent to 60 kg N/ha has been measured in streams adjoining farmland receiving 200 kg N/ha from chemical fertilizer and 100 kg N/ha from animal manures per year. The value of 0.1 is considered to be a more realistic estimate of FracLEACH than the default value of 0.3.**
Netherlands	**Default $Frac_{GASM}$. Any manure that is exported to other countries is not included in the calculation. The nitrogen in exported manure is determined annually by CBS. The sewage sludge supply source is not included in the calculation of indirect N_2O emissions from agricultural soil. Indirect N_2O emissions resulting from leaching and run-off N emissions are estimated using country-specific data on total N-input into soil (estimated at a Tier 2 level). IPCC default values are used for the fraction of N-input to soil that leaches from the soil and ends up partly as N_2O emissions from groundwater and surface water (Fracleach) and for the N_2O emission factors.**
Portugal	**Default FracLEACH for nitrogen applied to soil. For 20% of manure managed in anaerobic lagoons, which are directly discharged to the wastewater system, with agreement of the ERT, the N_2O emissions are calculated directly from the total amount of manure discharged, without considering volatilization losses are a leaching fraction.**
Sweden	**The national estimates of nitrogen leaching are calculated from the SOILNDB model , which is a part of the SOIL/SOILN model (Johnsson, 1990; Swedish EPA, 2002). The simulation model SOIL/SOILN was developed during the 1980s in order to describe nitrogen processes in agricultural soils. Since then the model has been developed and tested on data from controlled leaching experiments, and these tests show that the model estimates leachign from soils with good precision (Swedish EPA, 2002b). By using national data on crops, yields, soil, use of fertilizer/manure and spreading time, the leaching is estimated for 22 regions. These regions are based on similarities in agricultural production. For calculating nitrogen leaching in the inventory, the average N leaching per hectare, calculated by the SOILNDB model, is multiplied by the total Swedish area of agricultural soil. To estimate the implied FracLEACH,the leached nitrogen, according to the national model, is divided by the sum of nitrogen in fertilisers and anim**
United Kingdom	**Indirect emissions of N_2O from leaching and runoff are estimated according the IPCC methodology but with corrections for N_2O emissions to avoid double counting N. The sources of nitrogen considered, are synthetic fertiliser application and animal manures applied as fertiliser.**

N_2O emissions from other sources.

Seven countries report emissions of N_2O from the application of sewage sludge, according to the IPCC GPG. The emission factors used are in six cases the IPCC default factor for direct N_2O emissions, one Member States used a different value. An overview of the emissions from sewage sludge and the specified other 'other' sources in category 4D is given in Table 6.75. Furthermore, other N_2O emissions are reported bu the Netherlands, Portugal and the United Kingdom.

Table 6.75: Member State's emissions from "other" sources in category 4D

Member States 2010	Description	Value kg N/yr (1990)	IEF kg N_2O-N / kg N (1990)	EM N_2O (Gg) (1990)	Value kg N/yr (2008)	IEF kg N_2O-N / kg N (2008)	EM N_2O (Gg) (2008)
Austria	Sew age Sludge Spreading	1,034,480	0.0125	0.020	1,453,034	0.0125	0.029
Belgium	Sludge Spreading	75,274	0.0125	0.001	74,088	0.0125	0.001
Denmark	Industrial w aste used as fertilizer	1,528,720	0.0125	0.030	4,000,000	0.0125	0.079
Denmark	Use of sew age sludge as fertilizers	3,056,918	0.0125	0.060	2,796,563	0.0125	0.055
Finland	Municipal sew age sludge applied to soils	1,642,680	0.0125	0.032	198,798	0.0125	0.004
France	4.D.1.6.1 Sew age Sludge Spreading	15,411,141	0.0125	0.303	18,939,825	0.0125	0.372
France	4.D.1.6.2 Compost Spreading	21,242	0.0125	0.000	194,284	0.0125	0.004
Germany	Sew age sludge on agricultural fields	27,415,232	0.0125	0.539	27,911,963	0.0125	0.548
Italy	Sew age sludge applied to soils	4,875,207	0.0100	0.077	12,689,052	0.0100	0.199
Luxembourg	Sew age Sludge Spreading	377,061	0.0125	0.007	203,647	0.0125	0.004
Netherlands	Sludge application on land	5,000,000	0.0100	0.079	900,000	0.0100	0.014
Spain	Domestic Wastew ater Sludge	8,321,005	0.0125	0.163	39,823,640	0.0125	0.780
Spain	Municipal Solid Wastes Compost	8,506,498	0.0125	0.167	6,035,432	0.0125	0.118
Sw eden	Use of sew age sludge as fertilizers	1,180,000	0.0087	0.016	2,205,198	0.0087	0.030
Sw eden	Cultivation of mineral soils	2,949,000	0.5000	2.317	2,819,000	0.5000	2.215
United Kingdom	Improved Grassland	28,258,312	0.0125	0.555	28,629,348	0.0125	0.562
United Kingdom	Municipal sew age sludge applied to fields	17,964,000	0.0100	0.282	50,815,476	0.0100	0.799
EU15	**Total sewage sludge**	**87,881,717**	**0.0117**	**1.609**	**162,011,283**	**0.0114**	**2.914**
EU15	**Total compost**	**8,527,740**	**0.0125**	**0.167**	**6,229,716**	**0.0125**	**0.122**

Additional information on N_2O emissions estimated from the application of sewage sludge it given in Table 6.64

Table 6.76: Member State's background information on N_2O emissions estimated under the category 'other' in category 4.D

Member State	
Austria	**Country-specific data on N-content (Scharf et al., 1997).**
Denmark	**The category, "Other", includes emission from sewage sludge and sludge from the industrial production applied to agricultural soils as fer-tiliser. Information about industrial waste, sewage sludge applied on ag-ricultural soil and the content of nitrogen is provided by the Danish Environmental Protection Agency.**
Ireland	**Published estimates of sludge production (Smith et al, 2007) and the proportion applied on agricultural lands are used to estimate FS on the basis of 3 percent nitrogen content in sewage sludge with typical dry solids content of 25 percent (Fehily Timoney, 1985). The estimate of FS is included in N_2Odirect without deduction for volatilisation and the value is added to FAM for reporting purposes.**
Spain	**Data on the application of sewage sludge are available for the years 1989, 1993 and 1997. For the other years these data are linearly interpolated.**
Sweden	**N_2O from sewage sludge used as fertiliser is a part of the N_2O emissions from agricultural soils and may be reported, according to the IPCC Good Practice Guidance, if sufficient information is available. Statistics on the use of sewage sludge have been published irregularly and in different reports, but a time series has been created through interpolation and the emissions are reported for the first time in submission 2006 of the GHG inventory.**

Trends

Consistent with the decrease of animal numbers in Europe and the decrease of nitrogen in manure (see above), also the input of nitrogen to agricultural soils decreased considerably in the time between 1990 and 2010, as shown in Table 21.34. The input of manure decreased by 11%, and the input of mineral fertilizer decreased even more, by 28%. Accordingly, also the amount of nitrogen volatilized or leached decreased by 23% and 20%, respectively.

Fehler! Verweisquelle konnte nicht gefunden werden. through Figure 6.46 show the trend of direct N_2O emissions from the source categories mineral and organic fertilizer application and indirect emissions from atmospheric deposition and nitrogen leaching and run-off.

In several countries the fraction of mineral fertilizer that volatilises as NH_3 or NO_x is showing considerable fluctuation (see for example Sweden and Ireland). This is a direct consequence of the varying composition of the types of mineral fertilizer used and the NH_3 emission factors taken from the more detailed ammonia-inventory.

The fraction of livestock N excretion that volitilises as NH_3 or NO_x is reported to be more stable. A descreasing trend can be observed for Denmark and Belgium.

General observation include:

- Denmark: Reduction of total N_2O emissions since 1990 is due to a proactive national environmental policy over the last twenty years. The national emission from crop residues has decreased as result of a decrease in the cultivated area of beets for feeding, which has been replaced by cultivation of green maize. Another reason is a fall in the agricultural area and a greater part of the straw is harvest (52% in 1990 and 60% in 2007).

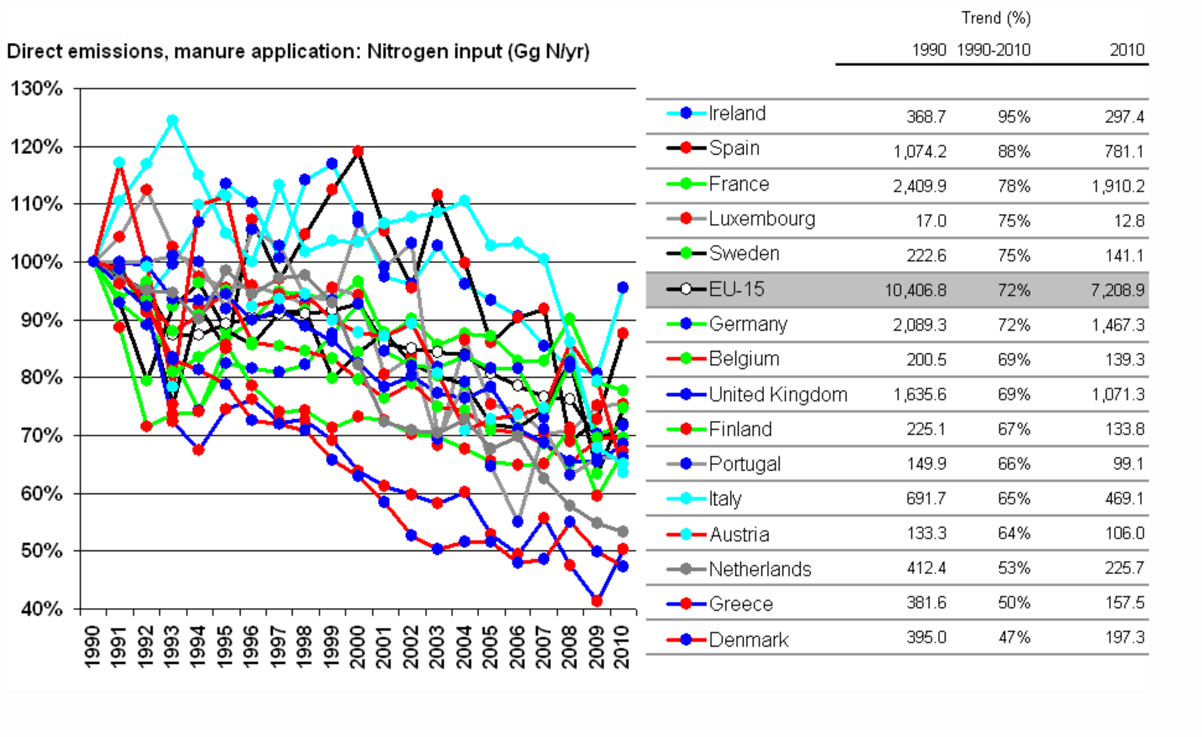
Table 6.77 gives additional information on the trend in category 4D as reported in the national inventory reports.

Table 6.77: Member State's background information on the trend for N_2O emissions in category 4D.

Member State	Trend in category 4D
Austria	**High inter-annual variations in N_2O emissions are caused by fluctuations in mineral fertilizer sales. These variations are caused by the effect of storage. As fertilizers have a high elasticity to prices, sales data are changing due to changing market prices very rapidly. Not the whole amount purchased is applied in the year of purchase. The fertilizer tax intensified this effect at the beginning of the 1990s. In the in-country review 2007 it was recommended to consider revising the time series by determining actual fertilizer use in accordance with the IPCC good practice guidance. Investigations showed that data on the actual fertilizer use are not available in Austria. Therefore it has been decided to continue to use the official fertilizer sales data as input data for the emission inventory.**
Belgium	**The fraction volatilised as NH_3 and NO in Flanders ($Frac_{GASM}$) decreased from a value of 0.36 kg(NH_3-N+NO-N)/kg Nex in 1990 to 0.20 kg(NH_3-N+NO-N)/kg Nex in 2006 due to the implementation of different successive Manure Action Plans in Flanders.**
Denmark	**FracLEACH is decreasing since the 1990s, when manure was often applied in autumn. The decrease in FracLEACH over time is caused by sharpened environmental requirements, banning manure application after harvest. The major part of manure application is made in spring and summer, where there is a precipitation deficit. This is due to a decrease in the emission from leaching and run off, which is decreased because of a decrease in N-input mainly from synthetic fertilizer. The annual fluctuating is due to climatic changes and especially the precipitation conditions.**
Finland	**Some parameters, such as the annual crop yields affecting the amount of crop residues produced, cause the fluctuation in the time series but this fluctuation does not have much effect on the overall N_2O emissions trend.**
Greece	**The reduction of synthetic nitrogen fertilizers use is attributed mainly to increase on the price of fertilizer as well as to increase in organic farming and to the impact of initiatives to promote good practice in fertilizer use.**
Netherlands	**The decrease of N_2O emissions from meadoes is caused by a relatively high decrease in N-input to soil (from manure and chemical fertilizer application and animal production in the meadow) partly counteracted by the increased IEF in this period that resulted from a shift from the surface spreading of manure to the incorporation of manure into soil as a result of ammonia policy driving a shift from surface spreading of manure to the incorporation of manure into the soil. The decrease in indirect N_2O emissions is fully explained by the decrease in N lost by atmospheric deposition and by leaching and run-off.**
Portugal	**Time series shows an abrupt decrease until 1992 and thereafter a lighter reduction: total synthetic nitrogen fertilizer use in 2003 is 22% less than in 1990. Nitrogen in fertilizers is the first source of nitrogen to soils in Portugal just above nitrogen in animal manure applied to soil. Interannual changes of emissions (2002/2003 16%, 2003/2004 6%, 2004/2005 8%, 2005/2006 11%, fluctuation from 2003) can be explained from variations of emissions from N applied as synthetic fertilizers. During this period a severe**

Member State	Trend in category 4D
	drought occured which caused reduction in the sales and use of fertilizers.
Sweden	Estimated standard yields for different crops are published annually by SJV/Statistics Sweden and are a function of crop yields estimated by surveys conducted over the last 15 years. By using standard yields instead of actual yields in the calculations, the time series becomes more regular. Variations in $Frac_{GASF}$ are a direct consequence of the varying composition of types of mineral fertilizers (Swedish Board of Agriculture, Statistics Sweden) and the NH_3 emission factors from CORINAIR (1998) (see inventory report Sweden). The fraction of nitrogen supply emitted as ammonium-N is model-based and take into account many factors that influence gas emissions. The methodology, based on data collected on the use of manure from telephone interviews with farmers, was developed in the early 1990s. Later, the methodology was extended to take into account more detailed information on the use of manure and manure storage.

Figure 6.36: Trend of N_2O emissions for mineral fertilizer – N-input

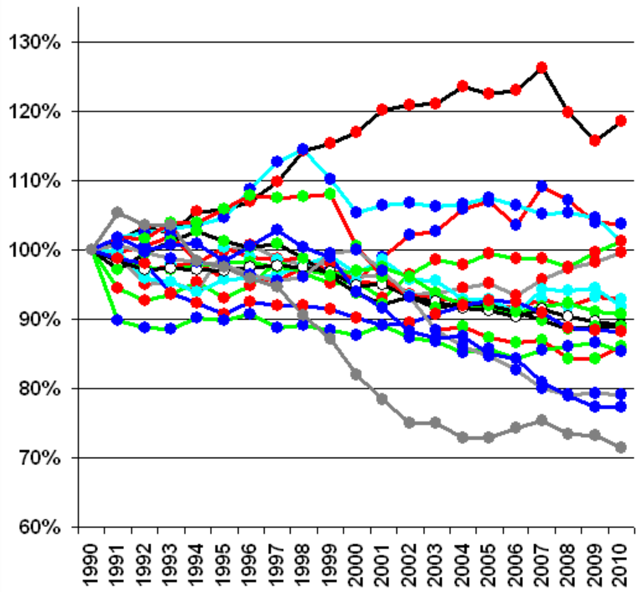


- Austria: High inter-annual variations in N_2O emissions are caused by fluctuations in mineral fertilizer sales. These variations are caused by the effect of storage. As fertilizers have a high elasticity to prices, sales data are changing due to changing market prices very rapidly. Not the whole amount purchased is applied in the year of purchase. The fertilizer tax intensified this effect at the beginning of the 1990s. In the in-country review 2007 it was recommended to consider revising the time series by determining actual fertilizer use in accordance with the IPCC good practice guidance. Investigations showed that data on the actual fertilizer use are not available in Austria. Therefore it has been decided to continue to use the official fertilizer sales data as input data for the emission inventory.
- Greece: The reduction of synthetic nitrogen fertilizers use is attributed mainly to increase on the price of fertilizer as well as to increase in organic farming and to the impact of initiatives to promote good practice in fertilizer use.
- Portugal: Time series shows an abrupt decrease until 1992 and thereafter a lighter reduction: total synthetic nitrogen fertilizer use in 2003 is 22% less than in 1990. Nitrogen in fertilizers is the first source of nitrogen to soils in Portugal just above nitrogen in animal manure applied to soil. Interannual changes of emissions (2002/2003 16%, 2003/2004 6%, 2004/2005 8%, 2005/2006

11%, fluctuation from 2003) can be explained from variations of emissions from N applied as synthetic fertilizers. During this period a severe drought occured which caused reduction in the sales and use of fertilizers.

Figure 6.37: Trend of N_2O emissions for organic fertilizer – N-input

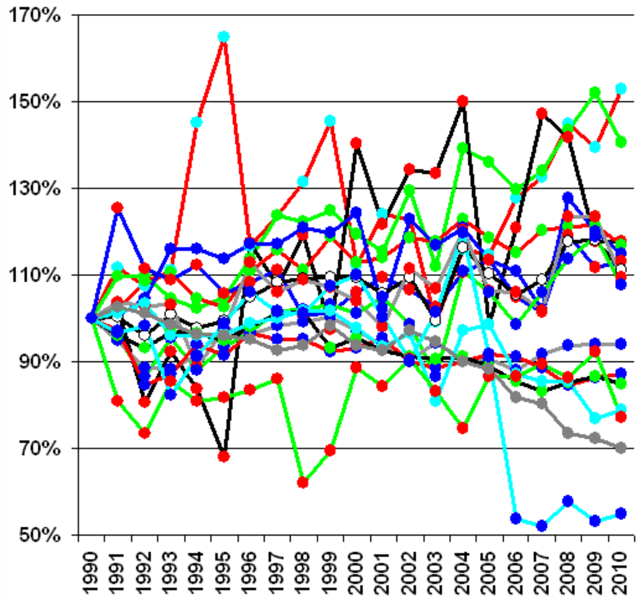
Direct emissions, manure application: Nitrogen input (Gg N/yr)



	1990	Trend (%) 1990-2010	2010
Spain	333.0	119%	385.1
Denmark	182.6	104%	189.8
Ireland	107.8	101%	112.8
Finland	60.1	101%	59.9
Luxembourg	5.9	100%	5.8
Austria	120.4	93%	112.2
Italy	473.9	92%	448.1
France	765.1	91%	696.8
EU-15	4,218.9	89%	3,780.1
Sweden	70.0	89%	62.3
Greece	42.9	88%	37.9
Belgium	159.8	86%	134.6
Germany	899.7	85%	780.0
Portugal	55.0	79%	43.6
United Kingdom	532.2	77%	411.1
Netherlands	410.5	71%	300.3

Figure 6.38: Trend of N_2O emissions from crop residues – N-input

Crop residues: Nitrogen input (Gg N/yr)

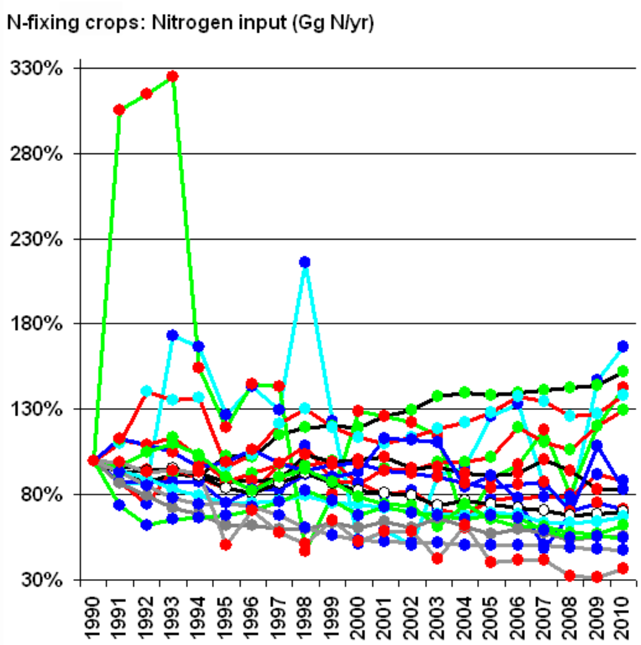


	1990	Trend (%) 1990-2010	2010
Austria	41.9	153%	58.3
France	346.0	141%	526.1
Spain	93.4	118%	109.9
Belgium	90.0	117%	109.2
United Kingdom	357.2	115%	428.2
Greece	23.6	113%	26.3
EU-15	2,171.4	111%	2,563.9
Luxembourg	3.1	109%	3.9
Germany	841.4	108%	999.9
Portugal	26.6	94%	25.0
Denmark	59.3	87%	51.2
Sweden	54.5	85%	47.2
Italy	147.5	79%	113.6
Finland	30.7	77%	28.4
Netherlands	36.4	70%	26.4
Ireland	19.7	55%	10.5

- Finland: Some parameters, such as the annual crop yields affecting the amount of crop residues produced, cause the fluctuation in the time series but this fluctuation does not have much effect on the overall N_2O emissions trend.

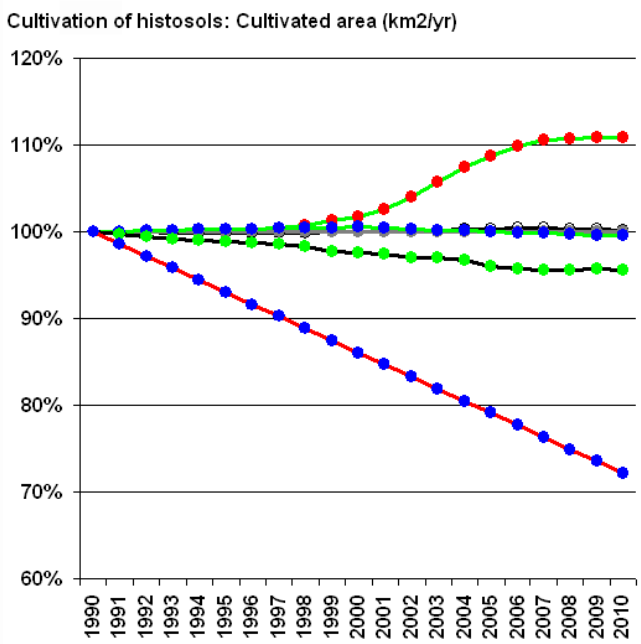
- Sweden: Estimated standard yields for different crops are published annually by SJV/Statistics Sweden and are a function of crop yields estimated by surveys conducted over the last 15 years. By using standard yields instead of actual yields in the calculations, the time series becomes more regular.

Figure 6.39: Trend of N_2O emissions from N-fixing crops – N-input



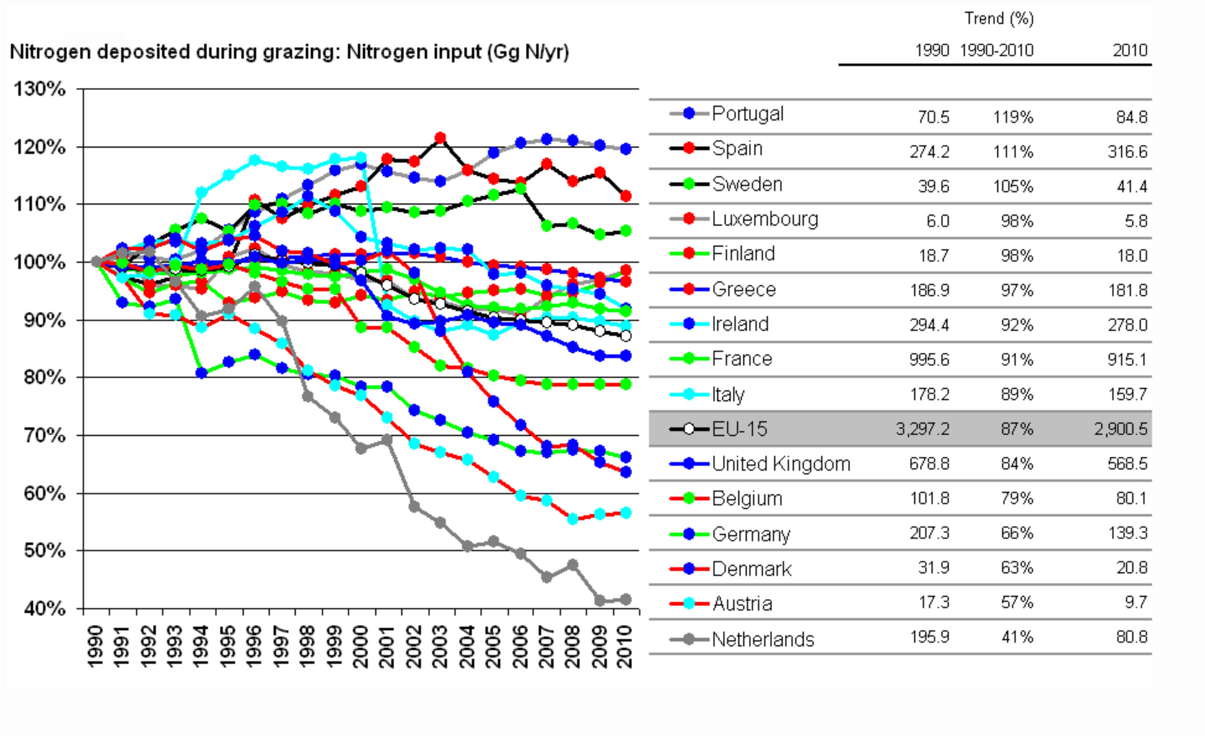
	1990	Trend (%) 1990-2010	2010
Ireland	0.5	167%	0.8
Sweden	23.6	152%	34.0
Finland	0.7	142%	0.8
Austria	16.8	138%	21.4
Belgium	5.6	129%	6.8
Denmark	44.3	88%	40.7
Spain	203.1	83%	169.0
United Kingdom	43.2	83%	46.7
Greece	1.1	71%	0.9
EU-15	1,263.0	70%	861.5
Italy	254.7	67%	163.8
France	515.8	62%	291.6
Netherlands	7.8	56%	4.3
Germany	140.4	55%	78.3
Portugal	5.0	48%	2.4
Luxembourg	0.3	37%	0.1

Figure 6.40: Trend of N_2O emissions from cultivated histosols – Cultivated area



	1990	Trend (%) 1990-2010	2010
Finland	2,906	111%	3,222
EU-15	20,161	100%	20,213
Belgium	25	100%	25
United Kingdom	392	100%	392
Greece	67	100%	67
Italy	90	100%	90
Netherlands	2,230	100%	2,230
Germany	12,354	100%	12,310
Sweden	1,517	96%	1,451
Denmark	580	72%	426
Austria			
France			
Spain			
Luxembourg			
Portugal			
Ireland			

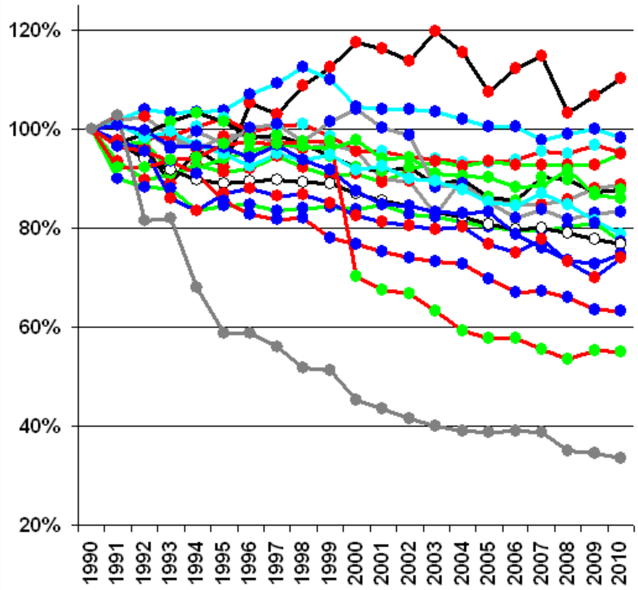
Figure 6.41: Trend of N_2O emissions from pasture, range, and paddock – N-input



- Netherlands: The decrease of N_2O emissions from meadoes is caused by a relatively high decrease in N-input to soil (from manure and chemical fertilizer application and animal production in the meadow) partly counteracted by the increased IEF in this period that resulted from a shift from the surface spreading of manure to the incorporation of manure into soil as a result of ammonia policy driving a shift from surface spreading of manure to the incorporation of manure into the soil. The decrease in indirect N_2O emissions is fully explained by the decrease in N lost by atmospheric deposition and by leaching and run-off.

Figure 6.42: Trend of N_2O emissions for atmospheric deposition – N-input

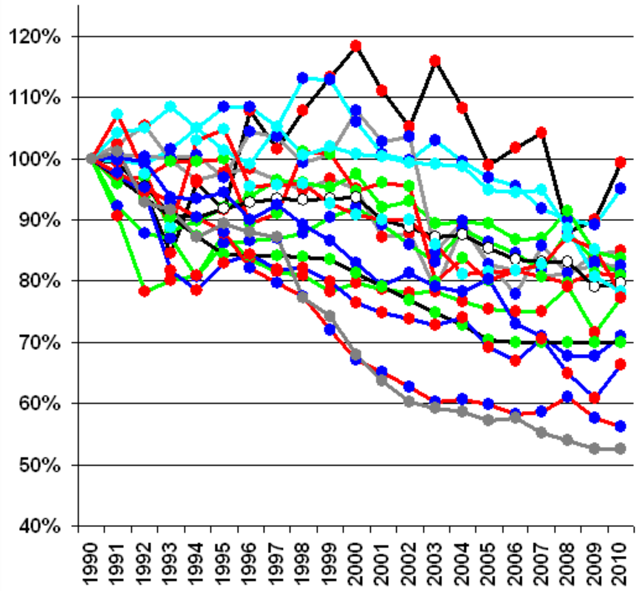
Nitrogen volatilised as NH3+NOx: Nitrogen input (Gg N/yr)



	1990	Trend (%) 1990-2010	2010
Spain	169.0	110%	180.5
Ireland	87.7	98%	87.8
Austria	51.8	95%	50.2
Finland	31.0	95%	28.7
Luxembourg	4.6	89%	4.1
Sweden	41.3	88%	36.0
France	660.3	86%	572.9
Portugal	43.2	83%	35.8
Italy	380.9	79%	310.0
Germany	587.7	77%	476.6
EU-15	2,912.1	77%	2,261.7
United Kingdom	273.6	75%	198.8
Greece	90.5	74%	63.3
Denmark	93.4	63%	59.4
Belgium	100.5	55%	55.4
Netherlands	296.7	34%	102.3

Figure 6.43: Trend of N_2O emissions for nitrogen leaching and run-off – N-input

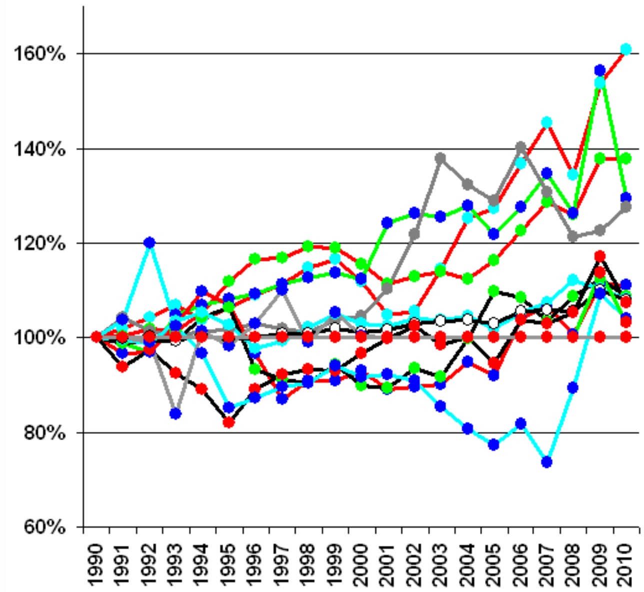
Nitrogen leached/run-off: Nitrogen input (Gg N/yr)



	1990	Trend (%) 1990-2010	2010
Spain	509.4	99%	458.7
Ireland	78.2	95%	69.8
Luxembourg	9.8	85%	8.3
France	1,394.6	84%	1,180.8
Portugal	92.2	83%	76.3
Germany	1,116.7	81%	928.3
Belgium	62.3	81%	50.6
EU-15	5,116.3	80%	4,048.8
Italy	516.0	78%	416.5
Austria	90.3	78%	76.8
Finland	50.6	77%	36.2
United Kingdom	496.1	71%	335.6
Sweden	76.3	70%	53.4
Greece	199.4	66%	121.2
Denmark	267.2	56%	153.9
Netherlands	157.1	53%	82.4

Figure 6.44: Trend of $Frac_{GASF}$

Indirect emissions: FracGASF (%)

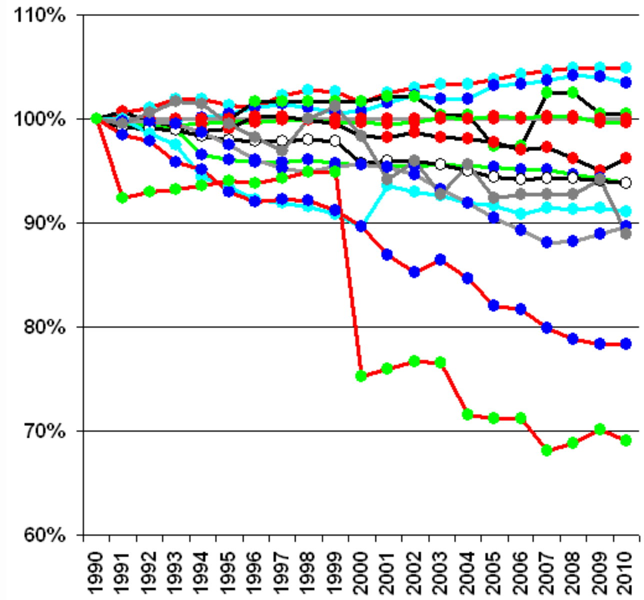


	1990	Trend (%) 1990-2010	2010
Austria	0.03	161%	0.04
Belgium	0.03	138%	0.04
Germany	0.03	129%	0.05
Netherlands	0.04	127%	0.05
Denmark	0.01	111%	0.02
Sweden	0.01	109%	0.01
Italy	0.09	108%	0.10
EU-15	0.05	108%	0.06
Spain	0.06	107%	0.07
Ireland	0.03	104%	0.03
Finland	0.01	103%	0.02
Greece	0.10	100%	0.10
Portugal	0.06	100%	0.06
France	0.10	100%	0.10
United Kingdom	0.10	100%	0.10
Luxembourg	0.10	100%	0.10

- Sweden: Variations in $Frac_{GASF}$ are a direct consequence of the varying composition of types of mineral fertilizers (Swedish Board of Agriculture, Statistics Sweden) and the NH_3 emission factors from CORINAIR (1998) (see inventory report Sweden).
-

Figure 6.45: Trend of $Frac_{GASM}$

Indirect emissions: FracGASM (%)



	1990	Trend (%) 1990-2010	2010
Austria	0.26	105%	0.27
Ireland	0.17	103%	0.17
Sweden	0.33	100%	0.33
Greece	0.20	100%	0.20
France	0.20	100%	0.20
United Kingdom	0.20	100%	0.20
Luxembourg	0.20	100%	0.20
Finland	0.25	100%	0.25
Spain	0.20	96%	0.19
Germany	0.32	94%	0.30
EU-15	0.23	94%	0.22
Italy	0.32	91%	0.29
Portugal	0.22	90%	0.19
Netherlands	0.11	89%	0.10
Denmark	0.25	78%	0.19
Belgium	0.30	69%	0.21

- Belgium: The fraction volatilised as NH_3 and NO in Flanders ($Frac_{GASM}$) decreased from a value of 0.36 kg(NH_3-N+NO-N)/kg Nex in 1990 to 0.20 kg(NH_3-N+NO-N)/kg Nex in 2006 due to the implementation of different successive Manure Action Plans in Flanders.

- Sweden: The fraction of nitrogen supply emitted as ammonium-N is model-based and take into account many factors that influence gas emissions. The methodology, based on data collected on the use of manure from telephone interviews with farmers, was developed in the early 1990s. Later, the methodology was extended to take into account more detailed information on the use of manure and manure storage.
- Sweden: The estimate of ammonia emissions (i.e. the basic data for $Frac_{GASM}$) for the years 1990-1994 are not comparable with these from 1995 and onwards. This is solved in the GHG inventory by using the values for 1995 for $Frac_{GASM}$ and FracGASG for earlier years in the inventory.
- Sweden: The interannual increase of indirect N_2O emissions in 2008/2009 is 7%. Amount of N from 4.D.3 is estimated as area of agriculture land times a leaching factor. The estimate of this area has increased since last year. This is likely only an effect of the method used. The value for the latest year is most uncertain but was corrected over the coming years when new data are collected.
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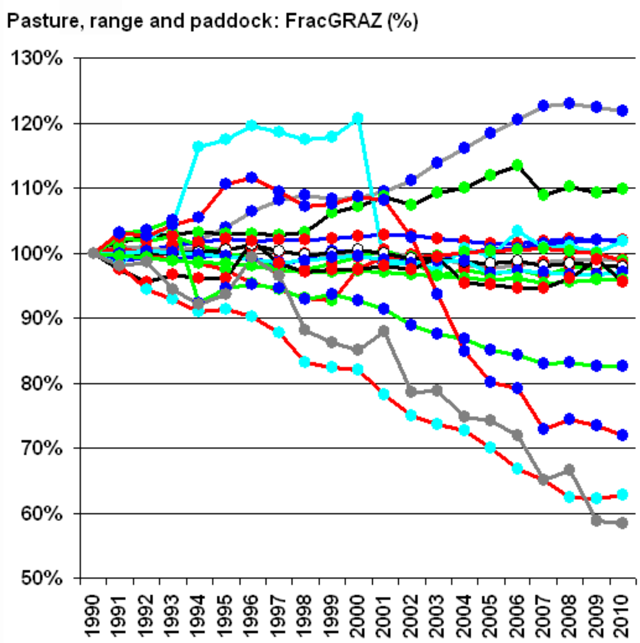
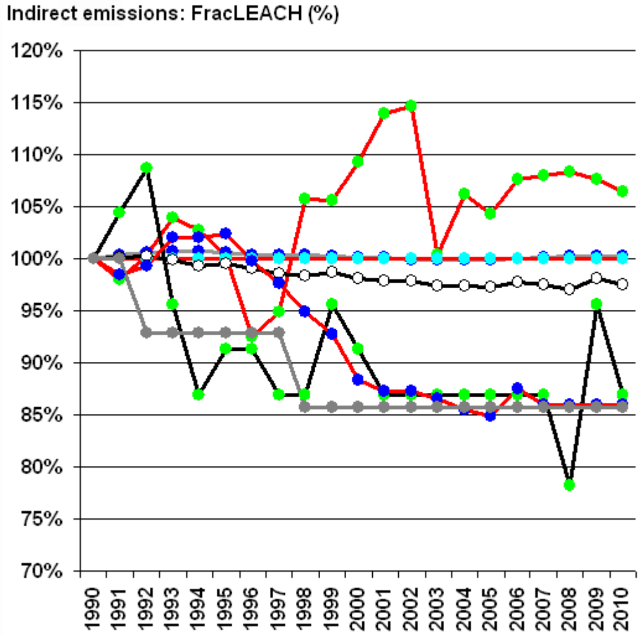
Figure 6.46: **Trend of $Frac_{GRAZ}$**



	1990	Trend (%) 1990-2010	2010
Portugal	0.45	122%	0.55
Sweden	0.30	110%	0.33
Greece	0.78	102%	0.79
United Kingdom	0.56	102%	0.57
Italy	0.19	102%	0.19
Luxembourg	0.45	99%	0.45
Belgium	0.31	99%	0.31
Finland	0.18	98%	0.18
EU-15	0.35	98%	0.35
Ireland	0.63	97%	0.61
France	0.43	96%	0.41
Spain	0.40	95%	0.40
Germany	0.13	83%	0.11
Denmark	0.12	72%	0.09
Austria	0.09	63%	0.06
Netherlands	0.28	58%	0.16

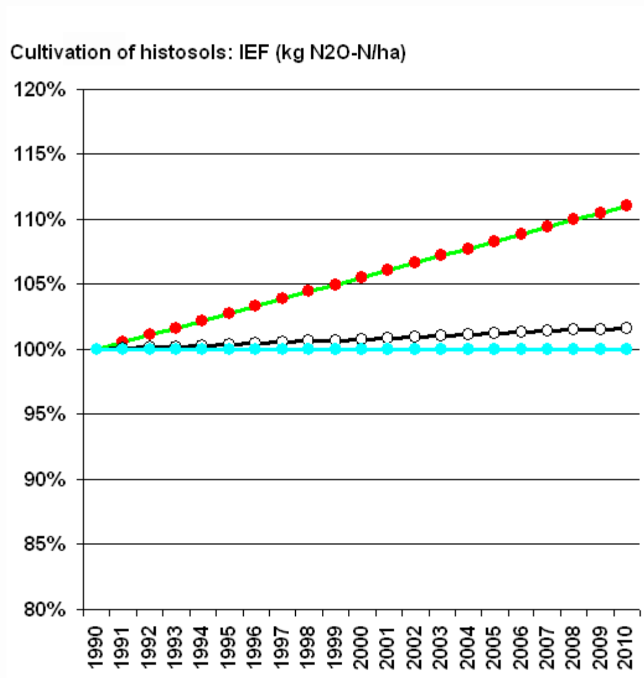
Figure 6.47: **Trend of FracLEACH**



	1990	Trend (%) 1990-2010	2010
Belgium	0.12	106%	0.13
Portugal	0.32	100%	0.32
Greece	0.30	100%	0.30
United Kingdom	0.30	100%	0.30
Italy	0.30	100%	0.30
Luxembourg	0.30	100%	0.30
Finland	0.15	100%	0.15
Ireland	0.10	100%	0.10
France	0.30	100%	0.30
Spain	0.30	100%	0.30
Germany	0.30	100%	0.30
Austria	0.30	100%	0.30
EU-15	0.26	98%	0.25
Sweden	0.23	87%	0.22
Denmark	0.38	86%	0.33
Netherlands	0.14	86%	0.12

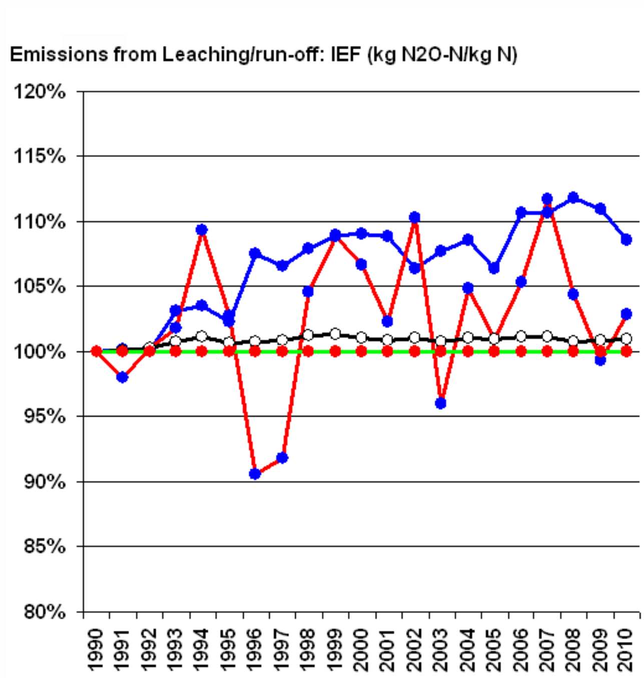
- Denmark: FracLEACH is decreasing since the 1990s, when manure was often applied in autumn. The decrease in FracLEACH over time is caused by sharpened environmental requirements, banning manure application after harvest. The major part of manure application is made in spring and summer, where there is a precipitation deficit. This is due to a decrease in the emission from leaching and run off, which is decreased because of a decrease in N-input mainly from synthetic fertilizer. The annual fluctuating is due to climatic changes and especially the precipitation conditions.

Figure 6.48: Trend of direct emissions from the cultivation of histosols - IEF



	1990	Trend (%) 1990-2010	2010
Finland	7.48869	111%	8.27646
EU-15	7.56129	102%	7.68000
Denmark	8.00000	100%	8.00000
Sweden	8.00000	100%	8.00000
Belgium	8.00000	100%	8.00000
Netherlands	4.70000	100%	4.70000
Germany	8.00000	100%	8.00000
United Kingdom	8.00000	100%	8.00000
Greece	8.00000	100%	8.00000
Italy	8.00000	100%	8.00000
Austria			
Luxembourg			
France			
Ireland			
Portugal			
Spain			

Figure 6.49: Trend of indirect emissions from leaching/run-off - IEF



	1990	Trend (%) 1990-2010	2010
United Kingdom	0.04228	109%	0.04690
Denmark	0.01884	103%	0.01871
EU-15	0.02635	101%	0.02658
Belgium	0.02500	100%	0.02500
France	0.02500	100%	0.02500
Sweden	0.02500	100%	0.02500
Spain	0.02500	100%	0.02500
Netherlands	0.02500	100%	0.02500
Italy	0.02500	100%	0.02500
Germany	0.02500	100%	0.02500
Ireland	0.02500	100%	0.02500
Greece	0.02500	100%	0.02500
Luxembourg	0.02500	100%	0.02500
Austria	0.02500	100%	0.02500
Portugal	0.02500	100%	0.02500
Finland	0.02500	100%	0.02500

Uncertainty and time series consistency

As described above, N_2O emissions from agricultural soils belong to the most uncertain source categories of national GHG inventories. For direct N_2O emissions, the highest uncertainty is attributed to the emission factor, which ranges up to 400% Greece relative uncertainty (expressed in 2•standard_deviation) and even 500% for each sub-category in Portugal. For indirect emissions, both the activity data and the emission factors are considered equally uncertain, which stems from the fact that a most uncertain parameter, the fraction of nitrogen leached, must be applied to determine the activity data. Thus, uncertainties of indirect N_2O emissions are estimated as up to more than 200% (Finland, Netherland, Portugal).

This large spread of the uncertainty estimates does generally not reflect real differences in the uncertainties, but rather differences in the interpretation of the available data:

- In the United Kingdom, the uncertainty assumed for agricultural soils uses a lognormal distribution since the range of possible values is so high. Here it is assumed that the 97.5 percentile is greater by a factor of 100 than the 2.5 percentile based on advice from the Land Management Improvement Division of DEFRA (per. comm.).
- The estimate of Portugal is based on the Good Practice Guidance that presents a possible variation from one-fifth to 5 times the default emission factor of 1.25 per cent. From that range an uncertainty of 500 per cent was assumed in uncertainty analysis.

An overview of the uncertainty estimates for activity data and emission factors are given in Table 6.66 and Table 6.67. An overview of uncertainty estimates for agriculture at country and EU15 levels will be given in section 6.4.

Table 6.68 compiles some background information on the estimates of the uncertainty of the values used as activity data and emission factors to estimate N_2O emissions from agricultural soils.

Table 6.78: Relative uncertainty estimates for activity data in category 4D

Member State 2010	Total	Direct	Animal Production	Indirect
Austria		5.0		5.0
Belgium		30.0		
Denmark			25.5	
Finland				
France		15.0	20.0	120.0
Germany		18.0	40.0	141.9
Greece		20.0	50.0	20.0
Ireland		11.2	11.2	11.2
Italy		20.0	20.0	20.0
Luxembourg		10.0	10.0	20.0
Netherlands		10.0	10.0	50.0
Portugal[1,2]	19.5			
Spain		18.0	16.0	190.0
Sw eden		15.0	35.0	28.4
United Kingdom	1.0			

1)
2)

Table 6.79: Relative uncertainty estimates for implied emission factors in category 4D

Member State 2010	Total	Direct	Animal Production	Indirect
Austria		150.0		150.0
Belgium		250.0		
Denmark			100.0	
Finland		71.0	82.0	248.0
France		140.0	200.0	430.0
Germany		54.0	200.0	317.0
Greece		400.0	100.0	50.0
Ireland		100.0	100.0	50.0
Italy		100.0	100.0	100.0
Luxembourg		150.0	150.0	150.0
Netherlands		60.0	100.0	200.0
Portugal	19.5			
Spain		400.0	100.0	50.0
Sw eden		65.8	150.0	121.9
United Kingdom	424.0			

Table 6.80: Member State's background information for uncertainty estimates in category 4.D

Member State	Background information to uncertainy estimates
Austria	Mineral Soils – EF: **Revision of the uncertainty estimate of N_2O from soils. A detailed investigation revealed that the source of the 48% uncertainty presented was a statement in an IPCC report (2000) referring to a measurement uncertainty. Here we have to deal with an emission factor uncertainty, which is estimated much higher, at an order of magnitude (IPCC, 2006). This higher number is still much smaller than the two orders of magnitude recommended by IPCC (2000). The latter was considered in part systematic uncertainty, however (the random uncertainty was considered smaller than the range now used) - this is still in part true, but only reflects our lack of knowledge on soil processes. Choosing to aply a quasi-standardized value conforms to the claim of (Winiwarter, 2007) that application of similar parameters between countries allows for a smaller error in an inter-comparison, even if the difference to a "true value" might be larger.In the latest Austrian study (WINIWARTER 2008) for the emission factor of N_2O from soils an uncertainty of 150% was applied. Uncertainty contributions of the activity (combined from agricultural area and average N-fertilizer input) at about 5% is almost negligible in this context. It is virtually N_2O alone that determines the uncertainty.**
Belgium	Mineral soils - AD: **N_2O emissions from soils involves the use of more AD (mineral fertilisers, atm. deposition and runoff, manure application, ...) Consequently the uncertainty on AD is estimated at 30% , which seems in line with the values applied by other parties.** Mineral soils – EF: **The uncertainty of N_2O from agricultural soils is crucial for the determination of the overall uncertainty. Although most countries use the IPCC default values, the uncertainty on emission factors varies widely : 2 orders of magnitude (Norway), 509 % (UK, in IPCC Good Practice Guidance), 200 % (France and the Netherlands, NIR 2003), 100 % (Ireland, NIR 2003), 75 % (Finland, overall uncertainty for AD*EF, [40]), 24 % (Austria, NIR 2003). For the time being, a more or less average value of 250 % is used for this uncertainty calculation.**
Denmark	Mineral soils – AD: **Both farmers and suppliers of mineral fertilisers are obliged to report to the Plant Directorate. The total sold to farmers is very close to the amount imported by the suppliers, corrected by storage. The total amount of mineral fertiliser in Denmark is, therefore, a very precise estimate for the mineral fertiliser consumed. This is also valid for N-excretion in animal manure.**
Finland	**The uncertainty estimate for N_2O emissions from agricultural soils is very high due to both lack of knowledge of emissions generating process and high natural variability and was estimated at -60 to +170% (direct) and -60 to +240% (indirect). For the 2005 inventory submission, uncertainty estimates were revised based on measurements data. The range of annual average emission factors obtained from different soils reveale that uncertainty may be larger than previously estimated.** Mineral soils - AD: **The most effective way to reduce uncertainty would be case D, i.e., the use of the climate-specific emission factors for N_2O from agricultural soils (Monni et al., 2007). On the basis of this study, at this stage the national field data does not enable the development of a reliable national emisison factor for mineral soils. The ntioal emission factor for N_2O emission from cultivated organic soils would be 7.9 kg ha^{-1} a-1 with an uncertainty of -114 to +187%, which is very close to the IPCC default value... These results from the field monitoring indicated that even if large national measurement campaigns are introduced, this source will still remain very uncertain. (Monni et al., 2007)** Organic soils: **The accuracy of the emission estimate for organic soils could be further improved by**

Member State	Background information to uncertainy estimates
	adopting separate emission factors for grass and cereals since emisisons from grass fields are consistently lower due to less frequent tillage of the soil and a longer period of nitrogne uptake of the grass compared to cereals (Monni et al., 2007)
Germany	**The detailed discussion in this source indicates that the error for relevant areas is on the order of 10 % and that the error for emissions is on the order of 50%.**
Ireland	**Large uncertainties still remain in relation to the N_2O emissions from the agricultural sector. These uncertainties are the main determinant behind uncertainty in total national emissions**
Italy	**Uncertainty for N_2O emissions from agricultural soils (direct soil emissions, indirect soil emissions and animal production) has been estimated to be 102%, as combination of 20% and 100% for activity data and emission factor, respectively.**
Luxembourg	**Arable land crops, used to estimate soil emissions, are on the high end at 10%, just the "fallows" (which is the basis for calculating indirect soil emissions) is considered statistically dependent, but twice as high. Most similar analyses of uncertainties of national GHG inventories have already shown previously that N_2O emissions from soils are poorly understood and are the highest priority for methodological improvement.** Mineral soils – EF: **Manure application emission factor follow a 70% uncertainty for CH_4 and a range from 50% to 200 % (lognormal distribution) for N_2O. The CH_4 emission factor for soil emissions is considered uncertain by +/-100%, the N_2O emission factor is within a factor of 10 (lognormal distribution, from 30% to 300% of the best estimate) following IPCC (2006).**
Netherlands	**The uncertainty in direct N_2O emissions from Agricultural soils is estimated to be approximately 60%. The uncertainty in indirect N_2O emissions from N used in agriculture is estimated to be more than a factor of 2 (Olivier et al.,2009).**
Portugal	Mineral soils – AD: **Comparing the values of nitrogen in synthetic fertilizers form these independent data sources between 1995 and 2000 a maximum uncertainty value of 17 per cent was obtained.** Mineral soils – EF: **From that range an uncertainty of 500 per cent was assumed in uncertainty analysis for nitrogen applied as synthetic fertilizers, manure, crop residues and nitrogen fixed by n-fixing crops. Considering that in the cases of nitrogen added to soil from n-fixing crops and crop residues, an additional 100 per cent uncertainty was added to take into account errors in the determination of nitrogen content of crops and residues from production.**
Sweden	Mineral soils – EF: **Direct N_2O emissions from agricultural fields are calculated with an error of about 80% in the emission factor. The disaggregating of direct emissions from manure and mineral fertilisers, respectively, in the Swedish inventory may reduce some of the variability but direct emissions from agricultural soils are still one of the most uncertain in the inventory.**
United Kingdom	**Emissions from agricultural soils were correlated. The uncertainty assumed for agricultural soils uses a lognormal distribution since the range of possible values is so high. Here it is assumed that the 97.5 percentile is greater by a factor of 100 than the 2.5 percentile based on advice from the Land Management Improvement Division of DEFRA (pers. comm.).** Mineral soils – EF: **The overall uncertainty quoted is calculated using the first method in order that uncertainties should not be underestimated in sectors showing a skewed distribution such as agricultural soils and N_2O as a whole.**

6.3.6 Agricultural Soils – CH_4

CH_4 fluxes from agricultural soils is reported only by Austria. In Austria, CH_4 emissions from Agricultural Soils originate from sewage sludge spreading on agricultural soils. They contribute only a negligible part of Austria's total methane emissions. The average carbon content of sewage sludge amounts to 300 kg C/t (Detzel et al., 2003; Schaefer 2002); 52% of the carbon is emitted to air from which 5% as methane. Emissions of 0.46 Gg CH_4 yr^{-1} are calculated.

In Germany, fluxes of CH_4 from agricultural soils are not considered for the first time in the inventory for the year 2008. CH_4 is taken up in aerobic soils, and N-application reduces this sink for CH_4. In former inventories, the estimation was based on the approach of Boeckx and Van Cleemput (2001), compiling the available observations in Europe, differentiating emissions for grassland ($EFCH_4$ = -2,5 kg ha^{-1} a-1CH_4) and cropland ($EFCH_4$ = - 1,5 kg ha^{-1} a-1 CH_4). In the course of the development of the IPCC(2006) guidelines, however, no consensus could be found how this CH_4 sink in agricultural soil could be considered (A. Freibauer, pers. comm.).

6.3.7 *Field burning of crop residues – CH_4 and N_2O (CRF source category 4.F)*

Burning of crop residues on the field gives rise to emissions of various compounds, including aerosols and trace gases. Field burning of crop residues is forbidden in Europe. Most countries therefore do not report CH_4 and N_2O emissions from this source category. Also at European level, this source category contributes only insignificantly to total emissions from agriculture. We therefore present only limited information, including total CH_4 and N_2O emissions and emissions from the two most important crop groups (cereals and 'other') (Table 6.81) and methodological information as described in the national GHG inventory reports (Table 6.82). The trend of CH_4 and N_2O emissions from field burning of crop residues is shown in Figure 6.47 and Figure 6.48. In many countries, field burning of crop residues has become illegal since 1990 so that the emissions show a significant decline by almost one order of magnitude. Only Greece and Italy report stable emissions from this source category.

Table 6.81: CH_4 and N_2O Emission from burning of crop residues in 2010

	Total Gg CO2-eq		Cereals Gg CO2-		Other Gg CO2-eq	
	CH4	N2o	CH4	N2o	CH4	N2o
Austria	0.9	0.0	0.5	0.0	0.4	0.0
Belgium						
Denmark	2.6	0.1	0.2	0.0	2.4	0.1
Finland	0.6	0.0	0.6	0.0		
France	21.0	0.6	17.1	0.4	2.0	0.1
Germany						
Greece	26.9	0.7	25.9	0.7		
Ireland						
Italy	12.8	0.3	12.8	0.3		
Luxembourg						
Netherlands						
Portugal	21.7	1.1	8.3	0.2	13.5	0.9
Spain	368.5	4.5			368.5	4.5
Sw eden						
United Kingdom						
EU-15	**455.2**	**7.3**	**65.5**	**1.6**	**386.8**	**5.6**

Table 6.82: Methodologies used to calculate CH_4 and N_2O Emission from field burning of crop residues in 2010

Member States	
Austria	**Burning agricultural residues on open fields in Austria is legally restricted by provincial law and since 1993 additionally by federal law and is only occasionally permitted on a very small scale. According to the Presidential Conference of the Austrian Chambers of Agriculture, about 0.3% of total area under cereals is burned.**
Finland	**Default. The share of straw burned in 2007 (0.25%) is an estimate made by several experts on crop cultivation in different parts of Finland. The trend of residue burning is assumed to follow the trend of rye crop yield as rye is the most common straw burned on fields. The share of burned residue from total cereal residue on the fields for the years 1990-2006 is estimated on the basis of the annual rye yield.**
Greece	**IPCC default**
Italy	**Emissions from fixed residues,stubble (stoppie), burnt on open fields, are reported in this category (4F) while emissions from removable residues (asportabili) burnt off-site, are reported under the waste sector. The following data are used: (a) annual crop production, removable residues/product ratio, and "fixed" residue/removable residues ratio; (b) dry matter fraction; (c) fraction of the field where "fixed" residues are burned, and fraction of residues oxidized during burning; (d) fraction of carbon and nitrogen from the dry matter of residues; (e) default emissions rates for C-CH_4 and N-N_2O.**
Portugal	**In-site burning of agricultural residues is still practiced nowadays in Portugal, being however forbidden by law-decree during the Forest Fire Season from May to September. Burning of residues from vineyards and olive oil are the most significant sources. Methodology according to IPCC, except for the fact that residue biomass is not estimated from crop production but from residue production quantities by cultivated area. Quantity of residues and actually burnt**

Member States	
	fraction from expert opinion from the Agriculture Ministry (Seixas et al., 2000). Only for rice a detailed and time-series could be developed following the information received from the agriculture experts from the Portuguese Ministry of Agriculture: (i) traditionally, stubbles and straw were burnt between crops, as the use of rice straw as fodder or bedding is not significant, and is not removed from field; (ii) more recently the agricultural practices have changed. It became more common to left the straw on ground and incorporate it into soil by plowing (only procedure allowed in the area subject to the "Techniques of Integrated Production and Protection", which is about 50 per cent of rice paddies in 2004). It may be assumed that, in 1990, 100 per cent of rice paddies were burnt and no organic amendments were added to soil. Today thea area subjected to burning is between 30 and 40%.
United Kingdom	**The estimates of the masses of residue burnt of barley, oats, wheat and linseed are based on crop production data (e.g. Defra, 2006a) and data on the fraction of crop residues burnt (MAFF, 1995; ADAS, 1995b). Field burning ceased being legal in 1993 in England and Wales. Burning in Scotland and Northern Ireland is considered negligible, so no estimates are reported from 1993 onwards.**

Figure 6.50: Trend of N_2O emissions from field burning of crop residues

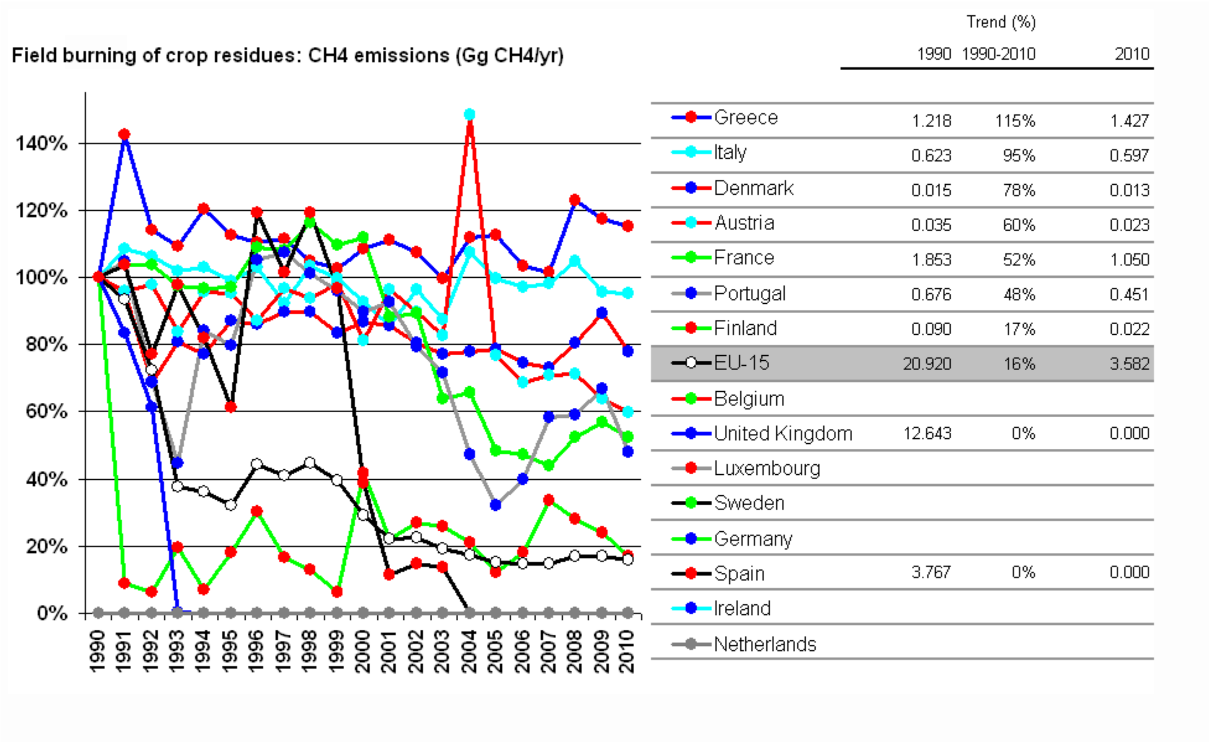
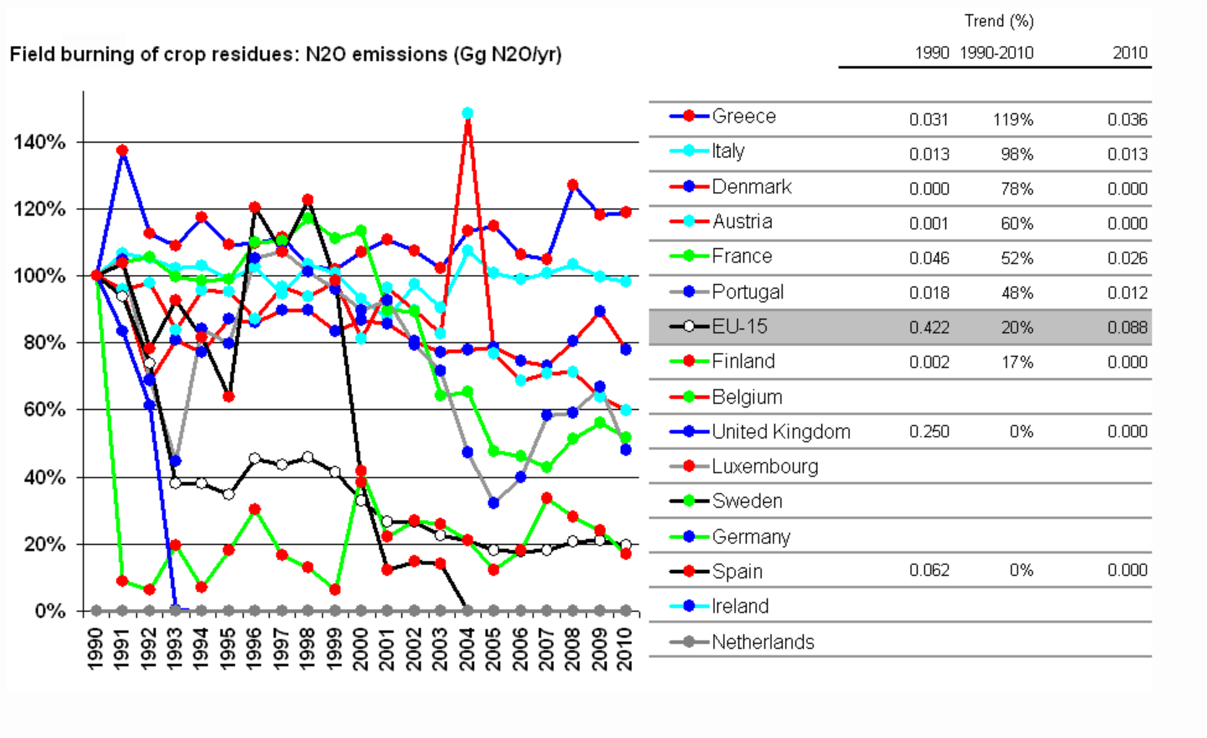


Figure 6.51: **Trend of N_2O emissions from field burning of crop residues**



6.4 Sector-specific quality assurance and quality control

The following sections describe a methodology to estimate the uncertainty of Member States and the EC's emission estimates in the sector agriculture. The method involves several additions to the approaches described in the IPCC guidelines (IPCC 2000, 2006). This includes:

(1) a quantitative assessment of the Tier level of the emission estimate based on the individual factors and parameters used for all members states and the EC;

(2) consistent aggregation of the available uncertainty information to the level of the categories including gap filling where necessary. This is done using both Tier 1 and Tier 2 methodology for both level and trend uncertainty;

(3) aggregation of categorical uncertainty estimates to the EU level using quantitative information on the level of independence. As a proxy for the level of independence, the Tier level is used and is defined as follows: Tier 1 if only default IPCC data are used in the estimation equation and Tier 2 if the emissions estimate is based on country-specific data. Through the aggregation of emission data by categories and countries, intermediate values between Tier 1 and Tier 2 become possible.

The methodology has been published in the Journal Climatic Change in the year 2010 (open access: http://dx.doi.org/10.1007/s10584-010-9915-5).

The following section describe the methodology and update the tables to the last inventory year of 2010.

6.4.1 Determination of the Tier level

The IPCC methodology estimates emissions Es from a certain source category s as

$$E_s = IEF_s \cdot AD_s \quad (1)$$

where ADs are the activity data for the source category s and IEFs is the implied emission factor for this category. There are three levels for estimating the emissions, called Tier 1, Tier 2, and Tier 3, moving from the use of default values over the inclusion of national information to the application of modeling tools. In order to define an EU-wide Tier level per source category and sector, two criteria must be met:

- For each source category and Member State a Tier level must be assigned.
- To assess the Tier level of aggregated emissions derived at different quality, the Tier levels must be measured on an interval scale, allowing 'intermediate' Tier levels.

To do so, we developed standard procedures for each source category. These are based on the following principles:

(i) However, the flow of nutrients in agriculture implies that the emission in one category can serve as activity level in another, for example, nitrogen excretion can be regarded as an emission of nitrogen in livestock production systems. According to the IPCC the amount of nitrogen excreted is an activity data for estimating N_2O emissions from manure management. Thus, in contrast to the IPCC definitions, we define as activity data only this information that must be obtained using statistical surveys (e.g., population data, distribution of animal manure systems etc.) and regard everything else as parameters (emission factors and other factors).

(ii) A Tier level is assessed for each parameter by comparing the IPCC default value with the value used by the countries. If the default IPCC value is used, the Tier level is set to Tier 1 and otherwise the Tier level is set to Tier 2. Caution must be taken if country-specific data are identical to the default values.

(iii) An appropriate estimation of the basic activity data (animal numbers, mineral fertilizer consumption, allocation of manure to the manure management systems) is regarded as basic requirement for the estimation of the source strength and is not considered in the calculation of the overall Tier level. Note however, that

Tier levels are aggregated applying different aggregation rules.

1. The MEDIAN-rule should be applied where the Tier level of a product of different parameters Pi is to be evaluated. For example the emission factor for CH_4 emissions from manure management is calculated from the CH_4 production potential, the methane conversion factor, and the volatile solid excretion. The aggregation of the Tier level of these parameters to estimate the level of quality of the emission factor should follow the following principles. (i) If parameters with very different quality are multiplied, the higher quality should get more weight; (ii) if parameters with different uncertainty are multiplied, it should be good practice to estimate the parameter which is associated with the higher uncertainty at a higher Tier level. Thus, the aggregation rule should reward if efforts have been made to improve uncertain parameters. However, with the lack of a comprehensive set of relative uncertainty estimates for the individual parameters, in the following equation an arbitrary weighting factors $w_{p,j}$ has been introduced, based on expert judgment.

$$Q_{\prod_i P_i} = 3 - \prod_i \left(3 - Q_{P_i}\right)^{\frac{w_{p,i}}{\sum_j w_{p,j}}} \qquad (2)$$

with i and j indicating the individual parameters to be multiplied. The term (3-Q_i) assures that a higher weight is given to the parameter estimated with the higher Tier.

In some cases, when there is clear domination of one multiplicative parameter, the median rule simplified and the Tier level of the product is approximated with that Tier level. This simplified rule has been applied to estimate the Tier level of CH_4 emissions from enteric fermentation, which is in many cases based or validated with direct measurements.

2. The MEAN-rule if an emission estimate is calculated as the sum of two or more sub-categories. In this case, the Tier levels of the individual estimates are aggregated using an emission-weighted average. E.g., the Tier level of indirect N_2O emissions from agriculture Q4D3 is calculated from the Tier levels calculated for indirect emissions through volatilization of nitrogen gases Q4D3a and leaching/run-off of nitrate Q4Db according to:

$$Q_{A+B} = \frac{Q_A \cdot E_A + Q_B \cdot E_B}{E_{A+B}} \qquad (3)$$

It must be noted, however, that a higher Tier-level does not automatically mean that also the emission estimate is more accurate. The relationship holds however, if (i) inherent links between processes are reflected in the methodology; (ii) parameters are based on statistically representative sample of measurements or carefully with experimental data validated models.

CH_4 emissions from enteric fermentation

The Tier level for CH_4 emissions from enteric fermentation is determined by comparison the Implied Emission Factor with the IPCC default emission factors. The Tier level for cattle, sheep, goats, swine, and reindeer is shown in Table 6.83z

Table 6.83: Tier level of IEFs for CH_4 emissions from enteric fermenations

	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine	Reindeer
Austria[1)]	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0	
Belgium	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0	
Denmark	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	
Finland	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 2.0
France	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	
Germany	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	
Greece	Tier 2.0	Tier 1.0	Tier 2.0	Tier 1.0	Tier 1.0	
Ireland	Tier 2.0	Tier 2.0	Tier 2.0	Tier 1.0	Tier 2.0	
Italy	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0	
Luxembourg	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0	
Netherlands	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0	
Portugal[1)]	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	
Spain	Tier 2.0	Tier 2.0	Tier 2.0	Tier 1.0	Tier 2.0	
Sweden	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 2.0
United Kingdom	Tier 2.0	Tier 2.0	Tier 1.5	Tier 1.0	Tier 1.0	
EU-15	**Tier 2.0**	**Tier 2.0**	**Tier 1.7**	**Tier 1.3**	**Tier 1.6**	

1) Dairy-cattle for Spain and Non-dairy cattle for Austria and Portugal: IEF equals default IPCC EF, however Tier 2 has been used according to the national inventory reports.

CH_4 emissions from manure management

The determination of the Tier level for the estimation of CH_4 emissions from manure management is done in four steps

1. "Default" CH_4 conversion factors for each manure management system are calculated on the basis of the allocation of manure to the different AWMS
3. The results are compared with the used MCF and a Tier 2 level assigned if the two numbers differs (see Table 6.84).

Table 6.84: Tier level of MCF for CH_4 emissions from manure management

MCF	Dairy	Non-dairy	Sheep	Goats	Swine	Poultry
Austria	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Belgium	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Denmark	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Finland	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
France	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Germany	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Greece	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Ireland	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Italy	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Luxembourg [1)]	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Netherlands [2)]	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Portugal	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Spain	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Sweden	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
United Kingdom	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
EU-15	**Tier 1.8**	**Tier 1.8**	**Tier 1.0**	**Tier 1.0**	**Tier 1.7**	**Tier 1.0**

Sheep and goats get Tier 1 for MCF!

The data used for B_0 and VS are compared with IPCC default values.

Table 6.85: Tier level of B_0 for CH_4 emissions from manure management

B0	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Sw ine	Poultry
Austria	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Belgium	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Denmark	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Finland	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
France	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Germany	Tier 1.0	Tier 2.0	Tier 1.0	Tier 2.0	Tier 1.0	Tier 2.0
Greece	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Ireland	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Italy	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Luxembourg	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Netherlands [2)]	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0
Portugal	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Spain	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Sw eden	Tier 1.0	Tier 1.0	Tier 2.0	Tier 2.0	Tier 1.0	Tier 2.0
United Kingdom	Tier 1.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
EU-15	**Tier 1.2**	**Tier 1.3**	**Tier 1.0**	**Tier 1.1**	**Tier 1.1**	**Tier 1.1**

Table 6.86: Tier level of VS for CH_4 emissions from manure management

VS	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Sw ine	Poultry
Austria	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Belgium	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0
Denmark	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0
Finland	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 2.0
France	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Germany	Tier 2.0	Tier 2.0	Tier 1.0	Tier 2.0	Tier 2.0	Tier 2.0
Greece	Tier 2.0	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0
Ireland	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 1.0
Italy	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Luxembourg	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 1.0
Netherlands [2)]	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0
Portugal	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0
Spain	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 2.0
Sw eden	Tier 2.0	Tier 2.0	Tier 1.0	Tier 2.0	Tier 2.0	Tier 2.0
United Kingdom	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
EU-15	**Tier 1.7**	**Tier 1.5**	**Tier 1.4**	**Tier 1.3**	**Tier 1.7**	**Tier 1.2**

4. The final Tier level is obtained using the MEDIAN rule from the Tier levels of MCF, B_0, and VS, using the following weigths: w_{MCF}=0.13; wB_0=0.13; w_{VS}=0.75. The highest weight is given to the Volatile solid excretion factor because it can and should be based on the detailed characterization of the animal performance.

Table 6.87: Tier level of the IEFs for CH_4 emissions from manure management

	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine	Poultry
Austria	Tier 1.9	Tier 1.9	Tier 1.0	Tier 1.0	Tier 1.9	Tier 1.0
Belgium	Tier 1.9	Tier 1.9	Tier 1.8	Tier 1.8	Tier 1.9	Tier 1.8
Denmark	Tier 1.9	Tier 1.9	Tier 1.8	Tier 1.8	Tier 1.9	Tier 1.8
Finland	Tier 1.9	Tier 1.9	Tier 1.0	Tier 1.0	Tier 1.2	Tier 1.8
France	Tier 1.2	Tier 1.2	Tier 1.0	Tier 1.0	Tier 1.2	Tier 1.0
Germany	Tier 1.9	Tier 2.0	Tier 1.0	Tier 1.9	Tier 1.9	Tier 1.9
Greece	Tier 1.9	Tier 1.9	Tier 1.8	Tier 1.0	Tier 1.2	Tier 1.0
Ireland	Tier 1.8	Tier 1.8	Tier 1.8	Tier 1.8	Tier 1.9	Tier 1.0
Italy	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Luxembourg	Tier 1.8	Tier 1.8	Tier 1.8	Tier 1.8	Tier 1.8	Tier 1.0
Netherlands [1)]	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0
Portugal	Tier 1.9	Tier 1.8	Tier 1.8	Tier 1.8	Tier 1.9	Tier 1.8
Spain	Tier 1.8	Tier 1.8	Tier 1.0	Tier 1.0	Tier 1.8	Tier 1.8
Sweden	Tier 1.9	Tier 1.9	Tier 1.2	Tier 1.9	Tier 1.9	Tier 1.9
United Kingdom	Tier 1.8	Tier 1.9	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
EU-15	**Tier 1.7**	**Tier 1.5**	**Tier 1.3**	**Tier 1.3**	**Tier 1.7**	**Tier 1.2**

[1)] Netherlands does not give background data in Table 4B(a), however according to the national inventory report a Tier 2 methodology is used.

N_2O emissions from manure management

The determination of the Tier level of the estimate of N_2O emissions from manure management is done in four steps

1. The comparison of the N-excretion rates used with the IPCC default valuees (see Table 6.88)
2. The determination of the Tier level of manure allocated to the manure management systems based on the Tier level of the N-excretion rate by animal type and the allocation of manure-nitrogen to the manure management systems reported in Table 4B(b) (see Table 6.89)
3. The comparison of the N_2O emission factor used with the IPCC default values (see Table 6.90)
4. The calculation of the overall Tier level on the basis of the MEDIAN rule by using the Tier level of the IEF (with a weight of 0.33) and the Tier level of the allocated manure nitrogen to the manure management systems (with a weight of 0.67).

Table 6.88: Tier level of the N-excretion rates for N_2O emissions from manure management

	Dairy	Non-Dairy	Sheep	Swine	Poultry	Buffalo	Goats	Horses	Mules and Asses
Austria	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0		Tier 2.0	Tier 2.0	
Belgium	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0		Tier 2.0	Tier 2.0	Tier 2.0
Denmark	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0		Tier 2.0	Tier 2.0	
Finland	Tier 2.0	Tier 2.0	Tier 2.0		Tier 2.0		Tier 2.0	Tier 2.0	
France	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0		Tier 2.0	Tier 2.0	Tier 2.0
Germany	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0
Greece	Tier 1.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 1.0	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0
Ireland	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0		Tier 2.0	Tier 2.0	Tier 2.0
Italy	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0
Luxembourg	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0		Tier 2.0	Tier 2.0	Tier 2.0
Netherlands [1)]	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0
Portugal	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0		Tier 2.0	Tier 2.0	Tier 2.0
Spain	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0		Tier 2.0	Tier 1.0	Tier 1.0
Sweden	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0		Tier 2.0	Tier 2.0	
United Kingdom	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0		Tier 2.0	Tier 2.0	
EU-15	**Tier 2.0**	**Tier 2.1**	**Tier 2.0**	**Tier 2.0**	**Tier 2.0**	**Tier 2.0**	**Tier 2.0**	**Tier 2.0**	**Tier 2.0**

[1)] Netherlands does not give N-excretion data in Table 4B(b), however according to the national inventory report a Tier 2 methodology is used.

Table 6.89: Tier level of the allocation of manure-nitrogen to the manure management systems for N_2O emissions from manure management

Member State	Liquid system[1)]	Daily Spread	Solid storage and dry lot	Pasture range paddock	Other
Austria	Tier 2.0		Tier 2.0	Tier 1.9	Tier 2.0
Belgium	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0
Denmark	Tier 1.8		Tier 2.0	Tier 2.0	Tier 2.0
Finland	Tier 0.9		Tier 0.7	Tier 1.2	Tier 1.2
France	Tier 2.0		Tier 2.0	Tier 2.0	
Germany	Tier 2.0		Tier 2.0	Tier 2.0	
Greece	Tier 2.0	Tier 1.7	Tier 1.6	Tier 1.9	Tier 1.1
Ireland	Tier 2.0		Tier 2.0	Tier 2.0	
Italy	Tier 2.0		Tier 1.9	Tier 2.0	Tier 2.0
Luxembourg	Tier 2.0		Tier 2.0	Tier 2.0	Tier 2.0
Netherlands	Tier 2.0		Tier 2.0	Tier 2.0	
Portugal	Tier 2.0		Tier 1.8	Tier 2.0	
Spain	Tier 1.8	Tier 1.8	Tier 1.8	Tier 2.0	Tier 2.0
Sweden	Tier 2.0		Tier 2.0	Tier 1.9	Tier 2.0
United Kingdom	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0
EU15	**Tier 2.0**	**Tier 2.0**	**Tier 2.0**	Tier 2.0	**Tier 2.0**

[1)] including anaerobic lagoon

Table 6.90: Tier level of the IEFs for N_2O emissions from manure management

	Liquid system[1)]	Solid storage and dry lot	Other
Austria	Tier 1	Tier 1	Tier 2
Belgium	Tier 1	Tier 1	Tier 1
Denmark	Tier 2	Tier 1	Tier 2
Finland	Tier 1	Tier 2	Tier 1
France	Tier 2	Tier 2	NA
Germany	Tier 2	Tier 2	NO
Greece	Tier 1	Tier 1	Tier 1
Ireland	Tier 1	Tier 1	NO
Italy	Tier 1	Tier 1	Tier 1
Luxembourg			Tier 1
Netherlands	Tier 1	Tier 2	NO
Portugal	Tier 1	Tier 1	NO
Spain	Tier 1	Tier 1	Tier 1
Sw eden	Tier 1	Tier 1	Tier 1
United Kingdom	Tier 1	Tier 1	Tier 2
EU15	**Tier 1.4**	**Tier 1.8**	**Tier 1.4**

Table 6.91: Tier level of the estimation of N_2O emissions from manure management

	Liquid system[1)]	Solid storage and dry lot	Other	Total
Austria	Tier 1.7	Tier 1.7	Tier 2.0	Tier 1.8
Belgium	Tier 1.7	Tier 1.7	Tier 1.7	Tier 1.7
Denmark	Tier 1.9	Tier 1.7	Tier 2.0	Tier 1.9
Finland	Tier 1.0	Tier 1.6	Tier 1.2	Tier 1.1
France	Tier 2.0	Tier 2.0	NA	Tier 2.0
Germany	Tier 2.0	Tier 2.0	NO	Tier 2.0
Greece	Tier 1.7	Tier 1.4	Tier 1.1	Tier 1.7
Ireland	Tier 1.7	Tier 1.7	NO	Tier 1.7
Italy	Tier 1.7	Tier 1.6	Tier 1.7	Tier 1.7
Luxembourg	Tier 2.0	Tier 2.0	Tier 1.7	Tier 2.0
Netherlands	Tier 1.7	Tier 2.0	NO	Tier 1.8
Portugal	Tier 1.7	Tier 1.6	NO	Tier 1.7
Spain	Tier 1.6	Tier 1.6	Tier 1.7	Tier 1.6
Sw eden	Tier 1.7	Tier 1.7	Tier 1.7	Tier 1.7
United Kingdom	Tier 1.7	Tier 1.7	Tier 2.0	Tier 1.8
EU15	**Tier 1.9**	**Tier 1.8**	**Tier 1.8**	**Tier 1.8**

1) including anaerobic lagoon

CH_4 emissions from rice cultivation

No combination of information is required.

N_2O emissions from agricultural soils

The determination of the Tier level of N_2O emissions from agricultural soils is done in four steps:

5. The comparison of the used emission factors (for direct N_2O emissions induced by the application of synthetic fertilizer, animal wastes, nitrogen from crop residues and N-fixing crops and by the cultivation of histosols; for N_2O emissions from manure deposited by grazing animals; for indirect N_2O emissions induced by volatilization of NH_3+NO_x from synthetic fertilizer and from applied manure, and induced by leaching/run-off of nitrogen from the

fields) with the respective IPCC default values.

6. With the exception of direct N_2O emissions induced by the application of mineral fertilizer, a Tier level has been considered for the nitrogen input data.

   (a) For the application of animal waste the Tier levels of N allocation to liquid systems (incl. anaerobic lagoons), solid storage and dry lot, and other systems has been combined using the MEAN rule.

   (b) For N-fixing crop, crop residues and cultivated area of histosols, the Tier level has been estimated from the information reported in the national inventory reports

   (c) For nitrogen deposited by grazing animals, the Tier level calculated under category 4B(b) for pasture, range, and paddock is used.

7. The Tier level of the N_2O emission estimate is calculated on the basis of the above-obtained information:

   (d) Application of synthetic fertilizer the Tier level of the emission factor is used

   (e) Direct emissions from other nitrogen sources using the MEDIAN rule with equal weights for the Tier level of the nitrogen input and the emission factor

   (f) N_2O emissions from grazing animals using the MEDIAN rule for N-input, $Frac_{GRAZ}$, and the emission factor using equal weights. The Tier level for $Frac_{Graz}$ has been determined on the basis of the information given in the national inventory reports

   (g) N_2O emissions from volalised nitrogen using the MEDIAN rule for the amount of volatilised nitrogen, which is calculated from the Tier levels for volatilised synthetic fertilizer and manure nitrogen using the MEAN rule, and the emission factor using equal weights. The Tier level for volatilised synthetic fertilizer is obtained by comparing $Frac_{GASF}$ with the IPCC default value. The Tier level for volatilised manure nitrogen is obtained using the MEDIAN rule on the basis of $Frac_{GASM}$ (comparing with the IPCC default value) and the Tier level of applied nitrogen manure using equal weights.

   (h) N_2O emissions from leached/run-off nitrogen using the MEDIAN rule for N-input, FracLEACH and the emission factor giving higher weight to FracLEACH and the emission factor (0.43 each) than to the N-input (0.14)

Table 6.92: Tier level of the estimation of direct N_2O emissions from agricultural soils

Member States	Synthetic fertilizer	Animal Wastes appl.			N-fixing crops			Crop Residues			Cultivation of Histosols		
	N2O emis.	N input	EF	N2O emissions	N input	EF	N2O emissions	N input	EF	N2O emissions	N input	EF	N2O emissions
Austria	Tier 1.0	Tier 1.8	Tier 1.0	Tier 1.5	Tier 2.0	Tier 1.0	Tier 1.6	Tier 2.0	Tier 1.0	Tier 1.6	Tier 1.0	NO	NO
Belgium	Tier 1.0	Tier 1.7	Tier 1.0	Tier 1.4	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.6
Denmark	Tier 1.0	Tier 1.9	Tier 1.0	Tier 1.5	Tier 2.0	Tier 1.0	Tier 1.6	Tier 2.0	Tier 1.0	Tier 1.6	Tier 2.0	Tier 2.0	Tier 2.0
Finland	Tier 1.0	Tier 1.1	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0	Tier 1.6	Tier 2.0	Tier 1.0	Tier 1.6	Tier 2.0	Tier 2.0	Tier 2.0
France	Tier 1.0	Tier 2.0	Tier 1.0	Tier 1.6	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	NO	NO
Germany	Tier 1.0	Tier 2.0	Tier 1.0	Tier 1.6	Tier 2.0	Tier 1.0	Tier 1.6	Tier 2.0	Tier 1.0	Tier 1.6	Tier 2.0	Tier 2.0	Tier 2.0
Greece	Tier 1.0	Tier 1.7	Tier 1.0	Tier 1.4	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.6
Ireland	Tier 1.0	Tier 1.7	Tier 1.0	Tier 1.4	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	NO	NO
Italy	Tier 1.0	Tier 1.7	Tier 1.0	Tier 1.4	Tier 2.0	Tier 1.0	Tier 1.6	Tier 2.0	Tier 1.0	Tier 1.6	Tier 1.0	Tier 2.0	Tier 1.6
Luxembourg	Tier 1.0	Tier 2.0	Tier 1.0	Tier 1.6	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	NO	NO
Netherlands	Tier 2.0	Tier 1.8	Tier 2.0	Tier 1.9	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 1.0	Tier 2.0	Tier 1.6
Portugal	Tier 1.0	Tier 1.7	Tier 1.0	Tier 1.4	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	NO	NO
Spain	Tier 2.0	Tier 1.6	Tier 2.0	Tier 1.8	Tier 2.0	Tier 1.0	Tier 1.6	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	NO	NO
Sw eden	Tier 2.0	Tier 1.7	Tier 2.0	Tier 1.9	Tier 2.0	Tier 1.0	Tier 1.6	Tier 2.0	Tier 1.0	Tier 1.6	Tier 1.0	Tier 2.0	Tier 1.6
United Kingdom	Tier 2.0	Tier 1.8	Tier 2.0	Tier 1.9	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.6
EU-15	**Tier 1.3**			**Tier 1.6**			**Tier 1.3**			**Tier 1.3**			**Tier 1.9**

Table 6.93: Tier level of the estimation of N_2O emissions from pasture, range and paddock

Member States	Animal Production			
	N-input	FracGRAZ	EF	N2O emissions
Austria	Tier 1.9	Tier 1.0	Tier 1.0	Tier 1.4
Belgium	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.4
Denmark	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.4
Finland	Tier 1.2	Tier 1.0	Tier 1.0	Tier 1.1
France	Tier 2.0	Tier 1.0	Tier 2.0	Tier 1.7
Germany	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.7
Greece	Tier 1.9	Tier 1.0	Tier 1.0	Tier 1.4
Ireland	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.4
Italy	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.4
Luxembourg	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.4
Netherlands	Tier 2.0	Tier 1.0	Tier 2.0	Tier 1.7
Portugal	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.4
Spain	Tier 2.0	Tier 1.0	Tier 2.0	Tier 1.7
Sw eden	Tier 1.9	Tier 2.0	Tier 1.0	Tier 1.7
United Kingdom	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.4
EU-15				**Tier 1.6**

Table 6.94: Tier level of the estimation of indirect N_2O emissions from nitrogen volatilised from agricultural soils

Member States	$Frac_{GASF}$	Manure application	$Frac_{GASM}$	Volatilized Manure	Volatili-zation	Emission Factor	N2O emissions from volatilised nitrogen
Austria	Tier 2.0	Tier 1.8	Tier 2.0	Tier 1.9	Tier 2.0	Tier 1.0	Tier 1.6
Belgium	Tier 2.0	Tier 1.7	Tier 2.0	Tier 1.9	Tier 2.0	Tier 1.0	Tier 1.6
Denmark	Tier 2.0	Tier 1.9	Tier 2.0	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.6
Finland	Tier 2.0	Tier 1.1	Tier 2.0	Tier 1.6	Tier 2.0	Tier 1.0	Tier 1.6
France	Tier 1.0	Tier 2.0	Tier 1.0	Tier 1.6	Tier 1.0	Tier 1.0	Tier 1.0
Germany	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.6
Greece	Tier 1.0	Tier 1.7	Tier 1.0	Tier 1.4	Tier 1.0	Tier 1.0	Tier 1.0
Ireland	Tier 2.0	Tier 1.7	Tier 2.0	Tier 1.9	Tier 2.0	Tier 1.0	Tier 1.6
Italy	Tier 2.0	Tier 1.7	Tier 2.0	Tier 1.9	Tier 2.0	Tier 1.0	Tier 1.6
Luxembourg	Tier 1.0	Tier 2.0	Tier 1.0	Tier 1.6	Tier 1.0	Tier 1.0	Tier 1.0
Netherlands	Tier 2.0	Tier 1.8	Tier 2.0	Tier 1.9	Tier 2.0	Tier 1.0	Tier 1.6
Portugal	Tier 2.0	Tier 1.7	Tier 2.0	Tier 1.9	Tier 2.0	Tier 1.0	Tier 1.6
Spain	Tier 2.0	Tier 1.6	Tier 1.0	Tier 1.4	Tier 1.8	Tier 1.0	Tier 1.5
Sw eden	Tier 2.0	Tier 1.7	Tier 2.0	Tier 1.9	Tier 2.0	Tier 2.0	Tier 2.0
United Kingdom	Tier 1.0	Tier 1.8	Tier 1.0	Tier 1.5	Tier 1.0	Tier 2.0	Tier 1.6
EU-15							**Tier 1.4**

Table 6.95: Tier level of the estimation of indirect N_2O emissions from nitrogen leached/run-off from agricultural soils

Member States	N input	$Frac_{LEACH}$	Emission factor
Austria	Tier 1.8	Tier 1.0	Tier 1.0
Belgium	Tier 1.7	Tier 2.0	Tier 1.0
Denmark	Tier 1.9	Tier 2.0	Tier 2.0
Finland	Tier 1.1	Tier 2.0	Tier 1.0
France	Tier 2.0	Tier 1.0	Tier 1.0
Germany	Tier 2.0	Tier 1.0	Tier 1.0
Greece	Tier 1.7	Tier 1.0	Tier 1.0
Ireland	Tier 1.7	Tier 2.0	Tier 1.0
Italy	Tier 1.7	Tier 1.0	Tier 1.0
Luxembourg	Tier 2.0	Tier 1.0	Tier 1.0
Netherlands	Tier 1.8	Tier 2.0	Tier 1.0
Portugal	Tier 1.7	Tier 2.0	Tier 1.0
Spain	Tier 1.6	Tier 1.0	Tier 1.0
Sw eden	Tier 1.7	Tier 2.0	Tier 1.0
United Kingdom	Tier 1.8	Tier 1.0	Tier 2.0
EU-15			

6.4.2 Uncertainty

Quantitative estimates of the contribution of agriculture to the overall uncertainty of the national GHG inventories are reported in Table 6.101. These data are calculated from the information on the uncertainty of activity data and implied emission factors (see sections above and Table 6.97 through Table 6.99 summarizing all categories in agriculture) and the emissions data. For several countries, N_2O emissions from agricultural soils are by far dominating the uncertainty of national inventory. The uncertainty estimate for this source category ranges from 10.9% of total national GHG emissions (excl. LULUCF, Portugal) to 243.7% of total national GHG emissions (United Kingdom). Overall, the estimate for the uncertainty range is relatively stable since the last years.

Table 6.96: Range of contribution of category 4D to overall GHG uncertainty. Minimum and maximum values since 2005 submission

	Minimum uncertainty	Maximum uncertainty
2005	**0.7% (Austria)**	**20.9% (France)**
2006	**1.5% (Austria)**	**17.6% (France)**
2007	**1.9% (Denmark)**	**19.9% (France)**
2008	**1.7% (Denmark)**	**20.1% (France)**
2009	**2.0% (Denmark)**	**17.9% (France)**
2011	**2.4% (Netherlands)**	**18.7% (United Kingdom)**
2012	**1.6% (Portugal)**	**18.2% (United Kingdom)**

The contribution of the whole agricultural sector to the overall uncertainty is very similar to the contribution of agricultural soils (16.8% to 244.3%), highlighting again the dominance of this category.

Some countries allocate the biggest contribution to the direct emissions and others to the indirect emissions of N_2O. For example, the uncertainty of direct N_2O emissions is estimated in the Greece inventory of being ±400% (69.0% of the national total) versus ±54% (11.3% of the national total) of the indirect emissions. On the other hands, the Netherlands estimate an uncertainty of ±61% and ±206% for direct and indirect N_2O emissions agricultural soils, respectively (corresponding to 12.0% and 18.5% of the national total uncertainty, respectively).

CH_4 emissions from enteric fermentation are less uncertain (3.3% to 12.2% of total national GHG emissions) and manure management contributes with less than 12.2% uncertainty.

An overview of the estimated total GHG inventory uncertainty carried out with the Tier 1 methodology and the contribution of the agricultural sector to the overall uncertainty (calculated from reported relative uncertainties for activity data and emission factors, and the reported emissions) is given in Table 6.101. The corresponding uncertainties for activity data and emission factors are given in Table 6.97 and Table 6.98, and the combined uncertainty (Tier 1 approach) is given in Table 6.99. The data for the combined uncertainty are “gap-filled” at the category-level, if required, to allow a meaningful comparison of the uncertainty estimates at EU-level, using information reported at the level below the categories.

A table summarizing background information on the uncertainty estimates is given in Table 6.100.

It is interesting to note that combined relative uncertainty of agriculture in some cases is higher than the overall uncertainty of the greenhouse gas inventory (for example in Austria and Spain). This is due to the fact that the combined uncertainty is calculated neglecting any other contribution to the uncertainty. As uncertainties are assumed to be uncorrelated between the different sectors, the consideration of more sectors can thus lead to the partial compensation of the individual uncertainties.

Some countries have carried out also a Monte Carlo uncertainty assessment. In most cases, both the input data and also the results do not deviate much from the Tier 1 analysis. Main differences between both methods are (i) the possibility to assess emission sources where the distribution of the uncertainty is non-normal and (ii) the consideration of correlation between source categories, which tends to reduce the compensation effect.

Table 6.97: Member States's uncertainty estimates for Activity Data used in the agriculture sector

Member State	Enteric ferment. (4A)	Manure Managem. (4B)		Agricultural soils (4D)			
				total	direct	animal prod.	indirect
	CH_4	CH_4	N_2O	N_2O	N_2O	N_2O	N_2O
Austria	*(1)	*(5)	10		5		5
Belgium	5	10	10	0	30		
Denmark	2	5	22	0		25	
Finland	0	0	0	0			
France	5	5	5	0	15	20	120
Germany	*(2)	*(6)	5	0	18	40	142
Greece	5	5	50		20	50	20
Ireland	*(3)	*(7)	11	0	11	11	11
Italy	20	20	20		20	20	20
Luxembourg					10	10	
Netherlands	*(4)	*(8)	10		10	10	50
Portugal	7	9	36	20			
Spain	3	3	16		18	16	190
Sweden	2	7	15	0	15	35	28
United Kingdom	0	0	1	1			

*(1)- Cattle: 10%
*(2)- Dairy cattle 6% and non-dairy cattle 4%. Buffalo 8%
*(3)- Dairy and non-dairy cattle and other animals: 1%
*(4)- Dairy and non-dairy cattle, swine and other animals: 5%
-
*(5)- Cattle and swine: 10%
*(6)- Dairy cattle 6% and non-dairy cattle 4%. Buffalo 0% and swine 8%
*(7)- Dairy and non-dairy cattle and other animals: 1%
*(8)- Dairy and non-dairy cattle, swine and other animals: 10%
-
-
-

Table 6.98: Member States's uncertainty estimates for Emission Factors used in the agriculture sector

Member State	Enteric ferment. (4A)	Manure Managem. (4B)		Agricultural soils (4D)			
				total	direct	animal prod.	indirect
	CH_4	CH_4	N_2O	N_2O	N_2O	N_2O	N_2O
Austria	*(1)	*(5)	100		150		150
Belgium	20	40	90		250		
Denmark	20	20	50			100	
Finland	32	16	82		71	82	248
France	40	50	50		140	200	430
Germany	*(2)	*(6)	63		54	200	317
Greece	30	50	100		400	100	50
Ireland	*(3)	*(7)	100		100	100	50
Italy	20	100	100		100	100	100
Luxembourg					150	150	
Netherlands	*(4)	*(8)	100		60	100	200
Portugal	12	74	93	20			
Spain	10	10	100		400	100	50
Sweden	11	18	38		66	150	122
United Kingdom	20	30	414	424			

*(1)- Cattle: 20%

*(2)- Dairy cattle 40% and non-dairy cattle 25%. Buffalo 26%

*(3)- Dairy and non-dairy cattle 15, other animals: 30%

*(4)- Dairy cattle 15%, non-dairy cattle 20%, swine 50% and other animals: 30%

*(5)- Cattle and swine: 50%

*(6)- Dairy cattle 40% and non-dairy cattle 24%. Buffalo 0% and swine 30.2824391157204%

*(7)- Dairy and non-dairy cattle and other animals: 15%

*(8)- Cattle, swine, poultry and other animals: 100%

Table 6.99: Member States's uncertainty estimates for agriculture (combined uncertainty calculated from the given uncertainty of AD and EF)

Member State	Enteric ferment. (4A)	Manure Managem. (4B)		Agricultural soils (4D)			
				total	direct	animal prod.	indirect
	CH_4	CH_4	N_2O	N_2O	N_2O	N_2O	N_2O
Austria	22	51	100	109	150		150
Belgium	21	41	91	252	252		
Denmark	20	21	55	103		103	
Finland	32	16	82	70	71	82	248
France	40	50	50	178	141	201	446
Germany	25	24	63	123	57	204	347
Greece	30	50	112	128	400	112	54
Ireland	11	11	101	58	101	101	51
Italy	28	102	102	66	102	102	102
Luxembourg	20	70	0	91	150	150	151
Netherlands	12	70	100	64	61	100	206
Portugal	14	75	100	28			
Spain	10	10	101	211	400	101	196
Sweden	11	19	41	56	67	154	125
United Kingdom	20	30	414	424			

Table 6.100: Member State's background information on the uncertainty estimates in the sector of agriculture

Member State	Uncertainties
Austria	**Separate uncertainty calculations, albeit with the same (as much as possible) input information was performed using a spreadsheet prepared specifically according to the Tier 1 approach (IPCC 2000), and with a Monte Carlo approach fully considering statistical dependence of detailed input data (Tier 2). Since the first detailed uncertainty analysis (Winiwarter and Rypdal, 2001) the Austrian inventory compilers have spent considerable effort to also obtain uncertainties from individual contributors to the inventory. Studies on methane emissions reported also uncertainty in emission factors (Amon et al. 2002, Gebetsroither et al. 2002).**
Belgium	**In Flanders, a complete study of the uncertainty was conducted in 2004 by an independent consultant, Det Norske Veritas, both on Tier 1 and Tier 2 level. The uncertainties were determined for the emission level 2001 and for the 1990-2001 trend in emissions for all source categories comprising emissions of CO_2, CH_4 and N_2O. These results are available in the technical report 'Quantification of Uncertainties – Emission Inventory of Greenhouse Gases of the Flemish Region of June 2004'.**
Denmark	**The uncertainty estimates are based on the Tier 1 methodology in the IPCC Good Practice Guidance (GPG) (IPCC, 2000). Uncertainty estimates for the all sectors are included in the current year. The estimated uncertainties for some of the emission sources, based on expert judgement (Olesen et al. 2001, Gyldenkærne, pers. comm., 2005). The uncertainties for the number of animals and the number of hectares with different crops under cultivation are very small.**
Finland	**Uncertainty is quantified with a Tier 2 approach (KASPER model, developed by VTT Technical Research Centre of Finland). A simulation model was constructed for uncertainty analysis using Monte Carlo simulation and sensitivity analysis using an extended version of Fourier Amplitude Sensitivity Test (FAST, Saltelli et al. 2005). In agriculture, an uncertainty estimate was given for each calculation parameter of the calculation model at a detailed level. A detailed description of the uncertainty analysis has been presented in Monni & Syri (2003), Monni (2004) and Monni et al. (2007).**
France	**Uncertainty calculation according to Tier 1 methodology. Strongest impact on total uncertainty arises from the category of N_2O emissions from agricultural soils.**
Ireland	**Tier 1 method. In some of the most important emissions sources in Agriculture (such as enteric fermentation and agricultural soils) and Waste (solid waste disposal, for example) the activity data or emission factors ultimately used are determined by several specific component inputs, which are all subject to varying degrees of uncertainty. The uncertainty estimates used for both activity data and emission factor for these sources have been derived by assigning uncertainties to the key component parameters and combining them at the level of activity data or emission factors, as appropriate, for each activity for input to the Tier 1 uncertainty assessment.**
Italy	**Tier 1 approach. In addition, a Tier 2 approach, corresponding to the application of Monte Carlo analysis, has been applied to specific categories of the inventory but the results show that, with the information available at present, applying methods higher than the Tier 1 does not make a significant difference in figures. For N_2O emissions from agricultural soils, a Montecarlo analysis was applied assuming a normal distribution for activity data and two tests one with a lognormal and the other with a normal for emission factors; the results with the normal distribution calculated an uncertainty figure equal to 32.44, lower than the uncertainty by the Tier 1 approach which was 102; in the case of the lognormal distribution there were problems caused by the formula specified in the IPCC guidelines which is affected by the unit and needs further study before a throughout application.**
Luxembourg	**In December 2007, the Environment Agency contracted Austrian Research Centers GmbH - ARC28 for performing a detailed uncertainty analysis of Luxembourg's GHG inventory. Monte-Carlo approach were used to calculate overall uncertainty. Within this project, we use the software "@RISK" from Palisade Co. (www.palisade.com).**
Netherlands	**Tier 1 method for base year and last reported year – for both the annual emissions and the emission trend for the Netherlands. All uncertainty figures should be interpreted as corresponding to a confidence interval of 2 standard deviations (2?), or 95%. In cases where asymmetric uncertainty ranges were assumed, the largest percentage was used in the calculation. Furthermore, a Tier 2 uncertainty assessment was carried out in 2006 (Ramirez, 2006). The study used the same uncertainty assumption as the Tier 1 study but accounted for correlations and non-Gaussian distributions. Results are at the same order of magnitude for the level assessment, although a higher uncertainty is found for the trend analysis. As part of the above mentioned study, the expert judgments and assumptions made for uncertainty ranges in emission factors and activity data for the Netherlands have been compared to the uncertainty assumptions (and their underpinnings) used in Tier 2 studies carried out by other European countries.**
Sweden	**During 2005, a SMED study was carried out to improve tranparency and quality in the uncertainty estimates of the Swedish National Greenhouse gas inventory (Gustafsson, 2005). Although much activity data in the agricultural sector is estimated from extensive surveys, with high quality estimates at national level, the sector contributes to a large part of the total estimated uncertainty.**
United Kingdom	**Both the Tier 1 and Tier 2 uncertainty estimates. The Tier 2 approach provides estimates according to GHG (1990, base year and latest reporting year) and has now been extended to provide emissions by IPCC sector and is based on a background paper (Eggleston et al., 1998). An internal review was completed of the Monte Carlo analysis was completed in 2006 (Abbott et al., 2006). The uncertainty of the majority of the sectors was assumed to be normally distributed; for certain sectors where data are highly correlated or the distributions non-normal, custum corrleations or fuctions have been used (landfill, sewage sludge distributions calculated from a known data series; agricultural soils lognormal distribution with the 97.5%il being 100 times the 2.5%il). Calculations are carried out using the @RISK software.**

The uncertainties estimates are combined to the EU-15 level for source categories in the agriculture sector and for the sector as a whole are combined with a Tier 1 approach considering an assumed degree of dependence between each pair of countries. The quantitative assessment of the quality-levels outlined above helps to derive a reasonable estimate for the correlation coefficient ρ_{XY} between two countries X and Y. To this purpose, the Tier levels Q_X and Q_Y are transformed with the following equation:

$$\rho_{X,Y} = \sqrt{(2 - Q_X) \cdot (2 - Q_Y)} \qquad (4)$$

Equation (4) leads to the situation of no correlation $(\rho_{X,Y} = 0)$ for two countries with a Tier 2 approach and full correlation $(\rho_{X,Y} = 1)$ if both countries used a Tier 1 approach. A correlation coefficient can be calculated for any intermediate situation. This information is further processed within the standard IPCC Tier 1 method for both level and trend uncertainty.

Table 6.101: Member States's uncertainty estimates for agriculture expressed in percent of total GHG emissions. The table shows three "scenarios" for the uncertainty at EU-15 level, i.e., (i) with the correlation between MS uncertainty estimates as quantified with equation (4); (ii) under the assumption of no correlation and (iii) under the assumption of full correlation between the uncertainty estimates of MS. Scenario (i) is considered to be the most realistic case, and scenarios (ii) and (iii) are giving the range of uncertainty at EU-15 level.

Member State	Total agriculture	Enteric ferment. (4A)	Manure Managem. (4B)		Agricultural soils (4D)			
					total	direct	animal prod.	indirect
		CH_4	CH_4	N_2O	N_2O	N_2O	N_2O	N_2O
	uncertainties expressed as % of total GHG emissions							
Austria	45.7	9.8	2.3	12.5	42.8	35.0		22.1
Belgium	102.1	7.3	6.8	7.1	101.4	59.7		
Denmark	54.2	6.0	2.8	2.4	53.7		2.1	
Finland	43.6	8.7	0.8	6.0	42.3	33.2	2.5	26.1
France	89.9	12.2	7.3	2.7	88.6	31.0	19.1	80.7
Germany	72.0	7.5	2.0	2.1	71.5	20.9	4.0	68.3
Greece	73.9	10.6	1.7	3.6	73.1	69.0	21.3	11.3
Ireland	23.1	5.5	1.3	2.5	22.3	16.2	14.8	3.8
Italy	33.8	9.0	7.8	11.2	29.5	21.9	4.7	19.3
Luxembourg	45.3	7.3	9.9		41.9	29.8	12.6	26.6
Netherlands	27.6	4.9	12.2	6.1	23.4	12.0	7.9	18.5
Portugal	16.8	5.1	10.7	4.0	10.9			
Spain	101.5	3.3	1.4	6.7	100.5	93.9	6.4	35.1
Sweden	31.4	3.9	0.7	2.4	31.1	21.3	7.9	13.2
United Kingdom	244.3	6.6	1.7	15.0	243.7			
EU15	**6.4**	**0.4**	**0.3**	**0.3**	**7.1**			
EU15 no corr	**4.2**	**0.4**	**0.2**	**0.2**	**4.1**			
EU15 full corr	**9.0**	**0.8**	**0.4**	**0.6**	**8.9**			

Uncertainties calculated from information contained in NIR on uncertainty of activity data and emission factors, and emission data, using the Tier 1 approach.

6.4.3 Improvements since last submission

A major revision of the present chapter on methodological issues and uncertainty in the sector agriculture has been done for the submission in 2006. The chapter gives now a complete overview of all relevant parameters required for the estimation of GHG emissions in this sector. This has been done in parallel to the calculation of all background parameter in the CRF tables for agriculture.

The changes are partly due to a “natural evolution” of the inventory generation over the years and partly motivated by recommendations made by the UNFCCC review team on the occasion of the in-country review in 2005. The main issues raised by the Expert Review Team in 2005 and the major changes include (i) more transparent overview tables on methodological issues; (ii) better presentation of trend development; (iii) streamlining information contained in CRF and NIR; (iv) continuous working with Member States in order to improve the inventory and allowing the quantification of all background data; (v) including a summary of workshops.

For the submission in 2007, few improvements have been added, mainly regarding the calculation of the quality of the EC estimate. Several errors that were identified in the background tables of the Member States could be eliminated, such as the inconsistent use of units or implied emission factors. These corrections did not have an impact on the calculated emissions, but made the aggregation of background information difficult and the comparison impossible.

For the submission in 2008, based on recommendations by the Expert Rview Team of the in-country review in 2007, several improvements were implemented, including higher transparency in describing the aggregation of animal numbers presented under Option B into Option A (which is used at EU level), time series consistencies and trends (including epidemic diseases and issues raised by the ERT, such as the buffalo population in Germany and the goat population in Luxembourg, manure managed in ‘other’ systems in Italy, or $Frac_{GASM}$ used in Sweden), and outliers. A discussion on the main policies driving the level of GHG emissions in Europe was introduced.

Further a novel approach to calculate uncertainties at the EU level including the assessment of the quality of the emission estimates at MS and EU level has been implemented and described in the NIR. This method was presented during the in-country-review in 2007 and its implementation in the EC-IR was suggested by the ERT. This is complemented by a series of tables giving background information for the estimates of the uncertainty levels for activity data and emission factors.

Emission sources reported by a few MS only (such as CH_4 emissions from enteric fermentation of poultry, reported by Austria and Luxembourg only) will still lead to a discrepancy between the IEF for EU-15 reported in the CRF-tables and the NIR. This is because our principle to not change the category MS report emissions (with the above-mentioned exception of the shift from Option B to Option A for cattle). In the annex to the NIR a weighted average of the IEF for poultry is calculated instead giving the IEF of those animals for which emissions have been quantified and included into the EU total. This is documented also in the CRF tables in a transparent way.

For the submissions in 2008 trough 2012, background information was further developed, in particular with regard to the general development and policy drivers in the countries. A new section was introduced giving most important information on the source category ‘Field Burning of

Agricultural Residues' and information on the methodology and trends of emissions in this category has been added. For the submission in 2011, a new section was added summarizing the findings of the GGELS project (Evaluation of the livestock sector's contribution to the EU greenhouse gas emissions (GGELS); http://afoludata.jrc.ec.europa.eu/index.php/dataset/detail/236).

Continuous work with MS helps to identify and correct errors; and justifications for un-documented national emission factors have been requested (for example, for the use of IPC2006 default values) and are now also included in national inventory reports (Germany). Even though **the number of errors could be significantly reduced with regard to previous submissions** a few errors remain and have been requested to be corrected by the MS, such as for example a few (remaining) mistakes in the units reported.

The MS CRF tables are carefully checked on these errors and corrected before calculating the background data for the European Union.

6.4.4 Activities to improve the quality of the inventory in agriculture

As a first activity to assure the quality of the inventory by Member States, a workshop on "Inventories and Projections of Greenhouse Gas Emissions from Agriculture" was held at the European Environment Agency in February 2003. The workshop focused on the emissions of methane (CH_4) and nitrous oxide (N_2O) induced by activities in the agricultural sector, not considering changes of carbon stocks in agricultural soils, but including emissions of ammonia (NH_3). The consideration of ammonia emissions allows the validation of the N_2O emission sources and it further strengthens the link between greenhouse gas and air pollutant emission inventories reported under the UNFCCC, the EC Climate Change Committee, the UNECE Long-Range Transboundary Air Pollution Convention, and the EU national emission ceiling directive. Objectives of the workshop were to compare the Member States' methodologies and to identify and explain the main differences. The longer term objective is to further improve the methods used for inventories and projections in the different Member States and to identify how national and common agricultural policies could be integrated in EU-wide emission scenarios.

Information on the workshop and the recommendations can be downloaded at the following website:

http://ccupeople.jrc.ec.europa.eu/leip/expmeetcat4d_2004/recommendations.htm

6.4.5 Comparison of national inventories with EU-wide calculations with the CAPRI model

The GGELS-project on the "Evaluation of the livestock sector's contribution to the EU greenhouse gas emissions" was commissioned by the Directorate-General for Agriculture and Rural Development to the Joint Research Centre and run from 09/2008-12/2010. The study included the implementation of an LCA (life-cycle assessment) approach into the CAPRI model including update of GHG-calculation modules, as well as an ex-ante according to the latest CAPRI projections for the year 2020 and an explorative assessment of technological and policy mitigation options. Ancillary assessments were made on a description of livestock systems in Europe, the GHG emissions related to imported meat product and livestock's impact on biodiversity.

For the LCA-approach, activity-based emissions according to the emissions source categories in the IPCC (2006) guidelines are converted to product-based emission intensities, using well-defined allocation rules. Additional emissions that are generated during the life-cycle of a product are estimated as well and included in the estimated emission intensities. The GGELS report include also a detailed comparison of activity-based emissions estimates calculated with the CAPRI model with those reported in the greenhouse gas inventory report of the European Comminuties in 2010 for the year 2004, which is the base year for the version of the CAPRI model used.

The report, executive summary and the data tables are available at:

http://afoludata.jrc.ec.europa.eu/index.php/dataset/files/236

A detailed description of the methodology used in the study is given in section 4.2. (Activity-based GHG emissions from the European livestock system considered in the sector 'agriculture' of the IPCC guidelines) of the report with additional data tables provided in the Annex to Chapter 4 (Quantification of greenhouse gas and ammonia emissions from the livestock sector in the EU – Methodology). Section 5 (Comparison of EU livestock GHG emissions derived by CAPRI with official GHG inventories) provides a detailed comparison between the emissions estimates.

In the following, a summary of this comparison is provided as given in the executive summary of the report:

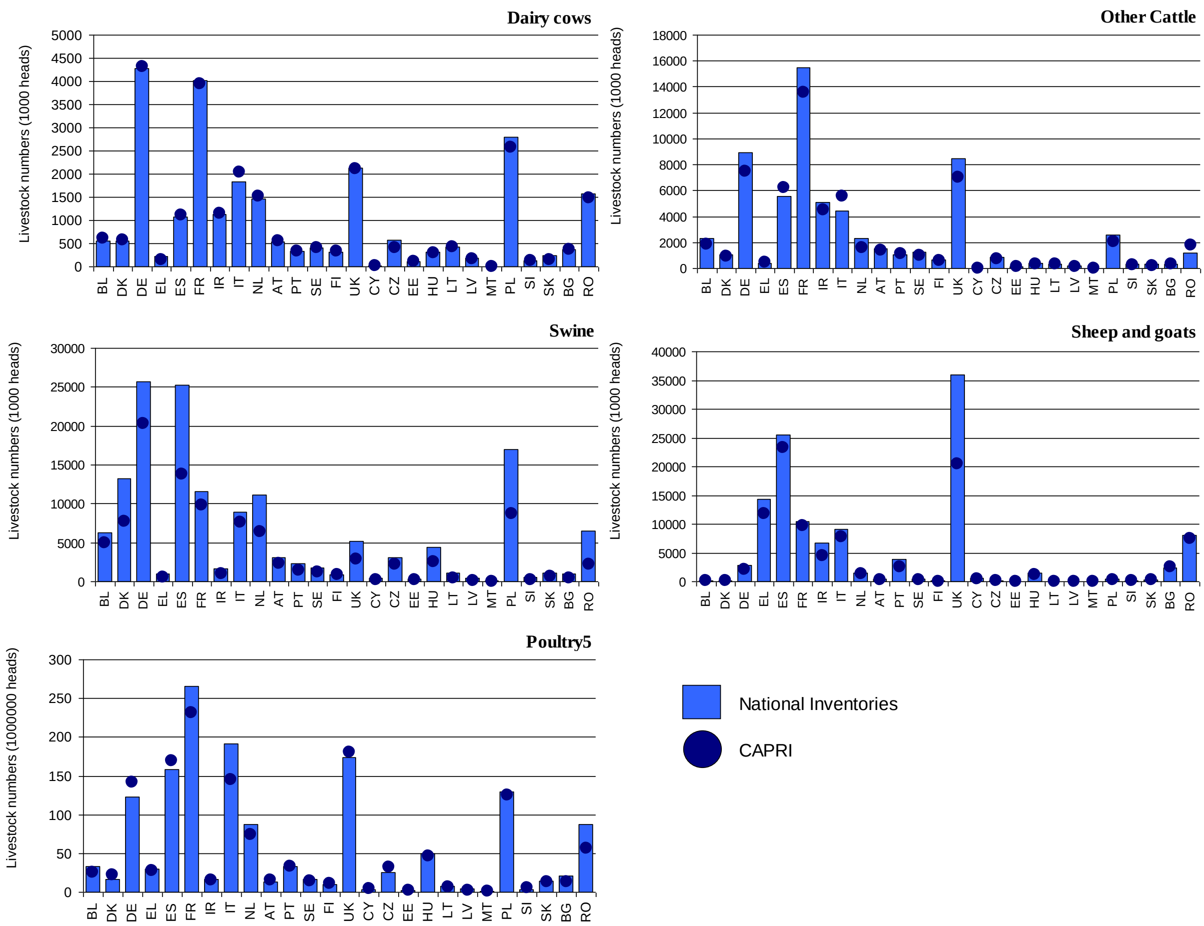
The objective of the GGELS project was to provide an estimate of the net emissions of GHGs and ammonia (NH_3) from livestock sector in the EU-27 according to animal species, animal products and livestock systems following a food chain approach.

For the comparison of activity-based GHG emissions calculated in the GGELS project (taking into account only emissions directly created during the agricultural production process) with official national GHG emissions submitted to the UNFCCC, we selected the latest inventory submission of the year 2010 (EEA, 2010), using the data reported for the year 2004, the base year selected also for the CAPRI calculations.

Differences in basic input parameters, such as animal numbers and mineral fertilizer application rates are limited, since both are based on the official numbers of livestock statistics. However, on the one hand EUROSTAT data are not always in line with national statistical sources used by national inventories, and on the other hand CAPRI changes input data if they are not consistent with each other. Moreover, for some animal activities CAPRI does not use livestock numbers but numbers of the slaughtering statistics. Therefore, some differences exist, especially in case of swine, sheep and goats, where CAPRI generally uses lower numbers than the national inventories. This has to be kept in mind when looking at the results in later sections.

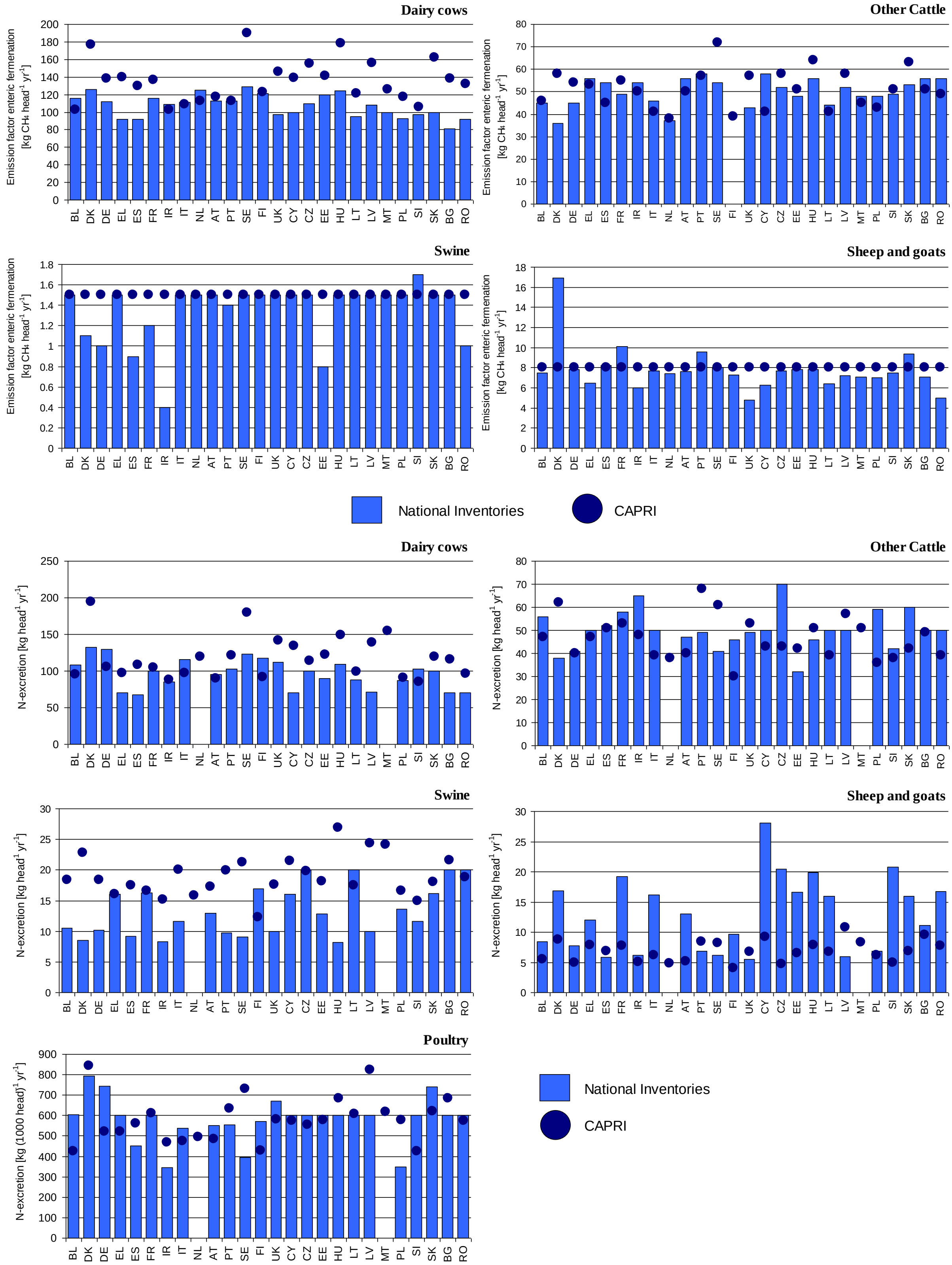
In some cases results differ substantially between CAPRI and the inventory submissions, which can be related to three different reasons: First, the approach of CAPRI and the national inventories is not always the same. Especially, the MITERRA approach, which is applied for the calculation of nitrogen emissions in the CAPRI model, differs substantially from the IPCC approach usually applied in the inventories. In CAPRI the excretion is not an exogenous parameter but is calculated as the difference between nitrogen intake and nitrogen retention of animals. For cattle and poultry deviations are generally low, while for swine, sheep and goats the differences are larger (see Figure 6.52). In case of swine the usually higher CAPRI values partly compensate the lower livestock numbers.

Figure 6.52: Comparison of livestock numbers used in National Inventories to the UNFCCC for the year 2004 (EEA, 2010) and livestock numbers used in CAPRI



Second, most countries base their inventory calculations on the IPCC guidelines 1996, while CAPRI uses parameters of the most recent guidelines of the year 2006. In some cases emission factors and other parameters suggested by the IPCC changed considerably between 1996 and 2006, leading to corresponding changes in the estimation of emissions. Finally, apart from different approaches and different parameters due to changes in the IPCC guidelines, also other input data can impact on the results. This could be i.e. differences in livestock numbers, the distribution of manure management systems or time spent on pastures, average temperatures, or more technical data like fertilizer use, milk yields, live weight, nutrient contents, nitrogen excretion etc., which are partly assumed and partly already an output of calculation procedures in the CAPRI model. Since the national inventories use other input data some differences in the results are not surprising. For example, differences in estimated CH_4 emissions from enteric fermentation are mainly due to different emission factors for dairy and non-dairy cattle, since other animal categories play a less important role with respect to total emissions from enteric fermentation. The following factors can be identified as potential reasons for the deviations. First, for cattle (Tier 2 approach) CAPRI calculates the digestible energy endogenously, while most inventory reports use default values. Secondly, in the inventories most countries apply a methane conversion factor of 6% (default value according to IPCC 1997, see IPCC 1996), while CAPRI uses 6.5% (default value of IPCC 2006, see IPCC, 2006), leading to higher emission factors in CAPRI of around 8%. Thirdly, animal live weight impacts directly on net energy requirement, but can only be compared for dairy cows. CAPRI generally assumes a live weight of 600 kg, while national inventories use different values ranging from 500 to 700 kg. However, a simple regression suggests that live weight is not a key factor for the generally higher CAPRI values. Finally, there are differences in the weight gain and milk yields. While assumptions on the weight gain are not available in the inventory submissions and, therefore, cannot be compared, milk yields are usually higher in CAPRI than in the national submissions, favouring higher emission factors in case of dairy cows.

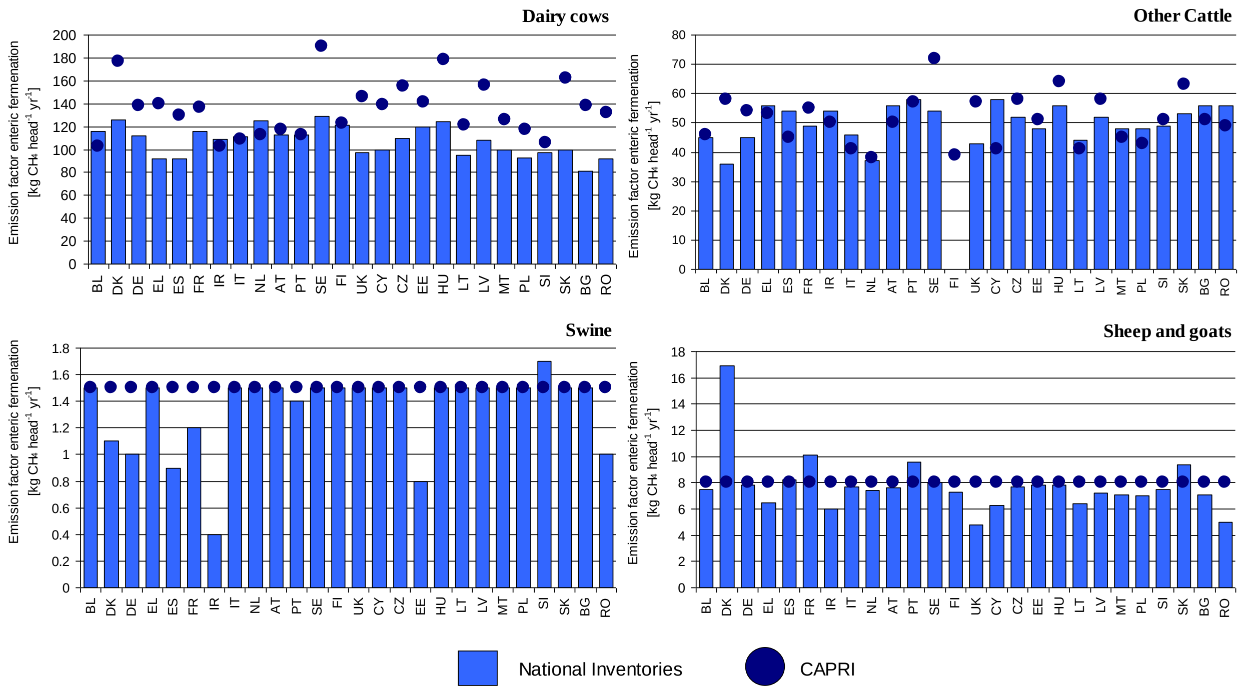
Figure 6.53: Comparison of N-excretion data used in National Inventories to the UNFCCC for the year 2004 (EEA, 2010) and N-excretion data calculated with CAPRI



For EU-27, CAPRI calculates total agricultural sector emissions of 378 Mio tons of $CO_{2\text{-eq}}$, which is 79% of the value reported by the member states (477 Mio tons, biomass burning of crop residues and CH_4

emissions from rice production not included). On member state level this ranges between 54% in Cyprus and 127% in Denmark. Therefore, Denmark is the only member state for which CAPRI estimates total emissions higher than the NIs. With respect to the different emission sources, the relation of CAPRI emissions to NIs are: 103% for CH_4 emissions from enteric fermentation, 54% for CH_4 and 93% for N_2O emissions from manure management, 92% for N_2O emissions from grazing animals, 81% for N_2O emissions from manure application to managed soils, 89% for N_2O emissions from mineral fertilizer application, 87% for N_2O emissions from crop residues, 89% for indirect N_2O emissions following volatilization of NH_3 and NO_X, 11% of N_2O emissions following Runoff and Leaching of nitrate, and 97% of emissions from the cultivation of organic soils.

Figure 6.54: Comparison of emission factors for enteric fermentation in dairy and non-dairy cattle, swine, and sheep and goats used in National Inventories to the UNFCCC for the year 2004 (EEA, 2010) and the emission factors calculated (in case of dairy and non-dairy cattle) or used (in case of swine and sheep and goats) in CAPRI



6.5 Sector-specific recalculations

6.5.1 Enteric Fermentation (CRF source category 4.A)

Information on recalculations of emission estimates in category 4A contained in the NIR of some countries are summarized below:

Table 1.102: Member State's background information for recalculations of emissions in category 4.A

Member State	Recalculations
Austria	
Belgium	**New methodolgy developped in the Brussels Region (principally based on IPCC default parameters).**

	Flemish region: update animal number for 2009 during the 2012 submission.
Denmark	
Finland	
France	
Germany	
Greece	
Ireland	
Italy	- Dairy Cattle: update of NE growth figures for dairy cattle - §NIR par.6.2.2 - Non Dairy Cattle: update of EF for female 1-2 years - §NIR par.6.2.2 - Buffalo: update of NE growth figures for buffalo- §NIR par.6.2.2 - update of rabbits population
Luxembourg	
Portugal	1) Introduction of agricultural census data (RGA 2009) which revised the 2000-2009 time series for all animal types. For some animal types (like swine) this affects the 1990-2009 time series; 2) Revised milk yield also due to RGA 2009; 3) Due to the in-depth AD revision provided by the RGA 2009 efforts were also made to revise the slaughtering values for the 1990-1999 time series.
Netherlands	
Spain	- Small update on parameters for the calculation of emissions from swine and poultry
Sweden	- The whole time series for number of horses has been updated with the results from a new survey carried out by the Swedish Board of Agriculture. - The whole time series for number of slaughter chickens has been updated due to an updated estimation method.
United Kingdom	- Animal numbers were revised and updated. - Animal categories have been revised and updated. - The time spent grazing for dairy and beef cattle has been changed. - For dairy cows the Tier 2 methodology for calculating enteric methane was revised from the 1996 Guidelines to the IPCC 2000 Good Practice Guidance.

6.5.2 Manure Management (CRF source category 4.B(a))

Information on recalculations of emission estimates in category 4B(b) contained in the NIR of some countries are summarized below:

Table 1.103: Member State's background information for recalculations of emissions in category 4.B

Member State	Recalculations
Austria	MCF for anaerobic digesters increased from 0% to 2% only plants under contract for electricity supply considered share of digested manure per animal category recalculated
Belgium	
Denmark	
Finland	
France	- Data on manure management systems have been revised on the basis of a study of the ministry of agriuclture (1994, 2001 and 2008)
Germany	
Greece	
Ireland	
Italy	- update of rabbits population - update of biogas recovered distribution between swine and cattle §NIR par.6.3.2
Luxembourg	
Netherlands	
Portugal	1) Introduction of agricultural census data (RGA 2009) which revised the 2000-2009 time series for all animal types. For some animal types (like swine) this affects the 1990-2009 time series; 2) Revised milk yield also due to RGA 2009; 3) Due to the in-depth AD revision provided by the RGA 2009 efforts were also made to revise the slaughtering values for the 1990-1999 time series.

Spain	
Sweden	**- The MCF for liquid manure has been revised. A study by Rodhe et al. 2008 investigated the emissions of methane and nitrous oxide from cattle slurry storage.**
United Kingdom	**- Animal numbers were revised and updated.** **- Animal categories have been revised and updated.** **- The time spent grazing for dairy and beef cattle has been changed.** **- Tier 2 for CH_4 from manure management has been developed.** **- AWMS distribution has been updated.**

6.5.3 Manure Management (CRF source category 4.B(b))

Information on recalculations of emission estimates in category 4B(b) contained in the NIR of some countries are summarized below:

Table 1.104: Member State's background information for recalculations of emissions in category 4.B-N_2O

Member State	Recalculations
Austria	
Belgium	**Flemisch region: AWMS has been corrected for rabbits for the entire time series during the 2012 submission.**
Denmark	
Finland	
France	**- nitrogen excretion coefficients have been updated on the basis of better country-specific data**
Germany	
Greece	
Ireland	
Italy	**- update of non dairy female 1-2 years liquid and solid MMS data** **- Solid storage and dry lot: update of activity data (population) - §NIR par.6.3.2**
Luxemburg	
Netherlands	
Portugal	
Spain	
Sweden	
United Kingdom	**- Animal numbers were revised and updated.** **- Animal categories have been revised and updated.** **- Updated N excretion factors for cattle.** **- AWMS distribution has been updated.** **- The N_2O-N emitted during manure management is no longer subtracted from the N available to apply to soils.**

6.5.4 Agricultural Soils – CH_4 (Source category 4.D)

Information on recalculations of emission estimates in category 4D contained in the NIR of some countries are summarized below:

Table 1.105: Member State's background information for recalculations of emissions in category 4.D

Member State	Recalculations
	No recalculations

6.5.5 Rice Cultivatoin – CH_4 (Source category 4.C)

Member State	Recalculations
Italy	**- Update of cultivation period for some rice varieties (4.c.1.2.1 Single Aeration, 4.c.1.2.2 Multiple**

Member State	Recalculations
	Aeration)
Portugal	**1) New data on areas in Techniques of Integrated Production and Protection.**

6.5.6 Agricultural Soils - N_2O (Source category 4.D)

Information on recalculations of emission estimates in category 4D contained in the NIR of some countries are summarized below:

Table 1.106: Member State's background information for recalculations of emissions in category 4.D

Member State	Recalculations
Austria	**- The reduced amount of digested manure resulted in slightly higher emissions from animal manure applied to soils.** **- The updated amount of sewage sludge applied to soils resulted in lower emissions 2008 and 2009**
Belgium	**Flemish region: category 4.D.1.2: During the centralized review of sept 2011 the ERT stated that Belgium has applied a wrong equation for estimating the N_2O emissions from animal manure application (FAM). This formula has been corrected for the entire time series during the 2012 submission.** **Small corrections in the calculation sheet in the Walloon region (time series).** **Flemish region: categories 4.D.1 and 4.D.3: update synthetic fertilizer use for 2009 during the 2012 submission.** **Flemish region: category 4.D.3.2: update NLEACH for the years 2008&2009 during the 2012 submission.** **Flemish region: category 4.D.1.4.: For some crops (non N-fixing crops) and for the entire time series, the fractions FracR and FracNCR0 has been corrected during the 2012 submission. These are now in line with the GPG2000.**
Denmark	
Finland	
France	**- Modification of the methodology for N-input by crop residues, taking into account specific harvest indices and results of the study « Pratiques culturales ».**
Germany	
Greece	
Ireland	
Italy	**- 4.D.1.2 Animal Manure Applied to Soils: update of fraction of livestock N excretion volatilized - §NIR par.6.5.2**
Luxemburg	
Netherlands	
Portugal	**- Introduction of RGA 2009 data which revised the 2000-2009 time series for all animal types and crops;** **- Revision of the 2009 value for apparent consumption of synthetic fertilizers.**
Spain	**- Update of data on cultivated area and yield** **- Update of data on compost application** **- Including data on information on consumption of N from "other synthetic fertilisers"**
Sweden	**- Statistics Sweden has recently started to publish standard yields also for temporary grass. From the new data together with a literature study of old values a new time series has been constructed that is now harmonized with the time series for the other crops.** **- New calculations from Statistics Sweden for nitrogen and phosphorus balances for agriculture has resulted in revised values for the years 2007-2009 for $Frac_{GASM}$, both for the stable and grazing period.** **- Owing to new data from Statistics Sweden the values for fraction of nitrogen that volatilizes as NH_3 and NO_x from manure management and grazing manure have been updated.** **- Data for average nitrogen leaching from agricultural soils has been updated.** **- There are new estimates for total area of agricultural land for the most recent five years. The reason is the method used by SLU for estimating agricultural where number of sample plots increase with new submissions**
United Kingdom	**- Animal numbers were revised and updated.** **- Animal categories have been revised and updated.** **- Updated N excretion factors for cattle.** **- AWMS distribution has been updated.** **- Crop areas, production and categories have been updated.**

Member State	Recalculations
	- The N_2O-N emitted during manure management is no longer subtracted from the N available to apply to soils. **- Correction to the calculation of direct N_2O from grazing - the N input is no longer corrected for 20% atmospheric deposition.** **- Crop residues now include all legumes not only Phaseolus beans.** **- Amended crop residue calculations to account for fraction of residue burnt (applies to wheat, barley, oats, linseed). Field burning detailed calculations have been amended to include the years 1990-1993.**

6.5.7 Field burning of agricultural residues - N_2O (Source category 4.F)

Information on recalculations of emission estimates in category 4F contained in the NIR of some countries are summarized below:

Table 1.107: Member State's background information for recalculations of emissions in category 4.F

Member State	Recalculations
France	**New methodology**

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7 LULUCF (CRF Sector 5)

Complying with relevant provisions, Sector 5 LULUCF (Land Use, Land Use Change and Forestry) of the European Union (EU) GHG Inventory is a compilation of the reports submitted by the EU's Member States (MS). MS' NIRs of 2012 are used as the primary source of data and information, unless otherwise specified and referenced.

This chapter provides the general trends of emissions and removals from LULUCF at the EU-15 level, compares the methods used by different countries and describes the efforts carried out to harmonize and improve the complete and consistent reporting of GHG inventory at EU-15 level. More detailed information can be found in the NIRs of individual MS.

In particular, for the EU-15, this chapter includes: an overview on LULUCF sector including overall trends, the contribution of land use changes, the completeness of reporting, the key categories and some general methodological information; the trends of net emissions, activity data and emissions factors for each category; some specific methodological information for the relevant categories; and an overview of cross-cutting issues including uncertainties, QA/QC, time series consistency and recalculations.

Meanwhile, the Chapter 22 (LULUCF for EU-27) provides some basic information for the new 12 MS of the European Union.

7.1 Overview of the sector (EU-15)

With almost all lands under more or less intensive management, Europe is a fine-grained mosaic of different land uses, resulting in a highly fragmented landscape. According to Eurostat (2008), forests and other woodland in EU-27 represent around 161 Million ha, or 42% of total land. The utilized arable area accounts for 27 % of total land, whereas permanent grasslands and built-in area represent around 15% and 8%, respectively. Although no major differences exist between EU-15 and the new 12 MS, the relative share of different land uses vary widely across individual MS, according to the prevailing ecological and socio-economic conditions.

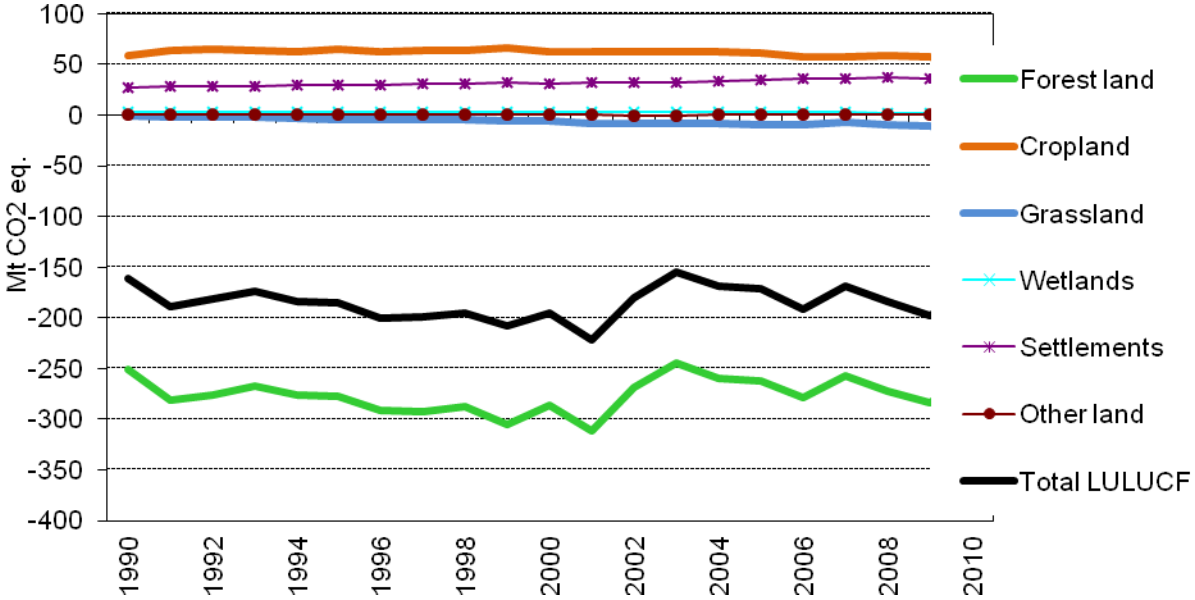
The EU agricultural and environmental policies have been the major driver of land use and land use change in Europe since 1990. In particular, the Common Agricultural Policy and rural development programs have stimulated less intense agricultural practices and a general decrease of area of the utilized arable land, compensated by the increase in forest and urban areas. Furthermore, the EU environmental policy (e.g. Natura 2000 network) has stimulated a significant increase of forest and woodlands area under conservation regime with the purpose of preserving biodiversity and landscapes. Currently, at EU-27 level, around 25% of total forest and woodland areas are excluded from harvesting, and felling accounts for only 60% of the net annual wood increment (Eurostat 2008[30]), which explains the significant build-up of biomass (i.e. carbon removal) in the forests.

[30] EEA Report No 3/2008, European forests - ecosystem conditions and sustainable use

7.1.1 Trends by land use categories

The Sector 5 LULUCF of the EU-15 is a net carbon sink, resulting from higher removals by sinks than emissions from sources. Overall, forests are a significant net carbon sink, croplands are a source and grasslands are a small sink (Figure 7.1). In 2010, the net CO_2 in LULUCF sink in the EU-15 was -179075 GgCO_2-eq. which represents an increase of about 7% compared to annual sink in 1990 (Figure 7.1). The contribution of CH_4 and N_2O is less than 3% of net annual sink.

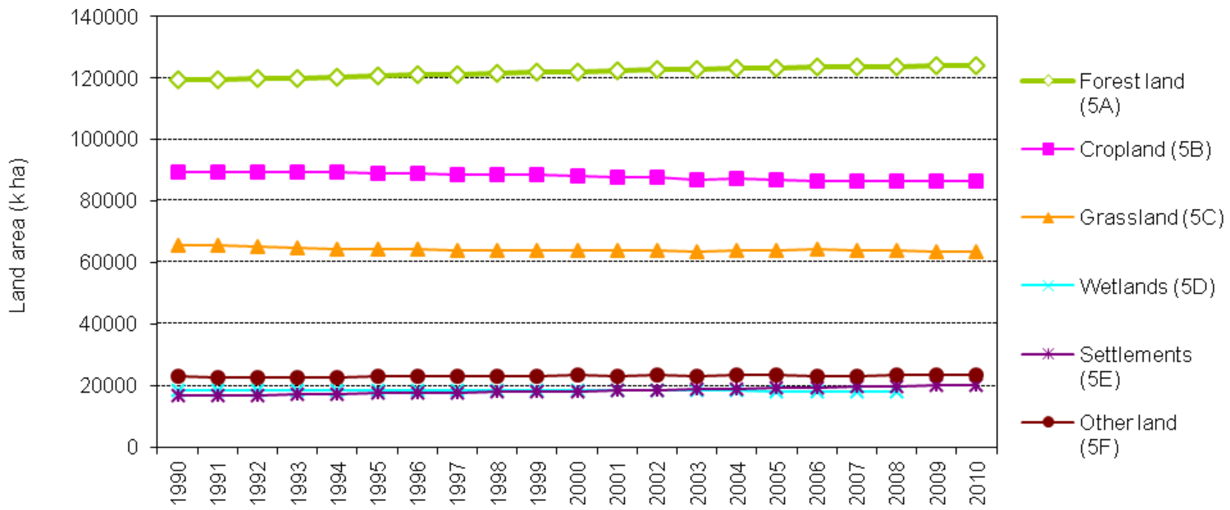
Figure 7.1 Sector 5 LULUCF: EU-15 GHG emissions (+) and removals (-) for 1990–2010, in CO_2 eq. (Gg), for all land use categories



The increase of the EU-15 sink was mainly achieved during the '90s. It was followed by a decline largely attributable to Germany, whose forest sink decreased of about 50000 Gg CO_2 in 2002. The other year-to-year variations of the forest sink are mainly related to major wind storms (e.g. 2000 in central-western Europe) and wild fires (e.g. forest fires in 1990, 2003 and 2007 in Mediterranean countries).

Increase of the removal trend is supported by modification of the land area. The reported land area of the different categories (Figure 7.2) confirms the trends known from other statistics (e.g. Eurostat), although the absolute numbers may slightly differ due to different definitions under different reporting requirements. For EU-15, the main changes in area from 1990 and 2010 regarded Forests land (+4%), Cropland (4%) and Settlements (+20%). Small inconsistency of total land area reported in time is caused by the fact that reporting complete and consistent information on activity data represents a challenging task for the MS (see Ch. 7.2 and followings for more details, and 7.8.4 for QA/QC and planned improvements).

Figure 7.2 **EU-15 total land area in the various LULUCF categories (kha), as reported in the MS' CRFs**



Although EU15 showed a net sinks in LULUCF sector in 2010, it should be noted that the MS are practically split in two groups: some with very small sinks (e.g. Belgium, Denmark and Ireland) other with high sinks (e.g. Italy, France, Spain, Finland and Sweden). Also, there are few countries that estimate LULUCF as a source: Germany (since 2002), Denmark, The Netherlands and United Kingdom.

Table 7.1 **Sector 5 LULUCF: MS' contributions to net CO_2 emissions in 2010**

Member State	Net CO_2 emissions (Gg)			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010	
	1990	2009	2010		(Gg CO_2)	(%)	(Gg CO_2)	(%)
Austria	-10.064	-3.694	-3.661	2,0%	33	-1%	6.403	-64%
Belgium	-1.255	-1.099	-1.134	0,6%	-35	3%	120	-10%
Denmark	4.403	-889	-2.184	1,2%	-1.294	146%	-6.587	-150%
Finland	-15.859	-36.268	-22.260	12,0%	14.008	-39%	-6.402	40%
France	-22.372	-39.398	-35.494	19,2%	3.904	-10%	-13.121	59%
Germany	-27.968	16.959	17.028	-9,2%	69	0%	44.996	-161%
Greece	-2.524	-3.043	-3.064	1,7%	-21	1%	-540	21%
Ireland	178	-1.101	-1.103	0,6%	-2	0%	-1.281	-719%
Italy	-34.758	-56.022	-56.659	30,7%	-637	1%	-21.901	63%
Luxembourg	345	-299	-298	0,2%	1	0%	-643	-186%
Netherlands	3.000	2.865	3.001	-1,6%	136	5%	1	0%
Portugal	-9.412	-14.155	-11.331	6,1%	2.824	-20%	-1.919	20%
Spain	-19.296	-28.612	-29.020	15,7%	-408	1%	-9.724	50%
Sweden	-41.342	-35.868	-34.193	18,5%	1.675	-5%	7.149	-17%
United Kingdom	3.099	-4.778	-4.409	2,4%	369	-8%	-7.508	-242%
EU-15	**-173.825**	**-205.402**	**-184.780**	**100,0%**	**20.622**	**-10%**	**-10.955**	**6%**

Overall, for the EU-15, LULUCF sector in 2010 offsets about 5 % of the total EU-15 emissions (without LULUCF), with values ranging from +1.8 % (as a source, in Germany) to -51.4 % (as sink, in Sweden)) (Table 7.2, column a). The most important LULUCF category, Forest Land, in 2010 was a net sink for all MS (Table 7.2), whose offset ranged from 1.3 % (in Netherlands) to 57.5 % (in Sweden), while the overall offset for the EU-15 was -7.7% (Table 7.2, column b). The most significant contributors to EU-15's 5A inventory are France and Italy (Table 7.2, column c).

Table 7.2 **Sector 5 LULUCF: Contribution of Sector 5 (column a) and Category 5A (column b) to total emissions (without LULUCF) and MS contribution to EU-15 Category 5A (column c)**

Member State	Sector 5 over total emission excluding LULUCF	Category 5.A over total emissions	Member States contribution to EU-15 total for Category 5A
	(a) (%)	(b) (%)	(c) (%)
Austria	-4,3%	-6,4%	1,9%
Belgium	-0,8%	-2,7%	1,2%
Denmark	-3,5%	-9,3%	2,0%
Finland	-29,6%	-44,0%	11,5%
France	-6,2%	-10,1%	18,5%
Germany	1,8%	-2,7%	8,8%
Greece	-2,6%	-2,0%	0,8%
Ireland	-1,7%	-2,2%	0,5%
Italy	-11,3%	-8,0%	14,0%
Luxembourg	-2,4%	-3,9%	0,2%
Netherlands	1,4%	-1,3%	0,9%
Portugal	-16,1%	-17,2%	4,2%
Spain	-8,1%	-7,1%	8,8%
Sweden	-51,4%	-57,5%	13,4%
United Kingdom	-0,6%	-1,8%	3,7%
EU-15	**-5,4%**	**-7,7%**	**100,0%**

Source: MS' submissions 2012, CRF table 5, 5A and Summary 2.

7.1.2 Contribution of land use changes

Entire land use change area only represents 8 % of the total reported land area in EU-15 (Table 7.3, column b), which is less than reported last year especially under recalculations of 5B2 and 5E2. "Other land" absolute area is similar to previous year submission (nevertheless, 1 percentage point higher).

The sink on conversions to forestland and grassland is almost balanced by emissions from conversions to settlements at EU-15 level. Overall, 2010 emission is 6 % smaller than that reported for 2010 under the effect of recalculations (the biggest fall was in "conversions to forestland", and the increase in "conversions to grassland"), and also likely because of land leaving their transition period. Despite small share of total land, the emissions and removals associated with land conversions represent, in absolute terms, 29% of the net emissions from LULUCF (Table 7.3, column d).

Table 7.3 **Contribution of land use changes in 2010 for EU-15, in terms of area (columns a-b) and GHG emissions (columns c-d).**

Land conversions	a) land area	b) % of area of the corresponding category[1]	c) emissions (+) and removals (-) (Gg CO_2 equivalents)	d) % of net emissions of the corresponding category[1,2]
5A2. Land converted to Forest Land	6,315	5%	-30,574	12%
5B2. Land converted to Cropland	6,541	8%	27,891	53%
5C2. Land converted to Grassland	8,834	14%	-20,215	70%
5D2. Land converted to Wetlands	682	4%	598	19%
5E2. Land converted to Settlements	4,046	20%	30,110	86%
5F2. Land converted to Other Land	1,241	5%	539	100%
Total land use changes	**27,660**	**8%**	**109927**	**29%**

[1] *the corresponding category is 5A (Forest land) for 5A2, 5B (Cropland) for 5B2 and so on.*
[2] *The contribution of emissions from land use changes to the total of each category was obtained by considering separately the absolute values of each subcategory, i.e. (abs 5A2)/(abs 5A1+ abs 5A2) x 100.*

Land use area under conversion is 16 % higher than in 2010 than in 1990 (Table 7.4). Overall, land use changes associate with emissions in 1990 and turned into removal in 2010.

Table 7.4 **EU-15 land use change matrix for the years 1990 and 2010, in terms of area and net emissions (in italics).**

Year 1990		Land area conversions from… (kHa)						Total "to"
		forestland	cropland	grassland	wetlands	settlements	otherland	
Conversions to	forestland		1097	2606	240	259	185	**4387**
	cropland	406		7363	28	394	18	**8208**
	grassland	691	7172		71	476	100	**8509**
	wetlands	78	72	100		26	84	**361**
	settlements	499	1316	1236	45		55	**3151**
	otherland	142	88	118	28	7		**384**
Total "from"		**1816**	**9745**	**11423**	**412**	**1161**	**442**	**24999**

Year 1990		Net emissions in conversion from …(GgCO_2)						Total "to"
		forestland	cropland	grassland	wetlands	settlements	otherland	
Net emissions in conversions to …	forestland		-5928	-13010	-937	-3513	-1222	**-24609**
	cropland	5344		30041	418	-38	151	**35916**
	grassland	3929	-20165		921	-2476	-102	**-17893**
	wetlands	1082	-455	-1067		-398	901	**63**
	settlements	7126	3169	11857	672		841	**23665**
	otherland	1117	-811	-32	0	0		**275**
Total "from"		**18598**	**-24190**	**27790**	**1074**	**-6425**	**568**	**17416**

Year 2010		Land area conversions from… (kHa)						Total "to"
		forestland	cropland	grassland	wetlands	settlements	otherland	
Conversions to	forestland		1492	3549	539	341	494	**6416**
	cropland	333		6014	41	358	15	**6762**
	grassland	618	7707		91	660	148	**9224**
	wetlands	178	85	198		660	168	**1289**
	settlements	646	1686	1539	80		125	**4076**
	otherland	145	306	532	130	26		**1140**
Total "from"		**1921**	**11276**	**11833**	**881**	**2045**	**950**	**28907**

Year 2010	Net emissions in conversion from …(GgCO_2)	Total "to"

		forestland	cropland	grassland	wetlands	settlements	otherland	
Net emissions in conversions to …	forestland		-11566	-13152	-1346	-3829	-2745	**-32639**
	cropland	5599		22821	590	-346	108	**28772**
	grassland	4033	-21404		1012	-3578	-117	**-20054**
	wetlands	1422	-415	-1819		-820	1287	**-344**
	settlements	11001	6711	11102	936		1686	**31435**
	otherland	1324	-572	-214	3	0		**542**
Total "from"		**23380**	**-27246**	**18738**	**1195**	**-8573**	**219**	**7712**

The most important land use changes in EU-15, in terms land area involved, are the conversions from grassland to cropland and vice versa, the conversions from grassland to forestland, and the conversion of forestland to settlements. On average, in 2010, out of lands area "under conversion" 22% are conversions to forest land, 14% are conversions to settlements and 32 % and respectively 23% are conversions to grasslands and respectively cropland. When interpreting the data of Table 7.4 it is important to note that some differences may occur among MS in terms of both land use definitions and the reported time series (e.g. some countries start only in 1990, and not all countries use the 20-yrs default transition period, some MS assume linear transition in time), but nevertheless these effects are minimized starting with 2010.

7.1.3 Completeness

Table 7.5 illustrates the current coverage of reporting for the various land sub-categories in the year 2010. The three main land uses have practically complete coverage.

Table 7.5 **Sector 5 LULUCF: Coverage of CO_2 emissions and removals in the various land sub-categories for the year 2010, as derived from 2012 submission**

Member State	Reporting category											
	Forest land		Cropland		Grassland		Wetland		Settlements		Other land	
	5A1 F-F	5A2 L-F	5B1 C-C	5B2 L-C	5C1 G-G	5C2 L-G	5D1 W-W	5D2 L-W	5E1 S-S	5E2 L-S	5F1 O-O	5F2 L-O
Austria	E	R	E	E	R	E		E		E		E
Belgium	R	R	E	E	E	R		R		E		E
Denmark	R	E	E	E	E	E	E	R		E		
Finland	R	E	E	E	E	E		E		E		
France	R	R	E	E	E	R		R		E		E
Germany	R	R	E	E	E	R	E	E	E	E		
Greece	R	R	R	E	E	E		E		E		E
Ireland	R	R	R	E	E	R	E	E		E		R
Italy	R	E	E	E	R	E	E	E	E	R	R	
Luxemb.	R	R	E	E		E		E		E		E
Netherl.	R	R		E	E	E		E		E		E
Portugal	R	R	R	E	E	R		E		E		R
Spain	R	R	R			R				E		
Sweden	R	R	E	E	R	R	E		E	E		
UK	R	R	E	E	R	R	E	E	E	E		

R = the pool acts as net Removal; E = the pool acts as net Emission
Empty cells = the pool was not reported, included elsewhere or reported as no changing.

For non forest land sub-categories emissions are mainly reported as not occurring for land remaining in the same category. Meanwhile there is a quite complete reporting on the conversions, with relevant IPCC guidelines implemented for pools (i.e. SOC – soil organic carbon change is not estimated for conversions from forest to 5E).

Despite heterogeneous definitions of land categories implemented by the MS, comparability of LULUCF sectors in the national GHG inventories is ensured as long as CO_2 removal and GHG emissions are estimated under complete national inventories. On the other hand, the quantitative effect of definitional differences are likely negligible.

Table 7.6 shows the completeness of reporting of C stock changes by pools for the three most important land sub-categories in 2010. Compared to the previous submissions, several MS have increased the number of pools estimated and reported. This is also the case of empty cells in Table 7.7 where such pools are not reported as sink or source, but demonstrated in the NIR to be very small sinks, then reported in the CRF by notation keys (and further making the link with Kyoto Protocol reporting), while the effort to provide estimates is ongoing.

Pools also have different definitions amongst MS, however, the quantitative effect of definitional differences are likely negligible.

7.1.4 Key categories

The following subcategories of the LULUCF sector of the EU-15 GHG inventory were found to be key categories for the trend and the level assessment in 2010:

5A1 Forest Land remaining Forest Land: CO_2

5A2 Land converted to Forest Land: CO_2

5B1 Cropland remaining Cropland: CO_2

5B2 Land converted to Cropland: CO_2

5C1 Grassland remaining Grassland: CO_2

5C2 Land converted to Grassland: CO_2

5E2 Land converted to Settlements: CO_2

Table 7.6 Sector 5 LULUCF: Reporting of carbon pools for the most important land sub-categories for the year 2012 (from Tables 5A, 5B and 5C of MS's CRF 2012)

	Forest land								Cropland								Grassland							
	FL-FL				L-FL				CL-CL				L-CL				GL-GL				L-GL			
MS	Biom	DOM	SOC Min	SOC Org	Biom	DOM	SOC Min	SOC Org	Biom	DOM	SOC Min	SOC Org	Biom	DOM	SOC Min	SOC Org	Biom	DOM	SOC Min	SOC Org	Biom	DOM	SOC Min	SOC Org
AT	R	R	E		R	R	E		E		R		R	E	E				R		E	E	R	
BE	R	R	R		R		R				E		E	E	E				E		E	E	R	
DK	R	R		E	R	R		E	E		E	E	E	E	R	E	E			E	E			E
FI	R		R	E	R		R	E	R		R	E	E	E	E	E			R	E	E	E	R	E
FR	R	E											E	E	E						E	E	R	
DE	R	R		E	R	R		E				E	E	E	E	E	R		R	E				E
GR	R				R				R		R	E	E				E				E			
IE	R	R		E	R	R		E			R		E		E				E	E	E	E	R	E
IT	R	R			R	R			R	R		E			E		R	R			E		R	
LU	R				R				E				E	E	E						E	E	R	
NL	R	E			R								E	E						E				E
PT	R	E	E		R	R	E		R		R		E	E	E						E	E	R	
ES	R				R				R		R												R	
SE	R	R	R	E	R	R	R	E	R	E	E	E	R	E	E	E	R	R	R	E	R	E	R	E
UK	R	R	R	R	R	R	R	R	R		E	E	R		E				R				R	

Pools: DOM – dead organic matter, Biom –biomas, SOCmin – mineral soils organic carbon, SOCorg – organic soils organic carbon

R: net Removal; E: net Emission

Empty cells = the pool was not reported or reported as zero (either "not estimated" (reported in CRF as "NE" alone or in combination with other keys), assumed as "no C stock change" (following IPCC tier 1), or assumed as "not occurring" (notation keys used "NO" and/or "NA")

ie means that the pools change is estimated but included elsewhere

7.1.5 Data and methods

This chapter provides general information on methods, activity data, carbon stock change factors and emissions factors on sink and sources for the main land sub-categories (5A: Forest Land, 5B: Cropland and 5C: Grassland). Detailed information can be found in Ch. 7.3, Methodological issues.

Given the heterogeneity of the countries in terms of ecological and socio-economic conditions, there are no unique definitions of different land uses across MS. Data on the area of land use categories, the land affected by disturbances and the amount of harvest used to estimate GHG emissions and removals mainly come from national statistics, national forest inventories and forest management plans (Table 7.7). Thematic maps are sometimes used (national maps, Corine Land Cover).

Table 7.7 Data sources for activity data as NIR 2012. NFI: national forest inventory; NS: national statistics (agricultural and forest statistics, management plans, cadastral data); NM: national maps; CLC: Corine Land Cover, EO: Earth Observation. Empty cells: data not necessary (for 5A)/no information reported/ no reported pool/Tier 1

Member State	Reporting categories								
	5A				5B		5C		Other LU categories
	5.A.1	5.A.2	Harvest	Distur-bances	5.B.1	5.B.2	5.C.1	5.C.2	
Austria	NFI	NFI		NFI	NS	NS	NS	NS	NS
Belgium	NFI	NFI		NS	CLC, NS		CLC, NS		NS
Denmark	NS, NFI	NS,NFI		NS	NS, NM		NS,NM		NS
Finland	NFI	NFI	NS	NS	NS		NFI, NS		NFI, NS
France	NFI, NM	NFI, NM	NS	NS	NS, NM	NS, NM	NS, NM	NS, NM	NS, NM
Germany	NFI	NFI		NS	NS, NM, CLC	NS, NM, CLC	NS, NM, CLC	NS, NM, CLC	NS, NM, CLC
Greece	NFI, NS	NS		NS	NS		NS		
Ireland	NFI, NS	NS, NM, CLC	NS	NS	NS	NM	NS	NM, CLC	NS, CLC
Italy	NFI, NS	NS	NS	NS	NS	NS	NS	NS	NS, CLC
Luxembourg	EO	EO		EO	EO	EO	EO	EO	EO
The Netherlands	NFI, NM	NFI, NM		NS	NM	NM	NM	NM	NM
Portugal	NFI, CLC	CLC, NS	NS	NS	CLC	CLC	CLC	CLC	CLC
Spain	NFI, CLC, NM	NS		NS	CLC, NS	CLC	CLC	CLC	CLC
Sweden	NFI	NFI	NFI	NFI	NFI	NFI	NFI	NFI	NFI
United Kingdom	NS	NS	NS	NS	NS	NS	NS	NS	NS

The methods used by the MS to estimate emissions and removals from the LULUCF sector vary among countries and land use categories, as depending on data availability. Table 7-8 is a summary of relevant information on each individual pool in the GHG inventory 2012 for the LULUCF sector.

Because of different underlying methods of each country, when comparing the absolute levels or trends of the implied emission/carbon stock change factors across MS, much caution should be used. Indeed, in some cases, large differences may only be attributable to the different estimating or reporting methodology and they do not truly reflect the different intensity of emissions and removals. For example, some implied emission factors may be significantly affected by new areas entering a given category or time series for land conversions started in 1990. Furthermore, the fact that not all countries use the 20-year default transition period for land use change categories means that the corresponding emission factors are not fully comparable across all MS.

Table 7-8 Summary of methods and C stock change factors used by countries to calculate emission and removals of different pools in the LULUCF sector.

MS	Forest land								Cropland								Grassland							
	FL-FL				L-FL				CL-CL				L-CL				GL-GL				L-GL			
	BM	DOM (1)	SOC Min	SOC Org (2)	BM	DOM	SOC Min	SOC Org (2)	BM (3)	DOM	SOC Min (4)	SOC Org (2)	BM (5)	DOM	SOC Min	SOC Org (2)	BM	DOM	SOC Min (4)	SOC Org (2)	BM	DOM	SOC Min	SOC Org (2)
AT	CS	CS	CS	NO	CS	CS	CS	NO	D,CS	D	CS,CS	NO	CS,CS	CS	CS	NO	NO	D	CS,CS	CS	CS	CS	CS	NO
BE	CS	CS,D	CS	NO	CS	NO	CS	NO	NE	D	CS	NO	CS,NO	D	CS	NO	NO	D	CS	NO	CS, NO	D	CS	NO
DK	CS	CS	NA	CS	CS	CS	CS	CS	CS	NA	CS	CS	CS,CS	CS	CS	CS	CS	NA	NA	D	D	CS	CS	CS
FI	CS	CS	CS	CS	CS	CS	CS	CS	CS	NE	D	CS	D	CS	CS,D	CS	NE	NA	D	CS	D	CS	CS	CS
FR	CS	CS,D	NO	NO	CS	CS	CS	NO	D	D	NO	NO	CS,NO	CS	CS	NO	D	D	NO	NO	CS	CS	CS	NO
DE	CS	CS,D	NO	CS,D	CS	CS	CS	CS	NO	NO	NO	CS	CS,CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS
GR	CS	NA	NA	NA	CS	D	IE,NO	NO	CS	D	D,D	D	CS,NE	D	IE	NO	D	D	IE,NO	NO	D	D	IE,NO	NO
IE	CS	CS,D	NO	CS	CS	CS	NO	CS	NO	NO	CS,D	NO	NO	NO	CS	NO	NO	NO	CS	CS,D	CS	NE	CS	CS
IT	CS	D,CS	NE	NO	CS	CS	CS	NO	CS	CS	NE,NO	D	NO	NO	CS	NO	CS	CS	NE,NO	NO	D	D	CS	NO
LU	CS	NO	NO	NO	CS,D	NO	CS	NO	D	D	NO	NO	CS	D	CS	NO	NO	NO	NO	NO	CS	CS	CS	NO
NL	CS	CS	NE	NE	CS	NE	NE	NE	NE	NE	NE	IE	CS	CS	NE	NE	NE	NE	NE	CS	CS	CS	NE	NE
PT	CS	CS	CS	NO	CS	CS	CS	NO	CS	NO	CS	NO	CS,CS	CS	CS	NO	NO	NO	NO	NO	CS	CS	CS	NO
ES	CS	NE	NE	NO	CS	NE	CS	NO	CS	NE	CS	NO	NO,NO	NO	NO	NO	NE	NE	NE	NO	NE	NE	CS	NO
SE	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS,CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS
UK	CS	CS	CS	CS	CS	CS	CS	CS	CS	D	CS	CS	CS,CS	CS	CS	CS	NO	NO	CS	NO	CS	CS	CS	CS

(D: default; CS: country specific; NA: not applicable; NE – not estimated; NO- not occurring)
Source: CRFs 2011/2012
"CS" country specific data, associated either with IPCC method (tier 2) or country-specific method (tier 3, if data are highly disaggregated). Note that sometimes not all parameters involved in the estimation are truly "CS" (e.g. root/shoot ratio and BEF are often taken by IPCC). However it is expected that if "CS" is reported, the most important parameters are truly "CS
"D" means that the default IPCC emission factors are used in the estimation. D is typically associated with IPCC default method (tier 1). If the heading is in grey, D means that NO change in C stock is assumed (following IPCC tier 1).
"NE" means either country assumes the emission/removal is negligible or not enough data is available for estimation
"NO" means emissions or removals "not occurring" in a country (it includes also "NA" - not applicable)
(1) for DOM under "FL r FL" the 2 notations separated by a comma mean: first one refers to DW (dead wood), second to LT (litter)
(2) for ORGANIC SOIL any notation key reported for a country showing some activity data of org soil for any land (sub)category is assumed as NE. D refers to the use of IPCC default emissions factors
(3) BIOMASS C stock change in CL-CL is assumed only for perennial woody crops. Biomass of annual crops is always assumed zero C stock change by definition.
(4) for SOC MIN on CL and GL the 2 notation keys separated by comma mean that the country uses IPCC default method (which is tier 1 if associated with D data or tier 2 if associated with CS data); in this case, the first notation key refers to "reference C stock", and second to "C stock change factor" (see IPCC-GPG for details). A cell with a single "CS" indicate a country-specific method and data (i.e. tier 3 if data are highly disaggregated)
(5) for BIOMASS under L - CL, "conversion to cropland", the 2 notation keys used mean: first one refers to FL-CL and second to GL-CL
Grey heading means that for these pools IPCC TIER 1 allows to assume no change in C stock (note that if the category is a key category, in theory higher tiers should be used)

7.2 Forest land (CRF 5A)

7.2.1 Overview of the Forest land category

Forests land is the dominant category in the LULUCF sector. According to the data provided by the MS in their 2012 submissions, total forest area in EU-15 increased from 120949 kha in 1990 to 126150 kha in 2010, which is some 4.3% more. This trend, reflected in official statistics of the MS and EU, is due to the decreasing grazing pressure and decreasing agricultural activities on marginal lands, which promoted natural forest expansion, and also to the promotion of national afforestation programs (including grant-aid). The largest forest area is in Sweden (65% of total country land area), Finland (65% of total area, while the lowest share is found in Malta (1%), the Netherlands (10%) and the United Kingdom (9%).

Deforestation does not appear to be a major issue in Europe; although it may be relevant for specific countries, 7% in total conversion area is represented by conversion from forestland (see Chapter 11 on KP LULUCF for more data on deforestation). In any case, the deforestation area is more than compensated by that of new planting and forest expansion.

Currently, European forests show a considerable sink, documented by both forestry administrative institutions and the scientific community. Also, national GHG inventories submissions report increasing IEFs (i.e. C stock change factor for biomass) over time series since 1990 for 5A1 Forest remaining forest, by almost all MS. For many centuries, European forests have been intensively exploited and consequently depleted of carbon. Since the middle of the 20th century, in most EU countries growth rates started to increase, as globalized trading and technological development diminished direct anthropogenic pressure on forests. This reversal was first noted during the extensive surveys carried out in the ‘80s, when there was concern that Europe’s forests were dying due to acid rains. Although it was found evidence of patches of damaged forests, it appeared progressively evident that most of European forests were growing much faster than previously thought from yield table estimates (Karjalainen 1999[31]). Overall, in the last 50 years, forests of Europe have increased by 75% their standing stock (Ciais et al. 2008[32]). Among the likely causes of this increased forest growth the scientific community has suggested: 1) harvesting less than the increment, especially in central and southern Europe, 2) young age structure, i.e. most forests are still recovering from past overexploitation and are still an exponential growth phase, 3) increased fertility of forest soils due to improved silvicultural practices, and 4) fertilizing effects of increased nitrogen deposition and possibly effects of the climate change (enhanced atmospheric CO_2 concentration and increased length of growing season, although considerable uncertainties still exist).

In addition to the above general causes, differences among countries in the absolute level and trend of the carbon sink may be also due to other factors, including:

- Different biological and ecological potential under the range of climatic zones;
- Past and current intensity of forest management: in Nordic countries like Finland and Sweden,

[31] Karjalainen, T., Spiecker, H. and Laroussinie, O. (Eds.). Causes and Consequences of Accelerating Tree Growth in Europe Eds. EFI Proceedings No. 27. European Forest Institute, Joensuu, Finland

[32] Ciais P, Schelhaas MJ, Zaehle S, Piao SL, Cescatti A, Liski J, Luyssaert S, Le-Maire G, Schulze E-D, Bouriaud O, Freibauer A, Valentini R, Nabuurs GJ (2008). Carbon accumulation in European forests. Nature Geoscience 1: 425-429

where the forest sector is very important for economy, almost all the growth is harvested and little biomass accumulates. By contrast, in countries like France and Italy, the current wood harvest is considerably less than the increment.

- The intensity and frequency of natural events, which is somewhat regionalized (e.g. forest fires are typically more frequent in the Mediterranean countries, windbreaks damages occur especially in coniferous plantations)

Nevertheless, over last decade few MS reported increased harvesting over last decade (i.e. Austria reported on average 38 % higher harvest) compared to previous period that explain reduction of annual sinks.

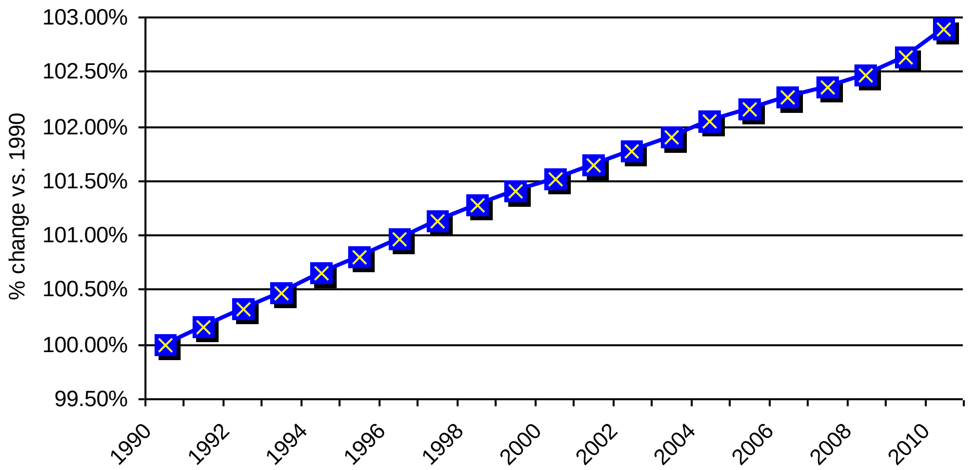
Forests and forestry are under competence of the MS. At European Union level there is only a general framework mainly aimed at coordinating the national forest policies and supporting the sustainable management of forests (i.e. Forest Strategy, Forest Action Plan).

7.2.2 Forest land remaining forest land (CRF 5A1)

7.2.2.1 Overview of Forest land remaining forest land

The area of "Forest remaining forestland" slightly increased by 3 % at EU-15 level since 1990 (Figure 7.3), with large differences among MS (e.g., +55% in Ireland, +21% in Italy, -10% in Netherlands).

Figure 7.3 The relative trend of 5A1 – forest land remaining forest land – area in EU-15, 1990-2010



In absolute terms, most of the land area increase of "Forest remaining forest" was reported by Italy (1544 kha) and decrease by Finland (of ~ 159 kha) (Table 7.9).

Table 7.9 The trend of activity data in the "forest land remaining forest land" subcategory 5A1 in EU-15's MS (kha, 1990-2010)

Member State	1990	1995	2000	2005	2010	Difference 2010 to 1990
Austria	3505	3558	3684	3743	3781	8%
Belgium	711	706	701	695	694	-2%
Denmark	539	537	535	533	533	-1%
Finland	21998	21984	21948	21885	21838	-1%

France	21978	22021	22099	22180	22247	1%
Germany	10205	10270	10334	10457	10585	4%
Greece	3359	3358	3357	3356	3355	0%
Ireland	306	354	391	416	473	55%
Italy	7450	7835	8220	8605	8995	21%
Luxembourg	79	81	82	84	86	9%
The Netherlands	381	369	358	347	341	-10%
Portugal	3734	3778	3823	3867	3912	5%
Spain	12587	12584	12582	12579	12600	0%
Sweden	27730	27842	27864	27883	27851	0%
United Kingdom	2001	2204	2344	2423	2599	30%
EU-15	**116562**	**117482**	**118321**	**119056**	**119890**	**3%**

At EU-15 level, 5A1 is a sink of about 251,000 GgCO_2 in 2010, roughly similar to that in 1990 and 10% smaller than in 2009 (Table 7.10). The strong increase of the sink in 2010 compared to 2009 is largely due to Italy and Finland (under various harvesting share which was variable in time).

Table 7.10 5A1 Forest Land remaining Forest Land: MS' contributions to net CO_2 removal/emissions

Member State	Net CO_2 emissions (Gg)			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2)	(%)	(Gg CO_2)	(%)		
Austria	-7,617	-2,965	-2,968	1.3%	-3	0%	4,649	-61%	T3	CS
Belgium	-3,481	-3,229	-3,231	1.4%	-2	0%	250	-7%	CS,T2	CS
Denmark	-844	-3,060	-5,689	2.5%	-2,629	86%	-4,845	574%	CS	CS
Finland	-23,925	-48,596	-33,181	14.6%	15,415	-32%	-9,256	39%	T2,T3	CS,D
France	-30,499	-52,245	-46,062	20.3%	6,183	-12%	-15,564	51%	T2,T3	CS
Germany	-66,121	-19,544	-19,587	8.6%	-43	0%	46,535	-70%	CS,T1,T2	CS,D
Greece	-1,379	-1,856	-1,856	0.8%	0	0%	-476	35%	T2	CS,D
Ireland	-803	-2,144	-2,010	0.9%	133	-6%	-1,207	150%	D,T1,T3	CS,D
Italy	-18,051	-39,036	-38,758	17.1%	278	-1%	-20,706	115%	T1,T2,T3	CS
Luxembourg	239	-393	-398	0.2%	-4	1%	-637	-266%	T2	CS
Netherlands	-2,412	-2,253	-2,146	0.9%	107	-5%	266	-11%	CS	CS
Portugal	-3,409	-10,524	-8,200	3.6%	2,325	-22%	-4,791	141%	CS,T2	CS,D
Spain	-18,716	-18,698	-18,741	8.3%	-43	0%	-25	0%	T2	CS,D
Sweden	-44,311	-38,165	-36,430	16.1%	1,735	-5%	7,882	-18%	T2,T3	CS
United Kingdom	-6,313	-9,280	-7,461	3.3%	1,818	-20%	-1,148	18%	CS,D,T3	CS
EU-15	**-227,643**	**-251,988**	**-226,717**	**100.0%**	**25,271**	**-10%**	**926**	**0%**		

The largest changes of the MS sinks are when compare to 1990, either increases (e.g Denmark, Finland, France) or decreases (e.g. Germany, Sweden). Major recalculations occurred by France (new data from IFN) and Italy (a large sink in the mineral soils is not reported anymore).

France estimated a removal estimates the CH_4 sink represented by undisturbed forest soils (which is reported as CO_2eq and included into 5A1 soil sink estimate), but nonetheless this is not included under accounted amount of the Forest management activity.

In most cases, CO_2 emissions from disturbances are implicitly included under CRF table 5A1 as losses in the year of event, while other non-CO_2 emissions are considered under 5(V); generally there is no subsequent change of the land use of burnt areas. The main types of disturbances across EU are forest fires (mainly Southern European countries) and wind storms (mainly in central Europe), while other type of disturbances generally have a localized effect and low magnitude, but also difficult to quantify in terms of biomass loss (e.g. insect outbreaks), thus practically not mentioned in the MS reports. Estimation of emissions from forest fires is made with Tier 1 method in case of small emissions (e.g. Austria) or with higher tiers where such emissions are significant (e.g. Portugal, Spain). Forest fires quite often affect the emission removal pattern in several countries (e.g. Portugal in 1990, 2003 and 2005; Italy in 2007), while the windstorms occasionally affected forests in Europe (e.g. France in 1999 and Denmark in 2000). Spain reports areas burnt ranging 20 – 250 kha annually.

7.2.2.2 Methodological issues for Forest remaining forest

Definitions of forest land are reported by EU-15's MS in their NIR 2012. In this EU-15 report, the consistency of the forest land representation is considered under two aspects: 1) within the country in terms of time and space and 2) across the MS within EU-15. The MS' forest definitions are not uniform, but slightly differ in terms of *quantitative* parameters, i.e., crown coverage, tree height and minimum land area (Table 7.11). Forest definitions implemented by the MS are in general consistent with reporting under other international processes (i.e. Food and Alimentation Organization's 2005 and 2011 FRA. Land for forestry administration purpose may be included or not in the forest land, thus additional *qualitative* criteria complement the forest definition of the MS (i.e. treatment of forest roads, nurseries, willow crops, etc (Table 7.12). Few countries have reported change of forest definition for the period since 1990, but apparently these changes do not affect the time series for activity data. Greece has a new forest definition starting 2003. Denmark changed from questionnaire based forestry information to NFI (National Forest Inventory) but implemented methods for GHG inventory estimation ensure consistency in time of activity data (i.e. reassessment of base year data based on earth observation information).

Table 7.11 Information on forest definitions and related parameters in MS's National Inventory Reports under UNFCCC

Member State	NIR 2010			
	Crown cover (%)	Height (m)	Area (ha)	Minimal width (m)
Austria	30	2	0,05	10
Belgium	20	5	0,5	-
Denmark	10	5	0,5	20
Finland	10	5	0.25 for Southern Finland/ 0.5 for Northern Finland	20
France	10	5	0,5	20
Germany	10	5	0.1	-
Greece	25	2	0,3	-
Ireland	20	5	0,1	20
Italy	10	5	0.5	-
Luxembourg	10	5		
The Netherlands	20	5	0,5	30
Portugal	10	5	0.5	20
Spain	20	3	1.0	25
Sweden	10	5	0,5	10
United Kingdom	20	2	0.1	20

The overall effect of different forest definitions on C stock changes at EU-15 level is difficult to assess, as it depends on numerous factors (i.e. land fragmentation, land use change frequency, transition period, land registry systems, GHG estimation methodology, etc.), but it is likely to be very small.

Table 7.12 **Additional qualitative criteria for defining "forestland"** (MS not listed do not show any additional information in NIR 2012)

Member State	Forest definition and additional information and description of forestland (according NIR 2012) (* often more detailed information is provided in the latest version of respective MS NIR)
Austria	Forestland includes permanently un-stocked basal areas that are directly connected with forest land in terms of space and forestry activity, and contribute directly to its management (i.e. hauling systems, wood storage places, glades, forest roads). Areas which are used in short rotation with a rotation period of up to thirty years as well as forest arboretums, forest seed orchards, Christmas tree plantations and plantations of woody plants for the purpose of obtaining fruits such as walnut or sweet chestnut do not account as forests but represent cropland. Rows of trees and areas with woody plants in a park structure are not forest land.
Denmark	Forestland includes temporarily non wooded areas, fire breaks, and other small open areas inside the forestland, Christmas tree are considered under forestland.
Finland	Includes productive forest land, part of the poorly productive forest land and forest roads. Parks and yards are excluded regardless of whether they meet the forest definition.
France	Includes forest roads, forest openings less than 20 m wide (e.g. for fire control), windbreaks and forest belts, as well as the poplar plantations and short rotations woody crops, if the criteria for forestland are met. 5 % of European forests are unmanaged on lands such as strong slopes or used for loisir, esthétique, cultural or military. Also, some 40 % of France's dependencies forestland is considered as unmanaged.
Germany	"Forest" within the meaning of the any area of ground covered by forest vegetation, irrespective of the information in the relevant cadastral survey or similar records. "Forest" also refers to cutover or thinned areas, forest tracks, firebreaks, openings and clearings, forest glades, feeding grounds for game, landings, rides located in the forest, further areas linked to and serving the forest including areas with recreation facilities, overgrown heaths and moorland, overgrown former pastures, alpine pastures and rough pastures, as well as areas of dwarf pines and green alders. Heaths, moorland, pastures, alpine pastures and rough pastures are considered to be overgrown if the natural forest cover has reached an average age of five years and if at least 50% of the area is covered by forest. Forested areas of less than 1,000 m2 located in farmland or in developed regions, narrow thickets less than 10 m wide, Watercourses up to 5 m wide do not break the continuity of a forest area.
Ireland	Forestland is also defined by minimum 50 % of conventional stocking. Includes recently clear felled areas. Tree grown for fruits or flowers, and shrub species (furze, rhododendron) are excluded. The forest area includes open areas within forest boundaries, assumed to be 15% based on NFI statistics.
Italy	Tree plantations and shrublands, that don't fulfill national forest definition, have been reported into cropland category (plantations) and in grassland category (shrublands).
Luxemburg	Permanently unstocked basal areas that are directly connected with forest in terms of space and forestry enterprise and contribute directly to its management (such as forestal hauling systems, wood storage places, forest glades, forest roads) also represent forests. Areas which are used in short rotation with a rotation period of up to thirty years as well as forest arboretums, forest seed orchards, Christmas tree plantations and plantations of woody plants for the purpose of obtaining fruits such as walnut or sweet chestnut do not account as forests but represent cropland. Rows of trees (except shelter belts for wind protection) and areas with woody plants in a park structure are not forest land.
The Netherlands*	Roads in the forestless than 6 m wide are also considered to be forest (under 'Forest' or 'Forest According to Definition' (FAD). Additional to FAD, 'Trees outside Forests' (TOF), that is - wooded areas that comply with the previous forest definition except for their surface area (=< 0.5 ha or less than 30 m width). These represent fragmented forest plots as well as groups of trees in parks and nature terrains and most woody vegetation lining roads and fields. These areas comply with the GPG-LULUCF definition of Forest Land (they have woody vegetation) but not to the strict forest definition that the Netherlands applies.
Portugal	Forests (areas occupied by forests and woodlands which can be used for the production of timber or other forest products) and agro-forestry areas (annual crops or grazing land under the wooded cover of forestry species). The forest trees are under normal climatic conditions higher than 5 m with at least 30 % canopy closure.
Spain	Includes systems with vegetation currently below the thresholds of the forestlands (dehesa) but it is expected these to be exceeded in areas which are not under pasture or cropland. "Dehesa" is, in general, an anthropogenic forest system essentially composed by a layer of trees with presence of scrub and usually a herbaceous layer, with or without crops, which is subject of extensive agro-forestry use, thanks to which it maintains its own structure over time. If it is below the forestland then it is included under cropland.
Sweden*	Land which hosts a potential yield of stem-wood exceeding one cubic meter per hectare and year. Permanent forest roads (width>5m) are not considered as forest land. All country forests are considered managed.

UK	Different definitions according the data source (i.e. forestry statistics definition used for GHG inventory includes integral open space, and felled areas that are awaiting restocking).

Under lack of historical annual data various method have been used by MS to develop time series for the annual activity data (i.e. forest land area), at least from 1990 to date: by interpolation (over NFI cycles, or from various statistics and maps), extrapolation (for periods since last NFI cycles), and combining other sources of data (remote sensing) (Table 7-13). The use of remote sensing and aerial photographs or their derived products such as Corine Land Cover maps are also used, in few cases especially, to derive past data or even entire time series (i.e. Spain, Portugal). Missing data for 1990 is compensated by data obtained in closest years. Consequently, MS developed consistent land representation and land use and use change matrix.

Table 7-13 Activity data sources and methodology for the subcategory 5A1 Forest land remaining Forest land

Member State	Description
Austria	The FL remaining FL area is derived from NFI data, with annual area interpolated between inventory years and assumed constant in time since the previous national forest inventory (2000/2002) and latest (2007/2010).
Belgium	A geo-referenced grid covers entire country on which intersection points the diagnosis of land use is carried on vectorial and raster thematic sets and layers images relevant from land us point of view.
Denmark	A land use / land cover map was produced for 1990 and 2005 based on satellite images data, other datasets used to derive 1992-2005 and NFI in situ data for 2005.
Finland	Estimation of the area of Forest land is based on successive NFI cycles (NFI 7-11) from different years in Northern and Southern Finland. The forest land category is sub-divided for organic and mineral soils.
France	The system is based on aerial photographs dataset combined with an annual "on-the-ground" survey of lands (defining both the land use and current activity), which allows a land use change matrix both annual (to capture rapid changes) and a 20-year span (to capture slower changes). For French Guyana a photointerpretation system based on Landsat and Spot, combined with permanent plots surveying just small share of total area, is used to estimate land use and changes.
Germany	Forest land area is computed based on two successive NFI (1987, 2002) for former Western Germany, while for former Eastern Germany it is estimated based on remote sensing and first NFI (2002), then linear extrapolation back to develop annual time series. Activity data is derived from a "wall-to-wall" database based on NFIs (for forestland and conversion from/to), topographical-cartographical information (digital landscape model) and CLC 1990, 2000 and 2006 (for land use) and earth observation data (time series).
Greece	Approach 1/2 is used for land representation, by combining several sources and databases: 1st National Forest Inventory (1994), annual Agricultural census, afforestation registry and statistics, general geographical data of National Statistical Service of Greece (i.e. decennial survey). Land use change matrix is available.
Ireland	Forest land area is obtained from sectorial Forest Inventory and Planning System data of 1995 and the total forest area is provided by Forest Service.
Italy	Forest area in 1990 -2010 was calculated through a linear interpolation between 1985 and 2002 data (supplied by the 1st and 2nd NFI). Data for 2003-2010 is extrapolated, building on Statistics' annual data on forest area. A number of rules are established to allow building of land use change matrix.
Luxemburg	Land use / land cover map for 1989 (data collected in the field), 1999 (on aerial colour infra-red ortho-photos) and 2007 (high resolution satellite images) in digital format covering the entire territory. Annual data is obtained by linear interpolation before 2007 and extrapolation since 2008 on.
The Netherland	Country level wall-to-wall approach based on harmonized and validated digital topographical maps of 1990, 2004 and 2009, linearly extrapolated till 2010.
Portugal	Area data is given by Corine Land Cover maps (1990, 2006), NFI (for forest area on tree species) and annual cartography of burnt areas, involving linear interpolations and extrapolations to obtain full time series.
Spain	Forest land area is provided from a combination between CORINE LAND COVER 1990-CLC90 and 2000-CLC00 (after the harmonization of their nomenclature) with Forest Maps of Spain, in order to identify the lands with trees crown cover over 10 %. Further on, annual estimation of area is obtained by linear interpolation between 1990 and 2000, and then extrapolated.
Sweden	A country level systematic grid of permanent monitoring plots (NFI) provides estimates of the areas of all land-use categories and gross & net land-use transfers since 1983 on.

UK	Forest plantations statistics established over 1920-1990 is used for modeling C stocks changes. Forests in existence before 1920 are considered not to have significant long term changes in their carbon pool stocks.

Furthermore, the MS breakdown own forestland area on various *subdivision* types and levels of detail, according to available datasets. Breakdown criteria differ across EU-15 MS, although they are consistent across time series. It was done by groups of species or forest types (i.e. broadleaves/coniferous; evergreen/deciduous; species based classification – beech, oak, pine, spruce, etc), climate (i.e. temperate, tropical), soil and site type (i.e. lowland, organic or mineral soils), geographic criteria (regions of the country), and management type (clear cut, hedgerows, horticulture area, arable land, fallow land, permanent cultures, peat extraction area, pastures, hayfield, perennial converted to annual crops, annual crops remaining annual/perennial).

For forestland, the *definitions of pools* are reported by most MS. The contributions to the annual sink are 88% for the biomass pool, 8% for SOC and 4% for DOM from net sink, while emissions from organic soils is 5% of total annual sink. There are slight variations regarding the definition of the pools among MS (Table 7-14), whose impact on the estimation of C stock changes and other GHG emissions may be low, but also difficult to assess in quantitative terms. For instance, forest inventories define the biomass pool according to the threshold of minimal diameter (i.e. DBH–stem diameter at breast height of sampled trees) as ranging from 0 to 7,5 cm. Concerning the belowground biomass, the information on what exactly it includes or excludes is rather poor. The litter and dead wood pools mostly differ in terms of threshold diameter and height/length, and decomposition time required considered. In soils, C stock changes are computed according to various soil depths. Usually, carbon stock in understory's biomass is only accounted for the purpose of forest fires emissions.

Table 7-14 Forest carbon pools definitions in the EU-15's MS

Member State	Description
	Aboveground biomass
Austria	Stem wood over bark with a diameter at breast height over 5 cm.
Belgium	Tree and shrub species with circumference exceeding 20/22 cm at 1.50 m height (i.e. 7 cm in diameter), while in coppices the stems under 7 cm diameter are also included.
Denmark	Biomass of living trees with a height over 1.3 m, under different schemes (i.e. trees larger than 40 cm are measured only within a 15 m circle). Smaller trees, shrubs and other non woody are not counted. Aboveground biomass is defined as living biomass above stump height (1 % of tree height).
Finland	Biomass of living trees with a height over 1.35 m, i.e. those trees that are measured in NFIs, including the stem wood, stem bark, living and dead branches, cones, needles/foliage. Understory is counted only to estimate the emission from forest fire.
France	Trees with DBH over 7.5 cm. Woody understory or annual/perennial non woody plants are not considered.
Germany	Trees with DBH over 7 cm.
United Kingdom	Modeled living woody biomass (complete individual cycle of trees, it does not include understory and annual/perennial non woody vegetation).
Ireland	Modeled complete individual cycle of living biomass (but not the understory and annual/perennial non woody vegetation).
Italy	All trees with DBH over 3 cm.
Luxemburg	Diameter of 4 cm at 3,5 m of the total height (average value)
Portugal	Living biomass above the soil, including: stems, stumps, branches, bark and foliage, and forest understory (only for estimation of emissions from forest fires).
Spain	Trees DBH over 7.5 cm "at foot" is measured, while those under 7.5 cm are only counted.
Sweden	Biomass of living trees with a height over 1.3 m. Small trees, shrubs and other vegetation (i.e. herbs) are not counted. Aboveground biomass is defined as tree part above stump height (1 % of tree height).
Greece, The Netherlands – na (there is no information available the NIR 2011)	

Belowground biomass	
Belgium	Diameter of estimated roots > 5 mm.
Denmark	In the NFI plots the stumps from trees harvested within a year from the measurement are measured for diameter.
France	Fine roots are included with the soil organic matter.
Finland	Stumps, and roots down to a minimum diameter of 1cm
United Kingdom	Fine roots biomass is integrated by the carbon accounting model used.
Ireland	Modeled approach integrating fine roots.
Portugal	Living biomass of all roots (the lower limit of root diameter, if any, is not explicitly defined).
Sweden	Biomass of living trees below stump height (1 % of tree height) down to a root diameter of 2 mm.
Austria, Germany, Greece, Italy, Luxemburg, The Netherlands, Spain - na	
Dead Organic Matter – Litter	
Austria	Litter not defined, but it is considered within the mineral soil pool
Denmark	Non-living biomass which is not included in other classes, under various status of decomposition on top of mineral or organic soil. It includes the litter, fumic and humic layers.
Finland	Non-living biomass with a diameter less than 10 cm in various status of decomposition (allocated by model in compartments: fine woody litter, coarse woody litter, extractives, celluloses and lignin-like compound). Biomass of ground vegetation (eg moss-, lichen-shrub- and twig vegetation) is not included in the living biomass, but it is included when the litter input to the soil is estimated.
France	Non-living dead wood lying on soil with maximum 7.5 cm diameter, dead leaves, humic and fumic layers, fine roots (which are not taken into account in the biomass).
Germany	The litter was considered to comprise all dead organic cover with a fraction < 20 mm. For some 80 % of points, the fraction > 20 mm was also included in the litter sample.
United Kingdom	Litter is integrated by the model.
Ireland	Modeled approach.
Portugal	Non-living biomass on top of mineral soil, in various stages of decomposition (include fumic, humic), (considered only in forest fires).
Sweden	Non-living biomass not classified in other classes, under various stages of decomposition, on top of mineral or organic soil: litter, fumic and humic layers. Litter includes, as well: a) live fine roots (<2 mm) from O horizon; b) coarse litter with "wood stem diameter" between 10-100 mm, and c) fine litter from the previous season or earlier.
Belgium, Greece, Italy, Luxemburg, The Netherlands, Spain: definitions not available in the NIR 2012	
Dead Organic Matter - Dead wood	
Austria	Only standing dead wood. Litter is included with the soil.
Belgium	Dead wood as measured or estimated by NFI, namely standing dead trees and fallen logs and branches. A dead tree is considered as fallen when it tilts at a vertical angle equal or superior to 45°. Dead trees above 20 cm of circumference are measured, under 20 cm are estimated visually.
Denmark	Standing deadwood with a DBH larger than 4 cm. Lying dead wood with a diameter of more than 10 cm, whose length is recorded. The degree of decay is recorded on an ordinal scale.
Finland	Non-living biomass which is not contained in litter (described by model as coarse woody litter input, larger than 10 cm in diameter, from natural mortality of trees and harvesting residues)
France	Standing trees, dead for less than 5 years, plus 10 % from the wood which is annually harvested
Germany	NFI 2002 collected data on fallen dead wood with a thicker-end diameter of at least 20 cm; standing dead wood with a diameter of at least 20 cm at breast height and trunks with either a height of at least 50 cm or a cut surface diameter of at least 60 cm. NFI 2008 collected data on all dead-wood objects with a thicker-end diameter of at least 10 cm. Data collection was for both NFIs on 3 species groups and 4 decomposition class.
United Kingdom	Dead wood is included in carbon accounting model
Ireland	Modeled approach
Greece	Dead wood that remain on site after fire is assumed to fully decompose in 10 years
Portugal	Non-living woody biomass on top of mineral soil, in various stages of decomposition (considered only in forest fires)
Sweden	Fallen dead wood or standing dead snags, with a minimum "diameter" of 100 mm and a length of at least 1.3 m
Italy, Luxemburg, The Netherlands, Spain: na	
Soil Organic Carbon (for organic soils see more in the section 7.6)	
Austria	Fumic and humus, the litter layers are unitary considered with mineral soil layers to 50 cm depth.
Belgium	Mineral soils for 0-30 cm.
Denmark	Organic carbon in the mineral soils below the litter, fumic and humic layers and all organic carbon in soils classified as Histosols. It is for 30 cm depth between top of the mineral soil or, alternatively, from the soil surface (if histosol).

Finland	Modeled organic carbon in mineral soils with undefined depth. Organic soils are considered under peatlands, with a site being classified as peatland if the organic layer is peat or if more than 75% of the ground vegetation is peatland vegetation.
France	Organic carbon in the first 30 cm layer of any mineral or organic soils.
Germany	C content in mineral soil (0 – 30 cm).
United Kingdom	Modeled approach, assessing soils carbon stock change on non-defined depth.
Italy	Organic carbon in mineral soils to 30 cm depth.
Ireland	Modeled approach, assessing soils carbon stock change on non-defined depth.
Luxemburg	Organic carbon content of soil per ha in the layer of 0-30 cm depth
Portugal	Organic carbon in the mineral soils down to 30 cm.
Spain	Organic carbon in the mineral soils down to 100 cm.
Sweden	Organic carbon in the mineral soils below the litter, fumic and humic layers and all organic carbon in soils classified as histosols, down to a depth of 50 cm.
Greece, The Netherlands: na	

It should be considered that what is not reported under a pool is usually reported under another one (e.g., fine roots are accounted for as either litter or soil organic matter), and as far as C stock change is required, the estimation error should be negligible. Based on that as far as the completeness of the inventory is ensured, the comparability of national GHG inventories is also ensured as far as the C stock changes could be summed up. Thus, as far as the component biomass is reported under various pools the lack of fully matching definitions is not a major problem, except that the different turnover may introduce higher uncertainty in the estimation. For certain pools or parts of the pools which are very difficult to address due to lack of data (i.e. fine roots or litter), it is commonly assumed that there is no annual change.

Net CO_2 removals or emissions are estimated by methods that quantitatively assess the change of the C stocks in forest carbon pools. The method used to determine the C stock change in Living Biomass pool is either the “stock change” or “gain-loss” (as defined by IPCC GPG LULUCF 2003), according to the availability of data (Table 7-16). The “gain-loss” method is implemented by 8 MS, while the “stock change” method is implemented by 7 MS.

Table 7-15 Estimation method used by MS for the C stock change in Living Biomass pool. Estimation method is either stock change (bold) or gain-loss (thin letters). In *italics* there are non-NFI based estimation methods.

MS	Estimation method
Austria	Gain-loss method based on NFI data
Belgium	**Stock change (Walloon region) and gain-loss method (Flemish region) both based on NFI data**
Germany	**Stock change method based on NFI data**
Denmark	***Stock change based on Forest census (before 2000) and NFI (since 2001). Gain loss over 2000-2005.***
Finland	Gain-loss method based on NFI and harvest datasets
France	Gain-loss method based NFI and harvest from non-NFI statistics
Greece	***Stock change method based on FMP database***
Ireland	Gain loss method from forestry statistics & yield table data based model and harvest statistics & firewood estimates
Italy	Gain-loss method based on NFI and harvest data derived from regional harvest statistics
Luxemburg	*Gain-loss method based on forestry statistics & yield table and harvest statistics*
The Netherlands	**Stock-change method based on NFI data**
Portugal	Gain-loss method based on NFI data and harvest statistics
Spain	**Stock change method based on NFI data**
Sweden	**Stock change based on NFI data**

UK	*Gain-loss method modeled from forestry statistics & yield table data and harvest statistics*

Sources of data for the estimation of C stocks in living biomass also differ from MS to another, upon data availability. Actually, NFIs represents the primary source of information for the GHG inventory in 11 MS, while the others are using country specific statistics on forest areas (including forest management planning database like in Greece), historical rates of afforestation, harvest or forest fires and involve yield models (e.g. UK, Ireland).

Table 7-16 Sources of data and basic methodological information for estimating of the C stock changes in Living Biomass pool in the subcategory 5A1

Member State	Description
Austria	Austrian NFI provides data on growing stock volume increment and drain (harvest, other losses). Annual data of increment and harvest result from using relative variation indices. Harvest indices results from ratio of NFI to other non-NFI datasets. Increment indices are based on representative sets of tree ring cores. Country specific biomass functions are applied to account for tree branches, evergreen foliage and a general function for below ground biomass.
Belgium	Regional, but National Forest Inventories like, datasets. Solid wood volumes of each species (aboveground woody biomass: stem + branches) is obtained from forest inventories data. Country specific BEFs are used.
Denmark	For 2010, data from 1st NFI cycle is directly used in the volume functions developed for the most common Danish forest tree species. Harvested wood is obtained from Statistics Denmark, to which non-commercial wood from thinning operations in conifers (not accounted in statistics), is added annually using a 20% constant factor. BEFs are from neighboring countries.
Finland	Biomass increment is estimated based on individual tree measurements (DBH, tree height) in last three successive NFIs and country specific biomass models. Loss is calculated from annual statistics, and includes logging, fuel wood and unrecovered natural losses.
France	Gain-loss method is used. NFI delivers data on forest growth, while loss by harvest statistics (both commercial and non-commercial). BEFs, allocation in roots, as well as C content in wood are country specific.
Germany	"Stock change method" is used with data from forest inventories. Biomass functions, country specific volume expansion factors and IPCC default root-to-shoot ratio. For former Eastern Germany data from forestry management plans is combined with NFI 2002 and 2008.
Greece	C stock change in living biomass is approached; forest increment from FMP (forest management plans database) disaggregated by forest type, with IPCC default factors for root/shoot ratio, wood density and BEFs. Loss was estimated from commercial round wood feelings, fuel wood gathering and wildfires.
Ireland	Annual increment is estimated using a model which calculates total standing carbon content of forests year-on-year, based on Irish forest yield tables by species, involving country specific BEFs and wood density.
Luxemburg	Increment of growing stock biomass in m^3 per ha and year was calculated on forest types using yield-tables and lossess derived from the official statistics.
Italy	Model applied at regional scale under availability of forest-related statistical data. The growing stock volume of the previous year is increased by the annually calculated increment of the current year and reduced by the losses due to harvest, mortality and wildfire in the current year. Aboveground and belowground biomass were obtained by using country specific BEFs. Commercial wood harvest data has been obtained from statistics.
The Netherlands	Country specific Tier 2 methodology based on growing stock volume data from NFI plots, using the equations from a European database.
Portugal	Tier 2 based on NFI data. All parameters are country specific.
Spain	NFI data.
Sweden	C stock change method that integrates Swedish NFI and Swedish Forest Soil Inventory in the same sample design and plots. Aboveground & belowground biomass per trees in permanent sample plots is obtained by biomass functions on NFI data.
United Kingom	Forest plantations statistics established after 1990 is used for modeling C stocks changes.

NFIs provide basic input both for forestland and conversions to/from forest land areas as well as the necessary data for the estimation of C stock changes in various pools under the implemented method. Methods for the collection of data in NFIs are typically based on repeated measurements in permanent sample plots (Table 7-17), but the design differ among MS in terms of spatial density and frequency of field survey. In recent years, the EU-15 MS have made considerable efforts to adjust their forest inventories to the specific requirements of UNFCCC/KP reporting, together with slight harmonization at European scale. Also, efforts have been made to adjust the inventory cycles to the period included in the first commitment period.

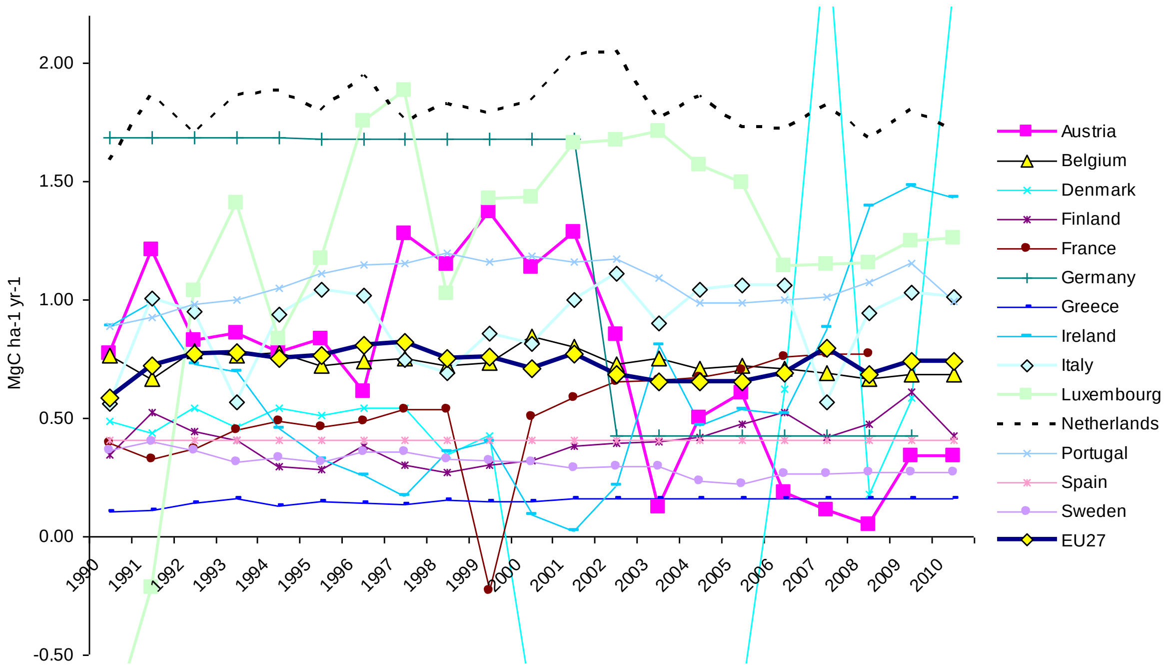
Table 7-17 Relevant information on the National Forest Inventories (NFI) of MS

MS	Type of survey (for 1990 and the latest cycle): sampling design, country coverage of the grid, stand measurement plot area	Cycle length (for latest inventory cycle)	Frequency / First NFI in …	Datasource for 2008-2012
Austria	Sample based inventory with four plots clusters in 4 x 4km grid. A plot is 300 m2 and includes a two concentric plots and an angle count sampling. It follows FL conversions.	3	5-10 years. First inventory 1961-1970.	NFI 2007-2010
Belgium	Regional forest inventories, with same approach for both Walloon and Flemish Regions. Ongoing single-phase, non-stratified inventory in 1.0 x 0.5km grid E-W oriented, with 1000 m2 circular plots area (including 2 other circular plots). 10 years cycle in permanent plots. It follows FL conversions.	10	10 years. First inventory 1984-1988 (Wallonia) and 1997-1999 (Flanders).	NFI 2010-on
Germany	Systematic single-level cluster sample with regionally stratified sampling intensities. Cardinal points orientation of 4x4km grid. Cluster square of side length of 150 with 4 circular plots. It follows FL conversions. For new lander conversions are given by remote sensing methods.	3	10 years. First inventory 1986-1989.	An interim inventory with 8 x 8 km grid in 2008.
Denmark	Continuous sample-based with partial replacement, 2x2 km grid. Four circular plots of radius of 15 m are clustered in a square with side length of 200 m. Plots consist in three concentric sub-plots. 1/3 of plots are permanent and re-measured every 5 years. It follows FL conversions.	5	5 years. First sampling inventory 2002-2006.	NFI 2007-2011
Spain	Systematic sample-based 1x1 km grid with permanent plots. The territorial units are the provinces (50). NIF is done one by one and it lasts 10 years. Sample plots consist in 4 concentric circles. It follows FL conversions.	10	Planned every 10 years	NFI 2008-2017
Finland	Sample-based systematic cluster sampling inventory covering entire country. Entire country measured in a year. Major forest regions surveyed with cycles of 5 years, with sampling design differ on the 6 regions: plots (of 250-450 m2) are organized in clusters (of 6x6 to 10x10Km). Distance between clusters and distance between plots in a cluster are ecologically and economically optimized.	5	~ 10 years since 1921, with first sampling inventory 1964-1970	NFI 2010-2013
France	Sample based covering entire country in a year and all land classes. All plots are temporary. Systematic clusters, 1.41x1.41km. Field measured circular plot is 25 m radius composed from four concentric plots.	5	~ 10 years, first inventory 1960-1980	NFI 2004-2010. AD by TERUTI 2005 on
Greece	Forest management planning (FPM) database for managed forests. Forest is revisited every 10 years.	10	First&last NFI 1965-1983	FMP database
Ireland	Forest Inventory and Planning System is a GIS-based system contains stand and site information. It covers all forest in the country.	1	First NFI 2004-2006	Forest Inventory and Planning System (1995) and Forest Service statistics on total area
Italy	Sample-based three-phase sampling with regional stratification. 1x1km grid. Plots consist in two circular concentric areas of 530 m2.	4	First in 1983-1986	NFI 2006-2007
Luxemburg	Simple systematic sampling. 0.1x0.05km grid. Plot consist in four concentric circular areas of 1000m2.	3	Every 5-10 years. First NFI 1999–2001	NFI 2008–2010
Netherlands	1x1km grid lay over GIS forest map. Plots are randomly drawn, with half as permanent. Plots	5	~ 10 years. First NFI 1988-1999	Digital topographical

	are 300 m2. Entire country is surveyed in a year.			maps and NFI 2001-2004
Portugal	Qualitative sampling based on interpretation of aerial photograph over a national0.5x0.5km grid, with clusters every 2x2km on forest land and 4x4km on shrub land. NFI clusters are 500/2000 m2 depending on species and consist in 5 plots of 10/40m2.	2	~ 10 years. First NFI 1965-1966	NFI 2003-2012
Sweden	Sample-based with covering annually whole country, with North-South decreasing sampling intensity. Plots are distributed in square/rectangular clusters with size decreasing from North to South, both for permanent (2/3) and temporary (1/3) ones. The clusters are square-shaped with 4 or 8 circular plots with (radius 10-20m). It follow FL conversions	10	5-10 years. First NFI 1923-1929	NFI 2003-2012
United Kingdo m	Permanent systematic sampling 8x8km grid, combined with a regional simple random sampling. Square sampling plot of 1 ha.	5	Various, NFI since 1924	NFI 2010-2014.

Furthermore, considerable effort has been made to improve and transform the information on forest inventory standing volume into C stock change estimates. These efforts include, e.g., developing new country specific biomass functions (e.g. Austria, Finland, Ireland and Spain), biomass expansion factors (BEFs), as well as inter-calibration and harmonization exercises (i.e. within projects).

Figure 7.4 Implied net carbon stock change factor for biomass pool in 5A1 (Mg C/ha year)

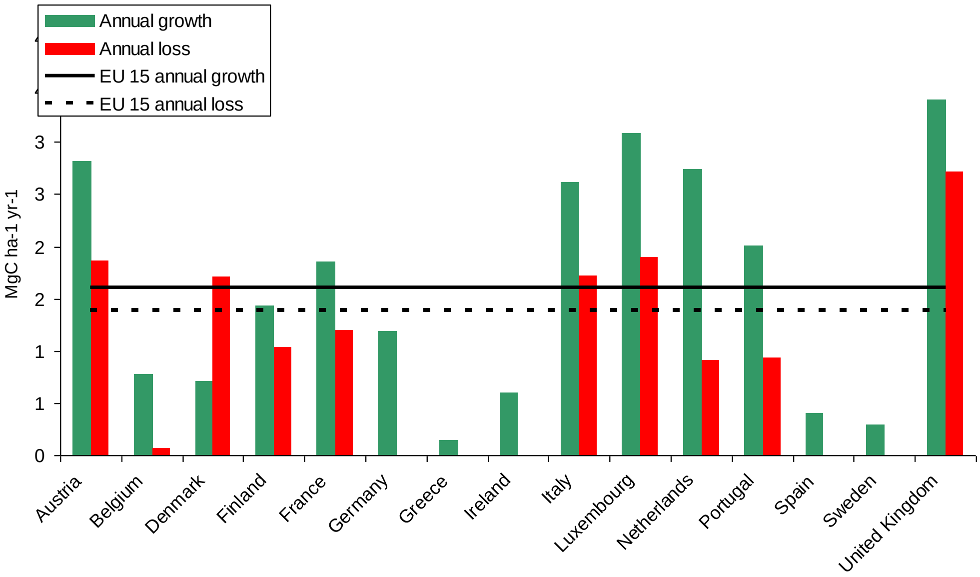


In 2012 submissions the multiannual simple average of IEF for net C stock change in biomass is 0.73 (in 2011 it was reported 2 % higher) with a range across MS's time series between -0.18 and 1.87Mg C/ha (see Figure 7.4). MS revised downward the IEF for net sink in biomass, i.e. Austria and France (current IEF is ~35-40 % less compared to previous one) or upward by Denmark (+150%).

In the most intensive forestry systems (i.e. Finland, Sweden) the IEF for annual net C stock change is, in general, smaller than in countries from Central Europe or with less intensive managements. Also, low IEF values are caused by various disturbances (i.e. major windstorm in France in 1999). Variable IEF in Ireland, Luxemburg or Netherland is explained by high dynamic of the small total country forestland area (high dynamic of harvested volume, afforestation and very low share of "remaining" forestland).

Biomass growth and loss vary across MS according eco-climatic conditions and management approaches (Figure 7.5). With recent improvement in UK by consistent reporting of forestland on subcategories (5A1 and 5A2), UK revised downward its IEF values compared to previous submission, when high values of IEF for biomass growth and loss under artificial plantations of very productive species are reported, while the net change is comparable to other countries (e.g. Austria, Ireland and Netherlands). Lowest IEF for net biomass change is shown by Greece (under low natural forests productivity and wildfire incidence).

Figure 7.5 **Multiannual simple average IEF for "growth" and "loss" of biomass in 5A1 (1990-2010, only net biomass changes displayed for MS reporting stock change methods)**



Denmark estimated 5A1 as source in 2000-2005, likely due to unbalanced stands age and current rate of harvesting (of old forest).

The methods used by the MS to estimate the C stock changes in SOC and DOM are adapted to existing data and information, and they could be connected with NFI or not (Table 7.18).

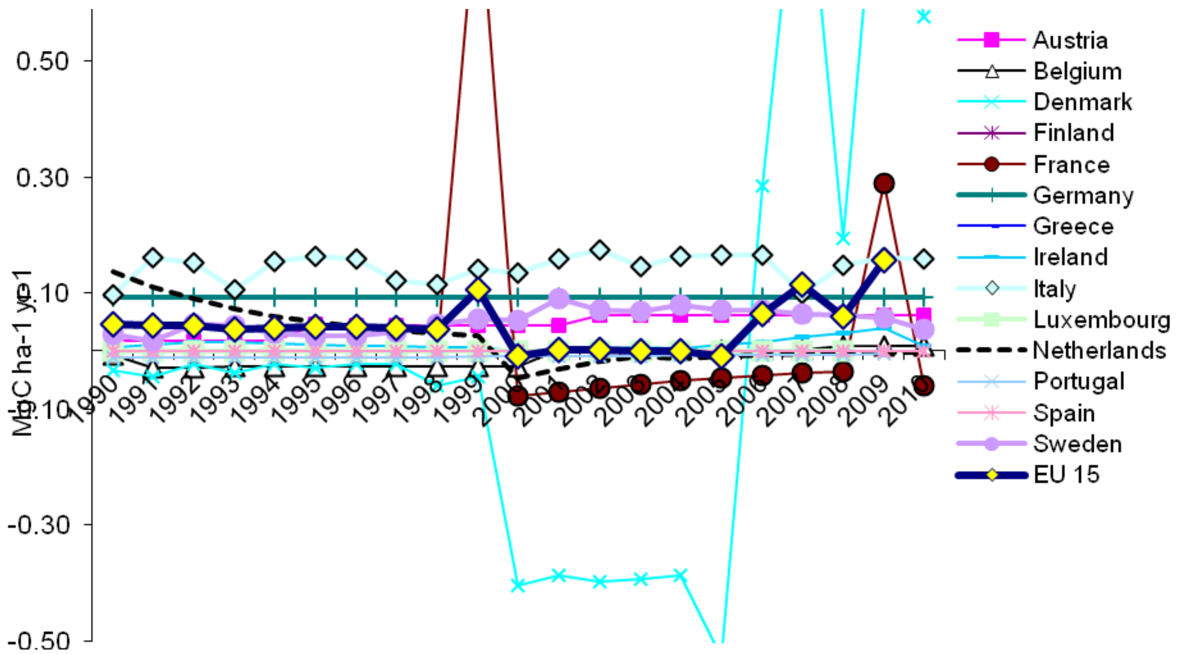
Table 7.18 **Sources of data and methods for estimating of C stock change in dead organic matter (DOM) and soil organic carbon (SOC) on land subcategory 5A1.** DOM is often reported separately on dead wood (DW) and litter (LT).

Member State	Description
Austria	NFI database, assuming a ratio of DW between deciduous/coniferous as the proportion of the tress in the stand LT and SOC are modeled by Yasso07 also including management options according forest law (i.e. forest management operations related conversions from stocked forest to non-stocked forest land, e.g. particularly forest roads).
Belgium	DW is measured in NFI plots. LT pool is considered neutral (based on measurements). SOC is estimated based on various datasets and research projects and activities. NFI dead wood data is also used, including specific basic density and a decay factor. NFI measured litter depth data to which a species specific density is applied.
Denmark	Database on soil sampling in successive moments in time (first in 1985, roughly every 10 years). NFI soil distribution database is used for scaling the sampled plots to total forest area.
Finland	LT and SOC in mineral soils are estimated using a model-based method. In organic soils, country specific measured emission factors were used in estimating decomposition of peat, combined with a model to estimate aboveground C stock changes. DW

	data is provided from NFI.
France	DW is provided by the NFI and a share of 10 % of the harvest is considered as LT (emitted in the year of the event). An annual removal of 2,4 kg/ha CH_4 is also counted by undisturbed forest soils.
Germany	Both LT and DW are computed based on country datasets (NFIs, Biosoil, soil inventory). SOC is preliminary reported under Tier 1 (ongoing research in 2011) and C stock change in LT is estimates as very close to zero.
Greece	Tier 1 for SOC and DOM. For wildfires affected areas there is a Tier 2 approach for DOM with country specific data.
Ireland	SOC and DW are considered neutral. LT C stock change is modeled with country specific data, it is also assumed that there is no litter input in the first 7 years since plantations establishment.
Italy	C stock change in DW estimated by applying the IPCC default dead mass conversion factor. LT and SOC are linearly regressed with country specific equations from the aboveground carbon stock, on available stratification of forests (on forest type, groups of forests types).
Luxemburg	SOM and LT are considered neutral. DW will be derived from NFI.
The Netherlands	DW is computed based on fix rate of tree mortality and DW decomposition rate applied to harvest statistics. Leaves and roots were not taken into account for the build up of dead wood.LT is assumed to build up based on several datasets. SOC is assumed to not change during the period 1990–2010.
Portugal	DOM is based on country specific data. SOC is considered neutral.
Spain	DOM and SOC are considered neutral.
Sweden	DW is provided by NFI dataset and Forest Soil Inventory database. Carbon in the LT is separately estimated for three different compartments: coarse litter, annual litter fall and fine litter. Change in mineral soils is estimated based on repeated soil sampling in combination with pedotransfer functions. In organic soils the changes are based on country specific emission factors.
United Kingdom	Forests in existence before 1920 are considered to have all pools neutral. C pools changes in post 1920 till 1990 afforestation are modeled.

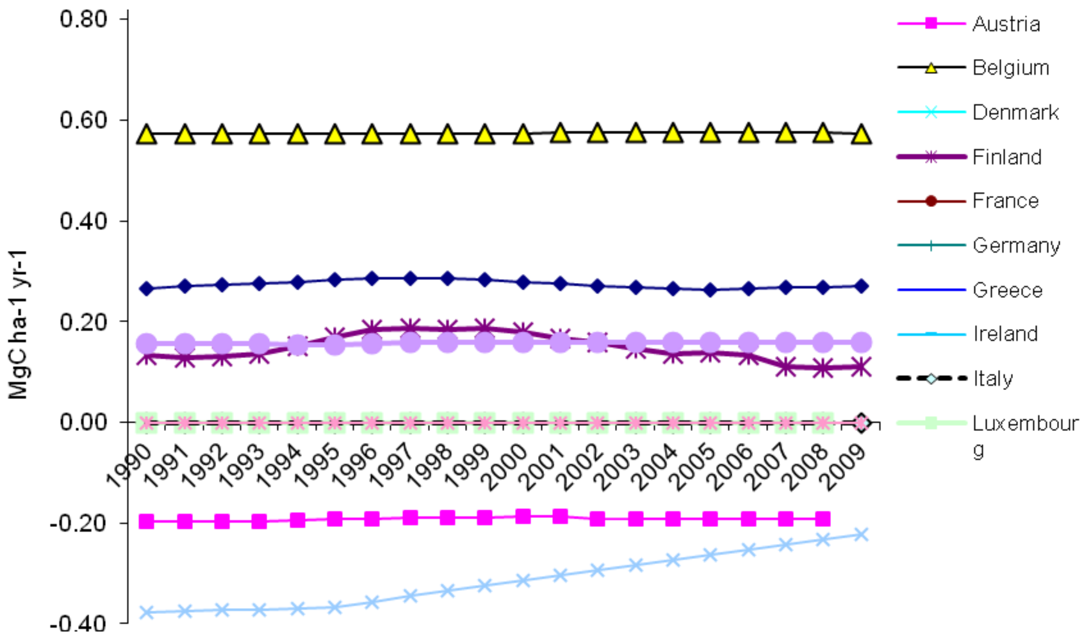
Majority of MS report either SOC, DW or LT under Tier 1 of IPCC, i.e. assuming no C stock change in these pools (see Table 7-8), because historical databases available allow reporting DW and SOC rather than LT. DOM is reported as a sink by most MS, with the highest annual sink reported by the UK (which relies on country specific data). Belgium, Denmark and Portugal report it as small source. At the EU-15 level, DOM is a multiannual average sink of 0.05 Mg C ha-1 yr-1, with a range from -0.14 to 0.33 Mg C ha-1 yr-1 (Figure 7.6). France report this pool as source since 1999 following the windstorm in 1999, estimating it as a major sink in 1999 and starting 2000 it became a source, while for pre-storm interval DOM was considered neutral (similarly for some other storm in 2009).

Figure 7.6 **Implied net carbon stock change factors in DOM in 5A1 (Mg C ha-1 yr-1).** (Outliers in the graph are France which reports 0.82 in 1999 and Denmark -0.5 Mg C ha-1 yr-1 in 2005).



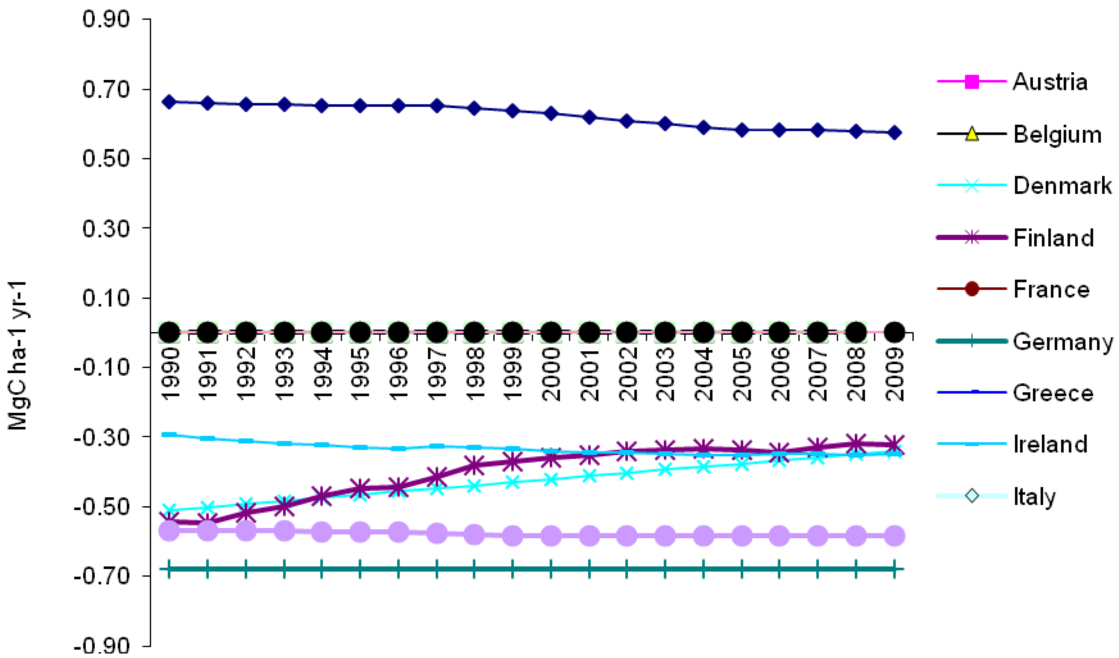
SOC in the forest mineral soils are reported as small annual sinks with exception of Austria (-0.2 mgCha-1yr-1, in average) and Portugal (-0.4 mgCha-1yr-1, in average) which report it as a relatively large source. At the EU-15 level, the C stock change factor for SOC in mineral soils is 0.24 Mg C ha-1 yr-1, with a range from -0.38 to 0.95 Mg C ha-1 yr-1 (Figure 7.7). Other countries report it under Tier 1 assuming and demonstrating that this pool is not a net source of emission (thus NO, NE in the CRF). Belgium displays an outlier in 2000 for changes in both organic and mineral soils (highlighted over EU QAQC).

Figure 7.7 Implied net carbon stock change factor in SOC for mineral soils in 5A1 (Mg C ha-1 yr-1)



In organic soils, multiyear simple average IEF is -0.29 Mg C ha-1 yr-1 (i.e. source), with a variation from 0.84 to -0.68 Mg C ha-1 yr-1 (just note that UK that reports organic soils as a sink for entire time series under the influence of last 100 years of afforestation). In forests on organic soils, these emissions offset in average 7 % of the annual sink given by the living biomass, DOM and SOM. Data is reported based on country specific data (more information could be found in sub-chapter 7.6).

Figure 7.8 Implied net carbon stock change factor in SOC for organic soils in 5A1 (Mg C ha-1 yr-1)



7.2.3 Land converted to forest land (CRF 5A2)

7.2.3.1 Overview of Land converted to forest land

According to data submitted by the MS, in 2012 the area of subcategory 5A2 - Land Converted to Forest Land was around 5% of the total forest land area, and increased by about 43 % since 1990 (Table 7.19). This increase is partly due to the fact that many MS report with the time series starting in 1990. For 2010 Italy, France and Spain reports the largest land area under this subcategory.

Table 7.19 Trend of activity data in subcategory 5A2 – land converted to forest land – in the EU-15 MS (kha) (na- if time series reported by the MS start in 1990/1991)

Member State	1990	1995	2000	2005	2010	Difference 2010 to 1990 (%)
Austria	387	373	271	235	219	-43%
Belgium	2	8	13	19	21	861%
Denmark	1	10	22	31	47	6491%
Finland	161	193	209	192	158	-2%
France	995	1209	1261	1287	1274	28%
Germany	562	562	562	470	349	-38%
Greece	NE,NO	6	23	32	33	na
Ireland	175	222	257	286	265	51%
Italy	635	867	1193	1554	1559	145%
Luxembourg	14	14	13	11	8	-41%
Netherlands	3	18	33	46	56	1781%
Portugal	305	305	305	305	305	0%
Spain	23	287	781	1013	1078	4524%
Sweden	514	391	363	405	583	13%
United Kingdom	610	498	450	401	306	-50%
EU15	**4387**	**4963**	**5756**	**6286**	**6261**	**43%**

At EU-15 level, in 2010 5A2 is a sink of 32,000 GgCO_2, 33% higher than in 1990 (Table (Table 7.20) and 6% less than 2009, with majority of MS reporting less removal (caused by land moved to 5A1). In 2010 the largest CO_2 removals were reported by France, Spain and Germany. Ireland and Finland report this subcategory as a source likely due to transfer of lands to 5A1 (after transition period) and emission from soils (especially from organic soils) under early stages of conversion.

Table 7.20 5A2 Land converted to Forest Land: MS' contributions to CO_2 net emissions

Member State	Net CO_2 emissions (Gg)			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2)	(%)	(Gg CO_2)	(%)		
Austria	-4,246	-2,546	-2,495	7.7%	51	-2%	1,751	-41%	T2	CS
Belgium	-23	-277	-281	0.9%	-3	1%	-258	-	CS,T1	CS
Denmark	8	-314	-542	1.7%	-228	73%	-550	-6533%		
Finland	633	446	416	-1.3%	-30	-7%	-217	-34%	T2,T3	CS
France	-4,376	-7,758	-7,578	23.3%	180	-2%	-3,203	73%	T2,T3	CS
Germany	-7,287	-6,012	-5,897	18.1%	114	-2%	1,390	-19%	CS,T1,T2	CS
Greece	NE,NO	-351	-351	1.1%	0	0%	-351	-	T1	D
Ireland	413	39	631	-1.9%	592	1518%	218	53%	T1,T3	CS,D
Italy	-433	-1,124	-1,171	3.6%	-47	4%	-738	171%	T1,T2	CS,D
Luxembourg	-113	-83	-78	0.2%	5	-6%	35	-31%	T1	CS,D
Netherlands	56	-510	-556	1.7%	-46	9%	-612	-1086%		
Portugal	-3,328	-3,074	-3,034	9.3%	40	-1%	294	-9%	CS,T2	CS,D
Spain	-94	-6,388	-6,481	19.9%	-93	1%	-6,387	6798%	CS,T1	CS,D
Sweden	204	-2,849	-1,709	5.3%	1,140	-40%	-1,913	-939%	T1,T2,T3	CS
United Kingdom	-5,842	-3,650	-3,410	10.5%	240	-7%	2,432	-42%	CS,T3	CS
EU-15	**-24,427**	**-34,451**	**-32,535**	**100.0%**	**1,916**	**-6%**	**-8,109**	**33%**		

Overall, Living Biomass is a sink with an average IEF value of 1.29 MgC yr-1 ha-1.

7.2.3.2 Methodological issues for Land converted to forest land

Methods used to identify the area under conversion, as well as to report emissions factors and emissions estimation (Table 7.21).

Table 7.21 Background information on sources of data and methodologies used in subcategory 5A2

Member State	Description
Austria	Approach 3 for land use change, based on NFI datasets which capture changes to/from forestland. NFI covers entire country and each grid point is terrestrially inspected. LUC is determined based on changes between NFIs. The split into the subcategories of previous or following land uses is done with the same ratio as the results for the NFI 2000/02. When conversions occur, NFI records data on the type of land in the neighborhood of the plot. C stock change in living biomass is estimated based on national scale value of annual increment (a constant value over the 20 years transition) and loss, with country specific conversions factors, using the default method. Reference C stock in mineral soil and litter are provided on 5 regions for all land uses provided by NFI, Austrian soil inventories and expert guess. Additional NFI measurement for estimation of living biomass C stock change in ARD areas is underway. Dead wood change is assumed as not occurring.
Belgium	Activity data results from the country wide grid of points in the reference years. SOC is estimated based on reference C stocks with various land uses, available from various national datasets and research activities. C stock change in DOM (LT, DW) is not estimated under Tier 1, assumed neutral.
Denmark	Activity data are determined by interpolations on maps in 1990 and 2005 built on satellite imagery datasets. Biomass C stock change is estimated using biomass functions with country specific expansion factors. For DOM change country specific constant values are used for each type of conversion. C stock change in SOC is under estimation based on research projects, old databases and under development a NFI joint system.
Finland	Data on land conversions is derived by successive NFIs. Mean biomass annual increment is estimated as an average of current stock per area unit divided by the number of years since the conversion (Cropland, Wetlands/peat extraction, Settlements) or similarly as for the category forest land remaining forest land (Grassland, Wetlands/peatland). Change of the soil C stock in mineral soil is modeled and in organic soils estimated using emission factors.
France	Land conversion area is determined by an approach combining datasets of aerial photographs with an annual on-the-ground survey of lands (assess both land use and occurring activities). NFI provides data to estimate C stock change in biomass and DOM. National reference C stocks in soils on each land uses type. French Guyana is only partially assessed (where relevant for conversions) by a photo interpretation system based on remote sensing combined with permanent plots, while biomass data are delivered by field measurements.
Germany	Time series start in 1990. Based on NFIs (1987, 2002) in Western Germany and on management plans & NFI 2002 in Eastern Germany, the area of conversion is deducted and assumed linearly distributed in time. Previous land use is reported only for the former Western Germany. Data from 2002 is extrapolated till 2007 and starting with 2008 the absolute value of land use changes from and to forestland is provided by federal cadastral system. NFI datasets and single tree biomass functions are used.

	For SOC there is used a country specific emission factor for each type of conversion. Litter was estimated from national datasets. No dead wood accumulation is determined after field measurements.
Greece	Afforestation area is provided from statistics, disaggregated by forest types. Changes in carbon pools are estimated using a Tier1 methodology and data from the GPG for LULUCF for all type of conversions. Carbon stock changes in the dead wood and litter pools were assumed to be zero under a Tier 1 assumption. C stock changes in soils were estimated according to Tier 1.
Ireland	Annual area is a spatially explicit GIS database for after 1990, with detailed information given by LPIS (including on the previous land use). Afforested area maps superimposed on Soil map and CORINE 1990 Land Cover Map supported the identification of the soils types. Biomass C stock is modeled. No change is demonstrated for SOC and DOM based on country specific data.
Italy	Land use change matrix starting 1990 has been assembled based national land use statistics of land use, combined with NFI. NFI provides data for biomass increase. Reference soil C stocks on land use are available.
Luxemburg	Annual biomass increment factor is computed based on yield tables for young stands. Reference C stock are available as country averages on land use.
The Netherlands	A land use matrix is available with land-use changes calculated based on land use maps in 1990, 2004 and 2010.. Changes in carbon stocks in living biomass are approximated by a linear regression as the mean growth rates per age, derived from the NFI.. DW and LT are assumed as sinks of uncertain magnitude and not reported.
Portugal	Conversion area data is given by Corine Land Cover maps (1990, 2006) and NFI. Burnt areas are provided based on annual wildfire cartography. DOM (only litter) stocks are country specific. Reference C stocks in soils are derived based on ICP Forest Level I/ Biosoil data.
Spain	Area data is given by national statistics. For all pools, the method for C stock change estimation is Tier 1, with some country specific factors. Annual average increment in aboveground biomass is estimated based on the Map of Potential Forest Productivity of Spain, and country average BEFs and root-to-shoot ratios, computed for each province. SOC and DOM pools are considered small sinks, thus Tier 1 is applied.
Sweden	NFI provides explicit gross & net land-use transfers from the base year onward. Estimation of C stock change in living biomass is based on NFI data and country specific biomass functions. For C stock change in soils and DOM it is involved a Tier 2 method based on country specific emission/removal factor.
United Kingdom	Areas of land use change to Forest is pavailable form planting data of the Forestry Commission. C pools changes in post 1990 afforestation are modeled based on country forestry statistics.

Heterogeneity in the approaches used by MS for subcategory 5A2 suggests caution in interpreting differences in the implied carbon stock change factors. For instance, possible reasons of differences may include time series length and their starting point (on the transition period adopted), use of averaged or annual biomass growth, emissions from previous land use or the attribution of emissions from previous land use pools in the first year of conversion. In some case, the combined effect of transition period length and high annual variation of past/current planted area over time may generate even emissions for some years (i.e. Ireland). MS developed land identification systems which are able to track or at least to define the previous land use.

In 5A2 DOM is a small sink with IEF ranging from 1 to 1.22, with the average of 1.10 Mg C ha-1 yr-1. Changes in SOC pool in mineral soils under 5A2 seems rather controversial as EU's QAQC does not have enough data to consider particular features of land (i.e. land history, land management, inclusion of litter layer), as far as all reported numbers rely on measurements and published references. Average C stock change in mineral soils is 0.23 Mg C ha-1 yr-1 with a range from -0.81 to 1.37. Some countries, especially Nordic countries (Germany, Finland, Sweden, UK) report decrease of the C stocks in soils.

Tier 2 is practically used exclusively for reporting emissions/removal from conversions (also for "remaining" cropland or grassland), but not for "forest remaining forestland". Part of the EU-15 MS report based on Tier 3 (e.g. Denmark, UK) or Tier 1 based on IPCC default data (i.e. Greece, Ireland). Spain and Belgium developed reference C stocks in soils on administrative regions bases (e.g. NUTS 3 in Spain) (Table 7.22).

Table 7.22 Reference C stock in mineral soils on forestland/grassland/cropland reported by the MS

MS	Land use	Reference C stock (tC/ha)	**Comments** (i.e. considered depth)
Austria*	Forestland	77-117	0-50 cm, includes litter above the mineral soil
	Cropland	56-90	0-50 cm, includes litter above the mineral soil
	Permanent cropland (vineyard)	58-78	0-50 cm, includes litter above the mineral soil
	Grassland (intensive use)	75-100	0-50 cm, includes litter above the mineral soil
	Grassland (extensive use)	120-139	0-50 cm, includes litter above the mineral soil
Belgium*	Forest Land	111/94	Wallonia / Flanders
	Cropland	44/52	Wallonia / Flanders
	Grassland	87/86	Wallonia / Flanders
	Peat land	100	Belgium
Finland	Cropland	59.1/74.6	IPCC derived reference for high activity soils/sandy soils
Greece	Cropland	48	National average IPCC derived
Luxemburg*	Forest Land	85	Country average
	Cropland	77	Country average
	Grassland	92	Country average
France	Forestland	70	Depth not specified
	Cropland	40	Depth not specified
	Grassland	65	Depth not specified
Italy*	Grassland	78.9	For undisturbed soil grasslands
	Cropland	56.7	Depth of 30 cm
Spain	Grassland	94.5	Values are valid at country level for the transition from cropland to grassland. Various depths 30-100 cm as available in the databases
	Cropland	71	Values are valid at country level for the transition from cropland to grassland. Various depths 30-100 cm as available in the databases
United Kingdom	All land use categories		Reference C stock for all regions and all land use, 1 m soil depth

**- more values of the reference C stocks are provided by the GHG National Inventory Report 2012*

For C stock change in SOC of organic soils, the IEF ranges from -2.8 by Finland up to +0.7 Mg C ha-1 yr-1 in case of organic soils on grassland and wetlands conversions in UK (reported as sink only over recent years, while as sources earlier). All reporting MS provide estimates based on country specific data and measurements (i.e. in Finland, the DOM and SOC C stocks change are simulated based on the inputs of aboveground and belowground litter and dead wood and emission from soil).

7.3 Cropland (CRF 5B)

7.3.1 Overview of the Cropland category

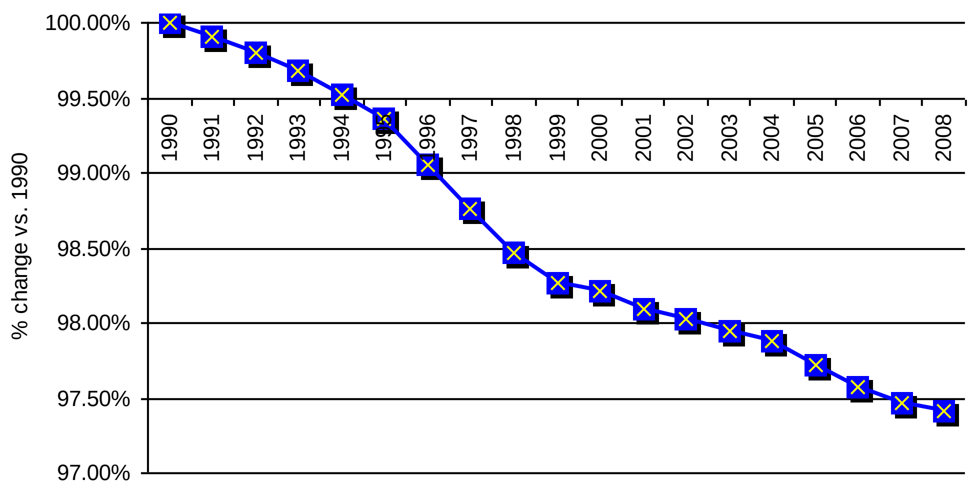
In the EU 15, this category includes arable lands for annual and permanent crops and set aside land. Based on the MS submissions, cropland area in EU-15 covers 85782 kha in 2010 (5% less than in 1990), equal to ~26 % of total reported land area.

7.3.2 *Cropland remaining cropland (CRF 5B1)*

7.3.2.1 Overview of Cropland remaining cropland

According to MS' CRFs, the area of "cropland remaining cropland" constantly decreases since 1990 (Figure 7.9).

Figure 7.9 **The relative trend of Cropland remaining Cropland over the period of 1990-2010 (% to 1990)**



MS show decrease of cropland area, with the exception of France, Luxembourg and United Kingdom. The largest percentage decreases are registered by Italy, Ireland and Portugal (Table 7.23). Overall, at the EU-15 level, the area of cropland remaining cropland decreased by ~2% from 1990 to 2010.

Table 7.23 **Trend of activity data in subcategory 5B1 - Cropland remaining cropland in EU-15's MS (kha)**

Member State	1990	1995	2000	2005	2010	Difference 2010 to 1990
Austria	1425	1413	1388	1383	1333	-6%
Belgium	966	939	911	883	850	-12%
Denmark	2917	2882	2848	2814	2775	-5%
Finland	2372	2361	2335	2324	2324	-2%
France	13587	13571	13899	14341	14725	8%
Germany	13630	13672	13713	13585	13567	0%
Greece	3944	3906	3848	3802	3681	-7%
Ireland	405	392	373	317	268	-34%
Italy	11170	11173	10618	10012	9508	-15%
Luxembourg	37	36	37	41	45	21%
The Netherlands	999	971	942	911	897	-10%
Portugal	3524	3252	2991	2767	2586	-27%
Spain	21175	20871	20317	20026	19796	-7%
Sweden	3069	3016	2964	2895	2877	-6%
United Kingdom	1692	2060	2507	3271	3979	135%
EU-15	**80913**	**80514**	**79691**	**79371**	**79212**	**-2%**

At EU-15 level, in 2010 subcategory 5B1 was a source of 25,500 $GgCO_2$, i.e. 27 % higher than in 1990 (Table 7.24) and comparable to 2010.

Table 7.24 5B1 Cropland remaining cropland: MS' contributions to net CO_2 emissions

Member State	Net CO_2 emissions (Gg)			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2)	(%)	(Gg CO_2)	(%)		
Austria	-152	52	72	0.3%	20	38%	224	-147%	T1,T2	CS,D
Belgium	1,056	937	936	3.7%	-1	0%	-120	-11%	CS,T2	CS
Denmark	4,607	3,464	2,370	9.3%	-1,093	-32%	-2,237	-49%	T1,T3	CS
Finland	4,859	4,483	4,457	17.5%	-26	-1%	-402	-8%	D,T1	D
France	1,054	993	1,102	4.3%	109	11%	48	5%	CS,T2	CS
Germany	23,415	24,997	25,000	98.2%	3	0%	1,585	7%	CS,D,T2	CS
Greece	-1,205	-563	-642	-2.5%	-79	14%	563	-47%	T1,T2	CS,D
Ireland	20	-21	-27	-0.1%	-7	33%	-47	-236%	T1	D
Italy	-19,066	-12,260	-12,226	-48.0%	34	0%	6,840	-36%	T1,T2,T3	CS,D
Luxembourg	-6	8	8	0.0%	0	0%	14	-231%	T1	CS,D
Netherlands	IE,NA,NE	IE,NA,NE	IE,NA,NE	-	-	-	-	-	NA	NA
Portugal	-104	-321	-312	-1.2%	9	-3%	-208	200%	D	D
Spain	-929	-3,719	-3,053	-12.0%	666	-	-2,124	-	T2	CS,D
Sweden	2,378	1,649	1,865	7.3%	216	13%	-513	-22%	T1,T2,T3	CS,D
United Kingdom	4,105	5,694	5,916	23.2%	222	4%	1,811	44%	CS,T3	CS
EU-15	**20,032**	**25,393**	**25,466**	**100.0%**	**72**	**0%**	**5,434**	**27%**		

Nevertheless, 5B1 represents an active sink in those MS where there are large areas of permanent croplands under active management. Mediterranean countries reports sink (e.g. Italy reports a very large and time decreasing sink in biomass of tree crops, which deserves a better analysis) or almost neutral land category (i.e. France), as owing large areas of permanent croplands (i.e. olive groves, vineyards), although removal is steadily decreasing since 1990. In fact, overall EU-15 removal since 1990 is dominated by Italy's permanent cropland, while overall emission is dominated by Germany's cropland Overall, in Germany this land subcategory is a source, turning entire LULUCF into a source, with all pools being sources, with obviously significant emissions associated with organic soils. Other countries report soils as relatively small source (e.g. UK) or sink (e.g. Finland).

7.3.2.2 Methodological issues for Cropland remaining cropland

The definitions of croplands are not always transparently reported by the MS, but when available they appear to match well the IPCC definition (Table 7-25). In some cases, the match with IPCC definition required aggregating or disaggregating existing national data and statistics. Quite often, cropland may not be clearly separated from grassland, and the approaches applied to report a land under either cropland or grassland may vary from one MS to another. Fact is that all 15 MS have developed consistent land use change matrices.

Table 7-25 Information on cropland definitions and/or description (na – definition not yet available)

Member State	Description

Austria	Arable land, including annual and perennial crops (used in short rotations, with rotation period of up to thirty years), as well as forest arboretums, forest seed orchards, Christmas tree plantations and orchards (e.g. walnut or sweet chestnut) and rows of trees and areas with woody plants in parks and green areas, and house garden.
Belgium	Arable and tillage land, and agro-forestry systems where vegetation falls below the thresholds used for the forest land category
Denmark	Land with annual crops, wooden perennial crops, area with hedgerows and "other agricultural area" (i.e. small undefined areas lying inside the cropland area). It includes farmlands, commercial plantations with perennial crops (fruit trees, orchards and willow), houses gardens, hedgerows (perennial trees/bushes not meeting the forest definition) in the agricultural landscape, as well as willow plantations on agricultural land for bioenergy purposes.
Finland	Area under arable crops, grass covered (for less than 5 years), set-aside, permanent horticultural crops, greenhouses and kitchen gardens.
Germany	Annual crops and cropland with perennial crops (long-lived crops: fruit crops, osiers, poplars, Christmas tree farms, nurseries). Area for cultivation of vegetables, fruit and flowers.
Greece	Annual and perennial crops as well as temporary fallow land. Forest plantations – mainly consisting of poplar trees - are considered as Cropland. Includes perennial woody crops, i.e. tree crops and vineyards.
Ireland	Permanent crops and tillage areas (including set-aside), as recorded by annual statistics.
Italy	Annual crops and perennial woody crops (e.g. woody plantations, that don't meet national forest definition, olive groves or vineyards).
Luxemburg	Includes agro-forestry systems where tree cover falls below the forest threshold, respectively covered by annual crops, artificial meadows (not permanent) and lands temporarily set aside, as well as agro-forestry systems where tree cover falls below forest definition but covered by different permanent crops
The Netherlands	Arable and tillage land, including rice-fields, and agro-forestry systems where the vegetation structure falls below the thresholds used for the Forest land category, and nurseries (including tree nurseries). Intensive grasslands are not included in this category and are reported under Grasslands.
Portugal	Arable land, permanent crops, heterogeneous agricultural areas.
Spain	Cultivated land, including cultivated areas in the dehesa (definition in Table 7.12). Annual crops (including fallow lands), perennial crops (olive groves, wines and other woody crops) and mix of annual and permanent crops are included, except when they qualify as forest land.
Sweden	Regularly tilled agricultural land.
United Kingdom	Non-forest biomass from yield improvements (from improved species strains or management, rather than fertilization or nitrogen deposition) and fenland drainage (in England only) which were drained many decades ago for agriculture purpose (although there was no land use change).
	France - na

Net fluxes of GHG in cropland remaining cropland are reported mainly for soils, which is the most significant pool in terms of C stock changes, while for biomass, the C stock changes are reported only for perennial woody crops (i.e. orchards, vineyards, Christmas trees, fruits, bushes, plantations). The soil pool definitions vary among MS, in terms of the estimated soil depth (e.g. 20 cm in Finland and Finland; 100 cm in Denmark; no depth is specified in case of modeled approaches) and as well as the threshold content for organic matter in organic soils. Methods used for the estimation of emissions and removals depend on data type and their time series availability (Table 7.26).

Table 7.26 Background information on C stock change estimation of data and methodology for estimation of activity data and C stocks in the subcategory 5B1

Member State	Description
Austria	Activity data is compiled from Statistic Austria (based on IACS*). For crops not covered by the IACS the data are revised and estimated by expert judgment. Annual C stock change in biomass is considered according to the type of permanent woody crops (Tier 1 for orchards, vineyards and house gardens and Tier 1 for energy crops, Christmas tree) and estimated based on country specific total biomass carbon stock at harvest/removal. C stock in mineral soils is computed from national reference C stocks and country specific average C stock change factors adjusted according to the technology and management change.
Belgium	Activity data for SOC is derived based on landscape units distribution generated by the topological intersection of the 1990 version of the Corine Land Cover (CLC) geo-dataset and the digitized Soil Association map of Tavernier et al. (1972). C stock for each type of unit is estimated for the years 1960, 1990 and 2000, based on several databases and modeling approaches. C stock change in biomass is not yet estimated.

Denmark	Activity data by Statistics Denmark in a GIS analysis of the country's agricultural area combined with LPIS databases and detailed climate, soil maps, mineral & organic soils and cropland & grasslands, based on aerial photos for 1990 and 2005. Further on stratified on administrative criteria. C stock change in horticultural biomass is estimated based on the country's average stock biomass for each crop type, while for hedgerows is modeled with NFI data. The estimation of the SOC stock change in mineral soils is modeled at county level validated against available long term field measurements. For organic soils, emission factors are country specific.
Finland	Cropland area is derived from NFI and Yearbook of Farm Statistics. Based on soil analysis the area is stratified on mineral & organic soils, low/high activity soils and fallow/till/no-till lands. C stock change in woody biomass is determined by country specific data for perennial crops. C stock changes in soils are computed from reference soil C stocks and IPCC default factors. CO_2 emissions from cropland on organic soils are computed based on national emission factors on land categories and use.
France	Unitary land assessment system for all lands (described under 5A1). C stock changes are considered neutral in all pools.
Germany	Cropland area is multi-source provided via GIS digitized maps, within "wall to wall" approach, built by the landscape model (ATKIS - Amtliches Topographisch-Kartographisches Informationssystem), CORINE land cover (CLC – 1990, 2000), digital soil map of Germany (BUEK 1000) and German Official Statistic data (land use surveys in 1991, 1999, 2003), harvests survey in 1989 – 2005, revision of NUTS 3 in 1998 and NFI). The approach allows estimating the area of land uses and the ratio of organic/mineral soils. Emissions from organic soils are estimated using a Tier 3 methodology, with country specific emission factors. Mineral soils are considered to be in CO_2-equilibrium.
Greece	Area data on cropland dynamic is provided by national statistics. The default IPCC method is combined with a Tier 2 methodology to estimate C stock changes in biomass in permanent woody crops. Tier 1 emission factor data is used for the estimation of C stock changes in mineral soils, with IPCC default C stock change factors and C stock reference in mineral soils. A weighted average value for reference soil organic carbon stock is computed at national level, based on default IPCC data.
Ireland	Annual statistics for tillage crops. For C stock change in biomass, Tier 1 is assumed. Tier 1 is applied for C stock change estimation in mineral soils. Soil types on land uses are derived from GIS analysis of CLC 1990 superimposed on the General Soil Association Map of Ireland. Reference C stocks are established in details for each soil type, and then assimilated with IPCC defaults, while adjusted by unique national values of stock change factors.
Italy	Time series of national land use statistics is available. Tier 1 based on highly aggregated area estimates for generic perennial woody crops has been used to estimate only aboveground biomass carbon stock change. Biomass plantations C stock change is modeled at regional scale (NUTS2). No change for mineral and organic soils was assumed.
Luxemburg	Calculation of annual change in carbon stocks of living biomass of land converted to cropland follows IPCC GPG 2003 LULUCF Tier 1 method with default C stock change factors data. SOC is demonstrated no chnage as adjustement factors are not chnaged.
The Netherlands	The years 1990, 2004 and 2010 are based on observations of land use; the values for the period in between are obtained through linear interpolations and the values for the years after 2010 are obtained by means of extrapolation. Soil carbon is conservatively reported as zero based on country specific data. 2010. C stock change is considered zero in all other pools.
Portugal	Area data is provided by Corine Land Cover maps (1990, 2000), NFI and agricultural statistics. Data for permanent biomass is based on neighbor countries values. Soil C stock change is estimates with country specific data.
Spain	Activity data is obtained from CLC 1990 and 2000, Forest Map of Spain, survey of yields and crop areas (1990-2003) and annual statistics of agriculture ministry (2004-2010).. C stock change in biomass is estimated only for perennial woody crops based on CS data on each main type of crop: olives, wines and other woody crops. Soil C stock change factors are adjusted on climatic regions.
Sweden	Activity data is provided by a national level systematic grid of permanent monitoring plots. Change in mineral soils is estimated based on repeated soil sampling in combination with pedotransfer functions. In organic soils the changes are based on country specific emission factors.
United Kingdom	Non-spatially-explicit land use land use data is provided from countries statistics, namely areas of CL, GL and SL in 1990, 1998 and 2007 come from the Broad Habitat areas reported for each country (England, Scotland, Wales and Northern Ireland) in the Countryside Surveys. A dynamic model of carbon stock change is used with the land use change matrices to estimate soil C stock changes due to land use change.

** IACS - Integrated Administrative Control System for EU subsidy payment scheme*

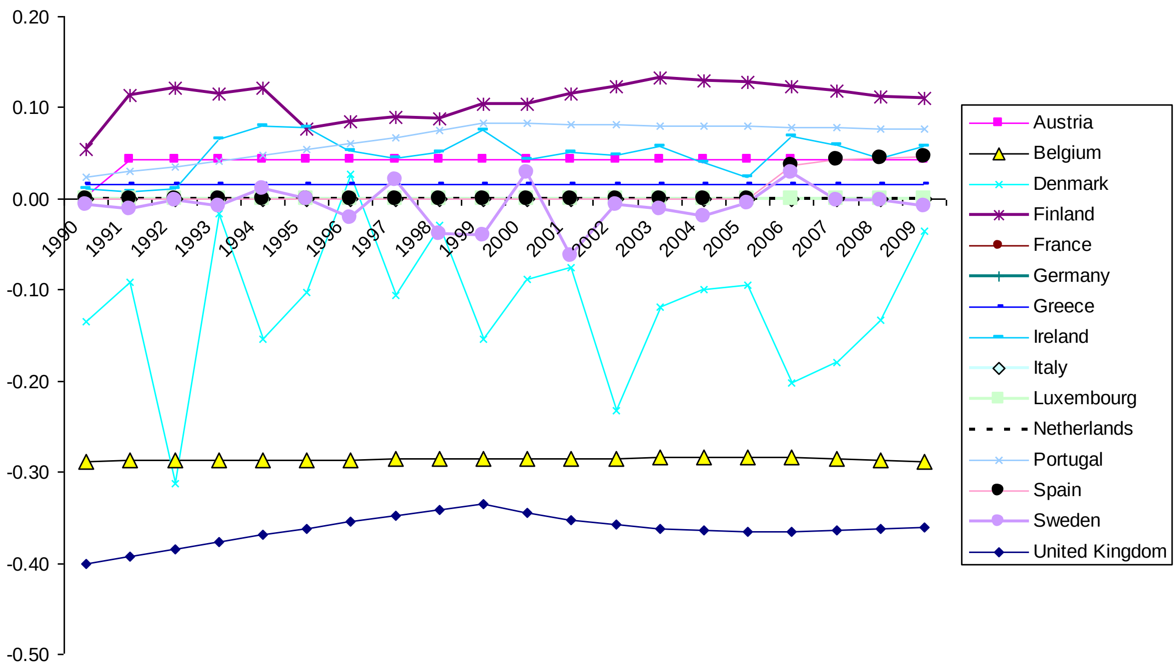
Although this subcategory is highly heterogeneous (in terms of soil, ecological conditions, management practices, crop type), relatively few MS report it on land subdivisions (which are likely available with the MS spreadsheets, but not included in their NIRs). Such approach would allow better understanding of the differences at continental scale.

Different C stock change factors for living biomass vary by different types of permanent crops and management across Europe, especially from North (i.e. bush-type currant crops) to South (i.e. olives crops and agro-forestry systems). At EU 15 level, there is an average C stock change factor of 0.04 Mg C ha-1 yr-1 (range between -0.4 and 0.11). Under dynamics of perennial cropland in some years it may associate with emissions (e.g. from 1994 on in Austria under decreasing of their area) or as estimates as sources (e.g. Denmark and Portugal). In few countries, the biomass C stock change is considered neutral (e.g. Germany, France).

For the estimation of C stock changes in mineral soils of cropland, most countries apply Tier 1 or 2 for emission factors and method, while few MS report using Tier 3 methodology based on models (e.g. Denmark, UK). Reference C stock (t C/ha) in mineral soils varies between countries (see Table 7.22). Actually, Tier 2 also assumes that the country develop its own C stock change factors. These factors are (according GPG for LULUCF, 2003) the tillage/management factor (F_{MG}), the land use factor (F_{LU}) and the organic material input factor (F_I). Noteworthy is that practically none of EU-15's MS developed its own factors and they all apply default IPCC ones, either directly selected or slightly modifying and adapting them by expert judgment, but not based on quantitative assessments (e.g. measurements). Is there one exception, Austria which derived own factors by weighting C stock changes in mineral soils based on available crop and management statistics since 1985. It was taken into account the changes in agricultural land management (e.g. increase of biological agriculture), tillage (e.g. crop residues remain on the fields) and crop rotation (increase of legumes and greening of arable areas) starting from 1990 soil C stocks and agricultural land use pattern. With the changes in agricultural practices the computed factors showed an increasing trend in time of soil C stock (i.e. CO_2 removal equivalent to 45 kg C ha-1yr-1).

Overall, the mineral soils are reported as small sources, with IEF for the C stock changes between -0.4 to 0.13 (Figure 7.8), somehow unlike to last reported year when mineral soils was mainly estimated as a sink by many countries.

Figure 7.10 **Implied C stock change factor in SOC mineral soils in 5B1 (Mg C ha-1yr-1)**



Extremes IEF values are reported by Belgium and UK of more than -0.28 (based on CS data). Denmark reports based on model dependent on actual air temperature and agricultural annual residues input in the soils which may explain the shape pattern for IEF and total emissions/removal since 1990.

Organic soils under cropland are reported under Tier 1 (involving IPCC default EF) or Tier 2 involving country-specific emission factors (e.g. Finland, Sweden, UK). Ireland reports there are no annual crops on organic soils (see IE NIR 2012 for more info). Some countries developed differentiated EF on type of crops or soil status (e.g. DK on soil management type). Emission factors range from -12 in Germany and Denmark to some -2.5 Mg C ha-1y-1 in Sweden and UK). An overview on the organic soils in EU-15 is provided in Ch. 7.6.

7.3.3 Land converted to cropland (CRF 5B2)

7.3.3.1 Overview of Land converted to cropland

At the EU-15 level, area reported under “land converted to cropland” decreased by 20% since 1990 (Table 7-27). Overall, the area under conversions is some 8 % of total cropland area, and it mainly originates in non-forest lands (in 2010 from total area under conversion 5% originates in forestland, thus deforestation). UK, but especially France, reports significant share of their cropland area as being under conversions, most of which are reported as occurring from grassland (> 90 % of area) and explained by the practice of swift shift from one use to another by current farming. Together, the conversion area in the two MS represent around 85% of total EU-15 area reported under such conversions.

Table 7-27 **Trend of activity data in subcategory 5B2 - Land converted to cropland – in EU-15 MS (kha)** (na- for the MS that start the time series in 1990/1991)

Member State	Year					Difference 2010 to 1990
	1990	1995	2000	2005	2010	
Austria	83	79	74	73	101	22%
Belgium	11	39	66	94	117	961%
Denmark	1	3	6	8	11	1749%
Finland	77	68	74	104	112	47%
France	4631	4563	4284	3847	3851	-17%
Germany	767	767	767	733	636	-17%
Greece	0	0	0	0	0	5400%
Ireland	NO	17	27	67	116	na
Italy	207	209	72	72	2	-99%
Luxembourg	8	8	8	8	7	-13%
The Netherlands	14	14	14	22	22	56%
Portugal	90	98	107	108	106	19%
Spain	NO	NO	NO	NO	NO	na
Sweden	32	49	62	84	87	172%
United Kingdom	2287	2404	2396	1894	1400	-39%
EU-15	**8208**	**8319**	**7959**	**7115**	**6570**	**-20%**

Emissions decreased by 20 % since 1990 (Table 7.28). Land converted to cropland is an important source at the EU-15 level: although 5B2 area is about 8% of the 5B area in 2010, the 5B2 annual emission is 11 % more than 5B1’s. Most of the emissions occur in case of conversion from forest land and from grassland. In 2010, the largest emissions are reported by France (comparable to 1990).

Table 7.28 **5B2 Land converted to cropland: MS' contributions to net CO_2 emissions**

Member State	Net CO_2 emissions (Gg)			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2)	(%)	(Gg CO_2)	(%)		
Austria	356	414	445	1.5%	31	7%	89	25%	T2	CS
Belgium	115	818	840	2.9%	22	3%	725	-	CS,T1	CS
Denmark	35	18	19	0.1%	1	4%	-16	-46%		
Finland	696	1,434	1,352	4.7%	-82	-6%	656	94%	D,T1,T3	CS
France	15,985	15,343	14,830	51.5%	-513	-3%	-1,156	-7%	T2,T3	CS
Germany	5,347	3,408	3,352	11.7%	-56	-2%	-1,994	-37%	CS,D,T2	CS
Greece	0	0	0	-	-	-	-	-	T2	CS
Ireland	NO	438	256	0.9%	-182	-42%	256	-	T1	D
Italy	746	119	64	-	-55	-	-681	-	T1	D
Luxembourg	40	18	18	0.1%	0	2%	-23	-56%	T1	CS,D
Netherlands	122	163	163	0.6%	1	0%	41	34%	T1	D
Portugal	813	522	507	1.8%	-15	-3%	-305	-38%	T2	CS,D
Spain	NO	NO	NO	-	-	-	-	-	NA	NA
Sweden	36	149	126	0.4%	-23	-15%	90	249%	T1,T2,T3	CS
United Kingdom	11,627	7,186	6,801	23.6%	-385	-5%	-4,826	-42%	D	CS
EU-15	**35,917**	**30,029**	**28,774**	**100.0%**	**-1,256**	**-4%**	**-7,144**	**-20%**		

7.3.3.2 Methodological issues for Land converted to cropland

MS main data sources for estimation of the C stock changes and CO_2 emissions are in Table 7.29.

Table 7.29 **Background information on C stock change estimation sources of data and methodology in subcategory 5B2**

Member State	Description
Austria	FL conversion from/to data from NFI and CL from /to GL from IACS data base. 2010 C stock change estimation reaches a IPCC Tier 2: living biomass is based on country specific factors. Soils C stock change is estimated by reference C stocks on regions, different land uses and a default transition period of 20 years.
Belgium	Only emissions from conversion from FL are estimated based on decrease of average living biomass C stock. SOC is computed based on regional reference C stock in soils.
Denmark	Data derived from remote sensing in 1990 and 2005, combined with data in LPIS. It is further stratified with the soil map in both mineral and organic soils & cropland and grasslands (further broken down for: annual crops, set-a-side, grass in rotation and permanent grassland).
Finland	Data from NFI. Woody biomass and DOM data are also given by NFI. Mineral soils C stock change is computed based on country specific C stock references assuming 20 years transition period.
France	Integrated land use conversion matrix. Only emissions from conversion from forests are estimated based on biomass, DOM and SOC NFI data.
Germany	GIS digitized maps, within integrated "wall-to-wall" approach covers entire land including conversions. A computation procedure derives C stock changes for relevant pools.
Greece	Data was provided by local forest service offices.
Ireland	GIS LPIS* database. Computation of emissions assumes a correlation between soil type and grassland use. Deforestation data is given by CLC. Only above-ground biomass change is estimated as the difference between initial and final carbon content of biomass for the lands converted. SOC emissions are estimated based on a Tier 1 methodology. Data on biomass on converted forestland is given by Forest Service databases
Italy	Land use change matrix is constructed based on time series of national land use statistics, with annual effective conversions derived under a hierarchy of expert judgment assumptions on well-known patterns of land-use changes in the country, further on combined with the target that the total national area to remain constant. Conversions from forest are derived based from administrative records at regional level collected by National Institute of Statistics.
Luxemburg	Country specific values of reference C stocks in the soils and standing living biomass before conversion from forestland and grassland or between annual and perennial crops implement default method.
The Netherlands	The activity data is derived from land use matrix and soil maps. Digitized soil maps are combined with soil profile details for 1990, 2004 and 2010, then extrapolated. National average data is available C stock change in DW, LT and LB.
Portugal	Conversion area is provided by Corine Land Cover maps (1990, 2000), NFI and agriculture statistics, involving linear

	interpolations and extrapolations to obtain full time series. Soil C stock change is based on country specific data
Spain	There are no detected conversions to croplands (reported as NO).
Sweden	Activity data is provided by NFI. Biomass data for conversion from forests is given by NFI. For C stock change in soils it is involved a Tier 2 method based on country specific emission/removal factor.
United Kingdom	Land use change data is derived from countries statistics from three consecutive Countryside Surveys (1990, 1998 and 2007), extrapolated to 2010 and the areas of land use change from Forest come from Forestry Commission data, the Department for Communities and Local Government and the Countryside Survey dataset. Changes in biomass and SOC due to land use change depends on a matrix of change based on repeated land surveys, linked to a dynamic model of carbon stock change and a database of soil carbon density for the UK.

* *LPIS – Land Parcel Information System (used by MS to implement the Common Agricultural Policy of the EU).*

Lower tiers are generally used in estimating and reporting C stock changes in this land subcategory, especially Tier 2 and enhanced Tier 1 by using country specific data with default methods.

At EU level, multiyear average C stock change factor in Living Biomass pool *in case of conversions from forestland* to cropland ranges between 45-60 Mg C ha-1 yr-1 for the MS which report only one year transition period (i.e. Belgium) to values under 4 Mg C ha-1 yr-1 for the MS that report over longer transition period. High values of IEF are reported for early '90 by MS reporting time series starting the 1990 (i.e. Denmark). Nevertheless, following the GPG for LULUCF (2012) emission from LB and DW, LT are assumed to occur in one year under such conversions.

In case of *conversions from grassland to cropland,* mostly soils emissions are reported. When biomass is reported, emissions are estimated using IPCC default values. IEF for C stock change in living biomass is either positive (e.g. Denmark) or negative (e.g. Germany). On mineral soils, the C stock change factors are smaller for grassland than for forestland converted to cropland, with general values under 3 Mg C ha-1 yr-1.

Conversions of grassland to cropland on organic soils occur rarely (overall EU-15 emission of 348 Gg C in 2010) and forestland to cropland (overall EU-15 emission of 704 Gg C in 2010).

7.4 Grassland (CRF 5C)

7.4.1 Overview of Grassland (CRF 5C)

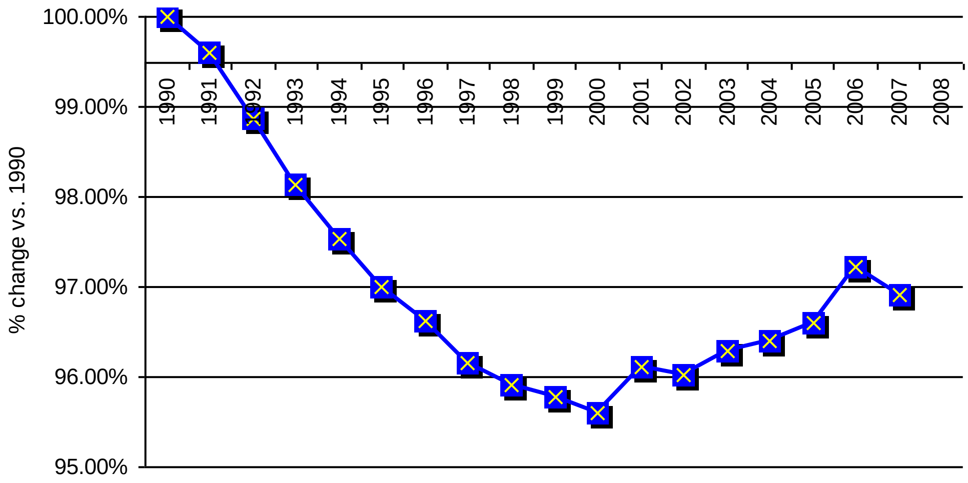
According to MS submissions, in 2010 the total grassland area was ~ 54000 kha or 5 % of total reported land area. The highest area of grasslands is in France (14,200 kha) and the lowest in Denmark (15 kha).

7.4.2 Grassland remaining grassland (CRF 5C1)

7.4.2.1 Overview of grassland remaining grassland

Area reported under this land subcategory is 5% less than in 2010 compared to 1990 (Figure 7.9).

Figure 7.11 **The relative trend of area of grassland remaining grassland over the period of 1990-2010 in EU-15 (% relative to 1990)**



All MS having large areas of grassland in 1990 showed a decrease (Table 7.30).

Table 7.30 **The trend of activity data in "grassland remaining grassland" subcategory 5C1 in EU-15's MS (kha, 1990-2010)**

Member State	1990	1995	2000	2005	2010	Difference 2010 to 1990
Austria	1879	1866	1871	1764	1711	-9%
Belgium	747	704	661	617	575	-23%
Denmark	117	114	111	109	106	-9%
Finland	171	161	163	172	173	1%
France	11224	10747	10685	10820	10704	-5%
Germany	6281	6150	6018	5902	5861	-7%
Greece	4797	4796	4794	4793	4792	0%
Ireland	4122	4059	3977	3814	3601	-13%
Italy	9220	8791	8920	9085	9142	-1%
Luxembourg	79	79	78	75	72	-9%
The Netherlands	1485	1449	1414	1372	1355	-9%
Portugal	180	169	189	344	505	181%
Spain	4720	4622	4535	4470	4423	-6%
Sweden	477	449	424	387	385	-19%
United Kingdom	11021	10526	9853	10333	10507	-5%
EU-15	**56520**	**54682**	**53693**	**54057**	**53911**	**-5%**

Category 5C1 grassland remaining grassland was a source of CO_2, with an amount of emissions in 2010 equal to some 30 % of 5B1 (despite their similar areas). Total annual emissions in 2010 were 42 % and respectively 3 % higher, than in 1990 and previous year, respectively (Table 7.31).

Table 7.31 5C1 Grassland remaining Grassland: MS' contributions to net CO_2 emissions

Member State	Net CO_2 emissions (Gg)			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2)	(%)	(Gg CO_2)	(%)		
Austria	-96	-86	-86	-0.9%	0	0%	10	-10%	T2	CS
Belgium	671	407	397	4.1%	-10	-2%	-274	-41%	CS,T2	CS
Denmark	189	145	142	1.5%	-3	-2%	-47	-25%	T2	CS
Finland	840	593	582	6.0%	-11	-2%	-258	-31%	D,T1	D
France	IE,NO	IE,NO	IE,NO	-	-	-	-	-	NA	NA
Germany	11,705	10,502	10,708	110.8%	206	2%	-996	-9%	CS	CS
Greece	0	0	0	-	-	-	-	-	T2	CS
Ireland	602	525	533	5.5%	8	2%	-69	-11%	T1	D
Italy	273	-2,265	-2,094	-21.7%	171	-8%	-2,367	-868%	T1,T2,T3	CS
Luxembourg	IE,NO	IE,NO	IE,NO	-	-	-	-	-	NA	NA
Netherlands	4,246	4,246	4,246	43.9%	0	0%	0	0%	T2	CS
Portugal	IE,NO	IE,NO	IE,NO	-	-	-	-	-	NA	NA
Spain	NE,NO	NE,NO	NE,NO	-	-	-	-	-	NA	NA
Sweden	-726	-603	-566	-5.9%	37	-6%	160	-22%	T2,T3	CS
United Kingdom	-1,022	-4,063	-4,199	-43.5%	-136	3%	-3,177	311%	CS	CS
EU-15	**16,682**	**9,400**	**9,663**	**100.0%**	**264**	**3%**	**-7,019**	**-42%**		

The largest contributor at EU-15 level is Germany (which reports an almost constant source) and Italy (which reports a sink). Several MS report NO (i.e. France reports no change in all pools according to Tier 2 methodology, after measurements and country specific data, while several MS report no change under Tier 1 for biomass (see Table 7.6). The C stock change in mineral soils on grassland is reported as not estimated by some half of the MS (e.g. Spain) or demonstrated as being nil. Few MS report the existence of unmanaged grassland (e.g. Ireland, France).

7.4.2.2 Methodological issues for Grassland remaining grassland

The definition of grassland is not always reported in the NIRs, but available descriptions show good match with the IPCC definition, despite different management approaches across the EU (Table 7-32).

Table 7-32 Definition and description of grassland (na–definition/description is not available in NIR 2012)

Member State	Description (* - more detailed information is available in the NIR)
Austria	Meadows cut once/twice/several times, cultivated pastures, litter meadows, rough pastures, alpine meadows and pastures and abandoned grassland.
Belgium	Rangelands and pasture land that is not considered under cropland. It also includes systems with vegetation that fall below the threshold of forest land category and are not expected to exceed it, without human intervention.
Denmark	Contains grassland defined according grazing land under LPIS, heath land which may or may not be used for sheep grazing, as well as all other areas not meeting the definitions of forest land. The area of grassland is divided in "grazing land" and "other grassland".

Finland	Grassland includes area of grass cover (for more than 5 years), ditches associated with agricultural land and abandoned arable land. Abandoned arable land in this context means fields which are not used any more for agricultural production and where natural reforestation is possible or is already going on.
France	Natural grasslands are not included in the reporting, if not improved as to have production under a specific threshold.
Germany	Meadow and pasture areas that cannot be considered cropland. In addition, it includes land that is covered with trees and shrubs but that does not fall within the definition of "forest", as well as natural grassland and recreational areas.
Greece	Rangeland and pasture with vegetation that falls below the threshold of national forest definition and are not expected to exceed that without human intervention. Pastures that have been fertilized or sown are considered as cropland.
Ireland	Improved grassland (pasture and areas used for the harvesting of hay and silage) and unimproved grassland (rough grazing) in use as recorded by annual statistics.
Italy	Grazing lands, forage crops, permanent pastures, and set-aside lands since 1970, all shrub lands (data derived from NFI). It also includes other wood lands that don't fulfill forest definition.
Luxemburg	All grasslands that are not considered as cropland including systems with vegetation or tree cover below forest threshold, natural grassland, recreational areas as well as agricultural systems. It inludes one cut meadows; two and more cut meadows, cultivated pastures, litter meadows, rough pastures and pastures and abandoned grassland.
The Netherlands	The Netherlands currently reports under grassland any type of terrain which is predominantly covered by grass. Apart from pure grasslands, all orchards (with standard fruit trees, dwarf varieties or shrubs) are included in the category grasslands vegetation. Rangeland and pasture land is the land that is not considered croplands. It also includes all orchards (with standard fruit trees, dwarf varieties or shrubs) and the vegetation that falls below the threshold used in the forest land category and are not expected to exceed, without human intervention, the threshold used in the forest land category. The category includes: "Grasslands" - areas predominantly covered by grass vegetation (whether natural, recreational or cultivated) and "Nature" - natural areas (excluding grassland) consisting in heath land, peat moors and other nature areas, with many of them having occasional tree as part of the typical vegetation structure.
Portugal	Pastures.
Spain	Pasture land, including grazing land not included in cropland. It includes also pastures and meadows in the dehesa (forested pasture) that do not comply with the definition of forest.
Sweden	Agricultural land that is not regularly tilled. All grasslands are assumed managed.
United Kingdom*	Area with broad well defined habitats: improved grassland, natural grassland, calcareous grassland, acid grassland, bracken, dwarf shrub heath, fen/marsh/swamp, bogs and mountains.

Quite often, grassland may not be clearly separated from cropland and/or wetlands, especially on land under conversion (e.g., in France and UK where a rolling management by conversion from and to cropland and grassland is reported up to 70 – 100 % of the total 5C area). The ability of the national GHG estimating systems to accurately assess the status of the land varies from one MS to another. The methods used by the MS to estimate the emissions related to grassland remaining grassland and conversions to grassland are described under the following subchapters. Lower tiers data are used for reporting emissions and removals for this land use category (Table 7.33).

Table 7.33 Background information from MS on C stock change estimation sources of data and methodologies in the subcategory 5C1

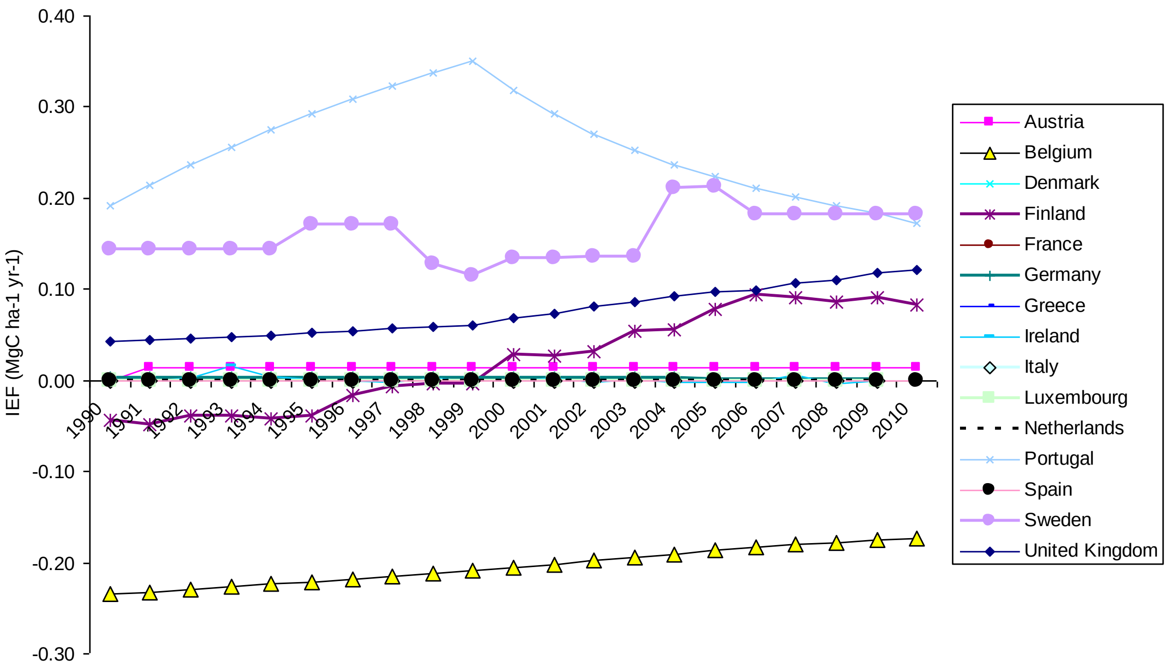
Member State	Description
Austria	Activity data is compiled from Statistic Austria (based on IACS). Biomass is neutral. SOC is estimated with Tier 2 based on national reference C stock and C stock change factors. Emission from organic soils was estimated based on area from soil inventories and Austrian Soil Information System and the IPCC default emission factors.
Belgium	Activity data is derived based on landscape units distribution generated by the topological intersection of Corine Land Cover (CLC1990) geo-dataset and digitized Soil Association map of Tavernier et al. (1972). Biomass is not estimated yet. SOC change is estimated based on a number of heterogeneous databases and modeling efforts.
Denmark	Grassland area is obtained by LPIS, with potential area reported under cropland. SOC is reported based on country specific data.

Finland	The area estimate of grasslands was derived from national statistics (Farm statistics for cropland area) and NFI data. C stock change in the biomass is not yet estimated. IPCC default soil C stocks for high activity and sandy grassland soils for wet temperate climate were used together with the default carbon stock change factors. For organic soils, both activity data and emission factor are country specific.
France	Matrix of explicit land use and land use changes, classifying managed and unmanaged grasslands (with natural grassland not counted under GHG inventory). For biomass, the C stock change is estimated only for woody biomass, with tree data delivered by NFI. All other pools are considered in equilibrium.
Germany	Integrated unitary system for land and land conversion classification, mapping and ranking in time (see Forestland). The approach allows for estimating the area of organic soils and their land use. Biomass C stock change is estimated based on country specific datasets. SOC stock change is considered based on national datasets and research.
Greece	The area is provided by agricultural statistics. No change in biomass. Aboveground grass and tree biomass are only considered for estimating emissions in case of wildfires. DOM and SOC are assumed to be neutral.
Ireland	An approach 1 is available with the Central Statistic Office's statistics. The IPCC soil types on land use categories are derived by GIS LPIS analysis of superimposition of CLC 1990 with General Soil Association Map of Ireland (with peat areas entirely classified under wetlands). No biomass C stock change assumed under static management practices. For SOC, the IPCC default values are used to establish the reference C stocks, and they are corrected for by using F_{LU}, F_{MG} and F_I default factors to account for land use and farming practices. On organic soils, emissions are estimated using with the IPCC default factor.
Italy	A time series of national land use statistics is available (same procedure for all LU, see under 5A1 activity data). Grassland includes two categories: 1) Grazing land and Other wooded land. For Grazing land a Tier 1 methodology is been used, therefore, no change in carbon stocks in the biomass, SOC and DOM pools is assumed, and 2) Other wooded land (i.e. shrub lands) C stock changes in biomass is modeled and in litter pool estimated by linear relation against aboveground carbon.
Luxemburg	Assumed neutral.
The Netherlands	The activity data is derived from land use matrix and soil maps. C stock change in biomass is not estimated. Carbon content is based on the soil map of the Netherlands in combination with a national random check of map units that provides detailed descriptions of soil profiles. Country specific method is used to estimate emissions from the drainage of organic soils.
Portugal	Area data is given by Corine Land Cover maps (1990, 2006), NFI and agricultural statistics. SOC data is country specific.
Spain	The activity data is obtained from CLC 1990 and 2006, and Forest Maps of Spain, survey of yields and crop areas (1990-2003) and annual statistics of agriculture ministry (2004-2010). All pools are considered neutral.
Sweden	All data is provided by the NFI. On organic soils country specific annual heterotrophic respiration is available. For C stock change in soils and DOM, it is involved a Tier 2 method based on country specific emission/removal factor.
United Kingdom	Non-spatially-explicit land use land use data is provided from countries statistics, namely areas of CL, GL and SL in 1990, 1998 and 2007 come from the Broad Habitat areas reported for each country (England, Scotland, Wales and Northern Ireland) in the Countryside Surveys. A dynamic model of carbon stock change is used with the land use change matrices to estimate soil C stock changes due to land use change.

The estimation of emissions covers mainly soils; while biomass data is poorly reported (with only 4 MS report it). Denmark and Germany reports it as source. Sweden reports the average IEF for C stock change in living biomass of 0.5 Mg C ha-1 yr-1 based on field inventory, while Italy of 0.03 Mg Mg C ha-1 yr-1.

Mineral soils C stock change is reported by eight MS, two more since last year. For MS estimating where it a sink, average SOC change is +0.07 Mg C ha-1 yr-1. Belgium reports it as a source for entire time series or Finland in the beginning of '90 (Figure 7-12).

Figure 7-12 C stock change factors for SOC in mineral soils in 5C1 (MgC ha-1 yr-1)



7.4.3 Land converted to grassland (CRF 5C2)

7.4.3.1 Overview of Land converted to grassland

The area of land converted to grassland represents some 14 % in the EU-15 of total reported grassland area, and it increased 6 % compared to 1990 (Table 7.34). From total area in conversions to grassland, 82 % was from cropland and 6 % from forestland. The highest share of conversion to grassland was reported by UK and France.

Table 7.34 Trend of activity data in the "land converted to grassland" subcategory 5C2 in EU-15's MS (kha, 1990-2010)

Member State	Year					Difference 2010 to 1990
	1990	1995	2000	2005	2010	
Austria	114	111	86	79	85	-25%
Belgium	8	28	48	68	95	1088%
Denmark	3	17	32	46	59	1747%
Finland	98	84	84	80	70	-29%
France	5197	5187	4805	4221	3528	-32%
Germany	382	382	382	404	407	6%
Greece	0	33	73	111	230	>>100%
Ireland	19	29	65	87	132	614%
Italy	192	192	709	1071	1521	692%
Luxembourg	16	16	16	15	14	-15%

The Netherlands	16	16	16	30	30	91%
Portugal	406	627	806	820	787	94%
Spain	6	37	67	98	122	1900%
Sweden	26	45	70	85	89	237%
United Kingdom	2026	2267	2409	2161	1873	-8%
EU-15	**8509**	**9070**	**9668**	**9374**	**9042**	**6%**

In contrast to 5C1, 5C2 is a small sink of about 20,000 GgCO_2 in 2010. The sink decreased by 12 % compared to 1990 and increase of 3 % compared to 2010. The highest removals are reported by France and United Kingdom and (Table 7.35).

Table 7.35 5C2 Land converted to Grassland: MS' contributions to the net CO_2 emissions

Member State	Net CO_2 emissions (Gg)			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2)	(%)	(Gg CO_2)	(%)		
Austria	353	398	374	-1.9%	-24	-6%	21	6%	T2	CS
Belgium	85	-403	-437	2.2%	-34	9%	-522	-615%	CS,T1	CS
Denmark	217	46	47	-0.2%	1	2%	-171	-79%		
Finland	-35	81	93	-0.5%	12	15%	128	-365%	CS,T1,T3	CS,D
France	-12,362	-7,228	-7,468	37.4%	-240	3%	4,894	-40%	T2,T3	CS
Germany	-143	-2,047	-1,647	8.2%	399	-20%	-1,504	1052%	CS	CS
Greece	0	0	2	0.0%	2	2876%	2	10977%	T2	CS
Ireland	-109	-187	-290	1.5%	-103	55%	-181	167%	T1,T3	CS,D
Italy	-753	-4,615	-4,968	24.9%	-353	8%	-4,215	560%	T1	CS,D
Luxembourg	32	25	27	-0.1%	2	9%	-5	-15%	T1	CS,D
Netherlands	245	242	250	-1.3%	8	3%	5	2%	T1	D
Portugal	95	-136	-123	0.6%	14	-10%	-217	-229%	T2	CS,D
Spain	-47	-888	-934	4.7%	-47	5%	-887	1898%	T2	CS,D
Sweden	-190	-114	-178	0.9%	-64	56%	12	-7%	T1,T2,T3	CS
United Kingdom	-5,239	-4,518	-4,733	23.7%	-215	5%	506	-10%	D	CS
EU-15	**-17,851**	**-19,344**	**-19,987**	**100.0%**	**-643**	**3%**	**-2,136**	**12%**		

7.4.3.2 Methodological issues for Land converted to grassland

The methods for estimating the stock changes and emissions of CO_2 from these land categories are summarized in Table 7.36.

Table 7.36 Background information from the MS on C stock change estimation sources of data and methodologies in subcategory 5C2

Member State	Description
Austria	The area is available based on IACS database and NFI for conversion from FL. For both biomass and mineral soils, the annual change is estimated under Tier 2 as a difference between the country's specific soil C stock reference before and after the conversion, then linearly distributed over a 20-year transition period (only 10 years in case of conversion from croplands)
Belgium	Only emissions from conversion from FL are estimated based on average living biomass carbon stock for forest. SOC is computed based on regional reference C stock in soils
Denmark	Area converted from various land use is based on remote sensing data in 1990 and 2005, combined with data in LPIS.
Finland	Data on land conversions is available with successive NFI cycles, with conversions from forestland estimated with a model for all pools. Estimation of emissions from conversion of non-forest land to grassland involves IPCC default data.

France	Explicit land use and land use change identification. Biomass and DOM change are only considered in conversion from forestland. For SOC, reference C stocks are established for the main land use types.
Germany	GIS digitized maps, within integrated "wall-to-wall" approach covers entire land including conversions. A computation procedure derives C stock changes for relevant pools.
Greece	No changes in biomass are assumed as they originate in croplands. Soil emissions are estimated based on a Tier 1 methodology with IPCC default C stock change factors and C stock reference in mineral soils.
Ireland	GIS analysis of CLC 1990 superimposed on the General Soil Association Map of Ireland. A Tier 1 methodology is used for estimation of change in biomass carbon stock. Also, Tier 1 is used for C stock change in mineral soils. Reference C stocks are established for each soil type, then harmonized with IPCC default types, to which adjusted IPCC default factors F_{LU}, F_{MG} and F_I are applied to account for land use and farming practice. On organic soils, the Tier 1 assumption is used and emissions are estimated with IPCC default factors.
Italy	A time series of national land use statistics is available. Tier 1 is used, therefore, no change in carbon stocks in the biomass pool is assumed. No change in DOM is assumed. SOC change is assumed to occur in 1 year applied to reference C stocks for on land use categories.
Luxemburg	On relevant conversion area the increases and decreases of biomass and soil C stocks are estimated as transition over 20 years based on reference C stock and default data for biomass.
The Netherlands	Activity data is derived from land use matrix and soil maps. Country specific method NFI data based is used to estimate CO_2 emissions from soils.
Portugal	Conversion area data is given by CLC 1990 and 2006, NFI and agricultural statistics, with annual conversions derived by linear interpolations and extrapolations to date. SOC factors and references are country specific.
Spain	The activity data is obtained from CLCs and NFI data for conversions from forestland. C stock changes in biomass are estimated as not occurring (as there are only croplands conversions to grasslands). SOC change is estimated based on country specific soil C stock reference.
Sweden	The activity data and biomass data in conversion from forest are provided by NFI. For mineral soils, a C loss factor is computed from the C amount and the soil's fine earth content for soil layers. For organic soils C stock change is based on annual dead organic matter production from NFI and country specific annual heterotrophic respiration.
United Kingdom	Land use change data is derived from countries statistics from three consecutive Countryside Surveys (1990, 1998 and 2007), extrapolated to 2010 and the areas of land use change from Forest come from Forestry Commission data, the Department for Communities and Local Government and the Countryside Survey dataset. Changes in biomass and soil carbon due to land use change depends on a matrix of change based on repeated land surveys, linked to a dynamic model of carbon stock change and a database of soil carbon density for the UK.

On lands converted to grassland, the highest C stock change reported is related to the biomass on conversions from forestland.

At the EU-15 level, the overall IEF for net C stock change in biomass averages -0.28, with a range between -7.5 by Netherlands and 0.6 Mg C ha-1 yr-1 by Sweden. The IEF for C stock change in DOM vary between -0.01 and -1.32 MgC ha-1yr-1.

The annual change in SOC varies between -0.02 by Denmark (only MS that report it as source) to 2.09 Mg C ha-1 yr-1.

7.5 Wetlands, Settlements and Other land

7.5.1 Wetlands (CRF 5D)

In the EU-15, the Wetlands (5D) area in 2010 was 5 % of total EU-15 land, 18,200 kha, with 6,400 kha in Finland, 7,100 kha in Sweden. The land included under this category has different definitions among MS (Table 7.37). France reports CO_2 and CH_4 emissions from flooded area under 5G Other (CRF table 5).

Table 7.37 Definitions of land included by MS under the category 5D Wetlands

Member State	**Description and supplementary elements for land classification** (* often more detailed information is provided blatest version of respective MS NIR)
Austria	Rivers, lakes, mires and peat areas (protected areas, in general) as classified by national statistical system.

Belgium	Land covered or saturated by water for all or part of the year (e.g. peatland) and that does not fall into the other land category. It includes reservoirs as a managed subdivision and natural rivers and lakes as unmanaged subdivisions.
Denmark	Permanent wetlands, wetlands for peat extraction and re-established anthropogenic wetlands. Several subdivisions may be distinguished: unmanaged fully water covered wetlands (lakes and rivers); unmanaged partly water covered wetlands (fens and bogs); managed drained land for peat extraction; managed partly water covered wetlands (re-established wetlands on primarily former cropland and grassland).
Finland	Inland waters (reservoirs, natural lakes and rivers), as well as peat extraction areas and peatlands which do not fulfill the definition of other land uses.
Germany	Reporting in the wetlands category primarily covers emissions from organic soils that are released during peat extraction. Reporting has to cover CO_2 losses from extraction areas, and during extraction, as well as emissions resulting from spreading of peat. Also, it includes (but they are not reported) the few non-drained semi-natural bogs that have been largely free of anthropogenic impacts, flooded lands, water-storage facilities (dams, reservoirs, etc.) and settling basins that are used for energy production, irrigation, shipping and recreation, and that are flooded or drained, or that otherwise have large water-level fluctuations.
Greece	Land that is covered or saturated by water for all or the greatest part of the year (e.g. lakes, reservoirs, marshes), as well as river bed (including torrent beds) and that does not fall into the forest land, cropland, grassland or settlements categories.
France	Lands covered or saturated by water all year long or part of it.
Ireland	Natural unexploited wetlands. Wetland areas commercially exploited for public and private extraction of peat and areas used for domestic harvesting of peat.
Italy	Lands covered or saturated by water, for all or part of the year, harmonized with the definitions of the Ramsar Convention on Wetlands.
Luxemburg	Land that is covered or saturated by water for all or part of the year (e.g. peat land) and that does not fall into other categories, including reservoirs.
The Netherland	Land covered or saturated with water for all or part of the year and does not fall into the other land category. It includes reservoirs as a managed sub-division and natural lakes and rivers as unmanaged, including natural open water in rivers, but also man-made open water in channels, ditches and artificial lakes.
Portugal	Inland wetlands, coastal wetlands, salt marshes, saline and intertidal flats.
Spain	Includes the lands covered or saturated by water all year long or part of it.
Sweden	Wetlands is assumed unmanaged (mires and areas saturated by fresh water) and managed (cca 10 000 ha used for peat extraction).
UK*	Includes sites currently registered for commercial extraction where extraction activity is visible on recent aerial/ satellite photographs or by field visits.

Table 7.38 Structure of lands reported under 5D Wetlands

Land category	Sub-division	Area (kha)	Net CO_2 emissions/ removals (Gg)
1. Wetlands remaining Wetlands	**Total**	**18.176**	**2.400**
	Managed	9.707	2.400
	Un-managed	8.469	0
2. Land converted to Wetlands	**Total**	**691**	**-1855**
	2.1 Forest Land converted to Wetlands	180	1.287
	2.2 Cropland converted to Wetlands	85	-398
	2.3 Grassland converted to Wetlands	203	-1.854
	2.4 Settlements converted to Wetlands	59	-818
	2.5 Other Land converted to Wetlands	186	424

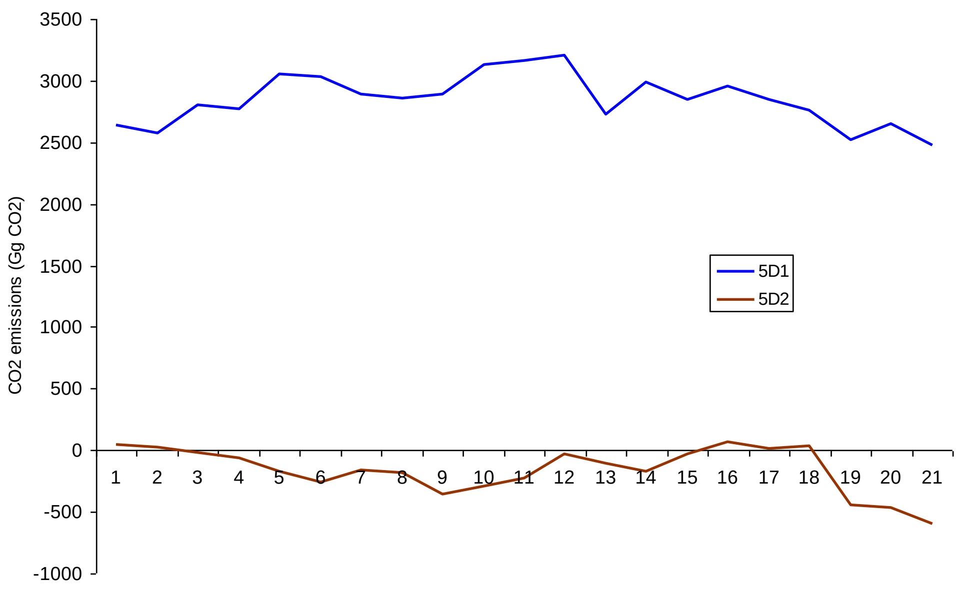
Note1: as “managed land” is assumed any land for which MS estimated emissions under 5D

Note2: For lands under conversion to WL, C stock change in soil is always computed. C stock change in living biomass is estimated only in conversion from FL.

From total wetland area in the EU-15, the annual conversion to wetlands (5D2) represented only 4.4%, with absolute area of wetlands under conversion of roughly 850 kha in 2010 (Table 7.38). This category is often subject to conversions to natural water regime and wetlands, in general established in areas of organic soils on grasslands. In 2010 the highest share of land under conversion is reported from Grassland and Forestland (each by 27%). Area of conversion to wetlands doubled since 1990, with the highest contribution of Sweden (area increased by 10 times since 1990).

Permanent wetlands are considered neutral regarding anthropogenic GHG emissions (e.g. France, Portugal and Sweden). Overall, the CO_2 emission from wetlands has decreased by 6% since 1990 (Figure 7-13). Only few MS report emissions on "remaining" areas (e.g. Germany only from soils; Ireland from biomass and soils).

Figure 7-13 Emissions from Wetlands remaining wetlands (5D1) and Lands converted to wetlands (5D2)



Emissions from peat extraction are reported under "managed" wetlands remaining wetlands. To compute emissions from peatland extraction Denmark reports the use of a peat density factor of 200 kg per m3, a dry matter content of 0.5, an ash content of 0.02 and a C-content of 0.58 kg C per kg organic matter. In general, in case of land use change to water bodies, all MS use final reference carbon stock of 0 Mg C/ha, so all C from the previous land use is considered emissions.

Emissions of CH_4 and N_2O from peat extraction activities (i.e. Finland, Denmark) are reported under Table 5(II), and these include emissions from active and temporarily set-aside peat extraction fields and abandoned non-vegetated peat extraction areas.

7.5.2 Settlements (CRF 5E)

In EU-15, the total reported Settlements (5E) area in 2010 is 20,300 kha. The lands included under this category have particular definitions across EU-15 MS (Table 7.39). All countries report increasing 5E2 areas between -10% for Luxemburg and UK and more than doubling for Denmark and Greece, compared to 1990. The area of land under conversion to settlements (5E2) is quite significant, being nearly 20% of total settlements area. For the lands under conversion, the highest share was reported as under conversion form grassland (37%), cropland (41%) and forestland (16%). Recalculations results in 5E2 being key category for some countries (e.g. Netherlands).

Table 7.39 Definitions of land reported by MS under 5E Settlements

Member State	**Descriptions supplementary elements for land classification** (* often more detailed information is provided in the latest version of respective MS NIR)
Austria	Includes buildings land: sealed, partly sealed and unsealed areas; parks and gardens; roads and railway tracks; excavation areas, and other not further differentiated settlement area.
Belgium	All developed land, including transportation infrastructure and human settlements of any size (i.e. including road sides) unless they are already included under other categories.
Denmark	Urban cores, industrial areas, roads, high build-up areas and low buildup areas. Low build-up areas are characterized as single-family houses surrounded by gardens, graveyards, sports facilities, etc (C is reported only for low build-up areas).
Finland	Combined area of NFI built-up land, traffic lines and power lines. Also parks, yards, farm roads and barns are included.
France	Corresponds to the artificialized land (settlements, parks, roads and infrastructure, etc.).
Germany	Open settlement and transport areas.
Greece	All developed land, including transportation infrastructure and human settlements of any size, unless they are already included under other land-use categories.
Ireland	Urban areas, roads, airports and the footprint of industrial commercial/institutional and residential buildings.
Italy	All artificial surfaces, transportation infrastructures (urban and rural), power lines and human settlements of any size, comprising also parks, have been included in this category.
Luxemburg	All developed land, including transportation and any size of human settlement unless already included under other categories.
The Netherlands*	Developed land, including transportation infrastructure and human settlements of any size, unless they are already included under other categories.
Portugal	Artificial areas such as urban, industrial, commerce and transport units, mines, dump and construction sites and artificial non-agricultural vegetated areas.
Spain	All developed land, transport infrastructure and establishments of any size, unless they are included in other categories.
Sweden	Infrastructure such as roads and railways, power lines, municipality areas, gardens and gravel pits.
UK*	Covers urban and rural settlements, farm buildings, caravan parks and other man-made built structures such as industrial estates, retail parks, waste and derelict ground, urban parkland and urban transport infrastructure. It also includes domestic gardens and allotments, linearly arranged landscape features such as hedgerows, walls, stone and earth banks, grass strips and dry ditches.

There are no emissions reported with “remaining” areas (actually reported under others inventory sectors), but under conversions to settlements (5E2) which have increased by 33% since 1990 (Table 7.40).

Table 7.40 5E2 Land converted to Settlements: MS' contributions to the net CO_2 emissions

Member State	Net CO_2 emissions (Gg)			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2)	(%)	(Gg CO_2)	(%)		
Austria	281	250	252	0.8%	2	1%	-29	-10%	T2	CS
Belgium	271	599	587	1.9%	-12	-2%	317	-	CS,T1	CS
Denmark	104	127	130	0.4%	4	3%	26	25%	T1	CS
Finland	821	1,823	1,810	5.8%	-12	-1%	990	121%	T2	CS
France	10,349	14,943	14,722	46.8%	-221	-1%	4,373	42%	T2,T3	CS
Germany	787	478	591	1.9%	113	24%	-196	-25%	CS,D,T2	CS
Greece	3	4	3	0.0%	-1	-23%	0	-4%	T2	CS
Ireland	9	30	20	0.1%	-11	-35%	11	115%	T1,T2	CS,D
Italy	2,527	3,400	3,409	10.8%	9	0%	882	35%	T1	CS,D
Luxembourg	139	110	109	0.3%	-1	-1%	-30	-21%	T1	CS,D
Netherlands	459	790	799	2.5%	9	1%	340	74%	T1	D
Portugal	1,094	2,204	2,129	6.8%	-76	-3%	1,035	95%	T2	CS,D
Spain	490	551	554	1.8%	3	1%	64	13%	T1	CS,D
Sweden	1,162	2,687	2,704	8.6%	18	1%	1,542	133%	T1,T2,T3	CS
United Kingdom	5,169	3,674	3,615	11.5%	-59	-2%	-1,554	-30%	CS,T3	CS
EU-15	**23,665**	**31,669**	**31,435**	**100.0%**	**-234**	**-1%**	**7,770**	**33%**		

For the EU-15, the emissions from Settlements are difficult to be captured with reasonable certainty level, mainly under lack of data. Conversions to settlements are better reported, but in many cases for conversion from forestland the pools for which reporting is not mandatory were omitted by some MS because methods are not available the IPCC LULUCF GPG (2003). On average, conversion from forest land is associated with emissions from all pools, and the same applies to grassland conversions at emissions rates mentioned for conversions to other land uses (e.g. depends a lot if trees are removed or not). In lands under conversions to settlements, a detailed study in Austria showed an annual increase of the stocks of all vegetation strata (including ground vegetation) of 2.08, with woody biomass annual increase of 0.58 Mg C ha-1 yr-1. Further on, soils C stock change assumes that 2/3 of land is sealed and that same C stock for unsealed areas as in GL, FL or CL and 0 for sealed areas. Luxemburg estimates the annual growth rates of settlement trees (IPCC GPG) and shrubs multiplied by the share of unsealed/total SL area, to derive annual C stock change, also estimating losses based on same shares and input values. Sealed areas were assumed to have nil C stock, while unsealed same as in Grasslands.

7.5.3 Other land (CRF 5F)

The area of category Other land (5F) covers at EU-15 level 23,800 kha in 2010. The land included under this category has particular definitions from across MS (Table 7.41). The largest share of "Other land" is reported by Spain (11,300 kha), Sweden (4,400 kha), and UK (2,300 kha).

Table 7.41 Definition of lands categorized by EU-15 MS under 5F Other land

Member State	Description and supplementary elements for land classification
Austria	Area with i) rocks and screes, ii) glaciers and iii) unmanaged alpine dwarf shrub heaths. This data is calculated as the difference of total country area and all other land uses, showing max 2 % difference by relevant cadastral data.

Belgium	Bare soil, rock, ice, and all unmanaged land areas that do not fall into any of the other five categories.
Denmark	Unmanaged area like moors, fens, beaches, sand dunes, lakes and other areas without human interference.
Finland	Mineral soils on poorly productive forest land, which do not fulfill the threshold values for forest, unproductive lands on mineral soils on rocky lands and treeless mountain areas.
France	All lands that do not correspond to any other land use categories (e.g.. rock areas).
Germany	Waste and swaths/aisles, glacier areas, scree slopes and sand bars and other land which cannot be allocated under other land categories. "Other land" consists of areas that are neither influenced nor cultivated by people.
Greece	All land areas that do not fall into any of other land-use categories (e.g. rocky areas, bare soil, mine and quarry land).
Luxemburg	This category includes bare soil, rock, ice, and all unmanaged land areas that do not fall into any of the other five categories. It allows the total of identified land areas to match the national area.
The Netherlands	Surfaces of bare soil which are not included in any other category like: bare sands and the earliest stages of succession from sand in the coastal areas (beaches, dunes and sandy roads) or uncultivated land alongside rivers. It does not include bare areas that emerge from shrinking and expanding water surfaces (which are included in wetlands).
Ireland	Natural grasslands not in use for agricultural purposes. Water bodies, bare rocks.
Italy	Definition is not available in NIR 2011.
Portugal	Beaches, dunes, sand plains and bare rocks and shrubland.
Spain	Bare soil, rock areas, ice and other areas of land that do not fall into any of the other land category.
Sweden	Waste land and most of the mountain area in northwest Sweden. All Other land is assumed unmanaged.
UK	Inland rock, standing water and canals and rivers and streams.

Other land category is sometimes also used to report unmanaged land areas (e.g. unmanaged grassland in Ireland, France and Spain). There are no reported emissions on 5F1 land category, but only in case of conversions to “Other land”. For conversion from forestland, in many cases, the pools for which reporting is not mandatory were omitted by some MS because methods are not available the IPCC LULUCF GPG (2003). Emissions from 5F2 have been relatively steady since 1990 around 1000-2000 Gg CO_2eq., although it should be noted that the uncertainties are likely to be very high.

7.6 Emissions from organic soils in EU-15

At EU-15 level, organic soils cover over 14,000 kha, located especially in Northern MS. Compared to 1990 total organic soils area was 2 % higher in 2010, under likely reclassification or updating (mainly by Sweden which reported in 2010 a 4 % larger area than in 1990). A major issue is that organic soils emissions represents 25 % of total EU-15 net removal in 2010 or some 14% of the all GHG fluxes involved in LULUCF (as absolute value).

The highest area of organic soils is in Finland (~ 6,300 kha), Sweden (~ 5,000 kha), Germany (1,500 kha) and the UK (400 kha). Definitions of organic soils are not always transparently reported in the NIRs 2011 (Table 7-42), so presumably the other MS follow the IPCC GPG LULUCF 2003’s FAO based definition.

Table 7-42 Elements used by MS to define organic soils pools

Member State	Description and supplementary elements for organic soils area classification
Austria	Sites with upper 0-30 cm of the soil having more than 17% content of organic carbon.
Denmark	20 % organic matter with a soil depth of minimum 30 cm. Wet organic soils are also defined as having a water table within 0-30 cm below the surface and thus not suitable for driving with agricultural machineries.

Finland	Definition by NFI. More than 20% organic matter in the top 20 cm layer. Thus, both mull soils and peat soils are included. Organic soils area are considered as "peatland" if the organic layer is peat or if more than 75% of the ground vegetation consists of peat land vegetation.
Ireland	Peat soils are organic soils with a depth greater than 30 cm and peaty/mineral soils are a continuum between the peat and mineral categories, and the organic content is greater than 20%.
Belgium, France, Germany, Greece, The Netherlands, Italy, Portugal, Spain, Sweden, UK - na – information on specific country parameters is not available in NIR 2012 (very often under because of the lack of importance of such source in the country).	

Some MS report that there is no clear or still provisional the distinction of peat land and water reservoirs (eg Belgium).

Methodologies to determine the characteristics of organic soils differ across MS. In Finland, as the country with highest organic soils area, mineral and organic soils activity data were derived from NFI data and geo-referenced soil database across all land uses. In Germany areas with organic soils is determined via a geo-referencing procedure with overlaying of General soil map of Germany and cadastral data for each type of land use. In Sweden, data is also provided by NFI combined with Swedish Forest Soil Inventory. Emissions factors are derived based on continuous monitoring or modeling (country specific data reported by MS is provided on land sub-categories sub-chapters). Overall, in the EU-15, most of organic soils area is under Forestland, but most of the emissions come from Cropland and Grassland (Table 7.43). In Sweden, drained area covers some 20 % (approx. 1M ha) out of a total area of about 4.3 Mha of histosols on Forestland, while area on drained histosols on Cropland was approx. 140 kha (in 2010).

Furthermore, most of the organic soils area (97%) is in the category "remaining" in the same category, with small share under various conversions. Area reported under conversion to Cropland increased, while all others decreased.

The highest IEFs are associated with stable cropland, conversions to cropland and grasslands under intensive management interventions, while organic soils in forestlands show the lowest IEF values.

Table 7.43 Total emissions and implied carbon stock change factors in EU-15 (average over 1990-2010)

Land use subcategory	Area in 2009 (kha)	Change of organic soils area compared to 1990 (%)	IEF (MgC ha-1 yr-1)	Net annual C stock change (Gg C)	Change of CO_2 annual emissions compared to 1990 (%)
5A1	11096	4%	-0,43	-4722	-23%
5A2	347	-10%	-0,23	-80	-63%
5B1	1244	1%	-7,35	-9137	2%
5B2	60	150%	-4,96	-298	76%
5C1	1309	-6%	-3,87	-5064	-2%
5C2	37	-43%	-2,15	-80	-61%
Total	14094	2%		-19380	-7%

Emissions from organic soils are included under relevant land use categories by the MS, where there is more detailed discussions available on the IEF. Here we only present data for different land use categories averaged over entire time series 1990-2010. Overall, CO_2 emissions at the EU-15 level steady decreased by 7 % compared to 1990 (to -71000 Gg CO_2 in 2010).

In general in the EU-15 MS, there are still small quantitative inconsistency in reporting organic soils under 5B1&5B2 and Table 4Ds1 regarding organic soils area under cultivation.

Additional to CL, GL, FL, organic soils are reported under Wetland, which includes peatland (including extraction) and flooded lands (i.e. dam construction, artificial lakes). Peat extraction emissions are reported under Wetlands or even Other Land (ex UK).

7.7 Other emissions from land uses: Tables 5(I)-5(V)

7.7.1 Direct N_2O emissions from N fertilization sources (CRF Table 5(I))

This source category covers direct nitrous oxide emissions from forest land fertilization. Majority of MS report there is no fertilization of forest land, with few including it in the emissions reported under the agricultural sector, using appropriate notation keys in the CRF tables (Table 7.44). Only Finland, Sweden and the UK report N_2O emissions under this source category. Sweden actually reports the highest amount of N_2O emissions from N based fertilization occasionally applied to increase the wood production in some middle aged or older stands on mineral soils.

Table 7.44 Direct N_2O emissions from N fertilization (Gg N_2O)

Member State	N_2O emissions (Gg)			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010	
	1990	2009	2010		(Gg)	(%)	(Gg)	(%)
Austria	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Belgium	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Denmark	IE,NA	IE,NA	IE,NA	-	-	-	-	-
Finland	0.09	0.08	0.07	25.3%	0	-9%	0	-16%
France	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Germany	NO	NO	NO	-	-	-	-	-
Greece	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Ireland	IE,NA	IE,NA	IE,NA	-	-	-	-	-
Italy	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Luxembourg	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Netherlands	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Portugal	IE,NA	IE,NA	IE,NA	-	-	-	-	-
Spain	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Sweden	0.19	0.15	0.21	73.5%	0	44%	0	15%
United Kingdom	0.02	0.00	0.00	1.2%	0	10%	0	-79%
EU-15	**0.29**	**0.23**	**0.29**	**100.0%**	**0**	**25%**	**0**	**0%**

For all MS activity data results from national or sectoral statistics, either in terms of total amount and type of synthetic fertilizer annually applied (i.e. Finland, Sweden) or as a fixed application rate and total annually fertilized area (i.e. UK), with IPCC default emission factor for N_2O emissions from N-inputs used in all cases. The IEF of the N_2O-N emissions per unit of fertilizer is roughly around 0.01 kg N_2O-N/kg N ha-1 yr-1.

On the whole, N_2O emissions from this source show no change in 2010 compared to 1990. Total EU-15 emissions from fertilization of forests soils in 2010 from this category is 0.29 Gg N_2O, knowing that some important share of such emissions is reported under Chapter 4 Agriculture.

7.7.2 N_2O emissions from drainage of soils (CRF Table 5(II))

This source category covers non–CO_2 GHG, respectively direct N_2O and CH_4 emissions from drainage of soils (CO_2 emissions are reported under other land categories, usually under Wetlands, while indirect N_2O emissions are reported under Chapter 4 Agriculture). Nevertheless, according to UNFCCC (decision 13/CP.9) and based on Appendixes 3a.2 and 3a.3 of the GPG LULUCF 2003, it is not mandatory for Parties to estimate emissions from this source. Accordingly, most countries do not report them considering them also negligible (NO or NE in Table 7.45). EU-15 drainage area reported by MS has increased by 29% compared to 1990, reaching 1227 kha in 2010 (also reported with a transition period, likely 20 years). Out of total area under drainage, 86 % of total area occurs on forestland, while drainage of organic soils (including peatland) occurs on 50% of total area. Overall non-CO_2 emissions practically did not change in time summing up 0.7 Gg N_2O (Table 7.45) and 2.4 Gg CH_4 in 2010 (Table 7.46), with insignificant changes for individual reporting countries.

Table 7.45 N_2O emissions from drainage of soils (Gg)

Member State	N_2O emissions (Gg)			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010	
	1990	2009	2010		(Gg)	(%)	(Gg)	(%)
Austria	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Belgium	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Denmark	0.0509	0.0393	0.0393	5.8%	0	0%	-0.0117	-20%
Finland	0.22	0.29	0.30	44.4%	0.0090	3%	0.0860	19%
France	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Germany	0.19	0.21	0.21	31.0%	0	1%	0	12%
Greece	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Ireland	0.07	0.13	0.13	18.6%	0	1%	0	93%
Italy	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Luxembourg	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Netherlands	NE	NE	NE	-	-	-	-	-
Portugal	NO	NO	NO	-	-	-	-	-
Spain	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Sweden	NA,NE	NA,NE	NA,NE	-	-	-	-	-
United Kingdom	0.01	0.00	0.00	0.2%	0	0%	0	-87%
EU-15	**0.53**	**0.67**	**0.68**	**100.0%**	**0**	**2%**	**0**	**28%**

In Denmark and Ireland, N_2O emissions from peatland are estimated based on the organic matter's C:N-ratio and default IPCC emission factor of 1.25%, while the activity data is provided by sectoral statistics. In Finland a Tier 2 methodology is used, with directly measured based CS emissions factors for CO_2, N_2O and CH_4, while the activity data (annual area of extraction active peatlands, set aside peat lands, industrial stocks) are compiled from statistics.

Table 7.46 **CH_4 emissions from drainage of soils (Gg)**

Member State	CH_4 emissions (Gg)			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010	
	1990	2009	2010		(Gg)	(%)	(Gg)	(%)
Austria	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Belgium	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Denmark	NA,NE,NO	NA,NE,NO	NA,NE,NO	-	-	-	-	-
Finland	1.68	2.27	2.34	100.0%	0.0750	3%	1	67%
France	NA	NA	NA	-	-	-	-	-
Germany	NA,NE	NA,NE	NA,NE	-	-	-	-	-
Greece	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Ireland	NA,NE	NA,NE	NA,NE	-	-	-	-	-
Italy	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Luxembourg	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Netherlands	NE	NE	NE	-	-	-	-	-
Portugal	NO	NO	NO	-	-	-	-	-
Spain	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Sweden	NA,NE	NA,NE	NA,NE	-	-	-	-	-
United Kingdom	NA,NE	NA,NE	NA,NE	-	-	-	-	-
EU-15	**1.68**	**2.27**	**2.34**	**100.0%**	**0**	**3%**	**1**	**40%**

IEF for N_2O emission per area on drained land vary between 0.06 to 1.84 kg N_2O-N/ha/year in case of drainage of organic soils on wetlands and from 0.09 to 0.4 for mineral soils on deforested lands. IEF for CH_4 emissions per drained area is reported some 15 kg CH_4/ha by Finland.

7.7.3 N_2O emissions from disturbances associated with conversion to cropland (CRF Table 5(III))

This source category covers direct N_2O emissions from land area converted to cropland. Under intensive soil management on cropland, any conversion to cropland is likely associated with a temporary increase in the mineralization of organic matter followed by the drop of total C stock and the restructuration of the C content on the soil profile. At the EU-15 level, land reported under conversions to cropland steadily increased over time by 9 % since 1990, to 10.185 kha (also reported for 20 years transition period). Most of these conversions occur in France, which reports large areas of conversion from Grassland to Cropland (some 3.5 mil ha in 2010, decreasing with 20 % since 1990). Notably, 99 % of areas under conversion occur on mineral soils across the EU-15. The Netherlands reported it as NE, likely considered it as negligible in case of small area of transitions from forestland, but seems an incompleteness in case of transitions from grassland (it reports such higher areas). Overall, decreasing trend of N_2O emissions from past years continues in 2010, with 2% less than in 2009 and 9% less than in 1990. Total EU-15 emissions reported in 2010 from this category is 8.3 Gg N_2O (Table 7.47), with the highest contribution from France and United Kingdom.

Table 7.47 **N_2O emissions from disturbances associated with land-use conversion to cropland (Gg)**

Member State	N_2O emissions (Gg)			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010	
	1990	2009	2010		(Gg)	(%)	(Gg)	(%)
Austria	0.13	0.16	0.16	1.9%	0.00	2%	0.03	22%
Belgium	0.03	0.29	0.30	3.6%	0.01	3%	0.27	1012%
Denmark	0.01	0.00	0.00	0.0%	0.00	1%	-0.01	-81%
Finland	0.02	0.04	0.04	0.5%	0.00	5%	0.02	81%
France	5.32	4.52	4.45	53.6%	-0.07	-2%	-0.87	-16%
Germany	0.64	0.62	0.60	7.2%	-0.02	-3%	-0.05	-7%
Greece	NO	NO	NO	-	-	-	-	-
Ireland	NA,NO	0.08	0.08	1.0%	0.00	0%	0.08	-
Italy	0.29	0.02	0.27	3.3%	0.25	1091%	-0.02	-6%
Luxembourg	0.01	0.01	0.01	0.1%	0.00	-1%	0.00	-10%
Netherlands	NE	NE	NE	-	-	-	-	-
Portugal	0.05	0.15	0.15	1.9%	0.00	3%	0.10	205%
Spain	NO	NO	NO	-	-	-	-	-
Sweden	0.08	0.23	0.23	2.8%	0.00	-1%	0.16	207%
United Kingdom	2.52	2.05	2.01	24.2%	-0.04	-2%	-0.51	-20%
EU-15	**9.10**	**8.17**	**8.30**	**100.0%**	**0.14**	**2%**	**-0.80**	**-9%**

In general, the methodology corresponds to Tier 1, which allows the estimation based on: 1) annual emission of carbon due to soil mineralization (IPCC default), 2) C:N, the average ratio in the soil (CS or IPCC default); 3) the emitted proportion of N_2O from N content (a constant of 1.25 % according the IPCC); 4) the ratio of 44/28 to convert N to N_2O; and 5) soil carbon stock (often IPCC default reference C stock) and 6) CS activity data (e.g. land conversion statistics). IEF N_2O-N emissions per area converted on both mineral and organic soils 10 kg N_2O-N/ha by Denmark, while all other reporting MS's IEF of around 0.2-0.8 kg N_2O-N/ha. Such differences still need to be understood as MS rely on IPCC default method and data, with only C:N ratios generally derived from national datasets and this may not explain such significantly different IEFs (probably the transition period is not considered by Denmark which apparently report 1 year transition period or because mixing mineral and organic soils, with values are some 10 time higher on organic soils, but not fully transparent in the NIR).

7.7.4 CO_2 emissions from agricultural lime application (CRF Table 5(IV))

This source category covers direct N_2O emissions from liming. Liming occurs especially in croplands (85% of applied amount, estimated based on activity data in NIRs 2012) and on permanent grassland (14%), while a very small amount is used on Forestland. Data is hardly available (eg. Austria estimated the amount based on expert judgment).

In the EU-15, annual consumption of lime has decreased by almost 22% since 1990, with a total EU-15 of some 10.4 mn tons applied in 2010, with 82 % applied on cropland and the rest on grassland. Similarly, the total EU-15 emissions decreased by 22% since 1990 (Table 7-48). Some MS reduced notably the emissions from lime applications (i.e. Denmark, Netherlands).

Table 7-48 **CO_2 emissions from agricultural lime application**

Member State	Net CO_2 emissions (Gg)			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010	
	1990	2009	2010		(Gg)	(%)	(Gg)	(%)
Austria	90.30	88.12	88.02	1.9%	0	0%	-2	-3%
Belgium	64.09	53.80	53.31	1.2%	0	-1%	-11	-17%
Denmark	622.92	184.94	185.27	4.0%	0	0%	-438	-70%
Finland	617.87	312.04	245.27	5.3%	-67	-21%	-373	-60%
France	1,053.95	1,101.77	969.57	20.9%	-132	-12%	-84	-8%
Germany	1,275.72	1,748.38	1,696.37	36.6%	-52	-3%	421	33%
Greece	NO	NO	NO	-	-	-	-	-
Ireland	355.04	307.32	307.32	6.6%	0	0%	-48	-13%
Italy	NA,NO	16.77	13.49	0.3%	-3	-20%	13	-
Luxembourg	0.59	4.07	4.07	0.1%	0	0%	3	591%
Netherlands	183.15	59.72	59.72	1.3%	0	0%	-123	-67%
Portugal	12.60	14.57	12.49	0.3%	-2	-14%	0	-1%
Spain	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Sweden	169.79	97.76	91.03	2.0%	-7	-7%	-79	-46%
United Kingdom	1,516.85	910.65	904.93	19.5%	-6	-1%	-612	-40%
EU-15	**5,962.87**	**4,899.92**	**4,630.86**	**100.0%**	**-269**	**-5%**	**-1,332**	**-22%**

The activity data are available from official national or sectoral statistics (e.g. agriculture sectors) or from field studies. All reporting countries relays on emission factor is the IPCC default one (*EF limestone* =0.120, and *EF dolomite*=0.122). The majority the MS do not differentiate between dolomite or lime, rather, they use a unique emission factor, as the share of dolomite in total amount applied is small (around 15 %). Commercially available products are discounted in terms of water content to only account for the limestone content in the calculations (i.e. Finland).

7.7.5 CO_2, CH_4 & N_2O emissions from Biomass Burning (CRF Table 5(V))

This source category covers CO_2, CH_4 and direct N_2O emissions from biomass burning, as well as emissions of other GHG (NO_x and CO). It includes emissions both from wildfires and controlled burning, on any type of land use (i.e. Forestland, Cropland, Grassland, Wetland and Settlement). Controlled burning in managed forests is not anymore a common practice in the EU-15, with few exceptions (i.e. Finland, Sweden, UK) or Grassland (UK) for confined activities. Wildfires are reported on grassland (e.g. Greece, still NE by Netherlands, Spain and Sweden) or wetlands (NE by Ireland and Netherland). Only UK reports non-CO_2 emissions from conversion to settlements.

Some MS report for first time in 2012 emissions from wildfire on forestland (e.g. Belgium) or complete estimation of emissions from all land categories (Portugal).

The majority of emissions is generated from wildfires in forests (both remaining and conversion lands), or from wildfires in grasslands (in Southern MS). In general, CO_2 emissions from forest fires are reported under 5A Forest land, while CO_2 for the other land categories and non-CO_2 gases emissions are reported under 5(V). Compared to previous years, following a EU QA/QC team recommendation, there is more harmonized and comparable reporting on area basis, by almost all MS.

Total EU-15 emissions reported in 2010 for this category is 0.4 Gg N_2O, 65 Gg CH_4 and 2,7 Gg CO_2, with the mention that most of MS report the CO_2 emissions from burning biomass as NO or IE, while often CH_4 and N_2O emissions are reported as NE by some MS. Overall, CO_2 emissions have decreased by 36 % since 1990 (Table 7.49). The CH_4 emissions decreased by 26% (Table 7.50) and those of N_2O by 41% (Table 7-51), but their trends are related to wildfire incidence, which is characterized by a large inter-annual variability.

Table 7.49 CO_2 emissions from Biomass Burning

Member State	Net CO_2 emissions (Gg)			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010	
	1990	2009	2010		(Gg)	(%)	(Gg)	(%)
Austria	IE,NA,NO	IE,NA,NO	IE,NA,NO	-	-	-	-	-
Belgium	3.17	NE,NO	NE,NO	-	-	-	-3	-
Denmark	NO	NO	NO	-	-	-	-	-
Finland	3.86	4.93	5.05	0.2%	0	2%	1	31%
France	1,594.01	428.93	307.41	11.5%	-122	-28%	-1,287	-81%
Germany	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	-	-	-	-	-
Greece	IE,NA,NO	IE,NA,NO	IE,NA,NO	-	-	-	-	-
Ireland	29.40	11.68	76.57	2.9%	65	556%	47	160%
Italy	IE,NA,NO	IE,NA,NO	IE,NA,NO	-	-	-	-	-
Luxembourg	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Netherlands	NA,NE,NO	NA,NE,NO	NA,NE,NO	-	-	-	-	-
Portugal	2,363.23	677.05	1,921.77	71.8%	1,245	184%	-441	-19%
Spain	3.49	53.89	52.33	2.0%	-2	-3%	49	1401%
Sweden	IE,NA,NO	IE,NA,NO	IE,NA,NO	-	-	-	-	-
United Kingdom	199.68	262.36	312.13	11.7%	50	19%	112	56%
EU-15	**4,196.84**	**1,438.83**	**2,675.25**	**100.0%**	**1,236**	**86%**	**-1,522**	**-36%**

Table 7.50 CH_4 emissions from Biomass Burning

Member State	Net CO_2 emissions (Gg)			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010	
	1990	2009	2010		(Gg)	(%)	(Gg)	(%)
Austria	0.03	0.01	0.01	0.0%	0.00	-13%	-0.02	-76%
Belgium	0.01	NE,NO	NE,NO	-	-	-	-0.01	-
Denmark	0.03	0.00	0.00	0.0%	0.00	21%	-0.03	-98%
Finland	0.19	0.05	0.03	0.0%	-0.02	-40%	-0.16	-84%
France	56.27	45.78	48.37	75.3%	2.59	6%	-7.89	-14%
Germany	0.43	0.22	0.15	0.2%	-0.07	-31%	-0.28	-65%
Greece	1.28	1.00	0.34	0.5%	-0.66	-66%	-0.94	-74%
Ireland	0.13	0.05	0.33	0.5%	0.28	556%	0.21	160%
Italy	8.70	3.27	2.06	3.2%	-1.21	-37%	-6.64	-76%
Luxembourg	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Netherlands	NA,NE,NO	NA,NE,NO	NA,NE,NO	-	-	-	-	-
Portugal	10.14	3.52	8.69	13.5%	5.18	147%	-1.45	-14%
Spain	8.23	2.94	2.90	4.5%	-0.05	-2%	-5.33	-65%
Sweden	0.08	0.13	0.03	0.1%	-0.09	-73%	-0.05	-59%
United Kingdom	0.87	1.14	1.36	2.1%	0.22	19%	0.49	56%
EU-15	**86.40**	**58.11**	**64.28**	**100.0%**	**6.17**	**11%**	**-22.12**	**-26%**

Table 7-51 **N_2O emissions from Biomass Burning**

Member State	Net CO_2 emissions (Gg)			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010	
	1990	2009	2010		(Gg)	(%)	(Gg)	(%)
Austria	0.00044	0.00011	0.00012	0.0%	0.00001	12%	-0.0003	-72%
Belgium	0.01	NE,NO	NE,NO	-	-	-	-0.0095	-
Denmark	0.00	0.00	0.00	0.6%	0.00000	5%	-0.0014	-97%
Finland	0.001	0.000	0.000	0.1%	-0.00005	-12%	-0.0010	-73%
France	0.49	0.31	0.34	79.0%	0.02868	9%	-0.1546	-31%
Germany	0.01	0.00	0.00	0.8%	0.00099	41%	-0.0033	-49%
Greece	0.01	0.01	0.01	1.6%	0.00022	3%	-0.0019	-22%
Ireland	0.00	0.00	0.00	0.1%	-0.00023	-44%	-0.0005	-60%
Italy	0.00	0.00	0.00	0.2%	0.00016	19%	-0.0017	-62%
Luxembourg	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Netherlands	NA,NE,NO	NA,NE,NO	NA,NE,NO	-	-	-	-	-
Portugal	0.14	0.01	0.05	11.3%	0.03639	305%	-0.0911	-65%
Spain	0.06	0.01	0.02	4.7%	0.01315	185%	-0.0363	-64%
Sweden	0.00	0.00	0.00	0.2%	-0.00348	-80%	0.0003	53%
United Kingdom	0.01	0.01	0.01	1.8%	-0.00525	-40%	0.0019	31%
EU-15	**0.73**	**0.36**	**0.43**	**100.0%**	**0.07060**	**20%**	**-0.2995**	**-41%**

On site burning of biomass (controlled burning) is prohibited in most of the EU MS, therefore, emissions are reported as not occurring in the CRF tables. Emissions from biomass burning in power plants are considered neutral if they originate in specialized crops or sustainable forest management practices (i.e. additional wood removal is well within the annual growth of the country forest). The methodology used to report emissions for fires is always Tier 2 for CO_2 with activity data provided by national statistics and country specific emission actors, whereas Tier 1 data is used for estimation of CH_4 and N_2O emissions.

7.8 Cross-cutting issues (EU-15)

7.8.1 GHG estimates uncertainty

Some MS performed for first time uncertainty analysis (e.g. Belgium under Tier 1) or enhanced analysis with transparent details on assumptions and inputs data (e.g. Austria). MS uncertain emissions or removal amounts on each land subcategory and GHG types are aggregated up to EU-15 under unified methodology and processing at EU level (see more on this under general ch.1 of the EU NIR). Overall LULUCF uncertainty is 34%, with a low uncertainty of 17% determined for 5A1 (Table 7.52).

Table 7.52 **Level and trend uncertainty assessment of the annual EU-15 emission/removal on LULUCF land subcategories and GHG sources.**

Source category	Gas	Emissions 1990	Emissions 2010	Emission trends 1990-2010	Level uncertainty estimates based on MS uncertainty estimates	Trend uncertainty estimates based on MS uncertainty estimates
5.A Forest Land	CO_2	-198,688	-164,602	-17%	17%	0.2%
5.A Forest Land	CH_4	29	29	2%	60%	0.2%

5.A Forest Land	N_2O	142	172	22%	97%	0.2%
5.B Cropland	CO_2	56,068	49,308	-12%	44%	0.1%
5.B Cropland	CH_4	0	0	189%	50%	0.9%
5.B Cropland	N_2O	1,004	905	-10%	50%	0.1%
5.C Grasland	CO_2	11,736	4,199	-64%	262%	0.5%
5.C Grasland	CH_4	18	24	35%	42%	0.1%
5.C Grasland	N_2O	2	2	35%	42%	0.1%
5.D Wetlands	CO_2	4,740	5,370	13%	25%	0.1%
5.D Wetlands	CH_4	0	0		0%	0.0%
5.D Wetlands	N_2O	8	3	-59%	116%	0.2%
5.E Settlements	CO_2	13,776	16,984	23%	25%	0.1%
5.E Settlements	CH_4	10	8	-17%	20%	0.0%
5.E Settlements	N_2O	1	1	-17%	20%	0.0%
5.F Other Land	CO_2	918	294	-68%	1073%	5.1%
5.F Other Land	CH_4	0	0		0%	0.0%
5.F Other Land	N_2O	0	0		0%	0.0%
5.G Other	CO_2	-2,373	-3,457	46%	35%	0.3%
5.G Other	CH_4	0	0		0%	0.0%
5.G Other	N_2O	0	0		0%	
5.I	CO_2	0	0		0%	0.0%
5.I	CH_4	0	0		0%	0.0%
5.I	N_2O	27	23	-16%	380%	0.6%
5.II	CO_2	0	0		0%	0.0%
5.II	CH_4	35	49	40%	30%	0.1%
5.II	N_2O	83	106	28%	36%	0.1%
5.III	CO_2	0	0		0%	0.0%
5.III	CH_4	0	0		0%	0.0%
5.III	N_2O	10	13	28%	100%	0.6%
5.IV	CO_2	1,241	431	-65%	38%	0.2%
5.IV	CH_4	0	0		0%	0.0%
5.IV	N_2O	0	0		0%	0.0%
5.V	CO_2	4	5	31%	71%	0.2%
5.V	CH_4	5	1	-85%	70%	0.5%
5.V	N_2O	1	0	-90%	68%	0.4%
5 (werhe no subsector data were submitted)	*all*	*-19,389*	*-32,224*	66%	*58%*	*39%*
Total - 5	**all**	**-130,592**	**-122,356**	-6%	**34.4%**	**26.7%**

Overall uncertainty in the trend of LULUCF annual removal is 27%, with highest contribution of 5A1and 5B2. Removal trend is also uncertain mainly under the influence of CO_2 removal on 5A1 and CO_2 emissions from 5B2.

Compared to previous uncertainty analysis performed for the inventory year 2009 in the EU submission 2011, there are changes explained by: inter-annual variations of emissions/removals estimates and share of contributors of MS (underpinned by ecological processes and management measures); new nominal uncertainty values reported by MS, as well as recalculations and revisions of previous estimates (i.e. for the base year). Additionally, there was an increased transparency of reporting uncertainty and more consistency in implementing related guidelines by all MS (i.e. uncertainty was explicitly reported on land subcategories) which facilitated the uncertainty assessment at EU-15 level. Despite that, identification of co-variation parameters among MS estimates and the quantification of the related correlation coefficients are difficult (i.e. under lack of access to explicit datasets used by each MS). Reasons for co-variation are mainly the use of Tier 1 and default IPCC parameters.

7.9 Verification

MS's NIRs report rather limited information on any thorough verification of the GHG inventory estimates, while there is none formally done at EU-15 level. However MS of EU-15 are under double QA/QC checks: own one at the country level and another one which is performed at EU-15 level under the EU GHG Monitoring Mechanism, with checks done (in fact for all 27 MS of the European Union). Currently, information on verification is reported more for the systems feeding data into national GHG estimation systems, but not on the national GHG estimation system itself.

7.10 Time series consistency

Time series consistency has been checked for all MS as part of the QA/QC program of the EU-15 GHG inventory, in terms of land categories definitions and representation in time and space. Although most of inconsistencies found had small quantitative effect on emissions/removal, MS were strongly encouraged to correct them or at least to acknowledge and discuss the issue in their respective NIRs.

Current MS submissions represents a step ahead in increasing the transparency of land definitions and other descriptive elements of land classified by country under specific land subcategory.

Land use category and subcategory definitions are not fully consistent across the EU-15 MS, but they are consistent with IPCC definitions (IPCC GPG for LULUCF). Differences are given by slightly different treatment of particular lands (i.e. hedges or bush areas categorized either under the cropland, grassland or forestland; woody plantations either under cropland or forestland; inclusion or not of the access roads in forest area), which is mainly related to various definitions used historically. Meantime, one of the key features of the methodology implemented by the national GHG inventory systems is to ensure fully consistent definitions for involved parameters and data.

Contrary to previous years reports, in 2011, there was an improvement on reporting consistency of time series and land allocation on land sub-categories (e.g. small difference by country's official geographical area, or varied from year to year). Such small differences may occur due to improvements in the mapping systems and precision, inherent measurement errors, feature of assessment system, natural expansion of land. In general, the land reported under UNFCCC varies by 1-2 % than official geographical area or in time since 1990.

According to the GPG for LULUCF (2003), C stock changes and GHG emissions have to be reported for managed land, while "unmanaged" land is to be reported only if they are subject to land use conversion by human activity. In the EU-15 MS, all forest land, cropland, grassland and settlement are assumed to be managed, such as a limited area of existing wetlands (i.e. used for peat extraction: Sweden, Finland). Small area of unmanaged forest and grassland are reported by some countries (i.e. Ireland, France). Land included under Other land remaining Other land is, in general, assumed as unmanaged, although national approaches may be very specific (i.e. 10.9 mn ha in Spain, 3.9 mn ha in Sweden, 0.8 mn ha in France, 1.3 mn ha in Finland, 1.9 mn ha in UK).

7.11 Quality Assurance and Quality control

QA/QC activities and efforts for improving reporting occurred at both the national and the EU level. QAQC procedures are described in the MS's NIRs and are part of the national QAQC system. They were developed under country own initiative on the implementation of the requirements, and often improved at the request of ERTs (i.e. a specific QA/QC plan which is additional to data quality and management rules specific to each data source). Quality of data falls with relevant data administrators. A national system is justified by avoiding intra-sectoral double accounting or missing sources/pools. At the national level, MS have in place quality management systems, which are part of their respective national GHG estimation systems that establish protocols for channels of data and information for compilation and reporting, data storage and archiving, detailed institutional coordination and responsibilities, as well as adequate financial allocations. The national systems are designed to be continuously improved (i.e. see Austria's NIR in 2012 submission), by taking into account new practices and suggestions coming from the review of national reports or by independent assessments (i.e. scientific papers, institutional evaluation). Quality assurance includes peer and public reviews. The purpose of such systems is to ensure adequate levels of transparency, consistency, comparability, completeness, accuracy and timeliness, as requested both by international agreements and EU-15 GHG monitoring directive.

Furthermore, EU-15 and MS improved their reports through:

- continuous improvement of the reporting of land categories less reported in the past, as well as the fluxes on all lands;
- extended use of the Good Practice Guidance for LULUCF (IPCC 2003) and also AFOLU Guidelines (IPCC 2006, i.e. Finland for Harvested Wood Products);
- more complete and time consistent land use transition matrix and comparison with other statistics;
- key category analysis including categories and subcategories of LULUCF sector;
- using higher Tier than before (at least for some pools or subcategories, including country specific data);
- use of improved activity data and emission factors and more use of country specific data;
- developments in uncertainty assessment and estimation;
- improved documentation on methodology;
- conducting national and joint research projects especially on the problematic pools (i.e. soil carbon and dead organic matter). The approach also consists in making use of existing historical database and development of new, dedicated research.
- Implementation of harmonized decision trees on notation keys

In addition to national efforts, several activities were carried out by the Joint Research Centre of the European Commission with respect to data quality of the LULUCF sector at the EU-15 level, including:

- Annual checking of early versions of the MS national GHG inventories for errors and inconsistencies, and interaction with national representatives when relevant for clarification and improvement. During the checking of the 2011 submission, 240 findings (i.e. possible problems and unclear issues, also based on the latest review of the EU-15 GHG inventory) were communicated to the MS, ranging from problems in the use of notations keys, inconsistent land use data, outliers in IEF for all the categories, and various requests for clarifications.
- Starting 2011 EU implements an internal review, as annual exercise, which focus on key LULUCF issues identified mainly in conjunction with reporting under Kyoto Protocol. The exercise is led by the JRC and involves LULUCF reviewers also involved in the UNFCCC review process. In 2011 the exercise focused on reporting DW, LT and SOC. In 2012 the plan

is to follow the issue of "providing transparent demonstration and justification that a pool is not a source" and methods approached by reporting MS used to estimate emissions in Forestland converted to Settlements.

- Efforts for improving and harmonizing Member State inventories, in close cooperation with the research community. Examples include:
  - Starting 2011, the implementation of the JRC prepared decission trees on notation keys a) *Use of notations keys for C POOLS - Tables 5(KP-I) of mandatory or elected activities* and b) *Use of notations keys for GHG SOURCES- Tables 5(KP-II) of mandatory or elected activities*. The purpose was to ensure more harmonized use of notation keys as to identify the incompleteness issues in due time and allow further automatic check, both for reporting under the Convention and Kyoto Protocol.
  - For the purpose of enhancing reporting, sharing experience amongst MS, also for the harmonization of methods for estimation, a series of technical workshops dedicated to UNFCCC reporting (including Kyoto Protocol), under the auspices of European Commission/Joint Research Center (DG ENV, DG JRC) were organized:
  - "JRC technical workshop on LULUCF issues under the Kyoto Protocol", held in *Brussels, November 16, 2011*
  - "JRC technical workshop on LULUCF issues under the Kyoto Protocol", held in *Brussels, November 9-10, 2010*
  - Technical workshop on projections of GHG emissions and removals in the LULUCF sector, Ispra (Italy), 27-28 January 2010.
  - Technical workshop on LULUCF reporting issues under the Kyoto Protocol, Ispra (Italy), November 13-14, 2008,
  - "Technical meeting on specific forestry issues related to reporting and accounting under the Kyoto Protocol" (Ispra, 27-29 November 2006, in collaboration with sink experts from EU, Japan, New Zealand and Canada,
  - "Improving the Quality of Community GHG Inventories and Projections for the LULUCF Sector", Ispra (Italy), September 22-23, 2005,

For further information on these workshops, see **http://afoludata.jrc.ec.europa.eu/events**.

- The JRC's AFOLU DATA web site (**http://afoludata.jrc.ec.europa.eu/data&tools**) offer interrogative databases (e.g. BEFs, conversion factors, European forest inventories and yield tables, models and other tools) to promote transparent, complete, consistent and comparable estimates of greenhouse gas fluxes in the AFOLU sector in Europe, and for the use of researchers, inventory experts and GHG inventory reviewers.

7.11.1 Recalculations

Due to continuous methodological improvements, mainly driven by the implementation of the relevant requirements and ensuring consistency with KP supplementary reporting and accounting, like revision of activity data (e.g. revision or improvement of land use matrix) and the use of new or improved factors (e.g. biomass conversion and/or expansion factors), as well as reallocation of emissions between sectors and the correction of identified errors, there have been several recalculations in the 2012 submissions of the MS, this of EU-15's.

The overall quantitative effect over the total emission of LULUCF sector of the recalculations in 2011 is an annual decrease of net removals by 50,000 GgCO_2eq, with small variation between years. The general trend of the increasing sink over time, however, was maintained.

In 5A1, major recalculations for entire time series were performed by Italy (~-30% of annual sink) and France (~-50%), Austria (~-25%) and Sweden (~-10%). Increase of the sink is recalculated by Finland (~+10%) and Germany (~+5%). Overall effect is a general decrease of the sink by 10 % for EU 15.

Major recalculation occurs for few countries under availability of new data. In 5A1 Austria uses new biomass functions which led to approximately 12 % lower net removals in living biomass and add the emission from mineral soils (numerically close to annual removal by biomass) and a small removal from DOM. *In 5A2 t*he sink of the mineral soil C pool is 40 % lower, those of the litter pool 60 % higher compared to previous submissions.
For cropland there was recalculation within +/-10 % compared to previous submissions. For Grassland Germany recalculated the increased emissions by 150 % and Italy reduced the sink by some 70%.

In fact, MS continuously recalculate the estimates for all pools, which is finally reflected in the 15 EU inventory. For example in 5A1 the annual sink in living biomass was recalculated downward and emissions from soils upward for 1990-2003, the interval of time which was submitted since the first submission in 2006 (Figure 7-14; Figure 7-15; Figure 7-16).

Figure 7-14 **Revision of annual estimates of C stock change in living biomass in 5A1 for 1990-2003 from 2006 to current submission to UNFCCC** (EU 15 aggregated level, submissions in 2011 and 2012 are highlighted in red, blue respectively)

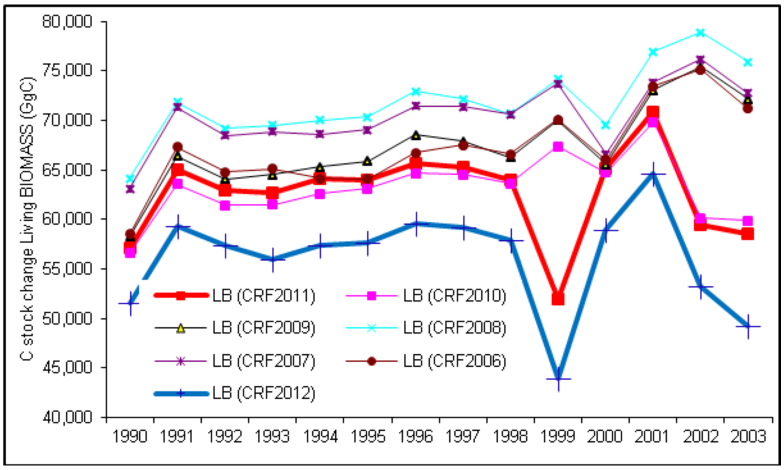


Figure 7-15 **Revision of annual estimates of C stock change in SOM min in 5A1 for 1990-2003 from 2006 to the current submission to UNFCCC** (EU 15 aggregated level, submissions in 2011 and 2012 are highlighted in red, blue respectively)

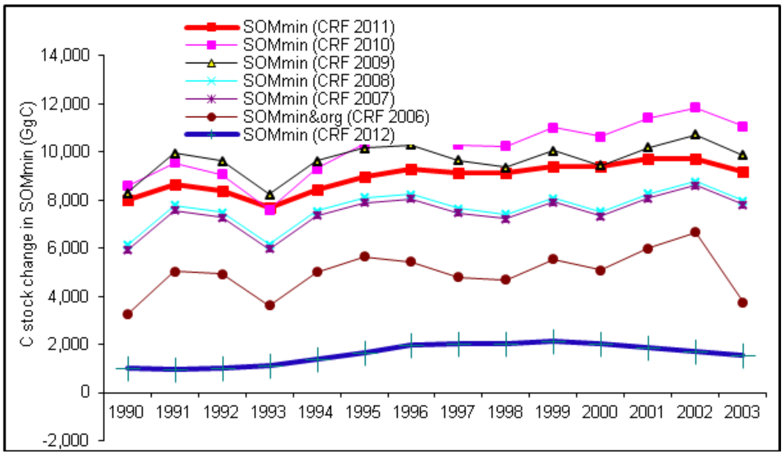
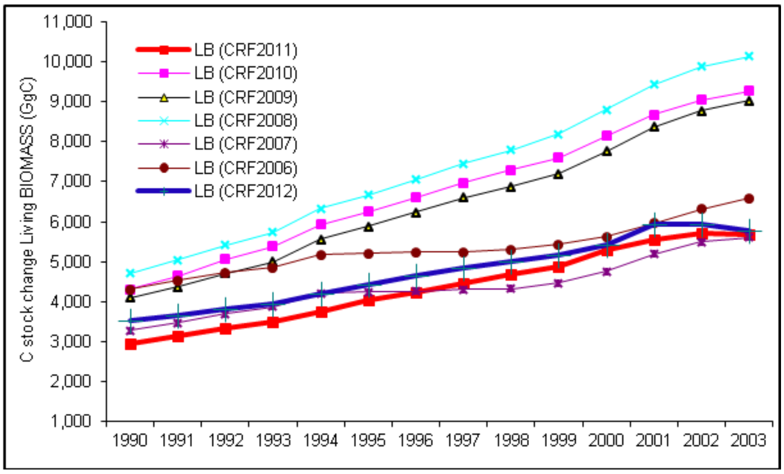


Figure 7-16 **Revision of annual estimates of C stock change in Living biomass in 5A2 for 1990-2003 from 2006 to the current submission to UNFCCC** (EU 15 aggregated level, submissions in 2011 and 2012 are highlighted in red, blue respectively)



8 Waste (CRF Sector 6)

This chapter starts with an overview on emission trends in CRF Sector 6 Waste for EU-15 Member States. For each EU-15 key source, overview tables are presented including the Member States contributions to the key source in terms of level and trend, information on methodologies and emission factors. The quantitative uncertainty estimates for this sector and the sector-specific QA/QC activities are summarised in separate sections. This chapter furthermore includes an overview of recalculations. In a separate chapter, an overview of the sector for EU-27 is provided.

8.1 Overview of sector (EU-15)

CRF Sector 6 Waste is the fourth largest sector in the EU-15, contributing 2.85 % to total GHG emissions. Total emissions from Waste have been decreasing by 37 % from 171 Tg in 1990 to 108 Tg in 2010 (Figure 8.1). In 2010, emissions decreased by 1.4 % compared to 2009. The key sources in this sector are:

- 6 A 1 Managed Waste disposal on Land:(CH_4)
- 6 A 2 Unmanaged Waste Disposal Sites:(CH_4)
- 6 B 2 Domestic and Commercial Wastewater:(CH_4)
- 6 B 2 Domestic and Commercial Wastewater:(N_2O)

Figure 8.1 Sector 6 Waste: EU-15 GHG emissions 1990–2010 from CRF in CO_2 equivalents (Tg)

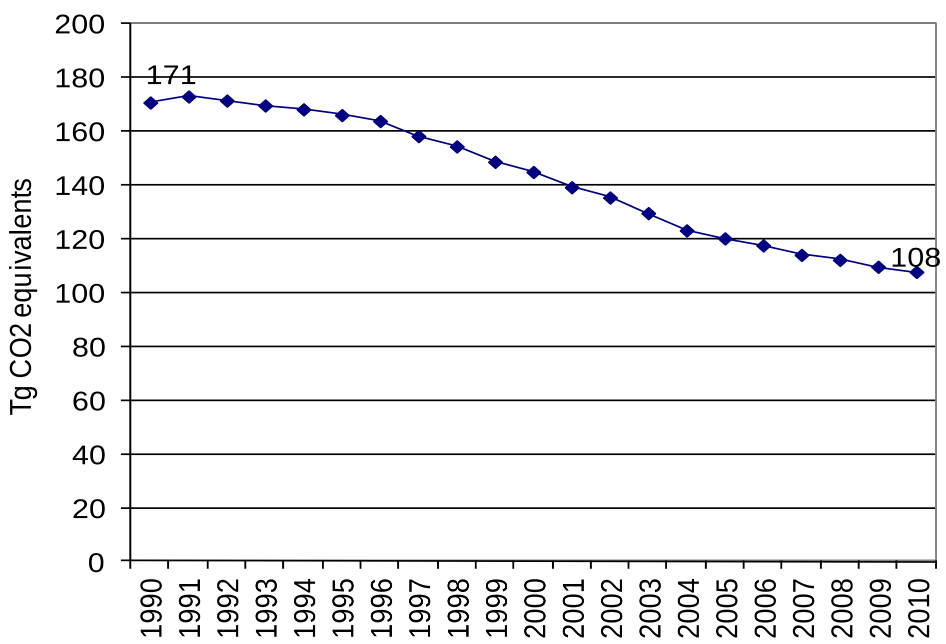
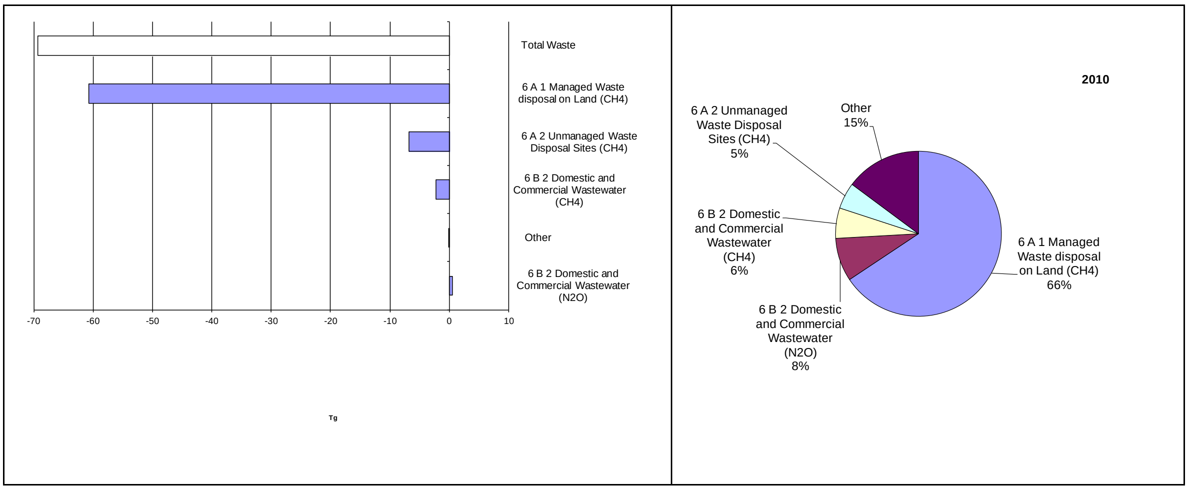


Figure 8.2 shows that CH_4 emissions from 6A1 Managed Waste Disposal on Land had the greatest decrease of all waste-related emissions, but still accounts for 66 % of waste-related GHG emissions in the EU-15.

Figure 8.2 **Sector 6 Waste: Absolute change of GHG emissions by large key source categories 1990–2010 in CO_2 equivalents (Tg) and share of largest key source categories in 2010**



8.2 Source categories (EU-15)

8.2.1 Solid waste disposal on land (CRF Source Category 6A) (EU-15)

Source category 6A Solid waste disposal on land includes two key sources: CH_4 from 6A1 Managed waste disposal on land and CH_4 from 6A2 Unmanaged waste disposal on land. Methane is produced from anaerobic microbial decomposition of organic matter in solid waste disposal sites. Source category 6A1 Managed waste disposal on land includes CH_4 emission arising from managed solid waste landfills. Methane recovery can also be reflected in this category. Source category 6A2 comprises corresponding CH_4 emissions from unmanaged landfills (without methane recovery).

Table 8.1 provides total greenhouse gas and CH_4 emissions by Member State from 6A Solid Waste Disposal on Land. CH_4 emissions from this category decreased by 42 % between 1990 and 2010 in the EU-15. Twelve EU-15 Member States reduced their emissions from this source, France, Greece, Portugal and Spain did not.

Table 8.1 **6A Solid Waste Disposal on Land: Member States' contributions to total GHG emissions and CH_4 emissions**

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2010 (Gg CO_2 equivalents)	CH_4 emissions in 1990 (Gg CO_2 equivalents)	CH4 emissions in 2010 (Gg CO_2 equivalents)
Austria	3,314	1,350	3,314	1,350
Belgium	2,555	596	2,555	596
Denmark	1,477	693	1,477	693
Finland	3,635	1,843	3,635	1,843
France	8,577	15,649	8,577	15,649
Germany	38,598	8,967	38,598	8,967
Greece	2,226	3,468	2,226	3,468
Ireland	1,173	727	1,173	727
Italy	15,254	12,892	15,254	12,892
Luxembourg	75	35	75	35
Netherlands	12,011	4,307	12,011	4,307
Portugal	3,033	4,577	3,033	4,577
Spain	4,893	11,439	4,675	11,437
Sweden	2,874	1,279	2,874	1,279
United Kingdom	42,927	14,689	42,927	14,689
EU-15	**142,623**	**82,510**	**142,404**	**82,508**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 8.2 provides information on emission trends of the key source CH_4 from 6A1 Managed Waste Disposal on Land by Member State. CH_4 emissions from this source account for 1.9 % of total EU-15 GHG emissions. Between 1990 and 2010, CH_4 emissions from managed landfills declined by 41 % in the EU-15. Ten EU-15 Member States reduced their emissions from this source during that period, France, Greece, Italy, Portugal and Spain did not. In 2010, CH_4 emissions from landfills decreased by 2 % compared to 2009. A main driving force of CH_4 emissions from managed waste disposal on land is the amount of biodegradable waste going to landfills. Total municipal waste disposal on land declined by 44 % between 1990 and 2010. In addition, CH_4 emissions from landfills are influenced by the amount of CH_4 recovered and utilised or flared. The share of CH_4 recovery has increased significantly in EU-15 since 1990.

The Member States with most emissions from this source in 2010 were the UK, France, Italy and Spain. These MS account for 69 % of EU-15 emissions in this year. The largest reductions in absolute terms between 1990 and 2010 were reported by Germany and the UK. The emission reductions are partly due to the (early) implementation of the landfill waste directive or similar legislation in the Member States. The landfill waste directive was adopted in 1999 and requires the Member States to reduce the amount of biodegradable waste disposed untreated to landfills and to install landfill gas recovery at all new sites.

Table 8.2 **6A1 Managed Waste Disposal on Land: Member States' contributions to CH_4 emissions and information on method applied and emission factor**

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)		
Austria	3,314	1,458	1,350	1.8%	-108	-7%	-1,964	-59%	T2	CS,D
Belgium	2,555	654	596	0.8%	-58	-9%	-1,959	-77%	CS	CS
Denmark	1,477	765	693	0.9%	-72	-9%	-784	-53%	CS,T2	CS,D
Finland	2,088	1,131	1,138	1.5%	7	1%	-950	-46%	T2	CS,D
France	4,783	14,516	14,544	19.7%	28	0%	9,760	204%	T2	CS
Germany	38,598	9,744	8,967	12.2%	-777	-8%	-29,631	-77%	T2	D,CS
Greece	63	848	1,058	1.4%	211	25%	995	1579%	T2	CS,D
Ireland	NO	591	575	0.8%	-16	-3%	575	-	T2	CS,D
Italy	10,060	11,600	11,334	15.4%	-267	-2%	1,274	13%	T2	CS
Luxembourg	75	38	35	0.0%	-3	-7%	-40	-53%	T2	D
Netherlands	12,011	4,637	4,307	5.8%	-330	-7%	-7,704	-64%	T2	CS
Portugal	428	2,471	2,502	3.4%	31	1%	2,075	485%	T2	CS, D
Spain	3,965	10,357	10,652	14.4%	295	3%	6,687	169%	T2	D,CR,CS
Sweden	2,874	1,367	1,279	1.7%	-89	-6%	-1,596	-56%	T2	D, CS
United Kingdom	42,927	15,274	14,689	19.9%	-584	-4%	-28,238	-66%	T2	CS
EU-15	**125,218**	**75,450**	**73,718**	**100.0%**	**-1,732**	**-2%**	**-51,500**	**-41%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

In response to the recommendation by the ERT (FCCC/ARR/2009/EC, para 81), an analysis for trends of emissions for those member States influencing most the European Union's trends is given. The UK decreased its CH_4 emissions steadily between 1990 and 2004 due to the implementation of methane recovery systems at UK landfill sites which reached a maximum in 2005, thus the British emission change between 2005 and 2009 is less noticeable.

The ERT also recommended to provide reasons for the increase of methane emissions from managed waste disposal on land for those MS showing the largest increase during the time series (France, Spain, Portugal, Italy and Greece) (FCCC/ARR/2009/EC, para 83).

CH_4 emissions on Spain increased continuously from 1990 and 2002 due to a growth of the annual municipal solid waste going to solid waste disposal sites by 108 %. During 2002 and 2004 no change in emissions could be observed; the reason for the interruption of the trend is the increase in the volume of biogas captured and burned in some of managed waste landfills in that time: a lot of landfills with biogas recovery systems were incorporated in the inventory. While in 2000 there were only 14 managed waste landfills with individual and detailed information in 2004 the number increased to 25.

Portugal, contributing with 3.4 % to EU-15 emissions in 2010, managed to slow down the increasing trend due to elevated biogas flaring in landfills; four new CH_4 recovery systems were established in 2005 and 2007.

France, contributing with 19.7 % to EU-15 emissions in 2010, increased its emissions at a constant rate until 2003; followed by a alleviated increase until 2010. Emissions followed the increased input of municipal waste going to landfills until 2000, which decreased afterwards. Following the in-country review in 2010, the capture rate of biogas has been revised which resulted in an increase in

CH_4 emissions over the entire period. This recalculation is the reason why France, for this year's inventory takes the second highest share in EU-15 emissions in 2010, whereas for the 2008 inventory (reporting year 2010) the French share in EU-15 methane emissions from managed waste disposal on land was only 7 %.

Greece's share in total EU-15 emissions in 2010 amounts to only 1 %, thus its contribution to the EU-15 emissions trend is marginal. The CH_4 generation varies during the time series; for the period 1990 to 1998 it increased steadily, taking into account that the starting year for the managed sites is the year 1990 and that quantities of municipal solid wastes for the period until 2000 was estimated on the basis of population figures and coherent assumptions regarding generation rates per capita and day. Since 2001, more accurate data was provided by the waste management sector of the Ministry of Environment, Energy and Climate Change (MEECC). CH_4 recovery was considered to have started in 1992, and increased steadily until 2009, then declining again in 2010.

Germany, contributing with 12 % to EU-15 emissions in 2010, managed to reduce CH_4 emissions steadily until now, inter alia due to an increase of methane recovery as facilities for gas collection were installed on almost all landfill sites; the collected part of the landfill gas increased continuously since 1990 until 2006 and declined thereafter since the emergence of landfill gas has been decreasing.

In response to the recommendation by the ERT (FCCC/ARR/209/EC, para 82), EU confirmed with Sweden, that it also applied the tier 2 methodology for estimating CH_4 emissions from managed solid waste disposal on land like all other MS (Table 8.2).

As mentioned above, source category 6A Solid waste disposal on land includes two key sources: CH_4 from 6A1 Managed waste disposal on land and CH_4 from 6A2 Unmanaged waste disposal on land. The twenty largest EU key categories cover about 70 % of total GHG emissions of which emissions from managed waste disposal on land are included, whereas CH_4 emissions from 6A2 Unmanaged waste disposal on land are not. Thus additional information with respect to a detailed analysis of review findings from UNFCCC inventory reviews is provided for 6A1 in EU-15 only. Table 8.3 summarizes the recommendations from the 2011 UNFCCC inventory reviews in relation to the category 6A1 Managed Waste Disposal on Land.

Table 8.3 6A1 Managed Waste Disposal on Land: Findings of the 2011 UNFCCC inventory review in relation to CH_4 emissions and responses in 2012 inventory submissions

Review findings and responses related to 6A1 Managed Waste Disposal on Land		
Member State	**Comment UNFCCC report of the review of the 2011 submission**	**Status in 2012 submission**
Austria	Austria applied the DOC value for 2004 for 2005 onwards, owing to the absence of information on the residual waste deposited in municipal solid waste disposal sites at the national level. The linear increase in the DOC values between 2000 and 2004 applied in the estimation is derived from the interpolation between two different data sources for 2000 and 2004, respectively. During the centralized review, Austria informed the ERT of the possibility of updating the DOC value for 2008 at the provincial level, which could then be applied to the whole country to adjust the 2004–2008 time series accordingly. The ERT recommends that Austria correct the DOC values with updated information, or re-evaluate the	Not yet adressed. [NIR 2012]

	method of data collection for DOC, in order to increase the accuracy of the estimated emissions from this category in its next annual submission. (FCCC/ARR/2010/AUT, para 95)	
	Austria assumes that industrial wastewater treated at municipal wastewater treatment plants contributes an additional 30 per cent to the sectoral N_2O emissions. As N_2O emissions from wastewater handling is a key category, the method used for this subcategory is not consistent with the IPCC good practice guidance. The ERT recommends that Austria identify industries that are large sources of wastewater and obtain data to estimate emissions by industry in accordance with the IPCC good practice guidance for ist next annual submission. (FCCC/ARR/2010/AUT, para 97)	Not yet adressed. [NIR 2012]
Belgium	Emissions from the category solid waste disposal on land were estimated using two different models: the multiphase model (for landfills with permits) and the first order decay (FOD) model (for old landfills) for the Flemish Region, and the FOD model for the Walloon Region (there are no landfills in the Brussels-Capital Region). The ERT noted a lack of transparency in the description of the models with regard to the management practices on closed landfills in the Flemish Region and inconsistencies in the terminology used for the parameters of the two models across the time series. The ERT reiterates the recommendation of the previous review report that Belgium list, in the next NIR, the parameters used for the two models in a single table, using the same terminology.(FCCC/ARR/2011/BEL, para 94)	Not yet adressed. [NIR 2012]
	The ERT noted some inconsistencies in the formulae used for the estimation of CH_4 emissions from the Flemish Region (see page 138 of the NIR) with regard to the omission of a few parameters, such as the normalization factor (that is currently less than 1, but if changed, this omission may lead to an underestimation of emissions); the oxidation factor; the methane conversion factor; the share of methane in the landfill gas; and the methane recovery, but which are, however, considered in the calculation; and discrepancies between the different assumptions for the two models used in the Flemish Region. The ERT finds that these inconsistencies hinder transparency and may affect the accuracy of the emission estimates. The ERT strongly recommends that the Party enhance the category-specific QC procedures both at the regional and at the national levels, in order to increase the accuracy and consistency of the reporting in the next annual submission. (FCCC/ARR/2011/BEL, para 95)	During the 2012 submission the emissions of CH_4 from solid waste disposal sites in the Flemish region were optimised for the complete time series after consultation of all operators involved. Consequently waste gas production figures and timing of flaring / valorisation were corrected for the complete time series. [NIR 2012, p.63]

	The ERT notes a lack of justification for the use of the two different models for the estimation of emissions from closed and active landfills with different assumptions and lifetimes, and strongly recommends that Belgium explore the possibility of using a unified/homogeneous approach for the whole country in its next annual submission. Until the Party is able to use a consistent approach, the ERT recommends that Belgium report separately in CRF table 6.A information from the regions, as well as from the closed and active landfills in the Flemish Region with their specific parameters according to the region-specific and model-specific conditions and assumptions used in order to ensure the transparency of its reporting. (FCCC/ARR/2011/BEL, para 96)	Model has been reviewed also. Some differences have been detected in comparison the model previously used in Wallonia and the model described in the 2000 IPCC Good Practice Guidance: the equations were different and the oxidation factor was applied before to subtract the CH_4 recovered. Therefore, from this submission, we use the equations and methodology of the IPCC Good Practice Guidance. [NIR 2012, p.163] No specific parameters are erported in the CRFs.
Denmark	To estimate emissions for this category, Denmark uses the first-order decay (FOD) model as described in the 2006 IPCC Guidelines, using country-specific AD and a combination of country-specific parameters for degradable organic carbon and IPCC default values. The ERT encourages Denmark to conduct research in order to develop country-specific parameters for the FOD model, in order to increase the accuracy of the estimates for this key category. (FCCC/ARR/2011/DNK, para 111)	Denmark has made some changes in the parameters used in the FOD model (oxidation factor, half-life time, fraction CH_4 in emitted gas, degradable organic carbon content for plastics, fraction of degradable organic carbon dissimilated) according to previous recommendations. However, an in depth investigation of the individual landfill practices have not yet been realised – improvements at this level are ongoing. [NIR 2012, p.560]
	Denmark uses the IPCC default methane generation rate constant (k) (0.05) as the key parameter for the FOD model. According to the IPCC good practice guidance, it would be necessary to include data on solid waste disposal (amount and composition) for three- to five-year half-lives for the waste deposited at the solid waste disposal sites to achieve accurate emission estimates (i.e. for about 40–70 years), but the ERT could not find that information in the NIR for the period before 1990. The ERT encourages Denmark to provide explanations in the NIR, together with the quantities for each waste fraction, in its next annual submission, in order to improve the transparency of the inventory. (FCCC/ARR/2011/DNK, para 112)	The methodology and activity data has been described and provided at a more detailed level that should increase the transparency and ability for the ERT to follow stepwise the calculation procedure and results. [NIR 2012, p.560]
Finland	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2011/FIN)	No follow-up necessary
France	The ERT recommends that France start to gather measured data on landfill gas captured in French landfills, and report them in the next annual submission. In particular, the ERT recommends that the Party collect data on: actual amounts of landfilled gas captured for all landfills; the CH_4 content of the landfill gas captured; the amount of landfill gas used for energy purposes and the amounts flared; and the electricity generated and used for own purposes or sold (the latter elements can be used to cross-check with the French energy balance). Data collection should cover not only operating landfills, but also potentially closed landfills with ongoing landfill gas recovery in order to gather data on complete amounts of gas recovery. The ERT recommends that France	A questionnaire campaign was intinitiated in 2011 at all French landfills to obtain the amount of captured and flared methane of each site. However, only information of privately managed landfills has been obtained so far. The survey will be extended to all landfills starting from 2012 for consideration in the next inventory submission. Meanwhile, methane capture is not considered for all landfills and the whole time series. The next inventory submission will consider the amount of methane captured at each landfill and distinguish

	follow the plan and report on the state of its implementation in the next annual submission. (FCCC/ARR/2010/FRA, para 133)	captured from flared landfill gas. In the future it is envisaged to obtain the data from yearly declarations from the landfill sites [NIR 2012, pp. 177-180].
Germany	The IPCC first order decay method was used to estimate emissions of CH_4 from this category. Germany uses different CH_4 generation rate constants (k) and degradable organic carbon (DOC) values for different waste types. The ERT noted that there is no comprehensive explanation of these parameters in the NIR. The fraction of DOC dissimilated is country-specific. Other parameters are defaults from the IPCC good practice guidance. The ERT noted that some additional information, such as the waste generation rate, is not presented in the NIR and CRF tables. The ERT recommends that Germany improve the transparency of reporting by providing more detailed information about the CH_4 generation rate constant, DOC, and waste generation rate in the NIR and CRF tables in the next annual submission. (FCCC/ARR/2010/DEU, para 144)	Not yet adressed. [NIR 2012]
	Germany assumes that the CH_4 collection efficiency, taking into account both energy recovery and flaring, was 45 per cent in 1990 and it constantly increased up to 60 per cent in 2004. During the review Germany provided additional data. Germany noted that the value is low compared with the reported value because it contains only recovery data from operational landfills and emphasized that CH_4 recovery in closed landfills is more significant. Germany also informed the ERT that the biogas utilisation value in the NEB supports the higher estimates. The ERT found that the documentation provided by the Party to substantiate its reported recovery was insufficient. The ERT reiterated the recommendations from previous reviews and recommended that Germany use monitored data to report recovery and actual emissions after recovery, and reconstruct the full time series using methodologies in line with the IPCC good practice guidance. Following the ERT recommendation, the Party resubmitted revised estimates for the full time series. As a result, in 2008 47.3 per cent of total CH_4 generated by waste disposal on land (421.10 Gg) was reported as recovered and deducted from total CH_4 emissions. The ERT recommends that the Party provide a detailed description of the new calculation approach in its next annual submission. (FCCC/ARR/2010/DEU, para 145)	No detailed description has been provided so far. In future, the Federal Statistical Office plans to collect data on landfill-gas collection and use also from landfills in their after-closure phases. It is expected that in 2012 environmental statistics will include, for the first time, data on landfill-gas collection that have been collected in a consistent manner, from all relevant landfills. [NIR 2012, p.574]

Greece	Greece reports only MSW; however, based on information from the Hellenic Statistical Authority, large amounts of industrial and commercial waste are generated but are not included in the inventory. The Party explained that industrial and commercial waste is mainly recycled and the rest is disposed of at the same managed and unmanaged SWDS that are used for MSW. Additionally, it was mentioned by the Party that disposed industrial and commercial waste is included in the amount of MSW disposed. During the review Greece submitted revised estimates of the emissions from industrial waste for the entire time series. The ERT recommends that the Party include more information on industrial waste in its next NIR. (FCCC/ARR/2011/GRC, para 84)	Emissions from industrial solid waste are now included in the 2012 submission. [NIR 2012, p. 291, 329]
	There are four landfill sites in Greece where CH_4 is recovered. However, according to the Party, for three of the sites it has not been possible to obtain data but it has been assumed that 60 per cent of the CH_4 at those sites is recovered. The Party explained that a recovery rate of 60 per cent is estimated at the SWDS in Athens where the CH_4 is measured because it is used for energy production. Taking into consideration the fact that the other three landfill sites have been constructed with similar characteristics to that of Athens, it is estimated that the same fraction of CH_4 is recovered at those sites. The ERT recommends that the Party further investigate the amount of CH_4 recovered at the sites where it is flared with no energy recovery and provide a justification for the calculation of the amount of CH_4 recovered in its next NIR. (FCCC/ARR/2011/GRC, para 85)	For estimating the amount of biogas flaring official data from the National Energy Balance were used. [NIR 2012, p.290, 329]
	Greece does not differentiate between garden and park waste and other non-food putrescibles and food waste as all have been included in the general putrescibles. As the DOC value of these waste types differs, their allocation to the same category is not in line with the Revised 1996 IPCC Guidelines. The ERT reiterates the recommendation made in the previous review report that Greece estimate these waste types separately using appropriate DOC values. (FCCC/ARR/2011/GRC, para 86)	Greece investigated the composition of municipal solid waste, searching for data in any scientific research that has been presented in Greek institutes, like universities etc. [NIR 2012, p. 287, 329].
Ireland	In the NIR, Ireland provides detailed information on the calculations and parameters applied to estimate CH_4 emissions from food, paper, wood and straw textiles, and disposable nappies. The ERT recommends that Ireland expand the information in its next annual submission to illustrate how all other waste streams are accounted for in the estimates. (FCCC/ARR/2010/IRL, para 103)	Additional information is provided in the NIR 2011 (Chapter 8, section 8.2.2. and Annex H, Tables H.1 and H.2.). [NIR 2012, annex I, p.310]
	Ireland has recalculated the estimates of CH_4 recovery from solid waste disposal on land on the basis of a detailed study of landfill sites undertaken by external consultants. This study quantified the CH_4 recovered through landfill gas flaring for all years since the practice was introduced and validated the CH_4 utilization value in the annual energy balance. The ERT recommends that Ireland include the information provided	Additional information is provided in the NIR 2011 (Chapter 8, section 8.2.3). [NIR 2012, annex I, p.310]

	during the review in its next annual submission to improve the transparency of the inventory. (FCCC/ARR/2010/IRL, para 104)	
Italy	Italy uses the tier 2 method to estimate CH_4 emissions from solid waste disposal on land, using country-specific AD and a combination of country-specific EFs and IPCC default values. The ERT encourages Italy to include an explanation of the finding of the energy conversion efficiency factor used to calculate the CH_4 recovered in the NIR of its next annual submission. (FCCC/ARR/2010/ITA, para 80)	Further information is added about the methane generation rate constant (k), the method used to estimate the amount of CH_4 recovered using the energy conversion efficiency factor and the procedure used to establish the time series for the amount of waste disposed in managed and unmanaged landfill sites. [NIR 2012, p. 506]
	The ERT noted that tables with emissions data for solid waste disposal on land have been included in the uncertainty and time-series consistency chapter of the NIR. The ERT recommends that these tables be moved to before the uncertainty and time-series consistency chapter in order to improve transparency. (FCCC/ARR/2010/ITA, para 81)	The table is not longer included under the chapter uncertainty and time series consistency. [NIR 2012, p.243]
Luxembourg	The IPCC first order decay method was used to estimate CH_4 emissions from solid waste disposal on land. Luxembourg uses different CH_4 generation rate constants (k) and degradable organic carbon (DOC) values for different waste types. All parameters are default values from the 2006 IPCC Guidelines, which better reflect the Party's circumstances and its use of more disaggregated AD than the values from the Revised 1996 IPCC Guidelines. The ERT noted that some additional information for the period 2006–2009, such as the waste generation rate and the fraction of MSW disposed to SWDS, has not been presented in the NIR or in the CRF tables. The ERT recommends that Luxembourg improve the transparency of its reporting by providing the missing information in the NIR and in the CRF tables in the next annual submission. (Non-key category) (FCCC/ARR/2011/LUX, para 117)	A time series from 1950-2010 on waste generation rate per capita and the fraction of MSW disposed on land is provided in the NIR 2012 [NIR 2012, p. 404].
Netherlands	In response to the list of potential problems and further questions raised by the ERT during the review, the Netherlands provided additional documentation on the data used for the FOD method and described the interpolation/extrapolation approach applied to derive the historical data on the amount of waste sent to landfills. The ERT agreed that this information explained the data used. The ERT recommends that the Netherlands include this information in its next annual submission. In addition, the ERT encourages the Netherlands to analyse the possibility of applying the interpolation/extrapolation approach based on drivers such as population and gross domestic product as this probably will improve the quality of the historical missing data. (FCCC/ARR/2011/NLD, para 138)	As a result of the 2011 in-country review, the Netherlands has (re)generated the historical land filled data (1945 –1990) and used this data for the estimation of CH_4 emissions. The reported amounts of land filled waste for 1950, 1955, 1960, 1965 and 1970 (Van Amstel, 1994) are linearly interpolated for the years in between. This recalculation was not included in the latest official CRF submission from November 2011 and therefore, does now show up in the recalculation sheet of the current CRF. [NIR 2012, p. 131]

Portugal	CH_4 emissions from solid waste disposal on land amounted to 4,916.46 Gg CO_2 eq in 2008. Within this category, emissions from municipal solid waste and industrial waste are estimated by using the IPCC first order decay (FOD) method and default parameters, except for degradable organic carbon, which was estimated using country-specific data on waste composition. The ERT reiterates the recommendation from the previous review report that Portugal explore the use of country-specific parameters in the FOD model for its next annual submission. The ERT noted that changes in emission trends are not well explained in the NIR and recommends that Portugal provide this information in its next NIR. (FCCC/ARR/2010/PRT, para 92)	Not yet adressed. There are no national studies that enable the use of country-specific parameters. The development of these can represent significant economic resources still not available. [NIR 2012, p.9-5]
Spain	To estimate CH_4 emissions from solid waste disposal on land, Spain uses the tier 2 method (first-order decay method) and collects data on solid waste disposal to managed landfills from questionnaires on landfill activities and from statistical information contained in the publication entitled "Environment in Spain". Following up on the conclusion made in the previous review report, the ERT noted that, on page 8.3 of the NIR, Spain refers to the lack of information for some years, and no information is provided in the NIR on how the time series of the quantity of solid waste was derived. Responding to a question raised by the ERT during the review, Spain confirmed that the information received from the questionnaires is not comprehensive, and it provided detailed information on the data contained in the aforementioned publication, which are derived from information provided by regional governments, and on the way in which the time series of the quantity of solid waste deposited at unmanaged disposal sites was extrapolated for the periods 1970–1990 and after 2005. The ERT recommends that Spain include this information in its next annual submission, in order to improve the transparency of the inventory. (FCCC/ARR/2010/ESP, para 122)	The inventory submission 2012 of Spain contains information on how the time series of solid waste disposal is generated [NIR 2012, pp. 8.10].
	As noted in the previous review report, the degradable organic carbon (DOC) values are estimated by extrapolation (pre-1981) or are kept constant for more than 10 years (1997–2008), and only for the period 1980–1997 are they based on data on the composition of municipal solid waste, as can be seen in table 8.2.3 of the NIR. Responding to a question raised by the ERT during the review, Spain stated that it envisages using other sources of information or expert judgement to extend the time series of DOC values. The ERT recommends that the Party either obtain the necessary updated data or justify why it considers that the assumption of a constant value is valid. (FCCC/ARR/2010/ESP, para 123)	A note is included under table 8.2.3 of the NIR 2012. It states that between 1997 and 2010 the waste composition has been kept constant. However, one of the measures included in the Integrated National Waste Plan refers to improving the information on waste composition with a pilote plan to characterise urbane household waste for the years 2010-2011. This activitiy is currently ongoing [NIR 2012, p. 8.16].
Sweden	No recommendation for improvement of this source category in Review Report. (FCCC/ARR/2010/SWE).	No follow-up necessary.

United Kingdom	The recalculations made using the new AD and EFs led to a significant decrease of the 2008 emissions from the sector and the ERT noted that the change in values for MSWF and the default values for degradable organic carbon into the country-specific ones is not properly documented in the NIR and its annex 3. The explanations and references7 provided by the consulting company Eunomia Research & Consulting Ltd on the request of the ERT were analysed and the ERT concluded that they are not sufficiently convincing and require further justification. The reasons for questioning the recalculations are: the poor quality of updated data on waste sent to landfill, as acknowledged by the consulting company itself; lack of justification for 'smoothening' assumption for dissimilable degradable organic carbon for the years since 1997; and the error made in putting new dissimilable degradable organic carbon values into the model. The ERT strongly recommends that the Party double-check the reliability of the data used in the recalculation and the relevance of the methods used and assumptions made, and either: make recalculations with corrected figures supported, in the NIR, by strong justifications for the changes made in methodologies, assumptions, data and parameters; or keep the previous values and approaches (2010 submission) unchanged until the Party is able to show sufficient evidence for justifying the changes. (FCCC/ARR/2011/GBR, para 100)	A detailed review of waste composition was undertaken during 2010 and new activity data have been included in the inventory. Since then, further checks have revealed a number of inconsistencies which have been corrected for the 2012 submission. Some implementation errors from that revision to the model have now been corrected, and we are confident that the new UK landfill estimates are more complete and accurate, compared to the 2010 submission. [NIR 2012, p. 278]
	The United Kingdom calculates CH_4 recovery values using the figures of gas utilized for energy and the total available flaring capacity of the landfills. The previous review report noted that the CH_4 recovery rate was increasing, reaching 71 per cent in 2008. For the year 2009 it was raised to 75 per cent. The NIR justifies the value by reference to the permit conditions for landfill operators, who are targeting to collect at least 85 per cent of CH_4 from the sites receiving biodegradable waste. The ERT reiterates the recommendation of the previous review reports that the United Kingdom collect the survey data and update AD in order to avoid a possible overestimation of recovered CH_4, and provide detailed information on the data in its next annual submission. (FCCC/ARR/2011/GBR, para 101)	Not yet adressed. [NIR 2012]

Note: Review reports (Centralized review 2011) for Austria, France, Germany, Greece, Ireland, Italy, Portugal, Spain and Sweden are not yet available.

Source: NIR 2012, UNFCCC inventory review reports, as published at UNFCCC: http://unfccc.int/national_reports/annex_i_ghg_inventories/inventory_review_reports/items/6048.php

CH_4 emissions from 6A2 Unmanaged Waste Disposal on Land account for 0.2 % of total EU-15 GHG emissions in 2010. Between 1990 and 2010, CH_4 emissions from this source decreased by 58 % in all MS (except for Spain) due to a decreasing amount of municipal waste going to unmanaged waste disposal sites (Table 8.4). The increase of CH_4 emissions from unmanaged waste disposal on land in Spain did not occur steadily throughout the whole time series but peaked in 2000, thus also showing a decreasing trend from 2000 onwards. The trend of the emissions from unmanaged landfills is due to two kinds of emissions: instant emissions, due to waste burning, and emissions originated by wasted disposed in a series of years up to the current year. The latter emissions are estimated by Spain with the first order kinetic methodology as the processes for decomposition in landfill of the municipal waste have a maturing period of several years, which may range from one year for the more labile components up to over 35 years for those with the lowest biodegradation rate. The combination of both processes (burning of wastes disposed in the current year plus emissions from wastes disposed in the past) produces this reversal of CH_4 emissions trend in 2000.

This could similarly be observed for Portugal in 1998, due to a continuous reduction of waste disposal in unmanaged sites. Since 1997 there has been a continuous reduction of this disposal type; the majority of unmanaged dumping sites closed in 2002.

Not all Member States reported emissions from this source since all waste disposal sites in the countries are managed (Austria, Belgium, Denmark, Finland, Germany (due to first Waste Act since 1972), Luxembourg, the Netherlands, Sweden) or considered to be not significant sources (the UK). France, Italy and Greece are responsible for about 74 % of the total EU-15 emissions. France and Italy had large absolute reductions between 1990 and 2010. Since 2005, no waste is disposed on unmanaged landfill sites any more. However, emissions are still produced from the waste disposed in the past.

The reduction of emissions from unmanaged waste disposal on land in Italy is caused by legal acts. The first legal provision concerning waste management was issued in 1982. In this decree, uncontrolled waste dumping as well as unmanaged landfills are forbidden, but the enforcement of these measures has been concluded only in 2000. Thus the share of waste disposed into uncontrolled landfills has gradually decreased, and in the year 2000 it has been assumed equal to zero; nevertheless emissions still occur due to the waste disposed in the past years.

Following the Greek National and Regional Planning of Solid Waste Management (compiled in the end of 2003), the process of closure and rehabilitation of unmanaged sites is in progress, and unmanaged solid waste disposal sites in Greece are expected to decline (from 4690 unmanaged sites in 1987 to 2182 sites still operating in 2000 and further).

Table 8.4 shows that 100 % of the EU-15 emissions are estimated using higher tier methodologies.

Table 8.4 **6A2 Unmanaged Waste Disposal on Land: Member States' contributions to CH_4 emissions and information on method applied and emission factor**

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)		
Austria	NO	NO	NO	-	-	-	-	-	NA	NA
Belgium	NO	NO	NO	-	-	-	-	-	NA	NA
Denmark	NO	NO	NO	-	-	-	-	-	NA	NA
Finland	IE,NO	NO	NO	-	-	-	-	-	NA	NA
France	3,794	1,185	1,105	19.1%	-80	-7%	-2,689	-71%	T2	CS
Germany	NO	NO	NO	-	-	-	-	-	NA	NA
Greece	1,911	1,689	1,609	27.8%	-80	-5%	-302	-16%	T2	CS,D
Ireland	1,173	163	152	2.6%	-11	-7%	-1,021	-87%	T2	CS,D
Italy	5,194	1,637	1,558	27.0%	-78	-5%	-3,636	-70%	T2	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NA
Netherlands	NO	NO	NO	-	-	-	-	-	NA	NA
Portugal	1,006	620	568	9.8%	-53	-8%	-438	-44%	T2	CS,D
Spain	698	819	785	13.6%	-35	-4%	87	12%	T2	D
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA
United Kingdom	NO	NO	NO	-	-	-	-	-	NA	NA
EU-15	**13,775**	**6,113**	**5,776**	**100.0%**	**-337**	**-6%**	**-7,999**	**-58%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 8.5 provides information on the contribution of Member States to EU recalculations in CH_4 from 6A Solid Waste Disposal on Land for 1990 and 2009 and main explanations for the largest recalculations in absolute terms.

Table 8.5 6A Solid Waste Disposal on Land: Contribution of MS to EU recalculations in CH_4 for 1990 and 2009 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2009		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	0	0.0	0	0.0	
Belgium	-75	-2.9	230	54.2	- During the 2012 submission the emissions of CH4 from solid waste disposal sites in the Flemish region were optimised for the complete time series after consultation of all operators involved. Consequently waste gas production figures and timing of flaring / valorisation were corrected for the complete time series. - In Wallonia, the DOC value has been recalculated for the years 2000, 2002, 2003, 2005, 2007, 2008, 2009 and 2010 following the 1996 IPCC Guidelines (for sludge, we use a DOC content of 9% as it is suggested in the 2006 IPCC Guidelines). - Model has been reviewed also. Some differences have been detected in
Denmark	366	33.0	-275	-26.4	The recalculation of emissions from Solid Waste Disposal on Land is primarily caused by the change in half-life times. In last year's submission all waste fractions were set to have a half-lift time of 14 years, but this year the halflife times are defined according to the different waste fractions. This decrease of half-life times for some waste fractions results
Finland	0	0.0	0	0.0	
France	-273	-3.1	-1,369	-8.0	- 6A1: Pour le CH4, la baisse des émissions est à imputer à une surestimation (liée à une approche simplificatrice) des émissions de la re-soumission de mai 2011 compensée en partie par une hausse des émissions due à la révision à la hausse du COD (Carbone Organique Dégradable).
Germany	0	0.0	1,281	15.1	Activity data: updated statistical data
Greece	367	19.8	837	34.0	Updated AD were used in calculations, concerning the composition of MSW at disposal sites and the amounts of CH4 recovered
Ireland	0	0.0	-327	-30.2	Revised estimate of methane recovery from utilisation
Italy	0	0.0	495	3.9	Update of methane recovered in 2009 and waste landfilled in 2008
Luxembourg	0	0.0	0	0.0	
Netherlands	0	0.0	0	0.0	
Portugal	0	0.0	-871	-16.5	1) Quantities of SW disposed into land: error of compilation in the 2011 subm. 2) Industrial waste: revision of the waste categories containing
Spain	-86	-1.8	-761	-6.4	An improvement in methodology has been applied; new activity data was available.
Sweden	0	0.0	0	0.0	
UK	-13,075	-23.3	-596	-3.8	Correction to model. Previous version included an error that over estimated DDOC landfilled.
EU-15	**-12,774**	**-8.2**	**-1,355**	**-1.6**	

8.2.2 Wastewater handling (CRF Source Category 6B) (EU-15)

Source category 6B includes two key sources: CH_4 and N_2O from 6B2 Domestic and commercial wastewater. Methane and nitrous oxide are produced from anaerobic decomposition of organic matter by bacteria in sewage facilities. N_2O may also be released from wastewater handling and human waste. Domestic and commercial wastewater includes the handling of liquid wastes and sludge from housing and commercial sources (including human waste) through wastewater collection and treatment, open pits/latrines, ponds, or discharge into surface waters. N_2O emissions from discharge of human sewage to aquatic environments are included here.

Table 8.6 shows total GHG, CH_4 and N_2O emissions by Member State from 6B Wastewater Handling. Between 1990 and 2010, CH_4 emissions from wastewater handling decreased by 20 % in EU-15 (in 8 MS, whereas Denmark, France, Ireland, Italy, Spain, Sweden and the UK increased their methane emissions), N_2O emissions from wastewater handling remains at the level of 1990 (with an increase in 9 MS, whereas Denmark, Finland, France, the Netherlands, Sweden and the UK reduced their emissions of nitrous oxide).

CH_4 emission trends for 6B Wastewater Handling are mainly driven by trends in CH_4 and N_2O emissions from 6B2 Domestic and Commercial Wastewater in France, Germany, Italy, Greece and Spain. Thus, in response to the recommendation by the ERT (FCCC/ARR/2009/EC, para 84), more information about the decrease and increase of CH_4 and N_2O emissions from 6B Wastewater Handling are included in the following subchapters.

Table 8.6 6B Wastewater handling: Member States' contributions to total GHG, CH_4 and N_2O emissions from 6B

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2010 (Gg CO_2 equivalents)	CH_4 emissions in 1990 (Gg CO_2 equivalents)	CH4 emissions in 2010 (Gg CO_2 equivalents)	N_2O emissions in 1990 (Gg CO2 equivalents)	N2O emissions in 2010 (Gg CO2 equivalents)
Austria	211	292	102	27	109	265
Belgium	512	424	218	126	293	298
Denmark	176	159	66	75	109	84
Finland	297	217	154	120	144	98
France	2,247	1,990	844	1,210	1,403	780
Germany	4,450	2,373	2,226	71	2,224	2,303
Greece	3,348	1,461	3,017	1,068	331	393
Ireland	129	161	15	16	114	145
Italy	3,822	4,726	1,990	2,752	1,832	1,975
Luxembourg	15	14	6	3	9	11
Netherlands	771	647	290	198	482	449
Portugal	2,944	2,853	2,481	2,269	463	584
Spain	2,315	3,605	1,243	2,357	1,072	1,248
Sweden	502	461	292	299	211	161
United Kingdom	1,437	1,482	278	338	1,158	1,144
EU-15	**23,177**	**20,868**	**13,221**	**10,930**	**9,955**	**9,938**

Abbreviations explained in the Chapter 'Units and abbreviations'.

CH_4 from 6B2 Domestic and Commercial Wastewater accounts for 0.18 % of total EU-15 GHG emissions. Between 1990 and 2010 emissions decreased by 26 %. Large decreases in absolute terms are reported from Germany and Greece, contributing to only 4 % of EU-15 emissions in 2010, whereas Spain, Italy and France had large emission increases (Table 8.7). Spain was responsible for 27 %, Italy for 23 % and France for 17 % of the EU-15 emissions from this source in 2010. Although these MS increased their emissions between 1990 and 2010, the trend of EU-15 emissions is nevertheless dominated by the large emission reductions in Germany and Greece.

Germany's reduction in CH_4 emissions occurred mainly during 1995 and 1998. The decrease of 76 % in that period was due to the legal requirement to connect households to decentralised wastewater treatment plants. For this reason many plants were built in the former GDR after the German reunification. Most of them were accomplished between 1995 and 1998 and started their work in this period of time.

The Greek CH_4 emissions decreased mainly during 1999 and 2001 (-56 %) due to the increased number of wastewater handling facilities under aerobic conditions. In Greece, domestic wastewater handling in aerobic treatment facilities shows a substantial increase since 1999, while in the industrial sector only a few units exist where wastewater is handled under anaerobic conditions; the penetration of such facilities increased from 32 % (of total population served) in 1999 and to 84 % in 2005.

The French CH_4 emissions showed an increasing trend from 1990 to 2001 and remained at constant level until 2010. The trend results mainly from wastewater treatment in autonomous systems. In France the number of inhabitants connected to a septic system increased from 1990 to 2001 (the share of population connected to an autonomous system increased from 13 % in 1990 to 18 % in 2001), and then remained almost constant until 2010 even with a small decrease.

Sweden, for the inventory submission in 2011 estimated emissions from wastewater handling for the first time. Corresponding to a recommendation raised during the Centralized Review in 2010, the completeness of the EU- inventory has thus been improved.

The largest increase in CH_4 emissions from domestic and commercial wastewater between 2009 and 2010 could be found for Spain, due to an increment in the wastewater treated. In turn this increment was mainly caused by i) the increase in the population number and ii) the increase in the percentage of the whole population whose wastewater discharge are treated in wastewater treatment plants.

Table 8.7 6B2 Domestic and commercial wastewater: Member States' contributions to CH_4 emissions and information on method applied and emission factor

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)		
Austria	102	27	27	0.4%	0	0%	-74	-73%	D	CS,D
Belgium	218	124	126	1.9%	2	1%	-92	-42%	CR,T1	CR,D
Denmark	66	75	75	1.1%	0	1%	9	14%	CS	CS
Finland	131	101	99	1.5%	-1	-1%	-32	-24%	D	CS,D
France	798	1,149	1,155	17.4%	6	1%	357	45%	T1	CS
Germany	2,226	81	71	1.1%	-10	-12%	-2,155	-97%	D	CS,D
Greece	2,163	218	216	3.2%	-3	-1%	-1,947	-90%	D	D
Ireland	13	10	10	0.2%	0	2%	-2	-19%	T1	D
Italy	713	1,514	1,519	22.9%	6	0%	806	113%	D	D
Luxembourg	6	3	3	0.0%	0	-2%	-3	-50%	T1	CS
Netherlands	190	184	181	2.7%	-3	-2%	-10	-5%	T2	CS
Portugal	1,056	758	756	11.4%	-2	0%	-300	-28%	D	CS,D
Spain	756	1,742	1,776	26.7%	35	2%	1,021	135%	D	CS,D
Sweden	284	289	290	4.4%	1	0%	6	2%	CS,T1	CS,D
United Kingdom	278	336	338	5.1%	1	0%	59	21%	CS	CS
EU-15	**9,001**	**6,613**	**6,645**	**100.0%**	**32**	**0%**	**-2,356**	**-26%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 8.8 provides information on the contribution of Member States to EU recalculations in CH_4 from 6B Wastewater handling for 1990 and 2009 and main explanations for the largest recalculations in absolute terms.

Table 8.8 6B Wastewater Handling: Contribution of MS to EU recalculations in CH_4 for 1990 and 2009 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2009		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	0	0.0	0	0.0	
Belgium	-1	-0.5	2	1.6	During the 2012 submission emissions of CH4 from domestic waste water are revised for the complete time series in the Flemish region because a revision of total inhabitants in this region took place. The number of
Denmark	0	0.0	0.3	0.4	For 1999-2009, an error in the calculation of CH4 has been corrected.
Finland	0	0.0	-1	-1.1	Correction on rural population
France	3	0.4	-1	-0.1	- 6B1: Modification de la DBO; mise à jour de l'activité boue + du taux de connection
Germany	0	0.0	0	0.0	
Greece	182	6.4	147	17.5	- Improvement of estimation methodology - Updated Activity Data,Additional sub-categories
Ireland	0	0.0	0	0.0	
Italy	0	0.0	0	0.0	
Luxembourg	0	0.0	0	0.5	
Netherlands	0	0.0	-6	-3.1	Improved activity data
Portugal	0	0.0	179	9.5	1) AD updates of % population served by handling systems and type of treatment
Spain	0	0.0	0	0.0	
Sweden	0	0.0	0	0.0	
UK	0	0.0	0	0.0	
EU-15	**183**	**1.4**	**319**	**3.1**	

N_2O from 6B2 Domestic and Commercial wastewater accounts for 0.25 % of total EU-15 GHG emissions. Between 1990 and 2010 emissions remained at the same level (Table 8.9). Comparably large decreases in absolute terms are only reported from France, whereas Italy and Spain had emission increases (Table 8.9). France increased the N efficiency of the waste-water plants since 1995, thus emissions decreased since that year and contribute with a share of 7.6 % to the EU-15 emissions in 2010, whereas this share in EU-15 emissions amounted to 13.9% in 1990.

Emissions are mainly driven by the daily per capita protein consumption, being one relevant component for the calculation of nitrous oxide emissions from household wastewater according to the IPCC method. Germany was responsible for 24 %, Italy for 20 % and Spain for 13 % of the emissions from this source in 2010. Table 8.9 also suggests that 8 % of the EU-15 emissions are estimated using higher tier methodologies.

Table 8.9 **6B2 Domestic and Commercial Wastewater: Member States' contributions to N_2O emissions and information on method applied and emission factor**

Member State	N_2O emissions (Gg CO_2			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)		
Austria	106	206	208	2.2%	2	1%	102	97%	D	CS,D
Belgium	293	296	298	3.1%	2	1%	4	2%	D	D
Denmark	109	81	84	0.9%	3	4%	-26	-23%	CS	CS
Finland	105	73	75	0.8%	2	3%	-30	-29%	CS,D	D
France	1,326	773	720	7.6%	-53	-7%	-607	-46%	T1	CS
Germany	2,224	2,304	2,303	24.2%	-1	0%	79	4%	D	CS,D
Greece	326	387	387	4.1%	1	0%	62	19%	D	D
Ireland	114	145	145	1.5%	0	0%	31	27%	T1	D
Italy	1,761	1,904	1,911	20.1%	7	0%	150	8%	D	D
Luxembourg	9	11	11	0.1%	0	-2%	2	18%	T1	D
Netherlands	466	444	447	4.7%	3	1%	-18	-4%	T2	D
Portugal	302	377	381	4.0%	4	1%	79	26%	D	D
Spain	1,072	1,243	1,248	13.1%	5	0%	176	16%	D	D
Sweden	173	139	139	1.5%	0	0%	-34	-20%	CS	D
United Kingdom	1,158	1,151	1,144	12.0%	-7	-1%	-15	-1%	T1	D
EU-15	**9,545**	**9,534**	**9,501**	**100.0%**	**-33**	**0%**	**-44**	**0%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 8.10 provides information on the contribution of Member States to EU recalculations in N_2O from 6B Wastewater Handling for 1990 and 2009.

Table 8.10 **6B Wastewater Handling: Contribution of MS to EU recalculations in N_2O for 1990 and 2009 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)**

	1990		2009		Main explanations
	Gg CO2 equiv.	Percent	Gg CO2 equiv.	Percent	
Austria	0	0.0	2	0.6	Update denitrification rate
Belgium	-1	-0.3	1	0.5	During the 2012 submission emissions of N2O from domestic waste water are revised for the complete time series in the Flemish region because a revision of total inhabitants in this region took place. The number of
Denmark	0	0.0	0	0.0	
Finland	0	0.0	-0.3	-0.3	Correction on protein consumption
France	16	1.1	-310	-27.1	- 6B1: Modification des rejets en azote direct et indirect des sites + modification du rendement en azote des STEP (indirect). - 6B2: Evolution du rendement en azote qui passe en 2009 de 58% à 79,5% (+37%) + modification de la population (légère) et du taux de connexion
Germany	0	0.0	0	0.0	
Greece	3	0.9	9	2.4	Updated Activity Data, Additional sub-categories
Ireland	0	0.0	0	0.0	
Italy	0	0.0	0	0.0	
Luxembourg	-0.1	-1.3	-0.2	-2.2	1990-2009: data on population as reported by Statec was streamlined with Eurostat reporting
Netherlands	16	3.5	8	1.9	Improved activity data
Portugal	2	0.5	24	4.5	1) AD updates of % population served by handling systems and type of treatment
Spain	0	0.0	-22	-1.7	Population, used as activity variable in the estimation of N2O emissions from human sewage, has been revised.
Sweden	0	0.0	3	1.9	New AD on protein consumption available
UK	-88	-7.0	-222	-16.1	Removal of double count of emissions from sewage sludge applied to agriculture.
EU-15	**-51**	**-0.5**	**-507**	**-4.9**	

8.2.3 Waste incineration (CRF Source Category 6C) (EU-15)

Source category 6C Waste incineration includes one key category: CO_2 from 6C Waste Incineration. This category includes incineration of waste, not including waste-to-energy facilities. Emissions from waste burnt for energy are reported under 1A Fuel combustion activities. Emissions from burning of agricultural wastes should be reported under 4 Agriculture.

Table 8.11 and Table 8.12 summarize greenhouse gas emission trends by Member State. CO_2 emissions from waste incineration account for 0.06 % of total EU-15 GHG emissions and decreased by 45 % between 1990 and 2010. All MS decreased their CO_2 emissions from waste incineration between 1990 and 2010, except for Greece and Sweden. The UK, Italy and Belgium had the largest decreases in absolute terms; these MS account for 28 % of the emissions from this source in 2010.

Table 8.11 6C Waste Incineration: Member States' contributions to total GHG and CO_2 emissions

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2010 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO2 emissions in 2010 (Gg)
Austria	27	2	27	2
Belgium	253	91	253	91
Denmark	0.21	0.31	IE	IE
Finland	0.00	0.00	IE	IE
France	1,861	1,540	1,737	1,436
Germany	0.00	0.00	NO	NO
Greece	0.35	4	0.22	3
Ireland	0.00	0.00	NE	NO
Italy	755	606	507	230
Luxembourg	0.00	0.00	IE	IE
Netherlands	0.00	0.00	IE	IE
Portugal	11	15	10	2
Spain	88	12	78	4
Sweden	45	109	44	104
United Kingdom	1,410	324	1,227	275
EU-15	**4,451**	**2,703**	**3,884**	**2,147**

Emissions of Denmark and Finland are included in the Energy sector.
Emissions of Luxembourg and the Netherlands are included in 1A1a
Emissions of Ireland are not reported because data for whole time series are not available.
Emissions of Germany are not reported because all waste incineration in Germany is carried out with energy recovery; for this reason, and in order to avoid double counting, the resulting emissions are reported in the energy section and CO_2 emissions from 6.C are not occurring.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 8.12 **6C Waste incineration: Member States' contributions to CO_2 emissions and information on method applied and emission factor**

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Change 2009-2010		Change 1990-2010	
	1990	2009	2010		(Gg CO2 equivalents)	(%)	(Gg CO2 equivalents)	(%)
Austria	27	4	2	0.1%	-2	-50%	-25	-92%
Belgium	253	77	91	4.2%	14	18%	-163	-64%
Denmark	IE	IE	IE	-	-	-	-	-
Finland	IE	IE	IE	-	-	-	-	-
France	1,737	1,517	1,436	66.9%	-80	-5%	-300	-17%
Germany	NO	NO	NO	-	-	-	-	-
Greece	0.22	4	3	0.1%	0	-11%	3	-
Ireland	NE	NO	NO	-	-	-	-	-
Italy	507	218	230	10.7%	12	5%	-277	-55%
Luxembourg	IE	IE	IE	-	-	-	-	-
Netherlands	IE	IE	IE	-	-	-	-	-
Portugal	10	5	2	0.1%	-3	-63%	-8	-82%
Spain	78	4	4	0.2%	0	0%	-74	-95%
Sweden	44	108	104	4.9%	-4	-4%	60	138%
United Kingdom	1,227	270	275	12.8%	4	2%	-953	-78%
EU-15	**3,884**	**2,207**	**2,147**	**100.0%**	**-60**	**-3%**	**-1,737**	**-45%**

Emissions of Denmark and Finland are included in the Energy sector.
Emissions of Luxembourg and the Netherlands are included in 1A1a.
Emissions of Ireland are not reported because data for whole time series are not available.
Emissions of Germany are not reported because all waste incineration in Germany is carried out with energy recovery; for this reason, and in order to avoid double counting, the resulting emissions are reported in the energy section and CO_2 emissions from 6.C are not occurring.

Abbreviations explained in the Chapter 'Units and abbreviations'.

8.3 Methodological issues and uncertainties (EU-15)

The following considerations address national methods and circumstances which are available in the Member States' national inventory reports. The focus is laid on the reporting categories 6A1 CH_4 emissions from managed solid waste disposal sites and 6A2 CH_4 emissions from unmanaged solid waste disposal sites since they are EU-15 key categories and contribute 1.9 % and 0.15 % of total GHG emissions, respectively. The reporting category 6B2 CH_4 emissions from domestic and commercial wastewater is a key source in the EU-15 as well and is also comprehensively analysed. Source categories 6B1, 6C and 6D are only briefly discussed.

8.3.1 Managed Solid Waste Disposal (CRF Source Category 6A1) (EU-15)

CH_4 emissions from managed solid waste disposal are key sources in all Member States. For key sources in the source category, 6A it is good practice to use the First Order Decay (FOD) method (Tier 2) to calculate the emissions and to display emissions trends over time. Almost all EU-15 Member States (with the exception of Luxembourg) applied – in line with the IPCC Good Practice Guidance – Tier 2 methodologies in order to estimate CH_4 emissions from managed solid waste disposal sites, which means that nearly 100 % of all EU-15 emissions are calculated using higher tier methods, see Table 8.2. Two Member States used a country-specific emission model in accordance with the Tier 2 methodology (Denmark and Belgium). Most remaining Member States applied the Tier 2 methodology proposed by the IPCC Good Practice Guidance and the IPCC Guidelines. Luxembourg applied the Tier 1 methodology. Table 8.13 summarizes the characteristics of the national methodologies for estimating CH_4 emissions from managed solid waste disposal sites.

Table 8.13 6A1 Managed Waste Disposal: Description of national methods used for estimating CH_4 emissions

Member State	Description of methods
Austria	For the calculation of emissions of solid waste disposal on land, IPCC Tier 2 method is applied. Where available, country-specific factors are used. If these were not available, IPCC default values are taken. [NIR 2012]
Belgium	The methodology used to calculate the emissions from solid waste disposal on land differs between the two regions in Belgium where these sites are located (Flanders and Wallonia). In the Flemish region, a combination of two models is used: a multiphase model for the estimation of emissions of the sites which are permitted and a first order decay model for all other, old waste disposal sites which are no longer permitted to dispose, but where still emissions occur after the ban of disposal on these sites (these are the solid waste disposal sites in after-care). Walloon region: The CO_2 and CH_4 emissions from solid waste disposal on land are calculated with a first order decay model that considers separately the emissions of industrial and municipal waste until 2007. This was due mainly because it was separated in the Walloon waste statistics. In 2010, Walloon waste figures have been given under another format which doesn't consider separately the amounts of industrial and municipal waste anymore. The overall methodology follows the Tier 2 IPCC methodology. No waste disposal sites are located in the Brussels region. [NIR 2012]
Denmark	The CH_4 emission at the Danish SWDSs is based on a First Order Decay (FOD) model according to an IPCC tier 2 approach (IPCC 1997, 2000 and 2006). The model calculations are performed using national statistics on landfill site characteristics and amounts of waste fractions deposited each year. In this year's submission the eight waste categories (Annex 3G, Table 3G-2.3a and b) has been assessed according to the waste types in units of mass fractions (Annex 3G, Table 3G-2.4a and h) and of individual content of degradable organic matter and half-life´s. [NIR 2012]
Finland	Finland uses a IPCC Tier 2 method as a basis for the estimation of CH_4 emissions. However Equation 5.1 from the GPG (2000) has been slightly modified, so that the term MCF (t) has been substituted by the term MCF (x) in the calculation of the methane generation potential $L_0(x)$. Calculations are not made separately for each landfill but the total waste amount and the average common MCF value for each year have been used. It has been thought that the situation in year t defines the MCF to be used for the emissions caused by waste amounts landfilled in the previous years (and degraded later in year t) as well.[NIR 2012]
France	Country-specific first order decay method consistent with IPCC Tier 2 Method by integrating data on the effectiveness of capture from biogas flared or recovered. Country-specific parameters are based on measurements. Quantities of waste landfilled are known from 1960 onwards and based on surveys from ITOMA of ADEME [NIR 2012]
Germany	IPCC Tier 2 Method used partly with IPCC default parameters, partly with CS parameters where available. [NIR 2012]
Greece	IPCC Tier 2 Method used. The estimation of methane emissions from solid waste disposal on land is based on the application of the FOD method. The method was applied separately for the managed and unmanaged waste disposal, taking account of the different conditions in those sites and the detailed information available regarding the opening and closure years of the operation of the managed sites. [NIR 2012]
Ireland	The methodology for estimating CH_4 production given in the 2006 IPCC Guidelines has been applied for use in the 2010 and subsequent submissions. In the present model analyses undertaken for both individual sites and groups of landfills, annual MCF values show an increase over time to reflect the change from generally shallow, poorly-managed landfills before 1998 (and therefore pre landfill licensing) to well controlled and engineered landfills in subsequent years. The model was applied for the five largest landfills individually and to all other landfills by assigning them to seven separate groups according to annual waste amount and life cycle. Two additional runs were used to account for sewage sludge and street cleanings. [NIR 2012]
Italy	Emission estimates from solid waste disposal on land have been carried out using the IPCC Tier 2 methodology, through the application of the First Order Decay Model (FOD). The assumption that all the landfills, both managed and unmanaged, started operation in the same year, and have the same parameters, has been considered, although characteristics of individual sites can vary substantially. [NIR 2012]

Member State	Description of methods
Luxembourg	The spreadsheet implementing the Tier 1 methodology from the 2006 IPCC Guidelines for national greenhouse gas inventories has been used. Following the recommendations of the in-country review of 2008 and the centralized review of 2009, the calculation was made since 1950 and also taking into account the pre-treatment of waste before being landfilled. In 2009, the Environment Agency conducted two studies: 1) Composition of the high caloric fraction from SIDEC and 2) Emissions of the waste deposited at the MSW landfills. In 2011 the study "Emissions of the waste deposited at the MSW landfills" was refined for the period 2004-2007, calculated for the years 2008 and 2009 and extrapolated for the years 2010 to 2030. [NIR 2012]
Netherlands	In order to calculate the CH_4 emissions from all the landfill sites in the Netherlands, the simplifying assumption was made that all the wastes are assumed to be landfilled on one landfill site, an action that started in 1945. However, characteristics of individual sites vary substantially. CH_4 emissions from this 'national landfill' are then calculated using a first-order decomposition model (first-order decay function) with an annual input of the total amounts deposited and the characteristics of the land-filled waste and the amount of landfill gas extracted. This is equivalent to the IPCC Tier 2 methodology. Since the CH_4 emissions from landfills are a key source, the present methodology is in line with the IPCC Good Practice Guidance. [NIR 2012]
Portugal	To better take into account to the fact that CH_4 emissions from SWDS occur over a long period of time and not immediately after disposal of waste on land, the methodological approach considered was the First Order Decay Method (Tier 2). [NIR 2012]
Spain	IPCC Tier 2 Method is used. Estimation parameters are partly taken from country-specific data as provided by landfill operators as well as from IPCC default parameters. [NIR 2012]
Sweden	Methane emissions have been calculated by using the IPCC default model and the IPCC First Order Decay (FOD) model respectively. The two methods are not really comparable. The FOD model, on the other hand, uses a time factor representing the delay in methane production, which results in a slower decrease of emitted methane. The estimates of the FOD model are used in the Swedish National GHG Inventory. [NIR 2012]
United Kingdom	The UK approach to calculating emissions of methane from landfills uses a "Tier 2" methodology based national data on waste quantities, composition, properties and disposal practices over several decades. The equations for calculating methane generation use a first-order decay (FOD) methodology.The The UK revised the model used to estimate emissions from the managed waste disposal on land in 2008. The new model (MELMod-UK) offers considerable advantages to the user in terms of transparency of approach, utility and ease of use. [NIR 2012]

Source: NIR 2012

The Tier 2 FOD method requires data on current as well as historic waste quantities, composition and disposal practices for several decades. In the following, a detailed overview of the most important parameters and methodological aspects of the FOD method applied by the Member States is presented. The main factors influencing the quantity of CH_4 produced are the amount of waste disposed of on land and the concentration of biodegradable C in that waste.

Amount of waste disposed on SWDS: The FOD method requires historic data on waste generation over decades but it is difficult to achieve consistent time series for the activity data over such long periods. The data sources used for generating time series of activity data by the Member States are summarized in Table 8.14.

Table 8.14 6A1 Managed Solid Waste Disposal: Data sources used for generating time series of activity data

Member State	Data sources used for generating time series (6A1)
Austria	Data for 2008 was (for the first time) taken from the EDM (Electronic Data Management), administered by the BMLFUW. This is due to the fact that since the beginning of 2009 landfill operators are obliged to register their data (waste input-output

Member State	Data sources used for generating time series (6A1)
	report) directly and electronically (per upload) at the portal of **http://edm.gv.at**. For 2009 no data has been reported any more. From 1998 to 2007 data were taken from the database for solid waste disposals “Deponiedatenbank” (“Austrian landfill database”) – a database, administered and maintained by the Umweltbundesamt until the end of 2008. From 1950 to 1997 the amounts of deposited residual waste were taken from national studies (HACKL & MAUSCHITZ 1999, UMWELTBUNDESAMT 2001c) and the respective Federal Waste Management Plans BUNDESABFALLWIRTSCHAFTPLAN 1995, 2001). However, the amount of waste from administrative facilities of industry is not considered (data from 1950 to 1999), whereas it is included in the Deponiedatenbank (“Austrian landfill database”), which is used for the activity data from 1998 onwards. The quantities of “non residual waste” from 1998 to 2007 were taken from the database for solid waste disposals “Deponiedatenbank” (“Austrian landfill database”). For the years 2008, 2009 and 2010 the quantities were taken from the EDM (Electronic Data Management). Only the amounts of waste with biodegradable lots were considered. There are no data available for the years before 1998. Thus extrapolation was done using the Austrian GDP (gross domestic product) per inhabitant as indicator. [NIR 2012]
Belgium	In the Walloon region the quantity of waste disposed comes from the statistics of OWD (Walloon Waste Office). Until 2009, it published each year the industrial and municipal waste disposed, based on the taxes declaration forms covering 50 solid waste disposal sites of various sizes. For 2009 data, industrial and municipal waste were gathered and there was only 33 SWDS in activity. Those statistics are available on a yearly basis since 1994. For the years before, the amounts have been estimated using available data and OWD expert judgement assumptions. In the Flemish region input data of waste disposal sites are available since 1990. The main source of data collection and information is originating from the public Flemish institute for waste management (OVAM). There is no waste disposal site in the Brussels region. [NIR 2012]
Denmark	The data used for the amounts of municipal solid waste deposited at managed solid waste disposal sites are (according to the official registration) worked out by the Danish Environmental Protection Agency (DEPA) in the so-called ISAG database. The ISAG data system provides landfill data for the years 1994-2009 [NIR 2012]
Finland	Activity data for the time series is taken from different sources: The VAHTI database contains data on the total amounts of waste taken to landfills from 1997 onwards. Corresponding data for the years 1992-1996 were collected to the Landfill Registry of the Finish Environment Institute. The activity data for municipal waste for the year 1990 is based on the estimates of the Advisory Board for Waste Management (1992) for municipal solid waste generation and treatment in Finland in 1989. The disposal data (amount and composition) at the beginning of 1990s for industrial, construction and demolition waste are based on surveys and research by Statistics Finland, VTT Technical Research Centre of Finland and National Board of Waters and the Environment. Estimated data on waste amounts before the year 1990 is based on a report by VTT. [NIR 2012]
France	Quantities of waste landfilled are known from 1960 onwards and based on surveys called ‘ITOMA’ made by ADEME. [NIR 2012]
Germany	The amount of landfilled municipal waste is taken from the Federal Statistics Office (1975 – 2004). The surveys of waste quantities commenced in 1975 on the basis of the Environmental Statistics Act in 1974. Waste quantities for the period from 1950 to 1975 were extrapolated on the basis of population data. Landfilled wastes after 1 June 2005 must not, according to the legislation, contain biodegradable components and do not, therefore, contribute to the generation of landfill gas. Data for landfilled waste in the former GDR in the 1980ies were provided by a national study. According to that study the amount of landfilled waste per capita was significantly lower than in the old German Länder (190 kg/capita versus 330 kg/capita). For the years 1990 and 1993 for the new German Länder detailed data about landfilled municipal solid waste is available. Since 1996, differentiated data is available on landfilled quantities of individual fractions of industrial waste. The amount of landfilled industrial waste between 1975 and 1996 was derived on the basis of the overall amount of landfilled waste. The amount of landfilled industrial waste is kept constant between 1950 and 1975. Data on landfilled sludges from municipal and industrial wastewater treatment is available since 1975 for the Old German Länder and was extrapolated for the time period before 1975 based on population data as well as on the assumption that the amount of sludges from industrial wastewater remained constant. [NIR 2012]
Greece	Estimates on solid waste quantities generated are included in various reports from research programmes and studies, but refer to specific points in time rather than to a whole period, while different assumptions have been applied in each case for the estimation of quantities generated. Therefore, data for some years are either missing or are unreliable. The quantities of municipal solid wastes for the period 1960-2000 was estimated on the basis of population figures and coherent assumptions

Member State	Data sources used for generating time series (6A1)
	regarding generation rates per capita and day, in order to derive complete time series for waste quantities generated. For the rest of the period 2001-2010 more accurate data for the quantities of municipal solid wastes was used as they were provided by the waste management sector of the Ministry of Environment, Energy and Climate Change (MEECC). For the estimation of the quantities of municipal solid wastes the method was used in previous submission were based on the assumption that MSW generation rates was in the order of 0.8 – 1.1 kg/ capita and day, depending on the type of region (rural, semi-urban, urban, large urban regions) in 1997. According to the Ministry of Environment, Energy and Climate Change (MEECC) the MSW generation rate was assumed to change annually by 0.028 kg/ capita and day, while a higher figure (annual increase by 0.035 kg/capita and day) was assumed for the regions of Athens, Central Macedonia, Crete and the islands of South Aegean. A higher figure for MSW generation rate (2.1 kg/ capita and day) was considered for foreign visitors. For the period 1960 – 1990 the rates of annual per capita waste increase are lower (0.8% - 1.5% depending on the region). [NIR 2012]
Ireland	The EPA commenced the development of the National Waste Database (NWD) in the early 1990s to address a severe lack of information on waste production and waste management practices in Ireland. The database was needed to support radical reform of national policy and legislation on waste pursuant to the Waste Management Act of 1996 and subsequent Government strategies on sustainable development (DELG, 1997) and waste management (DELG, 1998). National statistics generated from this database published on a three-year cycle, and interim reports published on a yearly basis since 2001 by the EPA are the primary basis for establishing the historical time-series of municipal solid waste (MSW) placed in landfills from 1995 onwards. Identification and risk assessment of historical landfills under S.I. No. 524 of 2008 (DEHLG, 2008) serves as the main source of information on landfilling of waste prior to 1995. The results of other surveys undertaken in previous years (Boyle, 1987, ERL, 1993, MCOS, 1994 and DOE, 1994) have also been used to some extent in compiling the MSW time-series. [NIR 2012]
Italy	Basic data on waste production and landfills system used for the emission inventory are those provided by the Waste Cadastre. The Waste Cadastre is formed by a national branch, hosted by ISPRA, and by regional and provincial branches. The basic information for the Cadastre is mainly represented by the data reported through the Uniform Statement Format (MUD), complemented by those provided by regional permits, provincial communications and by registrations in the national register of companies involved in waste management activities. Since 1999, ISPRA yearly publishes a report, in which waste production data, as well as data concerning landfilling, incineration, composting and generally waste life-cycle data, are reported. It has been assumed that waste landfilling started in 1950. The complete database from 1975 of waste production, waste disposal in managed and unmanaged landfills and sludge disposal in landfills is reconstructed on the basis of different sources, national legislation and regression models based on population. Since waste production data are not available before 1975, they have been reconstructed on the basis of proxy variables. Gross Domestic Product data have been collected from 1950 and a correlation function between GDP and waste production has been derived from 1975; thus, the exponential equation has been applied from 1975 back to 1950. Consequently the amount of waste disposed into landfills has been estimated, assuming that from 1975 backwards the percentage of waste landfilled is constant and equal to 80%. The amount of waste disposed in managed landfills is yearly provided by the national Waste Cadastre since 1995. The time series has been reconstructed backwards on the basis of several studies reporting data available for 1973, 1988, 1991, 1994 (Tecneco, 1972; MATTM, several years). In non hazardous landfills industrial wastes assimilated to municipal solid waste (AMSW) could be disposed. Their composition must be comparable to municipal solid waste composition. From 2001, data on industrial waste disposed in municipal landfills are available from Waste Cadastre. For previous years, assimilated municipal solid waste production has been reconstructed, and the same percentage of MSW disposed in landfill has been applied also to AMSW.Apart from municipal solid waste, sludge from urban wastewater handling plants has also been considered. Sludge disposed in landfill sites has been estimated from the equivalent inhabitants treated in wastewater treatment plants, distinguished in primary and secondary plants, applying the specific per capita sludge production. The total amount of sludge per year can be treated by incineration or composting, or once digested disposed to soil for agricultural purpose or to landfills. As for the waste production, also sludge landfilled has been reconstructed from 1950. Starting from the number of wastewater treatment plants in Italy in 1950, 1960, 1970 and 1980, the equivalent inhabitants have been derived and consequently the amount of sludge disposed in landfill sites, assuming 80 kg $inhab.^{-1}$ yr^{-1} sludge production. [NIR 2012]
Luxembourg	Activity data were calculated in accordance to the MSW produced per capita/year. Data on the population are from STATEC. No national data on municipal waste production from 1950 to 1989 were available. Data from Germany for the years 1950 and 1975 were used. Data in-between were interpolated. Data for Luxembourg for the year 1990 were available (581 kg) which were nearly identical to the IPPC default values (560 kg). Data up to the year 2010 were from the Environment Agency taking into account the effect of aerobic decomposition at SIGRE since 1993 and at SIDEC since 2007. [NIR 2012]

Member State	Data sources used for generating time series (6A1)
Netherlands	The amount of waste disposed on landfill sites are mainly based on the annual survey performed by the Working Group on Waste Registration at all the landfill sites in the Netherlands. The data can be found in the Internet; a corresponding documentation is also available, which contains the amount of methane recovered from landfill sites yearly. [NIR 2012]
Portugal	Since 1999, data on MSW is available, including production amounts, final disposal and, to a less extent, waste composition. For previous years information was available from the Strategic Plan on Municipal Solid Waste which was approved by the Government in 1997. This plan includes data from annual municipal registries. Another source of information is a research study performed by Quercus. The data was based on a survey performed in 1994, which enabled the calculation of per capita generation rates for 1994, based on the amounts of waste collected and the population served by waste collection. Before 1994, data on landfill wastes had to be estimated based on expert judgment for waste generation growth rates. For the period 1960-1980 it was considered a per capita waste generation growth rate of 2.5% per year; for the following years (1980-1994) 3% per year. To take into account the fact that part of the population (rural areas) was not served by an organised waste collection and waste disposal system, values of annual production were multiplied by the percentage of population served by waste collection in each municipality. After 2000, it was assumed that all the population of the country is served by waste collecting systems. The total amount of waste disposed to SWDS was then calculated based on this estimated value minus the amounts of waste incinerated and composted. The share of final disposal destiny for the first years of the time series was calculated having as a basis the Quercus survey. Data for recent years (mainly since 1999) refer to data collected from management systems. [NIR 2012]
Spain	From 1990 onwards, the information is provided directly by the Ministry of the Environment (MMA) in the publication, "The Environment in Spain". For large SWDS and those with biogas recovery, the AD is derived from questionnaires provided by each landfill. For the calculation of emissions, the MSW quantities to consider are those deposited since 1970. In the period from 1970 to 1990, the calculation of the waste deposited at managed SWDS without biogas capture and unmanaged SWDS has been estimated by multiplying the coefficient of MSW generation per inhabitant and day, by the population, the number of days in the year and the fraction of MSW generated that is deposited in each type of landfill. In 2010, 36 landfills operated with landfill gas capture. [NIR 2012]
Sweden	Household waste: A first national survey was elaborated by EPA in 1980, similar data in 1985 and 1990 and 1994 were provided by Statistics Sweden, since 1994 an annual survey on landfilled waste is carried out by Avfall Sverige – Swedish Waste Management. Figures on sludge from wastewater treatment and garden waste are available since 1990. Industrial waste: There is information on industrial waste from the 1980s but organic fractions were not specified. Studies on quantities and treatment of organic waste from industry in 1993 and 1996 were carried out by the Swedish EPA. Landfilled wastewater sludge from the pulp industry (important waste fraction) was yearly documented until 2000 by the Swedish EPA. Today the sludge from the pulp industry is incinerated and composted. Since 2006 waste statistics are reported to the EU. The treatment of waste is to be reported by treatment method for the different types of waste according to EWC-Stat. The method of treatment relates to various recovery and disposal operations ("R and D codes") are compiled into 5 different groups. Group 4, "Disposal operations: Land filling, deep injection, sur-face impoundment, permanent storage and others", is relevant for "Solid waste disposal on land, CRF 6A". So far, waste data has been reported for the reference years 2004, 2006 and 2008. No waste statistics on landfilling are compiled for the intermediate years by SEPA. In 2010, a study was carried out in order to analyze possibilities to use the reported waste data to WStatR for the calculations of CH_4 from solid waste land-fills. The study recommended implementation of WStatR-data from reference year 2006 and onwards. [NIR 2012]
United Kingdom	Estimates of waste composition and quantities have been taken from different sources – prior to 1995 they are from Brown *et al.* (1999), prior to 2000 they are based on the LQM (2003) study and from 1995 they are based on new information compiled by Eunomia (Eunomia, 2011). The new waste to landfill data indicates a significant decrease in the amount of LA-controlled and C&I waste sent to landfill since about 2002 and 2003. [NIR 2012]

Source: NIR 2012

Some Member States explicitly describe the consistency of their time series (compare Table 8.15).

Table 8.15 6A1 Managed Solid Waste Disposal: Consistency of time series of activity data

Member State	Consistency of time series

Member State	Consistency of time series
Austria	In the national study (HACKL & MAUSCHITZ 1999) as well as in the Federal Waste Management Plans the amounts of residual waste from administrative facilities of businesses and industries were not considered and therefore originally not included in the data of the years 1950 to 1999. Waste from these sources is however deposited and hence reported by the operators of landfill sites (therefore included in the Austrian landfill database) and thus considered in the time series from 1998 onwards. To achieve a consistent time series, data of the two overlapping years (1998 and 1999) were examined and the difference – which represents the residual waste from administrative facilities of industries and businesses – was calculated. This difference, relative to the change of residual waste from households, was then applied to the years 1950 to 1997 accordingly. There is no explicit description of time series consistency for non-residual waste. [NIR 2012]
Belgium	In the Flemish region input data of waste disposal sites are available since 1990. There is no waste disposal site in the Brussels region. In Wallonia, complete statistics on the amount of waste input in solid waste disposal sites are delivered on a yearly basis since 1994. For the previous years, the amounts have been estimated using available data and expert judgement from the waste offices. [NIR 2012]
Denmark	Registration of the amount of waste has been carried out since the beginning of the 1990s in order to measure the effects of action plans. The activity data is, therefore, considered to be consistently long enough to make the activity data input to the FOD model reliable. The consistency of the emissions and the emission factor is a result of the same methodology and the same model used for the whole time series. The parameters in the FOD model are the same for the whole time series. [NIR 2012]
Finland	In Finland, the historical waste amount is assessed starting from the year 1900. The uncertainties in historical activity data (estimated on the basis of different weighting of the population and GDP that are assumed to be good indicators of the amount of waste) are large but the amount of waste produced at the beginning of the 1900's was fairly small, thus reducing the significance of large uncertainties. The uncertainty estimates of the current amounts of waste are based on differences between different statistics and complemented with expert judgment. In the case of municipal sludge, the uncertainties in both historical and current activity data are quite large. On the other hand, the amount of industrial waste can be fairly accurately estimated based on industrial production, and therefore these uncertainties are the smallest in historical years. In Finland, the amount of landfill gas recovered is obtained from the Finnish Biogas Plant Register, and this figure is considered accurate. An interesting note is that methane recovery describes the reduction of emissions compared with the situation where gas is emitted. In this case, the emission reduction is accurately known, though total emissions contain higher uncertainties. [NIR 2012]
France	Since 1985, ADEME ensures completeness of the surveys by providing adjustments if necessary. Surveys are not available for each year, so interpolations are made. The CITEPA also conducts internal audits on the series consistency over time. [NIR 2012]
Germany	Over the long activity-data period involved, thirty years, time series inconsistencies are inevitable. In Germany, such inconsistencies are primarily a result of German reunification and the fusion of two different economic and statistical systems. Further aspects are changes of legislation and statistics in the waste sector. [NIR 2012]
Greece	The time-series consistency of emissions is controlled by applying consistent methodologies and verified activity data in line with IPCC guidelines. In case of changes or refinements in methodologies and EFs based on plant-specific data time-series consistency is ensured by performing recalculations according to the IPCC good practice guidance.[NIR 2012]
Ireland	The methodologies used in the derivation of emissions estimates from the waste sector are consistent over the time-series. In the case of category 6.A, this consistency applies to all three components that determine the ultimate emissions, i.e. CH_4 generation, CH_4 flared and CH_4 utilized. Adoption of the model in the 2006 IPCC Guidelines is justified by the information available for its detailed application and brings Ireland into line with other Parties using this methodology well in advance of the expected mandatory use of these guidelines for inventory reporting post-2012. [NIR 2012]
Italy	No detailed description of time series consistency. [NIR 2012]
Luxembourg	No information available. [NIR 2012]
Netherlands	The estimates for all years are calculated from the same model, which means that the methodology is consistent throughout the time-series. The time-series consistency of the activity data is very good due to the continuity in the data provided. [NIR 2012]
Portugal	No detailed description of time series consistency. [NIR 2012]

Member State	Consistency of time series
Spain	Approaches in line with IPCC Good Practice Guidance are used for the activity data. Detailed descriptions are provided how some of the estimation parameters such as DOC have been interpolated. [NIR 2012]
Sweden	The times series in the waste sector are calculated consistently, and when statistics are not produced annually, interpolation and extrapolation have been necessary tools for imputation. [NIR 2012]
United Kingdom	The estimates for all years have been calculated from the MELmod model and thus the methodology is consistent throughout the time series. Estimates of waste composition and quantities have been taken from different sources – prior to 1995 they are from Brown *et al.* (1999), prior to 2000 they are based on the LQM (2003) study and from 1995 they are based on new information compiled by Eunomia (Eunomia, 2011). [NIR 2012]

Source: NIR 2012

The amount of waste disposed on SWDS depends on the one hand on the total amount of waste generated and on the per capita waste generation rate, respectively. However, solid waste disposal in EU Member States is not estimated based on the per capita waste generation rate; the waste generation rate is not a parameter used in the higher tier emission estimation. All Member States are using higher tier methods for the estimation of emissions from solid waste disposal, based on national statistics of solid waste disposal on waste disposal sites (see Table 8.2).

In the additional information box of the CRF tables, the waste generation rate is not very well defined. No clear definition is available on which waste fractions should be included for comparability; neither the UNFCCC reporting guidelines, nor the CRF, nor the IPCC Guidelines provide an exact definition which waste types and waste streams should be included in the estimation of the waste generation rate.

In the case of Austria considerable amounts of composting is reported under 6D (other), which means that the composted waste amounts are excluded from 6A. Between 2008 and 2009, the waste generation rate in Austria as reported in CRF table 6A,C decreased from 0.15 kg/capita/day to 0.08 kg/capita/day. This decline is due to a drop in the amount of annual municipal waste at the solid waste disposal site of 43 % in 2008-2009 while the population remained at the same level than reported for the year before. Since 2009, no further deposition of waste directly without any pre-treatment occurred any more in four of the nine Austrian provinces where this was still allowed until the end of 2008. For Spain large number of tourists increase the waste amounts, but are not reflected in the population numbers.

It is difficult, though, to explain the differences for all Member States from the information available in the NIR. Because of the different coverage of wastes included, the waste generation rate reported does not reflect policies and measures to reduce waste generation.

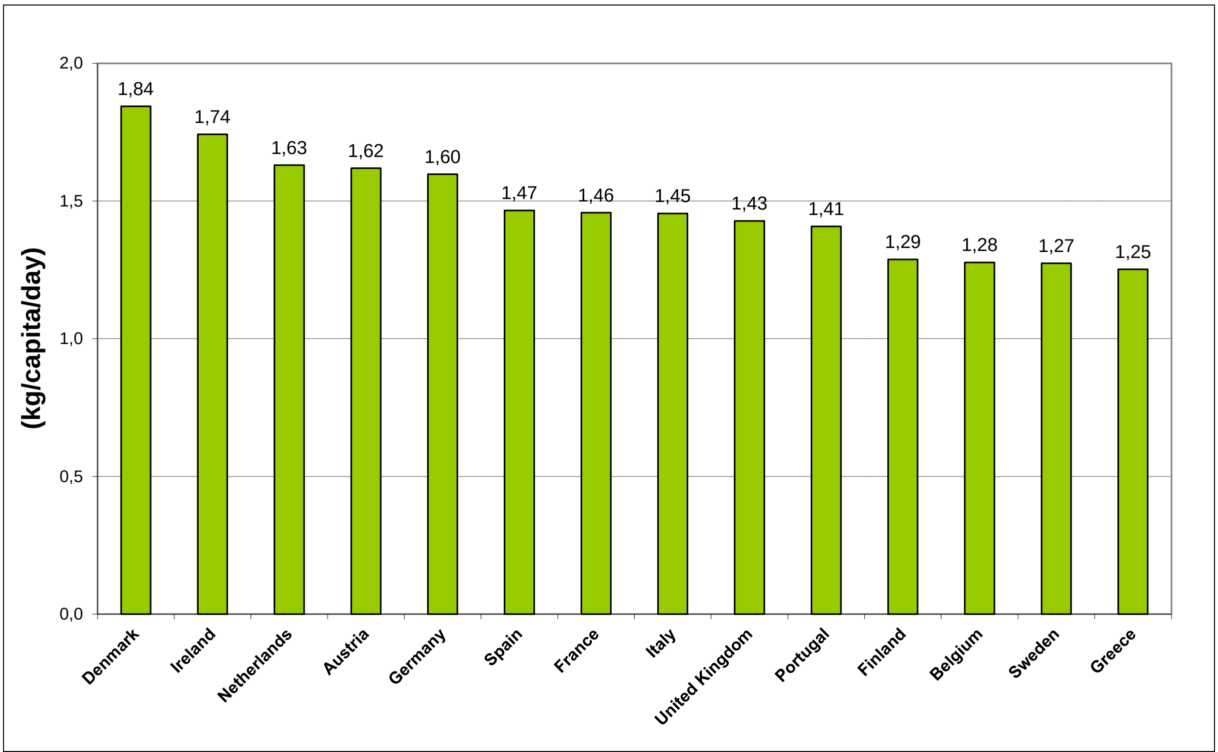
To understand the background of the differences in the MS a decomposition analysis of this parameter would be necessary, but some explanation for the differences are poorly monitored, such as the links between the waste generation and public awareness on waste or the quantified share of waste generated by tourists in tourist destination.

Therefore, Figure 8.3 shows the waste generation rate for EU-15 MS for 2010 based on the homogenous data source EUROSTAT: On the basis of the Regulation on waste statistics (EC) No.

2150/2002, amended by Commission Regulation (EU) No. 849/2010, data on the generation and treatment of waste is collected from the Member States. The information on waste generation has a breakdown in sources (several business activities according to the NACE classification and household activities) and in waste categories (according to the European Waste Classification for statistical purposes). The information on waste treatment is broken down to five treatment types (recovery, incineration with energy recovery, other incineration, disposal on land and land treatment) and in waste categories.

The waste generation rate per capita varies only slightly among the EU-15 Member States, from 1.25 kg/capita/day for Greece to 1.84 kg/capita/day for Denmark.

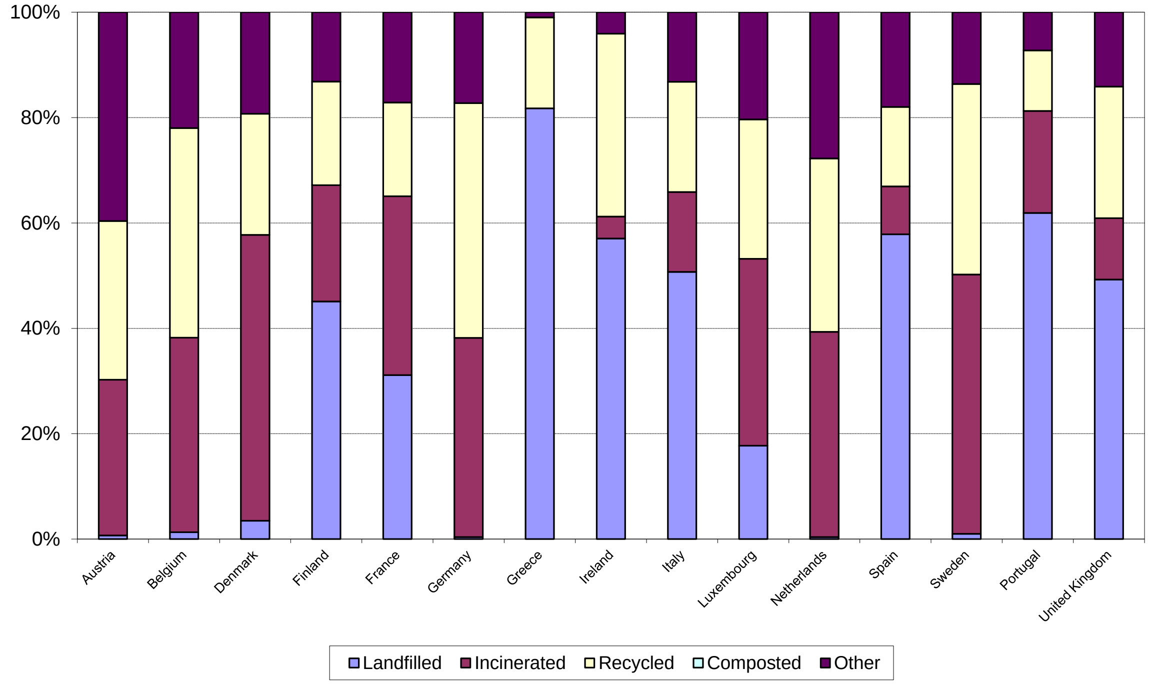
Figure 8.3 6A1 Managed Waste Disposal: Waste Generation Rate, 2010



Source: EUROSTAT 2012

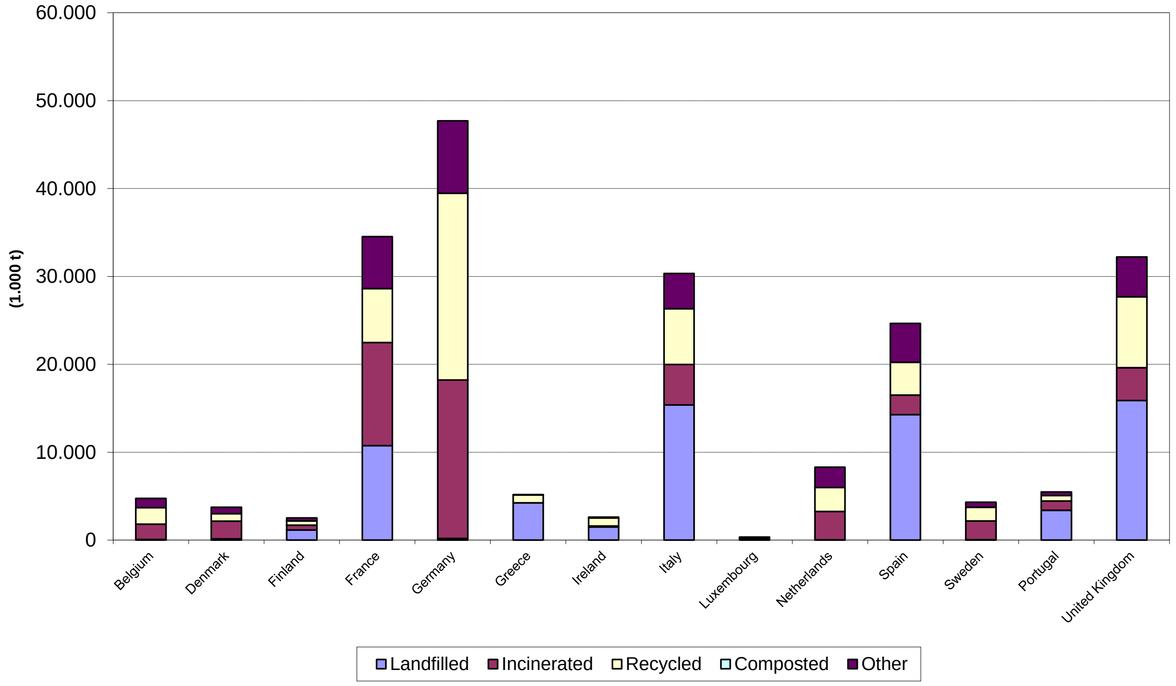
On the other hand the amount of waste generated on SWDS is strongly influenced by the waste management practices of the individual Member States: by the share of waste landfilled, incinerated, recycled and treated in other ways (including composting), compare Figure 8.4 and Figure 8.5.

Figure 8.4 **6A1 Managed Waste Disposal: Waste management practices in the EU-15 (shares) in 2010**



Source: EUROSTAT 2012

Figure 8.5 **6A1 Managed Waste Disposal: Waste management practices in the EU-15 (absolute values) in 2010**



Source: EUROSTAT 2012

Many Member States experienced a reduction of waste landfilled and an increase of amounts of waste recycled, composted and an increased recovery of landfill gas. Both trends have already taken place before the Landfill Directive and the Directive on packaging waste, but are further supported by these directives.

The waste management practices and policies which determine the fraction of MSW disposed to SWDS, the fraction of waste incinerated and the fraction of waste recycled differ significantly among the Member States. For example, disposing waste on SWDS is the predominant waste disposal route in Greece and Ireland with correspondingly few quantities of waste incinerated and recycled in these countries. The low share for incineration in the EU-15 especially in Greece is also due to considerable public concern over the use of large-scale waste incineration. In Germany, Denmark and the Netherlands it is vice versa. Since 2005, landfills in Germany remaining in operation may only store waste that conforms to strict categorization criteria. Landfills also must reduce landfill-gas formation from such waste by more than 90 % with respect to gas from untreated waste. In the Netherlands, waste policy also has the aim of reducing landfilling by introducing bans for the landfilling of certain categories of waste, e.g. the organic fraction of household waste (in the early 1990s) and by raising the landfill tariff to comply with the incineration of waste.

The amount of methane generated on SWDS depends on the Methane Correction Factor, the fraction of dissolved organic carbon (DOC) dissimilated, the fraction by volume of CH_4 in landfill gas and the waste composition, more precisely the fraction of DOC in waste. While the first three parameters do not vary strongly among the Member States, more information is provided on the DOC (Figure 8.6 and Table 8.17) as well on waste composition of land filled waste (Table 8.16). The latter parameters are again strongly influenced by waste management practices and policies.

Table 8.16 6A1 Managed Solid Waste Disposal: Waste composition of landfilled waste

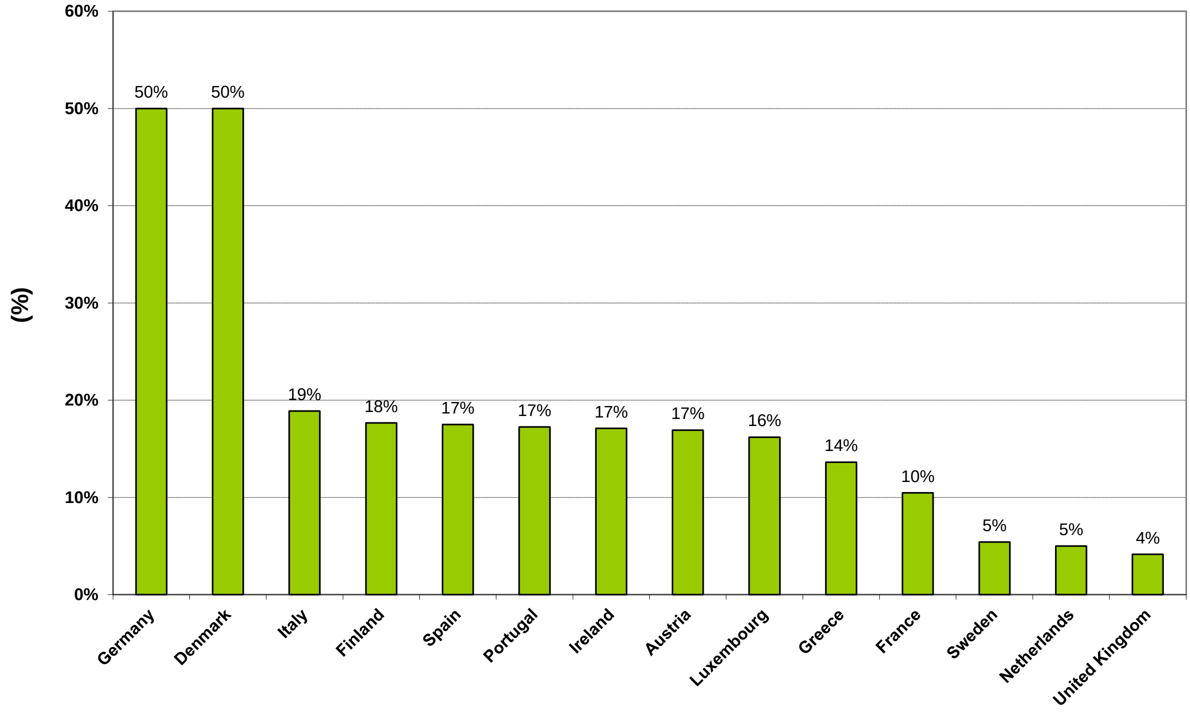
Member State	Composition of landfilled waste
Austria	Landfilled waste is differentiated in "residual waste" and ""non residual waste" (bulky waste, construction, mixed industrial waste, road sweeping, sewage sludge, rakings, residual matter from waste treatment). Detailed values such as for the half life period, DOC, and DOC_F are available for these waste types. The composition of residual waste is specified according to different waste fractions. [NIR 2012]
Belgium	Waste types are differentiated into municipal and industrial categories as well as into several sub categories. Several values for DOC, DOC_F and k are given. [NIR 2012]
Denmark	The following waste types are taken into consideration: Domestic waste, bulky waste, garden waste, commercial & office waste, industrial waste, building & construction waste, sludge, ash & slag. As material fraction the following types are differentiated: Waste food, cardboard, paper, wet cardboard and paper, plastics, other combustibles, glass and other non-combustibles. [NIR 2012]
Finland	Solid municipal waste, municipal sludge, industrial sludge, solid industrial waste, construction and demolition waste, industrial and municipal inert waste, and other inert waste are considered as waste groups. These groups are further split into several subgroups. The composition of solid municipal waste is paper, food, garden, plastics, glass, textiles, napkins, wood other (inter) and other (organic). Detailed DOC values are provided in the NIR. [NIR 2012]
France	The method used differentiates between easily biodegradable, average degradable and weakly biodegradable waste. [NIR 2012].
Germany	Several studies on the waste composition were evaluated. The analysis for the Old German Länder was performed for different waste types: household waste (organic material, paper/cardboard, composites, textiles, diapers, and wood), commercial waste, and bulky waste (organic material, paper/cardboard, textiles, and wood). For the former GDR waste fractions were taken from a study. According to that study, household waste in the GDR was composed of vegetable waste, paper/cardboard, wood, rubber, composites as well as textiles. [NIR 2012]
Greece	Accurate data on the composition of municipal solid waste generated at national level are not available, as a comprehensive analysis at national scale covering a complete time period (so as to take into account seasonal variations because of tourist activity) has not been accomplished yet. However, measurements in some regions have been carried out, although they refer to different time periods (e.g. ULAPA 1996, MEECC 1999).The composition of generated MSW comprises the following fractions: Putrescibles, textiles, wood, paper, plastics, metals, glass, and

Member State	Composition of landfilled waste
	rest. [NIR 2012]
Ireland	Waste constituents of MSW that contribute to DOC are food waste, paper, wood, textiles and disposable. Furthermore, street cleanings and sludge from municipal wastewater treatment are considered.[NIR 2012]
Italy	An in-depth survey has been carried out, in order to diversify waste composition over the years. A fourth slot (2006-2009) has been individuated on the basis of the analysis of several regional waste composition and the analysis of waste disposed into non hazardous landfills specified by CER code for the year 2007, available from Waste Cadastre database (ISPRA, 2010). The following waste fractions are considered: organic, garden and park waste, paper and paperboard, nappies, textiles and leather, sludge and wood. [NIR 2012]
Luxembourg	Waste composition is exactly known since 1992. The data from the national waste composition analyse 1992/94 were used till 2003. For the years 2004 to 2009 the data from the 2011 study were used taking into account the aerobic pre-treatment before landfilling. For 2010 values of the composition of the waste are as of 2009. For the years before 1992 no data are available. Luxembourg oriented its values near the IPPC default values but some changes were made: 1950-1974 it is assumed that the fractions "food", "paper" and "wood" landfilled were lower. The difference was allocated to the fraction "plastics, other inert" waste. For the years before 1992 no data are available. Waste composition comprises the following fractions: Food, Garden, Paper, Wood, Textile, Nappies and Plastics, other inert. [NIR 2012]
Netherlands	An average DOC value for waste as a whole is provided, but changes over time due to such factors as the prohibition of land filling of combustible wastes. [NIR 2012]
Portugal	SWDS include solid municipal or urban waste (household, garden, commercial-services wastes) and industrial wastes. For the fermentable fractions of urban waste the following categories apply: paper and textiles, non-food fermentable materials, food waste, and wood or straw. For industrial waste several groups exist: paper and textiles, garden waste, park waste or other non-food organic putrescibles, food waste, wood or straw, fuels, plastics, sludge from natural origin, sludge from non-natural origin or hydrocarbons, synthetic fibres, and non-natural organic substances.([NIR 2012]
Spain	The composition of municipal solid waste comprises the following categories: organic matter, paper and cardboard, plastics, glass, ferrous metals, non-ferrous metals, wood, textiles, rubber and latex, disposable and rechargeable batteries, other. For waste from origins other than direct household collection, other categories apply: compost, waste water sludge and others. Specific information on the waste composition is provided based on questionnaires by plant operators. [NIR 2012]
Sweden	Landfilled waste includes includes household and similar waste, park and garden waste, industry- and non-industry specific waste (organic fractions), industry- and non-industry specific waste (organic and inorganic fractions), construction and demolition waste (organic and inorganic fractions) and sludge from wastewater handling and pulp industry.Deposited waste is further broken down into different waste fractions for household and industrial wastes. [NIR 2012]
United Kingdom	The UK method divides the waste stream into four categories of waste: rapidly degrading, moderately degrading, slowly degrading, and inert. As recommended in the Good Practice Guidance, the estimates of waste disposal quantities include commercial and industrial waste, demolition and construction waste, sewage sludge disposal to landfill as well as municipal waste. [NIR 2012]

Source: NIR 2012

Fraction of Dissolved Organic Carbon (DOC) in MSW: The DOC content of landfill waste is based on the composition of waste and can be calculated from a weighted average of the carbon content of various components of the waste stream. Different countries are known to have MSW with widely differing waste compositions. While the average DOC value in MSW are illustrated in Figure 8.6, Table 8.17 provides corresponding detailed information on the DOC values extracted from the NIR.

Figure 8.6 **6A1 Managed Solid Waste Disposal: Fraction of DOC in MSW**



Source: CRF 2012 Table 6A,C Additional information.

Table 8.17 **6A1 Managed Solid Waste Disposal: Further information on DOC values**

Member State	Further information on DOC values
Austria	Detailed values for DOC_F and DOC differentiated with respect to the waste type are available in the NIR. A time series of bio-degradable organic carbon content of directly deposited residual waste is indicated for the years 1950 to 2008. [NIR 2012]
Belgium	Municipal waste is divided into 10 main fractions during sorting analysis in the Flemish region. These analyses were carried out in 1985, 1993-1994, 1994-1995 and 1995-1996 by the Flemish institute OVAM. These fractions are connected to 1 of the 3 biodegradation rates (quick, average and slow). The biodegradable fractions of rough waste on the solid waste disposal sites are (analyses carried out in 1995): paper and carton: 3%, trim wood (from gardening): 10%, wood (construction & demolition, furniture): 20% textile: 6%. The DOC values in the Walloon region for municipal and industrial waste were calculated using the detailed waste types from OWD and the IPCC Good Practice Guidance methodology This detailed estimation led to a complete recalculation, as the new estimated DOC were much lower than the default value previously used. In 2008, municipal and industrial waste values have been gathered in the Walloon statistics. Linear interpolation is used to estimate the intermediate values of DOC. [NIR 2012]
Denmark	For the following categories, investigations of DOC content have been carried out for Danish conditions: waste food, cardboard, paper, wet cardboard and paper, plastics, other combustibles, glass, other non-combustible. [NIR 2012]
Finland	DOC fractions of different types of waste are based on the IPCC default values, expert knowledge and national research data. DOC values of groups (solid municipal waste, municipal and industrial sludge (from dry matter), solid industrial waste, construction and demolition waste, industrial inert waste, and other inert waste) and of subgroups are provided in the NIR. [NIR 2012]
France	The OMINEA report (February 2012) fixes an average DOC of 150 kg/t for the easily degradable waste, 75 kg/ton is used for the average degradable waste and 0 for the weakly degradable wastes. The annual average DOC varies between 102 and 110 kg/ton. [NIR 2012]
Germany	For the DOC national and IPCC default factors were used. The following values were chosen: Organic material: 18%, garden and park waste: 20%, paper and cardboard: 40%, wood and straw: 43%, textiles: 24%, diapers: 24%,

Member State	Further information on DOC values
	composites: 10%, sludges from wastewater treatment: 50%, waste from MBT facilities 2.3%. [NIR 2012]
Greece	Time series of total amounts of DOC for waste on managed and unmanaged waste disposal sites as well as of sludge are provided. Degradable organic carbon (DOC): 0.4 for paper and textiles (default value), 0.3 for wood (default value), 0.15 for food waste (default value) and 0.4 for sewage sludge. [NIR 2012]
Ireland	The waste constituents of MSW that contribute to DOC are food waste, paper, wood, textiles and disposable nappies are identified in the available NWD breakdown for 1995, 1998, and 2001 through 2010. The IPCC default proportions of DOC content are used for all these constituents. Street cleansing composition data is available, and the DOC content is therefore calculated from its constituent components. In addition, a DOC content of 5 percent has been assumed for sewage sludge. [NIR 2012]
Italy	On the basis of data available on waste composition, the moisture content, the organic carbon content and the fraction of biodegradable organic carbon for each waste stream, the DOC contents and the methane generation potential values (L_0) have been generated. [NIR 2012]
Luxembourg	Waste analysis is being used to determine IPCC waste fractions to which default DOC contents are applied. The composition of the combustible fraction taken off the SIDEC waste and delivered to the MWI was analysed in 2009. This fraction having a higher C content than the average waste was taken into account for the calculation at the MWI. [NIR 2012]
Netherlands	The DOC changes over the time series. This change in DOC values over time is due to such factors as the prohibition of landfilling of combustible wastes.[NIR 2012]
Portugal	The estimation of DOC for urban waste is based on information on the waste composition from several sources. Furthermore, DOC values are available for the different groups of industrial waste. These DOC values resulted from weighted averages based on the quantities reported for each EWC category considered and the respective assigned DOC, and refer to disposal on land. [NIR 2012]
Spain	The degradable organic carbon content in MSW is obtained by applying equation 5.4 of the IPCC Good Practice Guidance to the data on the standard composition information derived from the data evaluated in the corresponding questionnaires provided by landfills that perform biogas capture as well as the information on the national mean standard composition from the remaining landfills that is provided by the publication “The Environment in Spain”. For waste from origins other than direct household collection, specific values based on tables 2.4 and 2.5 of 2006 IPCC Guidelines have been used for compost plants (0.2), waste water sludge (0.175) and others (0.04). [NIR 2012]
Sweden	IPCC values for gas potentials are used for the different fractions of household waste, as well as garden waste. Estimated DOC content for each waste category are provided. [NIR 2012]
United Kingdom	A detailed review of waste composition, in terms of materials, moisture content and dissimilable degradable organic carbon (DDOC) content has been undertaken and the results are described in Eunomia’s report (Eunomia, 2011). The new methodology calculates the DDOC content of various waste materials through reference to the lignin and non-lignin content. [NIR 2012]

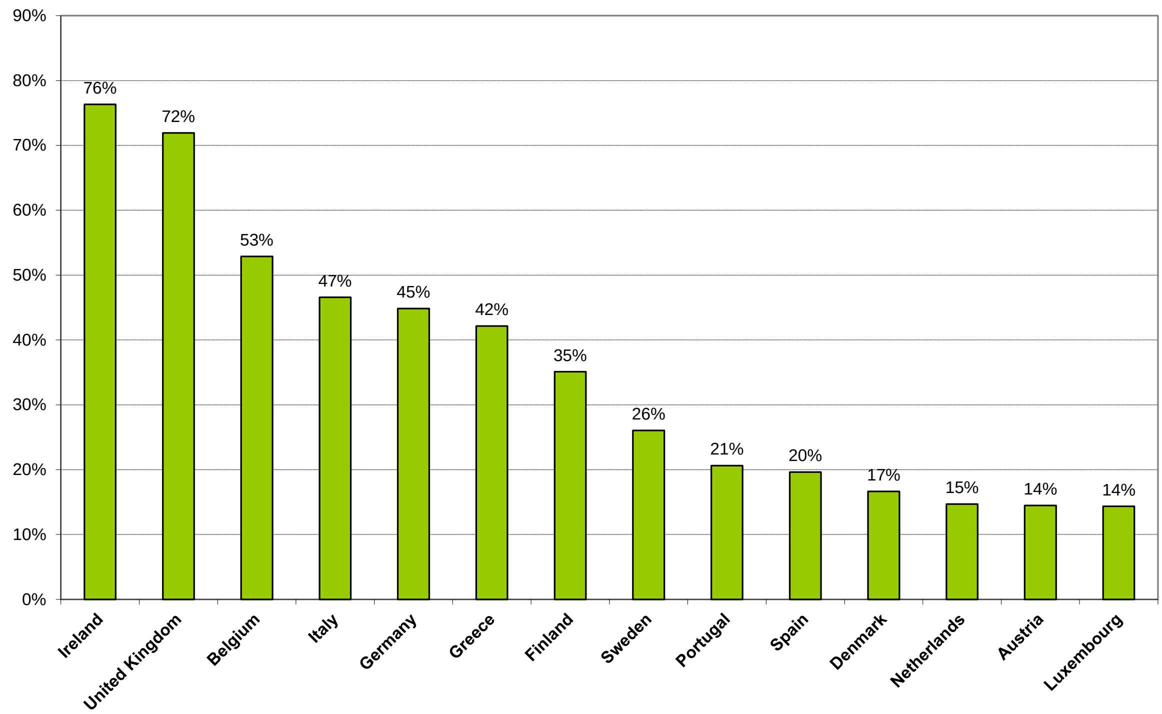
Source: NIR 2012, CRF 2012 ,Table 6A,C Additional information

Figure 8.6 presents an average DOC, however usually different DOC values for individual waste fractions are used. In the case of the United Kingdom, a detailed review of waste composition with regard to materials, moisture content and dissimilable degradable organic carbon was carried out. For Austria composting of biodegradable waste is reported separately. Consequently, considerable amounts of waste with high DOC are excluded from category 6A which results in a lower DOC for the remaining MSW. In Italy, DOC values are based on different national studies. In addition the DOC reflects the considerable reductions achieved in diverting biodegradable waste to other waste management methods such as composting or mechanical-biological treatment.

Besides lower quantities of organic carbon deposited into landfills, the major determining factor for the decrease in net CH_4 emissions are increasing methane recovery rates from landfills.

Methane recovery: The recovered CH_4 is the amount of CH_4 that is captured for flaring or energy use and is a country-specific value which has significant influence on the emission level. The percentage of CH_4 recovered, compare Figure 8.7, varies among the Member States between 14 % in Luxembourg and 76 % in Ireland and depends on the share of solid waste disposal sites that are able to recover CH_4 (see Table 8.18).

Figure 8.7 6A1 Managed Solid Waste Disposal: Methane recovery



*CH_4 recovery in% = CH_4 recovery in Gg/ (CH_4 recovery in Gg + CH_4 emissions in Gg)*100*
Source: CRF 2012 Table 6A,C

Compared to last year's information the methane recovery increased for six MS, out of which for three with a significant increase: Ireland: +14.1 %, Denmark: +8.0 %, Portugal: +7.7 %. For eight MS, the share remained constant or decreased, out of which for three with a significant decrease: Greece: -17.9 %, Belgium: -9.0 % and Germany: -6.3 %.

Recovery from UK landfills is financially driven, as the set minimum price given for the electricity generated in UK landfills results in a large financial incentive for recovery operators to collect all the gas produced. Furthermore, regulatory pressure exists to require a high level of gas collection in order to conform to the requirements of the 1993 Landfill Directive.

CH_4 recovery in EU-15 amounts to 47 % of generated CH_4. Methane recovery is further enhanced by the Landfill Directive, and monitoring programs will need to be established. The recovery potential depends on the waste management strategies, e.g. diverting organic fractions to composting leaves more inert materials on landfills and reduces the potentials to recover and use CH_4 (as in the case of the Netherlands, Austria or Denmark). Compared to last year's inventory report, CH_4 recovery for the

EU-15 decreased by 2 %; this reduction was mainly caused by the revision of German and UK CH_4 recovery.

Moreover, Member States use different methods to determine CH_4 recovery. Belgium, Finland, Ireland, Luxembourg, the Netherlands and Spain use measured plant-specific data. In Austria, France, Ireland, Italy, Portugal and the United Kingdom surveys are carried out. Denmark and Sweden take the corresponding data from their energy statistics. Germany uses general assumptions concerning the methane recovery.

Table 8.18 6A1 Managed Solid Waste Disposal: Further information on methane recovery

Member State	Number of SWDS recovering CH_4	Total number of SWDS	Further information on methane recovery
Austria		Excavated-soil landfills: 475 Construction-waste landfills: 90 Residual waste/treated waste landfills: 40 Mass waste landfills: 46	In 2004, the Umweltbundesamt investigated the amount of annual collected landfill gas by questionnaires sent to landfill operators showing that in 2001, the amount of collected landfill gas was more than 5 times higher than in 1990. In 1990 only 9 landfills were equipped with landfill gas wells. In 2001 at all operating mass landfills landfill gas was collected. In 2008 a further study was conducted (UMWELTBUNDESAMT 2008c) again sending questionnaires to landfill operators to get new data on collected landfill gas as well as information on its use. Results show, that from 2002 on the amount of landfill gas generated – and landfill gas recovered accordingly – decreased as a consequence of the reduced carbon content of deposited waste (despite a consistent recovery practice). As no new information on the amount of landfill gas recovered became available for the years 2008, 2009 and 2010, the mean value of the recovery rate of the years 2002 to 2007 (ranging from 12 % to 14 %) was taken as a proxy (13.2 %) to calculate the actual amount of landfill gas recovered. Moreover, the changing methane concentration in recovered landfill gas – decreasing from 48% (2002) to 45% (2007) (UMWELTBUNDESAMT 2008c) – has been considered in the calculation, resulting in less methane recovered and higher methane emitted accordingly. This is mainly due to the extensive capturing of landfill gas and the dilution of the landfill gas captured. For the years 2008-2010 the same methane concentration as 2007 can be assumed. [NIR 2012]
Belgium	14 (Wallonia, 2009)	33 SWDS only in Wallonia)	Methane recovery takes place in the Flemish region from 1994 on. Recovery data of the Flemish waste disposal sites are included for the first time in the 2009 submission. Consequently a complete dataset of recovery data became available in Belgium. Methane is recovered in the Walloon region from 1993 on. Each year, all the landfills with CH_4 recovery (14 in 2009) are contacted to collect data on the amount and CH_4 content of the biogas recovered (flaring or energy purposes). The CH_4 content is measured by landfill owners as it determines the possible use of the biogas (only "rich" biogas" is used in engines, the rest is flared). [NIR 2012]
Denmark	16 (2003)	53 (2003 still active)	Energy producing installations at 16 sites (DEPA, 2003a) are registered. The Danish Energy Agency registers the biogas amounts recovered at disposal sites in energy units (TJ) (DEA, 2011). The amount of gas in energy unit is converted to volume of gas using the net calorific value of 15.19 MJ per Nm^3 (DGC, 2009; Vattenfall, 2010; Verdo, 2011). As for the FOD model, the content of CH_4 in the gas recovered is estimated to 41 % and the density of CH_4 is 0.718 kg per m^3. Data for landfill gas plants are reported according to Energy Statistics from the Danish Energy Authority. [NIR 2012]
Finland	39		Data on landfill gas recovery are obtained from Finnish Biogas Plant Register. [NIR 2012]
France			Questionnaires were sent to landfills in order to find out about the quantity of landfill gas capture in private landfills. This survey is planned to be extended to all operators in 2012. Landfill gas recovery is currently not reported. [NIR 2012]

Member State	Number of SWDS recovering CH_4	Total number of SWDS	Further information on methane recovery
Germany		150 (2005)	For the years 2000 – 2008 data on the estimation of CH_4 recovery from landfills is included. The amount of used methane has been recalculated from the known electricity output, whereas the amount of internal energy consumption on the landfill site is not included. The data does not include land fill gas recovery from closed landfills. [NIR 2012]
Greece	4		According to data from the Ministry for Environment, recovery and flaring of biogas constitute management practices in the 4 major managed SWDS of Greece (in the cities of Athens, Patra, Thessalonica and Larissa). For two of these sites, Athens and Thessalonika, biogas is used for energy generation. For the other two sites, Patra and Larissa, flaring of biogas constitutes management practice for environmental protection and not for energy recovery. Thus, the collection of data on the amount of biogas flared has not been yet possible for these sites and the estimation of biogas recovered was based on the assumption that for technical reasons, 60% of biogas released is finally recovered and flared. For the SWDS of Athens and Thessalonica, in which almost 65% of total waste going to managed sites is disposed, data were collected by the National Energy Balance. In previous submissions, detailed measurements were used for SWDS of Athens for the years that they were provided. However, after the recommendations of the previous ERT review for further investigation regarding the amount of CH_4 recovered, official data from the National Energy Balance were used. For the rest of the sites, where biogas is recovered without energy use, namely Patra and Larissa, the assumption that 60% of the biogas being released is finally recovered and flared is used. [NIR 2012]
Ireland	8		A survey of landfill sites in 2010 to collect data for the years 2008 and 2009 was undertaken. The study was aimed at validating the values for 2008 as there were known issues with the information presented in the previous study and collecting information on flaring and utilisation for 2009. The survey was sent to 49 sites (both open and closed sites) on which flaring and or utilisation of landfill gas is known to occur. Information on the number of flares in use, together with data relating to flare capacity, run time and performance was used to estimate the volume of landfill gas flared at each site. The tonnage of CH_4 flared was calculated from landfill gas volume by accounting for gas temperature (assumed to be ambient air temperature) and pressure (provided in survey returns) and by using methane destruction efficiencies of 50 percent for open flares and 98 percent for closed flares. The study found that there were eight methane utilisation plants at landfills in Ireland in 2009 with a total of 23 engines. The amount of methane input to landfill gas utilisation plants is calculated from their known electricity outputs as obtained by SEAI from EIRGRID (Electricity Transmission System Operator) using an overall efficiency of 34.6 percent for the engines, which is considered typical of the engine types in general use. [NIR 2012]
Italy			The amounts of methane recovered and flared have been estimated taking into account the amount of energy produced, the energy efficiency of the methane recovered, the caption efficiency and the efficiency in recovering methane for energy purposes assuming that the rest of methane captured is flared. The total CH_4 recovered is the sum of methane flared and methane used for energy purposes. The methane used for energy production is estimated starting from the electricity produced (GWh) annually by landfills (TERNA, several years) assuming an energy conversion efficiency equal to 0.3, typical efficiency value for engines that produce electricity from biogas (Colombo, 2001). The methane flared has been estimated for the years 1990-1997 on the basis of information supplied by the plants (De Poli and Pasqualini, 1991); for the following years the methane flared has been estimated on the basis of information supplied by the main operators (Asja, 2003 and Acaia, 2004) regarding the efficiency in recovering methane for energy purposes with respect to the total methane collected. This value increased from 60% of the total, in 1998, to 70% since 2002. [NIR 2012]
Luxembourg	1	2	At the SIGRE site, a methane recovery system is operated since 2000, and, since 2002, at the SIDEC site. Recovery of landfill gas started in 2002 (flaring) and 2000 (electricity and heat plant), respectively. Recovered CH_4, as determined from monthly reports of the

Member State	Number of SWDS recovering CH_4	Total number of SWDS	Further information on methane recovery
			landfill operators (measured quantities) is subtracted from the estimated emissions. Data on CH_4 recovery is also available (from 2001 onwards) from the annual reports from SIGRE and SIDEC being sent to the Environment Agency in accordance to their permits. [NIR 2012]
Netherlands	53 (2009)	22 operating landfills (2010) and a few thousand older sites that are still reactive	The amount of waste disposed on landfill sites are mainly based on the annual survey performed by the Working Group on Waste Registration at all the landfill sites in the Netherlands. The data can be found in the Internet; a corresponding documentation is also available, which contains the amount of methane recovered from landfill sites yearly. [NIR 2012]
Portugal			Data on landfill gas recovered and combusted is flared or used for energy purposes. Until the present submission, data on recovered landfill gas referred only to the amounts of biogas consumed in electrical production in landfill systems, and was based on the information collected annually by DGEG in an annual inquiry. This year, an extra questionnaire was launched by APA aiming at collecting the total amount of landfill gas combusted either in flaring (without energy recovery) or used for energy purposes. This inquiry was focused on the more recent years (since 2005) and included additional variables on the characterization of the biogas (e.g. percentage of CH_4 in biogas). The annual quantities of biogas burnt (in flares and energy recovering units) reported by each landfill (in cubic meters) were converted into CH_4 amounts considering the CH_4 percentages in biogas (based on measurements) reported by management systems. In previous submissions the percentage of CH_4 considered in biogas was a theoretical of 60%. The conversion into mass was done considering a density of 0.72 kg/m3. [NIR 2012]
Spain	36		36 landfills in Spain have landfill gas recovery systems. Landfill gas is partly flared, partly utilized for energy purposes. [NIR 2012]
Sweden	57 (2010)	76 (2010)	In Sweden the first plant for biogas extraction from landfills was started in 1983. The business has increased until 2003 when gas was recovered in 72 plants. Since 2008, about 58 gas plants are in operation, and the amount of recovered gas is now decreasing because of the dramatic reduction of deposition of organic waste. Information on recovered gas (in energy units) is provided by Avfall Sverige and converted to use quantities by Statistic Sweden. [NIR 2012]
United **Kingdom**			Reliable data on methane collected for power generation are available (which set a lower limit on the actual gas collection) but better data on landfill gas flaring is needed to determine overall amounts of methane collected. Overall, it is believed that a 75% collection efficiency for methane as an average over the gas-producing life of modern landfills is not excessive, given industry and regulator experience, but further measurements are being pursued to improve confidence in this key factor. According to current estimates, about 69% of methane generated in all UK landfills is recovered – i.e. including old sites without gas collection. The remaining methane is available for oxidation and, in the absence of better data, the IPCC oxidation default factor of 10% is applied to this remainder. [NIR 2012]

Source: NIR 2012.

Industrial waste: Data on industrial waste may be difficult to obtain in many countries. DOC default values for industrial waste are not provided by the IPCC. Table 8.19 illustrates how industrial waste is considered in the individual Member States. Three Member States (France, Ireland, The Netherlands) do not consider or provide very little information on industrial waste in the NIR.

Table 8.19 6A1 Managed Solid Waste Disposal: Methodological issues regarding industrial waste

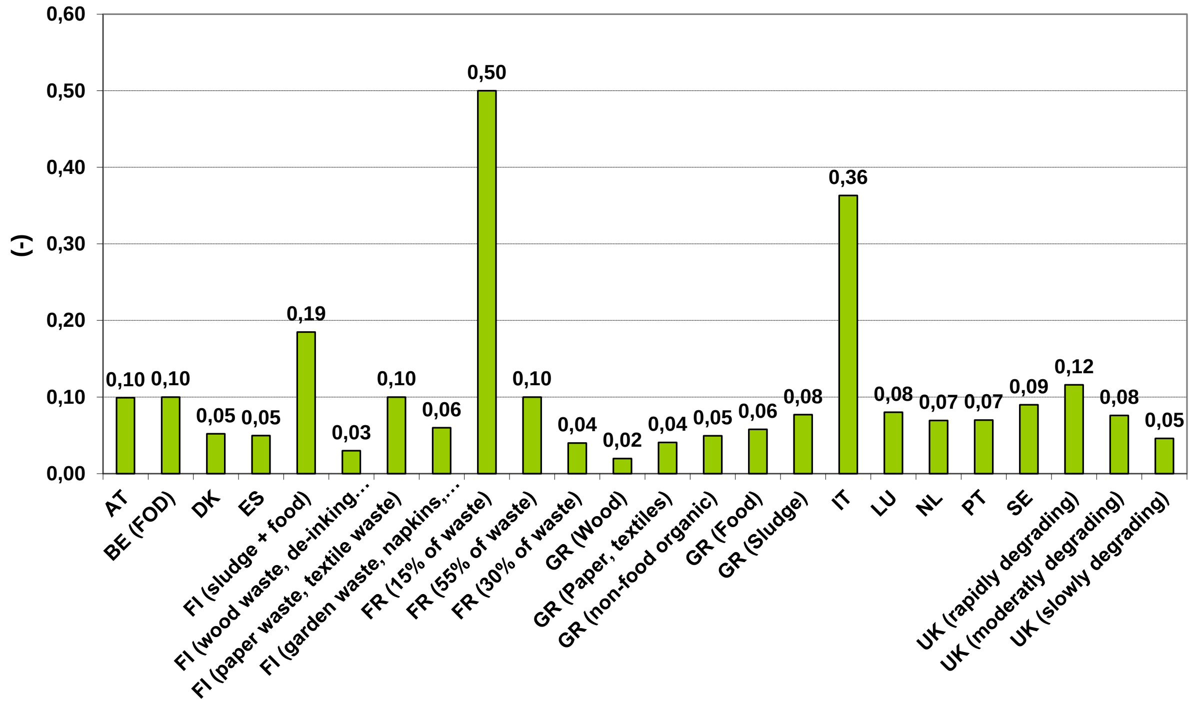
Member State	Industrial waste
Austria	"Mixed industrial waste" is considered under "non residual waste". Several waste types with their respective waste identification numbers are described. These are not clearly referenced as industrial wastes, though. [NIR 2012]
Belgium	In the Flemish region industrial waste is taken into account under the first order decay model. In the multi-phase model industrial waste is equal to household waste in terms of composition and consequently treated in the same way (domestic). In the Walloon Region the CO_2 and CH_4 emissions from solid waste disposal on land are calculated with a first order decay model that considers separately the emissions of industrial and municipal waste until 2007. This was due mainly because it was separated in the Walloon waste statistics. In 2010, Walloon waste figures have been given under another format which doesn't consider separately the amounts of industrial and municipal waste anymore. Emissions from industrial waste are calculated with the same model as municipal waste. The DOC value for industrial waste was estimated calculated using the detailed waste types from OWD and the IPCC Good Practice Guidance methodology. This detailed estimation led to a complete recalculation, as the new estimated DOC values were much lower than the default value previously used. [NIR 2012]
Denmark	Industrial waste is considered and data on its composition and amount deposited are used in the emission model. [NIR 2012]
Finland	Industrial solid waste and industrial sludge as well as industrial inert waste are considered as waste types. Activity data and several DOC values are provided in the NIR. [NIR 2012]
France	Industrial waste is included in the estimation. [NIR 2012]
Germany	The Federal Statistical Office provides detailed data about landfilling of industrial waste since 1996. In the inventory, waste quantities from the following industry branches are considered: wastes from agriculture, horticulture, forestry, fishery and food processing, wastes from wood processing, wastes from the production of cellulose, paper and cardboard, wastes from the textiles industry, packaging wastes as well as the wood fraction from construction and demolition wastes. [NIR 2012]
Greece	Industrial waste has been included for the first time in the 2012 inventory. Therefore the industrial waste amounts disposed in land provided by ELSTAT is used. These amounts are collected by the experts of ELSTAT based on individual researches (e.g. questionnaires sent to industries, etc). It must be noticed that these data are provided by ELSTAT only for the years 2004, 2006 and 2008. Thus, the historical data necessary for the rest of the years were estimated by using relative drivers i.e. the Greek GDP for the case of paper, wood and textiles and the Gross Production Value of livestock for the case of animal waste from food preparation and products, for the period 1960 to 2009. GDP evolution of Greece for the period 1960-2009 was obtained by the work 'The Greek Economy In The 20th Century" of Prof. John Milios of National Technical University of Athens, while GPV of livestock was obtained from FAO. [NIR 2012]
Ireland	Industrial waste is mentioned, but not considered explicitly. [NIR 2012]
Italy	In non-hazardous landfills industrial wastes assimilated to municipal solid waste (AMSW) could be disposed. Their composition must be comparable to municipal solid waste composition. From 2001, data on industrial waste disposed in municipal landfills are available from Waste Cadastre. For previous years, assimilated municipal solid waste production has been reconstructed, and the same percentage of MSW disposed in landfill has been applied also to AMSW. The complete database of AMSW production from 1975 to 2000 is reconstructed starting from data available for the years 1988 (ISTAT, 1991) and 1991 (MATTM, several years) with a linear interpolation, and with a regression model based on Gross Domestic Product (Colombari et al, 1998). From 1975 back to 1950 AMSW production has been derived as a percentage of MSW production; this percentage has set equal to 15%, which is approximately the value obtained from the only data available (MSW and AMSW production for the years 1988 and 1991). [NIR 2012]
Luxembourg	Today, there are no landfill sites for purely industrial waste in Luxembourg. However, one site existed in the past and it has been closed down in the early 1990s (Ronnebierg site). The emissions of the closed industrial waste disposal on land site (Ronnebierg) are estimated for the period 2000 to 2010. [NIR 2012]
Netherlands	Industrial waste is neither mentioned nor considered explicitly. [NIR 2012]

Member State	Industrial waste
Portugal	The fermentable part of industrial waste is considered. Historical time series are based on 1999 data which refer to annual registries relating to industrial unit declarations sent to the regional environment directorates which have been estimated on expert judgment. For the period 1960-1990 it was considered a growth rate of 1.5% per year; for the following years (1990-1998) 2% per year. Data for the years 2000, 2002 and 2003 refer to annual registries. The year 2001 refer to estimates based on the average of 1999 and 2000 data. Data for period 2004 to 2006 are interpolated values based on the 2003 and 2007 figures. Data from 2007 onwards refer to data collected under the Waste Registry . All industrial waste generated was considered to be disposed in SWDS together with urban waste. However, as there is no available information concerning final industrial waste disposal, it was assumed that all estimated waste produced has followed the urban disposal pattern between uncontrolled and controlled SWDS. Except for DOC, the same parameters are used for industrial waste as for municipal waste. [NIR 2012]
Spain	In questionnaires to landfill operators, information is collected also on “other non-classified waste”, such as construction waste, ash from combustion processes and industrial wastes. [NIR 2012]
Sweden	Detailed description available in the NIR of how activity data and emissions of relevant industrial wastes and sludges are generated. [NIR 2012]
United Kingdom	The estimates of waste disposal quantities include industrial waste. Waste quantities are obtained from studies, surveys, and models. [NIR 2012]

Source: NIR 2012

Methane generation rate constant: CH_4 is emitted on SWDS over a long period of time rather than instantaneously. The tier 2 FOD model can be used to model landfill gas generation rate curves for individual landfill over time. One important parameter is the methane generation rate constant. It is determined by a large number of factors associated with the composition of waste and the conditions at the site. Rapid rates which are associated with a high moisture content and rapidly degradable material can be found for example in part of the waste in Finland, France, Italy and the UK. Figure 8.8 provides some CH_4 generation rate constants as reported by the Member States in CRF table 6 A,C, while Table 8.20 summarizes information on the applied country-specific approach.

Figure 8.8 **6A1 Managed Solid Waste Disposal: Methane generation rate constant**



Source: CRF 2012 Table 6 A,C Additional information, NIR 2012

Table 8.20 **6A1 Managed Solid Waste Disposal: Further information on the methane generation rate constant**

Member State	Information on the half-time respectively the methane generation rate constant
Austria	Several values for the half life period of different waste types (residual waste, wood, paper, sludges, bulky waste and other waste, bio waste, textiles, construction waste and fats) are presented. [NIR 2012]
Belgium	Several values for the biodegradation rate are given. The multiphase model in the Flemish region uses three categories: Quick biodegradation: k1=0.173 (t1/2=4), Average biodegradation: k2=0.069 (t1/2=10), Slow biodegradation : k3 = 0.023 (t1/2 = 30). [NIR 2012]
Denmark	Separate half-life's according to the individual waste types and content of degradable organic matter have been applied to food waste (4[23]), cardboard (12[3]), paper (12[3]), wet cardboard and paper (12[3]), other combustible (14[2]) . [NIR 2012]
Finland	Methane generation rate constants are divided into four categories: k1= 0.185 for wastewater sludges and food waste, k2=0.03 for wood waste and de-inking sludge, k3=0.1 paper waste and textile waste, and k4=0.06 for garden waste, napkins, fibre and coating sludges. [NIR 2012]
France	NIR provides three values are provided: k1=0.5 for 15 % of the waste, k2=0.1 for 55 % of the waste and k3=0.04 for 30 % of the waste. (NIR 2012)
Germany	Several values for the half life are provided (years): food waste: 4, garden and park waste: 7, paper and cardboard: 12, wood: 23, textiles/diapers: 12, composites: 12, sludges from wastewater treatment: 4, waste from MBT facilities 12. [NIR 2012]
Greece	The estimation of k is determined by the conditions in the disposal sites (e.g. moisture content, temperature, soil type) and by the composition of waste landfilled. Considering the fact that climate in Greece is dry temperate (the ratio of mean annual precipitation to potential evapotranspiration is around 0.5), half life was estimated at 17 years for paper and textiles, 35 for wood, 12 years for food waste, 14 years for non-food-waste and 9 years for sewage sludge disposed on land. [NIR 2012]

Member State	Information on the half-time respectively the methane generation rate constant
Ireland	The 2006 IPCC Guidelines provide narrow ranges for the value of decay rate constant appropriate to the individual waste components under different climatic zones. Ireland has chosen the highest values given for the Western Europe wet temperate conditions for all waste constituents, as the value of the ratio MAP:PET (Mean Annual Precipitation: Potential Evapotranspiration) is greater than 2 in Ireland. [NIR 2012]
Italy	The methane generation rate constant k in the FOD method is related to the time taken for DOC in waste to decay to half its initial mass (the 'half life' or t½). The maximum value of k applicable to any single SWDS is determined by a large number of factors associated with the composition of the waste and the conditions at the site. The most rapid rates are associated with high moisture conditions and rapidly degradable material such as food waste. The slowest decay rates are associated with dry site conditions and slowly degradable waste such as wood or paper. Thus, for each rapidly, moderately and slowly biodegradable fraction, a different maximum methane generation rate constant has been assigned. National half-life values are suggested in a study. Accordingly, waste streams have been categorized in three main types: rapidly biodegradable waste (food waste, sewage sludge, k1=0.69), moderately biodegradable waste (garden and park waste, k5=0.14) and slowly biodegradable waste (paper and paperboard, textile and leather, wood and straw, k15=0.05). [NIR 2012]
Luxembourg	No information available. [NIR 2012]
Netherlands	Methane generation rate constant: 0.094 up to and including 1989, decreasing to 0.0693 in 1995 and constant thereafter, this corresponds to half-life times of 7.4 and 10 years, respectively. The change in k-values is caused by a sharp increase in the recycling of vegetable, fruit and garden waste in the early 1990s. [NIR 2012]
Portugal	The value of CH_4 generation rate constant (k) depends on several factors as the composition of the waste and the conditions of the SWDS. In the absence of national studies to determine this parameter, and following the recommendations of the in-depth review, the values used in the previous submissions were revised in order to apply the guidance from IPCC 2000. The k value considered was 0.07 (half life of about 10 years), which represents a higher decay rate compared to the k default value proposed by the IPCC 2000 (0.05 - half life of about 14 years). [NIR 2012]
Spain	The constant rate of methane generation takes the value recommended by the IPCC Good Practice Guidance (0.05) with the exception of three managed landfills for which k values of 0.035, 0.043 and 0.049 have been chosen. [NIR 2012]
Sweden	National value for half-life time of 7.5 years. The choice of the half-life factor has also been motivated by the rather wet climate conditions in Sweden (MAP/PET>1), and that the 2006 IPCC Guidelines recommends the default value of 7 for such climate conditions. [NIR 2012]
United Kingdom	MELMod uses waste to landfill data from 1945 to the present, a period equivalent to over four half lives for the slowly degrading waste (i.e. with a decay rate of 0.046 $year^{-1}$, equivalent to a half life 15 years). This lies within the range of 3 to 5 half-lives recommended by the IPCC Good Practice Guidelines. [NIR 2012]

Source: NIR 2012, CRF 2012 Table 6 A,C Additional information

Concerning the magnitude of the methane generation factor, Italy explains its high weighted average degradation rate with high moisture contents. The weighted averages of k should reflect the waste composition as well as the moisture content or average temperatures. In general, a comparison is difficult since many parameters have influence on the average value.

8.3.2 Unmanaged Solid Waste Disposal (CRF Source Category 6A2) (EU-15)

CH_4 emissions from unmanaged solid waste disposal were reported in only six Member States in 2010 (France, Greece, Ireland, Italy, Portugal and Spain). Two of these six Member States (Spain, Greece) still dispose MSW to unmanaged SWDS, compare column 'Annual MSW to unmanaged SWDS' in Table 8.21, while in France, Ireland, Italy and Portugal waste disposals from the past still emits (see Table 8.4). 100% of all EU-15 emissions from this category are calculated using higher tier methods. The Methane Correction Factor (MCF) reflects the way in which MSW is managed and the effect of management practices on CH_4 generation. According to the Revised 1996 IPCC Guidelines, the MCF for unmanaged disposal of solid waste depends of the type of site – shallow, deep or uncategorized. Table 8.22 gives an overview of the MCF applied the relevant Member States.

Table 8.21 6A2 Unmanaged Solid Waste Disposal: Selected parameters for calculating emissions from source category 6A2

Member State	Emissions reported from unmanaged SWDS	Annual MSW to unmanaged SWDS (Gg)	MCF CH_4		
			Unmanaged SWDS	Deep	Shallow
France	X	NO	0.50	NO	0.50
Greece	X	27.1	0.80	0.80	IE
Ireland	X	NO	NA	NA	NA
Italy	X	NO	0.60	NO	0.60
Portugal	X	NO	0.60	IE	0.60
Spain	X	108.00	0.60	0.80	0.40

Source: CRF 2012 table 6 and 6A,C

Table 8.22 6A2 Unmanaged Solid Waste Disposal: Further information

Member States	Unmanaged waste disposal on SWDS
France	The difference between managed and unmanaged MSWD is based on the degree of compaction of waste in MSWD. In French oversee territories, uncontrolled landfills are also considered. Uncompacted landfill were gradually closed in favor of compacted landfills. However, closed MSWD continue to emit methane because of the kinetics of the reaction. [NIR 2012]
Greece	Unmanaged wastes are considered to be landfilled in sites of similar characteristics concerning their composition and management (depth of sites), while the starting year of disposal and degradation of total unmanaged waste is assumed to be 1960. According to the Ministry of Environment, Energy and Climate Change (MEECC), 2182 unmanaged SWDS were still operating in 2000 (MEECC 2001). Following the National and Regional Planning of Solid Waste Management (compiled in the end of 2003), the process of closure and rehabilitation of unmanaged sites is already in progress and is expected to be completed in the following years, along with the construction of managed SWDS, following to the standards set by the EU directives, in order to cover the needs of the country. Nowadays, there is a small number of Unmanaged waste disposal sites which is planned to be eliminated until the end of 2011. [NIR 2012]
Ireland	In the 2006 IPCC guidelines the MCF varies from 0.4 for shallow unmanaged landfills to 1.0 for fully anaerobic deep and managed landfills. In the present model analyses undertaken for both individual sites and groups of landfills, annual MCF values show an increase over time to reflect the change from generally shallow, poorly-managed landfills before 1998 to well controlled and engineered landfills in subsequent years. The larger landfills that were in existence prior to the introduction of waste licensing were subject to some level of management but not to the extent of fully managed licensed sites after 1998. These large sites are assigned to the IPCC category of unmanaged deep sites for the years up to 1998 with MCF of 0.8 and to the managed category with MCF of 1.0 for the remainder of their lifetime. The 250 sites that operated primarily as small open town dumps and shallow uncontrolled disposal sites with significant aerobic conditions up to the introduction of waste licensing are assigned to the IPCC category of unmanaged shallow sites up to 1998, for which the appropriate MCF is 0.4. A transition from unmanaged shallow classification in 1960 to one-third unmanaged shallow and two-thirds unmanaged deep sites in 1998 is applied to the remainder of sites, giving an increasing MCF from 0.4 to 0.67 over this period. [NIR 2012]
Italy	From 2000, municipal solid wastes are disposed only into managed landfills, due to the enforcement of regulations. The share of waste disposed of into uncontrolled landfills has gradually decreased thanks to the enforcement of new regulations, and in the year 2000 it has been assumed equal to 0; emissions still occur due to the waste disposed in the past years. The unmanaged sites have been considered shallow. The MCF value used for unmanaged landfill is the default IPCC value reported for uncategorised landfills: in fact, in Italy, before 2000 existing unmanaged landfills were mostly shallow, because they resulted in uncontrolled waste dumping instead of real deep unmanaged landfills. To be conservative, the default IPCC value reported for uncategorised landfills has been used. It is assumed that landfill gas composition is 50% carbon dioxide and 50% methane. [NIR 2012]

Member States	Unmanaged waste disposal on SWDS
Portugal	The share of final disposal destiny (inter alia uncontrolled dumping sites) for the first years of the time series was calculated having as a basis the Quercus survey. Data for recent years (mainly since 1999) refer to data collected from management systems. There have been significant efforts at national level to deactivate and close all uncontrolled dumping sites. This effort was concluded in 2002 when all uncontrolled dumping sites had been closed. Concerning uncontrolled dumping sites, it was considered that there is gas burning when a dumping site has been closed and is associated with a managed landfill having recovery of CH_4. It was assumed that all estimated industrial waste produced have followed the urban disposal pattern between uncontrolled and controlled SWDS.[NIR 2012]
Spain	No statistical information is available for unmanaged SWDS. It is assumed that 50% of unmanaged landfills are deep (depth > 5 m) and the remaining 50% are shallow (depth < 5 m). For unmanaged SWDS it is also assumed that the waste is partly burned to reduce the volume. The burning fractions have been decreased during the inventory period. [NIR 2012]

Source: NIR 2012.

8.3.3 Waste water handling (CRF Source Category 6B) (EU-15)

CH_4 Emissions from domestic and commercial waste water handling (6B2) are a significant emission source in category 6B and key source in the EU. CH_4 emissions from waste water handling are calculated with the help of diverse methods (CR (CORINAIR), CS, D, M, T1 and T2). 9 % of all EU-15 CH_4 emissions from wastewater handling (6B) are calculated using higher tiers (i.e. all methods besides default and T1 methods). Table 8.23 provides an overview of the CH_4 emission sources in wastewater handling which have been identified by the Member States. Furthermore methods applied to determine CH_4 emission from municipal wastewater and sludge handling are described in detail.

Table 8.23 6B2 Domestic and Commercial Waste Water Handling: CH_4 emission sources and methods for determining CH_4 emissions

Member State	CH_4 emission sources and description of methods (municipal wastewater and sludge)
Austria	Municipal wastewater treatment in Austria uses mainly aerobic procedures. As a result no or negligible methane emissions are produced since such emissions only occur under anaerobic conditions. In the year 2008 – the latest year for which data is currently available – 92.8% of the Austrian population was connected to municipal wastewater treatment plants. The remaining wastewater is treated either in septic tanks (4.4% of the Austrian population), domestic wastewater treatment plants (2.5%), or other disposal facilities, which are not further specified in the respective data sources ("unspecified disposal routes": 0.3%). Wastewater treatment plants are using aerobic procedures (resulting in N_2O emissions), whereas septic tanks are characterised by anaerobic conditions (resulting in CH_4 emissions). As in there occur anaerobic processes, methane emissions are produced. CH_4 emissions from cesspools and septic tanks are calculated pursuant to the IPCC method. The following parameters were used: Average organic load: 60 g BOD_5 per inhabitant and day, methane producing capacity B_o: 0,6 kg CH_4/ kg BoB_5, methane conversion factor MCF: 0.27. The amount of inhabitants not connected to sewage systems and wastewater treatment plants was taken from the respective Austrian reports on water pollution control. Data for the years 1971, 1981, 1991, 1995 and 1998, 2001, 2003, 2006 and 2008 were available. The missing data were interpolated. The share of inhabitants connected to septic tanks has to be extrapolated from the year 2000 onwards. [NIR 2012]
Belgium	In this category, two sources of CH_4 emissions are taken into account, the municipal wastewater treatment plant and the sceptic tanks. The methodology for <u>the septic tanks</u> is based on an article (Vasel, 1992) which describes the characteristics and parameters of individual septic tanks. The IPCC default value of 0.6 kg CH_4/kg BOD is used. Each habitant produces 0.060kg BOD/day, whose 60 % eventually settles (IPCC fraction that readily settle). It is considered that only 25 % of

Member State	CH_4 emission sources and description of methods (municipal wastewater and sludge)
	the BOD loading is anaerobically degraded (0,060*0,6*0,25), because the septic tanks are regularly emptied and consequently the sludge is then treated aerobically. The annual emission factor becomes 1,971 kg CH_4/inhab*year (0,6*0,060*60%*25%*365 kgCH_4/kg BOD). The CH_4 emissions are estimated by multiplying these emission factors by the number of inhabitants not connected with a municipal wastewater treatment plant. In the Walloon region, after discussion with the regional responsible for municipal wastewater treatment plants, it appears that most of the plants are conducted aerobically. Those who use anaerobical digestion of the sludge recover the CH_4 for energy purpose. Consequently, no CH_4 emissions are accounted in this subcategory. In the Brussels region, there are two municipal wastewater treatment plants. One is conducted aerobically and the other anaerobically. The CH_4 produced by the anaerobical digestion is recovered for energy purpose. No CH_4 emissions are consequently estimated for this subcategory. In the Flemish region the emissions of CH_4 of the municipal waste water treatment plants are estimated by using the methodology as described in the EMEP/CORINAIR guidebook. An emission factor of 0,3 kg CH_4/inhabitant*year is used to calculate these emissions. [NIR 2012]
Denmark	The unspecified fugitive methane emission has this year been specified according to the identified systems and processes contribution to the fugitive methane emission from wastewater handling in Denmark. Fugitive methane releases from the municipal and private WWTPs have been divided into contributions from 1) the sewer system, primary settling tank and biological N and P removal processes, 2) from anaerobic treatment processes in closed systems with biogas generation and combustion for energy production and 3) septic tanks. Monitoring data on the influent biological oxygen demand (BOD) are available for mixed industrial and household wastewater, which are used for calculating the total organic waste (TOW) in the influent wastewater. From 1990 to 1998, the IPPC default methodology for household wastewater has been applied by accounting and correcting for the industrial influent load (Thomsen & Lyck, 2005). For the years 1999 to 2009 monitoring data from the national monitoring program exists. For the year 2009 the national total TOW data are calculated based on monitoring data from approximately 1000 municipal WWTPs; each WWTP represented by an average of 12 measurements. Yearly BOD data are calculated from measured BOD per litre influent waste water multiplied by the influent amount of water. A country-specific emissions factor for calculating the amount of methane produced during anaerobic treatment processes, the gross methane emission, at the Danish WWTPs have been derived. [NIR 2012]
Finland	A national methodology that corresponds to the methodology given in the Revised 1996 Guidelines is used in the estimation of the CH_4 emissions. Emission sources cover municipal (domestic) and industrial wastewater handling plants and uncollected domestic waste water for CH_4 emissions. For uncollected domestic wastewaters the Check method with default parameters (IPCC Good Practice Guidance) has been used. [NIR 2012]
France	Emissions from wastewater treatment are calculated according to the IPCC tier 1 method, distinguishing between collective wastewater treatment plants and cesspools. Some assumptions are made: 1. 2.4% of the water of the residential/commercial sector collected in waste water treatment plants is treated in natural lagoons, 2. this treatment corresponds to a conversion rate of 0.23. [NIR 2012]
Germany	Municipal wastewater treatment in Germany uses aerobic procedures (municipal wastewater-treatment facilities, small wastewater-treatment facilities), i.e. it produces no methane emissions, since such emissions occur only under anaerobic conditions. Treatment of human sewage from persons not connected to sewage networks or small wastewater treatment facilities represents an exception: in cesspools, uncontrolled processes (partly aerobic, partly anaerobic) may occur that lead to methane formation. Organic loads from cesspools are calculated pursuant to the IPCC method, in which the relevant population is multiplied by the average organic load per person. [NIR 2012]
Greece	CH_4 from waste water handling was estimated according to the default methodologies suggested by IPCC. Considering the fact that there are not sufficient data regarding all the wastewater handling facilities of the country and as a result methane emissions are calculated based on the total population served, emissions from wastewater treatment and the sewage sludge removed from wastewater are not considered separately. However, methane emissions from sewage sludge disposed in managed sites have been estimated. Therefore, in order to avoid double counting of emissions from sludge treatment, the organic load (in biochemical oxygen demand) of sludge that is actually disposed on land was subtracted by the organic load of wastewater treated. [NIR 2012]

Member State	CH_4 emission sources and description of methods (municipal wastewater and sludge)
Ireland	The only source of emissions from wastewater handling in Ireland is the anaerobic treatment of sludge. Approximately one-third of the population in Ireland is served by urban wastewater treatment plants, which are based on aerobic systems with no emissions of CH_4. The other one-third of the population uses septic tanks to treat wastewater mainly for individual houses in nonurban areas (Smith et al., 2004). The prevailing temperature in septic tanks is less than 15°C in Ireland, which is too low for the occurrence of methanogenesis and it is reasonable to assume that no appreciable emissions of CH_4 occur. Consequently the notation key "NO" is reported for CH_4 under wastewater in sub-categories 6.B.1 and 6.B.2 of the CRF tables. [NIR 2012]
Italy	In Italy wastewater handling is managed mainly using a secondary treatment, with aerobic biological units. The stabilization of sludge occurs in aerobic or anaerobic reactors; where anaerobic digestion is used, the reactors are covered and provided of gas recovery. It is assumed that domestic and commercial wastewaters are treated 95% aerobically and 5% anaerobically, whereas industrial wastewaters are treated 85% aerobically and 15% anaerobically. CH_4 emissions from sludge generated by domestic and commercial wastewater treatment have been calculated using the IPCC default method on the basis of national information on anaerobic sludge treatment system. Emissions from methane recovered, used for energy purposes, in wastewater treatment plants are estimated and reported under category 1A4a. CH_4 emissions from wastewater have been estimated assuming that 5% of domestic and commercial wastewater is treated anaerobically. This assumption may correspond to the Italian situation where wastewater is treated in aerobic biological units with the possibility of bad management cases. In the case of sludge, most of the CH_4 produced (254,436 Mg in 2010) is recovered and not emitted because of the anaerobic digestion of sludge where the reactors are covered and provided of gas recovery and the efficiency of captation is equal to 100%. Only CH_4 produced in Imhoff tanks (7,002 Mg in 2010) is emitted. [NIR 2012]
Luxembourg	Municipal wastewater treatment in Luxembourg uses mainly aerobic processes such as activated sludge or biofiltration. As a result, no or negligible methane emissions are produced, since such emissions only occur under anaerobic conditions. In these plants, sludge stabilisation is carried out in order to prevent uncontrolled putrefaction. In facilities with a treatment capacity smaller than 30.000 population-equivalents (p.e.) the stabilisation is usually carried out aerobically, with oxygen and energy consumption, while for facilities with a treatment capacity larger than 30.000 p.e., the stabilisation is normally carried out anaerobically with production of methane gas. The gas produced is usually used for energy recovery in combined heat/power generating systems or may be flared. In this emission inventory, methane emissions from these small anaerobic sludge treatments have been taken into account as there is no gas reuse and therefore methane emissions have been assumed. The methodology for these septic tanks is based on the IPCC method in which the relevant population (individual septic tanks) or population equivalents (for the small mechanical treatment plants) is multiplied by the average organic load per person. The 2006 IPCC default value of 0,6 kg CH_4/kg BOD is used. Each habitant produces 60 g BOD/day, and a MCF of 0,27 is assumed (STEINLECHNER et al. 1994). According to the national expert judgment and based on the study of Steinlechner et al. (1994), the MCF has been adapted to the national situation in Austria which is also applicable for Luxembourg. [NIR 2012]
Netherlands	In general, the emissions are calculated according to the IPCC guidelines, with country-specific parameters and emission factors being used for CH_4 emissions from wastewater handling (including sludge). The calculation methods are equivalent to the IPCC Tier 2 methods. The treatment of domestic and commercial wastewaters and the resulting wastewater sludge is accomplished using aerobic and/or anaerobic processes in public Wastewater Treatment Plants (WWTP). [NIR 2012]
Portugal	CH_4 emissions from domestic wastewater handling were estimated using a methodology adapted from IPCC 1996 Revised Guidelines and Good Practice Guidance, which follows three basic steps: 1. Determination of the total amount of organic material originated in each wastewater handling system, 2. Estimation of emission factors and 3. Calculation of emissions.[NIR 2012]
Spain	The methodology in Section 6.2 of the IPCC Good Practice Guidance has been applied. Computing the contributions of the water and sludge lines, the emissions are obtained as a product of the degradable organic load (water and sludge) and the methane emission factors, discounting from this product the amount of methane recovered. The methane emission factors are expressed as the product of the respective parameter B_0 of maximum capacity for

Member State	CH_4 emission sources and description of methods (municipal wastewater and sludge)
	methane production times the weighted methane conversion factor, WMCF. For domestic/commercial waste water, the organic load is the activity variable selected, expressed in mass of Biochemical Oxygen Demand (BOD_5). For the calculation of this variable, the population data currently served by waste-water treatment stations has been used, as detailed in the publication "The Environment in Spain" from the Ministry of the Environment. For the degradable organic load, a value of 300 mg BOD_5/litre of waste water and a flow of 200 litres/inhabitant equivalent per day, and 365 operating days per year, have been assumed. [NIR 2012]
Sweden	6B2a has been divided into three sections: a) Large wastewater treatment plant (treatment capacity: more than 2 000 pe); b) Small wastewater treatment plants (treatment capacity: 25 -2000 pe); c) Population not connected to wastewater discharge system. a) In Sweden, all large wastewater treatment plants are using aerobic wastewater treatment processes. No CH_4 is supposed to be generated because of the use of aeration in the wastewater treatment process. b) For small wastewater treatment plants, the situation is at the moment not well enough investigated and therefore Sweden is using the IPCC Good Practice Guidance method (Page 5.15 Box 5.1 Check method). Activity data on population connected to small wastewater treatment plants (700 000 people) is derived from background data from a survey in 2010. c) For population not connected to wastewater discharge system, the following applies: 1.) The sludge in the wastewater is collected in sand filters or infiltration beds, collected and transported to anaerobic digestion plants located at larger wastewater treatment plants. It is covered and reported in section CRF6B2b (sludge treatment). 2.) CH_4 emissions from the remaining waste water are likely to be NO (not occurring) or negligible. The waste water is rich in oxygen, and for biological processes to occur the water must not be too cold.222 Sweden has a rather cold climate with an average annual temperature of 4.8 (°C) 1991-2005. [NIR 2012]
United Kingdom	The methodology of the UK model differs in some respects from the IPCC default methodology. The main differences are that it considers wastewater and sewage together rather than separately. It also considers domestic, commercial and industrial wastewater together rather than separately. The inventory compilation method for methane estimates from water treatment and sewage sludge treatment and disposal is based on activity data from the water industry annual reporting system to UK industry regulators (for 2000 onwards) and an historic time series of sludge treatment data published by Defra (Defra EPSIM data, 2004). The UK Water Industry Research organisation has developed a spreadsheet emissions estimator tool, drawing upon available emission factors for sub-processes within the industry, and each UK water company uses this tool to estimate its annual emissions. From these reported emissions and activity data, implied emission factors for specific emission sub-sources can be derived. Emissions data have only been made available for the year 2008, and hence the Implied Emission Factors from 2008 have been applied to the activity data across all years. The use of such a limited dataset is not ideal, and the uncertainties in the emission estimates, especially for earlier years in the time series, are regarded as high. [NIR 2012]

Source: NIR 2012; CRF 2012 Tables 6, 6Bs1 and 6Bs2

CH_4 emissions from industrial wastewater and sludge handling are not key sources. Nevertheless, information about the methods applied for the estimation of CH_4 emissions from this source category is provided in Table 8.24.

Emissions of methane from industrial wastewater handling are reported by eight Member States (Finland, France, Greece, Italy, the Netherlands, Portugal, Spain and Sweden), but seven Member States indicate either that emissions are not estimated or not applicable or not occurring: Austria, Germany (NA), Belgium (NE), Ireland, Luxembourg (NO) or that emissions are reported elsewhere (Denmark and the United Kingdom).

The only MS that indicates CH_4 emissions from industrial wastewater as not estimated is Belgium which aims to collect data from industrial wastewater plants in the Flemish region, although the emissions originating from the industrial waste water plants are probably negligible.

Sweden, for the inventory submission in 2011, estimated CH_4 emissions from wastewater handling for the first time. To also correspond to the recommendation from the ERT (FCCC/ARR/2009/EC, para 85), these emissions have been considered for the EU inventory, thus increasing its completeness.

Emissions from sludge handling are reported by four Member States (France, Greece, Ireland and Spain), other Member States either reported emissions as not estimated (Belgium and the Netherlands) or not occurring (Luxembourg and Sweden) or not applicable (Austria and Germany) or reported the emissions elsewhere (five Member States: Denmark, Finland, Italy, Portugal and the United Kingdom).

An overview of methodological issues regarding CH_4 emissions from industrial wastewater and sludge handling is provided in Table 8.24.

Table 8.24 6B1 Industrial Waste Water Handling: CH_4 emissions and methods applied

Member State	CH_4 emissions from industrial wastewater		Methods for determining CH_4 emissions from industrial wastewater and sludge handling
	Waste water	Sludge	
Austria	**NA**	**NA**	Industrial wastewater treatment and sewage sludge treatment is carried out under aerobic as well as anaerobic conditions. As CH_4 gas is usually used for energy recovery or is flared, the amount of CH_4 emissions from industrial wastewater treatment and sewage sludge treatment is negligible and therefore reported as “not applicable”. In the energy sector sewage gas is considered as an energy source. [NIR 2012]
Belgium	**NE**	**NE**	Emissions originating from the anaerobical treatment of industrial wastewater (category 6B1) are not estimated in Belgium. The plants that apply this treatment in the Walloon region also recover the CH_4 for energy purposes. Consequently, as for the anaerobical municipal wastewater treatment plants, no CH_4 emissions are accounted in this subcategory. Although, like mentioned above, the emissions originating from the industrial waste water plants are probably negligible, attempts are going on in the Flemish region to collect data for this sector. So far, necessary data needed to make a rough estimation, are still missing. [NIR 2012]
Denmark	**IE**	**IE**	No distinction between emissions from industrial and municipal WWTPs is made, as Danish industries to a great extent are coupled to the municipal sewer system and waste water streams from households and industries therefore mixed in the sewer system prior to further treatment at centralised WWTPs. The contribution from the industry to the influent waste water at the centralised WWTPs has increased from zero to around 40% from 1987 to 2010 with the highest influent contribution occurring at the biggest and most advanced technological WWTPs in Denmark (Thomsen & Lyck, 2005; ASEP 2010). Monitoring data on the mixed household and industrial influent biological oxygen demand (BOD) are available for all WWTPs with a capacity above 30 PE treating more than 90 % of the Danish waste water. [NIR 2012]
Finland	**X**	**IE**	A national methodology that corresponds to the methodology given in the Revised (1996) Guidelines is used in estimation of the CH_4 emissions. The emissions from industrial wastewater treatment are based on the COD load. These DC (Degradable Organic Component) values of wastewaters with shared methane conversion factors have been used for both wastewater and sludge handling. The emissions from sludge disposal on land are, however, estimated and reported in the Solid waste disposal on land (landfills) subsector. These DC (Degradable Organic Component) values of wastewaters with shared methane conversion factors have been used for both wastewater and sludge handling. The emissions from sludge disposal on land are, however, estimated and reported in

Member State	CH_4 emissions from industrial wastewater		Methods for determining CH_4 emissions from industrial wastewater and sludge handling
	Waste water	Sludge	
			the Solid waste disposal on land (landfills) subsector. For the industrial wastewaters the emission factor is the IPCC default for the maximum methane producing capacity Bo = 0.25 kg CH_4/kg COD and a country-specific emission factor based on expert knowledge for the methane conversion factor MCF = 0.005. [NIR 2012]
France	**X**	**X**	For the estimation of CH_4, it is considered that the industrial effluent received at the waste water treatment plants are treated completely under aerobic conditions, unlike the effluent from the residential and commercial sector. However, some agro-food processing industries treating their waste water in situ are likely to use the natural lagoon. The IPCC equation for industrial water (according to the Chemical Oxygen Demand - COD) is then applied with Bo = 0.25 kg / kg COD. [NIR 2012]
Germany	**NA**	**NA**	The composition of industrial wastewater, in contrast to that of household wastewater, varies greatly by industrial sector. In Germany, the biological stage of industrial wastewater treatment is partly aerobic and partly anaerobic. Anaerobic wastewater treatment is especially useful for industries whose wastewater has high levels of organic loads. This treatment method has the advantages that it does not require large amounts of oxygen, produces considerably smaller amounts of sludge requiring disposal and generates methane that can be used for energy recovery. As in treatment of municipal wastewater, treatment of industrial wastewater releases no methane emissions into the environment. The processes include aerobic treatment and anaerobic digestion; gas formed in the latter is either used for energy recovery or is flared. No calculations for this source category are carried out at present. [NIR 2012]
Greece	**X**	**X**	The methodology for calculating methane emissions from industrial wastewater is similar to the one used for domestic wastewater. In order to estimate the total organic waste produced through anaerobic treatment, the following basic steps were followed: Collection of data regarding industrial production of approximately 25 industrial sectors / sub-sectors for the period 1990 – 2010. Calculation of wastewater generated, by using the default factors per industrial sector (m^3 of wastewater/t product) as suggested by the IPCC Good Practice Guidance. Calculation of degradable organic fraction of waste, by using the default factors (kg COD/m^3 wastewater) suggested by the IPCC Good Practice Guidance for each sector / sub-sector. The distribution between aerobic and anaerobic treatment of industrial wastewater for each industrial sector was estimated on the basis of data derived from a relevant project. The maximum methane production potential factors and the methane conversion factors for aerobic and anaerobic treatment, which were used for the final estimation of methane emissions, are similar to those used for domestic wastewater handling. For the first time in the current submission, country specific data were collected, thus additional industrial sectors with 100 % aerobic treatment of their wastewater were included in the estimation. In the previous submission, in case where 100% of sector was served by aerobic treatment, it was not taken into account, considering zero emissions. The additional sectors included in the wastewater were additional subsectors of food and beverage, and the sectors of paper and pulp, organic chemicals, soap and detergents, plastic and resins, paints and Petroleum Refinery in the already existing sectors of food and beverage, and in the sugar and textiles sectors. For the estimation of CH_4 emissions from sludge generated industrial wastewater handling is being used a methodology similar to the one used for the estimation of CH_4 emissions from industrial wastewater handling using the same country specific and default factors. [NIR 2012]
Ireland	**NO**	**X**	The anaerobic stabilisation of sludge is a source of CH_4 in Ireland. The amounts of industrial wastewater sludge produced are available from biennial reports on urban wastewater treatment and approximately three percent of this sludge is treated anaerobically. The average BOD of industrial wastewater sludge is 60 kg/t (40 percent of the typical BOD content of treated industrial wastewater) and DOC is estimated as the product of average BOD content and tonnes of dry solids of sludge. The

Member State	CH_4 emissions from industrial wastewater		Methods for determining CH_4 emissions from industrial wastewater and sludge handling
	Waste water	Sludge	
			emission factor for CH_4 is derived from equation 11 on page 6.21 of the Revised 1996 IPCC Guidelines using the IPCC default value of 0.6 for BO, 0.3 for the fraction of sludge treated and 1.0 for MCF. [NIR 2012]
Italy	**X**	**IE**	In Italy industrial wastewaters are treated 85% aerobically and 15% anaerobically. The methane estimation concerning industrial wastewaters makes use of the IPCC method based on wastewater output and the respective Degradable Organic Carbon for each major industrial wastewater source. No country-specific emission factors of methane per Chemical Oxygen Demand are available so the default value of 0.25 kg CH_4 kg^{-1} DC, suggested in the IPCC Good Practice Guidance, has been used for the whole time series. As recommended by the Good Practice Guidance for key source categories, data have been collected for several industrial sectors (iron and steel, refineries, organic chemicals, food and beverage, paper and pulp, textiles and leather industry). The total amount of organic material for each industry selected has been calculated multiplying the annual production by the amount of wastewater consumption per unit of product and by the degradable organic component. Moreover, the fraction of industrial degradable organic component removed as sludge has been assumed equal to zero. The yearly industrial productions are reported in the national statistics, whereas the wastewater consumption factors and the degradable organic component are either from Good Practice Guidance or from national references. National data have been used in the calculation of the total amount of both COD produced and wastewater output for refineries, organic chemicals, beer production, wine, milk and sugar sectors, the pulp and paper sector, and the leather sector. [NIR 2012]
Luxembourg	**NO**	**NO**	Industrial wastewater treatment and sewage sludge treatment is carried out under aerobic conditions (activated sludge process). As for the municipal facilities there are no methane emissions. [NIR 2012]
Netherlands	**X**	**NE**	The source category „wastewater handling" also includes the CH_4 emissions from anaerobic industrial wastewater treatment plants (WWTP), but these are small compared to urban wastewater treatment plants (WWTP). For anaerobic industrial WWTPs, the CH_4 emission factor is expressed as 0.176 t/t DOC design capacity, assuming a utilization rate of 80%, a CH_4-producing potential (Bo) of 0.22 t/t DOC and a methane recovery (MR) of 99%. [NIR 2012]
Portugal	**X**	**IE**	Methane emissions from industrial wastewater handling also follow the default methodology proposed in the 1996 IPCC Guidelines and the Good Practice Guidance. The organic wastewater load (TOW) is estimated using statistical production data on industries (ton product/yr) multiplied by pollution coefficients (kg O_2/ton product). These coefficients result from a study specifically done for the estimate of the loads from the Portuguese Industry (Cartaxo et al,1985) and had been developed from field monitoring data at installations in Portugal. [NIR 2012]
Spain	**X**	**X**	For industrial point sources, the emissions are based on data obtained from individualized questionnaires sent to each plant. The point source activity data comprise oil refineries and paper pulp manufacturing plants. Wastewater from food industry and chemical industry was estimates as area source based on the organic load. The methane emission factor selected, with regard to the volume of waste water treated, is derived from the EMEP/CORINAIR Guidebook. For the period 1990-2000 no data is available for the wastewater volume treated and the amount is derived by an extrapolation based on the driver production data. [NIR 2012]
Sweden	**X**	**NO**	The majority of the facilities in Sweden are using aerobic processes, where no CH_4 is supposed to be generated because of the use of aeration in the wastewater treatment process. In 2010, there were only five (5) facilities using anaerobic waste-water treatment processes in Sweden. These facilities were in the pulp industry and food industry. For methane emissions from industries with internal wastewater treatment, Sweden has chosen a national method to estimate the emissions based on data availability. According to wastewater treatment expertise, the loss of CH_4 in the energy recovery process should be within the range of 2 - 5 %. This factor can be combined with data on energy

Member State	CH_4 emissions from industrial wastewater		Methods for determining CH_4 emissions from industrial wastewater and sludge handling
	Waste water	Sludge	
			recovery from the anaerobic processes.[NIR 2012]
United Kingdom	**IE**	**IE**	Industrial waste water is considered together with commercial and domestic wastewater. [NIR 2012]

Source: NIR 2012, CRF 2012 Tables 6, 6.Bs1 and 6.Bs2
According to table 6.Bs1in CRF 2012; X= emissions are reported; NA=not applicable; NE= not estimated; IE= included elsewhere; NO=not occurring

According to the IPCC Good Practice Guidance, the emission factor for determining CH_4 emissions from wastewater and sludge handling is composed of the maximum methane producing potential (B_0) and the methane conversion factor (MCF). There is an IPCC default value available for the maximum methane producing potential which is applied in most of the Member States. In contrast, the MCF has to be determined country specifically and varies strongly among the Member States depending on wastewater and sludge treatment systems used; Table 8.25 provides an overview of the MCF applied by the Member States.

Table 8.25 6B Waste Water Handling: Methane Conversion Factors

Member State	MCF	Specification of MCF	Further information on MCF
Austria	**0.27**	Cesspools and septic tanks	Value is taken from a national study. [NIR 2012]
Belgium	-	-	No information provided [NIR 2012]
Denmark	**1**	Anaerobic treatment processes in closed systems with biogas extraction for energy production	Methane conversion factor depends on the extent to which BOD settles in the septic tanks has been set equal to 0.5 (IPCC, 2006) assuming that degradation for the settles DOC occurs under 100% anaerobic conditions. The methane recovery, MRad, for the anaerobic wastewater treatment with biogas production has been set to 99% according to expert knowledge (personal communication, Professor Jes Vollertsen, Aalborg University and ASEP, 2010). [NIR 2012]
Finland	**0.01** **0.005**	Municipal (domestic) wastewaters Industrial wastewaters	The estimated methane conversion factors for collected wastewater handling systems (industrial and domestic) are low in Finland because the handling systems included in the inventory are either aerobic or anaerobic with complete methane recovery. The emission factors mainly illustrate exceptional operation conditions. The MCF is based on expert knowledge. [NIR 2012]
France	**0.23**	For natural lagoons	Only for natural lagoons CH_4 emissions occur. [NIR 2012]
Germany	**0** **0.5**	Municipal wastewater treatment Cesspools	Aerobic conditions. The MCF for cesspools has been estimated on the basis of experience gained in other countries (septic tanks in the U.S., anaerobically treated municipal wastewater in the Czech Republic). [NIR 2012]
Greece	**-**	-	The default values for these factors are 0 for aerobic conditions and 1 for anaerobic conditions (and these values were applied in

			the calculations). [NIR 2012]
Ireland	**1**	Industrial Wastewater Sludge	The emission factor for CH_4 is derived from equation 11 on page 6.21 of the Revised 1996 IPCC Guidelines using the IPCC default value of 0.6 for Bo, 0.3 for the fraction of sludge treated and 1.0 for MCF. [NIR 2012]
Italy	**0.25**	Industrial wastewater	CH_4 emissions from sludge generated by domestic and commercial wastewater treatment have been calculated; the stabilization of sludge occurs in aerobic or anaerobic reactors; where anaerobic digestion is used, the reactors are covered and provided of gas recovery. For industrial wastewaters, no country-specific emission factors of methane per Chemical Oxygen Demand are available, so the default value of 0.25 kg CH_4 kg^{-1} DC, suggested in the IPCC Good Practice Guidance, has been used for the whole time series. [NIR 2012]
Luxembourg	**0.27**	Septic tank	The 2006 IPCC default value of 0,6 kg CH_4/kg BOD is used. Each habitant produces 60 g BOD/day, and a MCF of 0,27 is assumed (STEINLECHNER et al. 1994). According to the national expert judgment and based on the study of Steinlechner et al. (1994), the MCF has been adapted to the national situation in Austria which is also applicable for Luxembourg. The MCF defines the portion of methane producing capacity (B0) that degrades anaerobically and may vary between 0,0 (completely aerobic) to 1,0 (completely anaerobic) according to the IPCC 2006 Guidelines. [NIR 2012]
Netherlands	**0.5**	Septic tank	For septic tanks, the emission factor for CH_4 is expressed as 0.0075 tons per year per person connected to a septic tank, assuming a methane correction factor (MCF) of 0.5 and a CH_4-producing potential (Bo) of 0.25. In 2010, only 0.4% of the population was connected to a septic tank. [NIR 2012]
Portugal	**0.1** **0** **0** **0.3** **0.5**	No treatment Primary Secondary (well managed) Secondary (not well managed) Septic tanks	The new guidelines from IPCC that were recently published (IPCC,2006) present more detailed values, now specific of treatment systems and management conditions, and they were used to establish the new MCF values. In the case where the industrial effluent was discharged into the unitary municipal treatment system, the MCF was determined from the average situation in Portugal for the domestic wastewater system when there is any form of treatment, either primary, secondary or tertiary. [NIR 2012]
Spain	**0.15** **0.3** **0.005** **0.3**	industrial wastewater industrial sludge domestic wastewater domestic wastewater sludge	The Weighted Methane Conversion Factor, WMCF, is calculated in accordance with Equation 5.8 in the IPCC Good Practice Guidance. [NIR 2012]
Sweden	**-**	-	No information available. [NIR 2012]
United Kingdom	**-**	-	No information available.[NIR 2012]

Source: NIR 2012

Most Member States report N_2O emissions from waste water handling. Different methods are applied (CR, CS, D, T1 and T2). 5% of N_2O emissions from domestic wastewater handling are estimated by higher tier methods (Tier 2, CORINAIR (CR)). In Table 8.26 the methods for determining N_2O emissions from wastewater handling applied by the Member States are described in detail.

Table 8.26 6B Waste Water Handling: Methods for determining N_2O emissions

Member State	N_2O emissions from wastewater [1)]		Description of methods used (N_2O)
	Industrial	Domestic	
Austria	X	X	N_2O emissions from domestic and commercial wastewater handling are calculated by differing between wastewater arising from households connected and from households not connected to the municipal sewage system. N_2O emissions resulting from households not connected to the public sewage system were calculated according to the IPCC default method, as described in revised 1996 IPCC Guidelines. The data for the daily protein intake per person are taken from FAO statistics. The number of inhabitants is provided by *Austria Statistics.* Emission factor (0.01) and fraction of nitrogen in protein (0.16) are IPCC default values. N_2O emissions arising in waste water treatment plants are calculated by using a country-specific method based on IPCC. According to a national study, the amount of wastewater that is treated in sewage plants and the amount of nitrogen that is denitrificated should be considered. Finally the N_2O emissions arising from waste water treatment plants and other treatment are summed up. It is assumed that industrial wastewater handling additionally contributes 30% of N_2O emissions from municipal wastewater treatment plants. Data for the amount of wastewater that is treated in sewage plants as well as on the denitrification rate were taken from the Austrian reports on water pollution control and situation reports on the disposal of urban wastewater and sludge; missing data in between were interpolated. [NIR 2012]
Belgium	NE	X	The N_2O emissions from human sewage are estimated by using the methodology described in the IPCC 1996 Guidelines by multiplying the protein consumption per capita with the population, the N fraction in the protein and the default EF. The default values for N fraction in protein (kg N / kg protein) and N_2O emission factor are 16 % and 0.01 kg N_2O-N / kg sewage-N produced. The figure of protein consumption originates from the FAO statistics. The population figures come from the National Institute of Statistics. A revision of the protein consumption/capita took place from 2003 on, based on a revision of the FAO statistics. During the 2011 submission the FAO-values are revised for the complete time series. [NIR 2012]
Denmark	X	X	The emission of N_2O from wastewater handling is calculated as the sum of contributions from wastewater treatment processes at the WWTPs and from sewage effluents. The emission from effluent wastewater, i.e. indirect emissions, includes separate industrial discharges, rainwater conditioned effluents, effluents from scattered houses, from mariculture and fish farming. [NIR 2012]
Finland	X	X	In Finland, the N input from fish farming and from municipal and industrial wastewaters into the waterways is collected into the VAHTI database. For municipal wastewaters the measured values have been considered more reliable than the N input according to population data. In addition to the IPCC approach, also nitrogen load from industry and fish farming were taken into account. For uncollected wastewaters the nitrogen load is based on population data and protein consumption. The assessed N_2O emissions cover only the emissions caused by the nitrogen load to waterways. In addition to the emissions caused by nitrogen load of domestic and industrial wastewaters also the emissions caused by the nitrogen load of fish farming have been estimated. N_2O emission calculations are consistent with the IPCC method for discharge of sewage nitrogen to waterways. [NIR 2012]
France	X	X	IPCC method is used for domestic wastewater. The final emission factor is 21 g N_2O/inhabitant/year. The wastewater treatment plants have been eliminating N and therefore the EF decreased between 1990 and 2010. For industrial waste the N_2O emission factor is 14 g/hab/year. [NIR 2012]
Germany	NA	X	IPCC Default Method applied. For the amount of Protein per person and day FAO data is used. [NIR 2012]
Greece	X	X	N_2O from waste water handling were estimated according to the default methodology suggested by IPCC. N_2O emissions from domestic wastewater handling are estimated as the indirect nitrous oxide emissions from human consumption of food and their subsequent treatment through wastewater handling systems. Data on protein

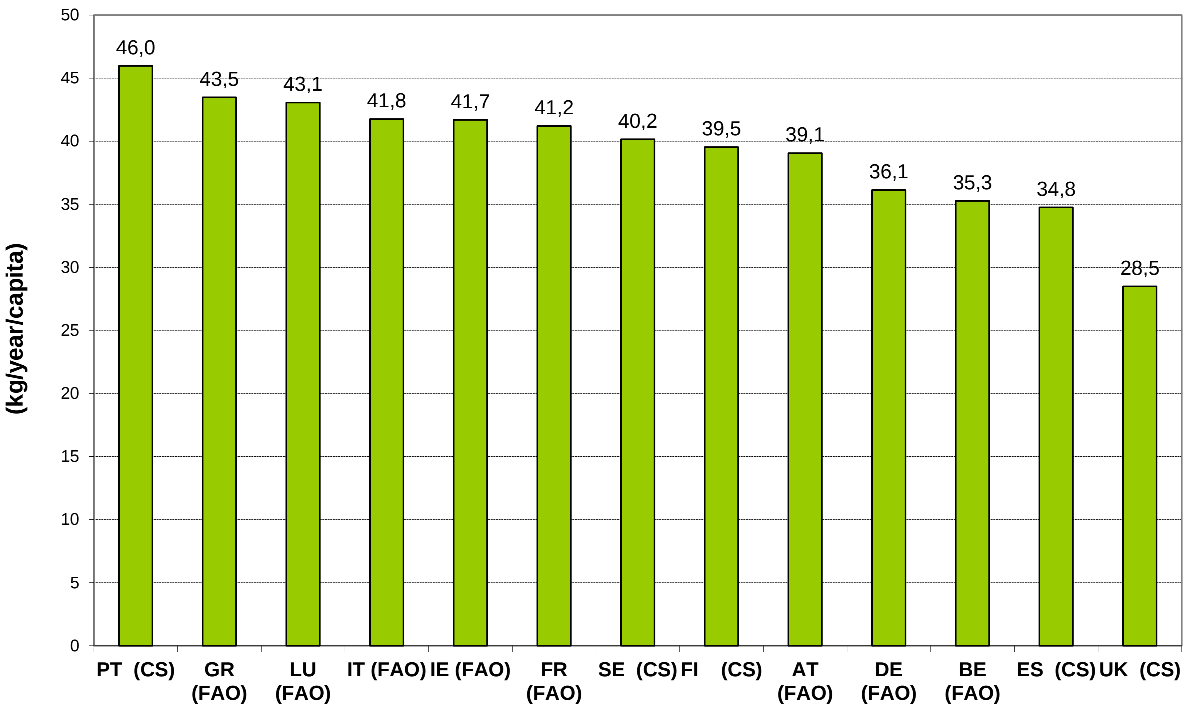
Member State	N_2O emissions from wastewater [1)]		Description of methods used (N_2O)
	Industrial	Domestic	
			consumption (*Protein*) are provided by FAO. N_2O emissions from industrial wastewater have been estimated for the first time in the current submission on the basis of the emission factors equal to 0.25 g N_2O/m3 of wastewater production (EMEP/CORINAIR, 2007). The waste water production is resulting from the model for the estimation of methane emissions from industrial waste water. [NIR 2012]
Ireland	**NA, NE**	**X**	Human consumption of food results in the production of sewage, which is processed in septic tanks or in wastewater treatment facilities and is then disposed of directly onto land, into the soil through percolation areas or discharged to a water body. N_2O emissions are estimated by taking the IPCC default value of 0.16 for the nitrogen content in protein and applying the default emission factor of 0.01 (kg N_2O-N/ kg sewage produced) to obtain the quantity of nitrogen in sewage ultimately entering the atmosphere as N_2O. [NIR 2012]
Italy	**X**	**X**	N_2O emissions from domestic and commercial wastewater treatment are reported in human sewage. The default approach suggested by the IPCC Guidelines and updated in the Good Practice Guidance, based on population and per capita intake protein has been followed. Fraction of nitrogen protein of 0.16 kg N kg^{-1} protein and an emission factor of 0.01 kg N-N_2O kg^{-1} N produced have been used, whereas the time series of the protein intake is from the yearly FAO Food Balance. N_2O emissions from industrial wastewater have been estimated on the basis of the emission factors equal to 0.25 g N_2O/m3 of wastewater production (EMEP/CORINAIR, 2007). The waste water production is resulting from the model for the estimation of methane emissions from industrial waste water. [NIR 2012]
Luxembourg	**X**	**X**	Pursuant to the 2006 IPCC Guidelines, nitrous oxide emissions from household wastewater can be evaluated by taking into account the average per-capita protein intake. The IPCC default values are used in each case for the nitrous oxide emission factor per kg of nitrogen in wastewater and for the nitrogen fraction in protein. The number of inhabitants and the commuters are provided by the STATEC. N_2O emissions from industrial wastewater handling are issued from only one chemical plant that produces plastics and which releases N to aquatic environments. This industrial wastewater treatment plant (WWTP) is equipped with a biological treatment with denitrification. N_2O emissions are based on the measured inflow data in the WWTP. The data available since the year 2002 are the flow as well as the mean annual nitrogen concentration in the WWTP. [NIR 2012]
Netherlands	**NE**	**X**	N_2O emissions from the biological N-removal processes in urban WWTP as well as indirect N_2O emission from effluents are calculated using the IPCC default emission factor of 0.01 tons N_2O-N per ton N removed or discharged. Since N_2O emissions from wastewater handling was identified in previous NIRs as a key source, the present Tier 2 methodology complies with the IPCC Good Practice Guidance. Because of their insignificance compared to N_2O from domestic wastewater treatment, no N_2O emissions were estimated for industrial wastewater treatment. In the NIR 2012 for the first time the N_2O emissions from septic tanks are calculated. This is done according to the default method provided in the IPCC 1996 revised Guidelines (IPCC,1997). For the calculation of the annual per capita protein uptake (see Table 8.4), data from FAO Statistics were used. For data on the % of people connected to septic tanks, the same time-series is used as in the calculation of CH_4 emissions from septic tanks. [NIR 2012]
Portugal	**X**	**X**	Emissions of N_2O from domestic wastewater were estimated following the proposal of IPCC 1996 Revised Guidelines. Activity data results of protein intake, according to FAO database, multiplied by total population. For industrial wastewater, the methodology proposed in the CORINAIR/EMEP Handbook, based on the knowledge of total production of wastewater, expressed in equivalent inhabitants, and the use of a simple and unspecific emission factor, was chosen. [NIR 2012]
Spain	**NE**	**NE**	N_2O emissions from waste water are not estimated. [NIR 2012]
Sweden	**X**	**X**	National activity data on nitrogen in discharged wastewater from municipal wastewater treatment plants and industries are used, in combination with a model

Member State	N_2O emissions from wastewater [1)]		Description of methods used (N_2O)
	Industrial	Domestic	
			estimating nitrogen in human sewage from people not connected to municipal wastewater treatment plants. [NIR 2012]
United Kingdom	**NE**	**X**	Nitrous oxide emissions from the treatment of human sewage are based on the IPCC default methodology. The most recent average protein consumption per person is based on the Expenditure and Food Survey (Defra, 2010). For the purposes of the 2010 estimates within the inventory, the Expenditure and Food Survey 2012 was not available in time, and therefore the data for 2009 has been used as a best estimate. [NIR 2012]

Source: NIR 2012, CRF 2012 Tables 6, 6.Bs1 and 6.Bs2
According to table 6.Bs1in CRF 2012; X= emissions are reported; NA=not applicable; NE= not estimated; IE= included elsewhere; NO=not occuring

One important parameter for the determination of N_2O emissions from wastewater handling, the annual per capita protein consumption is country-specific and applied by almost all Member States; an overview of the values is given in Figure 8.9. The Netherlands, however, does not determine N_2O emissions from wastewater handling via the average per-capita protein intake – as many countries do – but on basis of data on the total nitrogen loads removed in urban waste water treatment plants. Similarly, Denmark reports the indirect emissions from wastewater effluents under human sewage. The effluent considers discharged sewage nitrogen load consisting of contributions from municipal wastewater treatment plants, the separate industry, effluent from mariculture and fish farming, rainwater conditioned effluents and scattered houses not connected to the sewerage system.

Figure 8.9 6B Waste Water Handling: Protein consumption



Source: CRF 2012, Table 6 B; NIR 2012
CS= Country-specific value; FAO = FAO data basis
CS ES: Publication "Nutrition in Spain" by the Ministry of Agriculture, Food and Fisheries" (MAPA); CS FI: Tike, 2010; CS PT: National Statistical Office (INE); CS SE: National value: The Swedish yearbook of agricultural statistics 2007; CS GB: DEFRA, 2009: The

Expenditure and Food Survey.

8.3.4 Waste Incineration (CRF Source Category 6C) (EU-15)

Emissions from waste incineration are reported by nine Member States in 2010 (Austria, Belgium, France, Greece, Sweden, United Kingdom, Italy, Spain and Portugal). In Table 8.27 an overview of category descriptions and methodological issues is provided.

Table 8.27 6C Waste Incineration: Emissions reported and methodological issues

Member State	Emissions reported in CRF	Type of waste incinerated and methods applied
Austria	X	In this category, emissions from incineration of waste oil are included as well as emissions from municipal waste incineration without energy recovery. In Austria waste oil is incinerated in especially designed so called “USK-facilities”. The emissions of waste oil combustion for energy recovery (e.g. in cement industry) are reported under fuel combustion. In 2002, the Austrian waste incineration regulation came into force, introducing strong limits (from 2005 on) for air pollution for all kind of waste incineration plants without any limit of size. The facilities which do have the allowance for incineration of waste oil other than cement plants and large waste incineration plants were only 5 in the year 2010. In general, municipal, industrial and hazardous waste are combusted for energy recovery in district heating plants or in industrial sites and therefore the emissions are reported under fuel combustion. There is only one waste incineration plant without energy recovery which has been operated until 1991 with a capacity of 22 000 tons of municipal waste per year. This plant has been rebuilt as a district heating plant starting operation in 1996. Therefore the emissions since the re-opening of this plant are reported under fuel combustion from 1996 onwards. CORINAIR methodology is applied: the quantity of waste is multiplied by an emission factor for CO_2, CH_4 and N_2O. National emission factors for CH_4 are derived from residual fuel oil VOC emission factors (BMWA-EB 1990, BMWA-EB 1996, UMWELTBUNDESAMT 2001a). N_2O emission factors are taken from a national study (ORTHOFER et al. 1995). For waste oil, the same CO_2 emission factor as for *1 A 1 a* heavy oil (CO_2: 80 [t/TJ]) is used and a heating value of 40.3 GJ/Mg waste oil (source: Energy balance-residual fuel oil) is used to convert the emission factors from [kg/TJ] to [kg/Mg]. For municipal solid waste and clinical waste the CO_2 emission factor is calculated by means of default assumptions from (IPCC-GPG 2000). [NIR 2012]
Belgium	X	N_2O emissions from domestic waste incineration are calculated using activity data known from the individual companies involved combined with the emission factor of CITEPA, which is 60 g N_2O/ton waste. Since 2008, one of the plants in Wallonia provided plant specific data, consequently the average EF slightly decreased. In Flanders, only the fraction of organic-synthetic waste is taken into consideration (assuming that organic waste does not give any net CO_2 emissions). For the municipal waste, the institute responsible for waste management in Flanders (OVAM) is given the analysis of the different fractions in the waste. Based on this information, the amount of non-biogenic waste (excluding the inert fraction) is determined. The carbon emission factor is based on data from literature for the different fractions involved. For industrial waste, the amount of biogenic waste is considered to be the same as in municipal waste. The remaining amount is considered to be the non-biogenic part in which no inert fraction is present. For industrial waste, it is more difficult to determine the content of C and therefore the results of a study carried out by the VITO ‘Debruyn en Van Rensbergen ‘Greenhouse gas emissions from municipal and industrial wastes of October 1994’ are used. This study gives a content of C of the industrial waste of 65.5 %. Emissions of waste incineration plants with energy recuperation are allocated to the sector 1A1a and emissions of plants without energy recuperation are allocated to the category 6C. In Wallonia, following a legal decree in 2000, the air emissions from municipal waste incineration are measured by ISSEP and the results are validated by a Steering Committee. These results allow a crosscheck with the results of measurements directly transmitted by the incinerators to the environmental administration. From 1990 to 2000 CO_2 emissions of municipal waste incineration are reported assuming that 68 % of the waste is composed of organic material. This is based on the average garbage composition in Wallonia and the use of IPCC equation on organic content of the various materials. Since 2000, more precise data are reported by the waste incineration plants in the context of their environmental reporting. In 2005, the average organic content is 31 %. These emissions are now reported in the energy sector under 1A1a (biomass and other fuels, for the two respective fractions), according to IPCC guidelines. The emission factors for the incineration of hospital and municipal waste and corpses are estimated by measurements in situ in connection with EPA and EMEP/CORINAIR emission factors. [NIR 2012]
Denmark	IE	Incineration of municipal, industrial, clinical and hazardous waste takes place with energy recovery, therefore the emissions are included in the relevant subsectors under CRF sector 1A. [NIR 2012]
Finland	IE	Emissions of greenhouse gases CO_2, N_2O and CH_4 from Waste Incineration (CRF 6C) are reported in the energy sector (CRF 1A) in the Finnish inventory. There is no waste incineration on landfills in Finland and waste incineration for energy production is included in the energy sector. Waste incineration without energy recovery is nearly zero in combustion plants and it is also included in the energy sector. Waste

Member State	Emissions reported in CRF	Type of waste incinerated and methods applied
		incineration in households is quite small. In annual reporting of the recycling of wastepaper, the incineration of wastepaper is estimated to be only 23,000 tons. The incineration of paper and paperboard in households is estimated to be 31,000 tons together. [NIR 2012]
France	X	Emissions from waste incineration are reported for four categories: dangerous industrial waste incineration, municipal waste incineration without energy recovery, agricultural plastic film burning and other non-specified wastes. Furthermore, non-CO_2 emissions of incineration of biogenic waste are reported [NIR 2012].
Germany	NO	Reported in the energy sector (CRF 1). [NIR 2012]
Greece	X	Carbon dioxide, Methane and Nitrous oxide emissions from the incineration of clinical waste produced in the Attica region have been estimated. Incineration of clinical waste in a central plant is still limited, despite the fact that the facilities existed are planned to cover the total daily needs of hospitals in Athens. For the estimation of CO_2 emissions, the default method suggested by the IPCC Good Practice Guidance was used. CH_4 and N_2O emissions were estimated using default methodology and country specific emission factors. Data related to the amount of clinical waste incinerated derive from the ACMAR, which is operating the incinerator. For the other categories, data were collected by the ELSTAT for the 2004, 2006 and 2008, while for the rest of the years similar figures were assumed. The relevant parameters and emission factor used are the ones suggested in the IPCC Good Practice Guidance. [NIR 2012]
Ireland	NO	[NIR 2012]
Italy	X	Existing incinerators in Italy are used for the disposal of municipal waste, together with some industrial waste, sanitary waste and sewage sludge for which the incineration plant has been authorized from the competent authority. Other incineration plants are used exclusively for industrial and sanitary waste, both hazardous and not, and for the combustion waste oils, whereas there are few plants that treat residual waste from waste treatments, as well as sewage sludge. Emissions from waste incineration facilities with energy recovery are reported under category 1A4a, whereas emissions from other types of waste incineration facilities are reported under category 6C. For 2010, nearly 95% of the total amount of waste incinerated is treated in plants with energy recovery system.CH_4 emissions from biogenic, plastic and other non-biogenic wastes have been calculated. Regarding GHG emissions from incinerators, the methodology reported in the IPCC Good Practice Guidance has been applied, combined with that reported in the CORINAIR Guidebook. A single emission factor for each pollutant has been used combined with plant-specific waste activity data. Emissions have been calculated for each type of waste: municipal, industrial, hospital, sewage sludge and waste oils. A complete data base of these plants has been built, on the basis of various sources available for the period of the entire time series, extrapolating data for the years for which there was no information. For each plant a lot of information is reported, among which the year of the construction and possible upgrade, the typology of combustion chamber and gas treatment section, if it is provided of energy recovery (thermal or electric), and the type and amount of waste incinerated (municipal, industrial, etc.). Different procedures were used to estimate emission factors, according to the data available for each type of waste. As regards municipal waste, a distinction was made between CO_2 from fossil fuels (generally plastics) and CO_2 from renewable organic sources (paper, wood, other organic materials). Only emissions from fossil fuels, which are equivalent to 35% of the total, were included in the inventory. On the other hand, CO_2 emissions from the incineration of sewage sludge were not included at all, while all emissions relating to the incineration of hospital and industrial waste were considered. CH_4 and N_2O emissions from agriculture residues removed, collected and burnt 'off-site', are reported in the waste incineration sub-sector. Removable residues from agriculture production are estimated for each crop type taking into account the amount of crop produced, the ratio of removable residue in the crop, the dry matter content of removable residue, the ratio of removable residue burned, the fraction of residues oxidised in burning, the carbon and nitrogen content of the residues. CO_2 emissions have been calculated but not included in the inventory as biomass. All these parameters refer both to the IPCC Guidelines and country-specific values. [NIR 2012]
Luxembourg	IE	This category is presented under IPCC Sub-category 1A1a – Fuel Combustion Activities – Energy Industries – Public Electricity and Heat Production (see Section 3.2.6 in Chapter 3) because in the sole incinerator of the country (SIDOR site), energy from waste burning is recovered and injected in the electric public network. [NIR 2012]
Netherlands	IE	The source category Waste incineration is included in source category 1A1 Energy industries since all waste incineration facilities also produce electricity or heat used for energetic purposes. Total CO_2 emissions – i.e. the sum of organic and fossil carbon – from waste incineration are reported per facility in the annual environmental reports. The fossil-based and organic CO_2 emissions from waste incineration (e.g. plastics) are calculated from the total amount of waste incinerated. Per waste stream (residential and several others) the composition of the waste is determined. For each of these types a specific carbon content and fossil carbon fractions are assumed, which will yield the CO_2 emissions. The method is described in detail in a national study and in a monitoring protocol. [NIR 2012]
Portugal	X	CO_2 emissions from incineration are calculated according to IPCC Guidelines, for each waste type (e.g. municipal solid waste (MSW), hazardous waste, clinical waste, and sewage sludge). Until 1999, incineration of solid wastes refers exclusively to incineration of hospital hazardous wastes. The figure for 1995 was used

Member State	Emissions reported in CRF	Type of waste incinerated and methods applied
		as an estimated for the former years. In 1999, two new incineration units started to operate in an experimental regime. Their industrial exploration started at the end of the same year or early January 2000. More recently another unit started operating. These units are dedicated to the combustion of MSW which is composed of domestic/commercial waste. Emissions associated with the components of fossil origin – plastics, synthetic fibres, and synthetic rubber – are accounted for in the net emissions, which include also the non-CO_2 emissions from the combustion of organic materials (e.g. food waste, paper). CO_2 emissions from the biogenic component are only reported as a memo item. Data on clinical waste incinerated refers only to Mainland Portugal and corresponds to data declared in registry maps of public hospital units (there is no incineration in private units). The quantities of clinical waste incinerated decreased strongly in recent years. 25 incinerators were closed in recent years in Mainland Portugal, only remaining at present one hospital incinerator. Other clinical wastes receive alternative treatment or are treated abroad. The non-biogenic components fractions are considered to be different for MSW, and clinical waste. Data refer to combustion of industrial solid waste in industrial units which were collected from INR. Data for the years 2000, 2002 and 2003 refer to industrial units declarations. Data for the period 1990-98 are based on the same assumptions used for Industrial Solid Waste Disposed on Land: a per year growth rate of 2%. Data from 2004 onwards refer to data collected under the Waste Registry (Mapa Integrado de Registo de Resíduos (MIRR)) on the framework of SIRAPA (APA website for the communication between APA and environmental stakeholders). Data provided by the different waste operators and industrials on the amounts of non-urban waste generated are statistical treated by the INE (Statistical Institute) in order to extrapolate the information for the universe of each economic branch. Therefore, data from 2004 onwards represent a break from previous years, as data in earlier years were not extrapolated to considerer the non-responses. CH_4, N_2O and other emissions were estimated as the product of the mass of total waste combusted, and an emission factor for the pollutant emitted per unit mass of waste incinerated. Emission factors applied are either country-specific, being obtained from monitoring data in incineration units, or obtained from other references (US data, EMEP/CORINAIR). [NIR 2012]
Spain	X	Within this category, the emissions produced by the following activities have been estimated: incineration of corpses and clinical waste, municipal solid waste incineration without energy recovery and wastewater sludge incineration. For the incineration of human corpses in crematories, the combustion of a supporting fuel and some other material elements incinerated during the process also account for emissions. Emission factors are derived from data of the crematories of the Municipality of Madrid. The clinical waste streams suitable for treatment by incineration are those with a low infection potential and those named “cytotoxic waste” which present a high infection potential. The estimation of the amount of this type of waste produced is calculated by considering the number of hospital beds and a waste production factor per bed and day. Activity data are derived from the Statistical Yearbook of Spain published by INE and from the Statistics on Health Establishments from Ministry of Health and Consumption. Since 2004, all municipal waste incinerators are equipped with energy recovery. Sludge incineration includes sludges from urban and industrial wastewater treatment. The main source of emission factors is the EMEP/CORINAIR Guidebook. [NIR 2012]
Sweden	X	Emissions from incineration of hazardous waste, and in later years also MSW and industrial waste, from one large plant are reported in CRF 6C. Reported emissions are for the whole time series obtained from the facility’s Environmental report or directly from the facility on request. CO_2, SO_2 and NO_x are measured continuously in the fumes at the plant. In 2003 capacity was increased substantially at the plant by taking one new incinerator into operation. The new incinerator incinerates a mixture of MSW, industrial waste and hazardous waste. Only a minor part (less than 0.5%) of the total amount of MSW incinerated for energy purposes in Sweden are incinerated in the facility included in 6C. All other emissions from incineration of MSW are reported in CRF 1.Emissions reported are CO_2, NO_x, SO_2 and NMVOC. The CO_2 emission of biogenic origin of the MSW fraction of the waste, has since 2003 (when the incineration capacity increased dramatically, in order to treat MSW) been estimated using published information. According to information from the facility, occasional measurements concerning CH_4 and N_2O have been performed. The CH_4 measurement showed very low or non-detectable amounts. CH_4 is therefore reported as NE in the CRF tables. In submission 2010 also N_2O from waste incineration is reported for the whole time series 1990 – 2008. The estimates are based on occasional measurements of the N_2O concentrations in the flue gas made by the company together with information on yearly flue gas volumes 2003 - 2009. [NIR 2012]
United Kingdom	X	Incineration of chemical wastes, clinical wastes, sewage sludge and animal carcasses is included here. There are approximately 70 plants incinerating chemical or clinical waste or sewage sludge and approximately 2600 animal carcass incinerators. Animal carcass incinerators are, typically, much smaller than the incinerators used to burn other forms of waste. This source category also includes emissions from crematoria. Emissions are taken from research studies or are estimated on literature-based emission factors, IPCC default values, or data reported by the Environment Agency’s Pollution Inventory. [NIR 2012]

X = Emissions are reported in source category 6C, IE = included elsewhere, NE=not estimated, NO=not occurring
Source: NIR 2012, CRF 2012.

8.3.5 Waste – Other (CRF Source Category 6D) (EU-15)

Under CRF source category 6D eleven Member States report emissions for 2010. Emissions from composting have been reported by nine Member States (Austria, Belgium, Denmark, Finland, France, Germany, Italy, Luxembourg and the Netherlands). Denmark, France and Spain determine emissions from biogas production, Spain and Italy indicate emissions from sludge spreading, Germany from mechanical-biological waste treatment plants. In addition Denmark reports emissions of CO_2, CH_4 and NO_x from accidental fires; compare Table 8.28.

Table 8.28 6D Other: Reported emissions, 2010

Member State	Specification of "other waste"	6 D CO_2	6 D CH_4	6 D N_2O	6 D NO_x
Austria	Compost production	NA	2.54	0.35	NA
Belgium	Compost production	NA	1.17	NA	0.11
Denmark	Gasification of biogas	NO	NO	NO	NO
Denmark	Accidental fires	18.24	0.08	NE	0.04
Denmark	Compost production	NA	3.83	0.14	NA
Finland	Compost production	NO	2.99	0.20	NO
France	Compost production	NA	6.43	1.31	NO
France	Biogas production	NA	1.02	NA	NA
Germany	Compost production	NO	25.660	0.641	NO
Germany	Mechanical-biological waste treatment	NO	0.275	0.500	NO
Italy	Compost production	NA	0.25	NA	NA
Italy	Sludge spreading	NA	NA	NA	1.67
Luxembourg	Compost production	NO	0.36	0.03	NE
Netherlands	Compost production	NA	0.97	0.11	0.03
Portugal	Non-specified	NO	0.00	0.00	0.03
Spain	Anaerobic digestion at biogas facilities	NA	0.01	0.00	0.00
Spain	Sludge spreading	NE	1.74	NE	NE

Source: CRF 2012 Table 6

In Table 8.29 the source category is described further in detail.

Table 8.29 6D Other: Description and methodological issues

Member State	Waste – Other
Austria	In this category biological treatment of solid waste is considered. Emissions were estimated using a country-specific methodology. To estimate the amount of composted waste it was split up into two fractions of "other waste": 1) residual waste treated in mechanical-biological treatment plants, 2) composted waste: bio waste collected separately, loppings, home composting. Emissions were calculated by multiplying the quantity of waste with the corresponding emission factor (CH_4 and N_2O) based on national references. [NIR 2012]
Belgium	CH_4 emissions from compost production are estimated using regional activity data combined with a default emission factor of 0.75 kg CH_4/ton waste entering in the compost centres. The emission factor of 0.75 kg CH_4/ton waste composted is used after consultation with colleagues in the Netherlands who use this factor as a result of measurements carried out. In Wallonia, new figures are available for the activity data of the years 2006 to 2009. The activity data figures are based on the quantities of waste coming out of the compost centers. According to experts judgement, the rate between the output of the compost centers (i.e. the amount of compost production) and the input (i.e. the amount of fresh organic waste that are composted) is around 35 %. Then, by dividing the output by 0.35, we obtain the amount of waste that will be composted. This methodology is deemed more adequate and more reliable for the calculation of the CH_4 emissions coming from composting. [NIR 2012]
Denmark	Emissions in this category could stem from accidental fires, sludge spreading, compost production, biogas production and other combustion. Other combustion sources include open burning of yard waste and wild fires. CO_2 emissions from compost production are considered to be biogenic. Buildings have a high content of wood both in the structure and in the interior; this leads to 83 % of the CO_2 emission from accidental building fires to be biogenic. Emissions from accidental fires have been slowly increasing from both building and vehicle fires. For compost production there is neither methodological guidance for this source category in the Revised 1996 IPCC Guidelines (IPCC, 1997) nor the IPCC 2000 Good Practice Guidance (IPCC, 2000). Emissions from composting have been calculated according to a country specific method. [NIR 2012]
Finland	Emissions from composting have been calculated using the methods given in the 2006 IPPC Guidelines for Greenhouse Gas Inventories. Activity data are based on VAHTI database and the Water and Sewage Works Register. The activity data for composted municipal biowaste for the year 1990 are based on the estimates of the Advisory Board for Waste Management for municipal solid waste generation and treatment in Finland in 1989. Data on 1997, 2004 and 2005 are

Member State	Waste – Other
	from the VAHTI database and the intermediate years have been interpolated. In addition, composted solid biowaste in the years 1991-1996 has been interpolated using auxiliary information from the National Waste Plan until 2005. The new composting treatment code and composting plant code in Vahti registry have been used in the calculation of the years 2006-2010. [NIR 2012]
France	CH_4 and N_2O emissions from composting as well as CH_4 emissions from biogas production are considered. Emissions are estimated by multiplying emission factors with the amount of waste composted and the amount of waste used for the production of biogas, respectively. Activity data for composting is derived from periodic surveys ITOM performed by ADEME. For CH_4 emission a single emission factor of 952 g/t compost is used for all categories of waste. For N_2O emissions a single emission factor per waste type (green waste, mixed organic household waste, sludge and other) is applied. Activity data for the estimation of CH_4 emissions from biogas production is also derived from periodic surveys ITOM from ADEME; an emission factor of 2678 g/t waste is used. [NIR 2012]
Germany	In Germany, yearly increasing amounts of organic waste are composted. For this purpose, CH_4 and N_2O emissions from composting of municipal solid waste are estimated using a national method. Acitivity data is provided by the National Statistical Agency. Emission factors stem from a national study. Composting of garden and organic waste in individual households is not considered in this category. Since 1 June 2005, landfilling of biologically degradable waste is not permitted in Germany anymore. MSW has to be treated, therefore, prior to landfilling. Mechanical-biological treatment of waste is one of the options. A national method has been developed for the calculation of CH_4 and N_2O emissions in which the amount of waste treated in mechanical-biological treatment plants is multiplied with emission factors from a national study. Acitivity data is provided by the National Statistical Agency. [NIR 2012]
Italy	Under this source category CH_4 emissions from compost production have been reported. The composting plants are classified in plants that treat selected waste (food, market, garden waste, sewage sludge and other organic waste, mainly from the agro-food industry) and the mechanical-biological treatment plants, that treat the unselected waste to produce compost, refuse derived fuel (RDF), and a waste with selected characteristics for landfilling or incinerating system. It is assumed that 100% of the input waste to the composting plants from selected waste is treated as compost, while in mechanical-biological treatment plants 30% of the input waste is treated as compost on the basis of national studies and references. Information on input waste to composting plants are published yearly by ISPRA since 1996, including data for 1993 and 1994, while for 1987 and 1995 only data on compost production are available; on the basis of this information the whole time series has been reconstructed. Since no methodology is provided by the IPCC for these emissions, literature data have been used for the emission factor, 0.029 g CH_4 kg^{-1} treated waste, equivalent to compost production. [NIR 2012]
Luxembourg	Compost production sites generate N_2O and CH_4 emissions. The IPCC Tier 1 method has been applied to estimate both methane and nitrous oxide emissions from compost production. Default EFs have been used. Activity data is taken from STATEC Statistical Yearbook, Table A.3312 (these data are actually prepared by the Waste Division of the Environment Agency); and from Soil-Concept annual reports transmitted to the Waste Division of the Environment Agency. [NIR 2012]
Netherlands	This source category consists of the CH_4 and N_2O emissions from composting separately collected organic waste from households. A country-specific methodology for this source category is used with activity data based on the annual survey performed by the Working Group on Waste Registration at all the industrial composting sites in the Netherlands and emission factors based on the average emissions (per ton of composted organic waste) of some facilities in the late 1990s (measured during a large-scale monitoring programme in the Netherlands). Emissions from small-scale composting of garden waste and food waste by households are not estimated as these are assumed to be negligible. Since this source is not considered as a key source, the present methodology level complies with the IPCC Good Practice Guidance. [NIR 2012]
Portugal	CH_4 and N_2O emissions from landfill gas and other biogas burning: The capture and burning of landfill gas and biogas (e.g. from sewage sludge) is used for energy purposes or flaring (without energy recovery). For practical reasons all information related to the estimates of emissions from biogas combustion (with and without energy recovery) is presented here. However, the emissions related to energy recovery situations are accounted in sector 1A1a, and the emissions resulting from flaring are considered in category 6D. Emissions from the combustion of landfill gas and biogas with and without energy recovery have been estimated using emission factors based on the energy of the biogas consumed (combusted). [NIR 2012]
Spain	This category includes emissions from the spreading of sludge from waste water treatment plants. CH_4 emissions are estimated by applying an emission factor of 29 kg per tonne of dried mud as derived from the "Report on Complementary Information in the Frame of the Assistance provided for CORINAIR 90 Inventory, CITEPA". [NIR 2012]

Source: NIR 2012

8.4 EU-15 uncertainty estimates (EU-15)

Table 8.30 shows the total EU-15 uncertainty estimates for the sector Waste and the uncertainty estimates for the relevant gases of each source category. The highest level uncertainty was estimated for CO_2 from 6D Other and the lowest for CO_2 from 6A and 6B and for N_2O for 6A. With regard to trend N_2O from 6D shows the highest uncertainty estimates, CO_2 from 6A and 6B and for N_2O for 6A, the lowest. For a description of the Tier 1 uncertainty analysis carried out for the EU-15 see Chapter 1.7.

Table 8.30 Sector 6 -Waste: EU-15 uncertainty estimates

Source category	Gas	Emissions 1990	Emissions 2010	Emission trends 1990-2010	Level uncertainty estimates based on MS uncertainty estimates	Trend uncertainty estimates based on MS uncertainty estimates
6.A Solid Waste Disposal	CO_2	0	0		0%	0.0%
6.A Solid Waste Disposal	CH_4	142,272	81,960	-42%	21%	0.1%
6.A Solid Waste Disposal	N_2O	0	0		0%	0.0%
6.B Waste Water Handling	CO_2	0	0		0%	0.0%
6.B Waste Water Handling	CH_4	12,940	10,739	-17%	76%	0.3%
6.B Waste Water Handling	N_2O	9,950	9,932	0%	163%	0.1%
6.C Waste Incineration	CO_2	3,779	2,159	-43%	21%	0.1%
6.C Waste Incineration	CH_4	295	268	-9%	20%	0.2%
6.C Waste Incineration	N_2O	137	179	30%	93%	0.2%
6.D Other	CO_2	18	18	-1%	267%	0.1%
6.D Other	CH_4	108	740	585%	39%	2.0%
6.D Other	N_2O	46	459	906%	40%	3.7%
Total - 6	**all**	**169,546**	**106,453**	-37%	**23.6%**	**10.1%**

Note: *Emissions are in Gg CO_2 equivalents; trend uncertainty is presented as percentage points; the sum of the source category emissions may not be the total sector emissions because uncertainty estimates are not available for all source categories; uncertainty estimates for Portugal are not included.*

8.5 Sector-specific quality assurance and quality control (EU-15)

Under the Climate Change Committee a workshop was conducted in Spring 2005 on inventories and projections of greenhouse gas emissions from waste. The main objectives of the workshop were: (1) to provide an opportunity to learn about the methods used for inventories and projections in the different Member States, to share information, experience and best practice; (2) to compare the parameters chosen in the estimation methodologies across EU-15 Member States; (3) to compare emissions and methods used for GHG inventories with data and methods for EPER; and (4) to strengthen links between assessment of air pollution under the IPPC and emissions under the UNFCCC. In addition, the workshop provided an opportunity to discuss potential methodological changes or improvements of the draft 2006 IPCC inventory guidelines. The recommendations and presentations of this workshop can be downloaded from the Internet under the following link: http://air-climate.eionet.eu.int/docs/meetings/050502_GHGEm_Waste_WS/meeting050502.html. Clarifications from discussions of individual parameters used in the estimation of emissions from waste were incorporated in this report.

A second expert meeting under the Climate Change Committee on the estimation of CH_4 emissions from solid waste disposed to landfills was conducted in March 2006. This meeting was targeting in particular those EU Member States that do not yet use the IPCC FOD methods for their inventories (mostly new EU Member States). The objective of the expert meeting was to use the new default model provided by draft 2006 IPCC Guidelines for national GHG inventories in order to calculate CH_4 emissions for the participants' countries. 11 Member States, 2 EEA Member countries, and one accession country participated. 9 of the 14 countries had previously not estimated CH_4 emissions with a FOD method. The meeting enabled those Member States that still used Tier 1 method to use the FOD model with national/default data as available. Other Member States used the IPCC FOD model as quality check and for comparison with the results of the country-specific model with usually minor differences compared to the national model. The meeting also contributed to the exchange of experiences of specific circumstances regarding waste generation, composition and solid waste disposal in new Member States and on the estimation of CH_4 recovery in the absence of monitored data. In addition, the meeting provided recommendations to IPCC for further improvement and corrections of the draft default model.

8.6 Sector-specific recalculations (EU-15)

Table 8.31 shows that in the waste sector the largest recalculations in 1990 and 2009 were made for CH_4.

Table 8.31 Sector 6 Waste: Recalculations of total GHG and recalculations of GHG emissions for 1990 and 2009 by gas (Gg CO_2 equivalents and percentage)

1990	CO_2		CH_4		N_2O		HFCs		PFCs		SF_6	
	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent
Total emissions and removals	65,596	2.1%	-15,455	-3.4%	-3,212	-0.8%	-224	-0.8%	499	3.0%	-142	-1.3%
Waste	-18	-0.4%	-12,761	-7.5%	-77	-0.7%	NO	NO	NO	NO	NO	NO
2009												
Total emissions and removals	94,276	3.4%	-5,030	-1.6%	-2,289	-0.8%	3,203	4.9%	795	40.8%	-219	-3.6%
Waste	-338	-13.2%	-1,951	-2.0%	-475	-4.1%	NO	NO	NO	NO	NO	NO

NO: not occurring

Table 8.32 provides an overview of Member States' contributions to EU-15 recalculations. The large recalculations for the UK are due to a correction to the model for estimating emissions from landfills: the previous version of the model included an error that overestimated DDOC landfilled.

Table 8.32 **Sector 6 Waste: Contribution of Member States to EU-15 recalculations for 1990 and 2009 by gas (difference between latest submission and previous submission Gg of CO_2 equivalents)**

	1990						2009					
	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
Austria	0	0	0	NO	NO	NO	-8	-2	-3	NO	NO	NO
Belgium	0	-76	-1	NO	NO	NO	0	193	1	NO	NO	NO
Denmark	-4	365	0	NO	NO	NO	-7	-279	-1	NO	NO	NO
Finland	IE,NO	0	0	NO	NO	NO	IE,NO	-2	-1	NO	NO	NO
France	0	-439	-10	NO	NO	NO	-280	-1,537	-274	NO	NO	NO
Germany	NO	0	0	NO	NO	NO	NO	1,271	-7	NO	NO	NO
Greece	0	549	3	NO	NO	NO	0	984	10	NO	NO	NO
Ireland	NA,NE,NO	0	0	NO	NO	NO	NA,NO	-327	0	NO	NO	NO
Italy	-30	0	-1	NO	NO	NO	-32	495	-1	NO	NO	NO
Luxembourg	IE,NA,NO	0	0	NO	NO	NO	IE,NA,NO	0	0	NO	NO	NO
Netherlands	IE,NA,NO	0	16	NO	NO	NO	IE,NA,NO	-6	8	NO	NO	NO
Portugal	0	0	2	NO	NO	NO	4	-692	31	NO	NO	NO
Spain	0	-86	0	NO	NO	NO	-7	-1,452	-23	NO	NO	NO
Sweden	0	0	0	NO	NO	NO	0	0	3	NO	NO	NO
UK	15	-13,075	-88	NO	NO	NO	-9	-596	-220	NO	NO	NO
EU-15	**-18**	**-12,761**	**-77**	**NO**	**NO**	**NO**	**-338**	**-1,951**	**-475**	**NO**	**NO**	**NO**

NO: not occurring; NE: not estimated; NA: not applicable; IE: included elsewhere

9 Other (CRF Sector 7)

This sector does not include any emissions in 2010.

10 Recalculations and improvements

10.1 Explanations and justifications for recalculations

Table 10.1 to Table 10.2 provide an overview of the main reasons for recalculating emissions in the year 1990 and 2009 for each EU-15 Member State, which provided the relevant information, and by source categories, for the largest recalculations (>+/- 500 Gg CO_2 equiv.). For more details see the information provided by the Member States' submissions in Annex 1.12.

Table 10.1 Main recalculations by source category for 1990 and Member States' explanations for recalculations given in the CRF or in the NIR

		1990		Main explanations
		Gg CO_2 equiv.	Percent	
1A2_Manufacturing Industries and Construction CO_2	France	1,635	2.0	1990 : report grandes installations de combustion 1992 donc prise en compte des combustibles hors bilan de l'énergie (gaz industriels notamment) 2009 : Mise à jour bilan de l'énergie
1A3_Transport CO_2	France	1,301	1.1	Mise à jour des chiffres des Comptes des Transports de la Nation (CCTN)
1A2_Manufacturing Industries and Construction CO_2	UK	1,260	1.3	- Emission factors: Revision to coke emission factor due to updated GCV figures. Now reported to greater accuracy in national energy statistics - Activity data: Revisions made for some fuels from 2005 onwards in the national energy statistics. - Reallocation: Reallocations across sectors for Gas Oil. Reallocations within 1A2 to disaggregate emissions from 1A2f. More detail within the NIR.
1A1_Energy Industries CO_2	UK	1,250	0.5	- Methods: A gap in reporting of OPG use in refineries has been identified and resolved. This affects 2005 onwards; also some revisions to assumptions on EU ETS data for recent years in power stations and refineries. - Emission factors: Revisions have been made to solid fuel carbon factors as GCVs are now reported to a higher level of precision. - Activity data: Offshore installation data revised following consultation with the offshore regulatory agency and site operators. Activity data revised for powerstations from 2001 for gas oil.
1B2_Oil and natural gas CH_4	Germany	906	11.9	New country-specific emission factors
4D_Agricultural soils N_2O	UK	734	2.3	- Crop areas production and categories have been updated. The N_2O-N emitted during manure management is no longer subtracted from the N available to apply to soils. - Animal numbers and categories were revised and updated. The time spent grazing for dairy and beef cattle has been changed. AWMS distribution has been updated. Crop areas
1A3_Transport N_2O	Germany	562	82.7	- Emission factors: Revision of TREMOD; - Activity data: revision of energy balance
1A3_Transport CO_2	UK	-561	-0.5	Re-allocation of more petrol and DERV to off-road and inland waterways sectors. Revised vkm and vehicle fleet data.
4A_Enteric fermentation CH_4	Germany	-622	-2.3	Changes in activity data and background data
4B_Manure management N_2O	UK	-729	-27.1	Animal numbers and categories were revised and updated. Updated N excretion factors for cattle. AWMS distribution has been updated. The N_2O-N emitted during manure management is no longer subtracted from the N available to apply to soils.

		1990		Main explanations
		Gg CO_2 equiv.	Percent	
1A2_Manufacturing Industries and Construction CO_2	Italy	-849	-1.0	- Update of CO_2 emission factor for residual gas from chemical processes; update of CO_2 natural gas emission factor; update of CO_2 emission factors for petcoke, refinery gas and derived solid gases. - Reallocation of fuel oil and natural gas consumptions between energy production and manufacturing industries
1A1_Energy Industries CO_2	France	-957	-1.5	- 1A1a: Modification de l'activité pour les usine d'incinération des ordures ménagères. - 1A1b: En 1990, suppression du double compte des émissions d'un vapocraqueur qui était compté à la fois en raffinage et en industrie pétrochimique.
4D_Agricultural soils N_2O	France	-1,346	-2.4	Changement méthodo de l'estimation du N_2O issu de la décomposition des résidus de cultures
1A4_Other sectors CO_2	UK	-1,450	-1.3	- Revised assumptions: No domestic combustion of natural gas in Gibraltar. - Revisions to gas oil activity data based on new research. - Revisions made for some fuels in national energy statistics from 2005 onwards.
4B_Manure management CH_4	France	-1,516	-11.0	Création d'un modèle de calcul des émissions au niveau régional pour 41 catégories + Mise à jour des systèmes de gestion des déjections en batiment + Mise à jour des facteurs d'excrétion azotée
4A_Enteric fermentation CH_4	France	-1,595	-5.0	Création d'un modèle de calcul des émissions au niveau régional pour 41 catégories + Mise à jour des systèmes de gestion des déjections en batiment + Mise à jour des facteurs d'excrétion azotée
4D_Agricultural soils N_2O	Germany	-2,411	-4.8	Adjusted N-excretion model for 4D1.2 and 4D2; adjusted acitivity data for 4D1.4, 4D1.5, 4D3.1, 4D3.2.
6A_Solid waste disposal on land CH_4	UK	-13,075	-23.3	Correction to model. Previous version included an error that over estimated DDOC landfilled.

Table 10.2 Main recalculations by source category for 2009 and Member States' explanations for recalculations given in the CRF or in the NIR

		2009		Main explanations
		Gg CO_2 equiv.	Percent	
1A1_Energy Industries CO_2	UK	4,541	2.5	- Methods: A gap in reporting of OPG use in refineries has been identified and resolved. This affects 2005 onwards; also some revisions to assumptions on EU ETS data for recent years in power stations and refineries. - Emission factors: Revisions have been made to solid fuel carbon factors as GCVs are now reported to a higher level of precision. - Activity data: Offshore installation data revised following consultation with the offshore regulatory agency and site operators. Activity data revised for powerstations from 2001 for gas oil.
2F_Consumption of halocarbons HFC	UK	3,043	28.3	The refrigeration and air conditioning model has been re built to utilise bottom up data across all categories. All parameters have been reviewed and revised.
1A4_Other sectors CO_2	France	1,844	1.9	Mise à jour activité
2C_Metal production CO_2	Germany	1,790	14.8	Activity data: new statistical data available
6A_Solid waste disposal on land CH_4	Germany	1,281	15.1	Activity data: updated statistical data
1A4_Other sectors CO_2	Italy	1,191	1.4	- Update of CO_2 natural gas emission factor - Update of waste fuel consumption for commercial heating
4D_Agricultural soils N_2O	UK	1,150	4.6	- Crop areas production and categories have been updated. The N_2O-N emitted during manure management is no longer subtracted from the N available to apply to soils. - Animal numbers and categories were revised and updated. The time spent grazing for dairy and beef cattle has been changed. AWMS distribution has been updated. Crop areas
6A_Solid waste disposal on land CH_4	Greece	837	34.0	Updated AD were used in calculations, concerning the composition of MSW at disposal sites and the amounts of CH_4 recovered
2F_Consumption of halocarbons HFC	Greece	787	30.6	Mobile Air-Conditioning, HFC-134a: - Updated data provided by Association of Motor Vehicle Importers Representatives. - The percentage of HFCs penetration in the new equipment has been taken into account. - Emission factors: use of updated default value (GPG).

		2009		Main explanations
		Gg CO_2 equiv.	Percent	
1A4_Other sectors CO_2	Spain	742	2.1	1A4a, gaseous fuels: Data on energy from natural gas allocated within this category have been revised in order to: i) apply the annual mean values of NCV provided by the main gas transport company (default values for the national Inventory); ii) correct a mistake committed by the data source in the units associated to the figures related to cogeneration; iii) eliminate a double-accounting for a consumption of gas natural for cogeneration allocated to plants (incineration plants) that appear in the data on cogeneration reported by the data source for this category and, moreover, they have been already computed in the category of energy sector; and iv) include natural gas consumption of a few autoproducer plants allocated in this category. 1A4c, liquid fuels: Revision of diesel consumption data in the following activities: - Mobile forestry machinery: The extrapolated data for 2007, based in available time series to 2006, have now been updated according to new statistical data (source: MARM Statistical Yearbook). - Agricultural stationary combustion engines (except irrigation pump engines). Updating of the diesel consumption amount, calculated as a function of diesel consumption of mobile machinery (the latter having been updated). An additional recalculation has been effected on irrigation pump engines as data for 2009 have been come available (instead of extrapolated data of 2008)
4D_Agricultural soils N_2O	France	722	1.6	Changement méthodo de l'estimation du N_2O issu de la décomposition des résidus de cultures
1A2_Manufacturing Industries and Construction CO_2	Belgium	627	3.3	- During the 2012 submission some corrections were made of the emissions of CO_2 from the biggest plant in the iron & steel sector in the Flemish region; besides the revisions in 2009, corrections were made in the year 2007 for gaseous fuels and in the years 2005 and 2007 for liquid fuels. - During the 2012 submission a re-allocation took place in the Flemish region for the emissions from off-road (liquid fuels). The off-road emissions from construction are no longer allocated to the commercial/institutional sector (category 1A4a) but to the sector of manufacturing industry and construction/other (category 1A2f). - During the 2012 submission, the industrial off-road emissions are included for the for the first time in the Walloon region and in the Brussels region (see section 3.2.9. for more information). These emissions were already included in the inventory of the Flemish region in the 2011 submission.
1A5_Other CO_2	UK	622	25.6	Activity data revised. Military Casual Uplift included.
2B_Chemical industries CO_2	Belgium	586	31.5	- During the 2012 submission the emissions of CO_2 from the ammonia production in the Flemish region are revised from 2007 on. The company involved detected some errors in the calculation sheets. - During the 2012 submission some missing process emissions of CO_2 in the category 2B5 in the Flemish region were added from 2005 on. The emissions of more historical years (before 2005) will be discussed with the federation for the 2013 submission.

		2009		Main explanations
		Gg CO_2 equiv.	Percent	
2C_Metal production CO_2	France	-501	-15.0	2C1: Correction des consommations énergie et matière avec bilan 2009 actualisé
1A2_Manufacturing Industries and Construction CO_2	Germany	-532	-0.5	Activity data: new statistical data available
2F_Consumption of halocarbons HFC	France	-590	-3.9	- 2F1: Modif ication des données de l'EMP avec mises à jour de données statistiques et productions + correction des émissions f in de vie qui étaient surestimées par double-compte. - 2F2: Modif ication de la méthodologie -> les émissions de HFC des mousses OCF sont maintenant attribuées à la banque et non à la charge. - 2F4: Modif ication des données d'émissions d'un site qui a comptabilisé 2 fois les pertes matières ce qui a majoré sa déclaration d'émisisons.
1A3_Transport CO_2	Ireland	-590	-4.5	- New methodology based on airport to airport data - Revised Energy Balance data
1A4_Other sectors CO_2	Belgium	-596	-2.1	- During the 2012 submission a re-allocation took place in the Flemish region for the emissions from off-road. The off-road emissions from construction are no longer allocated to the commercial/institutional sector (category 1A4a) but to the sector of manufacturing industry and construction (category 1A2f) for the complete time series; - During the 2012 submission the off-road emissions are included for the first time in the Walloon region and in the Brussels region.
6A_Solid waste disposal on land CH_4	UK	-596	-3.8	Correction to model. Previous version included an error that over estimated DDOC landfilled.
1A1_Energy Industries CO_2	Belgium	-649	-2.5	In the Flemish region some corrections were made during the 2012 submission compared to previous submission in the category 1A1a: - a part of the emissions of CO_2 from other fuels (waste not biodegradable) was double counted for 2006 and 2007 and corrected during the 2012 submission; - some corrections in calculations for the emissions of CO_2 were made during the 2012 submission for the years 2007, 2008 and 2009 for natural gas (corrections of default values with emissions reported from companies involved) and for ‘other fuels’ (for 1 company ETS-emissions of CO_2 were taken over instead of using default emission factor); - emissions of CO_2 from CHP-installations in refineries (operational since 2000) were optimized during the 2012 submission and replaced by emissions reported by the companies involved in their annual integrated environmental reports.
1B2_Oil and natural gas CH_4	Germany	-711	-9.7	New country-specific emission factors
6A_Solid waste disposal on land CH_4	Spain	-761	-6.4	An improvement in methodology has been applied; new activity data was available.
4B_Manure management N_2O	France	-867	-14.5	Création d'un modèle de calcul des émissions au niveau régional pour 41 catégories + Mise à jour des systèmes de gestion des déjections en batiment + Mise à jour des facteurs d'excrétion azotée

		2009		Main explanations
		Gg CO_2 equiv.	Percent	
6A_Solid waste disposal on land CH_4	Portugal	-871	-16.5	1) Quantities of SW disposed into land: error of compilation in the 2011 subm. 2) Industrial waste: revision of the waste categories containing organic/fermentable fractions based in the categories. 3) Landfill gas recovered and combusted: new data (measured) collected for biogas flaring (without energy recovery).
1B1_Solid Fuels CH_4	UK	-908	-31.7	- New data used on mine closure dates and methane capture - Activity data revised in national energy statistics 2008 onwards
4A_Enteric fermentation CH_4	France	-958	-3.3	Création d'un modèle de calcul des émissions au niveau régional pour 41 catégories + Mise à jour des systèmes de gestion des déjections en batiment + Mise à jour des facteurs d'excrétion azotée
1A4_Other sectors CO_2	Austria	-987	-9.1	Revised energy balance. Exclusion of LPG for transport.
1A1_Energy Industries CO_2	Italy	-1,215	-0.9	- Update of CO_2 emission factors for pet coke, synthesis gases and derived gases: update of CO_2 natural gas emission factor - Reallocation of fuel oil and natural gas consumptions between energy production and manufacturing industries
6A_Solid waste disposal on land CH_4	France	-1,369	-8.0	- 6A1: Pour le CH_4, la baisse des émissions est à imputer à une surestimation (liée à une approche simplificatrice) des émissions de la re-soumission de mai 2011 compensée en partie par une hausse des émissions due à la révision à la hausse du COD (Carbone Organique Dégradable). - 6A2: Modification du COD de 110 à 114 avant 2000 (mais ef fet de cinétique)
1A1_Energy Industries CO_2	Germany	-1,626	-0.5	- 1A1a, gaseous fuels, activity data: New statistical data available. - 1A1c, solid fuels, activity data: New statistical data available.
1A2_Manufacturing Industries and Construction CO_2	Italy	-1,782	-3.2	- Update of CO_2 emission factor for residual gas from chemical processes; update of CO_2 natural gas emission factor; update of CO_2 emission factors for petcoke, refinery gas and derived solid gases. - Reallocation of fuel oil and natural gas consumptions between energy production and manufacturing industries
4D_Agricultural soils N_2O	Germany	-3,292	-7.6	Adjusted N-excretion model for 4D1.2 and 4D2; adjusted acitivity data for 4D1.4, 4D1.5, 4D3.1, 4D3.2.
1A4_Other sectors CO_2	Germany	-4,252	-2.9	New statistical data available.

10.2 Implications for emission levels

Table 10.3 provides the differences in total EU-15 GHG emissions between the latest submission and the previous submission in absolute and relative terms. The table shows that due to recalculations, total EU-15 1990 GHG emissions excluding LULUCF have decreased in the latest submission compared to the previous submission by -15567 Gg (-0.4 %). EU-15 GHG emissions for 2009 decreased by -4560 Gg (-0.2 %) due to recalculations.

Table 10.3 Overview of recalculations of EU-15 total GHG emissions (difference between latest submission and previous submission in Gg CO_2 equivalents)

	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Total CO_2 equivalent emissions including LULUCF (absolute)	47,061	65,741	77,385	70,745	70,782	93,040	88,163	85,527	91,516	83,950	93,416	90,734
Total CO_2 equivalent emissions including LULUCF (percent)	1.2%	1.7%	2.0%	1.8%	1.8%	2.3%	2.2%	2.2%	2.4%	2.2%	2.5%	2.6%
Total CO_2 equivalent emissions excluding LULUCF (absolute)	-15,567	-6,190	-526	-2,473	-5,455	4,459	3,520	2,688	5,009	3,602	1,064	-4,560
Total CO_2 equivalent emissions excluding LULUCF (percent)	-0.4%	-0.1%	0.0%	-0.1%	-0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.0%	-0.1%

Table 10.4 provides an overview of recalculations for the EU-15 key categories for 1990 and 2009 (see Section 1.5 for information on identification of EU-15 key categories). The table shows that the largest recalculations in absolute terms were made in the key category CH_4 from 6A 'Solid Waste Disposal on Land' for 1990 and in the key category CO_2 from 1A4 'Other Sectors' for 2009.

Table 10.5 and Table 10.6 give an overview of absolute and percentage changes of Member States' emissions due to recalculations for 1990 and 2009. Large recalculations in absolute terms were made in Germany, France, the UK and Spain. Recalculations in relative terms of more than 1,5 % were made in the UK, Greece, and Luxembourg.

Table 10.4 Recalculations for the EU-15 key source categories 1990 and 2009 (difference between latest submission and previous submission in Gg of CO_2 equivalents and in percentage)

Greenhouse Gas Source Categories	Gas	Recalculations 1990		Recalculations 2009	
		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
1A1 Energy Industries	CO_2	1068	0.1%	1265	0.1%
1A1 Energy Industries	N_2O	39	0.4%	104	1.2%
1A2 Manufacturing Industries	CO_2	2277	0.4%	-1736	-0.4%
1A3 Transport	CO_2	1389	0.2%	-32	0.0%
1A3 Transport	CH_4	-21	-0.5%	120	10.2%
1A3 Transport	N_2O	922	15.4%	-2	0.0%
1A4 Other Sectors	CO_2	-1594	-0.2%	-3179	-0.5%
1A4 Other Sectors	CH_4	-18	-0.2%	201	2.8%
1A5 Other	CO_2	-108	-0.5%	836	13.1%
1B1 Solid Fuels	CH_4	-5	0.0%	-959	-12.3%
1B2 Oil and Natural Gas	CH_4	881	2.9%	-616	-2.9%
2A Mineral Products	CO_2	415	0.4%	191	0.2%
2B Chemical Industry	CO_2	138	0.5%	980	3.3%
2B Chemical Industry	N_2O	-49	0.0%	212	0.9%
2C Metal Production	CO_2	-238	-0.4%	1284	4.1%
2C Metal Production	PFC	-100	-0.7%	-83	-12.2%
2C Metal Production	SF_6	12	0.7%	22	5.0%
2E Production of Halocarbons and SF6	HFC	80	0.3%	-46	-2.5%
2F Consumption of Halocarbons and SF6	HFC	-447	-69.4%	3080	4.8%
2E Production of Halocarbons and SF6	PFC	1	0.0%	-49	-0.9%
2F Consumption of Halocarbons and SF6	SF_6	1	0.0%	-49	-0.9%
4A Enteric Fermentation	CH_4	-1761	-1.3%	-1091	-0.9%
4B Manure Management	CH_4	-2022	-4.8%	-884	-2.1%
4B Manure Management	N_2O	-1152	-4.7%	-952	-4.4%
4D Agricultural Soils	N_2O	-2611	-1.1%	-1338	-0.7%
6A Solid Waste Disposal on Land	CH_4	-12774	-8.2%	-1355	-1.6%
6B Waste-water Handling	CH_4	183	1.4%	319	3.1%
6B Waste incineration	CO_2	-15	-0.4%	-324	-12.8%

Note: Many of these source categories are more aggregated than the EU-15 key source categories identified in Section 1.5.

Table 10.5 Contribution of Member States to EU-15 recalculations of total GHG emissions without LULUCF for 1990–2009 (difference between latest submission and previous submission Gg of CO_2 equivalents)

	1990	1995	2000	2005	2006	2007	2008	2009
Austria	-8	-5	-7	-4	-44	-8	-5	-320
Belgium	-63	460	739	893	1,102	1,018	1,531	747
Denmark	598	394	243	106	53	93	-100	-302
Finland	1	33	77	146	124	52	-177	-218
France	-3,896	-4,305	-2,038	-1,863	-561	-2,502	-1,881	-2,680
Germany	-1,763	-2,471	-3,072	-2,499	-3,362	-2,881	-5,145	-7,896
Greece	640	794	1,050	1,305	1,405	1,652	2,713	2,149
Ireland	342	281	238	94	213	268	-250	-653
Italy	89	1,963	-70	-144	77	1,192	-160	409
Luxembourg	6	0	-170	-202	-220	-187	-212	-169
Netherlands	168	138	40	-141	-169	114	-32	59
Portugal	660	997	1,069	557	237	-88	-111	-211
Spain	-347	-573	1,268	1,581	1,205	-803	-952	-1,282
Sweden	264	116	59	-207	-10	-196	29	-323
UK	-12,258	-4,011	47	3,067	4,958	5,877	5,815	6,128
EU-15	**-15,567**	**-6,190**	**-526**	**2,688**	**5,009**	**3,602**	**1,064**	**-4,560**

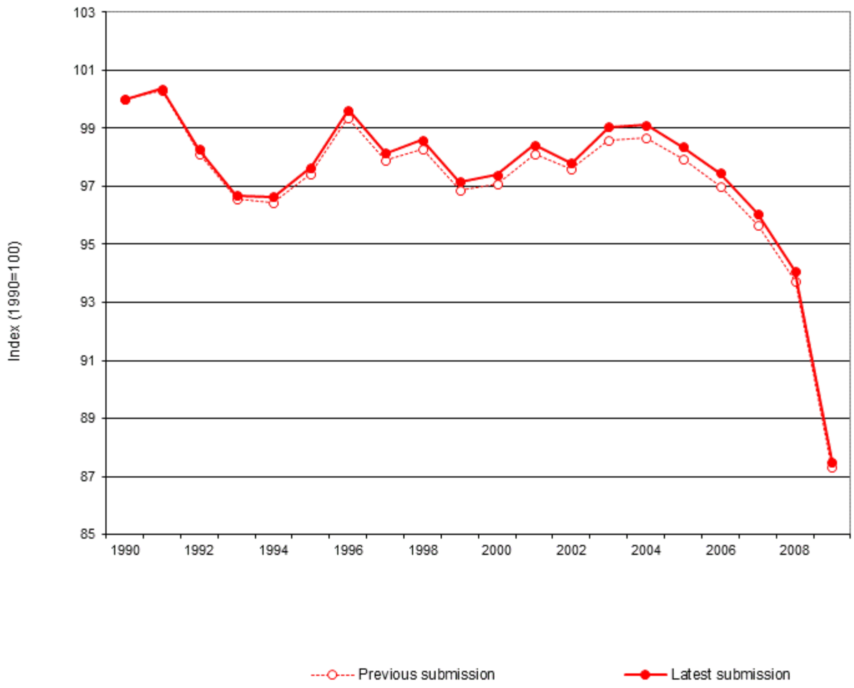
Table 10.6 Contribution of Member States to EU-15 recalculations of total GHG emissions without LULUCF for 1990–2009 (difference between latest submission and previous submission in percentage)

	1990	1995	2000	2005	2006	2007	2008	2009
Austria	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.4
Belgium	0.0	0.3	0.5	0.6	0.8	0.8	11	0.6
Denmark	0.9	0.5	0.4	0.2	0.1	0.1	-0.2	-0.5
Finland	0.0	0.0	0.1	0.2	0.2	0.1	-0.3	-0.3
France	-0.7	-0.8	-0.4	-0.3	-0.1	-0.5	-0.3	-0.5
Germany	-0.1	-0.2	-0.3	-0.2	-0.3	-0.3	-0.5	-0.9
Greece	0.6	0.7	0.8	10	11	12	2.1	18
Ireland	0.6	0.5	0.4	0.1	0.3	0.4	-0.4	-10
Italy	0.0	0.4	0.0	0.0	0.0	0.2	0.0	0.1
Luxembourg	0.0	0.0	-17	-15	-17	-15	-17	-14
Netherlands	0.1	0.1	0.0	-0.1	-0.1	0.1	0.0	0.0
Portugal	11	14	13	0.6	0.3	-0.1	-0.1	-0.3
Spain	-0.1	-0.2	0.3	0.4	0.3	-0.2	-0.2	-0.3
Sweden	0.4	0.2	0.1	-0.3	0.0	-0.3	0.0	-0.5
UK	-16	-0.6	0.0	0.5	0.8	0.9	0.9	11
EU-15	**-0.4**	**-0.1**	**0.0**	**0.1**	**0.1**	**0.1**	**0.0**	**-0.1**

10.3 Implications for emission trends, including time series consistency

Table 10.7 shows that due to the fact that both the 1990 and 2009 emissions have slightly decreased, the emission trend in the EU-15 did hardly change. In the previous submission the trend of GHG excluding LULUCF between 1990 and 2009 was – 12,7 %. In the latest submission the trend is -12,5 %.

Table 10.7 Comparison of EU-15 GHG emission trends 1990–2009 (excl. LULUCF) of the latest and the previous submission



10.4 Recalculations, including in response to the review process, and planned improvements to the inventory

10.4.1 EU response to UNFCCC review

As the EU has not yet received the draft review report 2011 Table 10.8 provides an overview of the improvements in the 2012 submission including responses to UNFCCC findings.

Table 10.8 Improvements in 2012 including in response to UNFCCC review findings

NIR chapter / Sectors	Source category / Issues	Reccomendations/ improvements planned	References	Status
General	Completeness	The completeness of the Party's inventory is dependent on the completeness of the member States' inventories. In response to a question raised by the ERT during the review, the European Union confirmed that member States' emissions are set to zero in the summation process where member States report notation keys. As a result, the European Union's CRF tables contain emission estimates for only part of the European Union for these categories, which suggests that these categories might be underestimated at the European Union level. The European Union further explained that several categories reported as "NE" should have been reported as not occurring ("NO"). It seems that the notation keys are used in different ways by the member States. The ERT therefore recommends that the European Union continue to undertake activities to harmonize the use of notation keys between the member States. The ERT requested further clarification from the European Union as part of the list of the potential problems. (para 11)	ARR 2010	implemented in 2012 Apart from the ongoing checks of NE we have included checks of NO and NA.
General	QA/QC	The European Union provided information on QA/QC procedures in line with the "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories" (hereinafter referred to as the UNFCCC reporting guidelines). An elaborated QA/QC plan is in place in accordance with decision 19/CMP.1 and the IPCC good practice guidance. It is not part of the submission but was sent to the ERT during the review in response to a request. The QA/QC plan is very detailed and includes general QC procedures (tier 1) as well as category-specific procedures (tier 2). QA by internal and external review is also described in the NIR. The GHG inventory now includes reported data from the European Union emissions trading scheme (EU ETS) for the period 2005–2008. EU ETS data are widely used throughout the member States. The ERT encourages the European Union to continue to work with member States in order to improve the quality of its inventories and the European Union's QA/QC procedures through the use of EU ETS data to extent possible. (para 24)	ARR 2010	ongoing This issue is also subjject of the ESD review.
General	Uncertainty analysis	Include LULUCF in the trend uncertainty analysis	Kick-off meeting 2011	implemented in 2012

General	Uncertainty analysis	The European Union has performed a tier 1 uncertainty analysis for the GHG inventory based on the tier 1 uncertainty estimates of the EU-15. The NIR provides information on the uncertainty analysis based on each member State's individual uncertainties for each category. An incomplete table in the NIR presenting an overview of uncertainty estimates available from the EU-15 member States was completed during the review following a request from the ERT. Uncertainty estimates are also listed in each sectoral chapter. The ERT encourages the European Union to perform a tier 2 uncertainty analysis based on the Monte Carlo approach (which was used for the waste sector). The description of the uncertainty analysis in chapter 1.7 of the NIR should be more transparent (e.g. the inclusion of a table with the uncertainties at the individual category level which are used to compile the uncertainty estimate of the European Union as a whole) and focus on the description of the overall uncertainty analysis of the European Union (e.g. by carrying out a Monte Carlo analysis). (para 22)	ARR 2010	implemented in 2012
General	Key category analysis	The European Community has reported key category tier 1 and tier 2 analyses, both level and trend assessment, as part of its 2009 submission. The key category analyses performed by the European Community and that performed by the secretariat6 produced similar results. The European Community has included the LULUCF sector in its key category tier 1 analysis, which was performed in accordance with the IPCC good practice guidance and the IPCC good practice guidance for LULUCF. The ERT noted that the disaggregation of categories is not the same for tier 1 and tier 2. During the review, the European Community indicated that tier 1 uncertainty analysis does not have the uncertainty estimates for all categories at the required level of detail. In addition to this, the key category tier 2 analysis does not include the LULUCF sector. The European Community plans to include the LULUCF sector in its next submission. The ERT appreciates the planned improvement and recommends that it be implemented in the next annual submission.(para 19)	ARR 2009	will be implemented in 2013
Chapter 3 / Sector Energy	International bunker fuels	The NIR includes a brief summary of a study on bunker fuel emissions conducted in 2007 by the ETC/ACC comparing the aviation emissions reported by member States with modelling results provided by Eurocontrol and discussed in the previous review report. The ERT again recommends that the European Union continue such QA exercises, that it try to address the issues identified, and that it continue to work on making data from Eurocontrol available to member States on a regular basis. (para 37)	ARR 2010	EEA is working on this issue and has obtained Eurocontrol data for quality checking
Chapter 3 / Sector Energy	1A2	The ERT recognized that some member States report emissions that are not disaggregated to appropriate subcategories, which has a significant impact on the EC-15 emission estimates. The following emissions are reported as included elsewhere ("IE"): non-ferrous metals by the United Kingdom and Portugal; chemicals by the United Kingdom and Germany; pulp, paper and print by the United Kingdom; and food processing, beverages and tobacco by the United Kingdom. Because large amounts of emissions are reported as "IE", information on emissions and trends in this sector does not necessarily reflect the actual emissions. The ERT recommends that the European Community continue its efforts to provide appropriately disaggregated data. All member States have the same obligations to report fuel consumptions to Eurostat, so the ERT believes that there should be no institutional/capacity barriers to prevent those countries from reporting appropriately disaggregated AD and corresponding GHG emissions. During the review, the European Community informed the ERT that the recently introduced EU Energy Statistics Regulation (22 October 2008) should lead to improvements in the quality of the energy data from 2009 onwards. (ARR 2008 para 38)	ARR 2008	UK implemented detailed fuel split in 2012

Chapter 4 / Industrial processes	2A3	Additionally, the French IEF (0.05 t/t) is the lowest among all reporting Parties (0.31–0.59 t/t) and lower than the IPCC default EF of 0.44 t/t. During the review, the European Union clarified that the AD reported by France refer to the quantity of limestone used for strings in the process of agglomeration. The use of these AD does not justify the very low French IEF of 0.05 t/t compared to the other reporting Parties. In order to improve transparency, the ERT recommends that the European Union provide explanations of the methods, AD and EFs used for estimating CO_2 emissions from limestone and dolomite use in France. (para 46)	ARR 2010	implemented
Chapter 4 / Industrial processes	2A7	The NIR does not explicitly mention CO_2 emissions from glass production in Ireland, Sweden or the United Kingdom. The EC explained during the initial review that CO_2 emissions from glass production were included in other categories in Sweden and the United Kingdom and that Ireland had not yet estimated these emissions. The ERT notes that this does not comply with the UNFCCC reporting guidelines and recommends that the EC include this information in the NIR and encourage Ireland to estimate this category. (IRR 2007 para 77)	IRR 2007	implemented
Chapter 7 / LULUCF	Completeness	In response to recommendations made in previous review reports, the 2010 NIR of the European Union shows continued improvements in the completeness of reporting of emissions and removals of all categories/subcategories, and in the reporting of carbon pools. However, some categories/subcategories are still reported as “NE” by several member States, such as the carbon stock changes in dead organic matter (DOM), as well as the emissions due to biomass burning in several land-use categories, and significant gaps exist in the reporting of all carbon pools. The European Union has provided information on its continuous efforts to encourage all member States to improve their LULUCF inventories, including for the reporting of activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol for future submissions. The ERT welcomes the improvements in the reporting of the LULUCF sector and recommends that the European Union continue to encourage its member States to develop the ability of the various national systems to report complete emissions and removals from the LULUCF sector and identify activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol. It further encourages the Party to provide further support to those member States that are still unable to fulfil the requirements of reporting a complete LULUCF inventory under the Convention. (para 69)	ARR 2010	Ongoing, with some improvement on CL and GL.
Chapter 7 / LULUCF	Consistency / QA/QC	In response to recommendations made in previous review reports regarding discrepancies between the values of net CO_2 emissions and removals in the land-use change matrix of lands from forests in table 7.4 of the NIR for the years 1990 and the corresponding totals in CRF table 5 for the same year, improvements have been made in harmonizing the information in the 2010 inventory. Discrepancies between NIR table 7.4 and CRF table 5 still exist, but are much smaller than in the previous annual submissiion. The ERT commends the European Union for these improvements and recommends that the Party continue to provide support to member States to improve consistency between the NIR and the CRF tables. (para 71)	ARR 2010	Implemented.

Chapter 7 / LULUCF	5A1	In response to a question raised by the ERT regarding the significant decrease in DOM for forest land remaining forest land between 1999 and 2000, the European Union explained that this change is due to France reporting a significant decrease in the DOM pool after a storm event in 1999. The European Union provided the answer given by France in response to its question on the same issue. France informed the European Union that the change was due to a large storm which increased the amount of dead wood at the end of 1999. France noted that the amount of dead wood in the forest was high in 2000 and has decreased since then towards its lower original stock. This answer does not explain why the 2000 value should drop so significantly. The ERT recommends that the European Union explain the dynamics of the DOM pool in France since 1999 in response to the storm, and provide the details in its NIR in the next annual submission. (para 74)	ARR 2010	Implemented.
Chapter 7 / LULUCF	5A1	An issue identified in previous review reports continues to be observed in the current inventory. In table 7.2 of the NIR, Italy's share of LULUCF sinks is reported to be 34.1 per cent of the total share of all 15 member States. According to Italy's 2008 inventory submitted in 2010, the area of forest land remaining forest land equals 8,838.7 kha, the implied carbon stock change factor for living biomass is 0.96 Mg C/ha, and the implied carbon stock change factor for soils is 0.86 Mg C/ha. By comparison, France's implied carbon stock change factor is 0.33 Mg C/ha for living biomass, and 0.01 Mg/C/ha for soils. As noted in the previous review report, Italy's approach assumes that soils build up their carbon stock almost as fast as vegetation. This assumption is not supported by adequate evidence and thus may lead to an overestimation of the increase in soil carbon stocks under growing forest vegetation. Hence, the approach is not fully consistent with the IPCC good practice guidance for LULUCF. The ERT recommends that the European Union continue to work with member States like Italy, which have elected to report forest management under Article 3, paragraph 4, of the Kyoto Protocol to improve the reporting of forest land remaining forest land and to ensure that the reported values are as accurate as possible. (para 76)	ARR 2010	Ongoing, EU internal review exercise is planned in August-September.
Chapter 7 / LULUCF	5B2	Most member States report land conversions to cropland with emissions exceeding any reported removals. In an improvement compared to last year's report, the NIR includes table 7.9, which lists the EFs used by member States for many subcategories. The ERT commends the European Union for this improvement, and some member States still use lower-tier method to estimates emissions/removals. Given the importance of this category for the European Union, the ERT encourages the Party to continue to support member States in improving the reporting in this area by using a higher-tier method where possible, as well as by improving the completeness of reporting. (para 80)	ARR 2010	Implemented.
Chapter 7 / LULUCF	5E2	The previous ERT noted that, although most member States report emissions and removals from the conversion of land to settlements, the corresponding EFs are not provided in the NIR. The ERT reiterates the recommendations of the last two review reports that member States include the EFs used in their NIRs in order to improve the transparency of reporting. (para 82)	ARR 2010	Ongoing. Some MS do not reports emissions from such conversions, as far as there is a lack of methods in IPCC GPG 2003, and an inconsistency as far as such pools have to be reported under KP (under deforestation). Within EU there

				is an effort to share the estimation methods used by reporting countries.
Chapter 8 / Waste	6A1	Industrial waste is neither mentioned nor considered by six member States in the NIR in solid waste disposal on land (Greece, Ireland, Italy, Luxembourg, Netherlands and Spain). The ERT strongly recommends that the European Union investigate the reasons for this and that the Party encourage member States to eliminate the potential underestimations in this key category for the sake of inventory completeness. (para 87)	ARR 2010	Additional data provided for Ireland, Italy, Luxembourg and Spain in NIR 2011. The NL provided further clarification during the review of the EU GHG inventory that industrial waste is included in 6A1. Greece provided revised estimates in response to the EU Saturday paper 2011.
Chapter 8 / Waste	6B	Six member States (Finland, Greece, Italy, Netherlands, Portugal and Spain) reported CH_4 emissions from industrial wastewater in 2008 while Denmark reported these emissions as "IE", Austria as 'NA', France, Germany, Ireland and Luxembourg as 'NO' and three member States reported these emissions as 'NE' (Belgium, Sweden and the United Kingdom). Six member States (Austria, France, Italy, Luxembourg, Portugal and Sweden) reported N_2O emissions from industrial wastewater, while the remaining member States reported these emissions as "NA", "NE" and "IE". The ERT recommends that the European Union encourage those member States reporting these emissions as "NE" to provide emission estimates. (para 91)	ARR 2010	Additional information has been included in NIR; only BE is indicating 'NE' for CH_4 emissions from 6B1. The Belgian NIR 2012 includes further information on this issue:`According to waste water specialists in the Flemish region, almost all industrial waste water is treated in an aerobic way i.e. without any emissions of CH_4. The very limited part of installations with anaerobic waste water treatment is using fermentation tanks that recovers mostly its emissions by

				flaring activities. As a consequence also in the Flemish region no or negligible amounts of emissions take place in this subcategory.`
Chapter 11 / KP-LULUCF	Transparency	Tables 11.9 and 11.10 of the NIR list the different approaches used by member States to identify land and units of land. Most member States use a national forestry inventory (NFI) to identify land subject to activities under Article 3, paragraph 3, of the Kyoto Protocol (afforestation and reforestation, and deforestation). While land areas are provided, limited information on whether the countries have provided georeferencing or geographical boundaries for multiple or single activities is provided. The ERT recommends that the European Union work with member States to provide more detailed information on geographical boundaries for land subject to activities under Article 3, paragraph 3, of the Kyoto Protocol, including maps and/or databases to identify the geographical locations and the system of identification codes for the geographical locations. (para 95)	ARR 2010	Ongoing. Land identification methods are better reported by the MS, following the UNFCCC review over last two years and the EU QAQC check.
Chapter 11 / KP-LULUCF	Completeness	Not all member States have reported the carbon stock changes for each of the five carbon pools as required for all activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol. This issue is further addressed in the individual review report of the member States. The ERT recommends that the European Union work with member States to report on all pools for activities under Article 3, paragraphs 3 and 4, or to demonstrate that a particular pool is not a net source. (para 96)	ARR 2010	Ongoing. There is a significant improvement in reporting, with MS providing either individual estimate for each pool or better justification for the inclusion of some pools under other pool.

Chapter 11 / KP-LULUCF	Uncertainty analysis	Not all member States have provided an uncertainty analysis for Kyoto Protocol estimates. The European Union notes that several member States are planning to include uncertainty estimates in their next annual submission. The ERT encourages the European Union to work with member States in order to include uncertainty analyses for activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol. (para 96)	ARR 2010	A model is already developed to cover entire LULUCF sector (land and gases) and an estimation will be adedd in the next submission.
Chapter 11 / KP-LULUCF	Afforestation / Reforestation	The European Union has included in its NIR a table (11.16) listing the justifications provided by member States as to why afforestation and reforestation activities are directly human-induced. Several member States have not provided adequate information on the size and geographical location of forest areas that have lost forest cover but which are not yet classified as deforested. As the European Union has noted in the NIR, further improvement is needed in this area and the ERT recommends that the European Union work with member States to provide more complete information on this category. (para 97)	ARR 2010	Ongoing. EU does effort to ensure that all MS report all items required under Decission 15/CMP1 by sharing experinece and organizing meetings, bilateral/multilateral activities.
Chapter 11 / KP-LULUCF	Deforestation	The European Union has also included information (table 11.17 of the NIR) on how harvesting or forest disturbance is distinguished from deforestation. The information provided is not complete for all member States. The ERT recommends that the European Union support member States in improving the reporting in this category. (para 98)	ARR 2010	Implemented.
Chapter 11 / KP-LULUCF	Deforestation	The ERT notes that there are inconsistencies and inappropriate uses of notation keys in some CRF cells for this category. The European Union has acknowledged this issue and states that it has raised it with individual member States. The ERT recommends that the European Union continue to work with member States to ensure that the appropriate notation keys are used and, where appropriate, to provide explanations for missing data. (para 99)	ARR 2010	Ongoing. A decission tree on harmonized use of the notation keys was developed by the MS and currently implemented by MS.

10.4.2 Member States' responses to UNFCCC review

Since the improvement of the EU inventory depends on Member States' efforts regarding completeness of estimation and improvement of methods and parameters used, Table 10.9 provides an overview of Member States' responses to the UNFCCC review ([33]). The table shows that a considerable amount of improvements were made compared since the previous submissions of Member States. In addition to the response to the UNFCCC review, a large number of additional improvements were implemented by Member States. However, an aggregation of all improvements conducted in all Member States would be too much information and too detailed to be included in this report.

([33]) Issues related to the NIR are not included in this table as already addressed in Table 1.11.

Table 10.9 General improvements related to national inventory system made by EU-15 Member States in response to the UNFCCC review

Member State	Cross-cutting issues as identified by the review team	Improvements in response to UNFCCC review as indicated in the NIR
Austria	Review report (Centralized review 2011) not yet available.	
Belgium	Review report (Centralized review 2011) not yet available.	
Denmark	Review report (Centralized review 2011) not yet available.	
Finland	The ERT identified the following cross-cutting issues for improvement: (a) The further improvement of transparency in the energy sector and the industrial processes sector, by including in the NIR the information provided to the ERT during the review;	For industrial processes information provided during the review has been included in the NIR 2012. [NIR 2012, p.398]
	(b) The further improvement of transparency in the LULUCF sector and on activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol;	The LULUCF section has been re-written to be more transparent. Under KP the identification of ARD has been described in higher detail. [NIR 2012, p.398]
	(c) The development of uncertainty estimates for activities under Article 3, paragraphs 3 and 4; **(FCCC/ARR/2011/FIN, para 114)**	The development of the uncertainty estimation method and procedure is ongoing. [NIR 2012, p.398]
France	Review report (Centralized review 2011) not yet available.	
Germany	Review report (Centralized review 2011) not yet available.	
Greece	The ERT identified the following cross-cutting issues for improvement: (a) The action needed to ensure that, in the future, all parts of the Party's inventory submission will be submitted by 15 April;	To be checked after 15April.
	(b) The continuation of efforts to strengthen the national system so that it can perform fully all its required functions, particularly those related to reporting on the LULUCF sector and activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, and those with regard to the timeliness of the annual submission;	Not yet addressed.
	(c) The implementation of sector-specific QA/QC procedures for all key categories and for the LULUCF sector and the provision of additional information on the QA/QC procedures for the data supplied by external sources (in particular the EU ETS);	Since at the time of the writing of this report the 2011 ERT review report was not finalized (draft), the numbering of the ERT suggestions and the text may change. For the same reason the recommendations concerning LULUCF were not included in the table. [NIR 2012, p.322]
	(d) The improvement of transparency in the energy (see paras. 31 and 36–42 above), agriculture (see paras. 55 and 57 above), LULUCF (see paras. 66–67, 72–74 and 79–80 above) and waste (see paras. 82 and 88 above) sectors and KP-LULUCF activities (see paras. 90 and 92–95 above);	See Energy: Details of the use of ETS reporting in energy sector's inventory calculations are provided in Annex II. …Inconsistencies in tables 1Ab, 1Ac and 1Ad have been corrected. A description of how "Apparent energy consumption" is calculated has been added in section 3.2.1. Table 3.9 was updated, accordingly. Natural gas used as feedstock for hydrogen production was reallocated to the IP sector. ….. Agriculture: Further improvements (corrections of values, QA/QC checks, further descriptions of swine and cattle) are done. Waste: Recalculations of CH_4 and N_2O emissions are done. [NIR 2012, p.324, Tab. 9.8] LULUCF and KP-LULUCF: The QA/QC procedures implemented in the LULUCF sector and their corresponding findings are not documented in the NIR.

Member State	Cross-cutting issues as identified by the review team	Improvements in response to UNFCCC review as indicated in the NIR
	(e) The provision of the planned inventory improvements, together with a prioritization and a time frame for implementing the improvements in the next annual submission. **(FCCC/ARR/2011/GRC, para 120)**	Not mentioned in the NIR.
Ireland	Review report (Centralized review 2011) not yet available.	
Italy	Review report (Centralized review 2011) not yet available.	
Luxembourg	Review report (In-country review 2011) not yet available.	
Netherlands	Review report (Centralized review 2011) not yet available.	
Portugal	Review report (Centralized review 2011) not yet available	
Spain	Review report (In-country review 2011) not yet available.	
Sweden	Review report (Centralized review 2011) not yet available	
United Kingdom	Review report (Centralized review 2011) not yet available	

10.4.3 Improvements planned at EU level

The following activities are planned at EU level with a view to improving the EU GHG inventory:

- Further implement the recommendations from the past reviews;
- Continue sector-specific QA/QC activities within the EU internal review;
- Further develop the EU QA/QC activities on the basis of the experience in 2011/2012

PART 2: SUPPLEMENTARY INFORMATION REQUIRED UNDER ARTICLE 7, PARAGRAPH 1

11 KP-LULUCF

This chapter presents:

- The activities elected by European Union Member States (MS) under Art. 3.4 and the accounting frequency,
- An overview of emissions / removals and information reported in the KP LULUCF tables submitted by EU-15 Member States for 2008 -2010
- A synthesis of the supplementary information required for 3.3 activities and any elected 3.4 activities, as reported by EU-15 Member States in their NIRs,
- Short information on KP LULUCF activities by EU-12 MS (in fact only for 10 MS, since Malta and Cyprus are not included because do not have commitments under Kyoto Protocol)

As shown by Table 11.1, 17 member states of EU-27 have elected forest management (FM), while only 3 have elected cropland management (CM), 2 have elected grazing land management (GM) and 1 revegetation (RV). Only 3 MS have chosen to account annually.

Table 11.1 **Activities elected under Art. 3.4 and accounting frequency. FM: forest management, CM: cropland management, GM: grazing land management, RV: revegetation, CP: commitment period.**

Member State		Art 3.4 elected activities	Accounting frequency
EU-15 Member States	Austria	-	end of CP
	Belgium	-	end of CP
	Denmark	FM, CM, GM	annual
	Finland	FM	end of CP
	France	FM	annual
	Germany	FM	end of CP
	Greece	FM	end of CP
	Ireland	-	end of CP
	Italy	FM	end of CP
	Luxemburg	-	end of CP
	Netherlands	-	end of CP
	Portugal	FM, CM, GM	end of CP
	Spain	FM, CM	end of CP
	Sweden	FM	end of CP
	United Kingdom	FM	end of CP

New Member States	Bulgaria	-	end of CP
	Czech Republic	FM	end of CP
	Estonia	-	end of CP
	Hungary	FM	annual
	Latvia	FM	end of CP
	Lithuania	FM	end of CP
	Poland	FM	end of CP
	Romania	FM, RV	end of CP
	Slovakia	-	end of CP
	Slovenia	FM	end of CP

It is important to note that the EU will neither issue nor cancel units based on the emissions and removals reported by EU-15 or EU-27 for KP-LULUCF activities. Therefore, all the emissions / removals and any information on KP LULUCF activities presented here are shown for information purpose *only*.

11.1 Overview of emissions / removals and information reported by EU-15 MS in the KP LULUCF tables

11.1.1 Coverage of carbon pools and GHG reported (KP CRF NIR 1)

All EU-15 countries report on all mandatory and elected activities (Table 11.2). In general, biomass carbon stock changes are directly estimated, whereas IE or NR notation keys are sometimes used for the three other pools. Concerning the GHG emissions from sources, the situation is rather country-specific. Compared to previous reporting year the coverage, notation keys and transparency of KP CRF improved. NE is used in more harmonized way by the MS for GHG sources when emissions are considered to be "*negligible*" or in case that there is no IPCC methods available to estimate it, but NE may still include few cases when the estimation is not yet performed (i.e. Greece reported R for some pools under D, but indeed no estimate is provided in the sectorial tables). IE is used when there is no possible separation on pools.

Table 11.2 **Synthesis of pools and GHG coverage for KP LULUCF activities for 2009 in EU-15 MS (from tables NIR 1)**

Member States	Change in carbon pool reported(1)						Greenhouse gas sources reported(2)						
	Above-ground biomass	Below-ground biomass	Litter	Dead wood	Soil Min	Soil Org	Fertilization	Drainage of soils under forest management	Disturbance associated with land-use conversion to croplands	Liming	Biomass burning		
							N2O	N2O	N2O	CO2	CO2	CH4	N2O
Afforestation/reforestation													
Austria	R	R	R	NO	R	NO	NO	0	0	NO	NO	NO	NO
Belgium	R	R	R	NO	R	NO	NO	0	0	NO	NO	NO	NO
Denmark	R	R	R	R	R	R	IE	0	0	IE	NO	IE	IE
Finland	R	R	IE	NO	R	R	NO	0	0	NO	R,NO	R,NO	R,NO
France	R	R	R	R	R	NO	NO	0	0	NO	R	R	R
Germany	R	R	R	NO	R	R	NO	0	0	R	R	R	R
Greece	R	R	NR	NR	NR	NO	NO	0	0	NO	R	R	R
Ireland	R	R	R	R	R	R	IE	0	0	NO	R	R	R
Italy	R	R	R	R	R	NO	NO	0	0	NO	IE	R	R
Luxembourg	R	R	R	R	R	IE,NO	IE	0	0	NO	IE	R	R
Netherlands	R	R	NR	NR	NR	R	NO	0	0	NO	NE	NE	NE
Portugal	R	R	R	IE	R	NO	IE	0	0	NE	R	R	R
Spain	R	IE	NR	NR	R	NO	NO	0	0	NO	NO,R	NO,R	NO,R
Sweden	R	R	R	R	R	R	NO	0	0	NO	NO	NO	NO
United Kingdom	R	IE	R	IE	R	R	R	0	0	NO	R	R	R
Deforestation													
Austria	R	R	R	IE	R	NO	0	0	R	NO	NO	NO	NO
Belgium	R	R	R	R	R	NO	0	0	NE	NO	NO	NO	NO
Denmark	R	R	R	R	R	R	0	0	R	IE	NO	IE	IE
Finland	R	R	IE	R	R	R	0	0	R	R	NO,IE	NO,IE	NO,IE
France	R	R	R	R	R	NO	0	0	R	R	R	R	R
Germany	R	R	R	R	R	R	0	0	R	NO	NO	NO	NO
Greece	R	R	NR	NR	NR	R	0	0	NO	NO	R	R	R
Ireland	R	R	R	R	R	R	0	0	NO	R	NO	NO	NO
Italy	R	R	R	R	R	NO	0	0	NO	NO	NO	NO	NO
Japan	R	R	R	R	R	IE	0	0	R	R	NO	NO	NO
Netherlands	R	R	R	R	NR	R	0	0	NE	R	NE	NE	NE
Portugal	R	R	R	IE	R	NO	0	0	R	NE	R	R	R
Spain	R	IE	R	R	R	NO	0	0	NO	NO	NO	NO	NO
Sweden	R	R	R	R	R	R	0	0	R	NO	NO	NO	NO
United Kingdom	R	IE	IE	IE	R	IE	0	0	R	R	R	R	R
Forest Management													
Austria	NA	NA	NA	NA	NA	NA	NA	NA	0	NA	NA	NA	NA
Belgium	NA	NA	NA	NA	NA	NA	NA	NA	0	NA	NA	NA	NA
Denmark	R	R	R	R	R	R	IE	R	0	IE	NO	R	R
Finland	R	R	IE	IE	R	R	R	NE	0	NO	R	R	R
France	R	R	R	R	R	NO	NO	NO	0	NO	R	R	R
Germany	R	R	R	R	R,NR	R	NO	R	0	R	R	R	R
Greece	R	R	NR	NR	NR	NO	NO	NO	0	NO	R	R	R
Ireland	NA	NA	NA	NA	NA	NA	NA	NA	0	NA	NA	NA	NA
Italy	R	R	R	R	NR	NO	NO	NO	0	NO	IE	R	R
Japan	R	R	R	R	R	IE	IE	NO	0	NO	IE	R	R
Netherlands	NA	NA	NA	NA	NA	NA	NA	NA	0	NA	NA	NA	NA
Portugal	R	R	R	IE	R	NO	IE	NO	0	NE	R	R	R
Spain	R	IE	NR	NR	NR	NO	NO	NO	0	NO	IE,NE	R,NE	R,NE
Sweden	R	R	R	R	R	R	R	NE	0	NO	R	R	R
United Kingdom	R	IE	R	IE	R	R	NO	NE	0	NO	R	R	R

Notation keys: R – C stock change or emissions from source is reported; NR – the pool is not reported, using the "not a source" principle; NE – removal/emission is not estimated; IE – included elsewere; NO –not occuring; NA – MS does not account the activity.

11.1.2 Areas and changes in areas between KP LULUCF activities (KP CRF NIR 2)

MS report land areas for all mandatory and elected activities (Table 11.3). At the EU-15 level, total area of AR (6000 kha) is much larger than D (1921 kha), i.e. total forest land area is increasing. In the year 2010, at the EU-15 level, 170 kha were afforested/reforested, 79 kha were deforested and 109284 kha were reported under forest management.

The areas of AR and D area vary considerably also among countries with rather similar situations. To some extent, this is explainable by different definitions used by countries for forestland and land conversions. Despite this diversity somehow hampers a harmonized assessment of land use changes in Europe, the essential thing is that MS follow the IPCC GPG-LULUCF.

Table 11.3 Synthesis of total area (kha) of KP-LULUCF activities as reported by EU-15 MS at the end of the 2010. Grey cells indicate that the activity has not been elected.

Member State	Art. 3.3 activities		Article 3.4 activities			
	AR	D	FM	CM	GM	RV
Austria	234	120,3				
Belgium	21	19,6				
Denmark	47	6,9	533	2,856	164	
Finland	167	323,9	21.798			
France	1.217	790,5	21.567			
Germany	377	196,8	10.557			
Greece	33	3,9	1.206			
Ireland	279	8,2				
Italy	1.637	14,4	7,448			
Luxembourg	9	7,7				
Netherlands	47	45,5				
Portugal	320	130,7	3.897	2.648	1281	
Spain	1.078	11.4	12,600	20,486		
Sweden	237	213,0	28,310			
UK	297	27,7	1,369			
EU-15	**6000**	**1921**	**109284**	**25990**	**1445**	**0**
EU-12 (see Table 11.19)	1386	168	25653			14
EU-27	**7386**	**2089**	**134937**	**25990**	**1445**	**14**

**Note that Spain reports annual instead of cumulated areas since 1990 in Table 5(KP-I)A.2. Deforestation; it also reports inconsistent areas in NIR2 and 5(KP-I)B.1, in this table D is corrected to cumulated value, while FM area is reported as in activity table. This fact as well as rounding made slightly different values in the NIR2 of the EU submission which is subject to automatic procedure of aggregation of data.*
Notation: AR: forestation/Reforestation, D: deforestation, FM: forest management, CM: cropland management, GM: grazing land management, RV: revegetation.

Most of AR area is reported in Italy, France and Spain (together they account for some 65% of total area reported in EU-15). Most of D area is reported by France, Finland, Sweden. Only in Finland deforested area is larger than afforested area. Some MS (i.e. Netherlands, Portugal, Spain, and Sweden) revised the AR area downward and few others (Austria, Portugal, Sweden) revised downward D area compared to previous submission. GM and CM areas were recalculated only by Portugal (caused by improvement of the new land use matrix available since 2011).

11.1.3 Key categories for KP LULUCF activities (KP CRF NIR 3)

Majority of EU-15 MS performed and transparently report on the key category for KP activities (Table 11.4). In most cases, AR and FM are key categories, whereas D is key category in only 6 MS. With the exception of D being a key category for N_2O in France, all other key categories relate to CO_2. CM results key categories in all MS which elected it. Some MS did not perform key category analysis for 2008 - 2010 which make difficult a proper assessment if they are approaching the correct tier methods to estimate the GHG associated with KP activities.

Table 11.4 Synthesis of KP-LULUCF activities being key category as reported by EU-15 Member States (from tables NIR 3). "K" indicates a key category. Grey cells indicate that the activity has not been elected.

MS	AR	D	FM	CM	GM	RV	**Comments** (qualitative/ quantitative criteria used)
Austria	K	K					Corresponding land categories are key under Convention inventory, although key category analysis includes all conversions
Belgium		K					Corresponding land category is key under Convention inventory
Denmark							KC analysis is not available in the NIR 3
Finland	K	K	K				Corresponding land categories are key under GHG inventory
France	K	K	K				Corresponding land categories are key under GHG inventory, with mention that D is key category for both CO_2 and N_2O
Germany	K		K				Corresponding land categories are key under GHG inventory
Greece	K		K				Corresponding land categories are key under GHG inventory
Ireland	K						Level assessment
Italy	K		K				Corresponding LU categories are key under Convention inventory
Luxembourg							KC analysis is not available in the NIR 3
Netherlands		K					Corresponding land category is key under GHG inventory
Portugal	K	K	K	K			Corresponding land categories are key under GHG inventory
Spain	K		K	K			Corresponding land categories are key under GHG inventory
Sweden	K	K	K				Corresponding land categories are key under GHG inventory
UK			K				Corresponding land categories are key under GHG inventory

11.1.4 Summary of emissions/removals and accounting quantities for KP LULUCF activities by EU-15 MS (KP CRF "Accounting" table)

From Table 11.5 results that, at the EU-15 level, in 2010 annual removals by AR exceeded by some 40% emissions from D. By far, the largest contributor to D emissions is France, responsible of 40 % of total emissions from deforestation in EU-15. Further on, Sweden and Finland are each responsible of some 15%.

The highest removals for AR are reported by France, Spain and Italy, all three achieving more than half (52%) of 2010 sink on EU-15 afforestation/reforestation.

The FM largest sinks are reported by Italy, Finland and France. Few countries (i.e. Sweden, Finland and France) offset debits under Art 3.3 with removals from forest management.

Table 11.5 **Emissions / removals and accounting quantities in 2010 for KP-LULUCF activities as reported by EU-15 Member States** (notation keys reported in this table are: NE – removal/emission is not estimated; IE – included elsewhere; NO –not occurring; NA – MS does not account the activity)

	Net emissions (+) and removals (-), Gg CO2eq																										
	A. Art 3.3 activities									B. Art. 3.4 activities																	
	A.1 AR						A.2. D			B.1 FM			B.2 CM				B.3 GM				B.4 RV						
	A.1.1 Lands not harvested			A.1.2 Lands harvested																							
	2008	2009	2010	2008	2009	2010	2008	2009	2010	2008	2009	2010	1990	2008	2009	2010	1990	2008	2009	2010	1990	2008	2009	2010			
Austria	-2488	-2608	-2621	NO	NO	NO	1362	1378	1362	NA	NA	NA	0	NA	NA	NA	0	NA	NA	NA	0	NA	NA	NA			
Belgium	-277	-281	-284	NO	NO	NO	496	490	490	NA	NA	NA	0	NA	NA	NA	0	NA	NA	NA	0	NA	NA	NA			
Denmark	-314	-542	0	IE,NO	IE,NO	IE,NO	39	40	41	-692	-3048	-5677	4650	3578	2488	3285	205	175	173	171	NA	NA	NA	NA			
Finland	409	411	363	NA	NA	NA	3575	3577	3632	-36395	-47278	-31836	0	0	0	0	0	NA	NA	NA	0	NA	NA	NA			
France	-7261	-7530	-7884	NA,NO	NA,NO	NA,NO	14795	13898	11178	-59563	-51586	-44599	0	NA,NO	NA,NO	NA,NO	0	NA,NO	NA,NO	NA,NO	0	NA,NO	NA,NO	NA,NO			
Germany	-5568	-5897	-5945	NA,NO	NA,NO	NA,NO	464	106	120	-19429	-19408	-19410	0	0	0	0	0	0	0	0	0	0	0	0			
Greece	-351	-351	-351	NA	NA	NA	10	7	2	-1847	-1846	-1855	0	NA	NA	NA	0	NA	NA	NA	0	NA	NA	NA			
Ireland	-2702	-2858	-3030	250	26	45	26	35	20	NA	NA	NA	0	0	0	0	0	NA	NA	NA	0	NA	NA	NA			
Italy	-6080	-6668	-6706	0	0	0	388	390	392	-36805	-34448	-36215	0	NA	NA	NA	0	NA	NA	NA	0	0	0	0			
Luxembourg	-77	-78	-94	NO	NO	NO	141	141	141	NA	NA	NA	0	NA	NA	NA	0	NA	NA	NA	0	NA	NA	NA			
Netherlands	-405	-442	-451	NA,NE,NO	NA,NE,NO	NA,NE,NO	763	788	813	NA	NA	NA	0	NA	NA	NA	0	NA	NA	NA	0	NA	NA	NA			
Portugal	-3781	-3902	-3968	819	772	725	1178	1238	1294	-11005	-11256	-8751	12	-263	-282	-342	42	-383	-416	-896	NA	NA	NA	NA			
Spain	-6386	-6486	-6487	NA,NO	NA,NO	NA,NO	106	107	108	-18677	-18636	-18680	-174	-3100	-2412	-2826	NA	NA	NA	NA	NA	NA	NA	NA			
Sweden	-826	-818	-796	NO	NO	NO	3247	3055	2766	-39847	-38611	-36927	0	NA	NA	NA	0	NA	NA	NA	0	NA	NA	NA			
UK	-2660	-2803	-2956	NO	NO	NO	878	562	734	-10709	-9783	-7491	0	0	0	0	0	0	0	0	0	0	0	0			
EU 15	**-38767**	**-40852**	**-41210**	**1069**	**798**	**770**	**27471**	**25811**	**23092**	**-234968**	**-235899**	**-211440**	**4489**	**216**	**-206**	**117**	**247**	**-207**	**-242**	**-724**	**0**	**0**	**0**	**0**			
EU 25	**-51973**	**-54871**	**-56078**	**1044**	**752**	**686**	**31992**	**28282**	**25488**	**-347610**	**-352157**	**-322290**	**4489**	**216**	**-206**	**117**	**247**	**-207**	**-242**	**-724**	**-1275**	**-239**	**-254**	**-268**			

Table 11.6 Accounting quantities in 2010 for KP-LULUCF activities as reported by EU-15 Member States.

MS	Accounting quantity on activities						MS accounting amount on LULUCF activities
	AR	D	FM	CM	GM	RV	
Austria	-7718	4101	0	0	0	0	**-3616**
Belgium	-842	1476	0	0	0	0	**634**
Denmark	-855	120	-917	-4600	-95	0	**-6348**
Finland	1184	10784	-14901	0	0	0	**-2933**
France	-22675	39871	-33330	0	0	0	**-16133**
Germany	-17410	690	-22733	0	0	0	**-39453**
Greece	-1052	19	-1650	0	0	0	**-2682**
Ireland	-8590	81	0	0	0	0	**-8509**
Italy	-19455	1170	-50967	0	0	0	**-69251**
Luxembourg	-248	423	0	0	0	0	**175**
Netherlands	-1298	2364	0	0	0	0	**1066**
Portugal	-11651	3710	-4033	-922	-1819	0	**-14715**
Spain	-19360	321	-12283	-7818	0	0	**-39139**
Sweden	-2440	9068	-17262	0	0	0	**-10633**
UK	-8419	2174	-6783	0	0	0	**-13028**
EU 15*	**-120829**	**76374**	**-164859**	**-13340**	**-1914**	**0**	**-224568**

***-** any information on EU KP LULUCF activities presented here is shown for information purpose *only*

11.1 Synthesis of supplementary information on KP LULUCF activities reported by EU-15 MS in their NIRs

This chapter attempts to synthesize relevant supplementary mandatory information requested for KP LULUCF activities by Annex of Decision 16.CMP.1, as reported by MS in their NIRs. Although most MS followed the structure suggested by the annotated NIR, the approach used to include the supplementary information sometimes differed among countries, which made it difficult to include everything in an exhaustive and synthetic way. For more detailed information, it is suggested to refer to the individual MS' NIRs.

11.1.4.1 General information

11.1.4.2 Definition of forest land and other lands and any other criteria

The parameters used to define "forest" under the Kyoto Protocol by EU-15 MS are summarized in Table 11.7. In most cases, parameters and definitions used for reporting FM under the Kyoto Protocol are identical to those used to report forest land under the Convention.

Table 11.7 Parameters used to define "forest" under the Kyoto Protocol

Member State	Minimum crown cover (%)	Minimum height (m)	Minimum area (ha)	Minimum width (m)
Austria	30	2	0.05	10
Belgium	20	5	0.5	-
Denmark	10	5	0.5	20
Finland	10	5	0.5	20
France[34]	10	5	0.5	20
Germany	10	5	0.1	-
Greece	25	2	0.3	-
Ireland	20	5	0.1	20
Italy	10	5	0.5	-
Luxemburg	10	5	0.5	-
Netherlands	20	5	0.5	30
Portugal[35]	10	5	0.1	20
Spain	20	3	1.0	25
Sweden	10	5	0.5	10
United Kingdom[36]	20	2	0.1	20

Countries where definitions under the KP and the Convention differ, include, Finland and the Netherlands. Finland reports minimal area of 0.5 ha under KP, whereas different minimal areas are used under the Convention (minimal forest area in Southern is 0.25 and 0.5 ha in Northern Finland)[37]. The Netherlands reports that forests reported under the Convention have a smaller width than those reported under the KP. In Sweden, the different methods to cumulate the areas under conversion in 5B2,5C2,5D2, etc and D generate a large difference partly due to computation and partly due to non-human induced conversions to Other Land and Wetlands (i.e. only some 50 % of conversion is reported under KP as deforestation), although consistent with the reporting requirement.

A difficulty in comparing various reports under national or international processes is given by the use of different forest definitions under UNFCCC/KP vs. other international reporting (e.g. Portugal reports minimum forest areas of 1 ha for KP, while it is 0.5 ha for FAO, providing justification that the KP requirements could be met only with 1 ha resolution).

[34] France definition applies for the forest under the European "metropolitan" territory and the French "territoires d'Outre-mer" which are also part of EU (Martinique, French Guyana, Reunion, and Guadeloupe). In Guyana forest covers 8000 kha, out of which 1500 kha are under management (19%), thus subject to Kyoto Protocol

[35] Portugal definition applies also for Autonomous Regions of Açores and Madeira

[36] Kyoto commitment extends coverage to the UK's Crown Dependencies (Guernsey, Jersey and the Isle of Man) and Overseas Territories that have ratified the Kyoto Protocol (the Cayman Islands, the Falkland Islands, Bermuda, Monserrat and Gibraltar)
[37] The proportion of National Forest Inventory sample plots located in forest areas under 0.5 ha is 0.1% (according Finland NIR 2011)

11.1.4.3 Elected activities under Article 3, paragraph 4, of the Kyoto Protocol

The 3.4 activities elected by EU-15 Member States were already included in the initial reports (IRR) and are provided again in the 2011 NIRs (see Table 11.1).

11.1.4.4 Description of how the definitions of each activity under Art. 3.3 and each elected activity under Art. 3.4 have been implemented and applied consistently over time

In most cases, definitions of KP activities have been applied with a broad interpretation. For instance, many countries considered as “directly human induced AR” any expansion in forest area since 1990 (see following chapters for more details). For FM, most countries considered all forest area as subject to “forest management” activity, with few exceptions (e.g. France reports that in Guyana only 1,500 kha of forests are managed (out of total 8000 kha); Greece reports under FM only one third of its forestland areas).

In order to meet the KP reporting requirements related to consistent land representation, identification and tracking several Member States improved the land representation system used for reporting to UNFCCC. In general, consistency in time is ensured by statistical methods and improvement of base year land data. GHG estimating methods were developed and implemented as to ensure time consistency with and within GHG inventory under UNFCCC reporting.

Usually in the EU-15 the data necessary for the KP activities estimations is provided by repeated cycles of the National Forest Inventories (NFIs), with additional involvement of maps, aerial photos or other databases especially for the base year (e.g. Corine Land Cover). In some MS, the NFI covers the entire country, so it is able to determine the time series of land use activities since 1990 under constant land use and activity definitions (e.g. Austria, Finland). Other Member States have put in place procedures to follow any change involving forests (e.g. procedures based on processing of aerial photographs or satellite images: Belgium, Denmark, and France).

In order to check the consistency, MS have also performed comparison and internal verification of the activity data area among various national datasets, if such datasets are available (i.e. Finland compared AR and D data generated from NFI with forest authority statistics).

11.1.4.5 Description of precedence conditions and/or hierarchy among Art. 3.4 activities, and how they have been consistently applied in determining how land was classified

Areas with potential conflict or overlapping between activities could occur within the main generic land use (i.e. broad definitions for forest management, afforestation and deforestation) or among different land uses (e.g. agroforestry systems in Southern Europe). MS performs specific QA/QC analysis of data used for reporting on KP (i.e. DK) as to avoid any double counting or missing areas. For forest related activities, MS implement methods that make possible to avoid double counting of land (ranging from field repeated assessment to field verification of the automatic procedures). For forest land related activities, the hierarchy applied by all MS is D-AR-FM.

Table 11.8 shows the land hierarchy applied among the land categories by those MS which elected multiple activities under Art. 3.4 of the Kyoto Protocol.

Table 11.8 **Precedence condition in those MS which elected multiple activities under art 3.4.**

MS	Hierarchy applied
Denmark	FM-CM-GM
Portugal	CM-GM-FM
Spain	FM-CM-FM

Once the land started to be accounted it can not leave the accounting, so it has to be continually estimated, reported and accounted over the commitment period (i.e. DK reports transitions to wetlands and settlements).

11.1.5 Land-related information (EU-15)

11.1.5.1 Spatial assessment unit used for the area of the units of land under Art. 3.3

The majority of the EU-15 Member States reported a single geographical boundary at country level due to the fact that the systems underpinning estimations of national GHG inventory (data collecting systems, databases, QA/QC and verification procedures) have been designed at the entire country scale. Consequently, any further breakdown of the country area into several reporting regions would risk generating larger uncertainty for sub-national scale estimates. Nevertheless, several large countries report two (e.g. Finland) or more geographical boundaries (e.g. France, Greece, Italy, Spain and UK, all of them on administrative regions).

Units of land area used for the assessment of the Art 3.3 activities are the same as minimal area or width defining forest for each MS. Methodologies developed to estimate land use conversions under GHG inventory are in line with the minimum defined area or sometimes the resolution is even better than that reported in the initial report (e.g. Germany, Netherland, Sweden).

11.1.5.2 Methodology used to develop the land transition matrix

The land transition matrix allows, among other, to check the consistency of land area reporting over time (i.e. to be complete and consistent, the sum of total reported area should match the official statistics of total national area (within the confidence limits) and be constant over time). With 2011 submission this “land balance principle” appears satisfied in all EU-15 MS. In order to ensure full time consistency, additional procedures were implemented for previous NFIs datasets to become compatible with latest NFI (i.e. field assessments to fully identify ARD areas in Austria).

Land transition matrices have been developed based on available databases and methodologies, covering all land use categories while define lands relevant for KP activities. Methodologies are based either on the extrapolation/interpolation of two/several points in time with uniform yearly distribution or on precise annual data provided by specific land surveys (subsidies schemes, land registries), and often combines several sources of data. The matrix developed by each MS implements country specific criteria and rules for land allocation (i.e. land hierarchy), and focus on high accuracy of land estimates for activities for which country has to report. On the other hand, the recalculations occurred in 2012 (especially on D area) indicate that some improvements already occurred.

In case of activities involving land conversions, sometimes the precise year of event is not known, so the mean annual rate of these activities are derived from data in available years or as random distribution between known years (see Sweden for the afforestation start, before 2006).

11.1.5.3 Maps and/or database to identify the geographical locations, and the system of identification codes for the geographical locations

Member States developed various methods and approaches to identify "lands" under Art3.3 and "units of land" under art 3.3 of the Kyoto Protocol, according to availability of data and resources (Table 11.9). In many cases the existing data characteristics were considered sufficient as to meet the land identification and tracking requirements.

Table 11.9 Geographical locations requirement coverage by systems adopted by the EU-15 MS of the land or units of land (for more detailed information on data sources and methods see Ch.7)

MS	Methods			Land identification and tracking features for the "lands" or "units of lands"
	NFI, forest inven tory	Mapping (including EO –Earth Observation s methods)	Land registry systems, including surveys	
Austria	X			Statistical methods, random distribution of units of land.
Belgium	X	X		Geo-processing.
Denmark	X	X		Land cover maps in various moments in time.
Finland	X			Statistical methods, random distribution of units of land or lands.
France			X	Statistical methods, random distribution of units of land or lands.
Germany	X	X		Precise geographical locations and its shapes in wall-to-wall mapping approach.
Greece			X	National land registry and forest mapping system
Ireland		X		Sectorial ARD land registry, GPS database.
Italy	X		X	NFI plots coordinates (AR), thus random distribution of units of land. Land statistics for D for each region.
Luxembourg		X		Geo-processing based on successive land use maps.
Netherlands	X	X		ARD activities are recorded on a pixel basis.
Portugal	X	X		NFI codes and intersection overlaid on land use map.
Spain	X	X	X	AR data is based on land registry system. FM, D is based on CLC maps and forest map.
Sweden	X			NFI data, random distribution of units of land.
United Kingdom			X	Statistics by forest authorities.

Most of the national estimating systems rely on NFI to identify and track units of lands under AR and D and land under FM, very often strengthen with additional field or remote sensing support.

In case of availability of non-annual data, the assessments were set as to overlap the commitment period. Mapping based on Earth Observation (e.g. Corine Land Cover) and other map types (e.g. soils distribution) are used as such or in combination with NFI. MS report in their NIR that developments and thorough checks (e.g. with aerial photos) and harmonization of various databases and sources were performed on the maps as to meet the requirements of land identification (e.g. NL).

National systems sometimes rely on land parcel identification systems (e.g. as used for subsidy payments) which allow each individual parcel recorded and traceable over time since the onset of the subsidized activity (often digitized and available in GIS, like in Ireland). Such systems are supported by adequate verification and validation/audit procedure at the country level as they are under public funding (e.g. Spain, Greece). In this respect, for example Ireland states that "afforestation areas recorded by the Forest Service are verified using a strict control and referrals process, following a post establishment site visit by a forestry inspector".

Table 11.10 Key information on methods to identify the geographical locations under KP activities and the data used

MS	Reporting Method used for identifying the geographical locations	Approach used for land representation
Austria	1	2/3
Belgium	1	3
Denmark	1	3
Finland	1	3
France	1	3
Germany	2	3
Greece	1	2
Ireland	2	3
Italy	1	2
Luxembourg	1	3
Netherlands	2	3
Portugal	1	3
Spain	1	2
Sweden	1	3
UK	1	2

11.1.6 Activity-specific information

11.1.6.1 Methods for carbon stock changes and GHG emission and removal estimates

Methods used for the estimation of emissions/removals related to the Art 3.3 and 3.4 activities are consistent with those used for reporting the corresponding land use subcategories under the Convention, as described under Chapter 7 of this NIR. In same chapter, these methods are described in detail, for each of the relevant land use subcategory (5A2, 5B2, 5C2, …). The check if an appropriate Tier is used is both part of the country own and EU QA/QC process.

Description of the methodologies and the underlying assumptions used

The main source of data for estimates in ARD and FM is mostly the national forest inventories (NFI). In few cases annual removals are modeled based on non-NFI data. SOC emissions associated with any conversion to/from forestland are estimated by modeling or by country specific reference C stock in soils on different land uses. The most problematic pools are LT, DW and soils, for which efforts are still ongoing either to estimate source/sink or to demonstrate that a pool is not a source. Data sources and methods are consistent with those described under relevant chapters of the NIR (Ch. 7 of the NIR).

The range of values of the Implied Emission Factor (IEF of C stock change factor) reported for Afforestation/Reforestation (Table 11.11) are similar as those reported used for estimation of GHG inventory estimates. Among MS, there are notable differences between IEF on net biomass increment reported, caused by the type of species and climatic conditions and other characteristics (i.e. non-uniform rate of harvesting, different species). One additional reason for large differences is the use of either time averaged or actual data, depending on the methodological approach of the MS. DW and LT are mainly reported as "no source" with justification provided in the MS's NIR (see Ch. 7 and Table 11.14 below). Mineral soils are either reported as source or sinks.

Table 11.11 IEF for net C stock changes (Mg C/ha) by pool on lands under AR activity in EU-15 (in the year 2010)

Member State	Above ground Biomass	Below ground Biomass	Litter	Dead wood	Min Soils	Org Soils
Austria	1.0	0.2	1.2	NO	0.7	NO
Belgium	1.9	0.4	NO	NO	1.4	NO
Denmark	0.2	0.1	-0.2	-0.2	0.1	-0.3
Finland	0.3	0.1	IE	NO	-0.5	-1.9
France	0.9	0.4	0.3	0.0	0.2	NO
Germany	3.1	1.0	0.5	NO	-0.3	-0.7
Greece	2.0	0.9	0.0	0.0	0.0	NO
Ireland	1.3	0.7	1.3	0.1	NA,NO	-0.5
Italy	0.8	0.2	0.0	0.0	0.1	NO
Luxembourg	2.0	IE	IE	NO	0.8	NO
Netherlands	2.1	0.8	NE	NE	0.2	-6.5
Portugal	1.5	IE	NE	NE	0.2	NO
Spain	0.6	0.2	0.3	0.0	-0.1	-0.6
Sweden	2.4	IE	0.1	IE	0.2	0.4
United Kingdom	1.0	0.2	1.2	NO	0.7	NO

Notation keys: IE – data is reported elsewhere i.e. included in other pools. NO – not occurring. NA- not applicable, NE-not estimated (the countries using NE still justify these pools as"no source" or negligible).

IEF values reported for deforestation (Table 11.12) are consistent with those reported under relevant CRF tables in the GHG inventory. Large IEF values for C stock change in mineral soils are estimated based on country specific data (i.e. Belgium, Portugal).

Table 11.12 **IEF for net C stock changes (Mg C/ha) in the pools under Deforestation activity in EU-15 (in the year 2008)**

Member State	Above ground Biomass	Below ground Biomass	Litter	Dead wood	Min Soils	Org Soils
Austria	-0.7	-0.2	-1.2	IE	-0.9	NO
Belgium	-4.0	-0.7	-0.3	-0.1	-1.6	NO
Denmark	-0.9	-0.2	-0.2	0.0	-0.2	-2.5
Finland	-1.7	-0.5	IE,NE,NO	0.0	-0.1	-4.0
France	-2.1	-0.5	-0.2	-0.1	-1.0	NO
Germany	0.0	0.0	-0.1	0.0	0.3	-4.6
Greece	NA,NO	NA,NO	0.0	0.0	0.0	0.0
Ireland	-0.4	-0.1	0.0	0.0	NA,NO	-0.1
Italy	-2.3	-0.5	-0.2	-0.3	-4.1	NO
Luxembourg	-4.5	IE	IE	-0.1	-0.4	NO
Netherlands	-2.6	-0.5	-1.3	-0.1	-0.2	-5.7
Portugal	-0.9	IE	-4.3	-5.0	-1.6	NO
Spain	-0.8	-0.3	-1.2	0.0	-1.2	-1.6
Sweden	-3.7	IE	IE	IE	-1.1	IE
United Kingdom	-0.7	-0.2	-1.2	IE	-0.9	NO

Notation keys: IE – values are reported together with other pools (their separation is not possible under the availability of data without increasing uncertainty of estimates). NA- not applicable, NO-not occurring.

For Forest Management (Table 11.13), the difference in IEF among MS is mainly caused by the different proportion of annual increment which is harvested, and for some country by the occurrence of natural disturbances or potential of growth. DW and LT are mainly reported as “no source” with justification provided in the NIR (see Chapter 7 and Table 11.14 below).

Table 11.13. **IEF for net C stock changes (Mg C/ha) in the pools under Forest management activity in EU-15 (in the year 2010)**

	Above ground Biomass	Below ground Biomass	Litter	Dead wood	Min Soils	Org Soils
Austria	NA	NA	NA	NA	NA	NA
Belgium	NA	NA	NA	NA	NA	NA
Denmark	2.0	0.4	0.5	0.1	NA	-0.3
Finland	0.3	0.1	IE	IE	0.1	-0.3
France	0.5	0.2	0.0	-0.1	0.0	NO
Germany	0.3	0.1	NO	0.1	NO	-0.7
Greece	0.3	0.1	0.0	0.0	0.0	NO
Ireland	NA	NA	NA	NA	NA	NA
Italy	0.9	0.1	0.0	0.3	NE	NO
Luxembourg	NA	NA	NA	NA	NA	NA
Netherlands	NA	NA	NA	NA	NA	NA
Portugal	0.4	IE	NE	NE	NE	NO
Spain	0.2	0.1	0.0	0.1	0.2	-0.6
Sweden	0.5	IE	0.5	IE	0.6	0.6
United Kingdom	NA	NA	NA	NA	NA	NA

Direct N_2O emissions from N fertilization (Table 5(KP-II)1)

Some countries report fertilization in old forests (e.g. Sweden), other in young plantations (e.g. UK). For the majority of MS, N fertilization of forests do not occur or, if any, emissions are reported under agriculture. Only UK provides estimates for this source category.

N_2O emissions from drainage of soils Table 5(KP-II)2

Several MS did not report N_2O and CH_4 emissions from drainage of soils under FM, as the method of estimation is included only in the Appendix 3a.2 of the IPCC GPG for LULUCF (i.e. the reporting is not mandatory). Nevertheless, Denmark and Germany reports emissions from this source category, based on IPCC default factor. Finland reports NE and mentions that a country specific method and emission factors for this source are under development. Estimation methods are consistent with those described under Chapter 7 of this report.

N_2O emissions from disturbance associated with land use conversion to cropland (Table 5(KP-II)3)

Forested areas converted to cropland are rather small in EU-15 (some 350 kha in EU-15, revised downward since last submission). Currently, the consistency among KP and Convention tables was specifically checked by the EU QA/QC procedure, so there is more harmonized approach in current submissions. Estimation method is consistent with that described under Chapter 7 of this report.

Carbon emissions from lime application (Table 5(KP-II)4)

Liming is not often applied as it is not economically reasonable at the heavy rates required (e.g. UK's NIR 2012). Sometimes liming is separately reported for deforestation areas (e.g. Finland, Netherland). In general, even if liming may occur occasionally, there are no separate reliable statistics, thus it is often reported under Chapter 4 Agriculture. Estimation method is consistent with that described under Chapter 7.

GHG emissions from biomass burning (Table 5(KP-II)5)

Forest fires on ARD unit of lands are generally reported as not occurring. A specific check during the EU QA/QC identified a number of misallocation with potential accounting effects (e.g. emissions from burning occurring on AR were included under FM). Consequently, the EU member states have made effort to estimate separately emission from biomass burning, including forest fires. Under missing data on burnt AR areas, conservatively it was assumed that burnt AR areas in total burnt equals AR area share in total Forestland (i.e. Finland). Estimation method is consistent with that described under Chapter 7.

Justification when omitting any carbon pool or any GHG emissions/removals

The "not a source" principle has been applied by several MS for the DW, LT and SOC pools (Table 11.14). During the EU QA/QC process, MS were recommended to use the notation key "NR" in CRF tables to indicate pools not reported because "not a source", along with the reference to the NIR (in the documentation box) where it is demonstrated that the respective pool is not a source, and also to add a comment to the reporting cell mentioning it.

Table 11.14 Overview of reasons for omissions of carbon pools.

Member State	Pools/ sources not considered	Activity	Demonstration/ Reasoning, including the very short methods description
Austria	DW	AR	DW, LT are assumed not to occur, if any it would be a sink, under slow ecosystem dynamics/ DW as standing dead tress is IE (considered in "biomass loss")
Belgium	LT, DW	AR	Reasoning based on system functioning (assumed Tier 1).
Denmark	SOC	FM	Reasoning based on system functioning (assumed Tier 1).
	LT, DW	CM, GM	Assumed not occurring.
Finland	DW	AR	DW assumed to be marginal over short period of time since 1990.
France	LT, SOC	FM	Small sinks are confirmed by national research project.
Germany	LT, SOC	FM	Estimated to be zero (LT) or small sink (SOC min) based on sampling.
	LT,DW	AR	Estimated (based on repeated field measurements) as not occurring.
Greece	LT,DW,SOC	ARD,FM	Reasoning based on system functioning (assumed Tier 1). Emissions from D from SOC are considered negligible under the time distribution of deforestation.
Ireland	SOC	AR	Statistical supported data that this pool is not a source
Italy	SOC	FM	Data based demonstration.
Luxembourg	DW	AR	Reasoning based on system functioning.
Netherlands	LT, DW	AR	No source based on NFI data.
Portugal	DW	CM, GM	Pool assumed to not occurring.
Spain	LT,DW, SOC	AR, FM	Reasoning based on system functioning (assumed Tier 1).

	DW,LT	CM	Reasoning based on system functioning (assumed Tier 1).
Sweden			All pools are accounted (as individual pools).
United Kingdom			All pools are accounted (although individual change pools are often reported as included IE).

The lack of estimation methods for some type of conversion from forest land and pools (i.e. DW and LT in deforestation associated with conversion to Settlements) in the IPCC land category chapters does not allow some MS to report these emissions, despite requirements in the Ch.4 of IPCC that all pools have to be reported.

11.1.6.2 Information on whether or not indirect and natural GHG emissions and removals have been factored out

In general, it is recognized that: (i) for Article 3, paragraph 4 activities the issue of "factoring out" was solved during negotiations with the *cap* for Forest Management and with the net-net accounting for the other Article 3, paragraph 4 activities; (ii) for Article 3, paragraph 3 activities, the dynamic effect of age is not relevant since all these activities have occurred after 1990; (iii) for the elevated CO_2 concentration and the indirect nitrogen deposition, there are no methodologies adopted by the UNFCCC.

11.1.6.3 Changes in data and methods since the previous submission (recalculations)

Some important recalculation occurred as compared to previous submission, mostly due to availability of new data. Removal from AR in estimated for 2009 is revised upward by some 6% under current submission. Similarly, emissions from D in 2009 are 12% higher under current submission. New AR estimates are mainly due to little changes in land data, but mostly due to improvement of C pools data, by all MS. FM removal is also 15% less for 2009 due to revised data mainly by France and exclusion of soils by Italy.

MS implement additional research projects on the development of new datasets in order to fully meet the requirements for accounting purpose, so for this reason recalculations are expected also over next years, including in the last year of the commitment period (e.g. DK research project implemented within NFI on forest soils), as many planned NFI or data sampling in other schemes, precisely in the last year of the commitment period.

Specific check and corrections during the EU QA/QC identified a number of emission misallocation with potential accounting effects (e.g. emissions from burning occurring on AR which were included under FM), compared to previous submission.

11.1.6.4 Uncertainty estimates

For the current submission there is an improvement of the information provided on uncertainty analysis performed by the EU-15 Member States on the emissions/removals of the LULUCF land sub-categories. Detailed information and discussion on uncertainty on emission/removal on land subcategories is provided in Chapter 7 of this report.

11.1.6.5 Information on other methodological issues

The methods used to estimate and reports under KP are the same tier method as those used for the UNFCCC reporting. Consistency of methods used for estimation was achieved by applying similar data processing to previous datasets (in NFI) or simply by implementation of compatible procedures for entire time series (in case of remote sensing).

11.1.7 Article 3.3

11.1.7.1 Information that demonstrates that activities under Art. 3.3 began on or after 1 January 1990 and before 31 December 2012 and are direct human-induced

Few Member States provide explicit annual time series for Art 3.3 activities in the NIR 2012. The information on the onset of the activity seems rather incomplete in the MS NIR; in some case, for AR it is mentioned the year of planting (e.g. DK, UK, GR, IE) or the encroaching of woody vegetation that will potentially meet the definition of forestland (i.e. in case of afforestation grants). NFI based methodologies (alone or combined with aerial photographs) allow for the assessment of the base year and thus any later change compared to that as "since 1990". The annual area change rates are often assumed constant or randomly distributed over the assessed period (e.g., Sweden before 2006). Early afforested area (i.e. immediately after 1990) is more uncertain if NFI was not performed in exactly the same year, which does not occur for the commencement and end of the commitment period (assuming better planning of assessments and availability of better methods and data nowadays).

According to the IPCC GPG LULUCF (Chapter 4.2.5.2) "*It is good practice to provide documentation that all afforestation and reforestation activities included in the identified units of land are direct human-induced. Relevant documentation includes forest management records or other documentation that demonstrates that a decision had been taken to replant or to allow forest regeneration by other means*". Table 11.15 shows a synthesis of current information reported by EU-15 Member States on the direct-human induced origin of AR lands.

Table 11.15 Summary of current information reported by EU-15 MS aimed at demonstrating that Afforestation/Reforestation activities are direct human-induced

	Type of information / justification provided					
	Areas converted have been verified and reported in registries for authorization	Areas converted, either subject to subsidies or not, have been reported in registries either for authorization or compilation of land use changes	Whole national territory covered by legal instruments for Land planning and/or management, therefore any change in land use is directly human-induced	Where a conversion results in a land use subject to management practice, the conversion is considered directly human-induced	As all land area is under management (i.e. subject to some kind of human interactions), all changes are considered as directly human-induced	A decision to change the use of a land or a decision not to continue the previous management practices has been made, which allow for conversion
Austria			**X**			
Belgium					X	
Denmark					X	
Finland						X
France				X		

Germany			X			
Greece	X					
Ireland	X					
Italy			X			
Luxembour g			X			
Netherland					X	
Portugal					X	
Spain		X				
Sweden				X		
United Kingdom		X				

Although in most cases a rather “broad” interpretation of “direct human induced AR” is applied, some MS apply a stricter approach. For instance, several member states (UK) do not report under AR the areas of planting that are not state-owned or grant-aided (i.e. whether these woodlands are explicitly managed is unknown). With the experience of first year reporting under Kyoto and the first review, several countries improved their approach on direct human-induced nature of AR (i.e. France, Portugal). MS considered natural forest expansion by inclusion under forest management.

11.1.7.2 Information on how harvesting or forest disturbance that is followed by the re-establishment of forest is distinguished from deforestation

Although the loss of forest cover is often readily identified, the classification of an area as deforested is more challenging. Most MS provided information on the criteria by which temporary removal or loss of tree cover can be distinguished from deforestation and how these criteria are consistently applied (Table 11.16). For instance, in the absence of detailed information of the future of land use, some MS defined the expected time periods (in years) between removal of tree cover and successful natural regeneration or planting. Most EU-15’s Member States report that in most cases there are legal obligations to restore the forest on harvested areas, with these legal provisions enforced and applied according to country circumstances. Furthermore, legislation usually does not allow for a land use change following a natural disturbance.

Table 11.16 Information on differentiation between temporary forest cover loss and deforestation (from MS’ NIRs)

MS	Short description of the approach
Austria	Differentiation of temporarily unstocked areas (e.g. harvested area, disturbances) and deforestation is made by actual procedures implemented by NFIs (e.g. handbooks and guides for field assessment, training of field staff to rightly distinguish between them). For deforestation field assessment procedure involve identification of the significant visible changes in soil structure or ground vegetation which may not represent the natural succession of a forest (e.g. consequences of anthropogenic activities like plowing, crop production, mowing or construction activities or natural abortion of the forest and its stand by e.g. landslides). *Temporarily unstocked areas* by forest management or forests with biotic and abiotic reduction of their crown coverage (windfall, fire, beetles) maintain the natural succession of ground vegetation and soil and therefore remain part of the forest.
Belgium	Permits released by the regional forestry authorities, thus the fate of all land is known (usually deforestation occurs only for settlements purpose).
Denmark	Deforested land is detected by analysis of satellite images, further on confirmed by additional sources (i.e.

	documentations). Mandatory period for reforestation of cut areas is 10 years.
Finland	If a NFI sample plot is on a clearcut area, the field assessor assesses if there are signs for permanent conversion or only cut. Maximum period allowed for regeneration is 3 years, with a usual delay in reforestation of 2 years.
France	Land use/cover and ground assessment are able to identify the land use and activity change on annual basis.
Germany	Law and observance of its implementation ensure that cut or natural disturbance area is reestablished as forest.
Greece	Only legally executed deforestations are considered under deforestation while the land that lost illegally the forest cover is not classified as deforested, but as areas that temporary loss of woody vegetation.
Ireland	NFI to identify if the lands are unstocked or deforested (5 years periodicity).
Italy	Implementation of different legal procedure for harvesting and deforestation.
Luxembourg	Legal obligation that the owner has to ensure the regeneration of forest in 3 years after a clear cut
Netherland	Mapping method used to ensure differentiation between deforestation and non deforestation tree cover loss.
Portugal	With current methodology if in 5 years the forest is not restored then the land is considered as deforested.
Spain	NFI captures any not regenerated areas (e.g. after forest fires). NFI is performed every 10 years.
Sweden	Missing forest cover identified for two consecutive inventories is not enough to classify the plot as deforested, but additional observable changes (as presence of infrastructure).
United Kingdom	Felling licenses system, in the near future doubled by new NFI, ensures the relevant activity areas are fully captured.

11.1.7.3 Information on the size and geographical location of forest areas that have lost forest cover but which are not yet classified as deforested

Improvements were noticed compared to previous submission. The methodologies adopted by each MS ensure consistent reporting in time and space of these areas. Such areas may be found after either natural or man-made disturbances, and may result in misallocation of lands (i.e. a harvested land should remain under FM while a deforested land should be reported under D). In general, the distinction between deforested areas and temporarily unstocked areas is allowed by the methodology developed by the country, which regularly implement multiple assessment criteria and hierarchical phases (including precise guidelines for field checks). The simple combination of NFI data with remote sensing data may not be fully adequate to assess the areas which can be classified as deforested, and thus these data are often complemented by other type of information (i.e. a deforestation typically requires a specific permit or specific visible changes of the soils). Supplementary arguments for correct classification of the land status are given by the law requirements and enforcement according national circumstances.

11.1.7.4 Information on emissions and removals of GHG from lands harvested during the first commitment period following AR on these units of land since 1990

Most Member States report that for AR, due to normative technical rules or economical constraints, harvest do not usually occur before 20 years old of the plantations, with the exceptions of some fast growing species. The majority of the MS interpret “harvesting” as clear cut done on short rotation forests or woody biomass crops (e.g. only Ireland reports a small areas under Table 5(KP-I) A1.2, less than 1 % of its total AR area). So far only 2 MS report such activities on rather small areas, Ireland and Portugal.

11.1.8 Article 3.4

11.1.8.1 Information that demonstrates that activities under Article 3.4 have occurred since 1 January 1990 and are human-induced

General consideration applies that all land that meet forest definition are forestland. Within that the land which are subject for forest management are defined at national level based on applicable definition and practices.

11.1.8.2 Information relating to Forest Management

EU-15 MS apply rather broad definition of "Forest management", with only few MS reporting some areas of forest not falling also in the FM definition. In few cases there are strict assumptions, i.e. that only the forests with a landscape or/and forest management plan in 1990 and 2010 are under FM (e.g., Greece reports under FM only 35% of forest land area reported under the 5A1). UK does not report the forest area already existing in 1920 (about 0.9 Million ha). France also does not report large areas of forest from overseas territories, because that is regarded as being unmanaged.

Forest management is understood as the set of forest practices and operations, which occur at the stand-level: felling for natural and artificial/planting regeneration, site and soil preparation (including drainage, burning of slash), planting of seedlings, seeding, thinning, pruning, fertilization and liming, harvesting of cutting residues and conservation of important habitats, and fire prevention. Instruments for sustainable forest management are obligations under national legislation of all MS with adequate institutional framework, further enhanced by strategies/programs and management plans.

Sustainable forestry has a long tradition in Europe, with earliest management planning dating hundreds years back. Currently each MS has in force their own legislation on forest lands, as well as other laws supporting in general the improvement and protection of forests. At the EU level, forestry is not regulated directly by specific rules, but there are strong requirements for the protection of forests via common environmental obligation (on nature protection, biodiversity protection etc.), sustainable rural development and renewable energy policies. Some countries report certification of the forests as an additional tool to highlight the sustainability of the whole chain of forestry and wood products (i.e. many MS certified forests under various schemes).

Data reported under different international processes (e.g. FAO, MCFPE, CBD) may be different due to the different reference time and definitions applied underlying different reporting obligations. Thus, any comparisons have to be done cautiously.

11.1.8.3 Information relating to Cropland Management, Grazing Land Management and Revegetation, if elected, for the base year

Cropland and Grazing land management activities consist in the implementation of specific practices and operations, which differ substantially from country to country. Cropland management is dedicated to agricultural cultures and crops, perennial and annual, woody and non woody, including lands temporary under reserve or out of the productive activity.

Data for the reference year 1990 and the first year of the commitment period are constructed based on remote sensing, sometimes enhanced by statistics (i.e. activity data) or surveys (i.e. crop species share). Data on improved technologies for cultivation are likely missing for the base year and generally it is realistically assumed that they did not occur (i.e. Portugal).

MS includes also some types of wooded vegetation areas (reported under cropland in the convention) as subject to management, implementing adequate stratification for estimation of C stock changes (also for the base year). Denmark includes under grazingland management "grassland having some wooden vegetation that does not meet the forest definition" and "wooded perennial fruit plantations and hedgerows" in the cropland management area.

11.1.9 Other information (EU-15)

11.1.9.1 Key category analysis for Art. 3.3 activities and any elected Art. 3.4 activity

Member States apply quantitative criteria for the assessment of the key categories (see Table 11.4), based on the correspondence between KP activities and land categories under the GHG inventory. Some MS use additional qualitative criteria.

11.1.10 Information relating to Article 6

There is no JI project developed within EU-15.

11.2 Overview of emissions / removals and information reported by new EU MS in the KP LULUCF tables

Forestland definition adopted by the new EU-12 MS is in line with national legislation and within the range defined by FAO and UNFCCC. Additional criteria apply for forestland classification and hierarchizing with other land uses.

Table 11.17 Parameters used by the new EU MS to define "forest" under the Kyoto Protocol

Member State	NIR 2011			
	Crown cover (%)	Height (m)	Minimum area (ha)	Minimal Width (m)
Bulgaria	10	5	0.1	-
Czech Republic	30	2	0.05	20
Estonia	30	2	0.5	-
Hungary	30	5	0.5	10
Latvia	20	5	0.1	20
Lithuania	10	5	0.1	10
Poland	10	2	0.1	10
Romania	10	5	0.25	20
Slovakia	20	5	0.3	-
Slovenia	30	2	0.25	-

11.2.1 Coverage of carbon pools and GHG reported (KP CRF NIR 1)

Seven new EU MS have elected Forest Management and only one has elected revegetation (Romania). Among the new EU MS, only one country has chosen annual accounting (Hungary).

All new MS report biomass pools while provide estimates or justification for no source of other pools (Table 11.18). Litter pool is often reported together with SOC because of data availability (i.e. Bulgaria, Czech Republic) or assumed not occurring based on system functioning (in AR activities). In deforestation Hungary reports the amount of emission negligible under the period since the event occurred.

Table 11.18 Synthesis of pools coverage for KP LULUCF activities for 2010 in new EU MS (from tables NIR 1)

KP activity/MS		Changes in carbon pool reported					
		Above-ground biomass	Below-ground biomass	Litter	Dead wood	Soil Min	Soil Org
AR	Bulgaria	R	IE	R	NR	R	NO
	Czech Republic	R	R	IE	R	R	NO
	Estonia	R	R	NE	NO	R	R
	Hungary	R	R	NR	NR	NR	NO
	Latvia	R	R	R	R	R	R

	Lithuania	R	R	R	R	R	NA
	Poland	R	R	IE	R	R	NO
	Romania	R	R	R	NR	R	NO
	Slovakia	R	R	IE	NO	R	NO
	Slovenia	NO	NO	NO	NO	NO	NO
D	Bulgaria	R	IE	R	R	R	NO
	Czech Republic	R	R	IE	R	R	NO
	Estonia	R	R	R	R	R	R
	Hungary	R	R	R	R	R	NO
	Latvia	R	R	R	R	R	R
	Lithuania	R	R	R	R	R	R
	Poland	R	R	IE	R	R	NA
	Romania	R	R	R	R	R	NO
	Slovakia	R	R	IE	R	R	NO
	Slovenia	R	R	R	R	R	NO
FM	Bulgaria	NA	NA	NA	NA	NA	NA
	Czech Republic	R	R	IE	R	NR	R
	Estonia	NA	NA	NA	NA	NA	NA
	Hungary	R	R	NR	NR	NR	NO
	Latvia	R	R	R	R	R	R
	Lithuania	R	R	R	R	R	R
	Poland	R	R	IE	R	R	NO
	Romania	R	R	NR	NR	NR	NO
	Slovakia	NA	NA	NA	NA	NA	NA
	Slovenia	R	R	NR	R	NR	NO

Notation keys: R – C stock change or emissions from source is reported; NR – the pool is not reported, using the "not a source" principle; NE – removal/emission is not estimated (could be either negligible or truly not estimated); IE – included elsewhere; NO –not occurring; NA – MS does not account the activity.

Land area on which different KP activities occur represents some 21 % for AR, 7% D and 20 % for FM out of total EU-27 MS land (Table 11.19). Recalculation of AR area has been revised upward by Bulgaria, Poland and downward by Estonia, Latvia, while Lithuania provides estimates for the first time. The largest area of AR is reported by Bulgaria and Poland. Deforestation areas are small in all countries, with few countries showing practically very general small land conversions.

Table 11.19 **Synthesis of total area (kha) of KP-LULUCF activities as reported by new EU MS at the end of the 2009 (from Tab. NIR 2). Grey cells indicate that the activity has not been elected.**

Member State	Art. 3.3 activities		Article 3.4 activities			
	AR	D	FM	CM	GM	RV
Bulgaria	227	6.6	NA			
Czech Republic	43	14.0	2,561			
Estonia	23	20.6	NA			
Hungary	151	9.1	1,656			
Latvia	219	36.4	3,130			
Lithuania	26	1	2140			
Poland	637	11.5	8,668			
Romania	27	54.7	6,312			14
Slovakia	33	7.8	NA			
Slovenia	NO	6.1	1,185			
EU 12	**1386**	**168**	**25653**			**14**
EU-15 (see Table 11.3)	6000	1910	109284	25990	1445	0
Total EU 27	**7386**	**2078**	**134937**	**25990**	**1445**	**14**

NO is used to report a proven key category for all MS that have elected it, while deforestation does not bring important share of emissions (Table 11.20). There is general full agreement between importance of the category and methodological tiers involved in the estimation.

Table 11.20. **Synthesis of KP-LULUCF activities being key category as reported by new EU MS (from tables NIR 3). "K" indicates a key category. Grey cells indicate that the activity has not been elected.**

2	AR	D	FM	CM	GM	RV
Bulgaria	K	K				
Czech Rep.			K			
Estonia	K	K				
Hungary	K	K	K			
Latvia	K	K	K			
Lithuania	K	K	K			
Poland	K	K	K			
Romania	K		K			K
Slovakia	K	K				
Slovenia		K	K			

11.2.2 Summary of emissions/removals and accounting quantities for KP LULUCF activities by EU-15 MS (KP CRF "Accounting" table)

Out of total emission/removal amount that could be accounted by the EU-27 MS for their commitment compliance, the new MS contribution is 24 % from AR, 12 % from deforestation and 31 % from Forest Management. Three countries offset their emissions from 3.3 with removals from 3.4. Slovenia reports no afforestation/reforestation activity, but very small area of deforestation. Lithuania and Latvia report higher emissions from deforestation than in afforestation/reforestation, so they also implement the offset ruling.

Table 11.22 Emissions / removals and accounting quantities for KP-LULUCF activities as reported by new EU MS (Note: sum of MS' emissions/removals is shown for information purpose only. The EU will neither issue nor cancel accounting units)

	Net emissions (+) and removals (-), Gg CO2eq																							
	A. Art 3.3 activities									B. Art. 3.4 activities														
	A.1 AR						A.2. D			B.1 FM			B.2 CM				B.3 GM				B.4 RV			
	A.1.1 Lands not harvested			A.1.2 Lands harvested																				
	2008	2009	2010	2008	2009	2010	2008	2009	2010	2008	2009	2010	1990	2008	2009	2010	1990	2008	2009	2010	1990	2008	2009	2010
Bulgaria	-1078	-1223	-1393	NO	NO	NO	289	159	206	NA,NO	NA,NO	NA,NO	0	NA,NO	NA,NO	NA,NO	0	NA,NO	NA,NO	NA,NO	0	NA,NO	NA,NO	NA,NO
Czech Rep	-272	-295	-322	NO	NO	NO	160	170	207	-4404	-6441	-5096	0	NA	NA	NA	0	NA	NA	NA	0	NA	NA	NA
Estonia	-303	-325	-347	0	0	0	870	293	300	0	0	0	0	NA	NA	NA	0	NA	NA	NA	0	NA	NA	NA
Hungary	-1087	-1061	-1175	-25	-47	-84	41	81	45	-2784	-1892	-1680	0	0	0	0	0	0	0	0	0	NA	NA	NA
Latvia	-441	-506	-506	NA,NO	NA,NO	NA,NO	488	409	360	-23599	-21102	-17309	0	NA	NA	NA	0	NA	NA	NA	0	NA	NA	NA
Lithuania	-77	-84	-197	0	0	0	6	11	35	-8147	-11207	-12068	0	NA	NA	NA	0	NA	NA	NA	0	NA	NA	NA
Poland	-9161	-9702	-10042	IE,NO	IE,NO	IE,NO	258	268	229	-41132	-42570	-42190	0	NA	NA	NA	0	NA	NA	NA	0	NA	NA	NA
Romania	-334	-354	-374	IE,NO	IE,NO	IE,NO	2090	480	476	-22263	-22740	-22200	NA	NA	NA	NA	NA	NA	NA	NA	-1275	-239	-254	-268
Slovakia	-453	-469	-512	0	0	0	174	282	181	NA	NA	NA	0	NA	NA	NA	0	NA	NA	NA	0	0	0	0
Slovenia	NA,NO	NA,NO	NA,NO	0	0	0	145	317	359	-10312	-10305	-10308	0	NA	NA	NA	0	NA	NA	NA	0	NA	NA	NA
EU 15	**-38767**	**-40852**	**-41210**	**1069**	**798**	**770**	**27471**	**25811**	**23092**	**-234968**	**-235899**	**-211440**	**4489**	**216**	**-206**	**117**	**247**	**-207**	**-242**	**-724**	**0**	**0**	**0**	**0**
EU 25	**-51973**	**-54871**	**-56078**	**1044**	**752**	**686**	**31992**	**28282**	**25488**	**-347610**	**-352157**	**-322290**	**4489**	**216**	**-206**	**117**	**247**	**-207**	**-242**	**-724**	**-1275**	**-239**	**-254**	**-268**

Table 11.21 Accounting quantities in 2010 for KP-LULUCF activities as reported by new EU 12 Member States.

MS	Accounting quantity on activities						MS accounting amount on LULUCF activities
	AR	D	FM	CM	GM	RV	
Bulgaria	-3694	654	NA,NO	0	0	0	**-3039**
Czech Rep	-889	537	-5867	0	0	0	**-6218**
Estonia	-975	NA,NO	0	0	0	0	**-975**
Hungary	-3323	168	-5317	0	0	0	**-8472**
Latvia	-1453	1257	-6233	0	0	0	**-6430**
Lithuania	-358	52	-5133	0	0	0	**-5439**
Poland	-28905	755	-15033	0	0	0	**-43184**
Romania	-1062	3046	-20167	NA	NA	3064	**-15119**
Slovakia	-1434	637	NA	0	0	0	**-797**
Slovenia	NA,NO	821	-7421	0	0	0	**-6600**
EU 12	**-162922**	**84300**	**-230030**	**-13340**	**-1914**	**3064**	**-162922**

11.2 Synthesis of supplementary information on KP LULUCF activities reported by EU-12 MS in their NIRs

Estimation methodologies adopted by the EU-12 MS are consistent with those used for reporting GHG inventory under the Convention. IEF for C stock change factors are within the ranges reported by EU-15 MS for afforestation/reforestation (Table 11.22), deforestation (Table 11.23) and forest management (Table 11.24).

Table 11.22 IEF for net C stock changes (Mg C/ha) by pool on lands under AR activity in EU-15 (in the year 2009)

Member State	Above ground Biomass	Below ground Biomass	Litter	Dead wood	Min Soils	Org Soils
Bulgaria	1.9	IE,NO	0.3	NE,NO	-0.5	NO
Czech Republic	1.6	0.3	IE	NO	0.2	NO
Estonia	1.5	0.7	NE	NO	NO	-0.2
Hungary	1.7	0.4	NE	NE	NE	NO
Latvia	0.5	0.2	NE	NE	NO	0.0
Lithuania	0.4	0.1	NE	NE	NE	-0.3
Poland	1.9	0.5	IE	0.0	1.9	NO
Romania	1.5	0.4	0.3	NO	1.7	NO
Slovakia	1.2	0.3	0.4	NO	2.3	NO
Slovenia	NO	NO	NO	NO	NO	NO

NE is used for reporting, either as no source (supported by justification mainly based on system functioning reasoning) or data is not yet reported and planed for improvement. NO is reported for pools which are demonstrated as no source. Values of biomass IEF for deforestation range wider both under biomass stocks considered (i.e. average by majority of countries or specific determined by NFI by Slovenia). High value of Slovenia is reported because IEF is only reported to current year (which not necessarily overestimate the overall emissions), under current improving of reporting system.

Table 11.23 **IEf for net C stock changes (Mg C/ha) in the pools under Deforestation activity in EU-15 (in the year 2008)**

Member State	Above ground Biomass	Below ground Biomass	Litter	Dead wood	Min Soils	Org Soils
Bulgaria	-5.5	IE	-0.3	-0.3	-2.6	NO
Czech Republic	-3.2	-0.6	IE,NA	-0.1	-0.1	NO
Estonia	-2.9	-0.8	NE	-0.1	NO	-0.1
Hungary	-0.7	-0.2	-0.1	-0.1	-0.4	NO
Latvia	-1.0	-0.3	-0.7	-0.2	2.4	1.0
Lithuania	-2.5	-0.6	-1.0	-0.1	-2.9	-3.7
Poland	-2.6	-0.5	IE	-0.1	-2.2	NA
Romania	-0.1	0.0	0.0	0.0	-2.2	NO
Slovakia	-4.9	-1.1	0.0	-0.2	-0.1	NO
Slovenia	-13.1	-0.9	-0.7	-0.6	-0.9	NO

In the forest management areas, DW and LT are mainly reported as “not a source” (thus NE or NO, NA).

Table 11.24. **IEf for net C stock changes (Mg C/ha) in the pools under Forest management activity in EU-15 (in the year 2009)**

Member State	Above ground Biomass	Below ground Biomass	Litter	Dead wood	Min Soils	Org Soils
Bulgaria	NA	NA	NA	NA	NA	NA
Czech Republic	0.6	0.1	NE,NO	NO	NE,NO	0.0
Estonia	NA	NA	NA	NA	NA	NA
Hungary	0.2	0.1	NE	NE	NE	NO
Latvia	1.2	0.4	NE	NE	NO	-0.7
Lithuania	0.3	0.1	0.1	0.1	0.0	-0.3
Poland	0.6	0.2	IE	0.0	0.5	NO
Romania	0.7	0.2	NO	NO	NO	NO
Slovakia	NA	NA	NA	NA	NA	NA
Slovenia	1.8	0.4	NA	0.1	NA	NO

GHG emissions from sources associated with KP activities are generally reported by the MS as not occurring. Forest land conversions to cropland are generally not allowed by law in European countries.

In the new EU-12 MS there is an ongoing effort for improvement of reporting, especially for the problematic pools for which historical data is practically not available. These issues were identified over EU QA/QC procedure and often highlighted by 2012 UNFCCC review process (included in the Saturday Papers as critical issues for improvement).

12 Information on accounting of Kyoto units

12.1 Background information

The standard electronic format (SEF) for providing information on ERUs, CERs, tCERs, lCERs, AAUs and RMUs for the year 2011 for the Community registry is submitted together with this report (Annex 1.13). The data in the Community registry reflect only the transactions to and from the Community registry, but not the sum of all Member States' transactions. Member States' separately submit information on Kyoto units in SEF tables to the UNFCCC.

12.2 Summary of information reported in the SEF tables for the Community registry

The standard electronic format tables for the Community are included in the submission. The SEF reporting software has been used for this purpose. The tables include information on the AAU, ERU, CER, t-CER, l-CER and RMU in the Community registry at 31.12.2011 as well as information on transfers of the units in 2011 to and from other Parties of the Kyoto Protocol.

The assigned amount for the EU, calculated pursuant to Article 3 paragraphs 7 and 8 as described in the EU's initial report, exceeds the sum of Member States' assigned amounts by 19,357,531 tonnes CO_2-equivalent. This arithmetical difference is due to the fact that the joint agreement under Article 4 of the Kyoto Protocol was formulated in percentage contributions based on base-year data available in 1998. As the Member States have revised their base-year emissions, the adopted percentage contributions under the burden sharing agreement no longer exactly match EU's 92 % commitment. As each assigned amount unit (AAU) can only be issued into a national registry once, the assigned amount of each Member State should be issued into its respective national registry after being recorded in the compilation and accounting database. The remaining assigned amount for the EU, amounting to 19,357,531 tonnes CO_2-equivalent (which is the arithmetical difference between the Community's assigned amount and the sum of the Member States' assigned amounts), was issued in the registry of the EU in 2011.

The total quantities of AAUs acquired and transferred during the reporting period are provided in SEF table 2b and 2c.

12.3 Summary of information reported in the SEF tables of Member States

SEF tables for the Community registry, EU-15 and EU-25 are provided in Annex 1.13 and Annex 2.13. The SEF tables for EU-15 include aggregated information for EU-15 and EU-25 Member States. Note that the EU-15 SEF tables also include transactions between the Community registry and the new EU Member States and non-EU Member States. Table 11.1 provides an overview of transactions included in Table 2(b) in the Community registry, EU-15 SEF tables and EU-25 SEF tables.

Table 12.1 Transactions included in Table 2(b) in the Community registry, EU-15 SEF tables and EU-25 SEF tables

Table 2(b)		Community registry SEF tables	EU-15 SEF tables	EU-25 SEF tables
From	**To**			
Community registry	EU-15 MS	Yes		
Community registry	new MS	Yes	Yes	
Community registry	Non-EU MS	Yes	Yes	Yes
EU-15 MS	Community registry	Yes		
EU-15 MS	new MS		Yes	
EU-15 MS	Non-EU MS		Yes	Yes
new MS	Community registry	Yes	Yes	
new MS	EU-15 MS			Yes
new MS	Non-EU MS			Yes

12.4 Discrepancies and notifications

With respect to the respective paragraphs of decision 15/CMP.1 the following information is provided for the Community registry:

- **Paragraph 12:** No discrepancies identified by the transaction log.
- **Paragraph 13**: No notifications directed to the Party to replace ICERs in accordance with Paragraph 49 of the annex to decision 5/CMP.1.
- **Paragraph 14:** No notifications directed to the Party to replace ICERs in accordance with para 50 of the annex to decision 5/CMP.1.
- **Paragraph 15:** No issue of non-replacement.
- **Paragraph 16**: No KP Units that are not valid.
- **Paragraph 17:** No actions were necessary to correct any problem causing a discrepancy.

12.5 Publicly accessible information

The information based on the requirements in the annex to decision 13/CMP is publicly available on the European Commission website: http://ec.europa.eu/environment/climat/gge_registry.htm

In accordance with Decision 13 of the first Meeting of the Parties to the Kyoto Protocol (COP/MOP 1), the following information is made publicly available from the Community Registry.

List of accounts

TYPE	COMM PRD	ACCOUNT HOLDER	REPRESENTATIVE ID	REPRESENTATIVE	TEL	FAX	EMAIL
Holding account	0	European Commission	EU100000000002312	Ronald Velghe	+32-229-84052	-	ronald.velghe@ec.europa.eu

Article 6 project information

No ERU have been issued in the Community Registry in 2008 No ERU have been issued in the Community Registry in 2009 No ERU have been issued in the Community Registry in 2010

The total quantity of ERUs, CERs, AAUs and RMUs in each account at the beginning of the year

This information is confidential.

The total quantity of AAUs issued on the basis of the assigned amount pursuant to Article 3, paragraphs 7 and 8

No AAU have been issued in the Community Registry in 2008 No AAU have been issued in the Community Registry in 2009 No AAU have been issued in the Community Registry in 2010 19,357,532 AAUs have been issued in the Community Registry in 2011

The total quantity of ERUs issued on the basis of Article 6 projects

No ERU have been issued in the Community Registry in 2008 No ERU have been issued in the Community Registry in 2009 No ERU have been issued in the Community Registry in 2010 No ERU have been issued in the Community Registry in 2011

The total quantity of ERUs, CERs, AAUs and RMUs acquired from other registries and the identity of the transferring accounts and registries

YEAR	Registry	AAU	ERU	RMU	CER
2008	AT	159,153	0	0	0
2008	CZ	1,884,071	0	0	0

2008	ES	10,229,902	0	0	0
2008	FI	792,678	0	0	0
2008	LU	72,000	0	0	0
2008	PT	2,235,418	0	0	0
2008	SK	2,684,303	0	0	0
2010	GB	633,525	0	0	303,069
2011	GB	377,706			653,402

No unit has been acquired from another registry in 2009.

The total quantity of RMUs issued on the basis of each activity under Article 3, paragraphs 3 and 4

No RMU have been issued in the Community Registry in 2008

No RMU have been issued in the Community Registry in 2009

No RMU have been issued in the Community Registry in 2010

No RMU have been issued in the Community Registry in 2011

The total quantity of ERUs, CERs, AAUs and RMUs transferred to other registries and the identity of the acquiring accounts and registries

YEAR	Registry	AAU	ERU	RMU	CER
2008	BE	162,019	0	0	0
2008	DK	2,593,754	0	0	0
2008	FR	5,664,238	0	0	0
2008	HU	131,000	0	0	0
2008	IT	579,204	0	0	0
2008	NL	3,062,720	0	0	0
2008	PL	90,000	0	0	0
2008	SE	18,429	0	0	0
2008	GB	5,627,661	0	0	0

2008	IE	128,500	0	0	0
2010	GB	508,009	0	0	0
2011	GB	65,000	0	0	0
2011	DK	5,000,000	0	0	0

No unit has been transferred to another registry in 2009.

The total quantity of ERUs, CERs, AAUs and RMUs cancelled on the basis of activities under Article 3, paragraphs 3 and 4

YEAR	AAU	ERU	RMU	CER
2008	0	0		
2009	0	0		
2010	0	0		
2011	0	0	0	0

The total quantity of ERUs, CERs, AAUs and RMUs cancelled following determination by the Compliance Committee that the Party is not in compliance with its commitment under Article 3, paragraph 1

YEAR	AAU	ERU	RMU	CER
2008	0	0	0	0
2009	0	0	0	0
2010	0	0	0	0
2011	0	0	0	0

The total quantity of other ERUs, CERs, AAUs and RMUs cancelled

YEAR	AAU	ERU	RMU	CER
2008	0	0	0	0

2009	0	0	0	0
2010	0	0	0	0
2011	0	0	0	0

The total quantity of ERUs, CERs, AAUs and RMUs retired

YEAR	AAU	ERU	RMU	CER
2008	0	0	0	0
2009	0	0	0	0
2010	0	0	0	0
2011	0	0	0	0

12.6 Calculation of commitment period reserve (CPR)

The EU commitment period reserve is 17,659,243,358 tonnes CO_2eq. as indicated as revised estimate in the report of the review of the initial report of the European Union (FCCC/IRR/2007/EC). The commitment period reserve for the EU is calculated as 90 per cent of its assigned amount pursuant to article 3, paragraphs 7 and 8 of the Kyoto Protocol and therefore remains unchanged during the first commitment period.

12.7 KP-LULUCF accounting

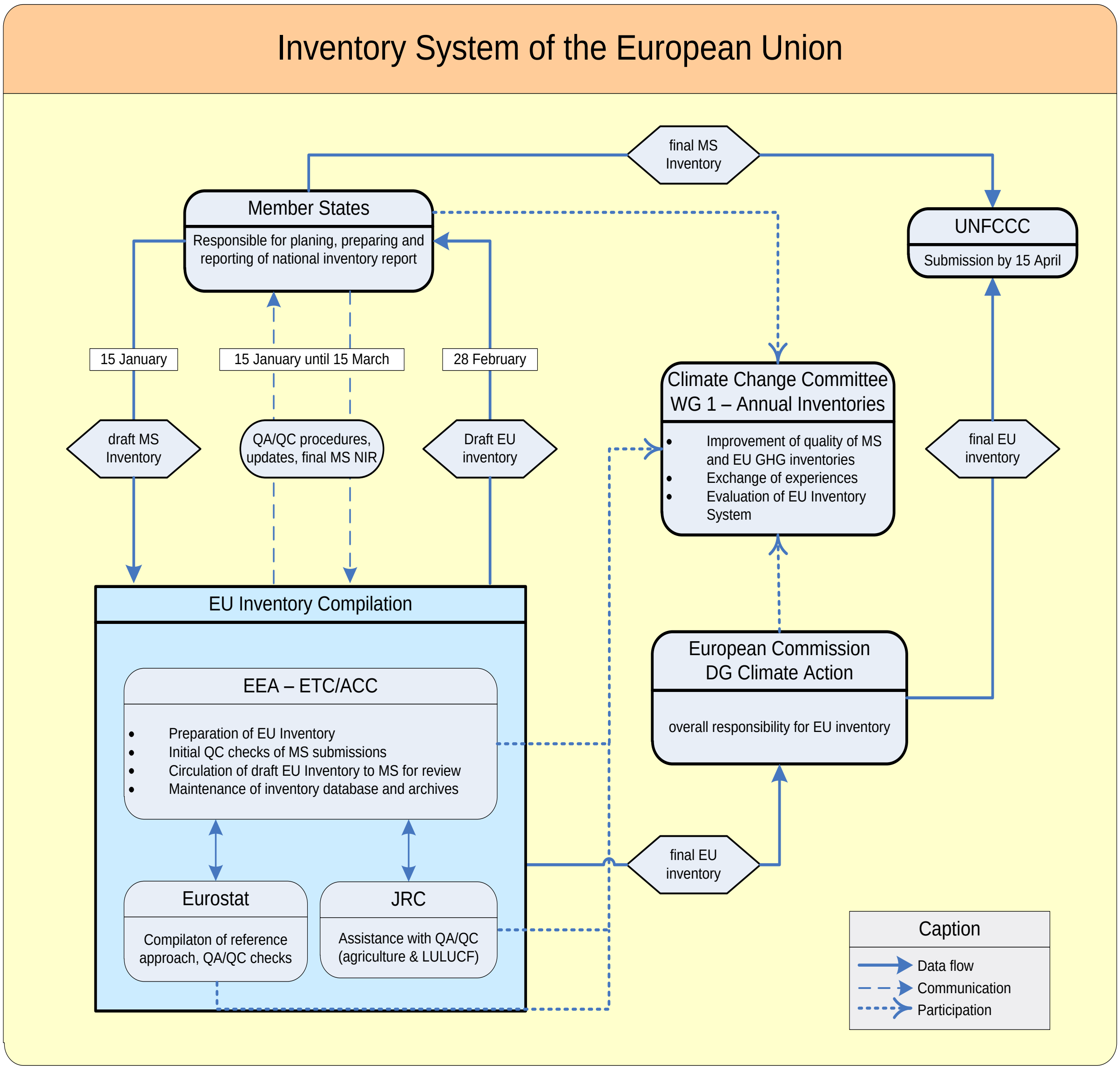
Each EU Member State will account for net emissions and removals for each activity under Article 3, paragraphs 3 and 4, if elected, by issuing RMUs or cancelling Kyoto Protocol units based on the corresponding reported emissions and removals from these activities and the specific accounting rules. The EU will neither issue nor cancel units based on the reported emissions and removals from activities under Article 3, paragraph 3 and paragraph 4. The EU will report the sum of Member States' cumulative accounting quantities for these activities at the end of the commitment period, representing the Member States' cumulative additions to or subtractions from their assigned amount at the end of the commitment period.

13 Information on changes in national system

No changes were made to the EU national system.

Figure 13.1 provides information about the National Inventory System of the European Union.

Figure 13.1 National Inventory System of the European Union.



14 Information on changes in national registry

A description of the EU registry was provided in the EU initial report. This description was updated in 2008 and the revised description was provided as Annex 13 to the NIR 2008.

Referring to paragraph 22 of the annex to Decision 15/CMP.1, the following changes have occurred in the Community Registry since the last report:

- In 2011, the EU national registry was amended in one major release, CR V6.0.

  The primary reason for this release was to refine the functioning of the EU national registry to the rules of Commission Regulation 920/2010. The core of the required changes was limited to EU ETS processes and did not affect existing Kyoto Protocol operations.

CR V6.0 implemented changes in the following areas:

- The STL web services serving the following functions:
  - Compliance management processes
  - User interface

15 Information on minimizing adverse impacts in accordance with Article 3, paragraph 14

15.1 Information on how the EU is striving, under Article 3, paragraph 14, of the Kyoto Protocol, to implement the commitments mentioned in Article 3, paragraph 1, of the Kyoto Protocol in such a way as to minimize adverse social, environmental and economic impacts on developing country Parties, particularly those identified in Article 4, paragraphs 8 and 9, of the Convention

Editorial comment: The EU is only required to report changes related to the information on minimizing adverse impacts in accordance with Article 3, paragraph 14. However for an improved understanding, the text from the last year's inventory report was included and updated parts are marked in bold.

In this section the EU provides information on how it is implementing its commitment under Article 3, paragraph 14 of the Kyoto Protocol, i.e. how it is striving to implement its commitment under Article 3, paragraph 1 of the Kyoto Protocol in such a way as to minimize potential adverse social, environmental and economic impacts on developing countries. In order to strive for such a minimization, an assessment of potential positive and negative impacts – both of direct and indirect nature - is necessary with a double objective to maximize positive impacts and to minimize adverse impacts. The EU is well aware of the need to assess impacts, and has built up thorough procedures in line with our obligations. This includes bilateral dialogues and different platforms in which we interact with third countries, explain new policy initiatives and receive comments from third countries.

Impacts on third countries are mostly indirect and can frequently neither be directly attributed to a specific EU policy, nor directly measured by the EU in developing countries. Therefore, the reported information covers potential adverse social, environmental and economic impacts that result from complex assessments of indirect influences and that are based on accessible data sources in developing countries.

Impact assessment of EU policies

In the EU a wide-ranging impact assessment system accompanying all new policy initiatives has been established. This regulatory impact assessment is a key element in the development of the Commission's legislative proposals. The Commission is required to take the impact assessment reports into account when taking its decisions, while the impact assessments are also presented and discussed during the scrutiny of legislative proposals from the Council and the Parliament. This approach ensures that potential adverse social, environmental and economic impacts on various stakeholders (in the case on developing country Parties) are identified and minimized within the legislative process. In general, impact assessments are required for all legislative proposals, but also other important Commission initiatives which are likely to have far-reaching impacts. Below the impact assessment process implemented in the EU policy making is explained in more detail in order to better demonstrate how the EU is striving for all strategies and policies to minimize their adverse impacts. Specific guidelines for the impact assessment have been adopted (European Commission 2009).

The Impact Assessment Guidelines specifically address impacts on third countries and also issues related to international relations. In this area the following questions have to be assessed:

- Trade relations with third countries: some policies may affect trade or investment flows between the EU and third countries; the impact assessment should analyse how different groups (foreign and domestic businesses and consumers) are affected, and help to identify options which do not create unnecessary trade barriers.
- Impact on WTO obligations: it should be analysed which impact each proposed policy option has on the international obligations of the EU under the WTO Agreement; the impact assessment should examine whether the policy options concern an area in which international standards exist.
- Impacts on developing countries: initiatives that may affect developing countries should be analysed for their coherence with the objectives of the EU development policy. This includes an analysis of consequences (or spill-overs) in the longer run in areas such as economic, environmental, social or security policies.

Key economic questions to be assessed in relation to third countries are:

- How does the policy initiative affect trade or investment flows between the EU and third countries? How does it affect EU trade policy and its international obligations, including in the WTO?
- Does the option affect specific groups (foreign and domestic businesses and consumers) and if so in what way?
- Does the policy initiative concern an area in which international standards, common regulatory approaches or international regulatory dialogues exist?
- Does it affect EU foreign policy and EU development policy?
- What are the impacts on third countries with which the EU has preferential trade arrangements?
- Does it affect developing countries at different stages of development (least developed and other low-income and middle income countries) in a different manner?
- Does the option impose adjustment costs on developing countries?
- Does the option affect goods or services that are produced or consumed by developing countries?

Key questions on social impacts in third countries are:

- Does the option have a social impact on third countries that would be relevant for overarching EU policies, such as development policy?
- Does it affect international obligations and commitments of the EU arising from e.g. the ACP-EU Partnership Agreement or the Millennium Development Goals?
- Does it increase poverty in developing countries or have an impact on income of the poorest populations?

Key questions on environmental impacts in relation to third countries are:

- Does the option affect the emission of greenhouse gases (e.g. carbon dioxide, methane etc) into the atmosphere?
- Does the option affect the emission of ozone-depleting substances (CFCs, HCFCs etc)?
- Does the option affect our ability to adapt to climate change?

- Does the option have an impact on the environment in third countries that would be relevant for overarching EU policies, such as development policy?

If third countries are likely to be affected, the impact assessment should analyse in greater detail what the specific impacts may be, how undesired effects can be avoided or minimised, or mitigated, how the policy options compare in this respect and what trade-offs have to be addressed in the final policy choice.

Consulting interested parties is an obligation for every impact assessment and all affected stakeholders should be engaged, using the most appropriate timing, forma and tools to reach them. Appropriate consultation tools can be consultative committees, expert groups, open hearings, ad hoc meetings, consultation via Internet, questionnaires, focus groups or seminars/workshops. Existing international policy dialogues are also be used to keep third countries fully informed of forthcoming initiatives, and as a means of exchanging information, data and results of preparatory studies with partner countries and other external stakeholders.

The EU's 5th national communication provides a detailed overview of the European policies and measures to mitigate GHG emissions in all sectors. All key strategies and climate policies have been subject to impact assessments as described above. All impact assessments and all opinions of the Impact Assessment Board are published online (see http://ec.europa.eu/governance/impact/ia_carried_out/cia_2010_en.htm). In addition to the general approach described above to address adverse social, environmental and economic impacts, more specific ways to minimize impacts depend on the respective policies and measures implemented. As the reporting obligation related to Article 3, paragraph 14 does not include an obligation to report on each specific mitigation policy, the EU chooses the approach to provide some specific examples for a more complete overview on the ways how the EU is striving to minimize adverse impacts.

Major EU policies such as the Directive on the promotion of the use of renewable energy (Directive 2009/28/EC and the extension of the EU emission trading scheme (ETS) to the aviation sector (Directive 2008/101/EC) are presented in more detail as examples in this chapter, because the related impact assessments identified potential impacts on third countries. **Furthermore, updates of EU policies which should lead to a low carbon and energy efficient economy are also addressed in more detail in the following subchapters**

Directive on the promotion of the use of renewable energy - Promotion of biomass and biofuels

The Directive on renewable energy (Directive 2009/28/EC), a part of the EU's climate and energy package, sets ambitious targets for all Member States, such that the EU will reach a 20% share of energy from renewable sources in the overall energy consumption by 2020 (with individual targets for each Member State) and a 10% share of renewable energy specifically in the transport sector, which includes biofuels, biogas, hydrogen and electricity from renewables.

The impact assessments related to enhanced biofuel and biomass use in the EU showed that the cultivation of energy crops have both potential positive and negative impacts. Positively, as the growing of EU demand for bioenergy generates new export revenues and employment opportunities for developing countries and boosts rural economies. Thus there could be clear economic and social benefits. At the same time, the new EU energy crop demand could increase the impact on biodiversity, soil and water resources and can have positive as well as negative effects on air pollutants. The extent of carbon reduction and other environmental effects from the promotion of biofuels can vary according to the feedstock employed, the way the feedstock and the biofuels are produced, how they are transported and how far. Growing future demand for biomass feedstock combined with growing global food consumption could add to the agricultural sector's pressure on land use and result in adverse land use change.

To address the risk of adverse impacts, Article 17 of the EU's Directive on renewable energy sources creates pioneering "sustainability criteria", applicable to all biofuels (biomass used in the transport sector) and bioliquids. The sustainability criteria adopted include:

- establish a threshold for GHG emission reductions that have to be achieved from the use of biofuels;
- exclude the use of biofuels from land with high biodiversity value (primary forest and wooded land, protected areas or highly biodiverse grasslands),
- exclude the use of biofuels from land with high C stocks, such as wetlands, peatlands or continuously forested areas.

Developing country representatives as well as other stakeholder were extensively consulted during the development of the sustainability criteria and preparation of the directive and the extensive consultation process has been documented.

Any negative economic aspects will also be monitored by the Commission. In addition, Article 18(4) of the Directive provides that the EU shall endeavour to conclude bilateral or multilateral agreements with third countries containing provisions on sustainability criteria that correspond to those of this Directive. Where the EU has concluded agreements containing provisions relating to matters covered by the sustainability criteria set out in Article 17(2) to (5), the Commission may decide that those agreements demonstrate that biofuels and bioliquids produced from raw materials cultivated in those countries comply with the sustainability criteria in question.

The Directive also ensures that the Commission will report every two years, in respect to both third countries and Member States which constitute a significant source of biofuels or of raw material for biofuels consumed within the Union, on national measures taken to respect the sustainability criteria for soil, water and air protection. The first report is to be submitted later in 2012.

The criteria pursuant to Article 17 apply to biofuels and bioliquids, not to solid biomass which is also promoted by the Directive. With regard to the energy use of all biomass forms, Article 17, paragraph 9 of the Directive requires the Commission to report on “requirements for a sustainability scheme for energy uses of biomass, other than biofuels and bioliquids, by 31 December 2009.” In 2010, the Commission adopted a report on sustainability requirements for the use of solid biomass and biogas in electricity, heating and cooling together with an impact assessment. The report makes recommendations on sustainability criteria to be used by those Member States that wish to introduce a scheme at national level, in order to avoid obstacles for the functioning of the internal market for biomass.

The Commission is also to report on biofuels' potential indirect land use change effect and the positive and negative impact on social sustainability in the Union and in third countries, including the availability of foodstuffs at affordable prices, in particular for people living in developing countries, and wider development issues. Reports shall address the respect of land-use rights. **The results of a study were published in 2011 and assess a range of sustainability impacts resulting from the use of biofuels in the EU (Hamelinck et al. 2011). Major findings of this study with regard to environmental and social impacts in third countries are:**

- **The total gross land use associated with EU biofuel consumption in 2008 is estimated to be 7 Mha, of which 3.6 Mha in the EU and 3.3Mha in third countries.**
- **The macro economic modelling shows an increased global agricultural land use of 1.3 Mha related to biofuel production between 2000 and 2008, indicating that not all land used for biofuels is expansion of agricultural land;**
- **The countries that appear to have been mostly influenced in their land use by biofuel export to the EU market are Argentina (soybean), Brazil (soybean and sugarcane), USA (soybean) and Ukraine (rapeseed), as well as Malaysia and Indonesia (both oil palm) - although to a smaller extent;**
- **The expansion of cropland is likely to have different effects in different countries. Some countries may be able to expand their cropland for specific crops by changing the crop rotation patterns, including reducing the amount of land in fallow, while others may have to expand on to pastures or natural vegetation. The effects of the latter are also likely to vary between different countries, depending on the types of land that become converted to cropland;**
- **Land use analysis in key biofuel producing regions indicate that land use for biofuel crops does not automatically imply expansion of cropland in the country where the biofuels are being cultivated. In the period 2001-2008, the EU, Argentina and Brazil experienced a net gain of cropland. Indonesia, Malaysia and USA have seen a net decrease of cropland;**
- **The EU biofuel demand is estimated to account for a rather small share of local environmental impacts from biofuel crop cultivation in most exporting countries;**
- **For the countries providing the EU with biofuels or their feedstocks in 2008, it can be stated that biodiversity monitoring is in place to a certain degree, but several countries could improve on specific aspects.**
- **Estimates for employment resulting from biofuels production vary widely. The global employment related to biofuels may be over 1.5 million, half of which in Brazilian cane and related ethanol production.**

The EU's biofuel sustainability criteria form the first global initiative to address the climate change and sustainability issues surrounding crop production.

The biofuels scheme, by imposing environmental standards and requiring high greenhouse gas savings (35% rising to 60%), put also pressure on the production of the raw materials used for other purposes. Some examples of voluntary sustainability scheme out of the biofuels field are in the pipeline.

The recent Communication from the Commission on voluntary schemes and default values in the EU biofuels and bioliquids sustainability scheme (2010/C 160/01)[38] sets up a system for certifying sustainable biofuels, including those imported into the EU. It lays down rules that such schemes must adhere to if they are to be recognized by the Commission. This will ensure that the EU's requirements that biofuels deliver substantial reductions in greenhouse gas emissions and that biofuels do not result from forests, wetlands and nature protection areas.

[38] OJ C160, 19.6.2010, p.1

The European Commission has so far (July 2011) recognised 7 voluntary schemes: International Sustainability and Carbon Certification (ISCC), Bonsucro EU, Round Table on Responsible Soy (RTRS EU RED), Roundtable of Sustainable Biofuels (RSB EU RED), Biomass Biofuels voluntary scheme (2BSvs), Abengoa RED Bioenergy Sustainability Assurance (RSBA), Greenergy Brazilian Bioethanol verification programme.

In line with Article 19(4) of Directive 2009/28/EC on the promotion of the use of energy from renewable sources[39] the Commission published in 2010 a report on the feasibility of drawing up lists of areas in third countries with low greenhouse gas emissions from cultivation (COM(2010) 427 final) concluding that, "while desirable, it is not yet feasible to set up legally binding lists of areas for third countries where a major component of the underlying calculation is uncertain and can easily be questioned, and where third countries have had no possibility to contribute on the methodology and data used. It is therefore not appropriate, at least at this stage, to produce legislative lists for third countries based on the current modelling of N_2O emissions from agriculture. However, it is important to enhance the understanding of the topic and survey the data used in view of a new assessment in 2012. The Commission has thus published the preliminary results of the JRC work together with all necessary data and description of methodology to support such a process on the webpage of the JRC. It will use this as the basis for a discussion with third countries in the framework of its dialogue and exchange with them under Article 23(2) of the Renewable Energy Directive."

Another way the EU will strive to minimize potential adverse impacts of biomass use is to promote second generation biomass technologies. Within the renewable energy Directive, second generation biofuels are promoted through Article 21, paragraph 2 which establishes that the contribution made by biofuels produced from wastes, residues, non-food cellulosic material, and ligno-cellulosic material shall be considered to be twice that made by other biofuels for the purposes of demonstrating compliance with national renewable energy targets; and EU research also has a major focus on bioenergy technologies. The goal of second generation biofuel processes is to extend the amount of biofuel that can be produced sustainably by using biomass consisting of the residual non-food parts of current crops, such as stems, leaves and husks that are left behind once the food crop has been extracted, as well as other crops that are not used for food purposes (non food crops) and also industry waste such as woodchips, skins and pulp from fruit pressing. Second generation biofuels are expected to expand the biomass feedstock available for biofuel production. Further research and impact assessments in this area are necessary to assess e.g. the long-term effects of the energy use of non-food parts of crops compared to their existing use.

Inclusion of aviation in the EU emission trading scheme

In 2005 the Commission adopted a Communication entitled "Reducing the Climate Change Impact of Aviation", which evaluated the policy options available to this end and was accompanied by an impact assessment. The impact assessment concluded that, in view of the likely strong future growth in air traffic emissions, further measures are urgently needed. Therefore, the Commission decided to pursue a new market-based approach at EU level and included aviation activities in the EU's scheme for greenhouse gas emission allowance trading. The finally adopted legislation was the result of an extensive stakeholder consultation including an internet consultation and an Aviation Working Group of experts set up as part of the European Climate Change Programme that identified the integration of aviation in the EU ETS as the lowest cost option to address the challenge of reducing emissions

[39] OJ L 140, 5.6.2009, p. 16

from this sector. The impact assessment also specifically addressed the effects on developing countries (European Commission 2006).

Aircraft operators from developing countries will be affected to the extent they operate on routes covered by the scheme. Data from Eurocontrol on the nationality of operators has been used to make an estimate of the aggregated costs for third country airlines from regions that include developing countries. As operators from third countries generally represent a limited share of emissions covered, the impact is also modest. For example, the total additional operating costs according to the impact assessment for all operators based in Africa would, at current activity levels, vary from €2 to €35 million per year depending on allowance prices and the share of allowances auctioned. In terms of the economic impacts, a larger proportion of the compliance costs would naturally be borne by carriers from Annex I countries as they generally have a higher market share on the routes covered. However, carriers from developing countries that are able to operate in competition with Annex I carriers on such routes would need to be covered in order to avoid a) distortions of competition and b) discrimination as to nationality in line with the Chicago Convention.

For carriers with relatively old and inefficient fleets the impact may be higher as the effective proportion of allowances acquired for free through benchmarking is lower. However, as third country airlines would generally only have a fraction of their fleet operating in Europe, they may in some cases be able to reduce any negative effects by shifting their most efficient aircraft to operate on routes covered by the scheme.

To the extent that aviation's inclusion in the EU ETS creates additional demand for credits from JI and CDM projects, there will also be indirect positive effects as such projects imply additional investments in clean technologies in developing countries.

Similarly, additional finance for climate change mitigation and adaptation in developing countries should be raised through the auction of emissions allowances by EU Member States. The legislation provides a list of such areas by which the Member State should use the monies raised, and specifically mentions use for adaptation in developing countries.

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There are further opportunities for developing countries to increase the demand for both CDM credits and future forms of sectoral mechanisms. The EU ETS legislation anticipates that third countries will take equivalent measures covering all flights departing from their territory for the EU. In such circumstances, when equivalent measures are taken, the scope of the EU scheme can be reduced with the exclusion of these flights. Developing countries can thus benefit from additional demand for credits over and above the quantity that is allowed already for compliance by participants in the EU ETS.

A roadmap for moving to a competitive low carbon economy in 2050

In 2011 the Commission released the Communication "A Roadmap for moving to a competitive low carbon economy in 2050" (COM(2011) 112 final) outlining a strategy to meet the long-term target of reducing domestic emissions by 80 to 95% by 2050 as agreed by European Heads of State and governments. The Roadmap shows how the sectors responsible for Europe's emissions - power generation, industry, transport, buildings and construction, as well as agriculture - can make the transition to a low-carbon economy over the coming decades. The transition towards a competitive low-carbon economy means that the EU should prepare for reductions in its domestic emissions by 80% by 2050 compared to 1990. Such a pathway would result in annual reductions compared to

1990 of roughly 1% in the first decade until 2020, 1.5% in the second decade from 2020 until 2030, and 2 % in the last two decades until 2050.

The shift to a resource-efficient and low-carbon economy should be supported by using all resources, decoupling economic growth from resource and energy use, reducing CO_2 emissions, enhancing competitiveness and promoting greater energy security. A low-carbon economy will mean a much greater use of renewable sources of energy, energy-efficient building materials, hybrid and electric cars, 'smart grid' equipment, low-carbon power generation and carbon capture and storage technologies.

Because more locally produced energy would be used in a low-carbon economy, mostly from renewable sources, the EU would be less dependent on imports of oil and gas from outside the EU. On average, the EU could save € 175 - 320 billion annually on fuel costs over the next forty years.

With the shift from fuel expenses (operating costs) to investment expenditure (capital expenditure) in clean technology and clean energy, investments costs will occur in the domestic economy, requiring increased added value and output from a wide range of manufacturing industries (automotive, power generation, industrial and grid equipment, energy–efficient building materials, construction sector etc.), while fuel expenses for fossil fuel imports which are to a large extent flowing to third countries would be reduced.

Resource Efficient Europe flagship initiative

In 2011 a new initiative "Resource-efficient Europe – Flagship initiative of the Europe 2020 Strategy" was launched (European Commission 2011b). as part of the overall Europe 2020 Strategy for smart, sustainable and inclusive growth. The flagship initiative for a resource-efficient Europe supports the shift towards a resource-efficient, low-carbon economy to achieve sustainable growth. It provides a long-term framework for actions in many policy areas, supporting policy agendas for climate change, energy, transport, industry, raw materials, agriculture, fisheries, biodiversity and regional development. This is to increase certainty for investment and innovation and to ensure that all relevant policies factor in resource efficiency in a balanced manner. The Communication on the strategy outlines that the EU has a strong interest in deepening cooperation on resource efficiency with international partners and emphasizes its willingness to continue efforts to provide a level playing field for industry, to improve the conditions for sustainable supply of raw materials, and better deployment of green technologies to support the most efficient use of scarce resources globally.

15.2 Information on how the EU gives priority, in implementing the commitments under Article 3, paragraph 14, to specific actions

The EU reports activities that are related to the actions specified in the subparagraphs (a) to (f) of paragraph 24 of the reporting requirements in the Annex to decision 15/CMP.1. However, no decision was agreed yet that these actions form part of the commitment under Article 3, paragraph

14. For some of the actions specified in the reporting requirements, it seems rather unclear how they relate to the minimization of adverse social, environmental and economic impacts resulting from policies and measures to mitigate GHG emissions, e.g. information related to the cooperation activities requested are activities that help both Annex I and Non-Annex I Parties in reducing emissions from fossil fuel technologies, but they do not directly address the minimization of potential adverse impacts in Annex I Parties.

For the purposes of completeness in reporting, the EU addresses all subparagraphs specified in the reporting requirements, however the main ways how the EU is striving to minimize adverse impacts are described in the previous section.

a) The progressive reduction or phasing out of market imperfections, fiscal incentives, tax and duty exemptions and subsidies in all greenhouse-gas-emitting sectors, taking into account the need for energy price reforms to reflect market prices and externalities

The actions addressed in subparagraph a) also form part of the commitment to implement policies and measures requested under Article 2, paragraph 1(a) (v), however Article 2 specifies that Annex I Parties shall "implement and/or further elaborate policies and measures in accordance with national circumstances, such as progressive reduction or phasing out of market imperfections, fiscal incentives, tax and duty exemptions and subsidies in all greenhouse gas emitting sectors that run counter to the objective of the Convention and application of market instruments." Subparagraph a) in the reporting requirements lacks such objective and therefore seems somewhat inconsistent with the commitment under Article 2. The promotion of research, demonstration projects, fiscal incentives or carbon taxes is important instrument to advance the objectives of the Convention, e.g. the use of renewable energies. A progressive reduction of all fiscal incentives or subsidies in all GHG emitting sectors would run counter the objective of the Convention and counter the ability of the EU to meet its commitment under Article 3, paragraph 1 of the Kyoto Protocol. Therefore the EU interprets this reporting requirement in a way consistent with Article 2 paragraph 1(a)(v) that the EU should focus on the progressive reduction or phasing out of market imperfections, fiscal incentives, tax and duty exemptions and subsidies that run counter the objectives of the Convention and application of market instruments.

The 2009 Review of the EU Sustainable Development Strategy assesses that "the Commission has been mainstreaming the progressive reform of environmentally harmful subsidies into its sectoral policies". For instance, environmental concerns have been gradually incorporated into the EU Common Agricultural Policy, including "decoupled" direct payments which have replaced price support; environmental cross compliance; a substantial increase in budget for rural development. As part of 2008 Common Agriculture Policy Health Check, additional part of direct aid has been shifted to climate change, renewable energy, water management, biodiversity, innovation; - transparency of agricultural subsidies has improved. It is important to note that in the other areas most subsidies are within the competence of the Member States and not of the EU, within the limits established by EU state aid rules.

EU policies aim to address market imperfections and to reflect externalities. For example the EU has made significant efforts to liberalise the internal energy market and to create a genuine internal market for energy as one of its priority objectives. The existence of a competitive internal energy market is a strategic instrument both in terms of giving European consumers a choice between different companies supplying gas and electricity at reasonable prices, but also in terms of making the market accessible for all suppliers, especially the smallest and those investing in renewable forms of energy.

With the implementation of the EU Emissions Trading Scheme, the EU uses a market instrument to implement the objective of the Convention and its commitment under Article 3, paragraph 1 of the Kyoto Protocol which aims at creating the right incentives for forward looking low carbon investment decisions by reinforcing a clear, undistorted and long-term carbon price signal.

With respect to financial support provided by the Member States to undertakings, the EU Treaty pronounces a general prohibition of "State aid". This concept encompasses a broad range of financial support measures adopted at national or sub-national level (i.e. not at EU level), and which can take various forms (subsidies, tax relieves, soft loans…). The Treaty provides for exceptions to this general prohibition. When State aid measures can contribute in an appropriate manner to the furtherance of objectives of common interest for the EU, and provided that they comply with certain strict conditions, they may be authorised by the Commission. By complementing the fundamental rules through a series of legislative acts and guidelines, the EU has established a worldwide unique system of rules under which State aid is monitored and assessed in the European Union. This legal framework is regularly reviewed to improve its efficiency. EU State aid control is an essential component of competition policy and a necessary safeguard for effective competition and free trade.

State aid reform in the EU aims to redirect aid to objectives of common interest which are related to the EU Lisbon Treaty, such as R&D&I, risk capital measures, training, and environmental protection. Environmental protection, and in particular, the promotion of renewable energy and the fight against climate change, is considered one of the objectives of common interest for the EU which may, under certain circumstances, justify the granting of State aid.

Specific "Community Guidelines on State aid for Environmental Protection"[40] have been established. The Guidelines foresee in particular the possibility to authorise the following types of State aid under certain conditions:

- Aid for undertakings which go beyond EU environmental standards or which increase the level of environmental protection in the absence of EU standards
- Aid for early adaptation to future EU standards
- Aid for energy saving
- Aid for renewable energy sources
- Aid for high-efficient cogeneration
- Aid for energy-efficient district heating (DH).

Directive 2003/96/EC on the taxation of energy products and electricity establishes EU-wide rules for the taxation of energy products used as motor or heating fuel, taxes on energy consumption, and common minimum levels of taxation. Under certain conditions the Directive allows for exemptions or reductions to promote renewable sources of energy. Thus, the tax exemptions allowed under this directive further promote the objectives of the Kyoto Protocol.

[40] Official Journal No C 82, 1.4.2008, p.1

b) Removing subsidies associated with the use of environmentally unsound and unsafe technologies

There is no clear definition of environmentally unsound and unsafe technologies; therefore the EU interprets this provision in the context of the Kyoto Protocol that unsound and unsafe technologies would be those increasing GHG emissions.

The phase-out of subsidies to fossil fuel production and consumption by 2010 was one of the objectives in the Communication from the Commission "A Sustainable Europe for a Better World: A European Union Strategy for Sustainable Development (Commission's proposal to the Gothenburg European Council, 2001)".[41]

Council Decision 2010/787/EU of 10 December 2010 on State aid to facilitate the closure of uncompetitive coal mines adopted a new coal regulation enabling Member States to grant State aid to facilitate the closure of uncompetitive mines until 2018, following the expiry of the current Coal Regulation (Council Regulation (EC) N° 1407/2002 of 23 July 2002) on 31 December 2010. The decision includes the following main elements:

the possibility of continuing to grant, under certain conditions, public aid to the coal industry with a view to facilitating the closure of uncompetitive hard coal mines until December 2018;

the modalities for the phasing-out of the aid, under which the overall amount of aid granted by a member state must follow a downward trend, in order to prevent undesirable effects of distortion of competition in the internal market. Subsidies will have to be lowered by at least 25% until 2013, by 40% until 2015, by 60% by 2016 and by 75% by 2017;

the obligation for member states granting aid to provide a plan on intended measures to mitigate the environmental impact of the production of coal; and

the possibility of allowing subsidies, until December 2027, in order to cover exceptional expenditure in connection with the closure of mines that are not related to production, such as social welfare benefits and rehabilitation of sites.

c) Cooperating in the technological development of non-energy uses of fossil fuels, and supporting developing country Parties to this end;

The technological development of non-energy uses of fossil fuels is not a current research priority in the EU, nor a priority of cooperation with developing countries because the EU is not a major producer of oil and gas. Given the long-term depletion of fossil fuel resources and the decline in coal

41 See http://eur-lex.europa.eu/LexUriServ/site/en/com/2001/com2001_0264en01.pdf

production, the EU's priority in general is the replacement of the use of fossil fuels by renewable resources and the more efficient use of resources.

d) Cooperating in the development, diffusion, and transfer of less-greenhouse-gas-emitting advanced fossil-fuel technologies, and/or technologies, relating to fossil fuels, that capture and store greenhouse gases, and encouraging their wider use; and facilitating the participation of the least developed countries and other non-Annex I Parties in this effort;

In March 2005, the EU and China signed an Action Plan on Clean Coal, which included cooperation on carbon capture and storage. The subsequent 2005 EU-China Summit established the EU-China Climate Change Partnership, which includes a political commitment to develop and demonstrate in China and the EU advanced, near-zero emissions coal (NZEC) technology through carbon capture and storage (CCS) by 2020. Phase I of this cooperation will be completed in 2009. Phase II of NZEC will run from 2010-2012. It will examine the site-specific requirements for and define in detail a demonstration plant and accompanying measures. It will include the technical and cost analysis of different options. Based on this analysis, the site of the power plant as well as the combustion technology (pulverised coal or IGCC), the capture technology and the transport and storage concepts will be determined. Phase II shall also include a detailed roadmap for the construction and operation of the demonstration plant as well as an Environmental Impact Assessment of the demonstration power plant and the carbon storage site. Phase III should commence thereafter and will see the construction and operation of a commercial-scale demonstration plant in China.

The Communication from the Commission entitled "Demonstrating Carbon Capture and Geological Storage (CCS) in emerging developing countries: financing the EU-China Near Zero Emissions Coal Plant project" from June 2009 sets out the plan of the European Commission to establish an investment scheme to co-finance the construction and operation of a power plant to demonstrate carbon capture and storage (CCS) technology in China. This investment scheme could serve as a model for other technology cooperation activities between developed countries and emerging/developing countries in the context of a post-2012 climate change agreement.

The EU is also cooperating with other Annex I and Non-Annex I Parties (Australia, Brazil, Canada, China, Colombia, Denmark, France, Germany, Greece, India, Italy, Japan, Korea, Mexico, Netherlands, New Zealand, Norway, Poland, Russian Federation, Saudi Arabia, South Africa, United Arab Emirates, United Kingdom and USA) in the "Carbon Sequestration Leadership Forum (CSLF)". The CSLF is a Ministerial-level international climate change initiative that is focused on the development of improved cost-effective technologies for the separation and capture of carbon dioxide (CO_2) for its transport and long-term safe storage. The mission of the CSLF is to facilitate the development and deployment of such technologies via collaborative efforts that address key technical, economic, and environmental obstacles. The CSLF will also promote awareness and champion legal, regulatory, financial, and institutional environments conducive to such technologies. In 2010 a Technology Roadmap was released by the Carbon Sequestration Leadership Forum. This road map indicates that significant international progress has been made in the past year on advancing carbon capture and storage, but that a number of important challenges remain that must be addressed to achieve widespread commercial deployment of CCS. The 2011 Strategic Plan Implementation Report recognized five new CCS projects bringing the total number of CSLF recognized technology demonstrations to 32. [42]

e) Strengthening the capacity of developing country Parties identified in Article 4, paragraphs 8 and 9, of the Convention for improving efficiency in upstream and downstream activities relating to fossil fuels, taking into consideration the need to improve the environmental efficiency of these activities

In the oil and gas industry the upstream sector is a term commonly used to refer to the exploration, drilling, recovery and production of crude oil and natural gas. The downstream sector includes the activities of refining, distillation, cracking, reforming, blending storage, mixing and shipping and distribution.

The EU contributes to strengthening of the capacities of fossil fuel exporting countries in the areas of energy efficiency via the work of the Energy Expert Group of the Gulf Cooperation Council (GCC)[43], in particular in the working sub-group on energy efficiency. As part of the EU's research programme, a project called "EUROGULF" was launched with the objective of analysing EU-GCC relations with respect to oil and gas issues and proposing new policy initiatives and approaches to enhance cooperation between the two regional groupings.

The European e-network on clean energy technologies, currently under development as part of the EU's research and development, is also aiming at the objective: promote research and technical development of clean energy technologies in the GCC countries. The Commission has recently started a project with the specific objective to create and facilitate the operation of an EU-GCC Clean Energy Network during the next three years. The network is to be set up to act as a catalyst and element of coordination for development of cooperation on clean energy. A website was created at **http://www.eugcc-cleanergy.net** where further information on the EU-GCC Clean Energy Network and its recent activities can be found. The Masdar Institute of Science and Technology in Abu Dhabi has been selected as the lead research institution to represent the Gulf Cooperation Council (GCC) in the European Union-GCC Clean Energy Network. A number of discussion groups and training seminars took place, e.g. on solar resource assessment.

Energy efficiency activities in the upstream or downstream sector are also candidates for CDM projects. Thus, the development of the CDM under the Kyoto Protocol and the demand of CERs by Annex I Parties under the Kyoto Protocol as well as by operators under the EU ETS have fostered such activities performed by the private sector. Related CDM projects are for example:

[42] See http://www.cslforum.org/ for more specific information
[43] The Gulf Cooperation Council covers Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates.

Rang Dong Oil Field Associated Gas Recovery and Utilization Project in Vietnam: The purpose of this project activity is the recovery and utilization of gases produced as a by-product of oil production activities at the Rang Dong oil field in Vietnam with the involvement of ConocoPhillips (UK).

Recovery of associated gas that would otherwise be flared at Kwale oil-gas processing plant in Nigeria involves the capture and utilisation of the majority of associated gas previously sent to flaring at Kwale OGPP plant. The Kwale OGPP plant receives oil with associated gas from oil fields operated by Eni Nigeria Agip Oil Company.

Recovery and utilization of associated gas produced as by-product of oil recovery activities at the Al-Shaheen oil field in Qatar

Flare gas recovery and utilisation project at Uran oil and gas processing plant in India which is handling the oil and gas produced in the Mumbai High offshore oil field.

Flare gas recovery and utilisation project at Hazira gas and condensate processing plant in India.

Flare gas recovery and utilisation project from Kumchai oil field in India

Flare gas recovery and utilisation project at the Ovade-Ogharefe oil field operated by Pan Ocean Oil Corporation in Nigeria

Flare gas recovery and utilisation project at Soroosh and Nowrooz offshore oil fields in Iran.

Leak reduction in aboveground gas distribution equipment in the KazTransgaz-Tbilisi gas distribution system in Georgia where leakages at gate stations, pressure regulator stations, valves, fittings as well at connection points with consumers are reduced.

There are currently 21 Coal Mine Methane Utilization Project in China which use coalmine methane previously released to the atmosphere.

Improved energy efficiency in the energy and the transport sector in a more general way is one of the priorities in the EU's development assistance as well as for the EIB (European Investment Bank) and the EBRD (European Bank for Reconstruction and Development). The EIB has also developed other means of financing, such as equity and carbon funds, to further support renewable energy and energy-efficiency projects (see here GEEREF and the Mediterranean Solar Plan, MSP). Related projects and specific activities can be found for example at http://www.eib.org/projects/topics/environment/renewable-energy/index.htm or http://www.ebrd.com/saf/search.html?type=eia

f) Assisting developing country Parties which are highly dependent on the export and consumption of fossil fuels in diversifying their economies.

The EU actively undertakes a large number of activities aiming at reducing dependence on the consumption of fossil fuels, in particular the EU support activities for the promotion of renewable energies and energy efficiency in developing countries contribute to reduction of dependence on fossil fuels, meeting rural electricity needs, and the improvement of air quality. As explained in more detail in chapter 8 of the EU's 5th national communication several support programmes exist in this respect. These include:

Renewable energy cooperation with the Mediterranean and Gulf countries

The major objective of the cooperation between the EU and the Mediterranean and Gulf countries in the field of renewable energy is to contribute to sustainable energy and climate mitigation and to develop an integrated and interconnected 'Green Energy Market'.

Several initiatives are already being developed by the European Union in cooperation with the partners in the Gulf region to boost energy as well as renewable energy development. This includes the EU-GCC (Gulf Cooperation Council) Energy Expert Group, which started working at the beginning of 1990s' and the EU-GCC Climate Change Expert Group that has met on a regular basis since 2007. In 2009 EU and GCC partners agreed on extending energy cooperation and more specifically on establishing an EU-GCC clean energy network thus bringing together the relevant EU and GCC stakeholders. The European Commission will support the establishment of a network of key actors from public and private sectors in the EU and the GCC with a view to deepening cooperate on clean energy. This network will act as a facilitator and identify projects in fields of common interest, such as solar and other renewable energies. In 2011, the 2nd discussion group's meeting of the EU-GCC Clean Energy Network was held in Brussels which focused on achieving concrete results and on discussing specific co-operation "packages" within the Five Discussion Groups: Renewable Energy Sources, Energy Demand Side Management & Energy Efficiency, Clean Natural Gas & related Clean Technologies, Electricity Interconnections & Market Integration, Carbon Capture and Storage.

Given the importance of research to further development of renewable energy in the GCC region, the Commission is also contributing to the establishment of a specific large-scale platform to foster international R&D cooperation with partners of the Gulf region.

The expansion and deployment of renewable energy is currently a key element in cooperation between the EU and the Mediterranean countries. The most important initiative is the Mediterranean Solar Plan, endorsed in 2008. The objective is the creation of 20 GW of new generation capacity in solar and other renewable energy sources around the Mediterranean Sea by 2020. The Regional Centre of Excellence for Renewable Energy and Energy Efficiency (RCREEE) facilitates development of renewable energy sources and promotion of energy efficiency measures in the Southern Mediterranean partner countries. Since 2008, when the centre was established in Cairo, the European Union has provided a financial contribution to enable the launch and initial operation of the Centre. Bearing in mind the importance of the infrastructures necessary for deployment and exports of green energy, the EU is contributing to the Maghreb Electricity Market Integration Project (IMME). The objective is to create a sub-regional electricity market between Morocco, Tunisia and Algeria and its progressive integration with the EU's electricity market. The Commission has so far provided a support of €5.6 million. These are only some examples from the cooperation with the Mediterranean countries.

Africa, Caribbean and the Pacific (ACP-E) Energy Facility

The ACP-EU Energy Facility is a contribution under the EU Energy Initiative to increase access to energy services for the poor. The Facility was approved by the joint ACPEU Council of Ministers in June 2005, with an amount of € 220million. The main activity of the Facility is to co-finance projects that deliver energy services to poor rural areas.

The Energy Facility was mainly implemented through a €198 million Call for Proposals which was launched in June 2006. Out of 307 proposals received, 74 projects have been contracted by the end of 2008 for a total amount of €196 million from the Energy Facility, with a total project cost of €430 million. Since 2008, the Facility has financed around 140 national and cross-border projects in ACP countries for about EUR 300 Million. Almost 13 Million people should benefit of an improved access to energy mostly utilising Renewable Energy technologies.

The main activities performed through Energy Facility projects can be classified into three different groups: (1) energy production, transformation and distribution, (2) extension of existing electricity grids and (3) "soft" activities such as governance, capacity building or feasibility studies. The sources of energy used for electricity generation were mainly renewable energies (77 % of the projects). Only one project using exclusively fossil fuels was funded. In total, € 81 million of commitments have been marked as climate change related under the Energy Facility, covering support to enhance use of renewable energies or increase energy efficiency. A replenishment of the ACP-EU Energy Facility has been decided under the 10th European Development Fund for the period of 2009-2013. Endowed with € 200 Million, it will focus on improving access to safe and sustainable energy services in rural and peri-urban areas. The new Energy Facility will also contribute to the fight against climate change by emphasizing the use of renewable energy sources and energy efficiency measures and by taking into account impacts of climate change on energy systems. The new Facility started being implemented by the end of 2009 and funding guidelines were approved in October 2010.

Euro-Solar Programme in Latin America

The Euro-Solar Programme is aiming to reduce poverty, allowing remote rural communities currently without access to electricity, to benefit from renewable electric energy. Approved in May 2006 and extended in December 2008, the Programme's total budget amounts to € 35.8 million, of which € 6.9 million will be provided by the Programme's eight beneficiary countries. The Progamme was finalized in 2011.

Latin America Investment Facility (LAIF)

The European Commission plans to establish the Latin America Investment Facility (LAIF). The European Commission has foreseen an amount of € 125 million for the period 2009-2013. The LAIF focuses on energy, environment and transport investment, contributing to cleaner transport infrastructure, improved energy efficiency and energy savings, the use of renewable energy, low-carbon production and of climate change adaptation technologies. The LAIF will operate by providing financial non-refundable contributions to support loans to partner countries from the European Investment Bank (EIB) and other European, multilateral and national, development finance institutions and will encourage the beneficiary governments and public institutions to carry out essential investments in the relevant sectors. The contribution of the Commission to the LAIF will be decided annually. In 2010 a commitment of € 34.85 million was available for grants. In 2011, additional € 40 million were approved. .

Global Energy Efficiency and Renewable Energy Fund (GEEREF)

The European Commission has launched an innovative pilot instrument to involve the private sector. The Global Energy Efficiency and Renewable Energy Fund (GEEREF), launched in 2007, is focused on energy efficiency and renewable energy projects in developing countries and economies in transition. GEEREF invests in regionally-oriented investment schemes and prioritises small investments below €10 million. In December 2008, the GEEREF Investment Committee approved two funds, and the first investments of a total value of € 22.5 million were carried out in 2009 focussing on projects in Sub-Saharan and Southern Africa and in Asia:

- €12.5 million investment in Berkeley Energy's Renewable Energy Asia Fund (REAF) for operationally and economically mature wind, hydro, solar, biomass, geothermal and methane recovery projects in India, Philippines, Bangladesh and Nepal.

- €10 million investment in the Evolution One Fund, dedicated to clean energy investment in Southern Africa (SADC countries).

- Furthermore, GEEREF invested €12.5 million in the Clean Tech Latin American Fund (CTLAF II), where the main objective is focused on the areas of renewable energy and clean technologies The CTLAF II is a capital fund investing in private companies and was established as the continued success of Cleantech Fund (I) which is now fully made available. The main geographic focus is Mexico, Brazil, Chile, Peru and Colombia and more information is available http://www.emergingenergy.com/).

- A new Fund called DI Frontier Market Energy and Carbon Fund ("DI") under the GEEREF package committed € 10 million. The main distinguishing feature is an integrated approach to project development, investment, and carbon trade. The Fund has a focus on Eastern and Southern Africa. Core focus countries include: Kenya, Mozambique, Tanzania, Uganda and Zambia. (more information is available under http://www.frontier.dk/).

In the regions where the two funds operate, there is a lack of equity investment available through the market for these types of projects. It is envisaged that GEEREF will invest in regional sub-funds for the African, Caribbean and Pacific (ACP) region, Neighbourhood, Latin America and Asia. Together the European Commission, Germany and Norway have committed about €108 million to the GEEREF over the period 2009-2012, the majority of which is provided by from the EU budget. It is envisaged that further financing from other public and private sources will be forthcoming. In 2007, the EU budget contributed €5 million towards a support facility for the GEEREF and a further €25 million in form of grants. After 2010 GEEREF plans to initiate fundraising to above € 200 million.

The EU through DG Development and Cooperation - EuropeAid also supports **(African, Carribean and Pacific)** countries in diversifying their economies; however, these activities are not limited to fossil fuel exporting countries, but are open to **ACP** countries based on **Economic** partnership agreements (EPAs). EPAs help ACP countries integrate into the global economy and improve the business environment, build up regional markets and promote good economic governance through reinforced regional cooperation in trade related issues. In 2008 the EU signed a comprehensive EPA with 13 CARIFORUM countries. Haiti is also expected to sign. Some ACP partners have signed interim economic partnership agreements with the EU as a first step towards comprehensive regional EPAs. The interim agreements secure and improve ACP access to the EU market and provide for more favourable rules of origin. Negotiations are ongoing with the African and Pacific regions to move from interim agreements to comprehensive regional agreements. The negotiations cover regional trade integration, trade in services, investment and trade-related rules. The strategy for private sector development in the ACP recommends the use of horizontal instruments (applicable to all ACP countries) in five priority areas where the Commission has a good experience and comparative advantages:

(1) Improvement of the macroeconomic framework and regulatory environment for enterprise development (Private Sector Enabling Environment Facility of the Business Environment (PSEEF) or BizClim with €20 million for 5 years);

(2) Investment and inter-enterprise co-operation promotion activities (PROINVEST - €110 million for 7 years);

(3) Facilitation of investment financing and development of financial markets (Investment Facility managed by the European Investment Bank (EIB) as revolving fund with €3,137 billion, completed by the EIB own resources with €2 billion for 2008-2013 and financial envelope of €400 million for the interest subsidies and technical assistance);

(4) Support for Small and Medium- sized Enterprises in the form of non-financial services (Centre for the Development of Enterprise (CDE) with €18 million per year, PROINVEST);

(5) Support for micro-enterprises and micro-finance (ACP-EU Microfinance Framework Programme with €15 million for 6 years, in collaboration with Consultative Group to Assist the Poor program (CGAP) and investment in debt and equity for banks and microfinance institutions provided by the EIB Investment Facility).

More specific information related to these activities can be obtained at: http://ec.europa.eu/europeaid/what/development-policies/intervention-areas/epas/epas_en.htm

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PART 3: ANNUAL INVENTORY SUBMISSION (EU-27)

16 Introduction

This part of the EU GHG inventory report includes data for the EU-27 Member States. The EU-27 Member States are (new MS are marked with n): Austria, Belgium, Bulgaria (n), Cyprus (n), the Czech Republic (n), Denmark, Estonia (n), Finland, France, Germany, Greece, Hungary (n), Ireland, Italy, Latvia (n), Lithuania (n), Luxembourg, Malta (n), the Netherlands, Poland (n), Portugal, Romania (n), Slovakia (n), Slovenia (n), Spain, Sweden and the United Kingdom. As the relevant information for the EU-15 Member States was given in part 1 of this report, this part provides information for the 12 new Member States. The relevant tables for the new Member States are included in this part as well as more detailed information on the 20 largest key categories. The general description of institutional arrangements at EU level are also included in part 1.

16.1 Institutional arrangements and inventory preparation

Table 16.1 shows the main institutions and persons involved in the compilation and submission of the new Member States' inventories.

Table 16.1 List of institutions and experts responsible for the compilation of new Member States' inventories and for the preparation of the EU inventory

Member State/EU institution	Contact address
Bulgaria	Detelina Petrova Executive Environment Agency 136, Tzar Boris III Blvd. 1618 Sofia
Cyprus	Theodoulos Mesimeris Head of Climate Action Unit Department of Environment Ministry of Agriculture, Natural Resources and Environment 1498, Nicosia, Cyprus
Czech Republic	Ondrej Minovsky Czech Hydrometeorological Institute (CHMI) Na Sabatce 17, CZ 14306 Prague 4
Estonia	Karin Radiko Ministry of the Environment Narva mnt 7a, 15172 Tallinn, Estonia Anne Mändmets Ministry of the Environment Narva mnt 7a 15172 Tallinn, Estonia

Member State/EU institution	Contact address
Hungary	László Gáspár Ministry of Environment and Water, department of Climate Policy Fõ u. 44-50, Budapest, 1011 Hungary
Latvia	Agita Gancone Ministry of Environmental Protection and Regional Development Peldu street 25, LV-149
Lithuania	Vytautas Krusinskas Lithuanian Ministry of Environment A. Jaksto 4/9, LT 01105 Vilnius
Malta	Krista Rizzo Malta Resources Authority – Climate Change Unit Millennia, 2nd Floor, Aldo Moro Road, Marsa MRS 9065, Malta.
Poland	Anna Olecka National Centre for Emissions Management Institute of Environmental Protection - National Research Institute Chmielna 132/134, 00-805 Warszawa, PL
Romania	Sorin Deaconu National Environmental Protection Agency Splaiul Independentei 294, Sector 6, Cod Postal 060841, Bucharest, Romania
Slovakia	Janka Szemesova Department of Emissions, Slovak Hydrometeorological Institute Jeseniova 17, 833 15 Bratislava, Slovak Republic
Slovenia	Tajda Mekinda Majaron Environmental Agency of the Republic of Slovenia Vojkova 1/b, SI-1000 Ljubljana

Table 16.2 summarises the information on national systems/institutional arrangements in the new EU Member States.

Table 16.2 Summaries of institutional arrangements/national systems of new Member States

MS	Institutional arrangements/national systems	Source

MS	Institutional arrangements/national systems	Source
Bulgaria	The BGNIS is developed following the requirements of the provisions of Decision 19/CMP.1 Guidelines for national systems under Article 5, paragraph 1, of the Kyoto Protocol. The BGNIS has been enshrined in law through a special Regulation of the Council of Ministers 215/21.09.2010 SG 76/2010. The new regulation establishes and maintain the institutional, legal and procedural arrangements necessary to perform the general and specific functions of BGNIS, defined in Decision 19/CMP.1. The new regulation reinforces the existing institutional agreements by specifying the roles of all data providers. Bulgaria's reporting obligations to the UNFCCC, UNECE and EC are being administered by the MoEW. All activities on preparation of GHG inventory in Bulgaria are coordinated and managed on the state level by MoEW. The Bulgarian Government by MoEW has the political responsibility for compliance with commitments under the Kyoto Protocol, including for functioning of BGNIS in accordance with the requirements of Decision 19/CMP.1 under Article 5, paragraph 1, of the Kyoto Protocol: • National Focal Point; • QA exeperts from Climate Change Policy Directorate and Air Protection Directorate; • Approval of inventory; • Submission of CRF / NIR / Kyoto Tables / SEF. The ExEA has been identified as the responsible organization for preparation of Bulgaria's National GHG Inventory under the UNFCCC and the Kyoto Protocol and designated as single national entity. ExEA has the technical responsibility for the national inventory: • acts as National Inventory Compiler (supervises inventory preparation process); • manages BGNIS; • compiles CRF tables and NIR; • coordinates the work of engaged consultants for supporting inventory; • coordinates and implements the activity of National QA/QC Plan; • National Inventory Focal Point. The ExEA coordinates all activities, related to collecting inventory data of GHG emissions by the following authorities: • National Statistical Institute; • Ministry of Economy and Energy (MEE); • Statistics Department within Ministry of Agriculture and Food Supplies (MAF) and their relevant services; • Ministry of Environment and Water; • State Forestry Agency (SFA); • Road Control Department (RCD/MIA) within the Ministry of Internal Affairs; • Large industrial plants • Branch Business Associations	Short NIR of GHG emissions in Republic Bulgaria 1988-2009 Jan 2011 p 4 ff.
Cyprus	The Ministry of Agriculture, Natural Resources and Environment (MANRE) is the governmental body responsible for the development and implementation of the majority of the environmental policy in Cyprus. Moreover, the MANRE is responsible for the coordination of all involved ministries, as well as any relevant public or private organisation, in relation to the implementation of the provisions of the European legislation associated with climate change. In this context, the MANRE has the overall responsibility for the national GHG inventory, and the official preparation and approval of the inventory prior to its submission. The entities participating in it are: • The MANRE designated as the national entity responsible for the national inventory, which keeps the overall responsibility, plays an active role in the inventory planning, preparation and management, and also compiles the annual inventory. • Governmental ministries and agencies through their appointed focal persons, ensure the data provision. No legal framework is available defining the roles-responsibilities and the co-operation between the MANRE and contact points of the involved ministries and agencies.	National GHG Inventor y Report 1990-2010 2012 Submissi on Jan 2012, p 5

MS	Institutional arrangements/national systems	Source
Czech Republic	The arrangement of institutions co-operating in the national GHG inventory is given by National Inventory System - NIS, which was established in accord with Decision 280/2004/EC, Article 4.4. This system accepted the rules from Resolution 20/CP.7 (FCCC/CP/13/Add.3) that was approved by COP/MOP-1 in Montreal, December 2005. The relevant information is given in the Czech Republic's Initial Report under the Kyoto Protocol, which was sent to European Commission (June 2006) and to UNFCCC (October 2006) In the Czech Republic, the Ministry of the Environment (MoE) is the national entity with overall responsibility for the NIS. The Czech Hydrometeorological Institute (CHMI), founded by the MoE, is designated as the coordinating and managing organisation responsible for the compilation of the national greenhouse gas inventory and reporting its results. In addition, the MoE provides additional specific financial resources for the NIS performance to the CHMI. The representative of CHMI for the NIS is Mr. Pavel Fott (fott@chmi.cz). The main roles and responsibilities of the CHMI are: inventory management, general and cross-cutting issues, QA/QC, reporting data (CRF), preparation of NIR, communication with the relevant UN FCCC and EU bodies, etc. Sectoral inventories are prepared by specialized institutions (sectoral compilers), which are coordinated and controlled by the CHMI. The responsibilities for the GHG inventory compilation from individual sectors are allocated as follows: • KONEKO marketing, Ltd. (KONEKO), with responsibility for the inventory compilation in the Energy sector, in particular for stationary sources and fugitive emissions; • The Transport Research Centre (CDV), with responsibility for the inventory compilation in the Energy sector, in particular for mobile sources; • The Czech Hydrometeorological Institute (CHMI), with responsibility for the inventory compilation in the Industrial Processes and Product Use sectors; • The Institute of Forest Ecosystem Research (IFER), with responsibility for the inventory compilation in the Agriculture and Land Use, Land Use Change and Forestry sectors; • Charles University Environment Centre (CUEC), with responsibility for the inventory compilation in the Waste sector. The official submission of the National GHG Inventory is prepared by the CHMI and approved by the MoE. Moreover, the MoE secures contacts with other relevant governmental bodies, such as the Czech Statistical Office (CSO), the Ministry of Industry and Trade (MoIT) and the Ministry of Agriculture (MoA).	National GHG Inventory Report 2011 of the Czech Republik Jan 2011 pp 5-6 No change with regard to previous submission

MS	Institutional arrangements/national systems	Source
Estonia	Single national entity with overall responsibility for the Estonian greenhouse gas inventory is the Estonian Ministry of the Environment (MoE). The inventory is produced in collaboration between the MoE, Estonian Environmental Research Centre (EERC), Estonian Environment Information Centre (EEIC) and Tallinn University of Technology (TUT). The MoE is responsible for: • Coordinating the overall inventory preparation process; • Approving the inventory before official submission to the UNFCCC; • Reporting the greenhouse gas inventory to the UNFCCC, including the National Inventory Report and CRF tables; • Concluding the formal agreements with inventory compilers (TUT, EERC); • Coordinating the cooperative work between the inventory compilers and UNFCCC Secretariat; • Informing the inventory compilers about the requirements of the national system and ensuring that existing information in national institutions is considered and used in the inventory where appropriate; • Informing the inventory compilers about new or revised guidelines; • Coordinating the UNFCCC inventory reviews. Climate Department in EERC is responsible for: • Compiling the National Inventory Report according to the parts submitted by the inventory compilers; • Coordinating of the implementation of the QA/QC plan; • Coordinating the inventory process; • Preparation of the UNFCCC inventory reviews and coordinating the communication with the expert review team, including responses to the review findings; • Overall archiving system. Department of Thermal Engineering and Department of Chemistry at TUT prepare the estimates for the Energy and Agriculture sectors. The EERC is responsible for the Industrial Processes, Solvents and Other Product Use and Waste sectors. Department of the National Forest Inventory at EEIC is responsible for the LULUCF and KP LULUCF sectors. All experts collect activity data, prepare relevant QC, fill in the sectoral data to the CRF Reporter and prepare sectoral parts of the NIR. They also have archiving system for the sectors that they are working with.	Greenhouse Gas Emissions in Estonia 1990-2009 Jan 2011 p 17ff

MS	Institutional arrangements/national systems	Source
Hungary	The designated single national entity is the Ministry of Environment and Water. Within the ministry, the Climate Change and Energy Department administers this responsibility by supervising the national system. At the end of 2006, a GHG division was established in the Hungarian Meteorological Service (OMSZ) for the preparation and development of the inventory. This division is responsible for all inventory related tasks, prepares the greenhouse gas inventories and other reports with the involvement of external institutions and experts on a contractual base and supervises the maintenance of the system. The GHG division coordinates the work with other involved ministries, government agencies, consultants, universities and companies in order to be able to draw up the yearly inventory report and other reports to the UNFCCC and the European Commission. The GHG division can be regarded as a core expert team of four people. The division of labour and the sectoral responsibilities within the team are laid down in the QA/QC plan and other official documents of OMSZ. The Head of Division coordinates the teamwork and organizes the cooperation with other institutions involved in inventory preparations. He is responsible for compilation of CRF tables and NIR. Within the team there are coordinators of the different sectors and also a QA/QC coordinator and an archive manager were nominated. Some parts of the inventory (mainly energy and waste) are prepared by the experts of the GHG division themselves. In the industry and solvent sector the former inventory compiler acted as sectoral expert, so he collected the data and prepared the inventory. The agriculture sector of the inventory has been prepared by the Research Institute for Animal Breeding and Nutrition for several years. This institute collects the data, chooses the calculation method, prepares the inventory in CRF format and sends it to the inventory compiler. At the very end of 2009, a new government decree on data provision relating to GHG emissions was put into force. As a new element, the participation of the Forestry Directorate of the Central Agricultural Office (CAO) together with the Forest Research Institute is now formalized by this decree. These two institutes are responsible for the forestry part of the LULUCF sector and for the supplementary reporting on LULUCF activities under Articles 3.3 and 3.4 of the Kyoto Protocol by way of making recommendations to HMS of the content of the inventory. The annual inventory cycle is carried out in accordance with the principles and procedures set out in the IPCC (1996) Guidelines and the IPCC Good Practice Guidance. Data are collected from the emitter if it is possible (especially in case of power stations, heating stations and industrial technologies) but statistical databases are also used as source of information. The most important statistical publications are the Statistical Yearbook of Hungary, the Environmental Statistical Yearbook of Hungary both published by the Hungarian Central Statistical Office (HCSO) and the Energy Statistical Yearbook published by the Energy Efficiency, Environment and Energy Information Agency. Since the use of ETS data has several advantages, the inventory team was granted access to the verified emissions database held by the National Inspectorate for Environment, Nature and Water. Basically, the sectoral experts are responsible for the choice of methods and emission factors. The calculation method – allowing for a few exceptions – was chosen by taking into account the technologies available in Hungary and according to the recommendations of the IPCC Guidelines.	National Inventory Report for 1985-2008, Hungary (Draft Excerpts) Jan 2010 pp 9-13

MS	Institutional arrangements/national systems	Source
Latvia	Ministry of the Environmental Protection and Regional Development of the Republic of Latvia (MEPRD) Climate Policy and Technology Department coordinate policy related to climate change and renewable energy in Latvia as well as are designated single national entity with overall responsibility for the Latvian GHG inventory. The MEPRD is responsible for: •Preparation of legal basis for maintaining the National System; •Informing the inventory compilers about requirements of the national system; • Overall coordination of GHG inventory process (including compilation of the final NIR and CRF, approval of QA/QC plan and procedures); •Final checking and approving of the GHG inventory before official submission to the EC and UNFCCC; •Timely submission of GHG inventory to the UNFCCC and Europen Commission; •Formal agreements with inventory experts and for experts that evaluate quality assurance process; • Coordinating the work between the involved institutions, experts, Europen Commission and UNFCCC (including coordination of the UNFCCC inventory reviews); •Keeping of archive of official submissions to UNFCCC and Europen Commission (starting from 2012 submission). Since 1st of August 2009 Latvian Environment, Geology and Meteorology Centre (LEGMC) is a governmental limited liability company and is responsible for collecting of activity data (activity data are mainly collected from other institutions and LEGMC uses them to calculate emissions), preparation of the emission estimates for the Energy, Industrial Processes, Solvent and Other Product use and Waste sectors, preparation of QC procedures for relevant categories and documentation and archiving of used materials for emission calculation. Since submission 2009, removals and emission calculations for the LULUCF sector were done by Latvian State Forest Research Institute "Silava" in collaboration with MoA. "Silava" is responsible for collecting of activity data, preparation of the removals/emission estimates, preparation of QC procedures as well as documentation and archiving of used materials for calculation. Since submission 2009, Institute of Physical Energetic (IPE) calculates emissions for Transport sector according to agreement with MEPRD. IPE is responsible for collecting of activity data, preparation of the emission estimates, preparation of QC procedures as well as documentation and archiving of used materials for calculation. For submission 2012, emissions from Agriculture sector were done by Latvia's University of Agriculture in collaboration with MoA. Latvia's Agriculture University is responsible for collecting of necessary activity data (cooperating with CSB), preparation of the emission estimates, preparation of QC procedures as well as documentation and archiving of used materials for calculation. The main data supplier for the Latvian GHG inventory is the Central Statistical Bureau of Latvia (CSB). Mainly MEPRD, LEGMC, IPE, Latvia's University of Agriculture contacted with five CSB experts.	Latvia's National Inventory Report 1990-2010 Mar 2012 p 25ff.

MS	Institutional arrangements/national systems	Source
Lithuania	The main entities participating in GHG inventory process are: - Ministry of Environment - Environmental Protection Agency - State Forestry Service - National Climate Change Committee - Permanent GHG inventory working group - Data providers - External consultants The Ministry of Environment is responsible for: • Overall coordination of GHG inventory process; • Preparation of legal basis necessary for National System functioning; • An official consideration and approval of GHG inventory; • Approval of QA/QC plan and procedures; • Timely submission of GHG inventory to UNFCCC Secretariat and European Commission; • Coordination of the UNFCCC inventory reviews in Lithuania; • Keeping of archive of official submissions to UNFCCC and European Commission; • Informing the inventory compilers about relevant requirements for the national system. Before final submission to the UNFCCC Secretariat and the European Commission, National Inventory Report is forwarded to the National Climate Change Committee for the comments and final approval. The National Committee on Climate Change was set up in 2001 in the first instance and renewed in April 2010. It consists of experts from government, academia and non-governmental organizations (NGOs) and has an advisory role. The main objective of the Committee is to ensure attainment of the goals related to the restriction of GHG emissions as set in the National Sustainable Development Strategy and implementation of the measures for attaining such goals.	Draft National GHG Emission Inventory Report 2012 of the Republic of Lithuania (Reported Inventory 1990 – 2010) Jan 2012 p10 ff.
Malta	From 2010 (monitoring year 2009) the Malta Resources Authority (MRA) is the authority entrusted with the role of compiling national greenhouse gas emission inventories, with the National Emissions Inventory Team within the Climate Change Unit at MRA being delegated the main responsibility for managing the inventory compilation system and for preparing the relevant submissions. The National Emissions Inventory System Team is responsible for all functions of the inventory system, from data collection, through data management, to the preparation and submission of reports. Activity data used for the preparation of this inventory was obtained from Malta's past GHG inventory compilation, the National Statistics Office, government entities (ministries, departments), other public bodies such as regulatory authorities, private establishments and published reports.	National Greenhouse Gas Emissions Inventory Report for Malta 1990 - 2009 Jan 2011 pp 5-7
Poland	The legal base for aligning the institutional base for preparation of the Polish GHG inventories constitutes the Act of 17 July 2009 on the System to Manage the Emissions of Greenhouse gases and Other Substances. The same Act created the National Centre for Emissions Management (KOBIZE) in the Institute of Environmental Protection – National Research Institute in Warsaw and described the tasks related to GHG inventories for national and international purposes. The Minister of Environment supervises the tasks carried out by KOBiZE. The emission calculation, choices of activity data, emission factors and methodology are performed by KOBiZE. KOBiZE is collaborating with a number of individual experts as well as institutions when compiling inventories. Among the latter are: Central Statistical Office (GUS), Agency of Energy Market (ARE), Institute of Ecology of Industrial Areas in Katowice (IETU), Motor Transport Institute (ITS) as well as Office for Forest Planning and Management (BULGiL). These institutions are mainly involved in providing activity data for inventory estimates. The KOBIZE experts have access to the individual data of entities participating in the European Union Emission Trading Scheme (EU-ETS). This ensures availability of data for major sources in emissions from stationary combustion sectors (1.A.1, 1.A.2) as well as from specific industrial processes. Such data are successively included into GHG inventory where possible after verification. Prior to submission the elaborated inventories undergo internal process for the official consideration and approval. .	Information based on Poland,s National Inventory Report 2011 March 2011

MS	Institutional arrangements/national systems	Source
Romania	The Governmental Decision no. 1570 for establishing the National System for the estimation of anthropogenic greenhouse gas emissions levels from sources and removals by sinks, adopted in 2007, and the subsequent relevant procedures are regulating all the institutional, legal and procedural aspects for supporting the Romanian authorities to estimate the greenhouse gas emissions/removals levels, to report and to archive the NGHGI information, including supplementary information required under Article 7, paragraph 1, of the Kyoto Protocol. The system is based on Article 5 of the Kyoto Protocol and complies with the provisions of the subsequent decisions of the CMPs of the Kyoto Protocol and with the provisions of the Decision 280/2004/EC of the European Parliament and of the Council and of the Decision 166/2005/EC of the European Commission concerning a mechanism for monitoring Community GHG emissions and for implementing the Kyoto Protocol. The main objective of the Governmental Decision is to ensure the fulfillment of the relevant provisions and the obligations of Romania under the UNFCCC, the Kyoto Protocol and the European Community legislation. The competent authority, which is responsible for administrating the National System, is the National Environmental Protection Agency (NEPA), under the subordination of the Ministry of Environment and Forests. The definition and characteristics of the Romanian National system for the estimation of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol (NS) comprise: • includes all institutional, legal and procedural arrangements made as a Party included in Annex I for estimating anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol, and for reporting and archiving inventory information; • represents a system for the collection, processing and adequate presentation of data and information for the elaboration of the NGHGI; • is designed and operated to ensure the transparency, consistency, comparability, completeness and accuracy of inventories as defined in the guidelines for the preparation of inventories by Parties included in Annex I, in accordance with relevant decisions of the COP and/or COP/MOP; • is designed and operated to ensure the quality of the NGHGI through planning, preparation and management of inventory activities; • is designed and operated to support compliance with the Kyoto Protocol and with the European Union legislation commitments related to the estimation of anthropogenic GHG emissions by sources and removals by sink; • is designed and operated to consistently estimate anthropogenic emissions by all sources and removals by all sinks of all GHGs, as covered by the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories and IPCC good practice guidance, in accordance with relevant decisions of the COP and/or COP/MOP. The elements on the implementation of the NS general functions are described below: Establish and maintain the institutional, legal and procedural arrangements necessary to perform the functions for national systems, as appropriate, between the government agencies and other entities responsible for the performance of all functions defined in these guidelines.	Romania's Greenhouse Gas Inventory 1989 – 2010 Mar 2012 p44

MS	Institutional arrangements/national systems	Source
Slovakia	The revised National Inventory Report 2011 dated on August 2011 reports the changes in the institutional arrangement, quality assurance/quality control plan and planned improvements in the NIS. Organisational changes in relation to the National Inventory System of Slovakia: • Rearrangement of the National Focal Point to the UNFCCC at the Ministry of Environment: In June 2011 a brand new division focused on climate change tasks was established within the organizational structure of the Ministry of the Environment. Specific Climate Change Policy Department serving also as the national Focal Point to the UNFCCC (Director Helena Princova) is now part of the Division of Climate Change and Economic Instruments, which also comprises Emission Trading Department and Department of Economic Instruments and Analyses. These changes increased importance of climate change policy as a whole in the context of environmental policy in the Slovak Republic. • Establishment of the High Level Committee on Coordination of Climate Change Policy: According to the Governmental Resolution No. 821/2011 from 19 December 2011, the High-level Committee on Coordination of Climate Change Policy (CCCP) was established. This Committee is created at the state secretary level and will replace previous co-ordinating body, i.e the High Level Committee on Climate-Energy Package established in August 2008. Main objectives of proposed close co-operation is to achieve all national and international goals in tackling climate change and adaptation in more efficient way and to increase all potential benefits from this effort. According to the Governmental decision No. 821/2011 the Committee will play an important role also in process of adopting new policies and measures (if necessary) based on information from the latest GHG emission inventory. • Rearrangement of the Single National Entity for the NIS SR During the process of changes in the organizational structure of SHMU (to increase efficiency and to save financial resources) the Department of Emissions was merged with the Department of Air Quality on 1 December 2010. The new unit is named the Department of Emissions and Air Quality Monitoring and serves also as the Single National Entity while providing all activities connected with coordination of the National Inventory System for the KP under the Article 5.1. This change has had no practical impact on the function of the SNE. SNE was officially appointed by the decision of the Director General of the SHMU in August 2011. It currently comprises 2.5 experts working on inventory tasks as a full time job. Composition of SNE is: NIS Coordinator, Deputy NIS Coordinator and Quality Manager. • Continuing the cooperation with the Ministry of Agriculture and Rural Development and National Forest Centre in Zvolen for KP requirements: A sectoral expert for LULUCF cooperates with National Forest Centre in Zvolen especially for Kyoto Protocol reporting requirements under Article 3.3. The cooperation will also continue in 2012. Unlike the previous period, Ministry of Agriculture and Rural Development will directly guarantee for some of activities under the reporting obligation for the LULUCF sector in the year 2012 on the basis of contract with the National Forest Centre and approved budget.	Slovak Republic Annual Report 2012 Jan 2012 p 15 f

MS	Institutional arrangements/national systems	Source
Slovenia	In Slovenia, the institution responsible for GHG inventories is the Environmental Agency of the Republic of Slovenia. In accordance with its tasks and obligations to international institutions, the Environmental Agency is charged with making inventories of GHG emissions, as well as emissions that are defined in the Convention on Long Range Transboundary Air Pollution within the specified time limit. In making the inventories, the Environmental Agency cooperates with numerous other institutions and administrative bodies which relay the necessary activity data and other necessary data for the inventories. The chief sources of data are the Statistical Office of the Republic of Slovenia (SORS) and the Ministry of Environment and Spatial Planning; however, the Environmental Agency obtains much of its data through other activities which it performs under the Environmental Protection Act. Emissions from Agriculture are calculated in cooperation with the Slovenian Agriculture Institute (KIS), and sinks in the LULUCF sector are calculated by the Slovenian Forestry Institute (GIS). A Memorandum of Understanding has been concluded with institutions that participate in inventory preparation, binding these institutions to submit quality and verified data to the Environmental Agency in due time. At the beginning of 2007, the agreement between Statistical Office of the Republic of Slovenia and the Environmental Agency came into force. Accordingly, all statistical data which are necessary for preparing GHG inventories are available each year by October 30 at the latest. In exchange, ETS data and emission estimates are reported to the Statistical Office within a defined time frame. Experts from the Slovenian Forestry Institute and the Agricultural Institute of Slovenia work on GHG inventories according to the standing rules of institutes (ordinance). Financing is assured by governmental institutions according to the yearly work plan. All data from external institutions are submitted to the Environmental Agency, where they are archived. The detailed process from gathering data to emissions calculation and reporting is described in our Manual of Procedures, which was prepared in 2005 and updated in 2008. In 2009, the QA/QC plan as part of the Manual was developed and mostly implemented.	Slovenia's National Inventory Report 2011 (selected chapters) Jan 2011 p 6-8

16.2 General description of methodologies and data sources used

16.2.1 The compilation of the EU GHG inventory

The EU inventory is compiled in accordance with the recommendations for inventories set out in the *'UNFCCC guidelines for the preparation of national communications by parties included in Annex 1 to the Convention, Part 1: UNFCCC reporting guidelines on annual inventories'* (FCCC/SBSTA/2004/8), to the extent possible. In addition, the *Revised IPCC 1996 guidelines for national greenhouse gas inventories* have been applied as well as the *IPCC Good practice guidance and uncertainty management in national greenhouse gas inventories*, where appropriate and feasible. In addition, for the compilation of the EU GHG inventory, Council Decision No 280/2004/EC and the Commission Decision 2005/166/EC.

The EU-27 GHG gas inventory is compiled on the basis of the inventories of the 27 Member States. The emissions of each source category are the sum of the emissions of the respective source and sink categories of the 27 Member States. This is also valid for the base year estimate of the EU-15 as fixed in the initial review report (which is included in part 1). Table 16.3 shows the base year emissions for the new EU Member States.

All EU Member States are Annex I parties to the UNFCCC except Cyprus. Malta acceded to Annex I status under the UNFCCC in October 2010; however, no quantified emissions limitation or reduction target is inscribed for Malta in Annex B to the Kyoto Protocol. Therefore, all Member States except

Cyprus have committed themselves to prepare individual GHG inventories in accordance with UNFCCC reporting guidelines and to submit those inventories to the UNFCCC secretariat by 15 April. In addition, all Member States (including Cyprus) are required to report individual GHG inventories prepared in accordance with UNFCCC reporting guidelines to the Commission by 15 January every year under Council Decision 280/2004/EC.

Table 16.3 Base year emissions for the new Member States

New MS	CO_2, CH_4, N_2O	HFC, PFC, SF_6	Base year emissions 1) (Tonnes CO_2 equivalents)
Bulgaria	1988	1995	132,618,658
Cyprus	Not relevant	Not relevant	
Czech Republic	1990	1995	194,248,218
Estonia	1990	1995	42,622,310
Hungary	1985-87	1995	115,397,149
Latvia	1990	1995	25,909,160
Lithuania	1990	1995	49,414,386
Malta	Not relevant	Not relevant	
Poland	1988	1995	563,442,774
Romania	1989	1989	278,225,022
Slovakia	1990	1990	72,050,764
Slovenia	1986	1995	20,354,042

1) Base-year emissions exclude emissions and removals from the LULUCF sector but include emissions due to deforestation
in the case of Member States for which LULUCF constituted a net source of emissions in 1990.
Source: Initial review reports of the new Member States (www.unfccc.int)

16.2.2 Use of data from EU ETS for the purposes of the national GHG inventories in EU Member States

For a general overview see section 1.3.2.1.

16.2.2.1 Bulgaria

General

A total of 155 operators have provided their verified CO_2 emissions required under the EU ETS for the years 2007-2010. These emissions have been incorporated in the inventory as far as posssible. Furthermore the background data for the emission calculations under the ETS were used for further QA/QC checks.

Energy

Data from the verified ETS reports was analysed in order to use a Tier 2 methodology for emission calculations. From all the operators only the largest 24 plants use plant specific methodologies, so it was possible to derive country specific EFs for the major solid fuels only. These country-specific emission factors are derived from the verified ETS reports as a weighted average from all operators, which have declared that they have used plant-specific emission factors (Tiers 2b or 3 according to the Methodology for monitoring GHG emissions of operators participating in the ETS). The EFs are calculated as the total sum of the verified CO_2 emissions divided by the total amount of the respective fuel as reported by the operators. For the years 2007 to 2010 are applied the respective annual emission factors and for the years 1988 to 2006 is applied an average EF, calculated as a weighted average.

For the 2010 submission, the country specific emission factors were calculated as a weighted average from the ETS reports for 2008 and applied to all the years. For the 2011 submission, the country specific factors were recalculated as a weighted average from all reports for 2007, 2008 and 2009. For the 2012 submission were applied the annual emission factors for the years 2007-2010, and an average emission factor for the years 1988-2006.

1A2 Manufacturing industries and production: There is a specific case for other fuels used in the cement industry, for which a separate calculation model was developed. Due to the fact that all cement plant participate in the ETS, their verified reports were used in order to calculate the country-specific EFs for the following fuels:

- SRF/RDF
- Waste oils
- Tyres
- Filters
- Biomass

Industrial Processes

In some categories emission and production data were reported directly by industry or ETS, IPPC and/or E-PRTR reports thus represent plant and country specific data. Verified CO_2 emissions reported under the EU ETS were available for the years 2007-2010. These emissions have been incorporated in the inventory as far as possible. Furthermore the background data for the emission calculations under the ETS were used for further QA/QC checks.

Emission estimations as well as activity data and emission factors are compared with EU ETS verified emission reports, IPPC reports as well as E-PRTR reports where available.

2A1 Cement Production: All 5 plants are covered by the EU ETS and the IPPC Directive and have been modernized accordingly during the last 10 years. The 2010 CO_2 emissions are taken from the operators EU ETS reports. As a part from the QA activities the aggregated national clinker production data provided by the NSI were compared with the production data reported by the cement plants in the annual reports for compliance with their IPPC permits (EPRTR data), as well as in their verified emission reports within the EU ETS.

2A2 Lime Production: Currently there are 4 lime producing plants in Bulgaria which fall under IPPC and EU ETS. They produce quicklime and dolomitic lime.

2A4 Soda Ash use: EU ETS reports - emission from soda ash used in glass production (calculated by plants in the reports) and using the mass balance approach are compared. Activity data for Soda ash use has been revised for the entire time series by using soda ash mass balance based on plant specific (EU ETS reports) and statistical data.

2A7 Glass Production: Currently there are six glass plants in Bulgaria mainly producing flat, container and domestic glass. All of them fall under IPPC and EU ETS. For the period 2007 - 2010 plant specific emissions, activity data and emission factors were used based on the data reported by operators under EU ETS (except one plant) and IPPC. Activity data has been revised by using IPPC permits reports and EU ETS data as well as statistical data for crosscheck.

2A7 Others (Ceramics Production): The CO_2 emissions from the verified ETS reports are used. These emissions are estimated taking into account the CaO and MgO content in the products. Country specific emission factor was calculated on the basis of data from ETS and IPPC reports of the operators. The ETS data used to estimate the EF take into account the CaCO3, MgCO3 in the used in the raw materials (clay).

2A7 Others Non-Specified (Wet Scrubbers): Currently there are three large combustion plants (LCP) in Bulgaria applying desulphurization for the flue gas cleaning. Tier 2 method for the CO_2 emissions estimation is used. The CO_2 emissions estimated using the above equation are taken from the LCP operators EU ETS reports. The quantities of calcium carbonate (CaCO3) and magnesium carbonate (MgCO3) used for the estimations are also taken form the EU ETS reports thus allowing to take into account the pure carbonates used in the process. Plant specific activity data on the amount of carbonates use are obtained from EU ETS reports.

2B1 Ammonia Production: Currently ammonia is produced in two plants in Bulgaria. Both plants are falling under the IPPC Directive and EU ETS.

2B2 Nitric acid Production: Currently nitric acid is produced in two plants in Bulgaria. Both plants are falling under the IPPC Directive and ETS.

2B42 Carbide Production and Use: There is one carbide producing plant in Bulgaria. It reports under EU ETS and has an IPPC permit.

2C1 Iron and Steel Production: The CO_2 emissions from the sector are calculated using country specific data from EU ETS reports. Country specific emission factor was developed for the EAF steel based on data from EU ETS reports for the period 2007 - 2010. In the calculation of ETS emissions the operators performed a mass balance of the Carbon content in the raw materials used and the produced end product. Country specific data from EU ETS reports as well as from BAMI and WSA on total crude steel production were received.

16.2.2.2 Cyprus

General

The main data sources used for inventory preparation are the National Statistical Service, the national energy balance, the government ministries / agencies involved, along with the verified reports from installations under the EU ETS. Quality control of activity data include the comparison of the same or similar data from alternative data sources (e.g. National Statistical Service, ETS reports and energy balance) as well as time-series assessment in order to identify changes that cannot be explained.

Energy

- 1A1 Energy Industries: For all gases and all sources, the revised IPCC1996 guidelines were applied with the exception of CO_2 from public electricity for the years 2005-2010. CO_2 from public electricity for the years 2005-2010 is according to the information submitted by the EAC in its annual verified report for the EU ETS. The data on fuel consumption was obtained from the Statistical Service for the years 1990-2004 and for 2005-2010 from the ETS annual reports. The carbon content and oxidation factor of the fuels is according to the revised IPCC 1996 guidelines, with the exception of HFO and diesel for 2005-2010 which is according to the ETS annual report of the EAC.
- 1A2 Manufacturing Industries and Construction: For all gases and all sources, the revised IPCC1996 guidelines were applied with the exception of CO_2 from cement and ceramics production (in non-metallic minerals and other respectively) for the years 2005-2010. CO_2 from the two sources for the years 2005-2010 is according to the information submitted by the installations in their annual verified report for the EU ETS. Fuel consumption data for the years 1990-2004 was obtained from the Statistical Service and for 2005-2010 from the ETS annual reports. The carbon content and oxidation factor of the fuels is according to the revised IPCC 1996 guidelines, with the exception of Pet-coke, HFO, Diesel, LFO and LPG consumed for cement production during 2005-2010 which is according to the ETS annual report of the EAC.
- 1A2f Other: According to the available breakdown of energy consumption by the Energy Service and the Statistical Service, no data is available on the consumption of fuels by specific industries. Therefore, all emissions are reported under other (1A2F). Specific data on energy consumption is only available for the installations that are in the EU ETS.
- QA/QC for fuel consumption: Activity data, methodology and any information used for electricity production after 2005 have been obtained from the reported submitted for the ETS directive and are therefore verified according to the ETS monitoring regulations.
- **Industrial Processes**2A1 Cement Production: For the years 2005-2010 detailed data is available via the verified EU ETS reports of the plants. These data refer to the quantities of carbonate raw material (CaCO3, MgCO3) used for the production of clinker.

16.2.2.3 Czech Republic

General

So far, data from the emission trading system has been used to only a limited degree in the Czech national greenhouse gas inventory (e.g. in the sector of Industrial processes - mineral products). It was recommended to the Czech inventory team during the recent "in-country review" that the data from EU ETS be used to a greater degree. For this purpose, the team began to prepare an "improvement plan" to provide for gradual inclusion of the relevant EU ETS data in the national inventory. The next part of this "improvement plan" will consist in gradual introduction of higher tiers into the national inventory. At the present time, CHMI, in cooperation with MoE, is preparing a database of activities and emission data from the EU ETS system, which could be used in preparation of the national inventory. Consequently, it can be expected that these data will be employed more extensively only in future inventories.

Energy

- 1A Fuel combustion: The fuel consumption is taken from the energy balance of the Czech Republic and is transformed to the IPCC structure. Consumption of the other kinds of fuels (Other fuels) was taken from the national ETS system (ETS, 2011).
- 1A2f Other: In this year's submission, this subcategory also includes the combustion of other kinds of fuel (Other Fuels). Activity data and data on CO_2 production were taken from the national ETS system (ETS, 2011), while CH_4 and N_2O emissions were calculated using the default emission factors for solid and liquid fuels.

QA/ QC: Attention is constantly devoted to obtaining data from the ETS national database for use in performing QA/QC procedures. At the present time, the creation of a database is included in the plan of the Ministry of the Environment. The sectoral QA/QC guarantor, in cooperation with the NIS coordinator, will assess the conditions for Tier 2 in the given sector (e.g. comparison with EU ETS data or with other independent sources). If everything is in order, the sectoral QA/QC guarantor organizes the QC check according to Tier 2. **Industrial Processes**

- 2A1 Cement Production: Since 2006 submission methodology equal to the Tier 3 has been employed. CO_2 emissions are based on data submitted by the cement kiln operators for preparation and standard operation of the EU ETS system, which includes all the cement kilns in Czech Republic. Information from individual kilns is reported to the competent authority. This data covers years 1990, 1996, 1998 - 2002 and 2005 - 2010. For other years the EF was extrapolated. All operating cement plants in the Czech Republic are equipped with dust control technology and the dust is then recycled to the kiln. Only in one cement plant is a small part of the CKD discarded, for technical reasons. Use of dolomite or amount of magnesium carbonate in the raw material, as well as fissile carbon (C) content is known, all above mentioned variables are used for emissions estimates in the EU ETS system.
- 2A2 Lime Production: A comparison of CO_2 emissions calculated according to IPCC methodology and process related emissions reported for EU ETS is made. ETS data closely corresponds to the IPCC methodology and national circumstances. The reports on EU ETS emissions from the individual installations have been verified by independent verifiers.
- 2A3 Limestone and Dolomite Use: In 2005 data was verified by comparison with data from the individual power plants, which were collected for EU ETS preparation and which cover the years 1999 – 2005. The EU ETS data form has been used since 2006. Emissions from limestone and dolomite use in sintering plants were new source, in 2006 submission, which was identified in the process of preparation of the EU Emission Trading Scheme. Only 2 sintering plants have existed in the CR in recent times. CO_2 emissions from this category are calculated on the basis of data from statistics (The Steel Federation, Inc - production of agglomerate / sinter) and the EF value, which

was derived from EU ETS CO_2 emission data based on the limestone and dolomite compositions and consumptions (0.08 t CO_2 / t sinter).

- 2A4 Soda Ash Use: Activity data were taken from EU ETS and from consultations with the operator of the relevant plant.
- 2A7 Other: The EF value was derived from individual installation data collected for EU ETS (emissions) and from CzSO (production). The calculation is based on the total production of ceramic products (fine ceramics, tiles, roofing tiles, and bricks) and the EF value.

It is planed to process all available information about uncertainty from the EU ETS and provide category and national specific uncertainty assessment.

16.2.2.4 Estonia

Energy

In 2012 inventory submission Energy Sector CO_2 emission factors were compared also with EFs used by Emission Trading System (ETS) enterprises.

Industrial Processes

- 2A1 Cement Production: The emissions of last six years (including 2010 emissions) have been compared with ETS data (as recommended by the UNFCCC review team). Differences between those two figures have been less than 1%.

16.2.2.5 Hungary (NIR 2012)

Energy

1A: It is important to note first that no emission data are taken directly from the ETS database and put into the CRF as they are. Instead, facility level activity data (fuel use) and carbon emission factors are used from the ETS database to calculate weighted averages of the emission factors for different fuel types. These derived country specific EFs are then applied with the fuel use from the national energy statistics. Fuel uses in energy statistics and ETS are compared to see whether the fuel use in a given category is fully covered by ETS plants or not. Fuel consumption data are compared both in natural units and in energy units to reveal any possible differences in net calorific values. Should such difference occur, emission factors need to be amended to achieve consistency in energy balance and verified emissions since national energy data serve always as activity data. It is also checked whether the oxidation factor used by the facilities is included in their EFs. Measured oxidation factors, especially in case of coal firing plants, are always taken into account.

- 1A1 Energy Industries: Energy consumption data were taken from the energy balance (1985-2010) of the Energy Statistics Yearbooks prepared by the Energy Centre. Besides, waste statistics and ETS data were taken into account. Some CO_2 emission factors have been taken from the EU ETS. It should be noted that only those measured factors were applied where the EU ETS covers all or most of the installation of the sector. For waste incineration also EU ETS data is used. The biggest co-incinerator plant is Mátra Power Plant. Since this plant reports its verified emissions in the framework of the European emission trading, direct ETS data relating its fuel use and CO_2 emissions were taken over. Verified energy use from EU ETS was compared to statistical data. It was noticed that data in metric tonnes are similar in the ETS to those in the statistics, but there are some differences in energy values due to different NCVs. Since the energy consumption in sectoral approach should be compared with those of reference approach, we kept the NCVs of energy statistics, however emission factors of coals were corrected for some years to achieve consistency in energy balance and verified emissions. For the main power plants the total fuel consumption's difference between the ETS and this dataset was around 1% in 2009.

- 1A2 Manufacturing Industries and Construction: Part of the emissions from waste incineration for energy purposes was allocated to this source category. Special attention was given to the four big cement factories, as they incinerate large amount of waste of fossil origin (plastics, rubber etc.). Their verified ETS data (emissions and fuel use) were analyzed, from which a specific emission factor was derived: 2.2 tonne CO_2/tonne fossil waste. From 2006 on, ETS data (fuel consumption and emission) of the cement factories were used directly. CO_2 emission in the process of manufacturing bricks and ceramics is calculated using the verified emission reports (EU ETS) in the *Industrial Processes Sector.* Carbon emission factors for coke oven coke and coke oven gas combusted by the iron and steel industry, where measured (by accredited laboratory) carbon content of fuels were available from the EU ETS. For all other fuels default emission factors have been used.
  Emissions from combustion related to natural gas transport are included under sector 1.AA.2 (Manufacturing Industries and Construction) instead of Other Transport. Nevertheless, we have checked that five compressor stations reported under the EU-ETS in 2010.
- 1B2 Oil flaring: All emissions included recently are also reported using default emission factors from GPG2000. The only exception is subcategory 1B2c2.1 – Oil refinery flaring, where EU ETS emission data of oil refinery flaring (reported directly by the company) is inserted too due to lack of emission factor.
- QA/QC: Energy consumption data were subject of several rounds of verification before use. Verified energy use from EU ETS was compared to the statistical data. It was noticed that data in metric tonnes are similar in the ETS to those in the statistics, but there are some differences in energy values due to different NCVs.

Industrial Processes

Although EU ETS data reported by the individual operators (summed together by industrial sector) would be probably more accurate than the use of default factors, its use in inventory preparation is very limited due to time series consistency problems. In 2010, in Industrial Processes sector EU ETS data is directly used solely in sector 2.A1 Cement production, 2.A.7 Other mineral (Glass and Bricks and ceramics) and partly in 2.A.3 Limestone and dolomite use.

- 2A1 Cement Production: In 2009 four factories were operating in Hungary. Production data for the whole time series were obtained directly from the factories and from the EU Emission Trading System (ETS) According to the ETS introduced by the European Union from 2005 on, the factories report their CO_2 emission. The reported quantities of CO_2 emitted between 2005 and 2010 are based on reports of the factories. As the country specific method is mainly the same as the emission reporting methodology of the EU ETS, the time series is more consistent this way, than it would be in the case of the use of Tier1 or Tier2 method of the IPCC Guidelines. As the use of ETS data means the use of verified data, where the carbon contents should be measured in accredited laboratory (or at least a laboratory yearly validated and inter-compared with accredited laboratory as it is prescribed in section 13.5 of Annex I of 589/2007/EC), we believe that the use of ETS data improves the accuracy of the data reported in the inventory.
- 2A2 Lime production: The activity data were received directly from the operators which increased the reliability of the information. Since 2005 also EU ETS data have been available. At the moment EU ETS data is used only for verification purpose in order to avoid time series consistency problem caused by the 4-8% difference.
- 2A3 Limestone and Dolomite use: Flue gas desulphurization has been carried out in one power plant since 2002 and in another one since 2004. Activity data on the use of carbonates for SO_2

scrubbing is either reported by the operators directly to the HMS or to EU ETS competent authority (In EU ETS the operators are required to report CO_2 emission from the use of carbonate for scrubbing separately in their annual emission report).

- 2A7 Glass Production: CO_2 emission from glass production was determined based on the data from the Emission Trading System. The ERT noted that the time-series consistency between 1985-2005 and 2006 is not fully ensured by this calculation method, therefore recommended to make further efforts to improve time-series consistency. We have compared the CO_2 emission from ETS data with the emissions calculated with our country-specific factor. CO_2 emissions from ETS was higher in 2006 and 2007 by 10.62% and 6.08%, respectively but lower in 2008, 2009 and 2010 by 14.42%, by 18.21% and by 21.69%. The lower value was due to the new data logging methodology of the HCSO, i.e. estimations were made from salesmanship. So, as it was also stated by the review report of last year, please note that for 2008 onwards the activity data are proxy data only and, thus, the IEFs are not comparable with those of previous years.2A7 Other: ETS data is used in this sector. The estimation of uncertainties is based on the uncertainty of EU ETS data. In EU ETS uncertainty of the activity data and/or the overall emissions has to be ensured by the operators at a level prescribed in the GHG emission permit. This is usually less than 7.5% (see 589/2007/EC Decision on the the monitoring and reporting of greenhouse gas emissions). The years before 2005 in the time series are calculated by the application of an emission factor calculated based on the 2005 EU ETS data.

16.2.2.6 Latvia

General

As all Latvia's industrial processes sector's companies are participating in ETS then data from these companies can be obtained from their annual GHG report within compliance obligations within ETS. These activity data used emission factors and used emission estimation methodologies can be reported in NIR and in CRF Tables as the data of ETS can't be confidential and all companies' annual GHG reports are published in LEGMC webpage.

Energy

- 1A: Carbon emission factor for industrial wastes (used tires) was estimated based on CO_2 emission factor reported by cement production plant within ETS.
- 1A2f Others: EF for CO_2 emission estimation for other fuels – used tires, combusted in CRF 1.A.2.f Other Manufacturing Industries – cement production, category for years 1999–2010 is taken from GHG emission reports that plant submitted under ETS. This CO_2 emission factor is estimated at the plant by using plant specific data about combustion installation, as well as net calorific value and carbon content measured and obtained in the plant laboratory.
- 1A2: CO_2 emission factor of municipal wastes combusted in cement production plants is taken from plant's annual GHG report within EU ETS for 2008-2010 IPCC 2006 as there is no information available of such fuel type. This CO_2 emission factor is estimated at the plant by using plant specific data about combustion installation, as well as net calorific value and carbon content measured and obtained in the plant laboratory.
- Activity data, CO_2 EF and estimated emissions of used tires and municipal wastes are taken from cement production plant's annual GHG reports within EU ETS. The data is verified by accredited verifier and then checked and approved by Regional Environmental Boards.

Industrial Processes

All industrial production data used in emission estimation from 2.A Mineral Products sector is taken from the annual GHG reports that industrial producers submit within EU ETS. According to EU ETS legislation all GHG reports have to be verified by the ISO accredited verifiers that checks that all reported information – activity data, CO_2 emission factors, estimated emissions as well as estimation methodology, is correct and corresponds to certain requirements from the legislation.

- 2A1 Cement Production: According to IPCC GPG alternative of activity data if clinker production data is not available is to use cement clinker data and the estimate this amount back to clinker production data. In the cement production plant it is done for the EU ETS annual reporting by taking into account clinker and cement ratio for the particular types of cement produced. According to cement production plant the CKD amount is weighted before it is sent to disposal site. The amount of weighted CKD as well as procedures of all data obtaining is verified by the accredited verifier within EU ETS. Cement, cement kiln dust production data and estimated clinker production data is taken from plant's annual GHG reports within EU ETS.
- 2A2 Lime Production: In iron & steel production facility lime necessary for steel smelting in open heart furnaces is produced only from limestone in vertical shaft kiln. The plant is reporting their non-marketed quicklime production data for 2005-2010 within ETS so the estimated emissions as well as used activity data and emission factor are taken from plant's annual GHG report within GHG.
- 2A3, 2A4 Limestone, Dolomite and Soda Ash Use: Limestone, dolomite and soda ash are used in glass production plants, steel production plant and lime production plants. All these plants are participants of EU ETS so the detailed information of used technologies, raw materials as well as emission factors are available as plants report their annual GHG reports to LEGMC. Activity data were taken from industrial production plants. Industrial producers are participants of the ETS the GHG reports of these enterprises have to be freely available according to EU ETS regulations. The GHG reports of ETS operators are published on LEGMC home page.
- 2A7 Glass Production: CO_2 emission factors used to estimate emissions from raw materials use in glass production are plant specific and taken from plants' annual GHG reports within ETS. Activity data, CO_2 emission factors and estimated emissions from glass production plants are taken from the annual GHG reports that plants submit within EU ETS. All GHG reports are verified by the ISO accredited verifiers that checks that all reported information is correct and corresponds to certain requirements from the legislation.
- 2A7 Bricks Production: There are five bricks production plants in Latvia. Some plants used 2004 in its application for GHG permit during the implementation of ETS in Latvia a methodology that is not in line with IPCC Guidelines. CO_2 emission factors used in emission calculation from bricks and tile production are the default from Monitoring and Reporting Guidelines within ETS so the uncertainty of emission factors is assumed as 50%. Activity data is taken from plants reported annual GHG reports within EU ETS. As bricks production plant is constantly changing used methodology to estimate their annual CO_2 emissions within ETS requirements, the emissions were recalculated using the most appropriate approach for the best result.
- 2A7 Tiles Production: There is only one tiles production plant in Latvia and CO_2 emissions from use of clay in tile production process in 1995-2010 are reported in this sector. The tiles production plant is participant of ETS so the data from plant's annual GHG reports is available for inventory. Activity data, CO_2 emission factor and estimated emissions are taken from the annual GHG reports that steel production plant submit within EU ETS.
- 2C Metal Production: There is only one Iron & Steel production plant in Latvia that produces crude steel by melting crude iron not only by melting scrap metals. The plant is participant of ETS and submits their annual GHG reports to LEGMC. It is possible to obtain more accurate and complete activity data and emission factors from enterprise that is involved in the emission trading system.

16.2.2.7 Lithuania

General

Annual ETS data reports by operators are indicated as one of the most important data sources for the Lithuanian GHG inventory preparation. For 1A Fuel combustion and Industrial processes EU ETS emissions data is used as a data source.

Energy

- For 1A1a Lithuania indicates under source specific improvements to investigate the possibility of using data provided in the EU ETS, reported by the operators for the energy sector emission estimates.

Industrial Processes:

- 2A1 Cement production: For the period 2005-2010 CO_2 emission data have been accessed via the verified EU ETS reports of the production plant. For the period 1990-2004 CO_2 emission was calculated using Tier 2 method using specific production data provided by the production company.

16.2.2.8 Malta

The total allocation for the period 2008 to 2012 amounts to 10.715 million allowances and has been allocated in its entirety to the two incumbent electricity generation plants that remain, to date, the only local participants in the scheme. It is pertinent to note that in 2010, emissions covered by the EU ETS amounted to approximately 66% of total net national greenhouse gas emissions.

Energy

- 1A1a: These are two power plants that are currently run on liquid fossil fuels, namely residual fuel oil (RFO) and gas oil (GO). It is important to note that for the years 2005 to 2010, fuel consumption data reported in verified emission reports as submitted by the operator under Directive 2003/87/EC have been used.

16.2.2.9 Poland

General

The experts of the National Centre have access to the individual data of entities participating in the European Union Emission Trading Scheme (EU-ETS). This ensures availability of data for major sources in emissions from stationary combustion sectors (1.A.1, 1.A.2) as well as from specific industrial processes. Such data are successively included into GHG inventory where possible after verification.

Energy

1A3e Pipelines transport: Since 2008, data from the transport via pipelines covered by the Community Emission Trading Scheme (EU ETS) were taken directly into GHG inventory.

Industrial Processes

For estimation of the 2010 emission, in sector 2. *Industrial Processes,* CO_2 process emission data were used from installations which take part in the EU ETS. Emissions based on such data were estimated in the following subcategories:

- subcategory 2.A. *Mineral Products*: 2.A.1. *Clinker Production*, 2.A.3. *Limestone and Dolomite Use* and from subcategory 2.A.7. *Other*: *Glass Production*, *Ceramics materials production*

- subcategory 2.C. *Metal Production*: processes included into *Iron and Steel Production* (2.C.1) such as: sinter production, pig iron production, steel production in basic oxygen process, steel production in electric arc furnace process
- subcategory 2.D. *Other Production*: 2.D.1. *Pulp and Paper*
- subcategory 2.G. *Other* – this subcategory includes data containing CO_2 process emissions from installations which take part in emission trading scheme that cannot be included in subcategory 2.A-2.F; for example emissions from refineries (process emissions, discharges and flaring)
- 2A1 Cement Production: CO_2 emission from clinker production is the sum of the process emissions given in the verified reports for 2010 for installation of clinker production, which participate in the EU ETS [KOBiZE 2011]. CO_2 emission from clinker production was taken from the verified reports for the years: 2005-2010 for installations which participate in EU ETS.
- 2A3 Limestone and Dolomite Use: In this subcategory there were used only emissions from limestone and dolomite use in sulphur removal installations in power industry installation that participate in EU ETS. Emissions for this subcategory in GHG inventory correspond to emissions from the EU ETS verified reports. CO_2 emissions concerning limestone and dolomite use in production of glass, ceramics and paper includes only the emission from installations covered by EU ETS.
- 2A7 Glass production: CO_2 emission from glass production was taken from the verified reports for 2010 for installation of glass and glass wool production, which participate in the emission trading scheme [KOBIZE 2011].
- 2A7 Other (Ceramics material production): CO_2 emission from production of ceramics materials was calculated based on the verified reports for 2010 for installation of ceramics production, which participate in EU ETS [KOBIZE 2011].
- 2C1 Iron and Steel Production: Carbon dioxide process emissions from iron and steel production for 2010 come from the verified reports on annual emissions of CO_2 from iron and steel installations in EU ETS [KOBiZE 2011]. The values of annual iron ore sinter productions were also taken from production amounts indicated in the verified reports. Based on verified reports of CO_2 emissions elaborated for the purpose of emission trading scheme, also emissions and production within this subcategory for years 2005-2009 were estimated.
- 2D Other Production: CO_2 process emissions from pulp and paper production for 2010 and for 2005-2009 were taken from the verified reports for installations of paper and cardboard production, which participate in EU ETS [KOBIZE 2011].
- 2G Other Processes: CO_2 emission value estimated as process emission of CO_2 from the verified reports for refineries, which participate in EU ETS was included in this sub-category [KOBIZE 2011].
- QA/QC: Activity data used in the GHG inventory concerning industry sector come from yearbooks published by the Central Statistical Office (GUS). GUS is responsible for QA/QC of collected and published data. Data on selected production is compared to data collected from installations/entities covered by the EU ETS. Data relating to EUETS installations are verified by independent reviewers and by verification unit established in the National Centre for Emissions Management (KOBiZE). Additionally data on industrial production is compared with public statistics in case where entire sector is covered by EU ETS.

16.2.2.10 Romania

General

A sum of operators has provided their verified CO_2 emission reports required under the EU ETS for the years 2007-2010.

The coverage of CO_2 emissions from ETS activities in relation to individual CRF source categories is provided in the Romanian NIR.

Data from the verified ETS reports were analysed in order to use a Tier 2 methodology for emission calculations. The number of plants, using a plant specific methodologies, made possible to achieve country specific EFs for a sum of solid and liquid fuels and natural gas. These emission factors (without oxidation fraction included) are derived from the verified ETS reports as a weighted average from all operators which have declared that they have used plant-specific emission factors (Tiers 3 according to the Methodology for monitoring GHG emissions of operators participating in the ETS).

Energy

- 1A Stationary combustion**:** It was accomplished a study by the Romanian Institute for Studies and Power Engineering (ISPE), analysing the data from the operators reporting on EU ETS, conducting to the development of the Country Specific Emission Factors. Thus the national emission factors based on EU-ETS operators reporting are used for some source categories under 1A.
- A further analysis on the EU-ETS 2011 reporting (object of a further Study) will be conducted in order to take into consideration these emissions, as Tier 3 approach, on the activity category where these operators have to report.
- 1A1 Energy Industries: Country Specific Emission Factors for the analysed fuels (liquid, solid and biomass) on EU-ETS reporting are used. It is planned to take into consideration the emissions from the operators reporting on EU-ETS (having their reports verified by accredited verifiers) in order to achieve a higher tier approach in the estimation of the CO_2 emissions.
- 1A2 Manufacturing Industries and Construction: Country Specific Emission Factors for the analysed fuels (liquid, solid and biomass) on EU-ETS reporting are used. It is planned to take into consideration the emissions from the operators reporting on EU-ETS (having their reports verified by accredited verifiers) in order to achieve a hire tier approach in the estimation of the CO_2 emissions
- 1A4 & 1A5: Since the resources for solid fuels in the Romanian economy are mainly from the internal exploitations, the weighted arithmetic averages for the emission factors calculated based on all the EU-ETS activities reporting, are used in the 1.A.4 – Other Sectors. Country Specific Emission Factors for the analysed fuels (liquid, solid and biomass) on EU-ETS reporting, are used.

Industrial Processes

- 2A1 Cement Production: Starting with 2008 the figures related with clinker production, plant specific CO_2 EF for clinker production and CO_2 emissions from clinker production were compared with the data reported in monitoring plan of GHG emissions for the EU-ETS cement production installations. The data are similar.

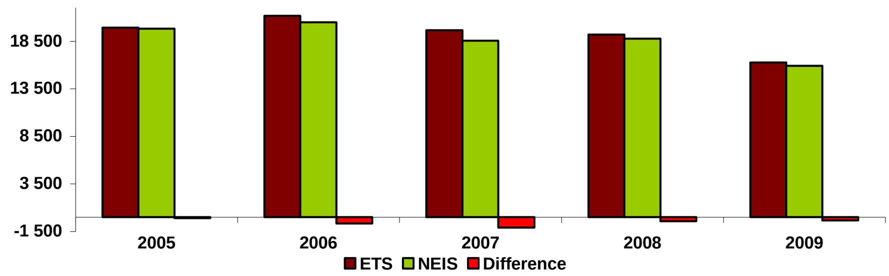
16.2.2.11 Slovakia (NIR 2012)

General

Significant changes in methodologies and emission factors were implemented to ensure consistency with the European Emission Trading Scheme (EU ETS), which represent significant progress in quality of estimation through comparison with the verified emissions for all installation included in the EU ETS.

QA/QC: In order to comply with the quality management criteria and data harmonization between ETS and the national emission balance at sectoral level, emission factors of the most important fuels have been re-evaluated and new methods have been implemented at the level of source operators. By comparison and correct allocation of CO_2 emissions in sector energy, it can be concluded that the balance is in a good compliance with the emissions verified within ETS. The comparison was provided for most important sources (energy and technology), but also only for energy sources. For the comparison study, 26 biggest emitters were taken, which represent more than 90% of all allocated emissions in the Slovak Republic.

Figure 2: ***Comparison of CO_2 emissions from energy sources (in Gg) allocated in ETS and estimated by sectoral approach from the dbase NEIS for 2005 – 2009***



Source: NIR of Slovakia, submission 2012, p. 67, Figure 3.21

Energy

- 1A2a Iron and Steel: The material balance was compared with the direct material balance reported by plants in the ETS. The identification of the fuels included into the balance second time was possible for the years 2005 – 2009. The study could be done only because of availability of data from ETS, directly from the operators included in the National Allocation Plan I for 2005 – 2007 and in the National Allocation Plan II for 2008 – 2009.
- 1AB Reference Approach: In the previous inventory submissions, the emission factors of several important fuels were revised according to national circumstances and according to the direct measurements by sources included in ETS. The CO_2 EF for natural gas, coal, coke, brown coal, lignite and coke oven gas were revised and the values are described in section 1.AA – sectoral approach. The consistency is strictly kept between EFs used in sectoral and reference approach.

Industrial Processes

- 2A1 Cement Production: The cement plants in the Slovak Republic (4 plants), where cement clinker is produced, are included into the ETS and the verification reports from the ETS were used for CO_2 emission inventory. On the basis of the information provided into the verified ETS reports, Tier 2 methodology according to the IPCC 2000 Guidelines has been applied since 2002 based on plant specific information. The calculations provided by the cement clinker producers in the ETS reports balanced CO_2 emissions on the basis of cement clink production and CaO and MgO contents. The ETS reports elaborated directly from the sources included in the National Allocation Plans (I and II) have been the most important sources of activity data since 2005. QA/QC: The data is compared with the information from Statistical Office of the Slovak Republic (Portland cement clinker production) and with the ETS reports.
- 2A2 Lime Production: Tier 2 according to the IPCC 2000 GL has been applied since 2003 with the

combination of plant specific activity data and emission factors estimated for each plant. The calculations provided by the lime producers in the ETS reports balanced CO_2 emissions on the basis of raw material used for production (Calmit lime plant) or produced lime (other lime plants) and $CaCO_3$ and $MgCO_3$ contents (Calmit lime plant) and CaO and MgO contents (other lime plants).
QA/QC: The data are compared with the information from the Statistical Office of the Slovak Republic (lime production) and available ETS reports.

- 2A3, 2A7: ETS data is used for QA/QC.
- 2B1 Ammonia Production: The Tier 2 methodology according to the IPCC 2000 GPG was applied to category 2B1 ammonia production and the plant specific emission factors were used. The information on ammonia production was provided directly by the company.
- 2C1 Iron and Steel Production: Iron and steel in the Slovak Republic are produced by several plants. For Iron and steel production in blast furnaces EU ETS reports are available since 2005, but no detail data fuel consumption or CO_2 emissions are presented in the reports. The methodology used by plant operator in EU ETS report based on mass balance. The emission calculation for EAF steel production was based on the available data and assumptions:
  - Železiarne Podbrezová: EU ETS reports are available since 2005. According to the questionnaires concerning the period 2000 – 2004; it was used approximately 13.4 kg of carbon (in all material inputs) for production of 1 tone of steel.
  - Metalurg Steel: EU ETS reports are available since 2007. According to the questionnaires concerning the period 2000 – 2006; the emission factor of CO_2 was 0.165 t per 1 tone of steel.
  - UNEX Prakovce: The plant is not included in the EU ETS. The default emission factor of CO_2 was used (0.08 t CO_2 / 1 t of steel).
- 2C2 Ferroalloys Production: Information about activity data were taken directly from the producers of ferroalloys in the Slovak Republic based on questionnaires.

QA/QC: For 2A1, 2A2 and 2B1 and 2C1: Information used for GHG emission inventories of IP sector are directly from the questionnaires sent to operators and producers in the Slovak Republic. First preliminary data related to the production and the quality of products in the Slovak Republic from the previous year is available at the beginning of October. This data are used for the estimation and verified by Mr. Vladimir Danielik – the sectoral expert for IP sector in the cooperation of the Slovak Technical University in Bratislava, the Faculty of Chemical and Food Technology. The data are compared with the information from the Statistical Office of the Slovak Republic and available ETS reports.

16.2.2.12 Slovenia

General

In 2006, an additional quality control check point was introduced by forwarding the assessment of verified emission reports from installations included in the National Allocation Plan to the Statistical Office of the Republic of Slovenia (SORS). The role of SORS is to compare data from installations included in the EU-ETS with data from their reporting system and to propose corrective measures, if necessary. The outcome of data consistency checks is used as preliminary information for the Ministry of the Environment and Spatial Planning to perform on-site inspections.

Energy

- 1A1a Public Electricity and Heat Production: From 2005 the activity data from the verified reports from ETS have been used for four power plants. For four thermal power plants the aggregated fuel from SORS data are compared with the sum of fuel used from verified ETS reports. The NCV values are also checked. If case these numbers are not the same the ETS data are taken in account for GHG inventory and notification to SORS is made to correct their data. In other cases where connection between both set of data is uniform, the data from Statistical office are substitute with data from verified reports from installations included in ETS, if necessary. ETS data are also used for different types of waste used as a fuel. The list of waste types is not always complete in the SORS data.
- QA/QC: The main source specific QA/QC activity is comparison of the ETS data with statistical data.

Industrial Processes

As Slovenia is small country only 12 installations from EU ETS report process emissions (2 cement, 3 lime, 3 steel and 4 glass producers), this QC can be performed manually. After entering this data to the calculation spreadsheet the QC is performed.

- 2A1 Cement Production: For the period 2005 - 2008, the EFs reported by the plants to the Ministry of Environment and Spatial Planning, as a competent authority in the European Union Greenhouse Gas Emission Trading System (EU ETS), are used to calculate emissions. To calculate emissions from cement production after 2005 we have been using data obtained by EU ETS. Data on clinker production and plant specific emission factors for both cement factories have been annually verified by independent verifiers. ETR recommended showing that the estimated CO_2 process emissions from cement production are comparable and consistent with the emissions reported under the EU ETS. EU ETS reports can not be publicly revealed due to sensitivity of information.
- 2A2 Lime Production: CO_2 emission was calculated according to IPCC methodology. The EFs for lime production for the period 2005-2010 are based on EU ETS data, whereas for the period 1986 -1989 the average EF for 1999-2004 was applied. Upon ERT recommendation year-specific EFs were used for the period 1999 -2004 instead of average EF. The EFs for the years 2005-2010 were derived from emissions and activity data on annual production of quicklime reported under EU ETS scheme.
- 2A3 Limestone and dolomite use: SO_2 scrubbing & Ceramics production - Data on CaCO3 and MgCO3 for the period 2005–2010have been obtained from verified ETS reports.
- 2C1 Iron and Steel production: For the period 2005-2010 we have used precise and verified data obtained from EU ETS.
- QA/QC: QC procedures for the plant data included in the inventory that are collected under the European Union Emissions Trading Scheme (EU ETS) have been performed. ETS emissions data from verified printed reports have been compared with data obtained in electronic form. ETS emissions data are collected by EU ETS experts from Environmental Agency of Republic of Slovenia. As national inventory team and EU ETS experts work together in the same institution, even in the same unit, it is very easy to access these hard copy reports for each company. Besides the data, reports include also the description of monitoring of this data, eventual stops and changes of production.

16.3 Key categories

A key category analysis has been carried out according to the Tier 1 method (quantitative approach) described in IPCC (2000) for the EU-27. The tables are included in Annex 2.1.

16.4 Information on the quality assurance and quality control plan

Table 16.4 gives an overview of QA/QC procedures in place for the new EU Member States.

Table 16.4 Overview of quality assurance and quality control procedures for the new MS (NIR descriptions)

MS	Description of the national QA/QC activities	Source
Bulgaria	The ExEA is also responsible for coordination and implementation of QA/QC activities for the national inventory. A quality manger is in place. The Bulgarian Quality Management System was established in the frame of project with Bulgarian Academy of Science, Geophysical Institute. The project was carried out and finished in 2008. The QA/QC plan is an internal document to organize, plan and implement QA/QC activities. Once developed for the next submission, it is referenced and used in subsequent inventory preparation, or modified as appropriate. The QA/QC plan has been updated in August 2010 in order to implement the new established legal, institutional and procedural arrangements within the BGNIS. The updated National QA/QC Plan was approved by the Ministry of Environment and Water in September 2010. National QA/QC Plan includes following elements: Responsible institutions; Data collection; Preparation of inventory; QC Procedures; QA Procedures; Uncertainty evaluation; Organisation of the activities in quality management system; Documentation and archiving. The legal and institutional arrangements within the BGNIS regulate the responsibilities of all engaged institutions for implementation of the requirements of the National QA/QC Plan. The QC procedures are performed by the sectors, who are directly involved in the process of preparation of inventory with their specific responsibilities. The QC procedures are implemented by all activity data provider and ExEA's sector experts (Order N 202/29.09.2010 by the Executive Director of ExEA) and/or external consultants. For 2011 submission the QA procedures are implemented by sector experts within the MoEW and experts from the ExEA, who are not directly involved in the preparation of inventory (Order № RD-218/05.03.2010 by the minister) or external reviewers.	Short NIR of GHG emissions in Republic Bulgaria 1988-2009 Jan 2011 p 19 ff

MS	Description of the national QA/QC activities	Source
Cyprus	The QA/QC system has been developed on the basis of the IPCC guidelines. The quality objectives used are the following: - Compliance with the IPCC guidelines and the UNFCCC reporting guidelines while estimating and reporting emissions/removals; - Continuous improvement of GHG emissions/removals estimates; - Timely submission of necessary information in compliance with relevant requirements defined in international conventions, protocols and agreements. The QA/QC system developed covers the following processes: - QA/QC system management, comprising all activities that are necessary for the management and control of the inventory agency in order to ensure the accomplishment of the above-mentioned quality objectives. - Quality control that is directly related to the estimation of emissions. The process includes activities related to (a) data inquiry, collection and documentation, (b) methodological choices in accordance with IPCC Good Practice Guidance, (c) quality control checks for data from secondary sources and (d) record keeping. - Archiving of inventory information, comprising activities related to centralized archiving of inventory information and the compilation of the national inventory report. - Quality assurance, comprising activities related to the different levels of review processes including the review of input data from experts if necessary, and comments from the public. - Estimation of uncertainties, defining procedures for estimating and documenting uncertainty estimates per source / sink category and for the whole inventory. - Inventory improvement, that is related to the preparation and the justification of any recalculations made.	National GHG Inventory Report 1990-2009 2011 Submission Jan 2011 pp 2-3

MS	Description of the national QA/QC activities	Source
Czech Republic	The objective of the national inventory system (NIS) is to produce high-quality GHG inventories. In the context of GHG inventories, high quality provides that both the structures of the national system (i.e. all institutional, legal and procedural arrangements) for estimating GHG emissions and removals and the inventory submissions (i.e. outputs, products) comply with the requirements, principles and elements rising from the UNFCCC, Kyoto Protocol, IPCC guidelines and EU GHG monitoring mechanism (Decision of the European Parliament and of the Council No 280/2004/EC). **Quality control procedures (QC)** The QC procedures used in the Czech GHG inventory comply with the IPCC good practice guidance. General inventory QC checks (IPCC GPG 2000, Table 8.1 and IPCC GPG LULUCF 2003, Table 5.5.1) include routine checks of the integrity, correctness and completeness of data, identification of errors and deficiencies and documentation and archiving of inventory data and quality control actions. In addition to general QC checks, category-specific QC checks including technical reviews of the source categories, activity data, emission factors and methods are applied on a case-by-case basis focusing on key categories and on categories where significant methodological and data revisions have taken place. Once the experts have implemented the QC procedures, they complete the QA/QC form for each source/sink category, which provides a record of the procedures performed. Results of the completed QC checks are recorded in the internal documents for the calculation and archived in the expert organizations and at the CHMI. Key findings are summarized in the sector-specific chapters of the NIR. **Quality assurance procedures (QA)** Quality assurance comprises a planned system of review procedures. The QA reviews are performed after the implementation of QC procedures to the finalized inventory. The inventory QA system comprises reviews and audits to assess the quality of the inventory and the inventory preparation and reporting process, to determine the conformity of the procedures taken and to identify areas where improvements could be made. While QC procedures are carried out annually and for all sectors, QA activities are expected to be performed by individual sectors and not so frequently. Each sector should be reviewed by the QA audit approx. once in three years as far as possible. Besides, QA activities should be focused mainly on key categories.	National GHG Inventory Report 2010 of the Czech Republic, Jan 2010 pp 7-11
Estonia	This section presents the general QA/QC program including the quality objectives and the QA/QC plan for the Estonian greenhouse gas inventory at the national inventory level. Source specific QA/QC details are discussed in the relevant sections of this NIR. All institutions involved in the inventory process (MoE, EERC; TUT and EEIC) are responsible for implementing QC procedures to meet the data quality objectives. MoE as the national entity is responsible for overall QC and is in charge of checking on an annual basis that the appropriate QC procedures are implemented internally in TUT; EERC and EEIC. The EERC as a coordinator has an overall responsibility for QC of the data of the emission inventory. EERC checks the QC reports of TUT, EERC and EEIC. When EERC disagrees with the report then the errors are discussed and changes are made if necessary. Each institution is responsible for reporting on their completion of the QC procedures on an annual basis. This reporting is based on a checklist of general and source-specific QC checks and a textual description of possible recalculations, issues to be followed up before the next submissions, and other relevant information. MoE as the national entity is responsible for the overall QA of the national system, including the UNFCCC reviews and any national reviews undertaken. During the Twinning Light project “Improving the quality of Estonia’s National Greenhouse Gas Inventory” with Finland in 2009 Estonia updated its QA/QC plan. The Estonia’s QA/QC plan consist of six parts: (1) production plan (see Table 1.1); (2) annual meetings; (3) QA/QC checks; (4) archiving structure; (5) response tables to the review process and (6) a list of planned activities and improvements.	Greenhouse Gas Emissions in Estonia 1990-2009 Jan 2011 p 33

MS	Description of the national QA/QC activities	Source
Hungary	QA/QC activities are performed in two levels: based on the ISO 9001 standards and following the IPCC recommendations. ISO activities: The Hungarian Meteorological Service introduced the quality management system ISO 9001:2000 in 2002 for the whole range of its activities. However, GHG inventory preparation was not among its activities in that time. Therefore, the scope of our ISO accreditation had to be modified and lots of efforts have been made to bring also the national system under the umbrella of the ISO QM system. Several regulatory ISO documents were created. The basic document is the Procedure on the activities of the GHG Division. It contains the basic principles of the inventory preparation and reporting processes, prescribes the obligation of making a QA/QC plan, and regulates the documentation and archiving activities. The QA/QC plan, which is an audited ISO document, consists of the following elements: - Specification of the sectoral responsibilities of the core team - Domination of an officer responsible for the QA/QC system: the QA/QC coordinator - Documentation - Data quality check - Reviews - Development plan The Hungarian Meteorological Service funds two research projects for the improvement of the inventory: Incorporation of ETS data in broader extent for revision of the used EFs and for better sectoral allocation of emissions Having an ISO system in place has an advantage of being subject to regular internal and external audits. During our last external audit the activities of the GHG Division were audited as well. Other QA/QC activities: Besides ISO requirements, other QA/QC activities are carried out, as well. For every sector of the inventory, there is a responsible person within the core team in the Met. Service. These sectoral responsibilities are laid down in the yearly QA/QC plan. Especially in case of external experts, this responsible member of our team conducts several quality checks on the provided calculations. Moreover, this exercise can be regarded as an interactive process throughout the whole inventory cycle, since the used methodologies, early results are discussed during the process of the emission/removal calculations. This QC procedure also led to a few recalculations. Many elements of the general Tier1 QC procedure are applied. The used parameters and factors, the consistency of data are checked regularly. Completeness checks are undertaken, new and previous estimates are compared every time. Data entry into the database is checked many times by a second person. If possible, activity data from different data sources are compared and thus verified. In response to our request, several data suppliers made declarations as regards quality assurance systems in place during the collection of the data. Nevertheless, the work continues to refine the used QA/QC procedures and implement further elements.	NIR for 1985-2008, Hungary (Draft Excerpts) Jan 2010, pp 17-18

MS	Description of the national QA/QC activities	Source
Latvia	According to CoM Regulation No. 157 (17.02.2009) all institutions involved in inventory process are responsible for implementing QC procedures. Mainly Tier 1 General Inventory Level QC procedures outlined in Table 8.1 of IPCC GPG 2000 are used. The legislation act determines: The quality objectives for GHG inventory; QA/QC plan that has been prepared to improve transparency, comparability, and completeness of GHG inventory. In the QA/QC plan quality control procedures to be used before and during the compilation of GHG inventory are described. Tasks and responsibilities of involved institutions; Check-list and procedure description for independent experts for quality assurance of GHG inventory. The result of quality depends on four main stages – planning, preparation, evaluation and improvements and is ensured by inventory experts during compilation and reporting of inventory. The inventory planning stage includes the setting of quality objectives and elaboration of the QA/QC plan for the coming inventory preparation, compilation and reporting work. The main objective of Latvia's GHG inventory system is to produce high quality GHG inventories. The quality requirements set for the annual inventories – transparency, consistency, comparability, completeness, accuracy, improvements and timelines. MoE as national entity is responsible for overall QC procedures and quality assurance of national system, including UNFCCC reviews.	Latvia's Short National Inventory Report 1990-2010 Mar 2012 p 36 ff
Lithuania	The Quality Assurance and Quality Control (QA/QC) Plan has been prepared in order to improve transparency, consistency, comparability and completeness of Lithuania's GHG inventory. The QA/QC Plan describes the quality objectives of the GHG inventory, the national system for inventory preparation, tasks and responsibilities. A description is provided of various formal procedures already implemented in the development of the GHG inventory and of planned improvements. As in 2011 the Lithuanian National System for the preparation of the GHG inventory was under enhancement for essential changes and improvements, QA/QC plan was updated in 2011. The Ministry of Environment and the Environment Protection Agency was responsible for the development of the updated QA/QC Plan. The Environment Protection Agency will be responsible for the coordination and implementation of the Plan with a supervision performed by the Ministry of Environment. As defined in GPG 2000, quality control is a system of routine technical activities, to measure and control the quality of the inventory as it is being developed. A basic quality control system should provide routine checks to ensure data integrity, correctness, and completeness and identify errors or omissions. In addition, procedures for documentation and archiving of inventory material and recording of all quality control activity data should be developed. Quality Assurance (QA) activities include planned system of review procedures conducted by personnel not directly involved in the inventory compilation/development process to verify that data quality objectives were met, ensure that the inventory represents the best possible estimate of emissions and sinks given the current state of scientific knowledge and data available, and support the effectiveness of the quality control (QC) program.	Draft National GHG Emission Inventory Report 2012 of the Republic of Lithuania, Reported inventory 1990-2010 Jan 2012 p 24

MS	Description of the national QA/QC activities	Source
Malta	The need for a standardized Quality Assurance/Quality Control (QA/QC) system within the national inventory system is recognized and is acknowledged as being an important aspect to be addressed in the ongoing development of the system in general. Work specifically aimed at developing a QA/QC system is expected to form part of the national inventory system team's work plan for 2011, to ensure the quality and reliability of the activity data, emission factors and emission estimates, in line with the principles of transparency, accuracy, consistency, comparability and completeness. Efforts were made to ensure as high a level of quality and reliability as possible. A priority task has been to ensure that the best available sources of data are used, especially where these have been verified (for example data on fuel consumption in power generation plants for the most recent years has been derived from verified emission reports that local installations are obliged to submit pursuant to Directive 2003/87/EC).	National Greenhouse Gas Emissions Inventory Report for Malta 1990 - 2009 Jan 2011 pp 5-7
Poland	The national entity – National Centre for Emission Management – which is responsible for preparation of GHG inventories, is also responsible for coordination and implementing the QA/QC activities. The program for Quality Assurance and Quality Control has been elaborated to improve and assure high quality of the Polish annual greenhouse gas inventory. It has been elaborated in line with the IPCC Good Practice Guidance and Uncertainty Management in National GHG Inventories (2000). The QA/QC program contains tasks, responsibilities as well as time schedule for performance of the QA/QC procedures. The following elements of the Quality Assurance and Quality Control system has been addressed: Inventory agency responsible for coordinating QA/QC activities, QA/QC plan, General QC procedures (Tier 1 method), Source category-specific QC procedures (Tier 2), QA review procedures, Reporting, documentation and archiving procedures.	direct communication based on NIR 2010

MS	Description of the national QA/QC activities	Source
Romania	This QA/QC Programme was established according to the UNFCCC and Kyoto Protocol's provisions related to GHG inventory preparation and national system establishment and also to 1996 Revised IPCC Methodology and Good Practice Guidance. Therefore, the document comprises information on: • The national authority responsible for the coordination of QA/QC activities; • The objectives of the QA/QC framework; • The QA/QC Plan; • The QC procedures; • The QA procedures; • The reporting, documenting and archiving procedures. According to the provisions of the Governmental Decision no.1570/2007 establishing the national system and to those in the NEPA's President Decision no. 119/2012, NEPA represents the competent authority responsible with the implementation of the QA/QC activities under the NGHGI. For this purpose, NEPA is performing the following activities: • Ensures that specific QA/QC objectives are established; • Develops and regularly updates a QA/QC plan; • Implements the QA/QC procedures Considering the provisions of relevant regulations, NEPA designated a QA/QC coordinator. The overall objective of the QA/QC programme is to develop the NGHGI in line with the requirements of the IPCC 1996, IPCC GPG 2000 and IPCC GPG 2003 and with the provisions of the Decision 280/2004/EC of the European Parliament and of the Council and Decision 166/2005/EC of the European Commission. Romania's QA/QC plan closely follows the definitions, guidelines and processes presented in Chapter 8 – Quality Assurance and Quality Control of the IPCC GPG 2000. The QA/QC plan constitutes the heart of the QA/QC procedures. It outlines the current and planned QA/QC activities. The specific QA/QC activities are performed during all stages of the inventory preparation. The QA/QC plan will be reviewed periodically if needed and can be modified as appropriate when changes in processes occur or based on the advice from independent reviewers. The QA/QC plan is intended to ensure the fulfillment of the NGHGI principles in Romania. The objectives of the plan include: • Applying greater QC effort for key source categories and for those source categories where data and methodological changes have occurred recently; • Periodically checking the validity of all information as changes in reporting, methods of collection or frequency of data collection occur; • Conducting the general procedures outlined in QC procedures (Tier 1) on all parts of the inventory over a complete exercise; • Balancing efforts between development and implementation of QA/QC procedures and continuous improvement of inventory estimates; • Customizing the QC procedures to the resources available and the particular characteristics of Romania's greenhouse gas inventory; • Confirming the national statistical institute and other agencies supplying activity data to NEPA have implemented QC procedures	Romania's Greenhouse Gas Inventory 1989 – 2012 Mar 2012 p71

<table>
<tr><th>MS</th><th>Description of the national QA/QC activities</th><th>Source</th></tr>
<tr><td>Slovakia</td><td>Ministry of the Environment of the Slovak Republic contracted in 2009 consultation company ISO Management to develop project “Proposal of Quality management system for the National Inventory system of the Slovak Republic (NIS SR), including the QA/QC plan”. Project has started in March 2009 and was split into two parts: Part I proposal of QA/QC procedure for the NIS SR and Part II – to implement QMS ISO 9001 for process of inventory preparation.

Outcome from the Part I is certification of Internal QA/QC plan of NIS SR, which is yearly updated and further developed based on the outcomes of control by the Ministry of the Environment as the national Focal Point to the UNFCCC.

Further outcome from Part I are External and Internal QA/QC plans of NIS SR, which is also yearly updated and improved based on inputs from other relevant ministries received within the interministerial process of comments on the GHG emission inventory and on the findings raised from the UNFCCC review process.

Proposals of both, the 2012 internal and external plans QA/QC plans for NIS SR are described in more details in the Annex of this report.

The Slovak Hydrometeorological Institute is accredited by ISO 9001, NIS SR is a part of this accreditation.</td><td>Annual report 2012

Submission under the EC GHG Monitoring Mechanism

Jan 2012, p 8</td></tr>
<tr><td>Slovenia</td><td>In 2009 the Republic of Slovenia has developed and mostly implemented a Quality Assurance and Quality Control plan as recommended by IPCC Good Practice Guidelines (IPCC 2000). QA/QC plan is a part of the Manual of Procedures, which has already been elaborated in 2005 and was updated in 2009. In beginning of 2009 a QA/QC manager within the inventory agency has been designated.

The general part of this system is incorporated into Oracle database (ISEE – “Emission inventory” information system) which has been established in the end of 2008. The main purpose of ISEE is:

to enable collection and archiving of activity data, emission factors and other parameters including description of sources from 1980 on for other pollutants, and from 1986 on for GHG emissions.

• to enable collection and archiving of activity data, emission factors and other parameters including descriptions of sources from 1980 on for other pollutants, and from 1986 on for GHG emissions;
• to calculate GHG and other pollutant emissions;
• to automatically fill in reporting tables (CRF Reporter).

As all calculations are performed in the database with software generated for this purpose, no human errors, common in calculations made in Excel spreadsheets, are expected. After these procedures, the activity data (fuel consumption and NCV) are transferred into the database, while EFs are imported manually. Then emissions are calculated automatically according to the built-in formulas. For 2008 and 2009, GHG emissions were also calculated in Excel spreadsheets. Both estimates were compared and all differences were carefully investigated and corrected.</td><td>Slovenia’s National Inventory Report 2012 (selected chapters)

Jan 2012

pp.15-16</td></tr>
</table>

16.5 Uncertainty estimates

Table 16.5 gives an overview of information provided by the new Member States on uncertainty estimates in their national inventory reports 2011 and presents summarised results of these estimates.

Table 16.5 Overview of uncertainty estimates available from new Member States

Member State	Bulgaria	Cyprus	Czech Republic	Estonia	Hungary	Latvia	Lithuania		Malta	Poland	Romania	Slovakia	Slovenia
Citation	NIR, Apr 2012, p. 70	NIR, Apr 2012, pp. 21-22	NIR, Mar 2012, p. 13	Uncertainty Table 2012	NIR, Apr 2012, p. 23	Uncertainty Table 2012	NIR, Apr 2012, p. 45		Uncertainty Table 2012	NIR, March 2012, p. 18	Uncertainty Table 2012	NIR, Apr 2012, p. 36	NIR Apr 2012, p. 26-27
Method used	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1
Documentation in NIR (according to Table 6.1/6.2 of GPG)	Yes	Yes	Yes	Yes (Annex 6)	Yes (Annex 7)	Yes (Annex 7)	Yes (Annex 2)		Yes (Annex 7)	Yes (Annex 6)	Yes (Annex 7)	Yes (Annex III)	Yes (Annex 7)
Years and sectors included	emissions: 2010; BY-2010; excluding LULUCF	emissions: 2009; trend: 1990-2009; including LULUCF	emissions: 2010; trend: 1990- 2010; including LULUCF	emissions: 1990; trend: 1990-2010; including LULUCF	emissions: 2010; trend: BY-2010; excluding LULUCF	emissions: 2010; trend: 1990-2010; including LULUCF	emissions: 2010; trend: 1990-2010; including LULUCF		emissions: 2010; trend: 1990-2010; including LULUCF	emissions: 2010; including LULUCF	emissions: 2010; trend: BY - 2010; including LULUCF	emissions 1990; trend: 1990-2010; including LULUCF	emissions: 2010; trend: 1986-2010; including LULUCF
Uncertainty (%)	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1 (i. L.)	Tier 1 (e. L.)	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1
CO_2		4.7%			4.9%		62.2%	1.4%		4.4%			
CH_4		3.0%			17.2%		8.5%	6.4%		19.3%			
N_2O		21.0%			132.9%		11.0%	8.2%		48.1%			
F-gases		0.7%								HFC 43.4% PFC 85.2% SF6 89.1%			
Total	14.6%	8.1%	3.8%	i. L.: 52.8% e. L.: 49.3%	18.2%	i. L.: 73.94%; e. L.: 44.44%	64.1%	10.5%	3.8%		e. L.: 9.7% i. L.: 12.7%	7.8%	e. L.: 6.91% i. L.: 30.03%
Uncertainty in trend (%)	Tier 1		Tier 1		Tier 1						Tier 1	Tier 1	Tier 1
CO_2													
CH_4													
N_2O													
F-gases													
Total	±3.05% points		±2.40% points	i. L.: ±26.4% points e. L.: ±16.2% points	±3.03% points	i. L.: ±114.01% points e. L.: ±32.03% points	±14.7% points	±2.2% points	±3.8% points		e. L.: ±1.3% points i. L.: ±1.9% points	±4.78% points	e.L.:±2.69% points i.L.:±4.17% points

16.6 Completeness and data basis

Table 16.6 summarises timeliness and completeness of the new Member States' submissions in 2012. It shows that GHG inventories for 2010 were submitted by all new Member States by 22 March 2012 (cut off date). The completeness of national submissions with regard to individual CRF tables can be found in the status reports in Annex 2.3.

Table 16.6 Date, mode and content of submissions of new Member States in 2010 (status 22 May 2012)

MS	Date	Submission mode	XML	SEF	CRF	KP LULUCF	NIR
BG	14.01.2012	CDR	BGR-2012-v1.1	2011	1988-2010	2008-2010	short NIR
BG	15.03.2012	CDR	BGR-2012-v1.2	-	1988-2010	2008-2010	yes
BG	12.04.2012	CDR	BGR-2012-v1.3	2011	1988-2010	2008-2010	yes
BG	19.05.2012	CDR	-	2011	-	-	-
CY	15.01.2012	CDR	CYP-2012-v1.1	-	1990-2010	-	short NIR
CY	12.03.2012	CDR	CYP-2012-v1.2	-	1990-2010	-	-
CY	11.04.2012	CDR	CYP-2012-v1.3	-	1990-2010	-	yes
CY	10.05.2012	CDR	CYP-2012-v1.5	-	1990-2010	-	yes
CZ	16.01.2012	CDR	CZE-2012-v1.1	2011	1990-2010	2008-2010	short NIR
CZ	22.03.2012	CDR	CZE-2012-v1.1_15March2012	2011	1990-2010	2008-2010	-
CZ	30.03.2012	CDR	-	-	-	-	yes
CZ	19.04.2012	CDR	CZE-2012-v1.1-13Apr2012	2011	1990-2010	2008-2010	yes
EE	13.01.2012	CDR	EST-2012-v1.1	2011	1990-2010	2008-2010	yes

EE	15.03.2012	CDR	EST-2012-v1.2	2011	1990-2010	2008-2010	yes
EE	16.04.2012	CDR	EST-2012-v1.3	2011	1990-2010	2008-2010	yes
HU	17.01.2012	CDR	HUN-2012-v1.1	2011	1985-2010	2008-2010	-
HU	03.02.2012	CDR	-	-	-	-	yes
HU	14.03.2012	CDR	HUN-2012-v1.2	-	1985-2010	2008-2010	-
HU	30.03.2012	CDR	HUN-2012-v1.2	-	1985-2010	2008-2010	yes
HU	10.05.2012	CDR	HUN-2012-v1.4	-	1985-2010	2008-2010	yes
LT	13.01.2012	CDR	LTU-2012-v1.1	2011	1990-2010	2008-2010	yes
LT	15.03.2012	CDR	LTU-2012-v1.2	-	1990-2010	2008-2010	yes
LT	26.04.2012	CDR	LTU-2012-v1.3	-	1990-2010	2008-2010	yes
LT	16.05.2012	CDR	LTU-2012-v2.3	-	1990-2010	2008-2010	-
LV	13.01.2012	CDR	LVA-2012-v1.1	2011	1990-2010	2008-2010	yes
LV	13.03.2012	CDR	LVA-2012-v1.2	-	1990-2010	2008-2010	yes
LV	14.04.2012	CDR	LVA-2012-v1.4	2011	1990-2010	2008-2010	yes
MT	16.01.2012	CDR	MLT-2012-v1.1	-	1990-2010	-	yes
MT	15.03.2012	CDR	MLT-2012-v1.3	-	1990-2010	-	yes
MT	18.04.2012	CDR	MLT-2012-v1.7	-	1990-2010	-	yes
MT	15.05.2012	CDR	MLT-2012-v1.11	-	1990-2010	-	yes
PL	13.01.2012	CDR	POL-2012-v1.1	2011	1988-2010	2008-2010	short NIR
PL	15.03.2012	CDR	POL-2012-v1.2	2011	1988-2010	2008-2010	yes
PL	15.05.2012	CDR	POL-2012-v2.1	2011	1988-2010	2008-2010	-
RO	15.01.2012	CDR	ROU-2012-v1.1	-	1989-2010	1989, 2008-2010	-
RO	15.01.2012	CDR	-	2011	-	-	-
RO	21.02.2012	CDR	ROU-2012-v1.2	-	1989-2010	1989, 2008-2010	-
RO	15.03.2012	CDR	ROU-2012-v1.2	2011	1989-2010	1989, 2008-2010	yes
RO	22.03.2012	CDR	ROU-2012-v1.2		1989-2010	1989, 2008-2010	yes
SI	12.01.2012	CDR	SVN-2012-v1.1	2011	1986-2010	2008-2010	short NIR
SI	15.03.2012	CDR	SVN-2012-v1.2	-	1986-2010	2008-2010	yes
SI	13.04.2012	CDR	SVN-2012-v1.3	2011	1986-2010	2008-2010	yes
SK	15.01.2012	CDR	SVK-2012-v1.1	2011	1990-2010	2008-2010	-
SK	17.01.2012	CDR	-	-	-	-	short NIR
SK	15.03.2012	CDR	SVK-2012-v1.2	-	1990-2010	2008-2010	-
SK	14.04.2012	CDR	SVK-2012-v1.3	-	1990-2010	2008-2010	-

The grey xml files have been used for the EU-27 inventory

In response to the Saturday paper 2010 the EU mobilized the mechanisms of its national system to further enhance its QA/QC programme and develop an appropriate action plan, in consultation with the MS, geared in particular towards complementing the existing procedures and improving the completeness regarding NEs of the EU greenhouse gas inventory in 2011 and beyond (see description in Chapter 1).

GHG inventory estimates for 2010 are available for all new Member States. The EU inventory team has provided gap filled estimates for KP LULUCF for Estonia. This does not affect the EU inventory submission as KP LULUCF tables are not compiled for the EU-27.

Table 16.7 to Table 16.10 show the data basis of the 2010 EU GHG inventory.

Table 16.7 Data basis of CO_2 emissions excluding LULUCF (Tg)

EU Member State	1990	1995	2000	2005	2006	2007	2008	2009	2010
EU-15	3,362	3,293	3,368	3,480	3,459	3,404	3,328	3,062	3,147
Bulgaria	83	62	48	52	53	57	54	46	48
Cyprus	5	6	7	8	8	8	9	8	8
Czech Republic	165	128	126	127	129	129	124	116	120
Estonia	37	18	15	16	16	19	17	14	18
Hungary	73	62	59	61	59	58	56	51	51
Latvia	19	9	7	8	8	9	8	7	8
Lithuania	37	15	12	14	15	16	15	13	14
Malta	2	2	2	3	3	3	3	3	3
Poland	373	359	316	318	331	332	327	312	332
Romania	189	135	100	108	114	112	108	89	87
Slovakia	61	45	41	43	42	40	41	36	38
Slovenia	15	15	15	17	17	17	18	16	16
EU-27	**4,420**	**4,149**	**4,117**	**4,255**	**4,255**	**4,204**	**4,108**	**3,773**	**3,891**

Table 16.8 Data basis of CH_4 emissions in CO_2 equivalents (Tg)

EU-15	437	413	373	325	319	314	311	306	304
Bulgaria	19	13	10	9	9	9	9	8	8
Cyprus	1	3	2	3	3	3	2	2	2
Czech Republic	18	13	11	11	11	10	11	10	10
Estonia	2	1	1	1	1	1	1	1	1
Hungary	12	10	10	9	9	9	9	8	9
Latvia	4	2	2	2	2	2	2	2	2
Lithuania	6	4	3	3	3	3	3	3	3
Malta	0	0	0	0	0	0	0	0	0
Poland	48	45	40	39	40	39	38	37	37
Romania	42	30	26	26	26	24	24	23	22
Slovakia	4	4	4	5	5	5	5	4	4
Slovenia	2	2	2	2	2	2	2	2	2
EU-27	**595**	**540**	**486**	**436**	**429**	**422**	**417**	**409**	**405**

Table 16.9 Data basis of N_2O emissions in CO_2 equivalents (Tg)

EU-15	400	382	341	311	298	297	289	278	269
Bulgaria	12	7	5	5	5	5	5	5	5
Cyprus	0	1	1	0	0	0	0	0	0
Czech Republic	13	9	8	8	8	8	8	8	7
Estonia	2	1	1	1	1	1	1	1	1
Hungary	13	7	8	9	9	8	7	7	7
Latvia	4	2	2	2	2	2	2	2	2
Lithuania	7	3	4	5	5	6	6	4	4
Malta	0	0	0	0	0	0	0	0	0
Poland	38	31	29	29	31	31	31	27	27
Romania	21	15	12	14	13	12	13	11	11
Slovakia	6	4	4	4	4	4	4	4	3
Slovenia	1	1	1	1	1	1	1	1	1
EU-27	**518**	**462**	**417**	**390**	**377**	**376**	**368**	**347**	**338**

Table 16.10 Data basis of actual HFCs, PFCs and SF_6 emissions in CO_2 equivalents (Gg)

Member State		1990	1995	2000	2005	2006	2007	2008	2009	2010
EU-15	HFC	27,879	41,430	46,112	56,776	59,000	62,471	66,201	68,755	73,119
	PFC	17,329	11,713	8,105	5,474	5,100	4,774	4,176	2,742	3,221
	SF_6	10,748	15,007	9,615	7,468	6,875	6,588	6,195	5,854	6,070
Bulgaria	HFC	IE,NA,NO	2	18	101	164	200	301	269	281
	PFC	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	0	0	0
	SF_6	4	5	7	9	9	9	10	10	13
Cyprus	HFC	NA,NO	NA,NO	20	37	44	54	65	111	150
	PFC	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
	SF_6	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	72
Czech Republic	HFC	NA,NE,NO	1	263	594	872	1,606	1,262	1,042	1,503
	PFC	NA,NE,NO	0	9	10	23	20	27	27	29
	SF_6	78	75	142	86	83	76	47	50	16
Estonia	HFC	NA,NE,NO	25	70	119	136	149	132	139	156
	PFC	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	0	0	0	NA,NE,NO	NA,NE,NO
	SF_6	NA,NE,NO	3	3	1	1	1	1	1	2
Hungary	HFC	NA,NO	1	223	603	662	811	940	855	914
	PFC	271	167	211	209	2	2	2	2	0
	SF_6	88	170	195	238	186	253	276	221	235
Latvia	HFC	IE,NA,NE,NO	1	5	34	73	116	95	100	105
	PFC	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
	SF_6	NA,NE,NO	0	1	8	7	9	10	14	12
Lithuania	HFC	NA,NO	5	14	61	80	104	136	151	172
	PFC	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
	SF_6	NA,NO	0	0	1	1	1	6	5	11
Malta	HFC	8	18	6	49	65	79	88	94	97
	PFC	NA,NO	NA,NO	0	0	0	0	0	0	0
	SF_6	0	2	2	2	2	2	2	2	2
Poland	HFC	NA,NO	41	865	4,149	4,885	6,231	7,581	7,402	6,763
	PFC	208	252	249	260	270	299	226	90	86
	SF_6	NA,NO	31	24	28	35	33	34	39	37
Romania	HFC	NA,NE,NO	95	163	487	641	840	890	703	695
	PFC	2,116	1,774	1,292	82	55	24	15	7	8
	SF_6	NA,NE,NO	0	0	50	68	58	16	7	5
Slovakia	HFC	NA,NO	22	81	180	207	236	273	309	321
	PFC	271	114	12	20	36	25	36	18	21
	SF_6	0	10	13	17	17	17	19	19	20
Slovenia	HFC	NA,NO	32	41	133	154	177	188	196	199
	PFC	257	106	106	133	125	91	21	7	14
	SF_6	10	13	16	19	18	18	17	16	17
EU-27	HFC	27,887	41,672	47,880	63,322	66,986	73,074	78,153	80,125	84,476
	PFC	20,453	14,126	9,984	6,189	5,610	5,235	4,505	2,893	3,380
	SF_6	10,928	15,315	10,017	7,925	7,302	7,064	6,633	6,238	6,511

Table 16.11 shows the geographical coverage of the new Member States' national inventories. As the EU inventory is the sum of the Member States' inventories, the EU inventory covers the same geographical area as the inventories of the Member States.

Table 16.11 Geographical coverage of the new Member States

Member State	Geographical coverage
Bulgaria	Bulgaria
Cyprus	Area under the effective control of the Republic of Cyprus
Czech Republic	Czech Republic
Estonia	Estonia
Hungary	Hungary
Latvia	Latvia
Lithuania	Lithuania
Malta	Malta
Poland	Poland
Romania	Romania
Slovakia	Slovakia
Slovenia	Slovenia

17 EU-27 greenhouse gas emission trends

This chapter presents the main GHG emission trends in the EU-27. Firstly, aggregated results are described for EU-27. Then, emission trends are briefly analysed mainly at gas level and a short overview of Member States' contributions to EU GHG trends is given. Finally, also the trends of indirect GHGs and SO_2 emissions are also presented.

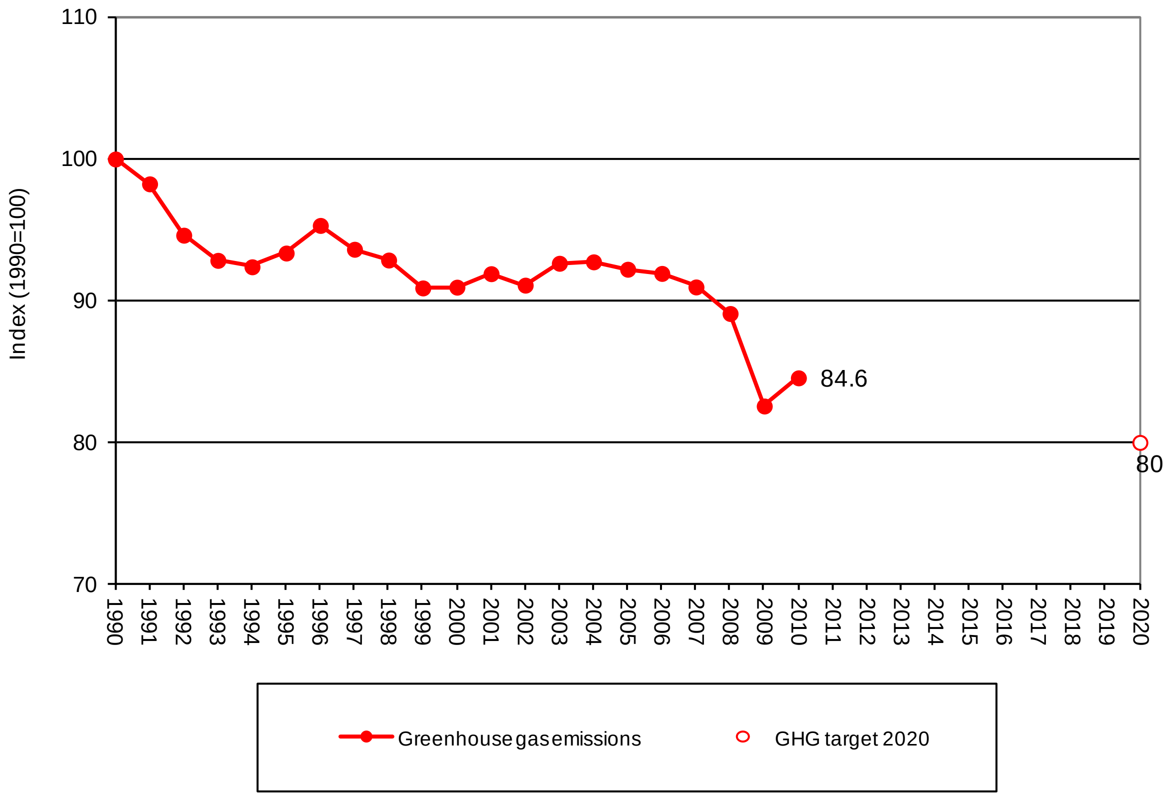
17.1 Aggregated greenhouse gas emissions

On 23 January 2008 the European Commission adopted the 'Climate Action and Renewable Energy' package. The proposal was part of draft legislation implementing the 'Integrated Energy and Climate Change' package of 10 January 2007, which was endorsed by the European Council in March 2007. In December 2008 the European Parliament and the Council reached agreement on the package. It was adopted by the Council on 6 April 2009. The package underlines the objective of limiting the rise in global average temperature to no more than two degrees Celsius above pre-industrial levels. To achieve this goal the EU committed to a unilateral emission reduction target of 20%[44] by 2020, compared with 1990 levels, and agreed to a reduction by 30% provided that other major emitters agree to take on their fair share of a global reduction effort.

Total GHG emissions, without LULUCF, in the EU-27 decreased by 15.4 % between 1990 and 2010 (-862 million tonnes CO_2 equivalents). Emissions increased by 2.4 % (111 million tonnes CO_2 equivalents) between 2009 and 2010 (Figure 17.1).

[44] All emission information for EU-27 in this report uses 1990 as the starting point when addressing emission reductions. EU-27 does not have a common target under the Kyoto Protocol in the same way as EU-15.

Figure 17.1 **EU-27 GHG emissions 1990–2010 (excl. LULUCF)**



Notes: GHG emission data for the EU-27 as a whole refer to domestic emissions (i.e. within its territory) and do not include emissions and removals from LULUCF; nor do they include emissions from international aviation and international maritime transport. CO2 emissions from biomass with energy recovery are reported as a Memorandum item according to UNFCCC Guidelines and not included in national totals. In addition, no adjustments for temperature variations or electricity trade are considered. The global warming potentials are those from the 1996 revised IPCC Guidelines for National Greenhouse Gas Inventories.

17.1.1 Main trends by source category, 1990-2010

Table 17.1 shows the source categories contributing the most to changes in greenhouse gas emissions between 1990 and 2010.

Table 17.1 EU-27: Overview of Top decreasing/increasing source categories 1990-2010 (+/- 20 Million tonnes CO_2 equivalents)

Source category	EU-27 Million tonnes (CO_2 eq.)
Road Transportation (CO2 from 1A3b)	159.3
Consumptions of halocarbons (HFC from 2F)	82.3
Cement Production (CO2 from 2A1)	-22.2
Production of halocarbons (HFC from 2E)	-25.8
Nitric Acid Production (N2O from 2B2)	-36.5
Enteric fermentation (CH4 from 4A)	-41.8
Manufacture of Solid fuels (CO2 from 1A1c)	-53.6
Solid waste disposal on land (CH4 from 6A)	-55.7
Adipic Acid Production (N2O from 2B3)	-58.3
Agricultural soils (N2O from 4D)	-70.9
Fugitive emissions from fuels (CH4 from 1B)	-73.4
Households and servicies (CO2 from 1A4)	-77.8
Iron and Steel Production (CO2 from 1A2a +2C1)	-92.2
Manufacturing industries (excl. Iron and steel) (Energy-related CO2 from 1A2 excl. 1A2a)	-207.9
Public Electricity and Heat Production (CO2 from 1A1a)	-208.7
Total	**-862.3**

Notes: As the table only presents sectors whose emissions increased or decreased by 20 million tonnes CO_2-equivalents, the sum for each country grouping EU-15/EU-27 does not match the total change listed at the bottom of the table.

17.1.2 Main trends by source category, 2009-2010

Between 2009 and 2010 emissions increased by 2.4 % in the EU-27. This was mainly due to emission increases in households and services and iron steel production. Manufacturing industries (excl. iron and steel) and public electricity and heat production also contributed significantly to the rising emissions in 2010 (Table 17.2).

Table 17.2 EU-27: Overview of Top decreasing/increasing source categories 2009-2010 (+/- 3 Million tonnes CO_2 equivalents)

Source category	EU-27 Million tonnes (CO_2 eq.)
Households and servicies (CO2 from 1A4)	43.1
Iron and Steel Production (CO2 from 1A2a +2C1)	32.9
Manufacturing industries (excl. Iron and steel) (Energy-related CO2 from 1A2 excl. 1A2a)	19.8
Public Electricity and Heat Production (CO2 from 1A1a)	14.1
Manufacture of Solid fuels (CO2 from 1A1c)	5.8
Consumptions of halocarbons (HFC from 2F)	4.4
Road Transportation (CO2 from 1A3b)	-4.7
Adipic Acid Production (N2O from 2B3)	-9.2
Total	**111.0**

Notes: As the table only presents sectors whose emissions have increased or decreased by at least 3 million tonnes of CO_2- equivalents, the sum for each country grouping does not match the total change listed at the bottom of the table

17.1.3 Main reasons for emission changes 2009-2010

Between 2009 and 2010, increases in the EU-27 were mainly due to:

- CO_2 from households and services (+43 million tonnes or +6.4 %)

  This increase was mainly caused by rising emission in the residential sector (1A4b).EU-15 Member States contributed most to the increase in the EU-27. Within the new Member States Poland and the Czech Republic reported the highest increases.

- CO_2 from iron and steel production (+33 million tonnes or +22.4 %)

  This increase was mainly triggered by a significant increase in crude steel production due to the recovery from the economic crisis. According to the World Steel Association crude steel production in EU-15 declined in in all major steel producing countries in 2009 (-30 %) and increased again in 2010 (+24 %).

- CO_2 from manufacturing industries excl. iron and steel (+20 million tonnes or +4.6 %).

  The increase was mainly due to EU-15 Member States. Within the new Member States the Czech Republic reported the highest absolute increases.

- CO_2 from public electricity and heat production (+14 million tonnes or +1.2 %)

  This increase was mainly caused by the EU-27, especially by increasing emissions from Bulgaria, the Czech Republic, Estonia and Poland.

- Other major emission increases occurred in manufacture of solid fuels and consumption of halocarbons.

Substantial emission decreases between 2009 and 2010 in the EU-27 were reported for:

- N_2O emissions from adipic acid production (-9.2 million tonnes or -85 %)

  This increase was caused only by EU-15 Member States.

- CO_2 emissions from road transport (-5.2 million tonnes or -1 %)

  This decrease was also mainly due to EU-15. Within the new Member States the Czech Republic, Hungary and Romania reported the highest absolute decreases, while Poland reported significant increases.

17.1.4 Overview of GHG emissions in new Member States

Table 17.3 Greenhouse gas emissions in CO_2 equivalents (excl. LULUCF) and Kyoto Protocol targets for 2008–12

MEMBER STATE	1990 (million tonnes)	Kyoto Protocol base year [(a)] (million tonnes)	2010 (million tonnes)	2009–2010 (million tonnes)	Change 2009–2010 (%)	Change 1990-2010 (%)	Change base year–2010 (%)	Targets 2008–12 under Kyoto Protocol and "EU burden sharing" (%)
EU-15	**4249.3**	**4265.5**	**3797.6**	**78.5**	**2.1%**	**-10.6%**	**-11.0%**	**-8.0%**
Bulgaria	114.3	132.6	61.4	2.5	4.3%	-46.3%	-53.7%	-8.0%
Cyprus	6.5	Not applicable	10.8	-0.3	-2.4%	67.6%	Not applicable	Not applicable
Czech Republic	195.8	194.2	139.2	4.4	3.3%	-28.9%	-28.4%	-8.0%
Estonia	40.9	42.6	20.5	4.1	25.2%	-49.8%	-51.9%	-8.0%
Hungary	97.3	115.4	67.7	0.8	1.2%	-30.4%	-41.4%	-6.0%
Latvia	26.6	25.9	12.1	1.1	10.2%	-54.5%	-53.4%	-8.0%
Lithuania	49.4	49.4	20.8	0.9	4.3%	-57.9%	-57.9%	-8.0%
Malta	2.0	Not applicable	3.0	0.02	0.6%	49.1%	Not applicable	Not applicable
Poland	457.4	563.4	400.9	19.1	5.0%	-12.4%	-28.9%	-6.0%
Romania	253.3	278.2	121.4	-2.0	-1.6%	-52.1%	-56.4%	-8.0%
Slovakia	71.8	72.1	46.0	1.8	4.1%	-35.9%	-36.2%	-8.0%
Slovenia	18.5	20.4	19.5	0.1	0.3%	5.7%	-4.1%	-8.0%
EU-27	**5583.1**	**Not applicable**	**4720.9**	**111.0**	**2.4%**	**-15.4%**	**Not applicable**	**Not applicable**

([a]) The base year under the Kyoto Protocol for each new Member State is further outlined in Table 16.3. As Cyprus, Malta and EU-27 do not have targets under the Kyoto Protocol, they do not have applicable Kyoto Protocol base years.

17.2 Emission trends by gas

Table 17.4 gives an overview of the main trends in EU-27 GHG emissions and removals for 1990–2010. The most important GHG by far is CO_2, accounting for 82.5 % of total EU-27 emissions in 2010 excluding LULUCF. In 2010, EU-27 CO_2 emissions without LULUCF were 3 891 Tg, which was 12.0 % below 1990 levels. Compared to 2009, CO_2 emissions increased by 3.1%. Emissions of CH_4 and N_2O decreased in 2010, while HFCs increased again in 2010.

Table 17.4 Overview of EU-27 GHG emissions and removals from 1990 to 2010 in CO_2 equivalents (Tg)

GREENHOUSE GAS EMISSIONS	1990	1995	2000	2005	2006	2007	2008	2009	2010
Net CO_2 emissions/removals	4,126	3,839	3,810	3,946	3,926	3,897	3,779	3,423	3,572
CO_2 emissions (without LULUCF)	4,420	4,149	4,117	4,255	4,255	4,204	4,108	3,773	3,891
CH_4	595	540	486	436	429	422	417	409	405
N_2O	518	462	417	390	377	376	368	347	338
HFCs	28	42	48	63	67	73	78	80	84
PFCs	20	14	10	6	6	5	5	3	3
SF_6	11	15	10	8	7	7	7	6	7
Total (with net CO_2 emissions/removals)	**5,297**	**4,913**	**4,780**	**4,848**	**4,812**	**4,781**	**4,653**	**4,268**	**4,409**
Total (without CO2 from LULUCF)	**5,591**	**5,222**	**5,087**	**5,157**	**5,141**	**5,087**	**4,982**	**4,618**	**4,729**
Total (without LULUCF)	**5,583**	**5,213**	**5,078**	**5,149**	**5,132**	**5,079**	**4,974**	**4,610**	**4,721**

17.3 Emission trends by source

Table 17.5 gives an overview of EU-27 GHG emissions in the main source categories for 1990–2010. The most important sector by far is Energy (i.e. combustion and fugitive emissions) accounting for 79.7 % of total EU-27 emissions in 2010. The second largest sector is Agriculture (9.8%), followed by Industrial Processes (7.3 %).

Table 17.5 Overview of EU-27 GHG emissions in the main source and sink categories 1990 to 2010 in CO_2 equivalents (Tg)

GHG SOURCE AND SINK	1990	1995	2000	2005	2006	2007	2008	2009	2010
1. Energy	4,304	4,040	3,986	4,093	4,085	4,022	3,943	3,661	3,763
2. Industrial Processes	465	442	394	408	406	419	397	330	343
3. Solvent and Other Product Use	17	14	14	12.814	13	12	12	11	12
4. Agriculture	594	515	504	479	475	476	475	464	462
5. Land-Use, Land-Use Change and Forestry	-286	-300	-298	-300	-320	-298	-322	-342	-312
6. Waste	203	201	180	156	154	149	147	143	142
7. Other	0	0	0	0	0	0	0	0	0
Total (with net CO_2 emissions/removals)	**5,297**	**4,913**	**4,780**	**4,848**	**4,812**	**4,781**	**4,653**	**4,268**	**4,409**
Total (without LULUCF)	**5,583**	**5,213**	**5,078**	**5,149**	**5,132**	**5,079**	**4,974**	**4,610**	**4,721**

17.4 Emission trends by Member State

Table 17.6 gives an overview of new Member States' contributions to the EU GHG emissions for 1990–2010. Member States show large variations in GHG emission trends.

Table 17.6 Overview of new Member States' contributions to EU GHG emissions excluding LULUCF from 1990 to 2010 in CO_2 equivalents (Tg)

Member State	1990	1995	2000	2005	2006	2007	2008	2009	2010
EU-15	**4,249**	**4,149**	**4,139**	**4,180**	**4,142**	**4,083**	**3,999**	**3,719**	**3,798**
Bulgaria	114	82	63	66	67	71	69	59	61
Cyprus	6	10	10	11	11	11	11	11	11
Czech Republic	196	150	146	146	148	149	144	135	139
Estonia	41	20	17	19	18	21	20	16	21
Hungary	97	79	77	79	78	76	73	67	68
Latvia	27	13	10	11	12	12	12	11	12
Lithuania	49	22	19	23	23	25	24	20	21
Malta	2	2	3	3	3	3	3	3	3
Poland	457	433	385	389	405	407	401	382	401
Romania	253	181	141	149	153	150	147	123	121
Slovakia	72	53	49	51	51	49	50	44	46
Slovenia	18	18	19	20	21	21	21	19	20
EU-27	**5,583**	**5,213**	**5,078**	**5,149**	**5,132**	**5,079**	**4,974**	**4,610**	**4,721**

The overall EU GHG emission trend is dominated by the EU-15 (mainly by Germany, the United Kingdom, Italy, France and Spain) accounting for 80.4 % of total EU-27 GHG emissions. Of the new Member States Poland contributes most to the total EU-27 GHG emissions, namely 8.5 %, followed by the Czech Republic and Romania (share of 2.9 % and 2.6 %, respectively). Poland decreased GHG emissions by 12.4 % between 1990 and 2010 (-28.9 % since the base year, which is 1988 in the case of Poland). Main factors for decreasing emissions in Poland — as for other new Member States — was the decline of energy inefficient heavy industry and the overall restructuring of the economy in the late 1980s and early 1990s. The notable exception was transport (especially road transport) where emissions increased.

17.5 Emission trends for indirect greenhouse gases and sulphur dioxide

Emissions of CO, NO_x, NMVOC and SO_2 have to be reported to the UNFCCC Secretariat because they influence climate change indirectly: CO, NO_x and NMVOC are precursor substances for ozone which itself is a greenhouse gas. Sulphur emissions produce microscopic particles (aerosols) that can reflect sunlight back out into space and also affect cloud formation. In the EU-27, SO_2 emissions decreased by 78 %, followed by CO (-61 %), NMVOC (-53 %) and NO_x (-46 %) (Table 17.7).

Table 17.7 Overview of EU-27 indirect GHG and SO_2 emissions for 1990–2010 (Gg)

GREENHOUSE GAS EMISSIONS	1990	1995	2000	2005	2006	2007	2008	2009	2010
	(Gg)								
NOx	17,173	14,769	12,723	11,663	11,354	11,042	10,226	9,382	9,285
CO	66,241	51,013	39,545	30,316	29,004	27,998	26,964	24,467	25,620
NMVOC	17,967	14,570	12,039	10,095	9,946	9,341	8,911	8,506	8,478
SO2	25,266	16,749	10,523	8,150	8,015	7,671	6,392	5,609	5,443

Table 17.8 shows the NO_x emissions of the new Member States between 1990 and 2010. The EU-15 makes up for 78.2 % of total NO_x emissions, followed by Poland with a share of 9.3 % in 2010. Most new Member States reduced their emissions, only Hungary, Cyprus and Malta had emission increases between 1990 and 2010.

Table 17.8 Overview of the EU-15 and the new Member States' contributions EU-27 NO_x emissions for 1990–2010 (Gg)

Member State	1990	1995	2000	2005	2006	2007	2008	2009	2010
EU-15	**13,695**	**12,054**	**10,512**	**9,504**	**9,191**	**8,882**	**8,175**	**7,460**	**7,259**
Bulgaria	266	186	150	162	163	169	164	140	143
Cyprus	15	18	20	19	19	20	18	18	16
Czech Republic	742	430	397	279	284	286	263	253	241
Estonia	77	41	38	37	36	39	36	31	36
Hungary	8	185	185	203	203	186	169	154	152
Latvia	65	39	36	37	37	38	34	32	33
Lithuania	220	65	54	57	65	71	68	59	66
Malta	8	9	8	10	9	9	9	9	9
Poland	1,280	1,120	838	873	865	885	828	822	867
Romania	511	380	325	327	332	308	314	275	328
Slovakia	227	179	108	102	97	96	94	83	89
Slovenia	59	63	52	53	53	54	53	46	45
EU-27	**17,173**	**14,769**	**12,723**	**11,663**	**11,354**	**11,042**	**10,226**	**9,382**	**9,285**

Table 17.9 shows the CO emissions of the new Member States between 1990 and 2010. The EU-15 has a share of 73.2 %, followed by Poland and Romania. These two account for almost 18 % of EU-27 emissions in 2010. All new Member States, except for Hungary and Malta reduced emissions between 1990 and 2010.

Table 17.9 Overview of the EU-15 and the new Member States' contributions EU-27 CO emissions for 1990–2010 (Gg)

Member State	1990	1995	2000	2005	2006	2007	2008	2009	2010
EU-15	**53,271**	**42,107**	**31,816**	**24,029**	**22,710**	**21,735**	**20,569**	**18,191**	**18,745**
Bulgaria	664	367	270	265	272	246	256	243	260
Cyprus	53	45	34	26	24	24	21	19	18
Czech Republic	1,072	934	682	558	542	584	498	454	455
Estonia	190	165	166	140	134	150	146	147	153
Hungary	32	554	559	555	561	542	538	527	534
Latvia	455	347	289	282	281	266	249	268	257
Lithuania	521	289	211	194	204	202	224	186	215
Malta	24	30	30	29	28	30	30	31	32
Poland	7,406	4,547	3,463	2,521	2,603	2,603	2,690	2,778	3,076
Romania	1,710	909	1,523	1,292	1,214	1,235	1,352	1,253	1,490
Slovakia	521	427	306	281	280	252	254	218	231
Slovenia	323	291	196	145	148	130	137	153	156
EU-27	**66,241**	**51,013**	**39,545**	**30,316**	**29,004**	**27,998**	**26,964**	**24,467**	**25,620**

Table 17.10 shows the NMVOC emissions of the EU-27 Member States between 1990 and 2010. The EU-15 makes up 82.3 % of total NMVOC emissions in 2010. Of the new Member States Poland and Romania have the highest shares. All new Member States except for Hungary reduced emissions between 1990 and 2010.

Table 17.10 Overview of the EU-15 and the new Member States' contributions EU-27 NMVOC emissions for 1990–2010 (Gg)

Member State	1990	1995	2000	2005	2006	2007	2008	2009	2010
EU-15	**15,379**	**12,765**	**10,400**	**8,514**	**8,391**	**7,804**	**7,412**	**7,063**	**6,978**
Bulgaria	533	117	68	58	61	57	58	51	52
Cyprus	17	16	14	13	13	13	12	11	11
Czech Republic	311	215	244	182	179	174	166	151	150
Estonia	54	43	38	35	36	39	35	31	33
Hungary	57	163	159	170	178	157	157	122	110
Latvia	101	67	65	73	75	83	74	61	65
Lithuania	121	80	75	88	85	81	72	67	68
Malta	6	7	3	3	4	4	3	3	3
Poland	831	769	599	566	567	596	582	634	662
Romania	375	190	254	271	248	227	242	213	249
Slovakia	134	91	67	71	69	67	66	64	62
Slovenia	48	47	52	49	42	39	34	34	34
EU-27	**17,967**	**14,570**	**12,039**	**10,095**	**9,946**	**9,341**	**8,911**	**8,506**	**8,478**

Table 17.11 shows the SO_2 emissions of the new Member States between 1990 and 2010. The largest emitters beside the EU-15, which makes up 47 %, are Bulgaria, Poland and Romania. These three States account for 47.7 % of total EU-27 emissions in 2010. All new Member States except for Hungary reduced emissions between 1990 and 2010.

Table 17.11 Overview of Member States' contributions to EU-15 and EU-27 SO_2 emissions for 1990–2010 (Gg)

Member State	1990	1995	2000	2005	2006	2007	2008	2009	2010
EU-15	**16,501**	**9,987**	**6,191**	**4,623**	**4,396**	**4,174**	**3,097**	**2,660**	**2,429**
Bulgaria	1,582	1,228	1,106	1,162	1,157	1,288	1,245	1,167	1,242
Cyprus	29	37	45	35	29	27	22	17	21
Czech Republic	1,876	1,095	264	219	211	217	174	173	170
Estonia	167	70	76	72	70	76	69	56	66
Hungary	10	707	489	148	123	99	106	89	37
Latvia	105	49	16	7	6	6	5	4	3
Lithuania	228	91	51	42	42	34	29	26	30
Malta	16	27	24	12	12	13	12	8	8
Poland	3,210	2,376	1,511	1,145	1,237	1,131	1,018	862	974
Romania	821	707	524	554	626	521	534	470	383
Slovakia	524	245	127	89	88	71	69	64	69
Slovenia	197	129	98	41	18	15	13	11	10
EU-27	**25,266**	**16,749**	**10,523**	**8,150**	**8,015**	**7,671**	**6,392**	**5,609**	**5,443**

18 Energy (CRF Sector 1)

18.1 Overview of sector (EU-27)

Figure 18.1 CRF Sector 1 Energy: EU-27 GHG emissions in CO_2 equivalents (Tg) for 1990–2010

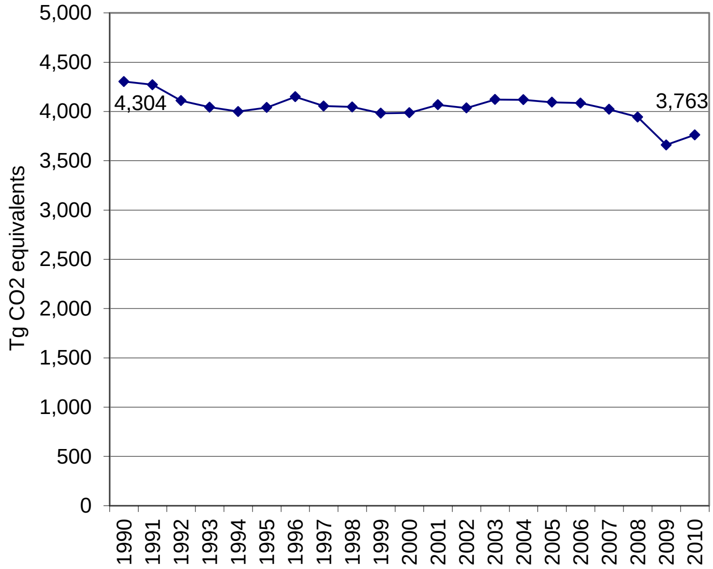
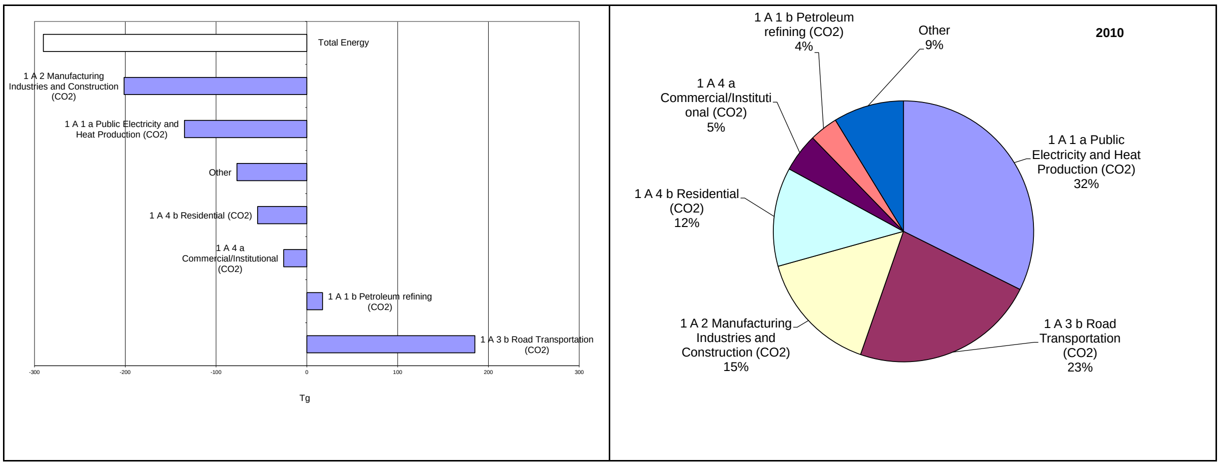


Figure 18.2 CRF Sector 1 Energy: Absolute change of GHG emissions in CO_2 equivalents (Tg) by large key source categories for 1990–2010 and share of largest key source categories in 2010



18.2 Source categories (EU-27)

18.2.1 Energy industries (CRF Source Category 1A1)(EU 27)

18.2.1.1 Public Electricity and Heat Production (1A1a) (EU-27)

Figure 18.3 1A1a-Public Electricity and Heat Production: Total, CO_2 and N_2O emission and activity trends

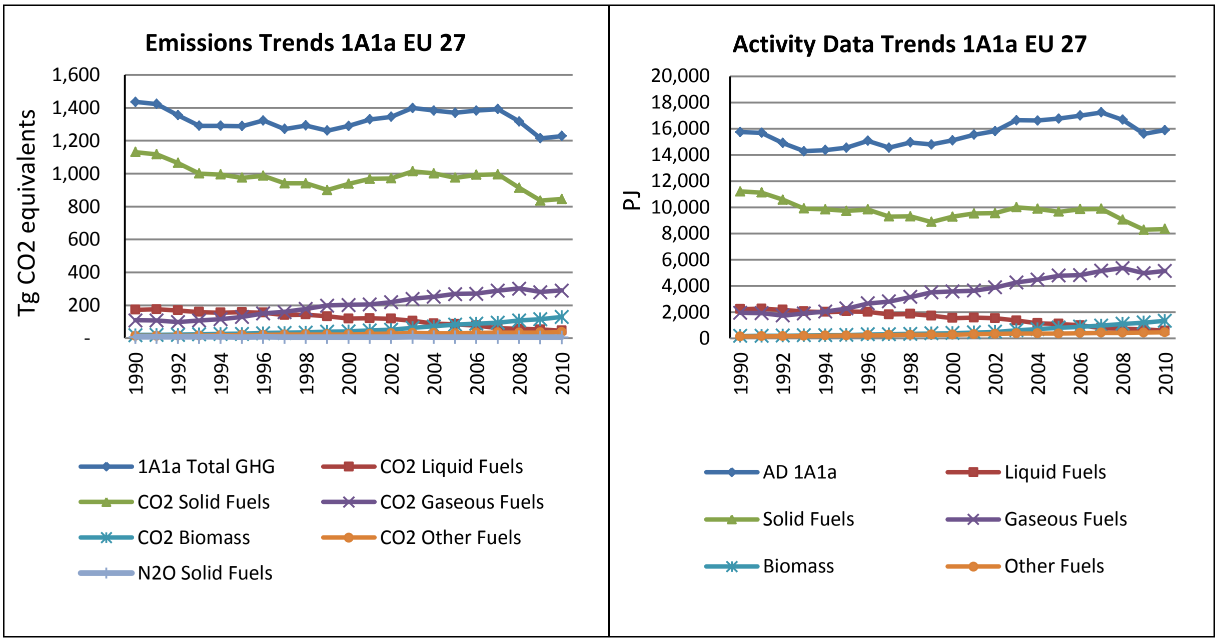


Table 18.1 1A1a Public Electricity and Heat Production, liquid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	123,602	42,382	35,848	78.3%	-6,534	-15%	-87,755	-71%		
Bulgaria	3,211	744	840	1.8%	96	13%	-2,371	-74%	T1	D
Cyprus	1,674	3,992	3,868	8.5%	-124	-3%	2,194	131%	D	CS
Czech Republic	819	313	189	0.4%	-124	-40%	-630	-77%	T1	D
Estonia	4,825	343	377	0.8%	34	10%	-4,448	-92%	T1,T2	CS,D
Hungary	1,830	601	372	0.8%	-230	-38%	-1,458	-80%	T2	D,PS
Latvia	3,051	80	55	0.1%	-25	-31%	-2,996	-98%	T1	CS
Lithuania	6,281	569	495	1.1%	-74	-13%	-5,787	-92%	T1	CS,D
Malta	749	1,897	1,887	4.1%	-10	-1%	1,138	152%	D,T1	D
Poland	5,115	574	772	1.7%	198	34%	-4,343	-85%	T2	D
Romania	19,932	1,276	1,008	2.2%	-268	-21%	-18,924	-95%	T2	CS
Slovakia	1,033	20	32	0.1%	12	61%	-1,002	-97%	T2	CS
Slovenia	277	38	23	0.0%	-15	-40%	-254	-92%	T1	D
EU-27	**172,401**	**52,830**	**45,764**	**100.0%**	**-7,066**	**-13%**	**-126,637**	**-73%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 18.4 **1A1a- Public Electricity and Heat Production, liquid fuels: Activity Data and Implied Emission Factors for CO_2**

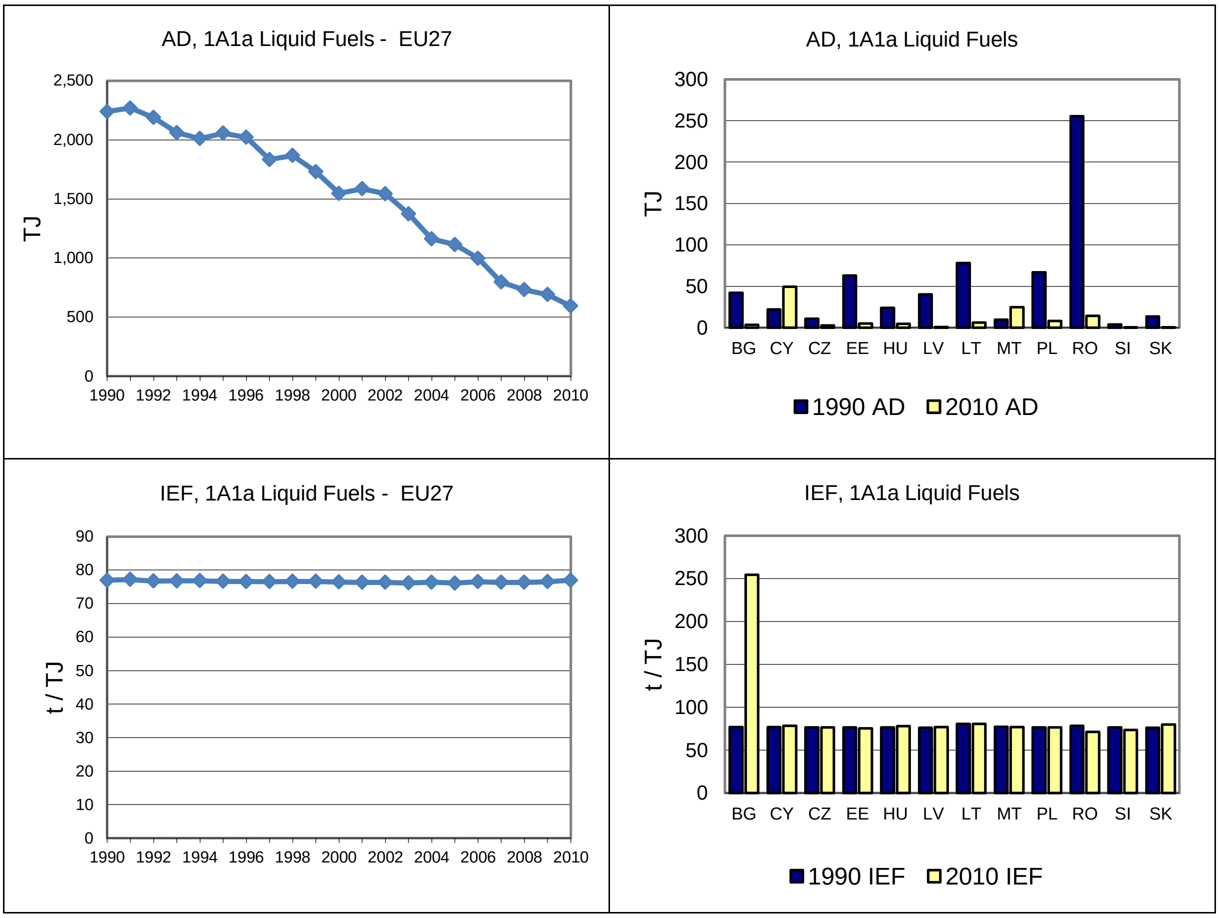


Table 18.2 **1A1a Public Electriciy and Heat Production, solid fuels: CO_2 emissions of EU-27**

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	752,876	557,214	555,893	65.8%	-1,320	0%	-196,983	-26%		
Bulgaria	27,884	25,627	27,407	3.2%	1,779	7%	-478	-2%	T2	CS,D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	51,658	48,883	51,154	6.1%	2,271	5%	-504	-1%	T1	CS,D
Estonia	21,824	9,017	12,545	1.5%	3,528	39%	-9,279	-43%	T1,T2,T3	CS,D
Hungary	12,725	7,549	7,531	0.9%	-18	0%	-5,194	-41%	T3	CS,PS
Latvia	339	45	40	0.0%	-5	-11%	-299	-88%	T1	CS
Lithuania	193	30	28	0.0%	-2	-7%	-166	-86%	T1	CS,D
Malta	611	NA	NA	-	-	-	-611	-100%	NA	NA
Poland	221,232	154,315	159,905	141.7%	5,590	4%	-61,326	-28%	T2	CS,D
Romania	25,086	23,197	20,754	18.4%	-2,444	-11%	-4,333	-17%	T1, T2	D, CS
Slovakia	11,542	4,433	4,083	0.5%	-350	-8%	-7,459	-65%	T2	CS
Slovenia	5,600	5,673	5,808	0.7%	135	2%	208	4%	T2	CS
EU-27	**1,131,571**	**835,983**	**845,146**	**100.0%**	**9,163**	**1%**	**-286,425**	**-25%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 18.5 **1A1a- Public Electricity and Heat Production, solid fuels: Activity Data and Implied Emission Factors for CO_2**

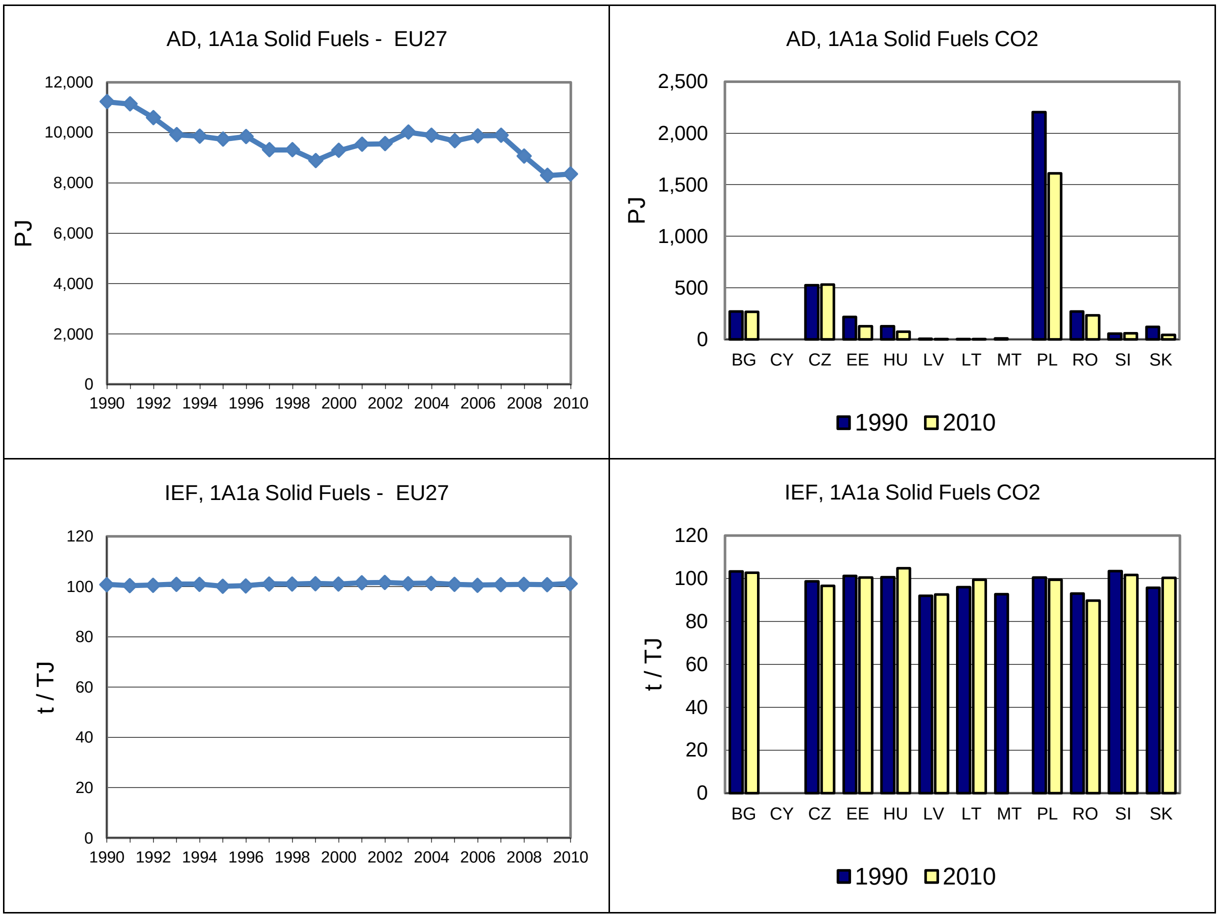


Table 18.3 **1A1a Electricity and heat production, solid fuels: N_2O emissions of EU-27**

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010	
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
EU-15	6,378	4,800	4,863	79.3%	63	1%	-1,515	-24%
Bulgaria	117	109	116	1.9%	7	7%	-1	-1%
Cyprus	NA	NA	NA	-	-	-	-	-
Czech Republic	229	219	230	3.8%	11	5%	1	0%
Estonia	4	8	9	0.2%	1	12%	6	138%
Hungary	59	33	33	0.5%	0	-1%	-26	-44%
Latvia	3	0.22	0.19	0.0%	-0.02	-10%	-3	-93%
Lithuania	1	0.25	0.21	0.0%	-0.04	-17%	-1	-79%
Malta	3	NA	NA	-	-	-	-3	-100%
Poland	1,016	717	738	12.0%	22	3%	-277.5	-27%
Romania	117	109	100	1.6%	-9	-8%	-17	-15%
Slovakia	52	21	19	0.3%	-2	-8%	-33	-64%
Slovenia	24	24	25	0.4%	1	3%	1	6%
EU-27	**8,003**	**6,041**	**6,134**	**100.0%**	**93**	**2%**	**-1,869**	**-23%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.4 1A1a Electricity and heat production, gaseous fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	60,401	253,521	261,344	90.1%	7,824	3%	200,943	333%		
Bulgaria	6,264	2,040	2,147	0.7%	107	5%	-4,117	-66%	T2	CS
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	1,541	1,757	1,990	0.7%	232	13%	448	29%	T1	D
Estonia	1,969	899	1,005	0.3%	106	12%	-964	-49%	T2	CS
Hungary	5,825	6,231	6,819	2.4%	588	9%	995	17%	T2	D
Latvia	2,644	1,700	2,089	0.7%	388	23%	-556	-	T2	CS
Lithuania	5,982	2,572	3,311	1.1%	738	29%	-2,671	-45%	T1	CS
Malta	NA	NA	NA	-	-	-	-	-	NA	NA
Poland	1,208	2,889	2,927	1.0%	38	1%	1,719	142%	T2	D
Romania	20,789	6,372	6,162	2.1%	-210	-3%	-14,627	-70%	T2	CS
Slovakia	2,089	1,974	2,043	0.7%	70	4%	-46	-2%	T2	CS
Slovenia	112	331	328	0.1%	-3	-1%	216	194%	T1	CS
EU-27	**108,823**	**280,286**	**290,164**	**100.0%**	**9,878**	**4%**	**181,341**	**167%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 18.6 1A1a- Public Electricity and Heat Production, gaseous fuels: Activity Data and Implied Emission Factors for CO_2

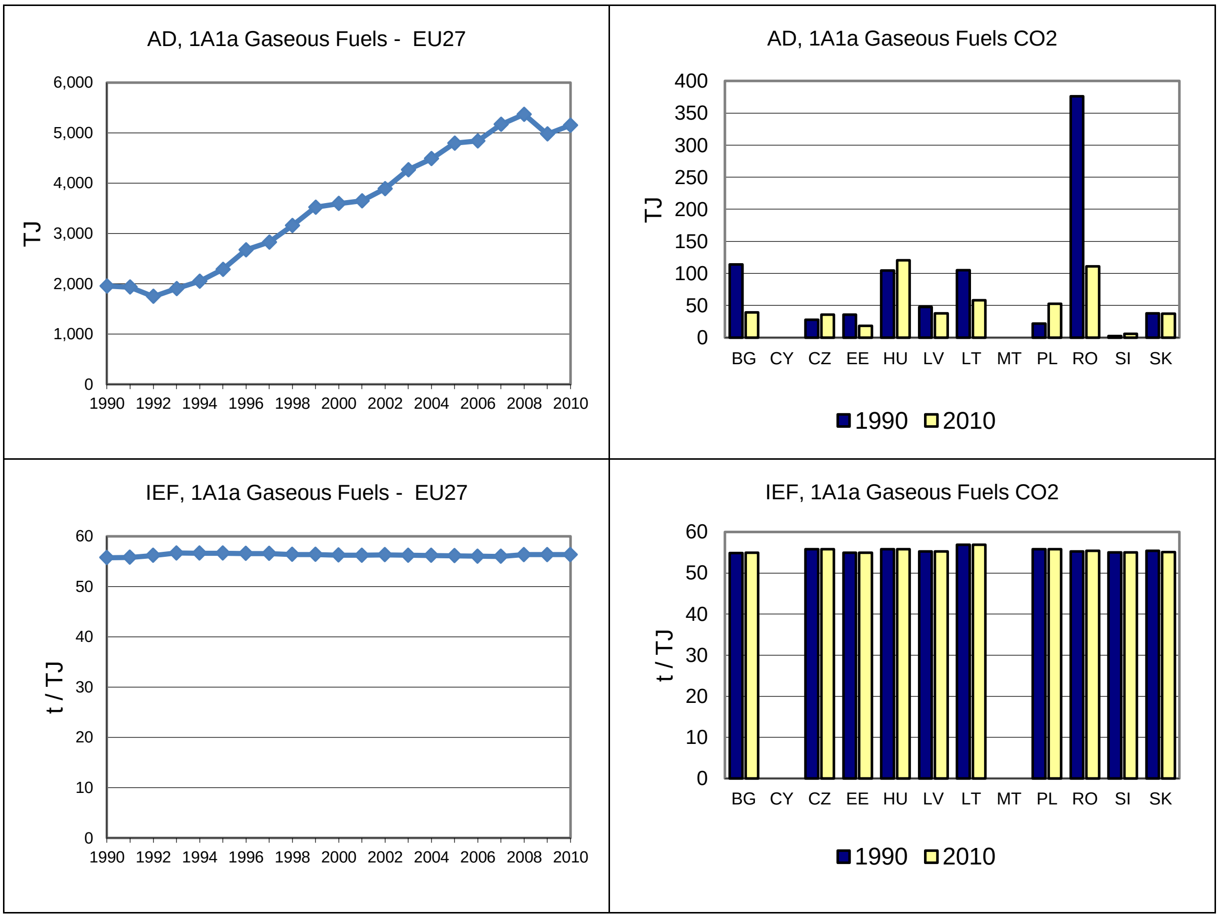


Table 18.5 **1A1a Public Electriciy and Heat Production, other fuels: CO_2 emissions of EU-27**

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	12,913	33,297	35,647	98.0%	2,349	7%	22,733	176%		
Bulgaria	NO	NO	NO	-	-	-	-	-	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	37	201	260	0.7%	59	30%	224	612%	T1	D
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	63	270	279	0.8%	10	4%	216	344%	T2	D,PS
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	NO	NO	NA	-	-	-	-	-	NA	NA
Malta	NA	NA	NA	-	-	-	-	-	NA	NA
Poland	NA	NA	NA	-	-	-	-	-	NA	NA
Romania	NO	NO	NO	-	-	-	-	-	NA	NA
Slovakia	170	298	172	0.5%	-126	-42%	2	1%	T1a,T2	CS,D
Slovenia	NO	12	16	0.0%	4	-	16	-	T1	D
EU-27	**13,183**	**34,077**	**36,374**	**183.0%**	**2,297**	**7%**	**23,191**	**176%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

18.2.1.2 Petroleum Refining (1A1b) (EU-27)

Figure 18.7 **1A1b Petroleum Refining: Total, CO_2 and N_2O emission and activity trends**

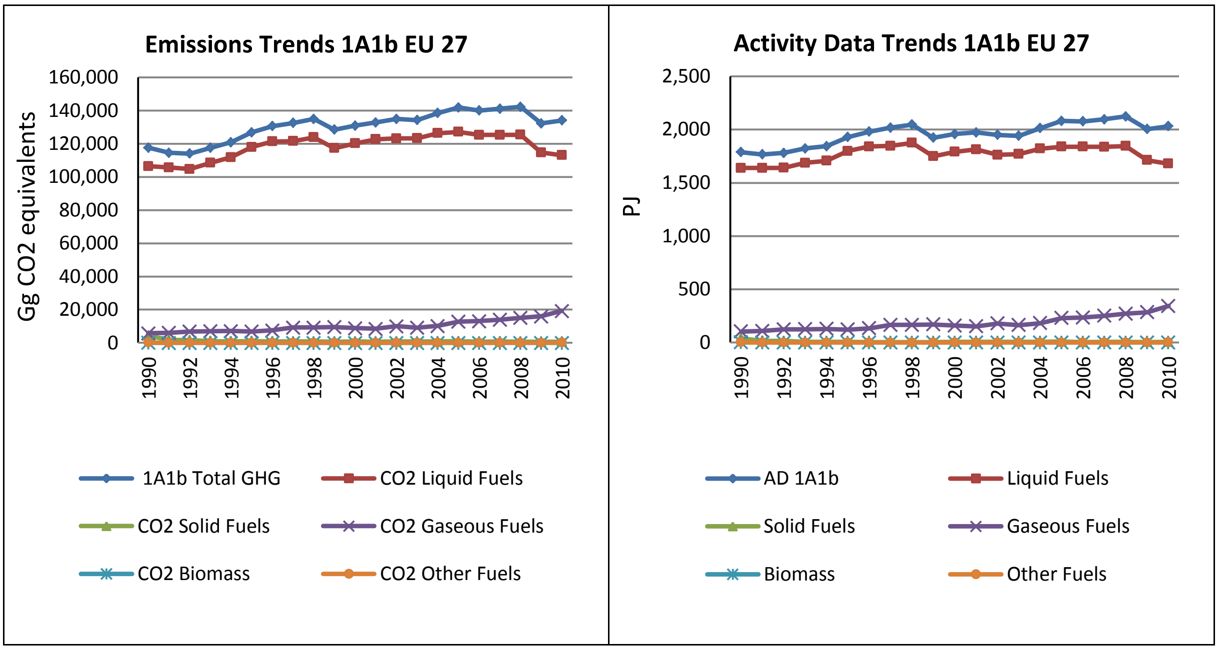


Table 18.6 1A1b Petroleum Refining, liquid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	96,256	103,273	100,541	89.1%	-2,731	-3%	4,286	4%		
Bulgaria	856	915	877	0.8%	-37	-4%	22	3%	T1	D
Cyprus	25	NO	NO	-	-	-	-25	-100%	NA	NA
Czech Republic	923	830	856	0.8%	27	3%	-67	-7%	T1	D
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	928	864	924	0.8%	60	7%	-5	0%	T2	D
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	1,495	1,707	1,569	1.4%	-138	-8%	73	5%	T1	CS,D
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	1,373	4,655	5,009	4.4%	354	8%	3,635	265%	T2	D
Romania	4,473	2,481	2,720	2.4%	239	10%	-1,753	-39%	T2	CS
Slovakia	507	IE	353	0.3%	353	-	-154	-30%	T2	CS
Slovenia	43	0	0	0.0%	0	4%	-42	-99%	T1	D
EU-27	**106,879**	**114,724**	**112,849**	**100.0%**	**-1,875**	**-2%**	**5,971**	**6%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 18.8 1A1b Petroleum Refining, liquid fuels: Activity Data and Implied Emission Factors for CO_2

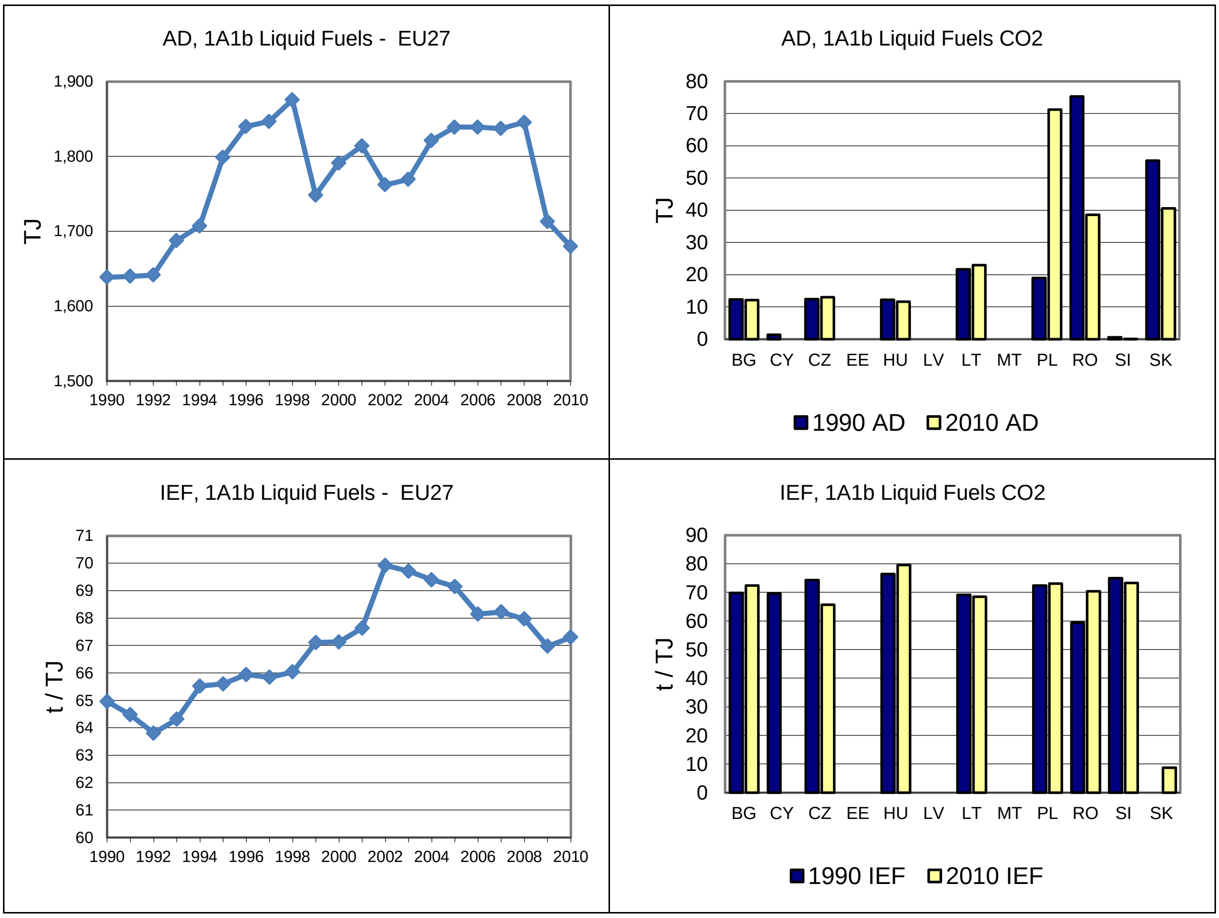


Table 18.7 1A1b Petroleum Refining, solid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010	
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
EU-15	3,581	437	528	2.2%	91	21%	-3,052	-85%
Bulgaria	NO	NO	NO	-	-	-	-	-
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	NO	NO	NO	-	-	-	-	-
Estonia	NO	NO	NO	-	-	-	-	-
Hungary	NO	NO	NO	-	-	-	-	-
Latvia	NO	NO	NO	-	-	-	-	-
Lithuania	NO	NO	NO	-	-	-	-	-
Malta	NO	NO	NO	-	-	-	-	-
Poland	736	2	2	0.0%	-1	-	-734	-100%
Romania	NO	NO	NO	-	-	-	-	-
Slovakia	NO	159	135	0.6%	-24	-15%	135	-
Slovenia	NO	NO	NO	-	-	-	-	-
EU-27	**4,317**	**598**	**665**	**100.0%**	**67**	**11%**	**-3,651**	**-85%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.8 1A1b Petroleum Refining, gaseous fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	3,869	12,862	15,251	62.4%	2,389	19%	11,382	294%		
Bulgaria	68	90	60	0.2%	-30	-34%	-9	-13%	T2	CS
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	324	239	222	0.9%	-18	-7%	-103	-32%	T1	D
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	689	404	531	2.2%	127	31%	-158	-23%	T2	D
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	NO	0	0	0.0%	0	-33%	-	-	T1	CS
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	93	970	966	4.0%	-4	0%	873	936%	T2	D
Romania	NO	909	911	3.7%	2	0%	911	-	T2	CS
Slovakia	755	1,151	1,924	7.9%	773	67%	1,169	155%	T2	CS
Slovenia	126	6	14	0.1%	8	-	-112	-89%	T1	CS
EU-27	**5,926**	**16,632**	**19,879**	**100.0%**	3,247	20%	13,953	-		

Abbreviations explained in the Chapter 'Units and abbreviations'

18.2.1.3 Manufacture of Solid Fuels and Other Energy Industries (1A1c) (EU-27)

Figure 18.9 1A1c- Manufacture of Solid Fuels and Other Energy Industries: Total, CO_2 and N_2O emission and activity trends

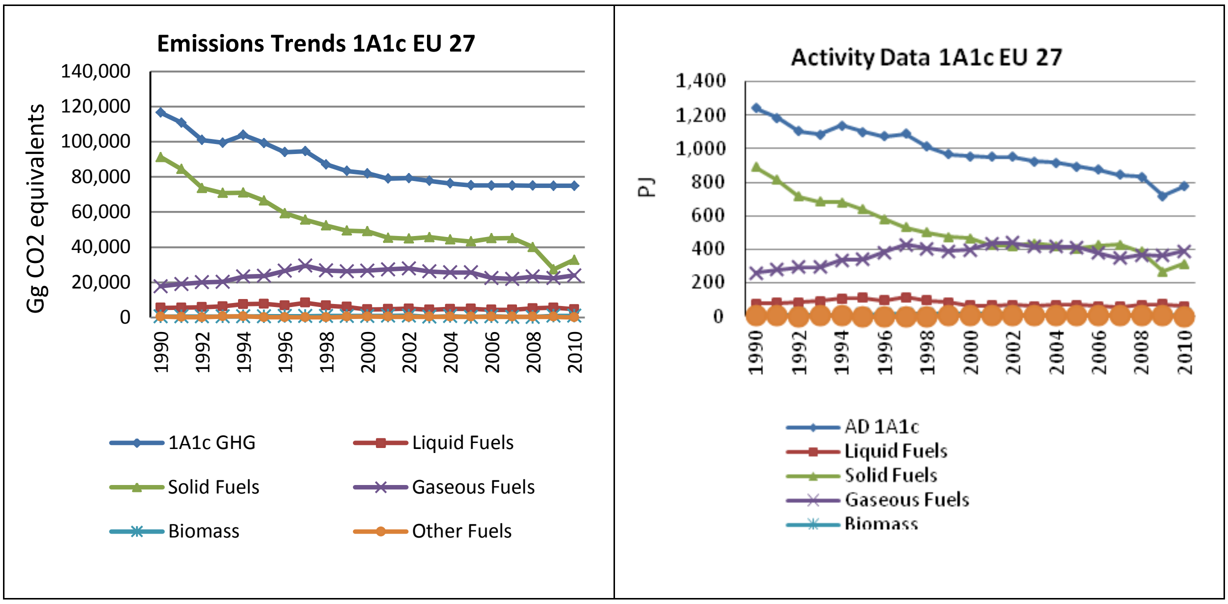


Table 18.9 1A1c Manufacture of Solid Fuels and Other Energy Industries, gaseous fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	16,985	21,179	22,391	91.6%	1,212	6%	5,406	32%		
Bulgaria	NO	0	2	0.0%	2	514%	2	-	T2	CS
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	NO	18	8	0.0%	-10	-55%	8	-	T1	D
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	IE	2	3	0.0%	0	5%	3	-	T1	D
Latvia	45	27	48	0.2%	21	76%	4	8%	T2	CS
Lithuania	NO	4	3	0.0%	-0.3	-8%	3	-	T1	CS
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	691	494	1,093	4.5%	599	121%	403	58%	T2	D
Romania	NO	609	849	3.5%	240	39%	849	-	T2	CS
Slovakia	NO	61	49	0.2%	-12	-20%	49	-	T2	CS
Slovenia	42	1	NO	-	-1	-	-42	-100%	NA	NA
EU-27	**17,762**	**22,396**	**24,447**	**100.0%**	**2,051**	**9%**	**6,685**	**38%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.10 1A1c Manufacture of Solid Fuels and Other Energy Industries, solid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	82,793	22,171	27,262	83.1%	5,091	23%	-55,531	-67%		
Bulgaria	291	3	4	0.0%	1	28%	-287	-99%	T2	CS,D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	2,393	1,137	1,229	3.7%	92	8%	-1,164	-49%	T1	CS,D
Estonia	84	387	674	2.1%	287	74%	590	702%	T3	PS
Hungary	IE	137	190	0.6%	53	39%	190	-	T2	D,PS
Latvia	164	NO	NO	-	0	-	-164	-	NA	NA
Lithuania	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	4,085	2,174	2,182	6.7%	8	0%	-1,904	-47%	T2	CS,D
Romania	NO	203	4	0.0%	-200	-98%	4	-	T2	CS
Slovakia	10	1,141	1,259	3.8%	118	-	1,248	11908%	T2	CS
Slovenia	36	NO	NO	-	-	-	-36	-100%	NA	NA
EU-27	**89,857**	**27,353**	**32,803**	**100.0%**	**5,450**	**20%**	**-57,055**	**-63%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

18.2.2 Manufacturing industries and construction (CRF Source Category 1A2)(EU 27)

18.2.2.1 Iron and Steel (1A2a) (EU-27)

Figure 18.10 1A2a- Iron and Steel: Total, CO_2 and N_2O emission and activity trends

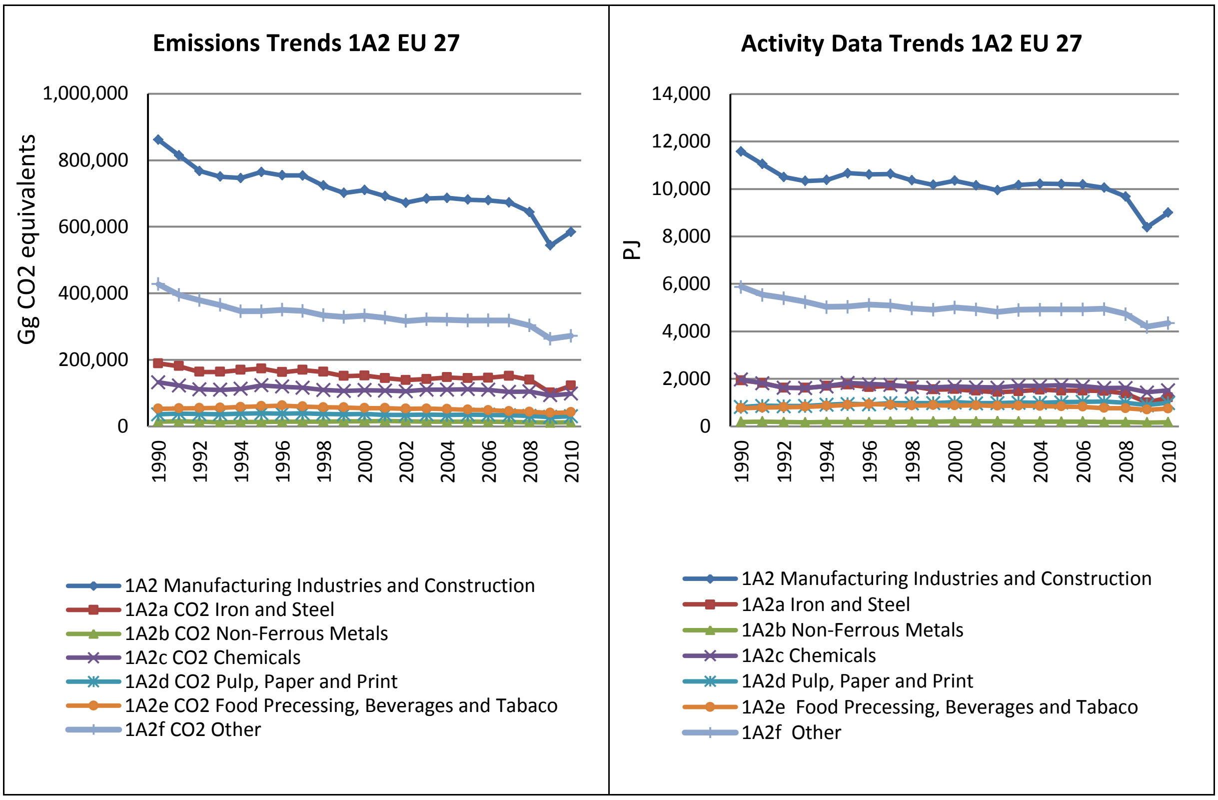


Table 18.11 1A2a Iron and Steel, liquid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	7,240	4,058	4,463	91.0%	406	10%	-2,777	-38%		
Bulgaria	37	3	NO	-	-3	-	-37	-	NA	NA
Cyprus	NE	NE	NE	-	-	-	-	-	NA	NA
Czech Republic	455	64	113	2.3%	49	77%	-342	-	T1	D
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	803	6	3	0.1%	-3	-43%	-800	-100%	T2	D
Latvia	154	61	77	1.6%	16	27%	-77	-50%	T1	CS
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Poland	855	9	9	0.2%	0	-4%	-846	-99%	T2	D
Romania	NO	353	229	4.7%	-124	-	229	-	T2	CS
Slovakia	164	1.1	0	0.0%	-0.8	-	-164	-100%	T2	CS
Slovenia	54	8	8	0.2%	0	0%	-46	-86%	T1	D
EU-27	**9,762**	**4,562**	**4,902**	**100.0%**	**340**	**7%**	**-4,860**	**-50%**		

Table 18.12 1A2a Iron and Steel, solid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	112,264	65,948	81,874	82.9%	15,927	24%	-30,389	-27%		
Bulgaria	2,512	99	112	0.1%	13	13%	-2,401	-96%	T2	CS,D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	7,680	3,292	2,634	2.7%	-658	-20%	-5,046	-	T1	CS,D
Estonia	3	1	1	0.0%	0	57%	-2	-62%	T1	D
Hungary	2,946	1,888	2,298	2.3%	410	22%	-649	-22%	T2	D,PS
Latvia	5	11	9	0.01%	-2	-19%	5	103%	T1	CS
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Poland	11,904	3,409	3,561	3.6%	152	4%	-8,343	-70%	T2	CS,D
Romania	11,471	2,705	4,646	4.7%	1,941	72%	-6,824	-59%	T1, T2	D, CS
Slovakia	3,093	3,577	3,661	3.7%	84	2%	567	18%	T3	PS
Slovenia	56	15	25	0.0%	10	68%	-31	-55%	T1	D
EU-27	**151,934**	**80,946**	**98,822**	**100.0%**	**17,876**	**22%**	**-53,112**	**-35%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 18.11 1A2a Iron and Steel, solid fuels: Activity Data and Implied Emission Factors for CO_2

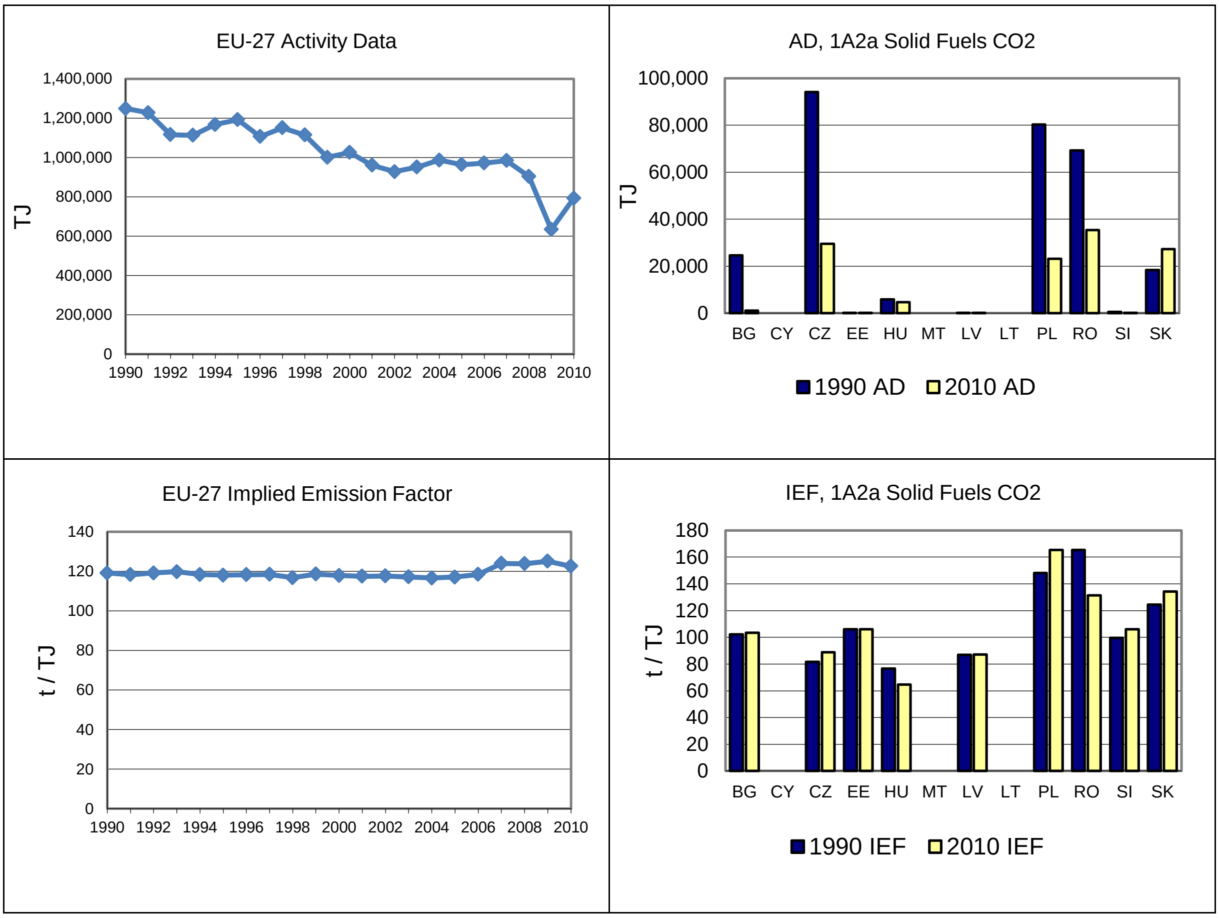


Table 18.13 1A2a Iron and Steel, gaseous fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	17,440	14,107	16,758	82.8%	2,651	19%	-682	-4%		
Bulgaria	1,032	223	130	0.6%	-93	-42%	-902	-87%	T2	CS
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	742	654	716	3.5%	63	10%	-25	-	T1	D
Estonia	NO	0	0	0.0%	0	0%	0	-	T2	CS
Hungary	1,448	290	158	0.8%	-132	-46%	-1,290	-89%	T2	D
Latvia	234	188	212	1.0%	24	13%	-22	-10%	T2	CS
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Poland	2,950	886	915	4.5%	30	3%	-2,035	-69%	T2	D
Romania	6,661	987	1,100	5.4%	113	11%	-5,561	-83%	T2	CS
Slovakia	1,301	59	81	0.4%	22	38%	-1,220	-94%	T2	CS
Slovenia	308	132	165	0.8%	33	25%	-144	-47%	T1	CS
EU-27	**32,116**	**17,525**	**20,235**	**100.0%**	**2,710**	**15%**	**-11,881**	**-37%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

18.2.2.2 Non Ferrous Metals (1A2b) (EU-27)

Figure 18.12 1A2b- Non ferrous Metals: Total, CO_2 emission and activity trends

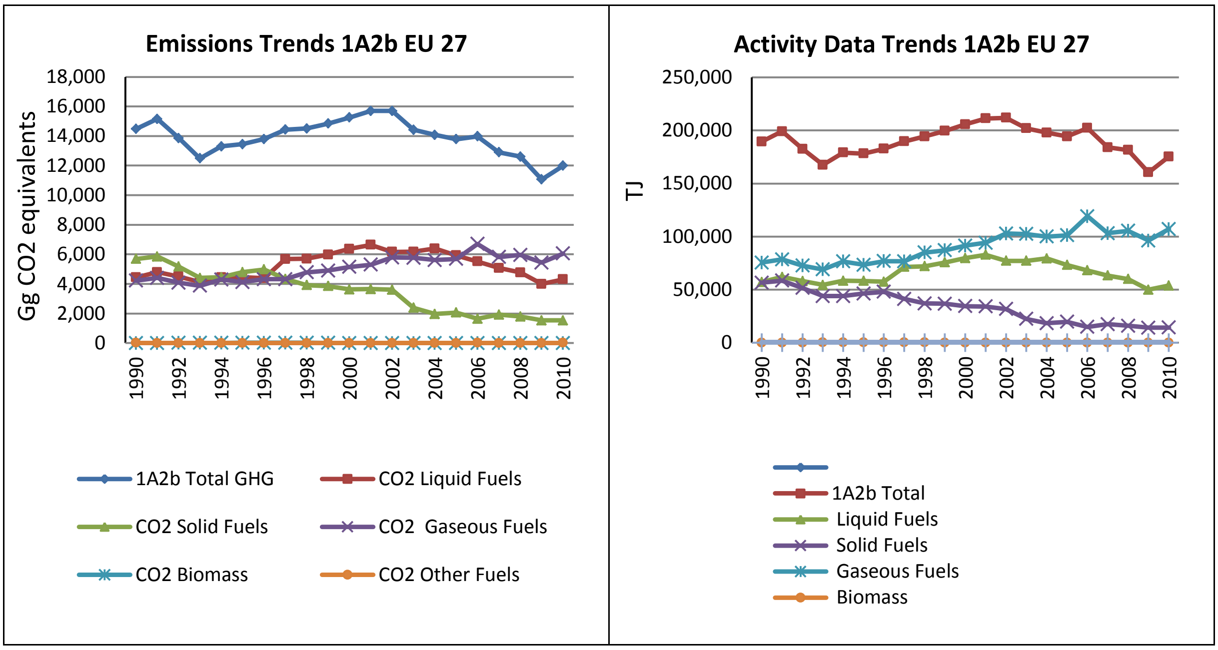


Table 18.14 1A2b Non ferrous Metals, solid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	3,542	497	500	32.9%	3	1%	-3,041	-86%		
Bulgaria	213	129	136	8.9%	6	5%	-77	-36%	T2	CS,D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	141	15	18	1.2%	3	17%	-123	-	T1	CS,D
Estonia	NO	1	3	-	2	121%	3	-	T1	D
Hungary	IE	IE	NA	-	-	-	-	-	NA	NA
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Poland	763	821	768	50.5%	-53	-6%	5	1%	T2	CS,D
Romania	87	IE	IE	-	-	-	-	-	NA	NA
Slovakia	798	68	91	6.0%	23	34%	-707	-89%	T2	CS
Slovenia	152	5	5	0.3%	-1	-	-147	-97%	T1	D
EU-27	**5,695**	**1,538**	**1,521**	**100.0%**	**-17**	**-1%**	**-4,174**	**-73%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.15 1A2b Non ferrous Metals, gaseous fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010	
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
EU-15	3,209	4,713	5,227	86.3%	514	11%	2,018	63%
Bulgaria	23	38	44	0.7%	6	15%	21	88%
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	54	51	102	1.7%	51	100%	47	-
Estonia	NO	3	3	0.0%	0	-13%	3	-
Hungary	IE	IE	188	3.1%	188	-	188	-
Latvia	NO	6	7	0.1%	2	33%	7	-
Lithuania	NO	NO	NO	-	-	-	-	-
Malta	IE	IE	IE	-	-	-	-	-
Poland	257	327	338	5.6%	11	3%	81	32%
Romania	IE	IE	IE	-	-	-	-	-
Slovakia	435	75	93	1.5%	18	24%	-342	-79%
Slovenia	163	81	56	0.9%	-25	-31%	-106	-65%
EU-27	**4,141**	**5,294**	**6,058**	**100.0%**	**764**	**14%**	**1,917**	**46%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

18.2.2.3 Chemicals (1A2c) (EU-27)

Figure 18.13 1A2c- Chemicals: Total, CO_2 and N_2O emission and activity trends

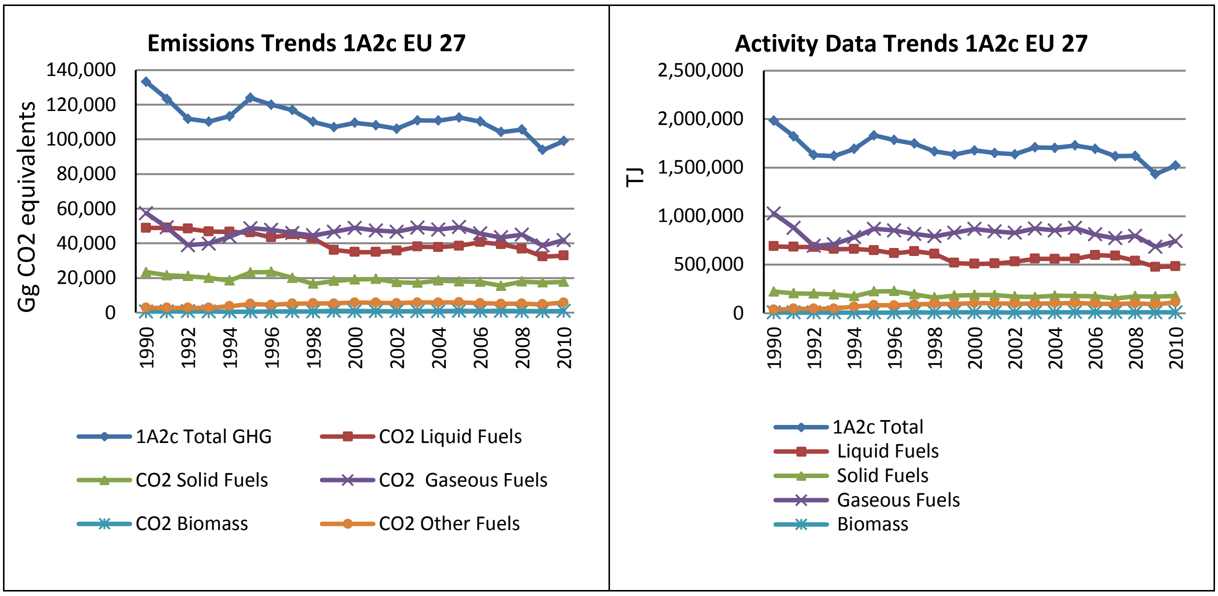


Table 18.16 1A2c Chemicals, liquid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	42,830	22,611	24,356	73.7%	1,744	8%	-18,475	-43%		
Bulgaria	930	105	19	0.1%	-86	-82%	-912	-98%	T1	D
Cyprus	NE	NE	NE	-	-	-	-	-	NA	NA
Czech Republic	2,678	4,090	4,332	13.1%	241	6%	1,654	-	T1	D
Estonia	13	2	6	0.0%	4	254%	-7	-52%	T1	CS,D
Hungary	387	173	69	0.2%	-104	-60%	-318	-82%	T2	D
Latvia	277	9	6	0.0%	-3	-	-270	-98%	T1	CS
Lithuania	72	1	5	0.0%	4	372%	-67	-93%	T1	CS
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Poland	306	1,809	1,706	5.2%	-103	-6%	1,400	457%	T2	D
Romania	NO	2,401	1,567	4.7%	-834	-35%	1,567	-	T1, T2	D, CS
Slovakia	1,363	1,066	961	2.9%	-105	-10%	-401	-29%	T2	CS
Slovenia	31	27	24	0.1%	-3	-10%	-7	-22%	T1	D
EU-27	**48,886**	**32,295**	**33,051**	**100.0%**	**756**	**2%**	**-15,835**	**-32%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.17 1A2c Chemicals, solid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	10,301	4,327	4,082	23.4%	-245	-6%	-6,218	-60%		
Bulgaria	416	216	314	1.8%	98	45%	-102	-25%	T2	CS,D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	6,313	6,684	6,828	39.2%	145	2%	516	-	T1	CS,D
Estonia	621	NO	NO	-	0	-	-621	-100%	NA	NA
Hungary	61	NO	3	0.0%	3	-	-58	-95%	T2	D
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Poland	3,367	5,493	5,627	32.3%	133	2%	2,259	67%	T2	CS,D
Romania	683	513	485	2.8%	-28	-5%	-198	-29%	T1, T2	D, CS
Slovakia	1,584	149	96	0.5%	-54	-36%	-1,488	-94%	T2	CS
Slovenia	1	NO	NO	-	-	-	-1	-100%	NA	NA
EU-27	**23,346**	**17,382**	**17,435**	**100.0%**	**53**	**0%**	**-5,911**	**-25%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.18 1A2c Chemicals, gaseous fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	33,140	32,299	35,088	85.4%	2,789	9%	1,947	6%		
Bulgaria	1,597	236	293	0.7%	57	24%	-1,305	-82%	T2	CS
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	342	468	625	1.5%	158	34%	283	-	T1	D
Estonia	166	16	7	0.0%	-9	-58%	-159	-96%	T2	CS
Hungary	821	534	662	1.6%	128	24%	-159	-19%	T2	D
Latvia	23	29	33	0.1%	5	17%	10	43%	T2	CS
Lithuania	341	197	187	0.5%	-11	-5%	-155	-45%	T1	CS
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Poland	295	545	672	1.6%	127	23%	377	128%	T2	D
Romania	18,499	2,677	2,658	6.5%	-19	-1%	-15,841	-86%	T2	CS
Slovakia	1,753	708	768	1.9%	61	9%	-985	-56%	T2	CS
Slovenia	175	140	91	0.2%	-50	-35%	-84	-48%	T1	CS
EU-27	**57,153**	**37,847**	**41,083**	**100.0%**	**3,236**	**9%**	**-16,070**	**-28%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.19 1A2c Chemicals, other fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	2,768	4,753	5,731	98.1%	978	21%	2,963	107%		
Bulgaria	NO	NO	NO	-	-	-	-	-	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	NO	NO	NO	-	-	-	-	-	NA	NA
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	NO	NO	NO	-	-	-	-	-	NA	NA
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Poland	NA	NA	NA	-	-	-	-	-	NA	NA
Romania	NO	83	110	-	27	-	110	-	T1	D
Slovakia	NO	NO	NO	-	-	-	-	-	NA	NA
Slovenia	0.5	4	NA	-	-4	-	-0.5	-100%	NA	NA
EU-27	**2,769**	**4,840**	**5,841**	**100.0%**	**1,001**	**21%**	**3,073**	**111%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

18.2.2.4 Pulp, Paper and Print (1A2d) (EU-27)

Figure 18.14 1A2d- Pulp, Paper and Print: Total, CO_2 and N_2O emission and activity trends

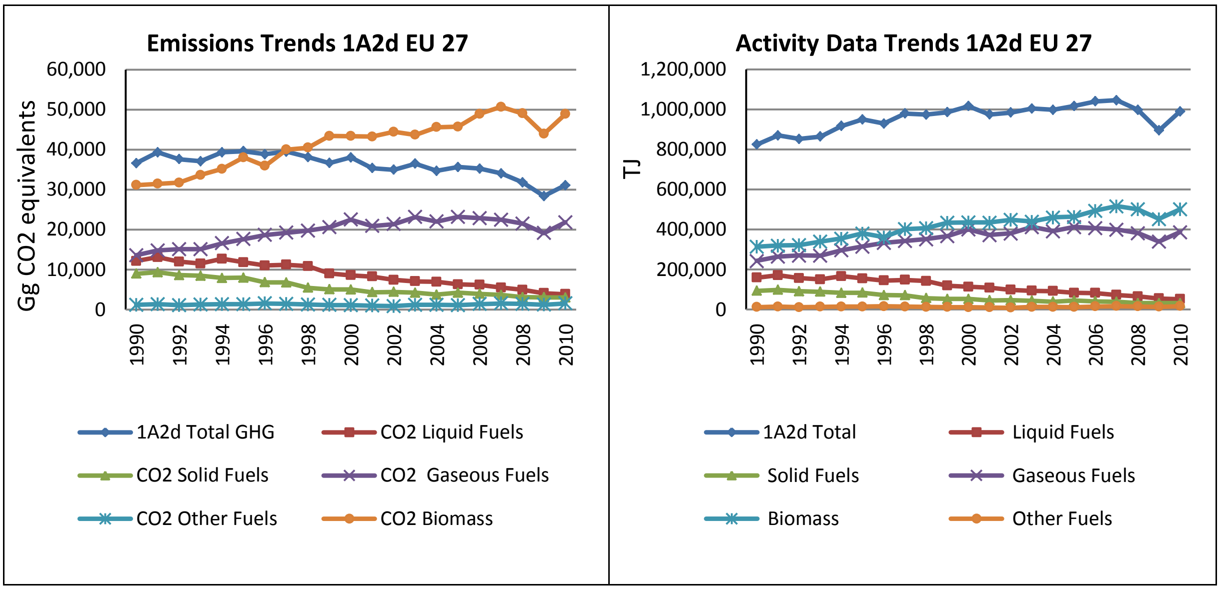


Table 18.20 1A2d Pulp, Paper and Print, liquid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	10,323	3,879	3,596	92.5%	-284	-7%	-6,727	-65%		
Bulgaria	15	NO	28	0.7%	28	-	12	79%	T1	D
Cyprus	NE	NE	NE		-	-	-	-	NA	NA
Czech Republic	473	54	58	1.5%	4	8%	-416	-	T1	D
Estonia	NO	1	1	0.01%	-0.37	-39%	1	-	T1	D
Hungary	86	15	10	0.25%	-5.19	-35%	-77	-89%	T2	D
Latvia	16	NO	NO	-	-	-	-16	-100%	NA	NA
Lithuania	72	0.13	0.19	0.00%	0.06	44%	-72	-100%	T1	CS
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Poland	104	150	149	3.8%	-1	-1%	45	43%	T2	D
Romania	NO	NO	15	0.4%	15	-	15	-	T1, T2	D, CS
Slovakia	985	21	25	0.6%	4	18%	-960	-97%	T2	CS
Slovenia	97	25	6	0.2%	-19	-76%	-91	-94%	T1	D
EU-27	**12,172**	**4,145**	**3,887**	**100.0%**	**-259**	**-6%**	**-8,285**	**-68%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.21 1A2d Pulp, Paper and Print, solid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	5,105	1,066	1,021	33.5%	-45	-4%	-4,084	-80%		
Bulgaria	NO	NO	NO	-	-	-	-	-	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	2,376	622	692	22.7%	69	11%	-1,684	-	T1	CS,D
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	24	0.1	NA	-	-	-	-24	-100%	NA	NA
Latvia	2	NO	NO	-	-	-	-2	-100%	NA	NA
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Poland	174	829	956	31.4%	127	15%	782	449%	T2	CS,D
Romania	NO	NO	NO	-	-	-	-	-	NA	NA
Slovakia	1,142	475	243	8.0%	-232	-49%	-899	-79%	T2	CS
Slovenia	169	122	137	4.5%	16	13%	-32	-19%	T1	D,PS
EU-27	**8,992**	**3,113**	**3,048**	**100.0%**	**-65**	**-2%**	**-5,943**	**-66%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.22 1A2d Pulp, Paper and Print, gaseous fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	12,693	17,981	20,386	93.4%	2,404	13%	7,693	61%		
Bulgaria	NO	62	74	0.3%	13	21%	74	-	T2	CS
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	183	223	246	1.1%	23	10%	63	-	T1	D
Estonia	NO	3	4	0.0%	1	48%	4	-	T2	CS
Hungary	51	75	152	0.7%	77	103%	101	198%	T2	D
Latvia	149	6	6	0.0%	0	0%	-144	-96%	T2	CS
Lithuania	193	50	67	0.3%	16	33%	-126	-65%	T1	CS
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Poland	6	274	269	1.2%	-4	-2%	264	4680%	T2	D
Romania	NO	107	247	1.1%	140	131%	247	-	T2	CS
Slovakia	152	126	128	0.6%	2	2%	-23	-15%	T2	CS
Slovenia	109	262	237	1.1%	-24	-9%	128	118%	T1	CS
EU-27	**13,536**	**19,167**	**21,817**	**100.0%**	**2,649**	**14%**	**8,281**	**61%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

18.2.2.5 Food Processing, Beverages and Tobacco (1A2e) (EU-27)

Figure 18.15 1A2e- Food Processing, Beverages and Tobacco: Total, CO_2 and N_2O emission and activity trends

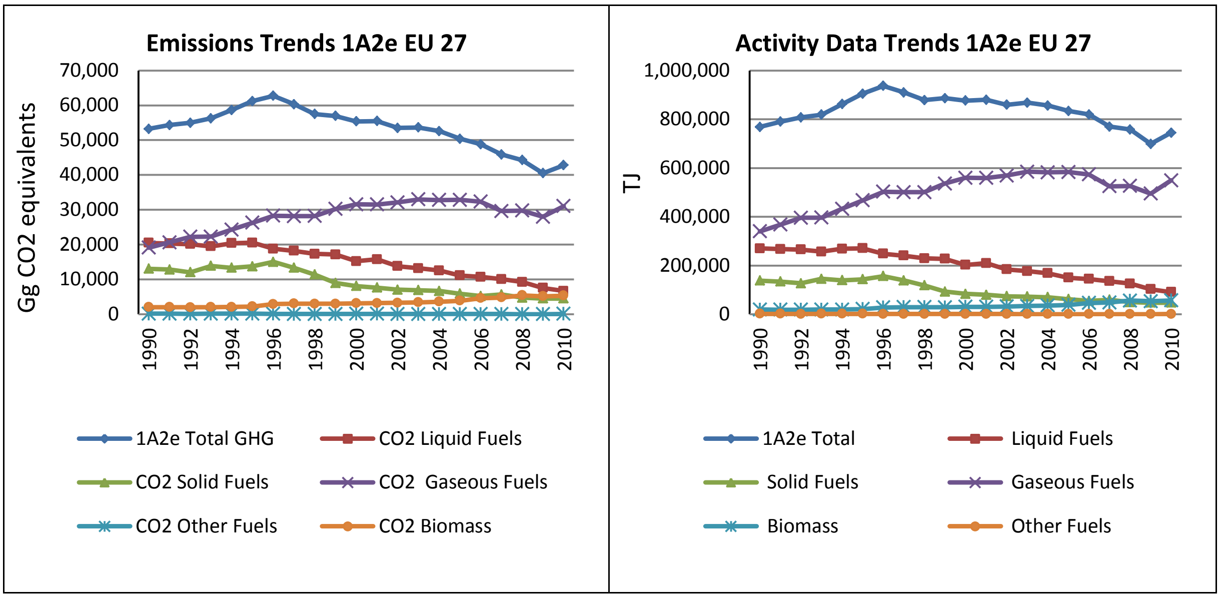


Table 18.23 1A2e Food Processing, Beverages and Tobacco, liquid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	16,560	6,655	5,892	88.2%	-764	-11%	-10,669	-64%		
Bulgaria	405	119	70	1.0%	-49	-41%	-335	-83%	T1	D
Cyprus	IE	IE	IE	-	-	-	-	-	NA	NA
Czech Republic	566	83	70	1.1%	-13	-15%	-495	-	T1	D
Estonia	439	7	4	0.1%	-3	-41%	-434	-99%	T1,T2	CS,D
Hungary	817	35	20	0.3%	-15	-44%	-797	-98%	T2	D
Latvia	798	45	45	0.7%	0	0%	-753	-94%	T1	CS
Lithuania	183	37	37	0.5%	0	0%	-146	-80%	T1	CS
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Poland	228	402	357	5.4%	-44	-11%	129	57%	T2	D
Romania	NO	148	141	2.1%	-6	-4%	141		T1, T2	D, CS
Slovakia	359	0	0	0.0%	0	-38%	-359	-100%	T2	CS
Slovenia	144	39	42	0.6%	2	6%	-102	-71%	T1	D
EU-27	**20,499**	**7,570**	**6,678**	**100.0%**	**-892**	**-12%**	**-13,820**	**-67%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.24 1A2e Food Processing, Beverages and Tobacco, solid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	6,021	1,663	1,632	35.4%	-31	-2%	-4,389	-73%		
Bulgaria	33	42	40	0.9%	-2	-4%	7	21%	T2	CS,D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	2,863	252	249	5.4%	-3	-1%	-2,613	-	T1	CS,D
Estonia	5	NO	NO	-	0.0	-	-5	-100%	NA	NA
Hungary	194	8	13	0.3%	5	66%	-180	-93%	T2	D
Latvia	91	5	5	0.1%	0	6%	-86	-94%	T1	CS,OTH
Lithuania	33	8	10	0.2%	1	14%	-24	-71%	T1	CS,D
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Poland	3,389	2,515	2,614	56.8%	99	4%	-775	-23%	T2	CS,D
Romania	133	NO	6	0.1%	6	-	-127	-96%	T1	D
Slovakia	312	29	35	0.8%	5	19%	-277	-89%	T2	CS
Slovenia	9	NO	NO	-	-	-	-9	-100%	NA	NA
EU-27	**13,082**	**4,522**	**4,603**	**100.0%**	**81**	**2%**	**-8,479**	**-65%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.25 1A2e Food Processing, Beverages and Tobacco, gaseous fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	16,229	24,024	26,850	86.5%	2,825	12%	10,621	65%		
Bulgaria	11	211	243	0.8%	31	15%	231	2034%	T2	CS
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	745	724	755	2.4%	31	4%	10	1%	T1	D
Estonia	15	2	3	0.0%	0	24%	-12	-83%	T2	CS
Hungary	804	511	602	1.9%	90	18%	-202	-25%	T2	D
Latvia	174	107	106	0.3%	-1	-1%	-68	-39%	T2	CS
Lithuania	484	207	228	0.7%	20	10%	-256	-53%	T1	CS
Malta	IE	IE	IE	-	-	-	-	-	NA	NA
Poland	110	1,169	1,206	3.9%	37	3%	1,096	997%	T2	D
Romania	NO	688	724	2.3%	36	5%	724	-	T2	CS
Slovakia	470	275	271	0.9%	-3	-1%	-198	-42%	T2	CS
Slovenia	65	75	70	0.2%	-5	-7%	5	7%	T1	CS
EU-27	**19,106**	**27,994**	**31,057**	**100.0%**	**3,062**	**11%**	**11,951**	**63%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

18.2.2.6 Other (1A2f) (EU-27)

Figure 18.16 1A2f- Other, liquid fuels: Total, CO_2 and N_2O emission and activity trends

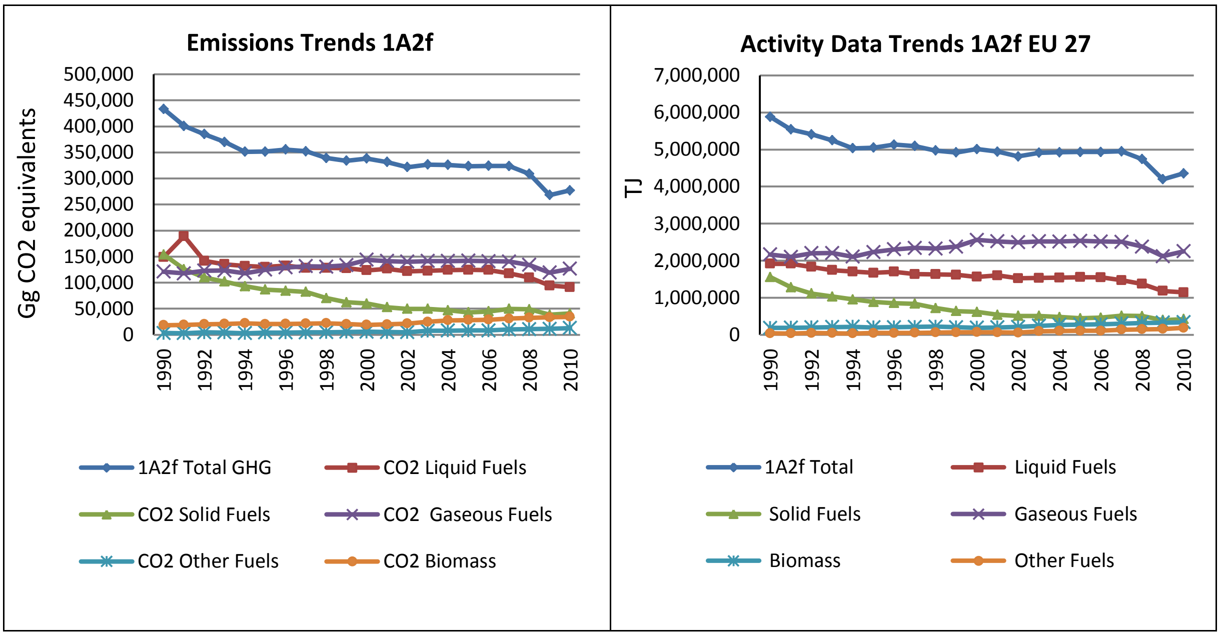


Table 18.26 **1A2f Other, liquid fuels: CO_2 emissions of EU-27**

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	116,508	85,867	83,605	91.1%	-2,262	-3%	-32,903	-28%		
Bulgaria	9,224	927	943	1.0%	16	2%	-8,281	-90%	T1	D
Cyprus	694	1,011	971	1.1%	-40	-4%	277	40%	D,T1	CS,D,PS
Czech Republic	4,935	1,284	1,414	1.5%	130	10%	-3,522	-71%	T1	D
Estonia	325	107	114	0.1%	8	7%	-211	-65%	T1,T2	CS,D
Hungary	1,149	464	422	0.5%	-42	-9%	-727	-63%	T1,T2	D
Latvia	945	112	138	0.2%	26	23%	-807	-85%	T1	CS
Lithuania	3,341	98	45	0.0%	-53	-54%	-3,296	-99%	T1	CS,D
Malta	59	31	35	0.0%	4	12%	-24	-41%	D,T1	D
Poland	2,196	2,407	1,702	1.9%	-705	-29%	-495	-23%	T2	D
Romania	7,251	2,087	1,988	2.2%	-99	-5%	-5,263	-73%	T1,T2	CS,D
Slovakia	1,286	209	56	0.1%	-153	-73%	-1,230	-96%	T2	CS
Slovenia	696	376	298	0.3%	-78	-21%	-398	-57%	T1	D
EU-27	**148,609**	**94,980**	**91,731**	**100.0%**	**-3,249**	**-3%**	**-56,878**	**-38%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 18.17 **1A2f Other, liquid fuels: Activity Data and Implied Emission Factors for CO_2**

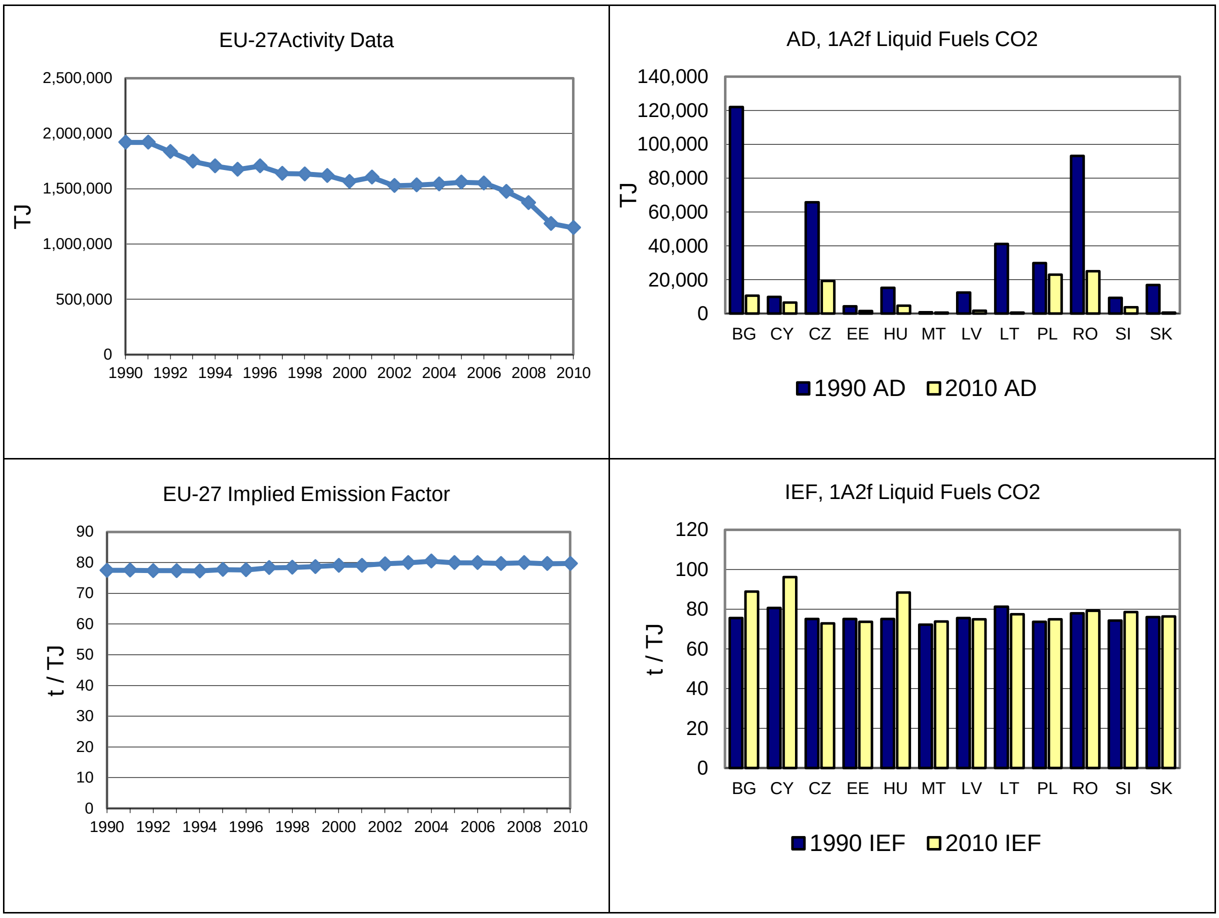


Table 18.27 1A2f Other, solid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	113,522	27,360	29,363	71.4%	2,003	7%	-84,159	-74%		
Bulgaria	2,178	396	495	1.2%	99	25%	-1,683	-77%	T2	CS,D
Cyprus	251	58	70	0.2%	12	21%	-182	-72%	D	PS
Czech Republic	12,150	1,133	1,173	2.9%	40	3%	-10,977	-90%	T1	CS,D
Estonia	793	350	247	0.6%	-103	-29%	-546	-69%	T1,T2	CS,D
Hungary	948	263	175	0.4%	-88	-33%	-773	-82%	T1,T2	CS,D
Latvia	38	121	164	0.4%	44	36%	126	330%	T1	CS,OTH
Lithuania	144	249	331	0.8%	82	33%	187	130%	T1,T2	CS,D
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	13,800	5,207	5,965	14.5%	758	15%	-7,835	-57%	T2	CS,D
Romania	7,097	1,960	2,003	4.9%	44	2%	-5,094	-72%	T1,T2	CS,D
Slovakia	2,897	1,077	1,043	2.5%	-34	-3%	-1,853	-64%	T2	CS
Slovenia	199	125	87	0.2%	-38	-30%	-111	-56%	T1	CS,D
EU-27	**154,017**	**38,299**	**41,117**	**100.0%**	**2,818**	**7%**	**-112,900**	**-73%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 18.18 1A2f Other, solid fuels: Activity Data and Implied Emission Factors for CO_2

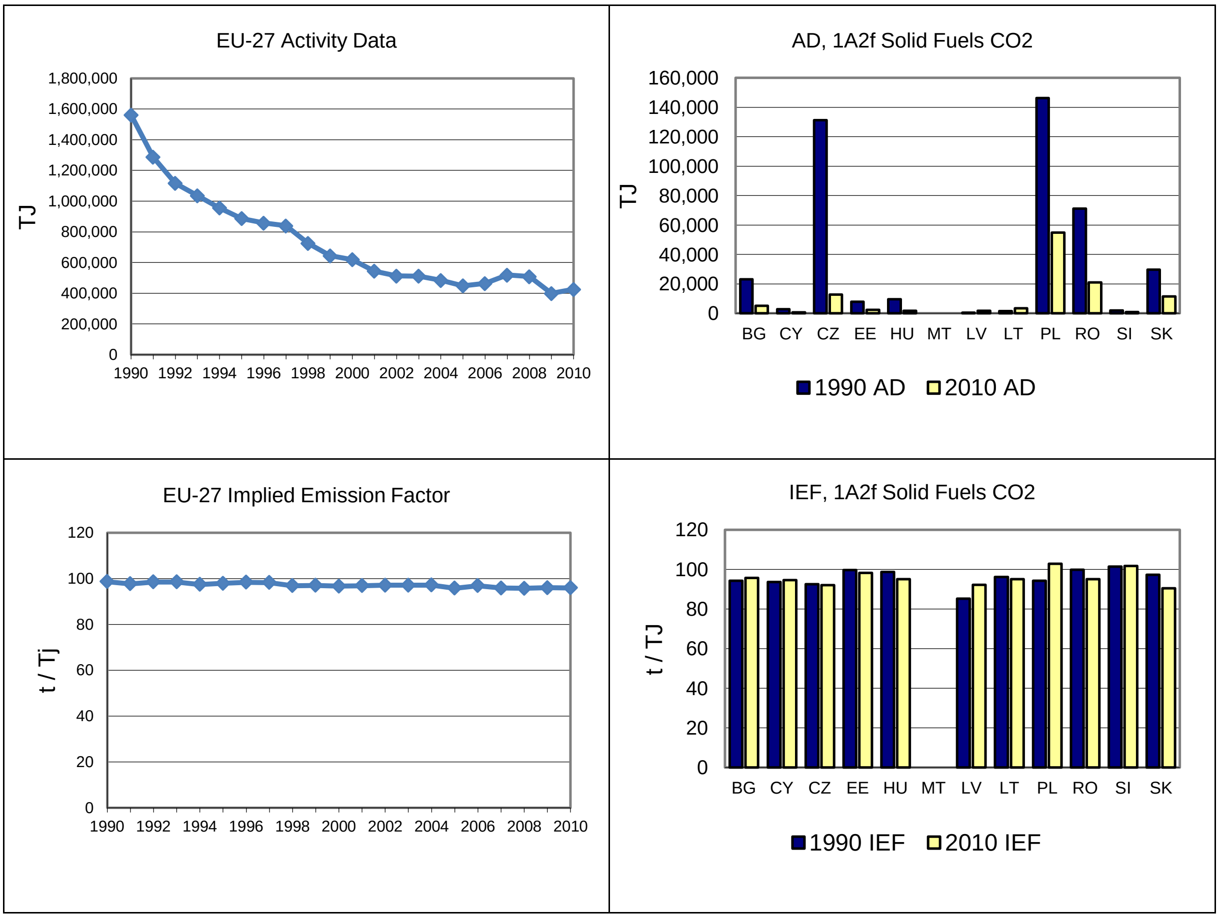
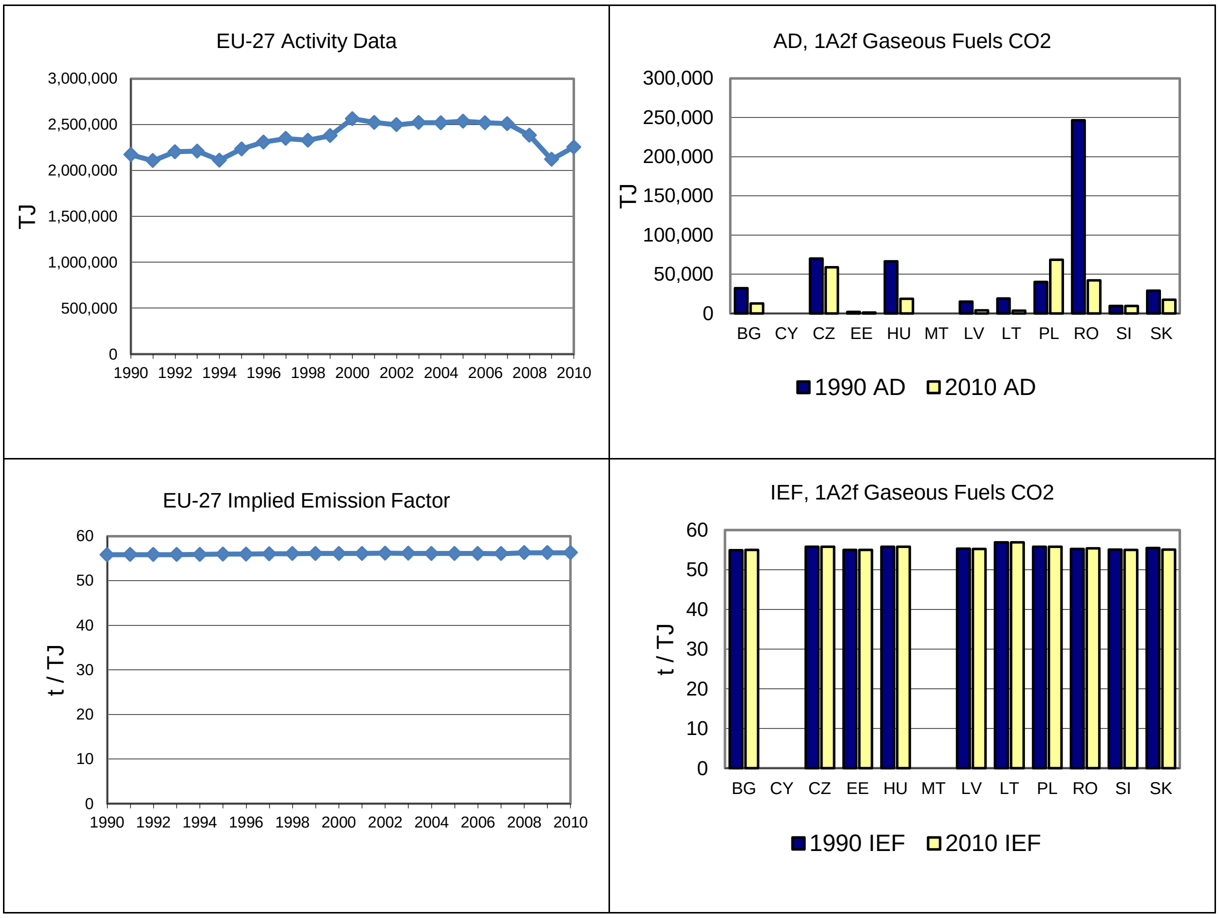


Table 18.28 1A2f Other, gaseous fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	91,723	107,173	113,609	89.7%	6,436	6%	21,886	24%		
Bulgaria	1,764	673	701	0.6%	28	4%	-1,063	-60%	T2	CS
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	3,918	2,894	3,295	2.6%	401	14%	-623	-16%	T1	D
Estonia	100	64	69	0.1%	5	7%	-31	-31%	T2	CS
Hungary	3,717	1,014	929	0.7%	-85	-8%	-2,788	-75%	T1,T2	D
Latvia	835	178	218	0.2%	40	22%	-618	-74%	T2	CS
Lithuania	1,093	169	201	0.2%	33	19%	-892	-82%	T1	CS
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	2,245	3,607	3,823	3.0%	216	6%	1,578	70%	T2	D
Romania	13,635	2,239	2,343	1.8%	104	5%	-11,292	-83%	T2	CS
Slovakia	1,613	835	967	0.8%	132	16%	-647	-40%	T2	CS
Slovenia	530	393	529	0.4%	135	34%	-1	0%	T1	CS
EU-27	**121,174**	**119,239**	**126,682**	**100.0%**	**7,443**	**6%**	**5,509**	**5%**		

Figure 18.19 1A2f Other, gaseous fuels: Activity Data and Implied Emission Factors for CO_2



18.2.3 *Transport (CRF Source Category 1A3) (EU-27)*

18.2.3.1 Civil Aviation (1A3a) (EU-27)

Figure 18.20 1A3a- Civil Aviation: Total, CO_2 and N_2O emission and activity trends

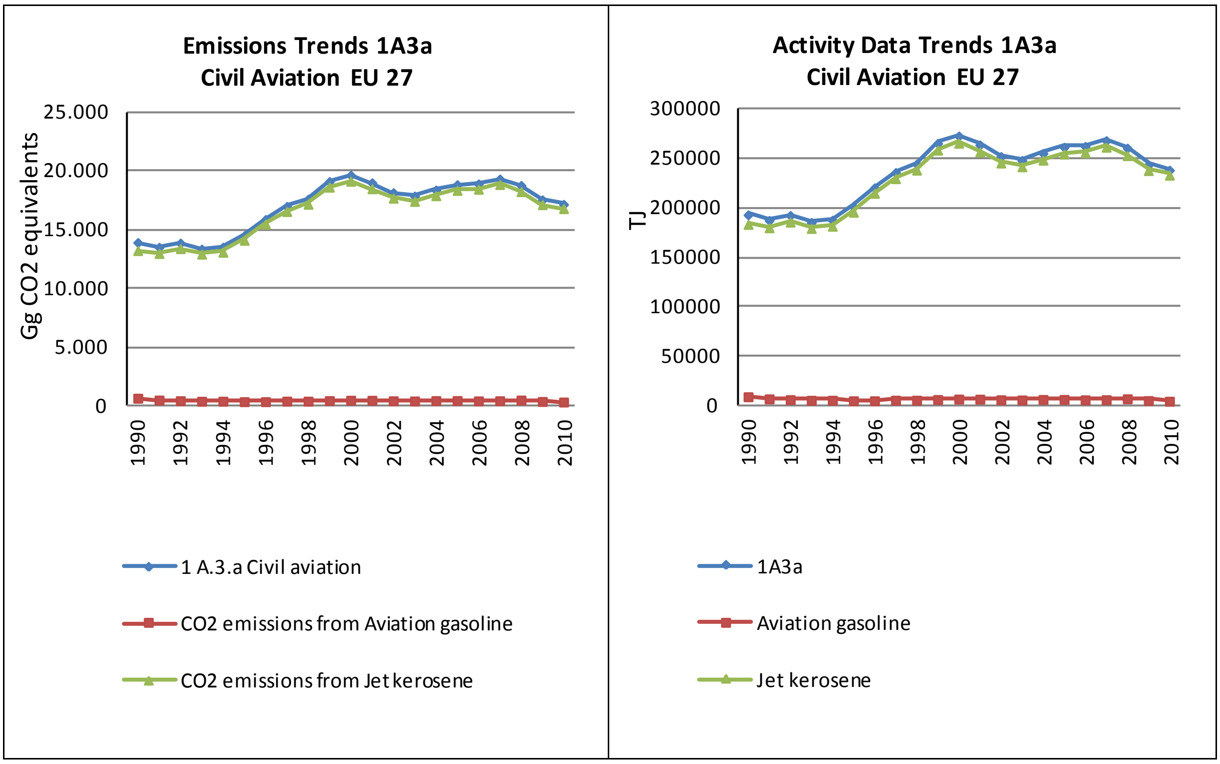


Table 18.29 1A3a Civil Aviation, jet kerosine: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	13.071	16.782	16.385	97,3%	-397	-2%	3.315	25%		
Bulgaria	114	68	43	0,3%	-25	-36%	-71	-62%	T1	D
Cyprus	NA	NA	NA	-	-	-	-	-	NA	NA
Czech Republic	1	2	3	0,02%	1,1	71%	1	89%	T1	D
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	NO	NO	NO	-	-	-	-	-	NA	NA
Latvia	0,05	0	0,16	0,00%	0,0	-9%	0,10	187%	T2	D
Lithuania	10	1	0	0,002%	-0,9	-72%	-9	-96%	T1	D
Malta	0	0	1	0,004%	0,2	45%	0	67%	T1	D
Poland	34	74	83	0,5%	9	12%	49	144%	T1	D
Romania	25	237	314	1,86%	77	32%	289	1172%	T2	D
Slovakia	7	6	5	0,03%	0	-8%	-2	-22%	T2	D
Slovenia	NO	NO	NO	-	-	-	-	-	NA	NA
EU-27	**13.262**	**17.171**	**16.834**	**100,0%**	**-336**	**-2%**	**3.573**	**27%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

18.2.3.2 Road Transportation (1A3b) (EU-27)

Figure 18.21 1A3b- Road Transport, CO_2 and N_2O emission and activity trends

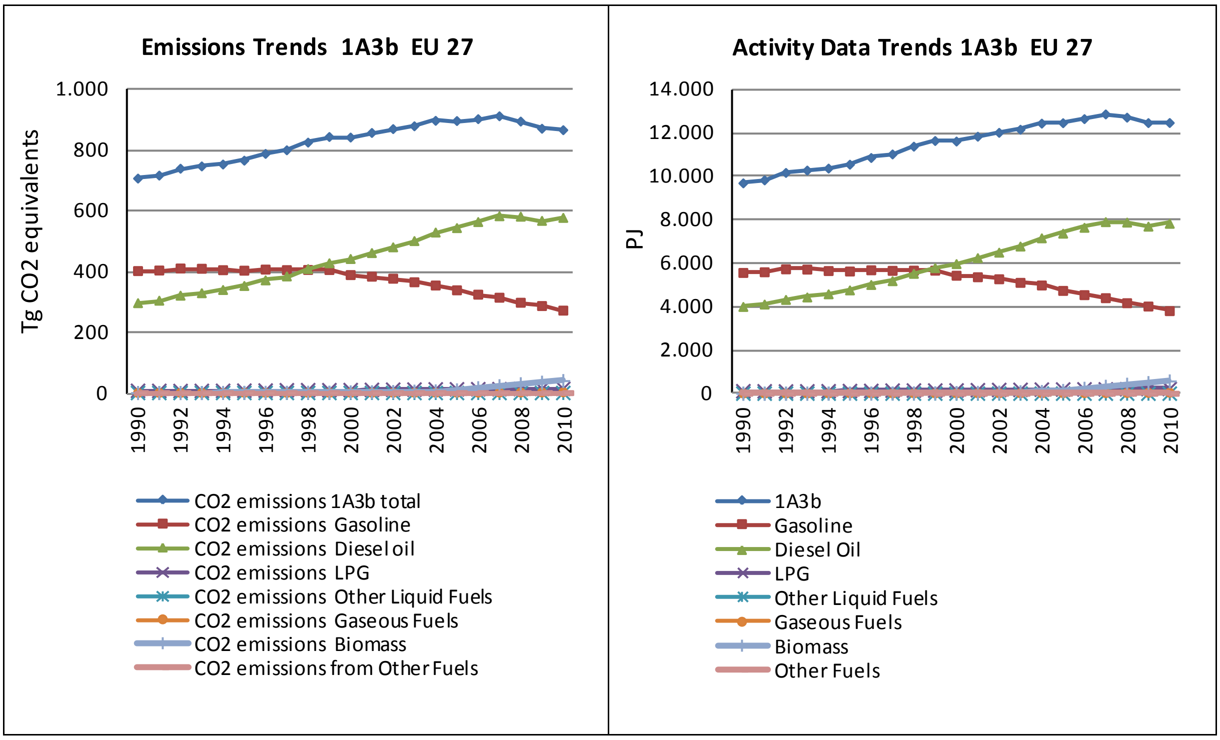


Table 18.30 1A3b Road Transport, diesel oil: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	268.209	494.240	501.330	86,9%	7.090	1%	233.122	87%		
Bulgaria	1.547	4.522	4.430	0,8%	-92	-2%	2.883	186%	T2	D
Cyprus	656	1.055	1.080	0,2%	25	2%	425	65%	T1	D
Czech Republic	2.836	10.869	10.433	1,8%	-436	-4%	7.596	268%	T1	D
Estonia	697	1.071	1.195	0,2%	124	12%	499	72%	T1	CS
Hungary	2.485	7.702	7.329	1,3%	-373	-5%	4.844	195%	T1	D
Latvia	616	1.862	2.031	0,4%	169	9%	1.415	230%	M	CS
Lithuania	2.134	2.347	2.678	0,5%	331	14%	544	26%	T2	CS
Malta	150	244	302	0,1%	59	24%	153	102%	D,T1	D
Poland	8.641	26.471	28.876	5,0%	2.405	9%	20.235	234%	T2	CS
Romania	4.186	9.462	9.110	1,6%	-351	-4%	4.925	118%	T2	OTH
Slovakia	3.123	3.930	4.483	0,8%	552	14%	1.360	44%	M	D
Slovenia	895	3.343	3.367	0,6%	24	1%	2.472	276%	M	M
EU-27	**296.174**	**567.118**	**576.646**	**100,0%**	**9.528**	**1,7%**	**280.472**	**95%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 18.22 1A3b Road Transport, diesel oil: Activity Data and Implied Emission Factors for CO_2

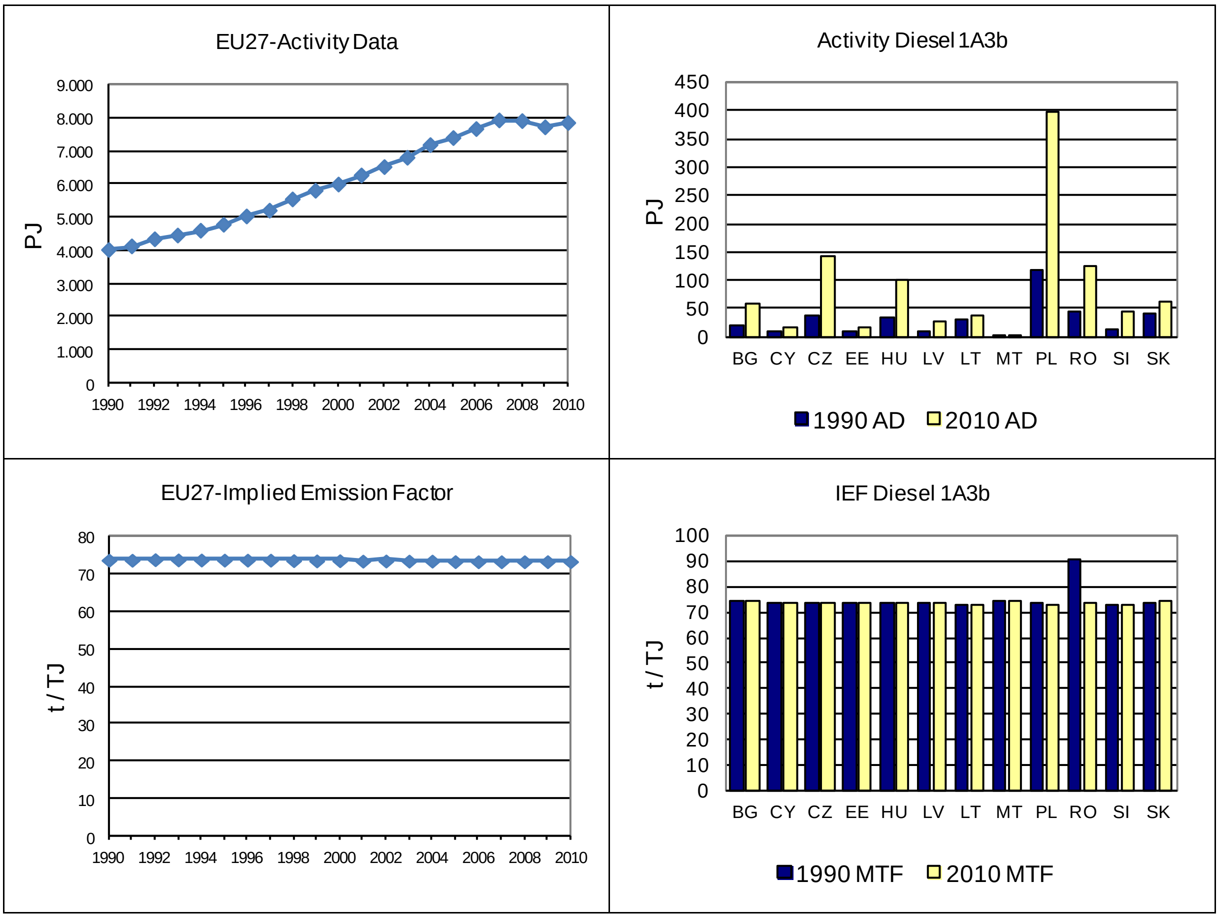


Table 18.31 1A3b Road Transport, gasoline: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	362.649	249.030	235.947	87,0%	-13.083	-5%	-126.702	-35%		
Bulgaria	4.390	1.914	1.805	0,7%	-109	-6%	-2.584	-59%	T2	D
Cyprus	492	1.156	1.177	0,4%	21	2%	685	139%	T1	D
Czech Republic	3.403	6.162	5.586	2,1%	-576	-9%	2.184	64%	T1	D
Estonia	1.562	924	857	0,3%	-67	-7%	-705	-45%	T1	CS
Hungary	4.985	4.216	3.805	1,4%	-412	-10%	-1.181	-24%	T1	D
Latvia	1.689	932	844	0,3%	-87	-9%	-845	-50%	M	CS
Lithuania	3.053	1.116	905	0,3%	-211	-19%	-2.149	-70%	T2	CS
Malta	183	226	229	0,1%	3	1%	46	25%	D,T1	D
Poland	9.714	12.610	12.225	4,5%	-385	-3%	2.510	26%	T2	CS
Romania	6.631	4.588	4.326	1,6%	-262	-6%	-2.305	-35%	T2	OTH
Slovakia	1.380	1.966	1.878	0,7%	-88	-4%	498	36%	M	D
Slovenia	1.711	1.847	1.758	0,6%	-89	-5%	47	3%	M	M
EU-27	**401.843**	**286.688**	**271.342**	**100,0%**	**-15.346**	**-5,4%**	**-130.501**	**-32%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 18.23 1A3b Road Transport, gasoline: Activity Data and Implied Emission Factors for CO_2

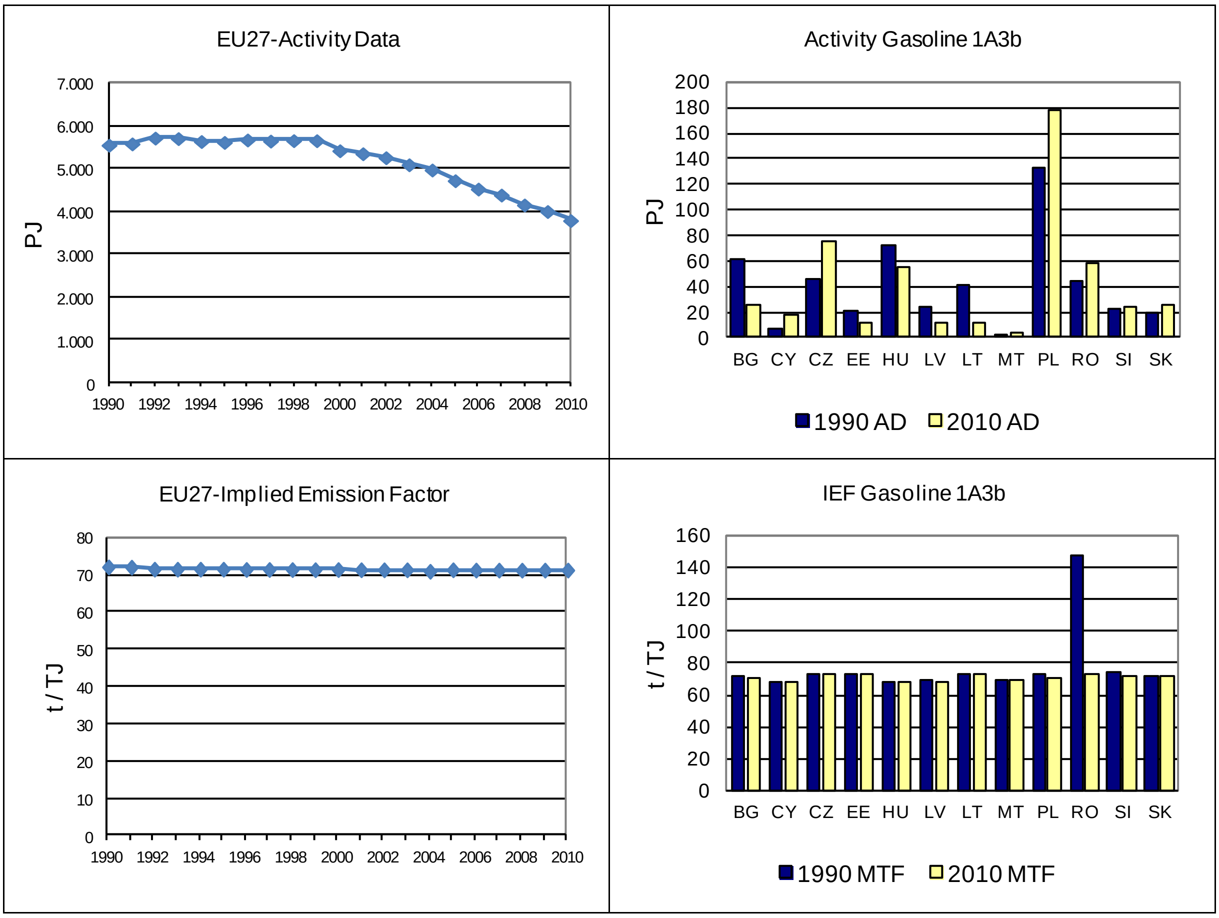


Table 18.32 1A3b Road Transport, LPG: Member CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	7.313	6.904	7.182	51,1%	277	4%	-131	-2%		
Bulgaria	NO	1.067	1.028	7,3%	-39	-4%	1.028	-	T2	D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	NO	242	230	1,6%	-12	-5%	230	-	T1	D
Estonia	9	0,2	0,3	0,002%	0,1	25%	-8	-96%	T1	D
Hungary	NA	70	76	0,5%	6,2	9%	76	-	T1	D
Latvia	37	54	62	0,4%	8	14%	25	67%	M	M
Lithuania	60	502	494	3,5%	-8	-2%	434	721%	T2	CS
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	NO	4.799	4.820	34,3%	22	0%	4.820	-	T2	CS
Romania	NO	238	62	0,4%	-176	-74%	62	-	T2	OTH
Slovakia	NO	74	83	0,6%	9	12%	83	-	M	D
Slovenia	NO	15	18	0,1%	4	-	18	-	M	M
EU-27	**7.418**	**13.966**	**14.056**	**100,0%**	**90**	**1%**	**6.637**	**89%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.33 1A3b Road Transport, diesel oil: N_2O emissions of EU-27

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	1.697	4.662	4.998	81,0%	336	7%	3.301	194%		
Bulgaria	20	36	40	0,6%	4	10%	20	98%	T2	D
Cyprus	2	3	3	0,0%	0	2%	1	65%	T1	D
Czech Republic	29	208	222	3,6%	14	7%	192	660%	T2	CS
Estonia	7	7	7	0,1%	0	0%	0	-2%	T3	CS
Hungary	41	134	128	2,1%	-6	-5%	87	212%	T2	D
Latvia	6	13	14	0,2%	1	6%	8	133%	M	M
Lithuania	21	20	24	0,4%	4	19%	3	16%	T3	CR
Malta	2,45	4	5	0,1%	0,96	24%	2,49	102%	D,T1	D
Poland	116	377	416	6,7%	38	10%	299	258%	T2	D
Romania	81	212	243	3,9%	31	14%	162	200%	T2	OTH
Slovakia	43	26	35	0,6%	8	32%	-8	-19%	M	D
Slovenia	11	36	38	0,6%	2	5%	27	257%	M	M
EU-27	**2.076**	**5.739**	**6.171**	**100,0%**	**432**	**8%**	**4.095**	**197%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.34 1A3b Road Transport, gasoline: N_2O emissions of EU-27

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010	
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
EU-15	4.282	1.894	1.664	58,5%	-231	-12%	-2.619	-61%
Bulgaria	56	20	15	0,5%	-4,85	-24%	-41	-73%
Cyprus	1	3	3	0,1%	0	2%	2	139%
Czech Republic	103	476	441	15,5%	-34	-7%	339	330%
Estonia	15	11	11	0,4%	0	0%	-4	-26%
Hungary	58	257	236	8,3%	-21	-8%	178	305%
Latvia	14	7	6	0,2%	-1	-16%	-7	-54%
Lithuania	19	12	9	0,3%	-2,13	-18%	-10	-51%
Malta	2,62	3	3	0,1%	0,04	1%	1	25%
Poland	68	149	144	5,1%	-5	-3%	76	111%
Romania	40	130	243	8,5%	113,15	87%	203	512%
Slovakia	16	36	30	1,0%	-6	-16%	14	90%
Slovenia	28	42	37	1,3%	-6	-13%	9	32%
EU-27	**4.702**	**3.039**	**2.842**	**100,0%**	**-197**	**-6%**	**-1.860**	**-40%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

18.2.3.3 Railways (1A3c) (EU-27)

Figure 18.24 1A3c- Railways, CO_2 and N_2O emission and activity trends

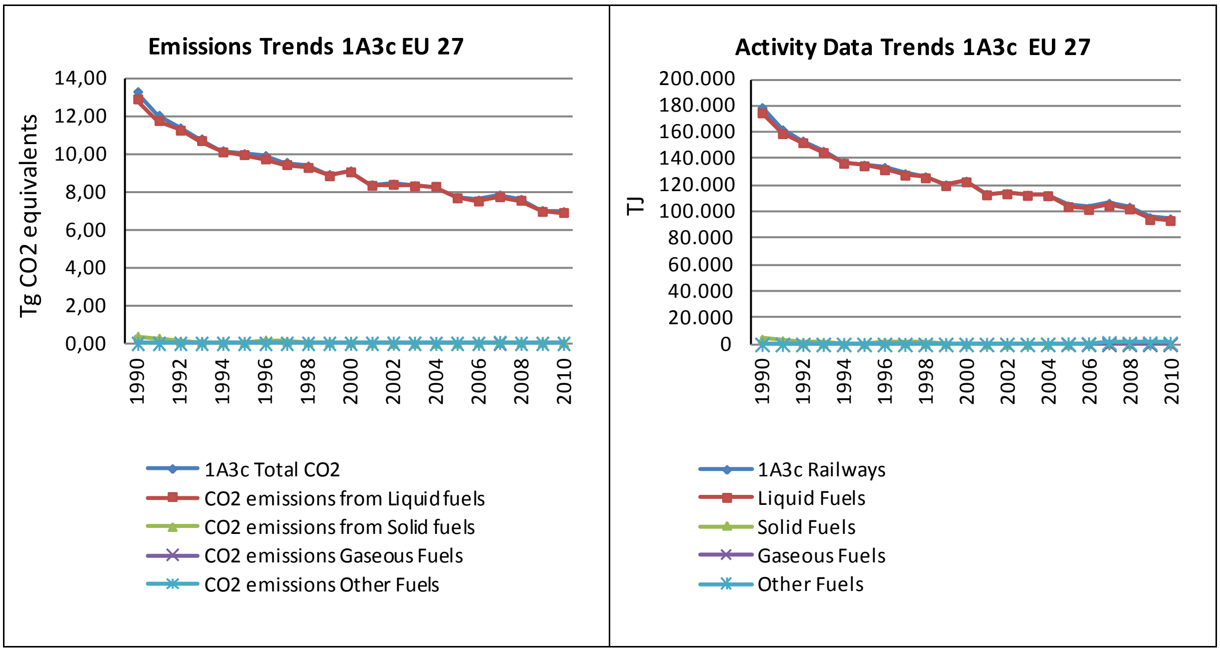


Table 18.35 1A3c Railways, liquid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	7.752	4.943	4.827	68,8%	-115	-2%	-2.925	-38%		
Bulgaria	318	62	62	0,9%	0	0%	-256	-81%	T1	D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	651	298	289	4,1%	-9	-3%	-363	-56%		
Estonia	143	107	156	2,2%	49	45%	13	9%	T2	CS
Hungary	513	265	268	3,8%	3	1%	-245	-48%	T1	D
Latvia	531	230	207	3,0%	-22	-10%	-324	-61%	T1	CS
Lithuania	350	175	185	2,6%	10	6%	-165	-47%	T2	CS
Malta	NO	NA	NA	-	-	-	-	-	NA	NA
Poland	1.770	383	458	6,5%	75	19%	-1.312	-74%	T2	CS
Romania	894	388	441	6,3%	52	13%	-453	-51%	T2	CS
Slovakia	377	86	88	1,3%	2	2%	-289	-77%	T1	D
Slovenia	64	37	37	0,5%	0	0%	-27	-42%	T1	D
EU-27	**13.364**	**6.974**	**7.018**	**100,0%**	**44**	**1%**	**-6.346**	**-47%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

18.2.3.4 Navigation (1A3d) (EU-27)

Figure 18.25 1A3d- Navigation, CO_2 and N_2O emission and activity trends

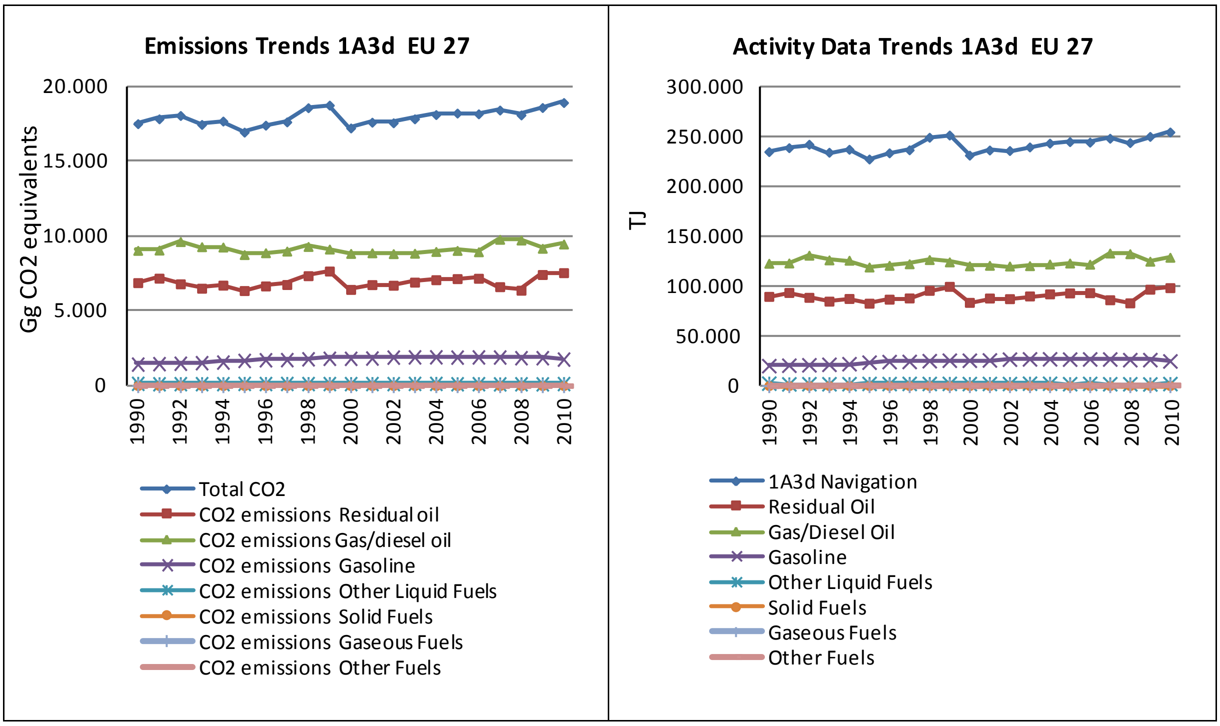


Table 18.36 1A3d Navigation, residual oil: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	6.696	7.444	7.570	100,0%	126	2%	874	13%		
Bulgaria	NO	NO	NO	-	-	-	-	-	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	NO	NO	NO	-	-	-	-	-	NA	NA
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	2	NO	NO	-	-	-	-2	-100%	NA	NA
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	NO	1	NO	-	-1	-	0	-	NA	NA
Malta	NA	NA	NA	-	-	-	-	-	NA	NA
Poland	58	2	1	0,01%	-1	-59%	-57	-99%	T1	D
Romania	147	0	NO	-	-	-	-147	-	NA	NA
Slovakia	NO	NO	NO	-	-	-	-	-	NA	NA
Slovenia	NO	NO	NO	-	-	-	-	-	NA	NA
EU-27	**6.903**	**7.447**	**7.571**	**100,0%**	**124**	**2%**	**668**	**10%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.37 1A3d Navigation, gas/diesel oil: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	8.762	8.912	9.186	96,6%	274	3%	424	5%		
Bulgaria	56	NO	NO	-	-	-	-56	-100%	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	56	16	13	0,1%	-3	-20%	-44	-78%	T1	D
Estonia	22	24	23	0,2%	0	-1%	2	7%	T1	CS
Hungary	28	3	3	0,0%	0	0%	-25	-89%	T1	D
Latvia	1	13	22	0,2%	9	75%	21	2538%	T1	CS
Lithuania	15	16	17	0,2%	2	10%	2	11%	T1	CS
Malta	8	39	68	0,7%	29	73%	60	707%	D,T1	D
Poland	76	10	1	0,0%	-9	-94%	-76	-99%	T1	D
Romania	39	166	179	1,9%	12	7%	140	359%	T2	CS
Slovakia	0,02	0,04	0,04	0,0%	0	4%	0	78%	CS	D
Slovenia	IE	IE	IE	-	-	-	-	-	NA	NA
EU-27	**9.064**	**9.198**	**9.512**	**100,0%**	**314**	**3%**	**447**	**5%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

18.2.3.5 Other (1A3e) (EU-27)

Table 18.38 1A3e Other: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010	
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
EU-15	7.031	8.020	7.980	81,3%	-40	0%	948	13%
Bulgaria	132	321	324	3,3%	3	1%	192	146%
Cyprus	NA	NA	NA	-	-	-	-	-
Czech Republic	494	153	153	1,6%	0	0%	-342	-69%
Estonia	NO	NO	NO	-	-	-	-	-
Hungary	NO	NO	NO	-	-	-	-	-
Latvia	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Lithuania	1.854	209	215	2,2%	6	3%	-1.638	-88%
Malta	NA	NA	NA	-	-	-	-	-
Poland	1.299	1.278	1.112	11,3%	-167	-13%	-187	-14%
Romania	7	19	24	0,2%	5	25%	17	240%
Slovakia	7	2	2	0,0%	0,0	0%	-5	-78%
Slovenia	NO	NO	NO	-	-	-	-	-
EU-27	**10.824**	**10.002**	**9.809**	**100,0%**	**-193**	**-2%**	**-1.015**	**-9%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

18.2.4 Other Sectors (CRF Source Category 1A4) (EU-27)

18.2.4.1 Commercial/Institutional (1A4a) (EU-27)

Figure 18.26 1A4a Commercial/Institutional, CO_2 and N_2O emission and activity trends

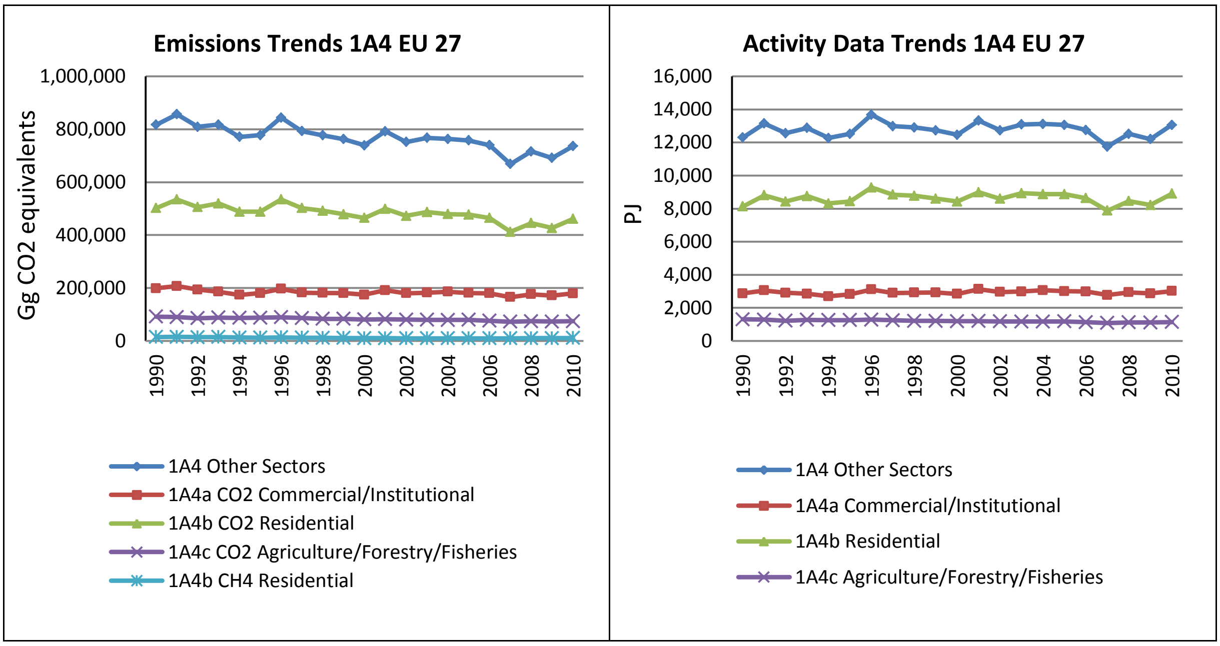


Table 18.39 1A4a Commercial/Institutional, liquid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	74,142	45,408	43,686	92.6%	-1,722	-4%	-30,456	-41%		
Bulgaria	2,954	201	138	0.3%	-63	-31%	-2,816	-95%	T1	D
Cyprus	10	59	56	0.1%	-3	-6%	46	452%	T1	D
Czech Republic	1,786	46	46	0.1%	0	0%	-1,740	-97%	T1	D
Estonia	19	7	10	0.0%	3	45%	-9	-49%	T1,T2	CS,D
Hungary	1,296	54	61	0.1%	8	14%	-1,235	-95%	T1	D
Latvia	1,131	115	109	0.2%	-5	-5%	-1,022	-90%	T1	CS
Lithuania	976	8	12	0.0%	4	46%	-964	-99%	T1	CS
Malta	62	69	72	0.2%	3	4%	10	17%	D,T1	D
Poland	NO	1,457	2,158	4.6%	701	48%	2,158	-	T2	D
Romania	NO	186	211	0.4%	25	13%	211	-	T1, T2	D, CS
Slovakia	384	4	8	0.0%	4	83%	-376	-98%	T2	CS
Slovenia	267	636	593	1.3%	-43	-7%	326	122%	T1	D
EU-27	**83,028**	**48,252**	**47,161**	**100.0%**	**-1,091**	**-2%**	**-35,867**	**-43%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.40 1A4a Commercial/Institutional, solid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	27,789	1,988	2,047	32.6%	60	3%	-25,742	-93%		
Bulgaria	60	19	17	0.3%	-1	-8%	-42	-71%	T2	CS,D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	6,274	114	123	2.0%	9	8%	-6,151	-98%	T1	CS,D
Estonia	8	3	1	0.0%	-2	-58%	-7	-86%	T1,T2	CS,D
Hungary	650	13	12	0.2%	-1	-8%	-639	-98%	T1	D
Latvia	1,332	69	94	1.5%	25	36%	-1,238	-93%	T1	CS,OTH
Lithuania	1,186	225	206	3.3%	-19	-8%	-980	-83%	T1	CS,D
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	11,633	3,193	3,741	59.5%	548	17%	-7,892	-68%	T2	CS,D
Romania	NO	1	2	0.0%	1	183%	2	-	T2	CS
Slovakia	1,729	58	44	0.7%	-15	-25%	-1,685	-97%	T2	CS
Slovenia	200	NO	NO	-	-	-	-200	-100%	NA	NA
EU-27	**50,861**	**5,683**	**6,288**	**100.0%**	**605**	**11%**	**-44,573**	**-88%**		

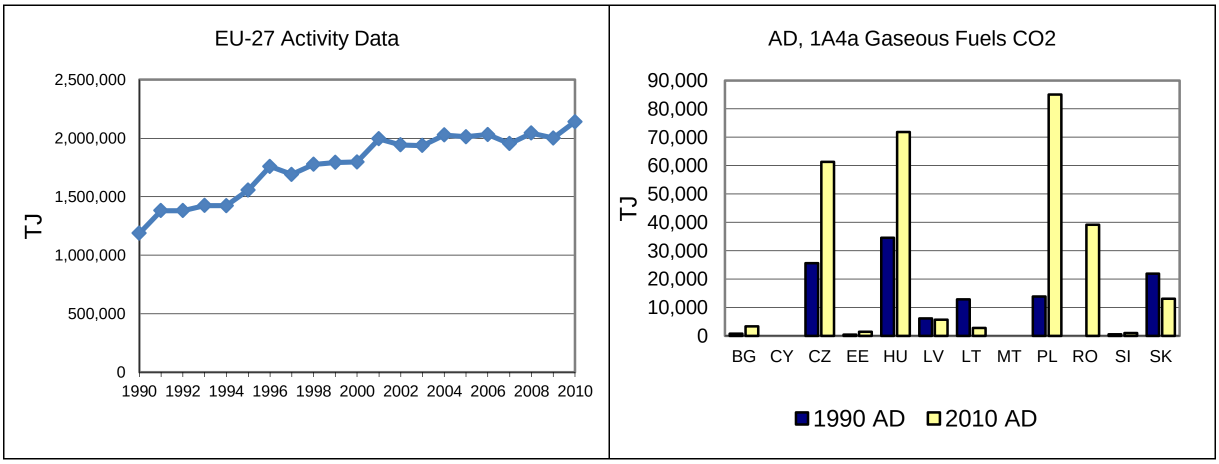
Abbreviations explained in the Chapter 'Units and abbreviations'.

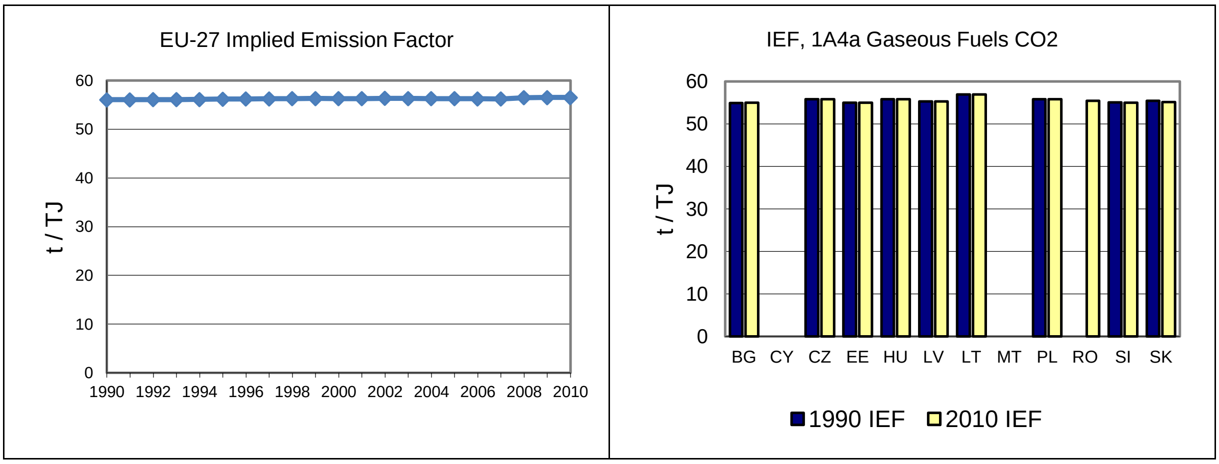
Table 18.41 1A4a Commercial/Institutional, gaseous fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	60,058	98,729	105,089	86.9%	6,360	6%	45,031	75%		
Bulgaria	39	152	184	0.2%	32	21%	146	376%	T2	CS
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	1,428	3,002	3,424	2.8%	422	14%	1,996	140%	T1	D
Estonia	20	72	76	0.1%	4	5%	56	274%	T2	CS
Hungary	1,928	3,599	4,021	3.3%	422	12%	2,093	109%	T1	D
Latvia	337	300	311	0.3%	11	4%	-27	-8%	T2	CS
Lithuania	730	148	159	0.1%	11	7%	-571	-78%	T1	CS
Malta	NO	NO	NO	-	-	-	0	-	NA	NA
Poland	770	3,925	4,745	3.9%	820	21%	3,975	517%	T2	D
Romania	NO	2,151	2,171	1.8%	20	1%	2,171	-	T2	CS
Slovakia	1,215	691	718	0.6%	27	4%	-498	-41%	T2	CS
Slovenia	29	42	54	0.0%	13	30%	25	88%	T1	CS
EU-27	**66,554**	**112,810**	**120,951**	**100.0%**	**8,141**	**7%**	**54,398**	**82%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 18.27 1A4a Commercial/Institutional, gaseous fuels: Activity Data and Implied Emission Factors for CO_2





18.2.4.2 Residential (1A4b) (EU-27)

Figure 18.28 1A4b Residential, CO_2 and N_2O emission and activity trends

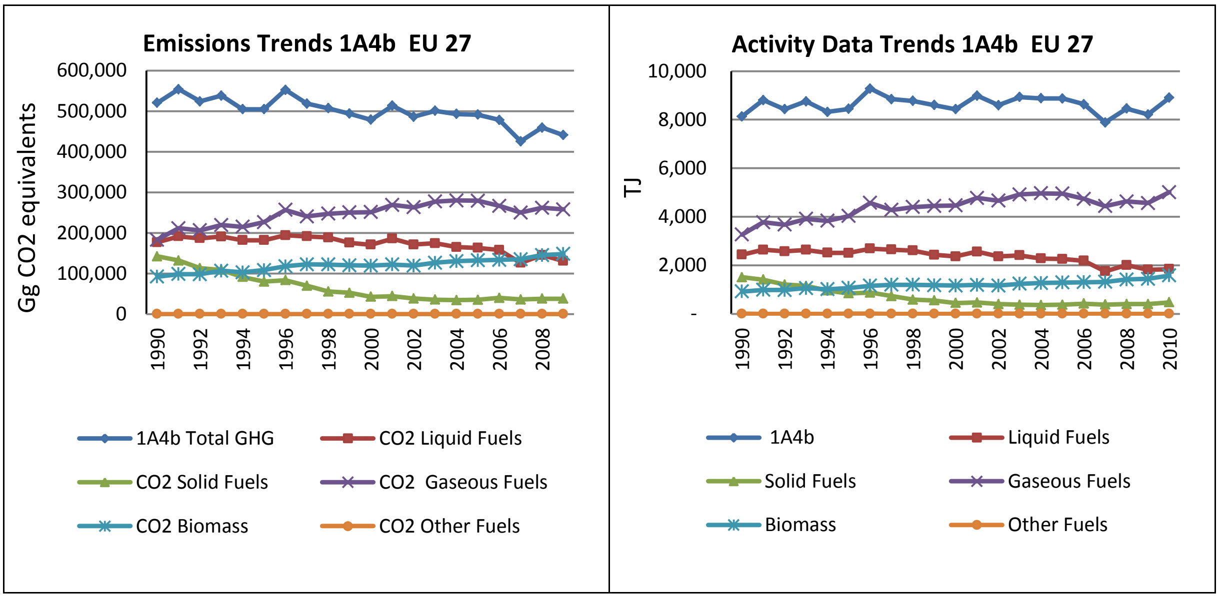


Table 18.42 1A4b Residential, liquid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	169,658	126,287	128,748	97.0%	2,460	2%	-40,910	-24%		
Bulgaria	156	69	61	0.0%	-9	-12%	-95	-61%	T1	D
Cyprus	55	113	96	0.1%	-17	-15%	41	75%	T1	D
Czech Republic	490	34	11	0.0%	-23	-68%	-479	-98%	T1	D
Estonia	550	40	38	0.0%	-3	-6%	-512	-93%	T1,T2	CS,D
Hungary	3,423	209	276	0.2%	66	32%	-3,147	-92%	T1	D
Latvia	330	138	154	0.1%	16	11%	-176	-53%	T1	CS
Lithuania	399	108	113	0.1%	5	5%	-286	-72%	T1	CS
Malta	35	46	41	0.0%	-5	-11%	6	18%	D,T1	D
Poland	106	2,201	1,592	1.2%	-609	-28%	1,486	1398%	T2	D
Romania	912	839	620	0.5%	-220	-26%	-293	-32%	T1, T2	D, CS
Slovakia	NO	73	80	0.1%	8	10%	80	-	NA	NA
Slovenia	434	890	930	0.7%	40	4%	495	114%	T1	D
EU-27	**176,548**	**131,048**	**132,758**	**100.0%**	**1,710**	**1%**	**-43,790**	**-25%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 18.29 1A4b Residential, liquid fuels: Activity Data and Implied Emission Factors for CO_2

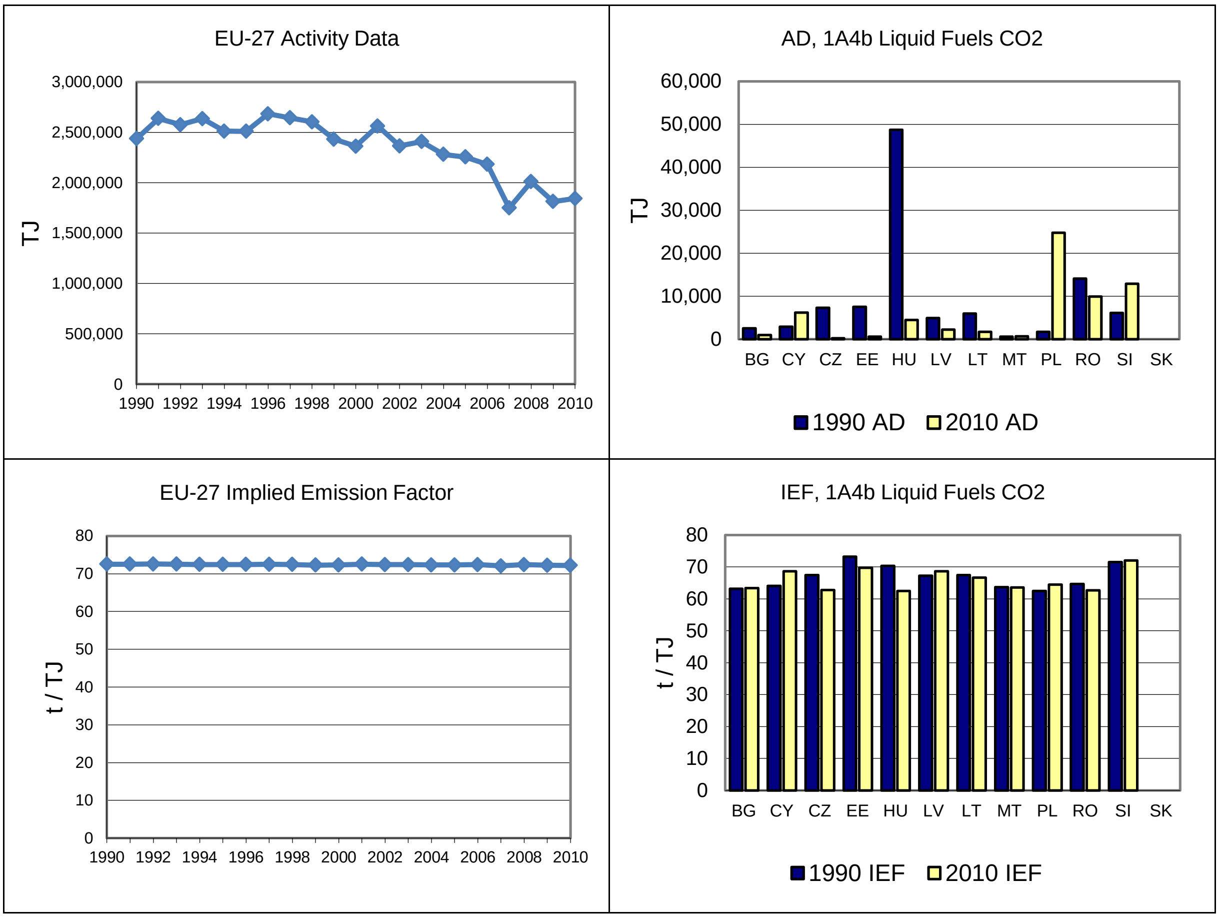


Table 18.43 1A4b Residential, solid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	74,513	11,006	12,035	27.1%	1,029	9%	-62,478	-84%		
Bulgaria	2,635	553	758	1.7%	205	37%	-1,876	-71%	T2	CS,D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	17,373	2,166	2,357	5.3%	191	9%	-15,016	-86%	T1	CS,D
Estonia	669	30	34	0.1%	4	15%	-635	-95%	T1,T2	CS,D
Hungary	7,981	572	610	1.4%	38	7%	-7,370	-92%	T1	CS,D
Latvia	585	82	106	0.2%	24	29%	-480	-82%	T1	CS
Lithuania	1,459	143	244	0.5%	101	71%	-1,215	-83%	T1	CS,D
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	25,923	22,337	27,832	62.6%	5,495	25%	1,909	7%	T2	CS,D
Romania	2,706	53	37	0.1%	-16	-30%	-2,668	-99%	T1,T2	D,CS
Slovakia	5,949	260	452	1.0%	192	74%	-5,497	-92%	T2	CS
Slovenia	338	3	3	0.0%	-1	-16%	-335	-99%	T1	D
EU-27	**140,131**	**37,206**	**44,469**	**100.0%**	**7,263**	**20%**	**-95,662**	**-68%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.44 1A4b Residential, gaseous fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	161,967	228,819	252,378	89.0%	23,558	10%	90,411	56%		
Bulgaria	NO	117	114	0.0%	-3	-3%	114	-	T2	CS
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	2,746	4,813	5,568	2.0%	755	16%	2,822	103%	T1	D
Estonia	116	116	126	0.0%	11	9%	10	9%	T2	CS
Hungary	3,937	7,827	7,905	2.8%	78	1%	3,969	101%	T1	D
Latvia	220	238	288	0.1%	50	21%	69	31%	T2	CS
Lithuania	526	346	377	0.1%	31	9%	-149	-28%	T1	CS
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	6,821	7,528	8,285	2.9%	757	10%	1,464	21%	T2	D
Romania	5,225	4,971	5,119	1.8%	147	3%	-106	-2%	T2	CS
Slovakia	1,586	2,767	3,066	1.1%	299	11%	1,480	93%	T2	CS
Slovenia	25	244	262	0.1%	18	7%	237	948%	T1	CS
EU-27	**183,168**	**257,785**	**283,487**	**100.0%**	**25,702**	**10%**	**100,319**	**55%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 18.30 **1A4b Residential, gaseous fuels: Activity Data and Implied Emission Factors for CO_2**

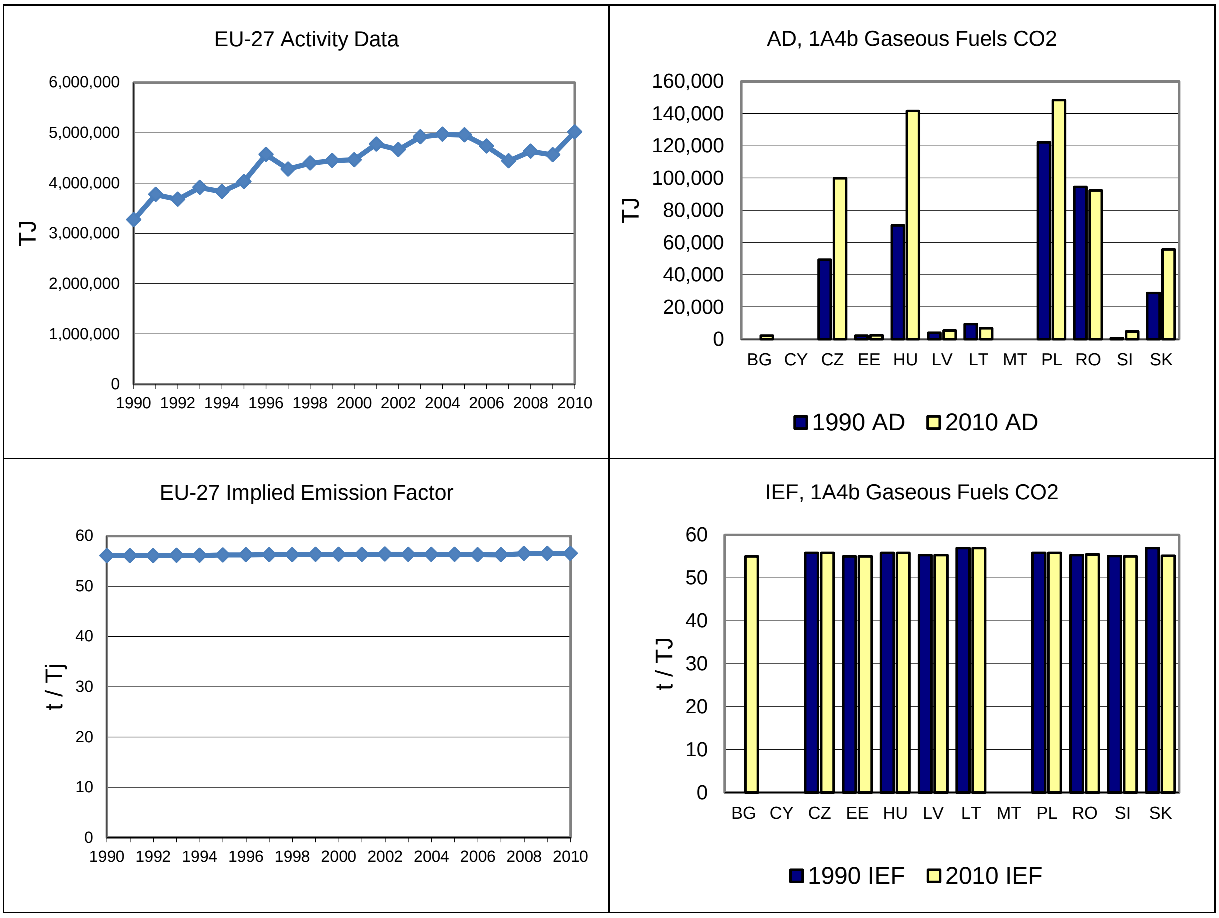


Table 18.45 **1A4b Residential, biomass: CH_4 emissions of EU-27**

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010	
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
EU-15	5,917	4,447	4,616	60.6%	169	4%	-1,301	-22%
Bulgaria	45	172	188	2.5%	15	9%	142	312%
Cyprus	NA	2	1	0.0%	-0.63	-33%	1	-
Czech Republic	37	274	305	4.0%	31	11%	268	724%
Estonia	34	108	112	1.5%	3.04	3%	78	231%
Hungary	46	93	174	2.3%	80	86%	127	274%
Latvia	126	212	194	2.5%	-18	-9%	68	54%
Lithuania	57	154	151	2.0%	-2.73	-2%	95	167%
Malta	NA	NA	NA	-	-	-	-	-
Poland	216	646	710	9.3%	65	10%	494	228%
Romania	152	895	930	12.2%	35	4%	778	513%
Slovakia	30	119	108	1.4%	-11	-9%	78	259%
Slovenia	86	114	122	1.6%	7.78	7%	36.21	42%
EU-27	**6,746**	**7,237**	**7,611**	**100.0%**	**374**	**5%**	**865**	**13%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

18.2.4.3 Agriculture/Forestry/Fisheries (1A4c) (EU-27)

Figure 18.31 1A4c Agriculture/Forestry/Fisheries, CO_2 and N_2O emission and activity trends

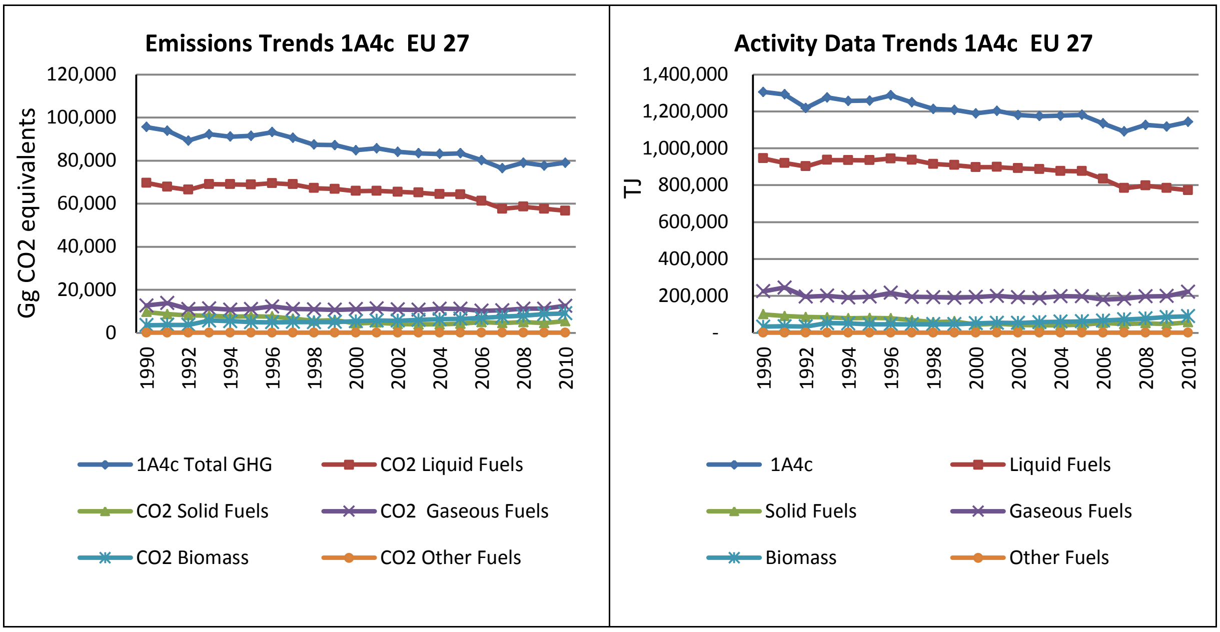


Table 18.46 1A4c Agriculture/Forestry/Fisheries, liquid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	56,845	50,125	49,208	86.9%	-917	-2%	-7,636	-13%		
Bulgaria	1,482	390	381	0.7%	-9	-2%	-1,102	-74%	T1	D
Cyprus	14	21	20	0.0%	-1	-4%	6	42%	T1	D
Czech Republic	342	27	30	0.1%	3	12%	-312	-91%	T1	D
Estonia	477	191	199	0.4%	8	4%	-278	-58%	T1,T2	CS,D
Hungary	2,134	697	780	1.4%	83	12%	-1,354	-63%	T1	D
Latvia	694	308	330	0.6%	22	7%	-364	-52%	T1	CS
Lithuania	103	22	29	0.1%	6	29%	-74	-72%	T1	CS
Malta	NE	11	11	0.0%	1	6%	11	-	D,T1	D
Poland	3,715	4,867	4,726	8.3%	-141	-3%	1,010	27%	T2	D
Romania	3,479	703	682	1.2%	-21	-3%	-2,798	-80%	T1, T2	D, CS
Slovakia	3	4	6	0.0%	3	80%	3	109%	T2	CS
Slovenia	329	202	207	0.4%	5	3%	-122	-37%	T1	D
EU-27	**69,619**	**57,567**	**56,609**	**100.0%**	**-958**	**-2%**	**-13,010**	**-19%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.47 1A4c Agriculture/Forestry/Fisheries, solid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	3,712	256	301	5.5%	45	18%	-3,411	-92%		
Bulgaria	147	20	16	0.3%	-4	-22%	-131	-89%	T2	CS,D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	1,493	53	53	1.0%	0	0%	-1,440	-96%	T1	CS,D
Estonia	16	NO	NO	-	0	-	-16	-	NA	NA
Hungary	212	3	2	0.0%	-1	-36%	-210	-99%	T1	D
Latvia	95	2	2	0.0%	0	0%	-92	-97%	T1	CS
Lithuania	148	2	2	0.0%	0	-11%	-146	-99%	T1	CS,D
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	3,688	4,270	5,030	92.4%	759	18%	1,342	36%	T2	CS,D
Romania	67	39	35	0.64%	-4	-10%	-32	-48%	T1	D
Slovakia	1	2	1	0.0%	-1	-30%	0	6%	T2	CS
Slovenia	NO	NO	NO	-	-	-	-	-	NA	NA
EU-27	**9,579**	**4,647**	**5,442**	**100.0%**	**794**	**17%**	**-4,137**	**-43%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.48 1A4c Agriculture/Forestry/Fisheries, gaseous fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	8,716	10,345	11,606	92.2%	1,260	12%	2,889	33%		
Bulgaria	3	60	56	0.4%	-3	-6%	53	1628%	T2	CS
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	415	121	149	1.2%	29	24%	-265	-64%	T1	D
Estonia	4	2	2	0.0%	1	43%	-1	-40%	T2	CS
Hungary	627	290	288	2.3%	-2	-1%	-339	-54%	T1	D
Latvia	779	29	54	0.4%	25	87%	-725	-93%	T2	CS
Lithuania	168	64	74	0.6%	10	16%	-93	-56%	T1	CS
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	25	88	83	0.7%	-5	-6%	58	232%	T2	D
Romania	1,919	145	171	1.4%	26	18%	-1,749	-91%	T2	CS
Slovakia	41	93	101	0.8%	7	8%	60	146%	T2	CS
Slovenia	NO	NO	NO	-	-	-	-	-	NA	NA
EU-27	**12,696**	**11,237**	**12,585**	**100.0%**	**1,348**	**12%**	**-112**	**-1%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

18.2.5 Other (CRF Source Category 1A5) (EU-27)

18.2.5.1 Stationary (1A5a) (EU-27)

Table 18.49 1A5a Stationary, solid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	4,667	10	10	70.5%	0	-1%	-4,657	-100%		
Bulgaria	29	NO	NO	-	-	-	-29	-100%	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	NO	NO	NO	-	-	-	-	-	NA	NA
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	NO	NO	NO	-	-	-	-	-	NA	NA
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	IE,NO	IE,NO	IE,NO	-	-	-	-	-	NA	NA
Malta	NA	NA	NA	-	-	-	-	-	NA	NA
Poland	IE	IE	IE	-	-	-	-	-	NA	NA
Romania	1,191	NO	NO	-	-	-	-1,191	-100%	NA	NA
Slovakia	198	4	4	29.5%	0	8%	-194	-98%	T2	CS
Slovenia	NA	NA	NA	-	-	-	-	-	NA	NA
EU-27	6,085	13	14	**100.0%**	**0**	**1%**	**-6,071**	**-100%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

18.2.5.2 Mobile (1A5b) (EU-27)

Table 18.50 1A5b Mobile, liquid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	13,672	5,737	5,256	82.1%	-481	-8%	-8,416	-62%		
Bulgaria	NO	NO	NO	-	-	-	-	-	NA	NA
Cyprus	NA	NA	NA	-	0	-	-	-	NA	NA
Czech Republic	1,601	1,117	1,083	16.9%	-34	-3%	-518	-32%	T1	D
Estonia	44	29	41	0.6%	12	40%	-3	-6%	T1	D
Hungary	NO	NO	NO	-	-	-	-	-	NA	NA
Latvia	NO	2	1	0.0%	-1	-47%	1	-	T2	CS
Lithuania	NE,NO	11	16	0.2%	5	41%	16	-	T1	D
Malta	NA	NA	NA	-	-	-	-	-	NA	NA
Poland	NO	NO	NO	-	-	-	-	-	NA	NA
Romania	NA	NA	NA	-	-	-	-	-	NA	NA
Slovakia	NA	NA	NA	-	-	-	-	-	NA	NA
Slovenia	NA	3	3	0.0%	-0.45	-13%	3	-	T1	D
EU-27	**15,316**	**6,901**	**6,400**	**100.0%**	**-501**	**-7%**	**-8,916**	**-58%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

18.2.6 Fugitive emissions from fuels (CRF Source Category 1.B) (EU-27)

18.2.6.1 Fugitive emissions from Solid Fuels (1B1) (EU-27)

Table 18.51 1B1a Coal Mining: CH_4 emissions of EU-27

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	44.014	6.711	6.295	33,5%	-416	-6%	-37.718	-86%		
Bulgaria	1.619	686	742	3,9%	56	8%	-877	-54%	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	7.600	3.200	3.265	17,4%	66	2%	-4.335	-57%	T3	CS
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	659	14	12	0,1%	-2	-15%	-648	-98%	NA	NA
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	NA	NA	NA	-	-	-	-	-	NA	NA
Poland	13.092	7.282	7.148	38,0%	-134	-2%	-5.944	-45%	NA	NA
Romania	3.267	920	783	4,2%	-137	-15%	-2.484	-76%	NA	NA
Slovakia	571	355	320	1,7%	-36	-10%	-251	-44%	NA	NA
Slovenia	303	249	249	1,3%	0,09	0%	-53	-18%	T3	CS
EU-27	**71.124**	**19.417**	**18.814**	**100,0%**	**-603**	**-3%**	**-52.310**	**-74%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

18.2.6.2 Fugitive emissions from oil and natural gas (1B2) (EU-27)

Table 18.52 1B2a Fugitive CO_2 emissions from oil: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	7.838	9.131	8.768	93,6%	-362	-4%	930	12%		
Bulgaria	1	0,27	0,25	0,0%	-0,02	-8%	-0,40	-62%	T1	D
Cyprus	NA,NE,NO	NA,NE,NO	NA,NE,NO	-	-	-	-	-	NA	NA
Czech Republic	0,02	0,07	0,06	0,0%	-0,01	-18%	0,04	203%	T1	D
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	1	0	0	0,0%	-0,02	-7%	-0,38	-62%	D	D
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	0,051	0,067	0,063	0,001%	-0,004	-7%	0,012	25%	T1	D
Malta	NA,NE	NA,NE	NA,NE	-	-	-	-	-	NA	NA
Poland	43	185	185	2,0%	0	0%	142	335%	CS,T1	CS,D
Romania	769	436	416	4,4%	-20	-5%	-354	-46%	T1	D
Slovakia	0,0012	0,0007	0,0006	0,0%	-0,000149	-21%	-0,000591	-51%	T1	CS
Slovenia	NO	NO	NO	-	-	-	-	-	NA	NA
EU-27	**8.652**	**9.752**	**9.370**	**100,0%**	**-382**	**-4%**	**718**	**8%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.53 1B2b Fugitive CH_4 emissions from natural gas: CH_4 emissions of EU-27

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	25.937	18.474	18.552	62,1%	78	0%	-7.385	-28%		
Bulgaria	751	416	457	1,5%	41	10%	-294	-39%	T1	D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	878	666	701	2,3%	35	5%	-177	-20%	T1,T2	CS
Estonia	178	76	82	0,3%	6	7%	-96	-54%	T1	D
Hungary	908	1.514	1.533	5,1%	19	1%	625	69%	D	OTH
Latvia	236	100	93	0,3%	-7	-7%	-143	-61%	CS	PS
Lithuania	IE,NO	IE,NO	IE,NO	-	-	-	-	-	NA	NA
Malta	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Poland	3.076	4.187	4.405	14,8%	218	5%	1.329	43%	T1	CS
Romania	7.681	3.297	3.353	11,2%	55	2%	-4.328	-56%	T1	D
Slovakia	448	681	657	2,2%	-23	-3%	209	47%	T1	CS
Slovenia	58	29	29	0,1%	-0,21	-1%	-28	-49%	T1,T3	CS,D
EU-27	**40.151**	**29.439**	**29.861**	**100,0%**	**422**	**1%**	**-10.289**	**-26%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 18.54 1B2c Fugitive CO_2 emissions from venting and flaring: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	6.663	5.776	5.915	94,4%	139	2%	-747	-11%		
Bulgaria	3	2	4	0,1%	2	132%	1	33%	T1	D
Cyprus	NE,NO	NE,NO	NE,NO	-	-	-	-	-	NA	NA
Czech Republic	4	17	14	0,2%	-3,33	-20%	10	254%	T1	D
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	173	100	90	1,4%	-10	-10%	-82	-48%	D	D,PS
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	1	9	9	0,1%	0	0%	8	872%	T1	D
Malta	NA	NA	NA	-	-	-	-	-	NA	NA
Poland	0	0	0	0,0%	0,000	0%	0,005	329%	D	D
Romania	438	244	234	3,7%	-10,643	-4%	-203,930	-47%	T1	D
Slovakia	0,02	0,02	0,02	0,0%	-0,003	-15%	0,000	-2%	T1	CS
Slovenia	NO	NO	NO	-	-	-	-	-	NA	NA
EU-27	**7.281**	**6.148**	**6.267**	**100,0%**	**118**	**2%**	**-1.014**	**-14%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

18.3 Reference approach (new Member States)

Table 18.55 Comparison between Eurostat and national reference approach for fuel combustion for the new MS (CRF 1.A) (45);

MS	Gaseous fuels			Liquid fuels			Solid fuels		
	Eurostat TJ	Crf TJ	Difference %	Eurostat TJ	Crf TJ	Difference %	Eurostat TJ	Crf TJ	Difference %
BG	93,838	96,312	2.6%	161,610	159,972	-1.0%	288,336	288,578	0.1%
CY	- -	- -	- -	96,926	97,587	0.7%	702	697	-0.7%
CZ	335,723	336,360	0.2%	377,719	369,899	-2.1%	773,452	759,827	-1.8%
EE	23,551	23,553	0.0%	42,628	22,208	-47.9%	163,998	164,427	0.3%
HU	410,955	410,955	0.0%	276,412	273,293	-1.1%	114,219	117,457	2.8%
LT	104,321	82,007	-21.4%	106,292	104,231	-1.9%	8,604	8,730	1.5%
LV	61,206	61,313	0.2%	49,222	49,029	-0.4%	4,565	4,458	-2.3%
MT	- -	- -	- -	33,896	33,945	0.1%	- -	- -	- -
PL	536,108	536,109	0.0%	1,083,845	1,080,212	-0.3%	2,286,192	2,318,133	1.4%
RO	451,681	451,681	0.0%	380,186	350,782	-7.7%	293,437	291,189	-0.8%
SI	36,125	36,126	0.0%	106,643	106,507	-0.1%	61,042	59,595	-2.4%
SK	419,218	419,862	0.2%	305,404	283,546	-7.2%	304,717	296,408	-2.7%

(45) Minus means that Member State-based estimates are lower than the Eurostat-based estimates.

19 Industrial processes (CRF Sector 2)

19.1 Overview of sector (EU-27)

CRF Sector 2 Industrial Processes is the third largest sector contributing 7 % to total EU-27 GHG emissions in 2010. The most important GHGs from this sector are CO_2 (5 % of total GHG emissions), HFCs (2 %) and N_2O (0.4 %). The emissions from this sector decreased by 26 % from 462 Tg in 1990 to 343 Tg in 2010 (Figure 19.1). In 2010, the emissions increased by 4.4 % compared to 2010, due to the recovery of the economic recession. Cement production dominates the trend until 1997. Factors for declining emissions in the early 1990s were low economic activity and cement imports from Eastern European countries. Between 1997 and 1999 the trend is dominated by reduction measures in the adipic acid production in Germany, France and the UK. In addition, between 1998 and 1999 large reductions were achieved in the UK due to reduction measures in HCFC production. The large decrease in 2009 mainly occurred in cement production and iron and steel production.

Figure 19.1 CRF Sector 2 Industrial Processes: EU-27 GHG emissions for 1990–2010 in CO_2 equivalents (Tg)

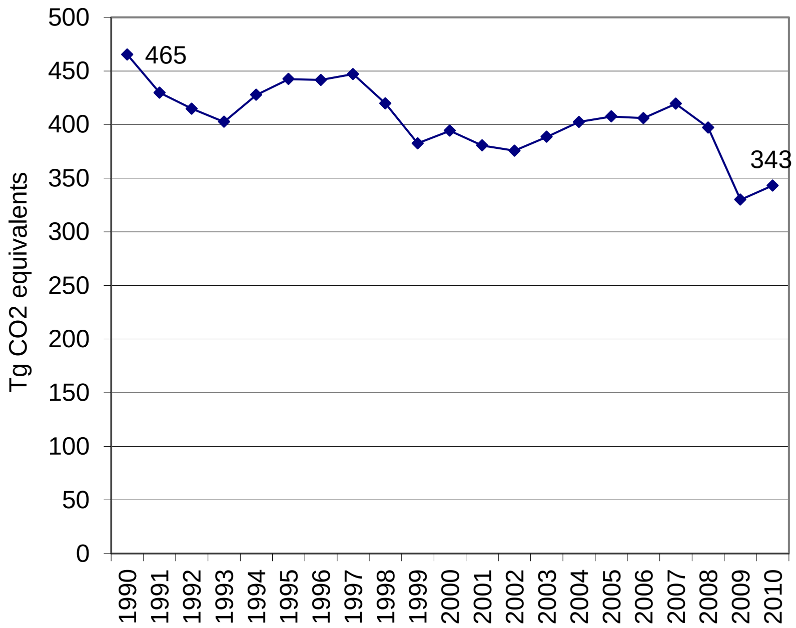
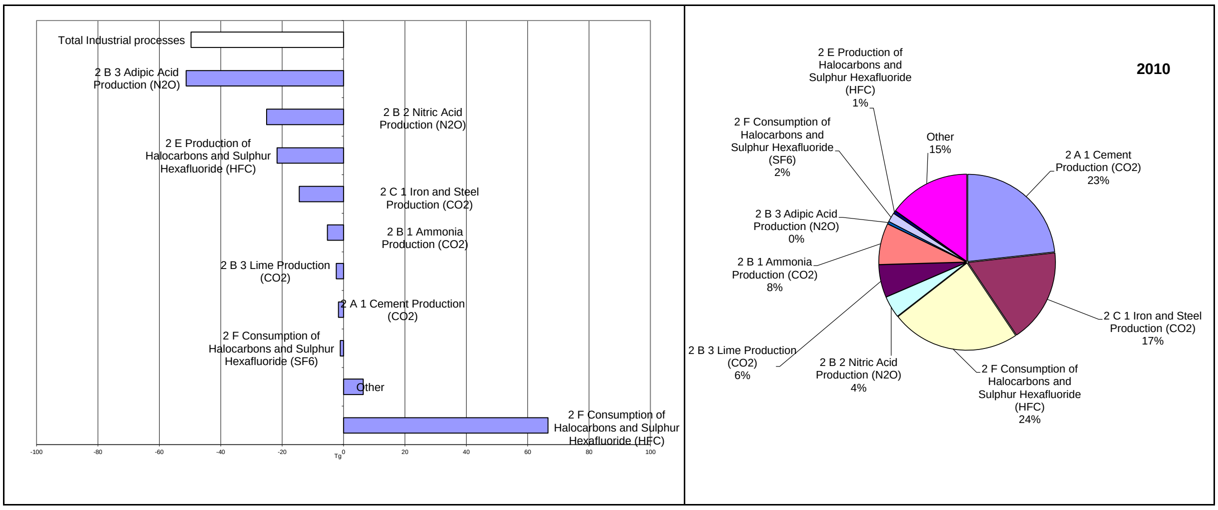


Figure 19.2 shows that large emission reductions occurred in adipic acid production (N_2O) mainly due to reduction measures in Germany, France, the UK and Italy, and in production of halocarbons and SF_6 (HFCs). Additional N_2O emission reductions were achieved in nitric acid production. Large HFC emission increases can be observed from consumption of halocarbons and SF_6. The contribution of the new Member States to a possible change of the share in total process-related GHG emissions is small; again the three largest key sources account for about two thirds of total process-related GHG emissions in the EU-27 (Figure 19.2).

Figure 19.2 CRF Sector 2 Industrial processes: Absolute change of GHG emissions by large key source categories 1990–2010 in CO_2 equivalents (Tg) and share of largest key source categories in 2010



19.2 Source categories (EU-27)

19.2.1 Mineral products (CRF Source Category 2A) (EU-27)

The source category 2A Mineral Products includes three key sources: CO_2 from 2A1 Cement Production, CO_2 from 2A2 Lime Production and CO_2 from 2A3 Limestone and Dolomite Use. In source category 2A1 Cement Production by-product CO_2 emissions in cement production are reported that occur during the production of clinker, an intermediate component in the cement manufacturing process. Source category 2A2 Lime Production accounts for CO_2 emitted through the calcination of the calcium carbonate in limestone or dolomite for lime production. Source category 2A3 Limestone and Dolomite Use covers a number of industrial applications generating CO_2 through the heating of limestone or dolomite, such as in metallurgy (iron and steel), glass manufacture, agriculture, construction or environmental pollution control.

19.2.1.1 2A1 Cement Production

In 2010, CO_2 emissions from 2A1 Cement production were 22 % below 1990 levels in the EU-27; for the EU-15 the decrease of CO_2 emissions from Cement production was 20 % in the period 1990 to 2010. CO_2 emissions decreased by 2 % from 2008 to 2009 in the EU-27 (-1 % in EU-15). In the period 2009-2010, Estonia, Latvia, Lithuania and Poland increased emissions from cement production, while the other new Member States decreased their emissions from cement production. In Latvia a new cement production plant started its operation in 2009. This cement production plant was erected during the economical development period and has a threefold maximum capacity compared to the already existing plant. This was the reason for the strong emission increase in Latvia.

Table 19.1 provides information on emission trends of the key source CO_2 from 2A1 Cement Production for EU-12. Among the new Member States Poland and Romania are the largest emitters accounting for 8 % and 4 %of EU-27 emissions.

Bulgaria, Romania and Lithuania had large reductions in absolute terms between 1990 and 2010. The largest drop in Romanian emissions occurred in 2008-2009, where the production of clinker decreased by 25 %. In the early nineties a significant decrease in Lithuanian emissions (-95 % during 1990 and 1993) was caused by a decrease of the production rate of clinker due to economic changes. The large drop in emissions in Bulgaria was caused by a significant reduction of clinker production – about -75 % in one of the plants, more than -50 % in other two plants and around -20% in the last two plants. In 2010 in some new MS the effects of the economic crisis prevailed such as in Bulgaria, Hungary, Slovakia or Slovenia while other MS recovered from the crisis and increased cement production.

Table 19.1 **2A1 Cement production: CO_2 emissions of EU-27**

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	80,174	65,407	64,532	81.3%	-874	-1%	-15,642	-20%		
Bulgaria	2,100	1,000	805	1.0%	-194	-19%	-1,295	-62%	T2	PS
Cyprus	668	673	555	0.7%	-118	-18%	-113	-17%	T1	PS
Czech Republic	2,489	1,566	1,469	1.9%	-97	-6%	-1,020	-41%	T3	PS
Estonia	483	257	310	0.4%	53	21%	-173	-36%	T2	PS
Hungary	1,797	973	735	0.9%	-237	-24%	-1,062	-59%	T2	PS
Latvia	366	179	431	0.5%	252	141%	65	18%	T2	PS
Lithuania	1,668	284	289	0.4%	5	2%	-1,379	-83%	T2	PS
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	5,453	5,757	6,221	7.8%	464	8%	768	14%	T2,T3	CS
Romania	4,445	3,093	2,778	3.5%	-315	-10%	-1,667	-38%	CS,T2	PS
Slovakia	1,438	1,199	845	1.1%	-354	-30%	-593	-41%	T3	PS
Slovenia	482	433	368	0.5%	-65	-15%	-114	-24%	T2	CS
EU-27	**101,564**	**80,820**	**79,340**	**100.0%**	**-1,481**	**-2%**	**-22,225**	**-22%**		

Table 19.2 shows information on methods applied, activity data, emission factors for CO_2 emissions from 2A1 Cement production in the new Member States for 1990 and 2010. The table shows that all EU-12 MS use clinker production as activity data for calculating CO_2 emissions and it also suggests that 96 % of EU-12 emissions are estimated with higher Tier methods.

The EU-27 IEF (excluding UK, as the British activity data is confidential and thus no IEF is provided) in 2010 is 0.53 t CO_2/t of clinker produced. The implied emission factors per tonne of clinker produced vary slightly from 0.51 t CO_2/t for Hungary to 0.55 t CO_2/t for Slovenia and Estonia; all new MS use country-specific and plant-specific emission factors. No significant changes of IEFs during 1990 and 2010 could be observed for any MS. Only for Hungary a decline of IEF during 1990 and 2010 could be found (-8 %). Explanations for changes of the implied emission factors are given in the following overview:

Implied Emission Factor, Hungary

- *The decrease of IEF from 2002 onwards reflects the dependency on the used limestone and produced clinker quality volume.*

Table 19.2 2A1 Cement Production: Information on methods applied and emission factors for CO_2 emissions

Member State	Method applied	Emission factor	1990 Activity data Description	1990 Activity data (kt)	1990 Implied emission factor (t/t)	1990 CO_2 emissions (Gg)	2010 Activity data Description	2010 Activity data (kt)	2010 Implied emission factor (t/t)	2010 CO_2 emissions (Gg)
EU15			EU15 w/o UK (91%)	136839	0.53	72878	EU15 w/o UK (94%)	114920	0.53	60740
Bulgaria	T2	PS	Clinker production	3987	0.53	2100	Clinker production	1515	0.53	805
Cyprus	T1	PS	Clinker production	1249	0.53	668	Clinker production	1043	0.53	555
Czech Republic	T3	PS	Clinker production	4726	0.53	2489	Clinker production	2748	0.53	1469
Estonia	T2	PS	Clinker production	910	0.53	483	Clinker production	577	0.54	310
Hungary	T2	PS	Clinker production	3210	0.56	1797	Clinker production	1433	0.51	735
Lithuania	T2	PS	Clinker production	3058	0.55	1668	Clinker production	536	0.54	289
Latvia	T2	PS	Clinker production	669	0.55	366	Clinker production	835	0.52	431
Malta	NA	NA		NO	NO	NO		NO	NO	NO
Poland	T2,T3	CS	Clinker production	10309	0.53	5453	Clinker production	11768	0.53	6221
Romania	CS,T2	PS	Clinker production	8379	0.53	4445	Clinker production	5199	0.53	2778
Slovenia	T2	CS	Clinker production	891	0.54	482	Clinker production	681	0.54	368
Slovakia	T3	PS	Clinker production	2836	0.51	1438	Clinker production	1636	0.52	845
EU27			**EU27 w/o UK (93%)**	**177,062**	**0.53**	**94,269**	**EU27 w/o UK (95%)**	**142,891**	**0.53**	**75,548**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 19.3 summarizes the methodological information for cement production provided by EU-12 Member States in their national inventory reports. The majority of the new Member States uses data collected from plants under the EU emission trading scheme (Bulgaria, Cyprus, the Czech Republic, Hungary Poland, Slovakia and Slovenia).

Table 19.3 2A1 Cement Production: Summary of methodological information provided by Member States

Cement Production new MS	
Member State	**Methodology comment**
Bulgaria	The GHG emissions from the sector are calculated by using clinker production data and a country specific method, similar to a Tier 2 Method according to item 3.1.1 from the IPCC GPG. The aggregated national clinker production (CP) data in t/y are provided by the NSI. The 2009 CO2 emissions are taken from the operators EU ETS reports. The aggregated national clinker production (CP) data provided by the NSI and plants cover the period from 1988 to 2009. [NIR 2012]
Cyprus	For the years 2005-2010 detailed data is available via the verified EU ETS reports of the plants. These data refer to the quantities of carbonate raw material (CaCO3, MgCO3) used for the production of clinker. For the period 1997-2004, the data submitted by the installations for the preparation of the National Allocation Plan 2005-2007 was used, whereas for the period 1990-1996, the emissions were estimated using the EF of 1997. For years after 2005, data submitted in the annual reports of the installations for the ETS are used.[NIR 2012]
Czech Republic	CO2 emissions from 2A1 Cement production can be calculated according to the 2000 GPG from the production of cement (Tier 1) or clinker (Tier 2). New IPCC Guidelines (IPCC, 2006) describe a new approach based on direct data from individual operators of cement kilns (Tier 3). Since 2006 submission methodology equal to the Tier 3 has been employed. CO2 emissions are based on data submitted by the cement kiln operators for preparation and standard operation of the EU ETS system, which includes all the cement kilns in Czech Republic. Information from individual kilns is reported to the competent authority. This data covers years 1990, 1996, 1998 - 2002 and 2005 - 2010. For other years the EF was extrapolated. Data on cement clinker production is published by the Czech Cement Association (CCA) (CCA, 2010), which associates all Czech cement producers. Clinker production data together with extrapolated EF was used for years without direct data from cement kiln operators. The IEF, which is calculated based on CO2 emissions and clinker production, varies from 0.5267 to 0.5534 t CO2 / t clinker. [NIR 2012]

Cement Production new MS	
Member State	**Methodology comment**
Estonia	Emissions from cement production were calculated using Tier 2 methodology. Emission factors used in calculating the emissions from cement production are plant-specific provided by the industry. In calculating the emissions from cement production the amount of clinker produced annually is used as activity data. The clinker production data was received directly from the plant - AS Kunda Nordic Cement – throughout the time series. Data on the cement kiln dust was also provided by the plant. [NIR 2012]
Hungary	Emissions were estimated using a country specific method similar to the IPPC Tier 2 methodology. In 2009 four factories were operating in Hungary. Production data for the whole time series were obtained directly from the factories and from the EU Emission Trading System (ETS). The reported quantities of CO2 emitted between 2005 and 2010 are based on reports of the factories. For the preceding years, raw material consumption was used for emission calculation instead of cement or clinker production. [NIR 2012]
Latvia	Tier1 method from IPCC GPG 2000 was used to estimate clinker production data from final cement production amount when clinker / cement ratio for different types of cement is known. For CO2 emission factor as well as emission estimations IPCC GPG 2000 Tier2 method is used. The CO2 emission factor is calculated for all years of the time series 1990–2010 according to CaO content in used limestone that is measured in laboratory of cement production facility. The produced clinker is not weighed in cement production plant but clinker production is estimated from final cement type by multiplying it with cement/clinker ration according to cement producer GHG report.[NIR 2012]
Lithuania	Cement is produced in a single company UAB "Akmenes Cementas". For the period 1990-2004 CO2 emission s were calculated by a Tier 2 method using specific production data provided by the production company. CO2 emissions were calculated from material mass balance assuming that all carbon contained in raw materials (limestone) was released to the atmosphere as CO2. Actual CO2 emissions were calculated from the clinker production data and composition. In addition it was assumed that CO2 was released from calcinated fraction of kiln dust. The data on generation of cement kiln dust (CKD) (fraction not recycled to the kiln) were provided only for 2005-2010. An average value was used for the period when specific data were not available. According to the UAB "Akmenes Cementas", only about 5% of the CKD is calcinated. For the period 2005-2010 CO2 emission data have been accessed via the verified EU ETS reports of the production plant. [NIR 2012]
Malta	Not occuring. [NIR 2012]
Poland	CO2 emission from clinker production is the sum of the process emissions given in the verified reports for 2010 for installation of clinker production, which participate in the EU ETS [KOBiZE 2011]. Data on clinker production for the entire inventoried period was taken from [GUS 1989b-2011b]. CO2 emission from clinker production was taken from the verified reports for the years: 2005-2010 for installations which participate in EU ETS. For other years emissions were estimated based on clinker production and emission factors. [NIR 2012]
Romania	The method for calculating emissions of CO2 from cement is in line with the IPCC GPG 2000 (Tier 2). The AD necessary to estimate emissions from this source category are provided by economic agents (clinker production data) and National Institute for Statistics (cement production). For 1989-2007 period the CO2 emission factor use for clinker was 0.53 t CO2/t clinker (average between the base year 1989 implied EF and 2008 EF (the first year with laboratory analyses for plant specific CaO and MgO content in clinker). Starting with 2008 the figures related with clinker production, plant specific CO2 EF for clinker production and CO2 emissions from clinker production were compared with the data reported in monitoring plan of GHG emissions for the EU-ETS cement production installations. [NIR 2012]
Slovak Republic	According to the IPCC Guidelines, it is a good practice that CO2 emissions are estimated from the mass of produced cement clinker from cement. However, in the Slovak Statistical Yearbook only Portland cement clinker is published. The cement plants in the Slovak Republic (4 plants), where cement clinker is produced, are included into the ETS and the verification reports from the ETS were used for CO2 emission inventory. Production of cement from clinker is based on milling the clinker with solid additives. Therefore it is meaningful to balance only clinker production. On the basis of the information provided into the verified ETS reports, Tier 2 methodology according to the IPCC 2000 Good Practice Guidance has been applied since 2002 based on plant specific information. The calculations provided by the cement clinker producers in the ETS reports balanced CO2 emissions on the basis of cement clinker production and CaO and MgO contents. [NIR 2012]
Slovenia	The Tier 2 method has been applied. Activity data are data on the annual production of clinker. Clinker production data were obtained from the Statistical Office of the Republic of Slovenia for the period 1986–1998, and directly from the two plants that produce cement for the years 1999–2010. EFs from both before and after 2005 based on plant specific production conditions. There are two producers of cement in Slovenia and the data for both periods were obtained from these two cement works. The same sources of raw material and methodology were used for calculation both before and after 2005 EFs. To calculate emissions from cement production after 2005 we have been using data obtained by EU ETS. Data on clinker production and plant specific emission factors for both cement factories have been annually verified by independent verifiers. [NIR 2012]

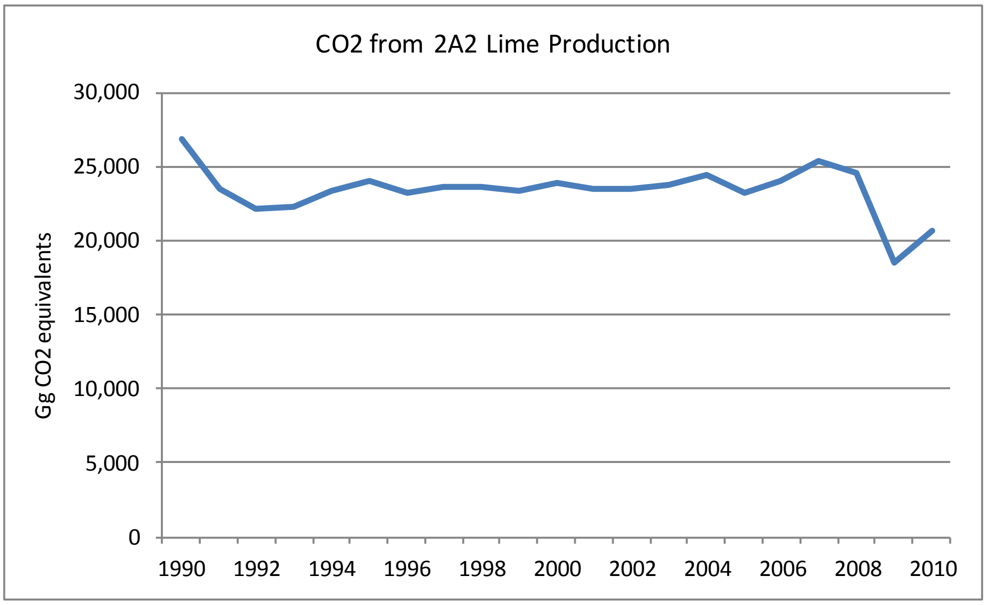
Source: NIR 2012.

19.2.1.2 2A2 Lime Production

CO_2 emissions from 2A2 Lime Production account for 0.4 % of EU-27 total GHG emissions in 2010. Between 1990 and 2010, CO_2 emissions from this source decreased by 23 % in the EU-27, and in the EU-15 emissions decreased by 13 % in the same period, thus emphasizing the large emission reductions in the new Member States (Table 19.4).

Romania and Poland are the largest emitters accounting for 7.6 % and 6.7 % of EU-27 emissions respectively, followed by Bulgaria (4.5 %). The decrease of CO_2 emissions between 1990 and 2010 was mainly caused by reductions during 1990 and 1993 (-17%) occurring in Bulgaria (-66%), the Czech Republic (-42 %), Hungary (-43 %), Romania (-35 %) and Slovenia (-51 %), due to a decreased production of lime and dolomite in that period (Figure 4.3).

Figure 19.3 2A2 Lime Production: EU-27 CO_2 emissions



An increase of CO_2 emissions from lime production between 1990 and 2010 could only be found for Cyprus and Latvia. Nevertheless this offset does not contribute to the emission trend due to the negligible share of Cyprus and Latvia in EU-27 emissions (Table 19.4). All new MS increased emissions from lime production between 2009 and 2010 after a large emission decrease in the years before due to the economic crisis.. In absolute terms CO_2 emissions increased mostly in Bulgaria in that time period..

The table shows that about 33 % of EU-12 CO_2 emissions from 2A2 Lime Production are estimated with higher Tier methods.

Table 19.4 2A2 Lime Production: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	17,220	13,519	15,053	72.8%	1,534	11%	-2,167	-13%		
Bulgaria	1,035	641	920	4.4%	279	44%	-116	-11%	T2	D
Cyprus	4	8	9	0.0%	1	10%	5	149%	D	D
Czech Republic	1,337	625	671	3.2%	45	7%	-666	-50%	T1	CS
Estonia	131	16	18	0.1%	2	11%	-114	-87%	T1	PS
Hungary	653	206	211	1.0%	5	3%	-442	-68%	D,T2	D
Latvia	8	7	13	0.1%	6	84%	5	56%	T1	D
Lithuania	216	4	19	0.1%	14	339%	-198	-91%	T1	D
Malta	NE	NO	NO	-	-	-	-	-	NA	NA
Poland	2,453	1,315	1,379	6.7%	64	5%	-1,074	-44%	T1	D
Romania	2,807	1,468	1,554	7.5%	86	6%	-1,252	-45%	D	D
Slovakia	770	689	729	3.5%	39	6%	-42	-5%	T3	PS
Slovenia	206	71	90	0.4%	19	27%	-116	-56%	D	CS
EU-27	**26,840**	**18,570**	**20,665**	**100.0%**	**2,095**	**11%**	**-6,175**	**-23%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 19.3 summarizes the methodological information for lime production provided by EU-12 Member States in their national inventory reports. Latvia, Slovenia and Slovakia included an explicit reference to the use of plant-specific data under the EU ETS

Table 19.5 2A2 Lime Production: Summary of methodological information provided by Member States

Lime Production new MS	
Member State	**Methodology comment**
Bulgaria	The emissions from the sector are calculated using country specific data on the total amount of lime produced provided by NSI. Default emission factor is applied. The emissions are estimated following the general approach recommended in 1996 IPCC Guidelines and using the following equation from 2000 GPG (p.3.19). Country specific data on the total lime production (quicklime) are provided by NSI. [NIR 2012]
Cyprus	The calculation of GHG emissions from Industrial Processes is based on the methodologies described in Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, the 2000 IPCC Good Practice Guidance and the EMEP/CORINAIR Emission Inventory Guidebook 2007. [NIR 2012]
Czech Republic	Emissions from lime production were calculated in accordance with 2000 GPG. Only CO2 emissions generated in the process of the calcination step of lime treatment are considered under category 2A2. CO2 emissions from combustion processes (heating of kilns and furnaces) are reported under category 1A2f. National EF reflects the production of lime and quick lime (0.7884 t CO2 / t lime) (Vácha, 2004). Activity data are based on statistics from the Czech Lime Association (CLA, 2011), which publishes data on pure lime production, so that these data were considered to be more accurate in comparison with data from the Czech Statistical Office, which do not differentiate between lime and hydrated lime. [NIR 2012]
Estonia	Emissions from lime production are calculated by multiplying emission factors with activity data. Activity data are collected mainly directly from the industry but in the earlier years (1990–1996) industrial statistics have also been used. Emission factors are calculated by the industry or are based on IPCC's default factors. The methods for calculating emissions from lime production are consistent with the IPCC Tier 1 level method. [NIR 2012]
Hungary	The amount of CO2 generated by this sub-sector was calculated according to the method recommended by the Revised Guidelines. The emissions were calculated using the production data received from the manufacturers and the proper stoichiometric ratio (0.785). Naturally, the corresponding stoichiometric ratio was used for slack lime (Ca(OH)2) production data as well. [NIR 2012]
Latvia	CO2 emissions from lime production in steel production plant are estimated with Tier1 method based on total produced quicklime data and default emission factor. Default CO2 emission factor from IPCC GPG was used by steel production plant as per tonne of high calcium quicklime – 0.785 tCO2/t lime. Activity data of produced lime in steel production company is taken from plant's GHG reports within ETS. [NIR 2012]
Lithuania	The data on lime production were provided by the Statistics Lithuania. The data on hydrated lime production are provided by the Statistics Lithuania from 2002. Actual hydrated lime production data were used for emission calculation in 2002-2010 and it was assumed that hydrated lime production was zero in 1990 to 2001. CO2 emission was calculated by Tier 2 method using production data provided by the Statistics Lithuania and limestone composition data provided by the AB "Naujasis Kalcitas". CO2 emissions were calculated from material mass balance assuming that all carbon contained in raw materials (limestone) was released to the atmosphere as CO2. [NIR 2012]

Lime Production new MS	
Member State	**Methodology comment**
Malta	Lime production was commonplace in Malta in the past. Nowadays the industry has stopped operating and any lime used in Malta is imported. The activity data utilised (quantity of lime produced) was compiled by Gauci from data provided by the National Office of Statistics. The CO2 emissions from this activity during the period 1995-1998 have been reported. For the years 1990 till 1994 no emissions have been reported, since at the time only two lime production plants were operational and hence the quantities of lime roduced were confidential data and were not available at the National Statistics Office. The 2006 IPCC Guidelines [3] provide two default emission factors. The Lime produced in Malta can be classified as high Calcium lime, thus an emission factor of 0.75 [ton CO2 per ton lime] is used.[NIR 2012]
Poland	Emission of CO2 from lime production was calculated based on data on lime production from [GUS 2011b]. The applied emission factor is estimated according to IPCC recomendations [IPCC 2000]. Emission for entire period 1988-2010 was estimated based on emission factors. Data about production was taken from statistical yearbooks [GUS 1989b-2011b]. The same value of emission factor equal 767 kg CO2/Mg of lime was used for all years. [NIR 2012]
Romania	Total CO2 emissions from lime production were estimated using production data and the emission factors, in line with the Good Practice Guidance - IPCC GPG 2000. The ADs necessary to estimate emissions from this source category (quicklime and dolomite lime) are provided by the National Statistics. The data set in case of dolomite lime production is not complete; the data for 1989-1991 are missing. A linear extrapolation was used to estimate dolomite lime production for 1989-1991 in order to complete the time series. [NIR 2012]
Slovak Republic	Tier 2 according to the IPCC 2000 GPG has been applied since 2001 with the combination of plant specific activity data and emission factors estimated for each plant. The calculations are based on the data provided by the lime producers in questionnaires and in the ETS reports (produced lime and CaO and MgO contents). The emission factor of CO2 using the data on the purity of lime is 0.765 t CO2/t of lime. [NIR 2012]
Slovenia	CO2 emission was calculated according to IPCC methodology. The EFs for lime production for the period 2005-2010 are based on EU ETS data, whereas for the period 1986 -1989 the average EF for 1999-2004 was applied. Upon ERT recommendation year-specific EFs were used for the period 1999 -2004 instead of average EF. The EFs for the years 2005-2010 were derived from emissions and activity data on annual production of quicklime reported under EU ETS scheme. Similar to cement production, for allocation plan purposes more detailed data directly from producers for 1999 -2004 were obtained. Data on fraction of CaO and MgO in lime for the period 1999-2004 enabled us to determine our own emission factor. [NIR 2012]

Source: NIR 2012.

19.2.1.3 2A3 Limestone and Dolomite Use

CO_2 emissions from 2A3 Limestone and Dolomite Use account for 0.19 % of total EU-27 GHG emissions in 2010. Between 1990 and 2010, CO_2 emissions in the EU-27 decreased by 11 %. The increase of emissions in five new Member States (Poland, the Czech Republic, Slovenia, Slovakia and Hungary) offset emission reductions achieved in EU-15 MS by 23 % (Table 19.6). The Czech Republic and Poland were responsible for 11 % and 10 % of the emissions from this source respectively, followed by Romania with 6 %.

Emission reductions of more than 80 % during 1990 and 2010 occurred in some MS (Lithuania, Latvia) but due to their low share in EU-27 emissions (0.0 % and 0.2 %, respectively), no significant effect on EU-27 could be observed. Due to Romanian share of 6 % in EU-27 emissions in 2010, decreases in Romania significantly contributed to the overall reduction (highest reduction in absolute terms); the decline was due to a significant decrease of limestone and dolomite consumption level in 2008 and 2009. The low level of 2009 consumption was determined by the economic crisis and consumption increased again in 2010. The changes of activity data contributed with 100 % to the change of the emission trends. In absolute terms Poland had the largest increase of emissions from 2A3. In this source category, the MS include limestone and dolomite used in flue gas desulphurization in power plants which participated in EU ETS between 2005 and 2010. The remaining emissions from limestone and dolomite used arose in other subcategories where these minerals are used. Table 19.6 suggests that about 78 % of EU-12 CO_2 emissions from 2A3 Limestone and Dolomite Use are estimated with higher Tier methods for 2010 (Tier 2 and Tier 3).

Table 19.6 **2A3 Limestone and Dolomite Use: CO_2 emissions of EU-27**

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	7,508	5,572	5,731	64.1%	159	3%	-1,777	-24%		
Bulgaria	IE	IE	IE	-	-	-	-	-	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	678	945	1,021	11.4%	76	8%	344	51%	CS	CS
Estonia	IE	IE	IE	-	-	-	-	-	NA	NA
Hungary	202	272	310	3.5%	38	14%	107	53%	D,T2	D
Latvia	141	17	20	0.2%	3	16%	-121	-86%	T2,T3	D,PS
Lithuania	4	0.2	0.0	0.0%	0	-87%	-4	-99%	T2	D
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	NA	707	874	9.8%	167	24%	874	-	T3	PS
Romania	1,221	364	494	5.5%	130	36%	-727	-60%	OTH	D
Slovakia	318	289	340	3.8%	51	18%	22	7%	T3	PS
Slovenia	27	147	152	1.7%	5	4%	126	473%	D	D
EU-27	**10,100**	**8,312**	**8,942**	**100.0%**	**630**	**8%**	**-1,158**	**-11%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.
Emissions of Bulgaria are included in 2A1, 2A2, 2A7 (glass and FGD) and 2C1
Emissions of Estonia are included in 2A1, 2A2 and 2A7

Table 19.3 summarizes the methodological information for limestone and dolomite use provided by EU-12 Member States in their national inventory reports. The Czech Republic, Latvia and Poland use plant-specific data reported and verified under the EU ETS.

Table 19.7 2A3 Limestone and Dolomite Use: Summary of methodological information provided by Member States

Limestone and dolomite use new MS	
Member State	**Methodology comment**
Bulgaria	The emissions from the limestone and dolomite usage are reported under the specific production industries, e.i. Cement Production, Lime Production, Glass Production, Desulphurisation, etc..[NIR 2012]
Cyprus	Not occuring. [NIR 2012]
Czech Republic	CO2 emissions from sulphur removal were calculated from coal consumption for electricity production, the sulphur content and the effectiveness of sulphur removal units between 1996, when the first sulphur removal units came into operation, and 2005. In 2005, these data were verified by comparison with data from the individual power plants, which were collected for EU ETS preparation and which cover the years 1999 – 2005. The EU ETS data form has been used since 2006. Emissions from limestone and dolomite use in sintering plants were new source, in 2006 submission, which was identified in the process of preparation of the EU Emission Trading Scheme. Only 2 sintering plants have existed in the CR in recent times. CO2 emissions from this category are calculated on the basis of data from statistics (The Steel Federation, Inc - production of agglomerate / sinter) and the EF value, which was derived from EU ETS CO2 emission data based on the limestone and dolomite compositions and consumptions (0.08 t CO2 / t sinter). [NIR 2012]
Estonia	The emissions are reported in 2A1, 2A2 and 2A7. [NIR 2012]
Hungary	The emissions were calculated according to the Revised Guidelines using the correct stochiometric ratios as emission factors (440 kg CO2 / ton limestone and 477 kg CO2/ ton dolomite, along with the default factor for fraction of purity of 1).. Only limestone and dolomite used during various phases of iron production and limestone quantities used during flue gas desulphurization are calculated here. Activity data of the limestone and dolomite used in iron and steel industry were obtained on the basis of the data received from the manufacturers. For those years when such data were not available, the default value (250 kg dolomite/t iron mentioned in chapter 2.13.3.1 of IPCC1996 Revised Guidelines) was used. Flue gas desulphurization has been carried out in one power plant since 2002 and in an other one since 2004. Activity data on the use of carbonates for SO2 scrubbing is either reported by the operators directly to the HMS or to EU ETS competent authority (In EU ETS the operators are required to report CO2 emission from the use of carbonate for scrubbing separately in their annual emission report). [NIR 2012]
Latvia	CO2 emissions from Limestone and Dolomite Use in Glass and Metal industry, limestone use in sugar production and Soda Ash Use in Glass Production are estimated with Tier2 method basing on plant specific activity data and default IPCC 1996 emission factors. CO2 emissions from Lime production in two direct lime production plants are calculated basing on data of carbonates – dolomite and limestone use. Purity factor from IPCC GPG 2000 is taken into account in estimation of CO2 emissions from dolomite use in lime production calculation. Tier3 method is used in CO2 emission from dolomite use in lime production processes estimation as plant specific activity data as well as plant specific CO2 emission factors are used in estimation. Activity data were taken from industrial production plants. Industrial producers are participants of the ETS the GHG reports of these enterprises have to be freely available according to EU ETS regulations. [NIR 2012]
Lithuania	Specific CO2 emissions caused by thermal degradation of limestone and dolomite are covered in sections dealing with cement, lime, glass, mineral wool, brick and tile production. This section covers limestone flux use in iron foundries. Consumption of limestone flux in iron foundries was calculated as one tent of iron production in accordance with the information provided by the foundries. CO2 emission was calculated by Tier 2 method iron production data provided by the Statistics Lithuania. CO2 emissions were calculated from material mass balance assuming that all carbon contained in raw materials (limestone) used as flux was released to the atmosphere as CO2. [NIR 2012]
Malta	Not occuring. [NIR 2012]
Poland	In this subcategory there were used only emissions from limestone and dolomite use in sulphur removal installations in power industry installation that participate in EU ETS. Emissions for this subcategory in GHG inventory correspond to emissions from the EU ETS verified reports. It should be noted that this emission constitutes only part of total emission from limestone and dolomite use. The rest of it was included into other categories where these minerals are used. CO2 emissions concerning limestone and dolomite use in production of glass, ceramics and paper includes only the emission from installations covered by EU ETS. [NIR 2012]
Romania	The IPCC methodology has been followed for estimating the CO2 emissions from limestone and dolomite used. The method estimates the amount of limestone and dolomite used in the iron and steel production, pulp and paper production, sugar mills production, ceramics plants, for all time series. The activity data were provided directly by the plants (iron and steel producers, pulp and paper producers, sugar mills producers, ceramics producers). In order to estimate CO2 emissions from limestone and dolomite used subsector it was made a questionnaire which it was sent to the local environmental protection agencies. The completed questionnaire has been sent to NEPA where the data are aggregated. In order to avoid the double counting with lime production subsector there was improve the data on statistics lime production subtracting from the total amount of statistics lime production, the amount of lime used in the two iron and steel integrated plants, which produce lime for its own use. [NIR 2012]
Slovak Republic	The limestone used in the Slovak Republic often contains a small amount of MgCO3. Emissions are calculated on the basis of carbonates using Tier 2 method according to the IPCC 2000 GPG and the plant specific emission factors from 2004. Emission factor is based on the stoichiometry of limestone and dolomite in mixtures and it was 0.441 t per ton of used carbonates in 2010. [NIR 2012]
Slovenia	Consumption of limestone and dolomite in production of iron and steel produces CO2 emissions. Primary production from ore existed only in the 1986 and 1987, after 1990 steel production is based on utilization of scrap iron and steel. Activity data on CaCO3 consumption were obtained directly from iron and steel producers. CO2 emissions have been calculated according to IPCC methodology. Default emission factor, 440 kg CO2/ton limestone, has been applied for the whole period. [NIR 2012]

Source: NIR 2012.

19.2.2 Chemical industry (CRF Source Category 2B) (EU-27)

CO_2 emissions from 2B1 Ammonia Production account for 0.55 % of total EU-27 GHG emissions in 2010. Between 1990 and 2010, CO_2 emissions from this source decreased by 21 %, contributing to additional 5 % to the reduction in EU-15 (-16 %) (Table 19.8). Poland is responsible for 14 % and Romania for 10 % of emissions from ammonia production in the EU-12, followed by Lithuania (4 %). Bulgaria, Romania and Hungary had large reductions in absolute terms between 1990 and 2010.

Between 2008 and 2010, the CO_2 emissions increased by 9 % in the EU-27. The largest absolute emission increases occurred in Romania and Bulgaria. In Romania the production and related natural gas consumption increased significantly. Emission reductions mainly occurred in Slovakia where the production plant was shut down for 3.5 months because of malfunction..

For the whole time series besides Poland, increased its emissions from Ammonia Production during 1990 and 2010. In Lithuania, the increase of ammonia produced and natural gas consumed of more than 100 % occurred during 2006 and 2007 due to a new production line that was put into operation by the producing company. Nevertheless, a reduced demand for the product caused by the global economic crisis led to a drop in emissions in Lithuania 2008-2010. Table 19.8 shows that no Member States uses default methodologies for the estimation of CO_2 emissions from ammonia production and that 67 % of EU-12 emissions are estimated with higher Tier methods for 2010 instead.

Table 19.8 2B1 Ammonia Production: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	19,557	15,386	16,485	63.1%	1,099	7%	-3,072	-16%		
Bulgaria	3,087	577	735	2.8%	159	27%	-2,352	-76%	T2	PS
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	807	634	618	2.4%	-17	-3%	-189	-23%	T1	CS
Estonia	420	30	NO	-	-30	-	-420	-	NA	NA
Hungary	1,056	433	471	1.8%	38	9%	-585	-55%	T2	D
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	1,191	1,173	1,150	4.4%	-23	-2%	-40	-3%	T2	PS
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	2,811	3,493	3,623	13.9%	130	4%	812	29%	T2	CS
Romania	3,438	1,671	2,543	9.7%	872	52%	-896	-26%	T1a	PS
Slovakia	617	618	485	1.9%	-134	-22%	-132	-21%	T2	PS
Slovenia	NO	NO	NO	-	-	-	-	-	NA	NA
EU-27	**32,983**	**24,015**	**26,109**	**100.0%**	**2,094**	**9%**	**-6,874**	**-21%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

CO_2 emissions from 2B5 Other were not reported by any new MS, except for Poland that reports CO_2 emissions from ethylene production under this source category. However the share in EU-27 emissions in 2010 is only minor, amounting to 0.001 % (Table 19.9). CO_2 emissions increased especially during 2005 and 2006 (+89 %) due to changes in ethylene production.

Table 19.9 2B5 Other: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	10,438	14,856	15,973	100.0%	1,117	8%	5,536	53%		
Bulgaria	NO	NO	NO	-	-	-	-	-	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	IE,NA	IE,NA	IE,NA	-	-	-	-	-	NA	NA
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	IE,NO	IE,NO	IE,NO	-	-	-	-	-	NA	NA
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	0.09	0.15	0.15	0.0%	-0.004	-3%	0.058	63%	T1	CR
Romania	NE	NE,NO	NE,NO	-	-	-	-	-	NA	NA
Slovakia	NO	NO	NO	-	-	-	-	-	NA	NA
Slovenia	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
EU-27	**10,438**	**14,856**	**15,973**	**100.0%**	**1,117**	**8%**	**5,536**	**53%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

N_2O emissions from 2B2 Nitric acid production account for 0.29 % of total EU-27 GHG emissions in 2010. Between 1990 and 2010, N_2O emissions from this source in EU-27 decreased by 73 % (Table 19.). Lithuania and Slovakia are responsible for 10.5 % of these emissions in the EU-27, followed by Poland (7 %).

Hungary, Romania and Poland had large reductions in absolute terms between 1990 and 2010, followed by Bulgaria,

Between 2009 and 2010, the N_2O emissions decreased by 11 % in the EU-27. Large emission reductions could be found for Czech Republic, Lithuania and Slovakia whereas a substantial increase occurred in Romania. In the Czech Republic, the N_2O abatement system based on catalytic decomposition of N_2O, installed in the Czech dominant plant for the nitric acid production, was in 2010 used even more effectively than before. N_2O emissions were evaluated in this plant from continuous measurement of N_2O concentration in the output gas. In Lithuania nitric acid is produced by one company. As part of a Joint Implementation project a secondary catalyst was installed in 2008. The secondary catalyst (on Al2O3 basis with active metal oxides CuO and ZnO) was installed underneath the platinum gauze which led to a decrease of the IEF. Plant specific N_2O emission factors based on the measurements in automated monitoring system (AMS) were used.

Hungary reduced its emissions since 2005; until 2005, Hungary used obsolete technology. The implementation of a new and more advanced state-of-the-art production technology was started in 2005 and installed in September 2007, resulting in drastic emission reductions. The new factory applying the EnviNO$_x$ technology reached a reduction of emissions of about 95-99%. At the same time the old production lines were closed.

The emission increase in Romania occurred due to a significant increase in production and due to the fact that the plant using SCR technology recorded a decrease in the efficiency of its abatement techniques for N_2O emissions reduction (from 85% in 2009 to 82% in 2010).

Table 19.8 suggests that only one new Member State uses default methodologies but that only 42 % of EU-12 N_2O emissions from 2B2 Nitric acid production are estimated with higher Tier methods.

Table 19.10 2B2 Nitric acid production: N_2O emissions of EU-27

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	35,723	11,569	9,632	69.6%	-1,937	-17%	-26,091	-73%		
Bulgaria	1,503	272	267	1.9%	-4	-2%	-1,236	-82%	T3	PS
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	1,127	506	373	2.7%	-133	-26%	-753	-67%	T1	PS
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	3,214	15	11	0.1%	-4	-28%	-3,203	-100%	T2	PS
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	929	657	578	4.2%	-79	-12%	-351	-38%	T2	PS
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	3,163	871	926	6.7%	56	6%	-2,237	-71%	T1	CS
Romania	3,460	517	1,152	8.3%	636	123%	-2,307	-67%	D	CR,D
Slovakia	1,187	1,091	904	6.5%	-188	-17%	-284	-24%	T2	PS
Slovenia	NO	NO	NO	-	-	-	-	-	NA	NA
EU-27	**50,307**	**15,498**	**13,844**	**100.0%**	**-1,654**	**-11%**	**-36,463**	**-72%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

N_2O emissions from 2B3 Adipic Acid Production were not reported by any new MS in 2010, except for Poland and Romania in 1990. Romania stopped its adipic acid production in 2001 and thus suspended this activity from 2002 onwards and Poland stopped its adipic acid production already in 1994 (Table 19.1).

Table 19.11 2B3 Adipic Acid Production: N_2O emissions of EU-27

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	58,927	10,804	1,587	100.0%	-9,217	-85%	-57,340	-97%		
Bulgaria	NO	NO	NO	-	-	-	-	-	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	NO	NO	NO	-	-	-	-	-	NA	NA
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	NO	NO	NO	-	-	-	-	-	NA	NA
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	372	NO	NO	-	-	-	-372	-100%	NA	NA
Romania	574	NO	NO	-	-	-	-574	-100%	NA	NA
Slovakia	NO	NO	NO	-	-	-	-	-	NA	NA
Slovenia	NO	NO	NO	-	-	-	-	-	NA	NA
EU-27	**59,872**	**10,804**	**1,587**	**100.0%**	**-9,217**	**-85%**	**-58,286**	**-97%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

N_2O emissions from 2B5 Other account for 0.05% of total EU-27 GHG emissions in 2010 and are only reported by the Czech Republic and Poland. Both MS are responsible for 14 % of these emissions in the EU-27 and both consider N_2O emissions from the production of caprolactam under 2B5. The MS increased their N_2O emissions during 1990 and 2009, thus lowering the overall reduction of emissions achieved by EU-15 during that period by 5 %.

The increase in Czech emissions by 13 % occurred between 2005 and 2006 due to the calculation method applied. Caprolactam production data are not provided by the official Czech statistics because of confidentiality (there is only one plant in the Czech Republic). Emissions of N_2O were estimated by external experts for years 1990 to 2005 by approximating the production capacity in that time period. After consultations with the producer, the N_2O emission factor was revised, resulting in higher emissions since 2006. N_2O emissions in Poland increased steadily from 1990 to 2005 (+54 %) and decreased afterwards until 2009 and increased again from 2009 to 2010 (Table 19.). This trend is driven by the caprolactam production in the country.

Table 19.5 2B5 Other: N_2O emissions of EU-27

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	4,587	1,672	2,028	86.1%	356	21%	-2,559	-56%		
Bulgaria	NO	NO	NO	-	-	-	-	-	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	84	94	94	4.0%	0.000	0%	11	13%	CS	CS
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	NO	NO	NO	-	-	-	-	-	NA	NA
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	143	213	234	9.9%	21	10%	91	64%	T1	CS
Romania	NE	NE,NO	NE,NO	-	-	-	-	-	NA	NA
Slovakia	NO	NO	NO	-	-	-	-	-	NA	NA
Slovenia	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
EU-27	**4,814**	**1,979**	**2,356**	**100.0%**	**377**	**19%**	**-2,457**	**-51%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

19.2.3 Metal production (CRF Source Category 2C) (EU-27)

CO_2 emissions from 2.C Metal production account for 1% of the total EU-27 GHG (w/o LULUCF) emissions in 2010. Poland, the Czech Republic, Romania and Slovakia are responsible for 33% of overall emissions from this sector. Poland is responsible for 11% of the overall EU27 emissions. All MS reported decreasing in this sector.

Table 19.6 2C1 Iron and Steel Production: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	47,059	28,912	37,961	63.5%	9,049	31%	-9,098	-19%		
Bulgaria	1,973	73	52	0.1%	-21	-29%	-1,921	-97%	T2	CS,PS
Cyprus	NA	NA	NA	-	-	-	-	-	NA	NA
Czech Republic	12,533	5,298	5,919	9.9%	622	12%	-6,613	-53%	T1	D
Estonia	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Hungary	3,039	1,898	2,243	3.8%	345	18%	-796	-26%	CS,T1	D
Latvia	13	10	11	0.0%	2	18%	-2	-12%	T2	PS
Lithuania	21	4	4	0.0%	0	2%	-17	-81%	T1	D
Malta	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Poland	7,470	5,108	6,708	11.2%	1,600	31%	-762	-10%	CS,T2,T3	CS
Romania	8,713	3,294	3,035	5.1%	-259	-8%	-5,678	-65%	T2	CS,D
Slovakia	4,114	3,269	3,808	6.4%	539	16%	-306	-7%	T2,T3	CS
Slovenia	30	30	45	0.1%	15	50%	15	51%	T2	PS
EU-27	**84,964**	**47,894**	**59,787**	**100.0%**	**11,892**	**25%**	**-25,177**	**-30%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 19.7 2C1 Iron and Steel Production: Information on activity data, emission factors for CO_2 emissions

Member State	1990 Activity data: Description	1990 Activity data: (kt)	1990 Implied emission factor (t/t)	1990 CO2 emissions (Gg)	2010 Activity data: Description	2010 Activity data: (kt)	2010 Implied emission factor (t/t)	2010 CO2 emissions (Gg)
Bulgaria	**Iron and steel production**		**0.46**	**1973**	**Iron and steel production**	**0**	**0.07**	**52**
	steel production - kt	2184	0.90	1973	steel production - kt	746	0.07	52
	pig iron for production of steel - kt	C	NO	NO	pig iron for production of steel - kt	NO	NO	NO
	Sinter: aglomerate - kt	2081	NO	NO	Sinter: aglomerate - kt	NO	NO	NO
	Coke: at 6% wet - kt	C	NO	NO	Coke: at 6% wet - kt	NO	NO	NO
	Other			NA	Other	0	0.00	NA
Cyprus	**Iron and steel production**		**NA**	**NA**	**Iron and steel production**	**0**	**NA**	**NA**
	Steel	0	NA	NA	Steel	0	NA	NA
	Pig Iron	0	NA	NA	Pig Iron	0	NA	NA
	Sinter	0	NA	NA	Sinter	0	NA	NA
	Coke	0	NA	NA	Coke	0	NA	NA
	Other				Other	0	0.00	NA
Czech Republic	**Iron and steel production**		**0.39**	**12533**	**Iron and steel production**	**0**	**0.36**	**5919**
	Steel	10098	1.24	12533	Steel	5274	1.12	5919
	Pig Iron	6106	IE	IE	Pig Iron	3987	IE	IE
	Sinter	8469	IE	IE	Sinter	4628	IE	IE
	Coke	7285	IE	IE	Coke	2548	IE	IE
	Other			NO	Other	0	0.00	NO
Estonia	**Iron and steel production**		**NA,NO**	**NA,NO**	**Iron and steel production**	**0**	**NA,NO**	**NA,NO**
	(Steel)	NO	NO	NO	(Steel)	NO	NO	NO
	Pig Iron	NO	NO	NO	Pig Iron	NO	NO	NO
	Sinter	NO	NO	NO	Sinter	NO	NO	NO
	(Coke)	NO	NO	NO	(Coke)	NO	NO	NO
	Other			NA	Other	0	0.00	NA

	1990				2010			
Member State	**Activity data**		**Implied emission factor (t/t)**	**CO2 emissions (Gg)**	**Activity data**		**Implied emission factor (t/t)**	**CO2 emissions (Gg)**
	Description	**(kt)**			**Description**	**(kt)**		
Hungary	**Iron and steel production**		**0.53**	**3039**	**Iron and steel production**	**0**	**0.61**	**2243**
	Steel: crude steel	2963	0.13	382	Steel: crude steel	1678	0.13	216
	Pig Iron: 0	1697	IE	IE	Pig Iron: 0	1325	0.06	74
	Sinter: 0	IE	IE	IE	Sinter: 0	IE	IE	IE
	Coke: Consumption	1040	2.55	2657	Coke: Consumption	686	2.85	1953
	Other			NA	Other	0	0.00	NA
Lithuania	**Iron and steel production**		**0.20**	**21**	**Iron and steel production**	**0**	**1.06**	**4**
	Steel	NO	NO	NO	Steel	NO	NO	NO
	Pig Iron	106	0.20	21	Pig Iron	4	1.06	4
	Sinter	NO	NO	NO	Sinter	NO	NO	NO
	Coke	NO	NO	NO	Coke	NO	NO	NO
	Other			NO	Other	0	0.00	NO
Latvia	**Iron and steel production**		**0.12**	**13**	**Iron and steel production**	**0**	**0.12**	**11**
	(crude steel produced from crude iron)	109	0.12	13	(crude steel produced from crude iron)	91	0.12	11
	Pig Iron	NO	NO	NO	Pig Iron	NO	NO	NO
	Sinter	NO	NO	NO	Sinter	NO	NO	NO
	Coke	NO	NO	NO	Coke	NO	NO	NO
	Other			NA	Other	0	0.00	NA
Malta	**Iron and steel production**		**NA,NO**	**NA,NO**	**Iron and steel production**	**0**	**NA,NO**	**NA,NO**
	Steel	NO	NO	NO	Steel	NO	NO	NO
	Pig Iron	NO	NO	NO	Pig Iron	NO	NO	NO
	Sinter	NO	NO	NO	Sinter	NO	NO	NO
	Coke	NO	NO	NO	Coke	NO	NO	NO
	Other			NA	Other	0	0.00	NA

	1990				2010			
Member State	Activity data		Implied emission factor (t/t)	CO2 emissions (Gg)	Activity data		Implied emission factor (t/t)	CO2 emissions (Gg)
	Description	(kt)			Description	(kt)		
Poland	**Iron and steel production**		**0.22**	7470	**Iron and steel production**	**0**	**0.35**	**6708**
	Steel	IE	IE	IE	Steel	IE	IE	IE
	Pig Iron	8657	0.17	1430	Pig Iron	3638	0.78	2837
	Sinter: production	11779	0.07	834	Sinter: production	5837	0.25	1444
	Coke: production	13516	0.19	2609	Coke: production	9738	0.17	1623
	Other			2596	Other	0	0.00	804
Romania	**Iron and steel production**		**0.30**	**8713**	**Iron and steel production**	**0**	**0.36**	**3035**
	steel production	8946	0.06	549	steel production	3735	0.04	168
	(pig iron production)	5916	1.38	8163	(pig iron production)	1722	1.67	2867
	sinter used	11357	IE	IE	sinter used	1978	IE	IE
	(coke used)	2885	IE	IE	(coke used)	988	IE	IE
	Other			IE	Other	0	0.00	IE
Slovenia	**Iron and steel production**		**0.05**	**30**	**Iron and steel production**	**0**	**0.07**	**45**
	Steel produced	632	0.05	30	Steel produced	641	0.07	45
	Pig Iron	NO	NO	NO	Pig Iron	NO	NO	NO
	Sinter	NO	NO	NO	Sinter	NO	NO	NO
	Coke	NO	NO	NO	Coke	NO	NO	NO
	Other			NA	Other	0	0.00	NA
Slovakia	**Iron and steel production**		**0.43**	**4114**	**Iron and steel production**	**0**	**0.38**	**3808**
	Steel	3562	1.15	4096	Steel	4402	0.86	3790
	Pig Iron	3561	IE	IE	Pig Iron	3649	IE	IE
	Sinter	151	IE	IE	Sinter	44	IE	IE
	Coke	2340	IE	IE	Coke	1985	IE	IE
	Other			18	Other	0	0.00	18

According to the IPCC methodology, processes including auto-producers - power and heat production facilities located in iron and steel plants excluding heating of coke ovens (where usually coke oven gas is combusted) and fuel combustion (gaseous fuels and coke) in sinter plants (agglomeration of iron ores) should be taken into account in 1A2a; while processes including consumption of carbonaceous reducing agents, especially in blast furnaces, oxidation of carbon contained in a pig iron or scrap and the burning off carbonaceous electrodes should be taken into account in 2C1. Additionally, emissions coming from limestone and dolomite use in iron and steel plants should be included under 2A3 and Emissions coming from heating of coke ovens should be reported under 1A1c.

However, some EU-27 Member States do not keep this boundary for different reasons (local traditions used in history and in this context an attempt to keep consistency in data series). E. g. some Member States report emission from blast furnace gas and from converter gas under 1A2a instead of under 2C1, because they interpret it as emissions from energy supply.

Thus, for an overview of EU-27 total emissions it seems to be more convenient to take into account all emissions covered by the combined category 1A2a + 2C1. Resulting emissions for the EU-15 Member States in the combined category 1A2a + 2C1 are given in Table 19.

Table 19.8 CO_2 Emissions of EU-27 Member States in 1A2a and 2C1 Iron and Steel

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2010	Share 2C1
	1A2a	2C1	Combined		
EU-15	103,096	37,961	141,057	77.5%	27%
Bulgaria	242	52	294	0.2%	18%
Cyprus	NE,NO	NA	0	0.0%	-
Czech Republic	3,463	5,919	9,382	5.2%	63%
Estonia	1	NA,NO	1	0.0%	0%
Hungary	393	2,243	2,636	1.4%	85%
Latvia	299	11	310	0.2%	4%
Lithuania	NO	4	4	0.0%	NA
Malta	IE,NA	NA,NO	0	0.0%	#DIV/0!
Poland	4,760	6,708	11,468	6.3%	58%
Romania	5,990	3,035	9,025	5.0%	34%
Slovakia	3,742	3,808	7,550	4.1%	50%
Slovenia	198	45	243	0.1%	19%
EU-27	**122,184**	**59,787**	**181,971**	**100.0%**	**33%**

Table 19.9 2C1 Iron and Steel Production: Information on activity data and methods used for CO_2 emissions

Member States	Description of methods
Bulgaria	The CO_2 emissions from the sector are calculated using country specific data from EU ETS reports. Data from Bulgarian association of metallurgical industry (BAMI, http://www.bcm-bg.com/) as well as data from World Steel Association (WSA, http://worldsteel.org) are used for crosscheck. Country specific emission factor was developed for the EAF steel based on data from EU ETS reports for the period 2007 - 2009. In the calculation of ETS emissions the operators performed a mass balance of the Carbon content in the raw materials used and the produced end product. Thus CO_2 emissions were calculated similar to the the IPCC GPG Tier 2 method (equation 3.6B).
Cyprus	NO

Member States	Description of methods
Czech Republic	CO_2 emissions were determined for category 2C1 using a procedure corresponding to Tier 1 of the Good Practice Guidance for 2C1. This calculation was based on the amount of coke consumed in blast furnaces. The calculation was carried out using NCV = 28.69 MJ/kg in 2009 (NCV interval for period 1990 - 2009 is (27.9 - 28.8 MJ/kg) and using the carbon emission factor for coke, 29.5 t C / TJ, which is the IPCC default value (IPCC, 1997). As the final products in metallurgical processes are mostly steel and iron with very low carbon contents, the relevant correction for the amount of carbon remaining in the steel or iron was taken into account by using factor 0.98, i.e. the same factor that is standardly used for combustion of solid fuels (the oxidation factor).
Estonia	NO
Hungary	Partly for reasons related to the Hungarian traditions of energy statistics, the emissions of the sector from fuels are not included here but in sub-sector 1.A.2.A. CO_2 released from limestone and/or dolomite is taken into account under sub-sector 2.A.3 (Limestone and dolomite use). Iron and steel production data were obtained from the reports of the International Iron and Steel Institute and the similar European agency (EUROFER). Initially, limestone consumption data were calculated on the basis of the default value in the Revised Guidelines. In recent years data received from the factories have been used. In order to make emission calculations complete, carbon dioxide releases from raw iron and graphite electrode of the electric arc furnace (EAF) during steel production were also calculated here. For these calculations, the following default values were used: carbon content of iron: 4%; carbon content of steel: 0.5%; specific emission of electrode: 5 kg CO_2/t steel.
Latvia	CO_2 emission estimations from crude steel production IPCC GPG 2000 Tier2 method is based on estimation of carbon losses through the production processes when remaining carbon is emitted to air. CO_2 emissions were estimated only from crude iron used. Carbon emitted from consumed electrodes in electric arc furnaces has to be taken into account. These emissions are estimated by multiplying emission factor with mass of steel produced in electric arc furnaces. Default emission factor – 1.5 kg carbon per tonne of steel is used because plant reported emission factor – 6 kg carbon per tonne of steel, is considered as unreliable high. For 2008 plant reported 18 kg per tonne of steel as also was assumed as incredibly high. CH_4 and indirect GHG emission estimations from crude steel production. The CH_4, NMVOC, CO, NO_x and SO_2 emissions from iron and steel production are calculated at the LEGMC based on activity data from the CSB and steel production plant according to EMEP/CORNAIR methodology and emission factors.
Lithuania	CO_2 emissions from blast furnaces were calculated from coke consumption using default emission factor 3.1 tonnes CO_2 per tonne coke (Revised 1996 IPCC Guidelines, Table 2-12, p. 2.26). Revised 1996 IPCC Guidelines do not provide emission factor for electric arc furnaces. Therefore emission factor 0.08 tonne CO_2 per tonne of steel produced is provided in 2006 IPCC Guidelines was used for evaluation of CO_2 emissions from electric arc furnace.
Malta	NO
Poland	Iron Ore Sinter Production: Carbon dioxide process emissions from iron ore sinter production for 2009 come from the verified reports on annual emissions of CO_2 from iron ore sinter installations in EU ETS. Based on verified reports of CO_2 emissions elaborated for the purpose of emission trading scheme, also emissions and production within this subcategory for years 2005-2008 were estimated. Emissions of CO_2 for the years 1988-2004 were calculated (using carbon balance method) based on data (amount of feedstock material and output from production process) from questionnaires regarding to installations included into the EU ETS collected by the National Administration of Emission Trading Scheme. Steel Cast Production The data on CO_2 process emissions from steel cast production as well as on amount of cast steel was estimated according to the methodology given in [Holtzer 2007]. CO_2 emission estimated in mentioned study concerns only melt process of alloy since this is main sources of process emission. CO_2 emission occurring at pouring into moulding sands is not included. Iron Cast Production

Member States	Description of methods
	The data on CO_2 process emissions from iron cast production as well as on amount of cast iron was estimated according to the methodology from [Holtzer 2007]. Estimation of CO_2 emissions concerns only melting process of alloy since this is the main source of process emission. CO_2 emission occurring at pouring the liquid metal into the moulding sands was not taken into consideration. Pig Iron Production In Blast Furnaces CO_2 emission for 2009 from pig iron production was taken from the verified reports prepared by installations included in EU ETS. Pig iron is produced in the integrated steel plants, so additional information was needed for application of data from the verified reports. This additional data for separation of blast furnace process and steel production in integrated steel plants were received directly from plants. Basic Oxygen Furnace Steel Production Amount of CO_2 process emission from basic oxygen furnace steel production in 2009 was taken from the verified reports from steel plants participating in EU ETS. Like in case of sintering plants and blast furnace process also in 2.C.1.f total CO_2 emission, without excluding emission from fuels used for energy purpose of this process, was assumed. For years 1988-2004, CO_2 process emission from basic oxygen furnace steel production was estimated on the basis of carbon balances (table 4.4.5) prepared by Polish Steel Association (HIPH) [HIPH 2007]. Electric Furnace Steel Production Process emissions of CO_2 from steel production in electric furnaces in 2009 were taken from the verified reports prepared by installations included in EU ETS. Values of emissions for 2005-2008, were also taken from the verified reports. Coke Production Processing emission of CO_2 from coking plants in the period 1990-2009 was estimated based on elementary carbon budgets in the coking plants. Data concerning input and output are based on [Eurostat] and [GUS 1991a-2010a].
Romania	The method for calculating emissions of CO_2 from Iron and steel production is in line with the Good Practice Guidance (Tier 2 method). The recommended Tier 2 method, according to the IPCC Good Practice Guidance, is to base the calculations on the amount of reducing agent (coke oven coke) used in blast furnaces for the production of iron. Other information needed to use the Tier 2 method is the amount of pig iron produced as well as the amount used for steel production and produced steel, and the carbon content of all those parts. All these information have been collected at plant level.
Slovakia	Tier 2 methodology based on the plant specific information about activity data and emission factors was applied for the estimation of emissions from steel, pig iron production and Tier 1 approach for the estimation of emissions from limestone use. The technological emissions from iron (2C1.1) and steel (2C1.2) production, limestone use (2C1.5) and emissions from coke electrodes used by EAF steel production (2C1.5) are included in the category 2C1 iron and steel production. The CO_2 emissions originated from coke production in iron and steel industry and emissions originated from sinter production are still included in energy sector, category 1A2a in line with the IPCC2006 GL.
Slovenia	Data on the amount and carbon content of input and output material were obtained from three iron and steel producers. Average EF for the period 1999–2004 has been 47 kg CO_2/t of steel. This emission factor has been applied for calculating emissions from 1988 onwards. This EF is not appropriate for the base year because of the different type of production of steel (from ore). For the period 2005-2009 precise and verified data obtained from EU ETS was used.

PFC emissions from 2.C.3 are listed in Table 19.10. Only 4 of the new member states report PFC emissions from Aluminum Production in 2010, however, Poland are responsible for 8.9% of overall PFC emissions from this sector. All MS reported decreasing emissions, whereas Romania could achieve a reduction of nearly 100%. Only Poland could achieve a reduction of only 65%.

Table 19.10 2C3 Aluminum Production: PFC emissions of EU-27

Member State	PFC emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	13,247	594	697	85.8%	103	17%	-12,550	-95%		
Bulgaria	NA,NE,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	NO	NO	NO	-	-	-	-	-	NA	NA
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	271	NO	NO	-	-	-	-271	-100%	NA	NA
Latvia	NO	NO	NO	-	-	-	-	-	NA	NA
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NA
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	208	76	72	8.9%	-4	-5%	-136	-65%	T1c	D
Romania	2,116	7	8	1.0%	1	12%	-2,108	-100%	T2	D,PS
Slovakia	271	18	21	2.6%	3	19%	-250	-92%	T3	PS
Slovenia	257	7	14	1.7%	6	84%	-244	-95%	T3	PS
EU-27	**16,370**	**702**	**812**	**100.0%**	**109**	**16%**	**-15,559**	**-95%**		

19.2.4 Production of halocarbons and SF_6 (CRF Source Category 2E) (EU-27)

Table 19.11 shows HFC emissions of sector 2E1. No new member state reported by-product emissions, EU15 are responsible for 100% of all HFC emissions from this sector.

Table 19.11 2E1 By-Product Emissions: HFC emissions of EU-27

Member State	HFC (Gg CO_2 equivalents)			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	21,158	651	977	100.0%	326	50%	-20,180	-95%		
Bulgaria	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Cyprus	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Czech Republic	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Estonia	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Hungary	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Latvia	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Lithuania	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Malta	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Poland	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Romania	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Slovakia	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
Slovenia	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA
EU-27	**21,158**	**651**	**977**	**100.0%**	**326**	**50%**	**-20,180**	**-95%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

19.2.5 Consumption of halocarbons and SF_6 (CRF Source Category 2F) (EU-27)

HFC emissions from Refrigeration and Air Conditioning account for 79% of overall HFC emissions. The major share of emissions from this sector lies with the EU-15 (87.0%), Poland, the Czech Republic and Hungary are responsible for about 10% of overall emissions from this sector (Table 19.12). The high increase in absolute terms of the EU 15 between 1990 and 2010 is due to the phase-out of ozone-depleting substances such as chlorofluorocarbons under the Montreal Protocol and the replacement of these substances with HFCs (mainly in refrigeration, air conditioning, foam production and as aerosol propellants). Only Romania is the only new member states that reported a decrease in emissions between 1990 and 2010.

Table 19.12 2F1 Refrigeration and Air conditioning: HFC emissions of EU-27

Member State	HFC (Gg CO_2 equivalents)			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	84	53,403	56,476	87.0%	3,074	6%	56,392	67444%		
Bulgaria	NO	204	228	0.4%	24	12%	228	-	T2	D
Cyprus	NA	111	150	0.2%	39	35%	150	-	T2	D
Czech Republic	NO	918	1,392	2.1%	474	52%	1,392	-	T2	D
Estonia	NO	129	144	0.2%	16	12%	144	-	T2	CS
Hungary	NO	780	866	1.3%	87	11%	866	-	T2	CS
Latvia	IE,NA,NE,NO	93	96	0.1%	4	4%	96	-	T2	D,OTH
Lithuania	NA,NO	145	166	0.3%	21	14%	166	-	T2	CS
Malta	NO	89	94	0.1%	4	5%	94	-	M	M
Poland	NO	3,706	4,195	6.5%	489	13%	4,195	-	T1a,T1b,T2	D
Romania	NO	601	591	0.9%	-10	-2%	591	-	OTH	OTH
Slovakia	NO	294	310	0.5%	16	5%	310	-	D	CS
Slovenia	NO	188	190	0.3%	2	1%	190	-	T2	D
EU-27	84	60,660	64,899	**100.0%**	**4,239**	**7%**	**64,816**	**77518%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

HFC emissions from sector 2F4, Aerosols/Metered Dose Inhalers are reported in Table 19.13. EU-15 are responsible for 97% of these emissions, Poland, Czech Republic, Romania and Hungary account for 2.7% of emissions. However, Bulgaria, Czech Republic, Latvia, Malta and Romania reported a decrease of emissions between 2009 and 2010. Estonia (+3%), Hungary (+14%), Lithuania (+16%) reported an absolute increase of emissions.

Table 19.13 2F4 Aerosols/Metered Dose Inhalers: HFC emissions of EU-27

Member State	HFC (Gg CO_2 equivalents)			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	36	7,552	9,166	97.0%	1,613	21%	9,130	25423%		
Bulgaria	NO	10	10	0.1%	-1	-7%	10	-	T2	D
Cyprus	0.000	0.000	0.000	0.0%	0	-	0	-		
Czech Republic	NO	48	28	0.3%	-21	-43%	28	-	D	D
Estonia	NO	3	3	0.03%	0	3%	3	-	T2	CS
Hungary	NO	17	20	0.2%	2	14%	20	-	CS,D	CS
Latvia	NE,NO	3	2	0.03%	-0.1	-4%	2	-	T2	D
Lithuania	NA,NO	4	5	0.1%	1	16%	5	-	T1	D
Malta	NO	2	2	0.02%	0.0	-2%	2	-	CS	CS
Poland	NO	178	178	1.9%	0	0%	178	-	T1a,T1b,T2	D
Romania	NO	24	24	0.3%	0	-2%	24	-	OTH	OTH
Slovakia	NO	7	7	0.1%	0	0%	7	-	D	CS
Slovenia	NO	5	5	0.1%	0	0%	5	-	T1	D
EU-27	**36**	**7,854**	**9,449**	**100.0%**	**1,594**	**20%**	**9,413**	**26212%**		

SF_6 emissions from sector 2F9, other are reported in Table 19.14. EU-15 are responsible for 99.2% of these emissions, only Hungary, Romania, Estonia, Malta and the Czech Republic reported emissions from this sector. Whilst the EU 15 reported an increase (+7%) of emissions between 2009 and 2010, only Czech Republic as a new member state reported a decrease of about 24%. Hungary reported an increase of emissions (+57%).

Table 19.14 2F9 Other: SF_6 emissions of EU-27

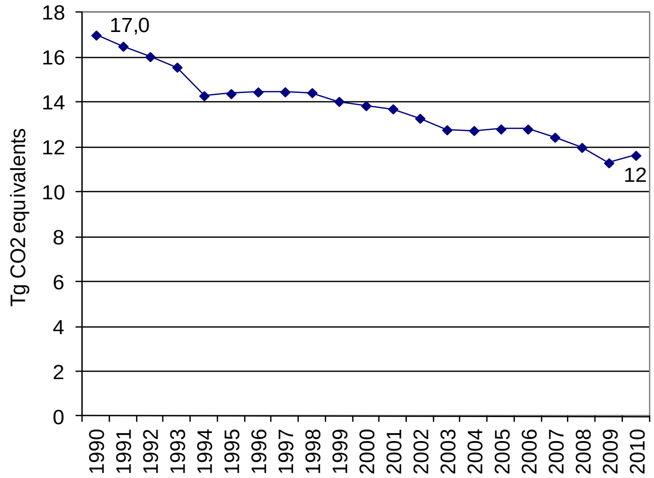
Member State	SF_6 emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010	
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
EU-15	4,397	3,395	3,635	99.2%	239	7%	-763	-17%
Bulgaria	NO	NO	NO	-	-	-	-	-
Cyprus	NA	NA	NA	-	-	-	-	-
Czech Republic	NO	5	4	0.1%	-1	-24%	4	-
Estonia	NO	0.05	0.05	0.0%	0	0%	0.05	-
Hungary	NO	16	25	0.7%	9	57%	25	-
Latvia	NO	NO	NO	-	-	-	-	-
Lithuania	NA	NO	NO	-	-	-	-	-
Malta	NO	0.00	0.00	0.0%	0	0%	0	-
Poland	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Romania	NO	3	NO	-	-3	-	0	-
Slovakia	NO	NO	NO	-	-	-	-	-
Slovenia	NO	NO	NO	-	-	-	-	-
EU-27	**4,397**	**3,418**	**3,663**	**100.0%**	**244**	**7%**	**-735**	**-17%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

20 Solvent and other product use (CRF Sector 3)

CRF Sector 3 Solvent and Other Product Use contribute 0.20 % to the total EU-27 GHG emissions (Table 20.5). The EU-27 Member States jointly achieved emission reductions of about 34 % from 17.003 Tg in 1990 to 11.31 Tg in 2010 (Figure 20.1 and Table 20.1).

Figure 20.1 **Sector 3 Solvent and Other Product Use: EU-27 GHG emissions for 1990–2010 in CO_2 equivalents (Tg)**



In 2010, the emissions decreased by 5.7 % compared to 2009 (Table 20.1).

Table 20.1 **Sector 3 Solvent and Other Product Use: Member States' contributions to GHG emission**

Member State	Greenhouse gas emissions			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010	
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
EU-15	13.482	9.728	9.195	81,3%	-533	-5%	-4.287	-32%
Bulgaria	898	51	48	0,4%	-3	-6%	-850	-95%
Cyprus	-	-	-	-	-	-	-	-
Czech Republic	765	515	506	4,5%	-9	-2%	-259	-34%
Estonia	21	22	18	0,2%	-4	-18%	-3	-12%
Hungary	226	406	340	3,0%	-66	-16%	114	50%
Latvia	51	44	27	0,2%	-17	-38%	-24	-47%
Lithuania	198	96	100	0,9%	4,81	5%	-97	-49%
Malta	2	2	2	0,01%	-1	-24%	-0,88	-36%
Poland	629	796	752	6,6%	-45	-6%	122	19%
Romania	541	135	122	1,1%	-13	-9%	-418	-77%
Slovakia	147	167	164	1,5%	-2,21	-1%	17	12%
Slovenia	43	28	31	0,3%	3	12%	-12	-29%
EU-27	**17.003**	**11.991**	**11.306**	**100,0%**	**-685**	**-5,7%**	**-5.697**	**-34%**

In the following table the emission of CO_2, N_2O and NMVOC as well as the Total GHG emission for the EU-15 and for all EU-27 Member States are listed as recommended in IRR 2007 (para 78) (Table 20.2).

Table 20.2 **Sector 3 Solvent and Other Product Use: EU-15 and EU-27 emissions of CO_2, N_2O, NMVOC and GHG**

		CO_2	N_2O	NMVOC	Total emissions		CO_2	N_2O	NMVOC	Total emissions
				Gg	Gg CO_2 eq				Gg	Gg CO_2 eq
BG	A. Paint Application	9.20		4.18	9.20	B. Degreasing and Dry Cleaning	0.50	NA	0.23	0.50
CY		NE		3.29	NE		NE	NE	0.06	NE
CZ		108.85		34.63	108.85		49.18	NA	15.65	49.18
EE		5.23		2.38	5.23		2.29	NO	1.04	2.29
HU		32.57		11.99	32.57		0.00	NO	0.01	0.00
LV		11.46		3.91	11.46		0.02	NO	0.01	0.02
MT		NA		IE	NA		NA	NA	IE	NA
PL		345.16		110.75	345.16		70.72	NA	22.69	70.72
RO		12.39		3.98	12.39		25.09	NE	8.05	25.09
SI		NO		8.34	NO		NE	NE	0.08	NE
SK		58.88		20.28	58.88		6.14	NO	3.00	6.14
LT		46.10		14.79	46.10		11.91	NE	3.82	11.91
EU15		2,234.30		895.43	2,234.30		297.93	0.00	143.02	297.93
EU27		2,864.15		1,113.94	2,864.15		463.79	0.00	197.65	463.79
BG	C. Chemical Products, Manufacture and Processing	0.61		0.28	0.61	D. Other	15.43	0.07	7.01	***35.61***
CY		NE		NE	NE		NE	NE	0.81	***NE***
CZ		40.60		12.92	40.60		71.55	0.75	22.77	***304.05***
EE		0.30		0.13	0.30		5.03	0.02	2.29	0.02
HU		NO		NO	NO		NO	0.76	NO	***236.31***
LV		0.85		0.29	0.85		24.96	0.02	8.52	***29.61***
MT		NA		IE	NA		NA	0.00	1.78	***1.29***
PL		75.32		24.17	75.32		164.19	0.40	52.68	***288.19***
RO		NO		7.28	NO		87.26	NE	28.00	***87.26***
SI		NE		3.57	NE		NA	0.10	NA	***30.38***
SK		18.53		8.42	18.53		NO	0.26	0.15	***80.79***
LT		NE		NE	NE		31.24	0.01	10.02	***31.24***
EU15		322.37		312.94	322.37		2,999.42	11.98	1,373.57	***6713.43***
EU27		458.57		369.99	458.57		3,399.09	14.36	1,507.60	***7851.36***
BG	*Total Solvent and Other Product Use*	*25.74*	0.07	*11.70*	*45.91*					
CY		*NE*	NE	*4.16*	*0.00*					
CZ		*270.18*	0.75	*85.97*	*502.68*					
EE		*12.84*	0.02	*5.84*						
HU		*32.57*	0.76	*11.99*	*268.88*					
LV		*37.30*	0.02	*12.72*	*41.95*					
MT		*NA*	0.00	*1.78*	*1.29*					
PL		*655.40*	0.40	*210.29*	*779.40*					
RO		*124.74*	NE	*47.30*	*124.74*					
SI		*NA,NE,NO*	0.10	*11.99*	*30.38*					
SK		*83.56*	0.26	*31.86*	*164.35*					
LT		*89.25*	0.01	*28.64*	*89.25*					
EU15		*5,854.01*	11.98	*2,724.95*	*9,568.02*					
EU27		*7,185.59*	14.36	*3,189.18*	*11,637.86*					

Table 20.3 Sector 3 Solvent and Other Product Use: EU-27 CO_2 emissions as well as their share

	Unit	1990	2010
CO2 emission in 'Solvent and Other Product Use'	[Gg]	11,606	7,186
Total GHG emission in 'Solvent and Other Product Use'	[Gg CO_2 eq]	13,482	9,568
Share of CO2 emission in Total GHG in 'Solvent and Other Product		*86%*	*75%*
Total National CO2 Emissions and Removals (excluding net CO2 from LULUCF)	[Gg]	4,420,532	3,892,457
Share of CO2 emission from 'Solvent and Other Product Use' in Total CO2 Emissions and Removals		*0.26%*	*0.18%*
Total National GHG Emissions and Removals (without LULUCF)	[Gg CO_2 eq]	5,584,277	4,720,474
Share of CO2 emission from 'Solvent and Other Product Use' in Total GHG Emissions and Removals (without LULUCF)		*0.21%*	*0.15%*

Table 20.4 Sector 3 Solvent and Other Product Use: EU-27 N_2O emissions as well as their share

	Unit	1990	2010
N2O emission in 'Solvent and Other Product Use'	[Gg]	17.4	14.4
Total GHG emission in 'Solvent and Other Product Use'	[Gg CO_2 eq]	13,482	9,568
Share of N2O emission in Total GHG in 'Solvent and Other Product Use'		*40%*	*47%*
Total National N2O Emissions	[Gg]	1,670	1,090
Share of N2O emission from 'Solvent and Other Product Use' in Total National N2O Emissions		*1.04%*	*1.32%*
Total National GHG Emissions and Removals (without LULUCF)	[Gg CO_2 eq]	5,584,277	4,720,474
Share of N2O emission from 'Solvent and Other Product Use' in Total GHG Emissions and Removals (without LULUCF)		*0.10%*	*0.09%*

Table 20.5 Sector 3 Solvent and Other Product Use: EU-27 GHG emissions as well as their share

	Unit	1990	2010
GHG emission in 'Solvent and Other Product Use'	[Gg CO_2 eq]	13,482	9,568
Total National GHG Emissions and Removals (without LULUCF)	[Gg CO_2 eq]	5,584,277	4,720,474
Share of GHG emission from 'Solvent and Other Product Use' in Total GHG Emissions and Removals (without LULUCF)		*0.24%*	*0.20%*

21 Agriculture (CRF Sector 4)

21.1 Overview of sector (EU-27)

Figure 21.1 Sector 4-Agriculture: EU-27 GHG emissions for 1990–2010 in CO_2 equivalents (Tg)

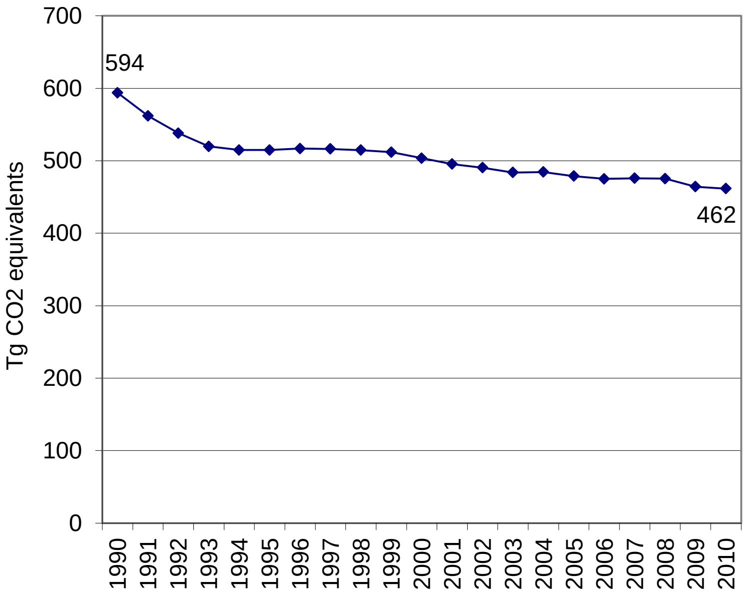
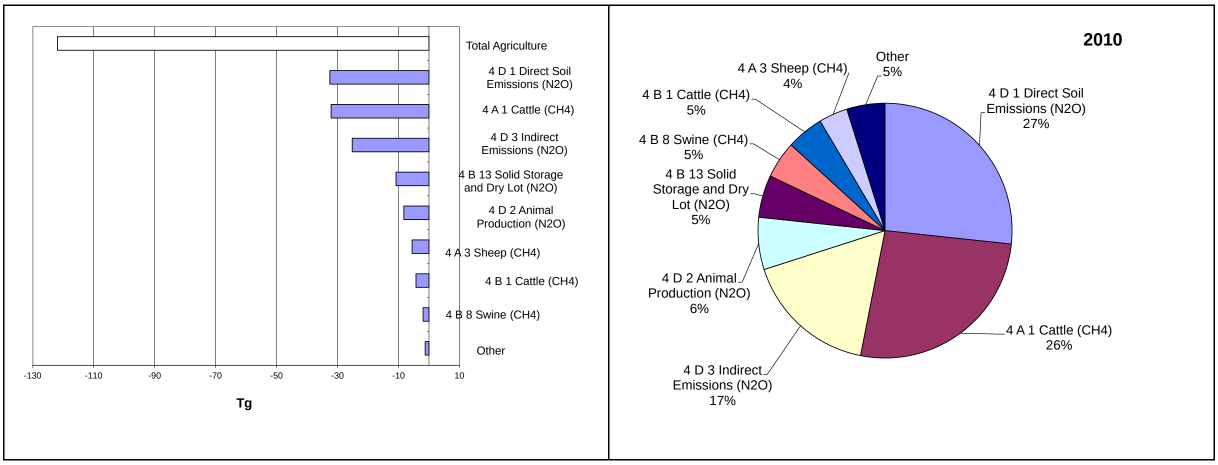


Figure 21.2 Sector 4-Agriculture: Absolute change of GHG emissions by large key source categories 1990–2010 in CO_2 equivalents (Tg) and share of largest key source categories in 2010



21.2 Source categories (EU-27)

21.2.1 Enteric fermentation (CRF Source Category 4A) (EU-27)

Table 21.1 4A1 Cattle: CH_4 emissions of EU-27

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	115,585	102,726	102,332	84.0%	-394	0%	-13,253	-11%		
Bulgaria	2,362	973	962	0.8%	-11	-1%	-1,400	-59%	T2	CS
Cyprus	80	81	79	0.1%	-1	-1%	0	0%	T1	D
Czech Republic	3,982	1,942	1,892	1.6%	-50	-3%	-2,090	-52%	T2	CS
Estonia	1,110	418	423	0.3%	5	1%	-687	-62%	T1,T2	CS,D
Hungary	2,609	1,255	1,243	1.0%	-12	-1%	-1,366	-52%	T2	CS
Latvia	2,064	638	641	0.5%	3	1%	-1,423	-69%	T2	CS,D
Lithuania	3,139	1,182	1,142	0.9%	-39	-3%	-1,997	-64%	T2	CS
Malta	27	24	22	0.0%	-2	-8%	-5	-19%	CR	CR
Poland	13,896	8,578	8,600	7.1%	22	0%	-5,296	-38%	T2	CS
Romania	8,478	3,951	3,184	2.6%	-767	-19%	-5,294	-62%	T2	CS
Slovakia	1,802	758	748	0.6%	-10	-1%	-1,054	-58%	T2	CS
Slovenia	625	626	621	0.5%	-5	-1%	-4	-1%	T2	CS
EU-27	**155,760**	**123,151**	**121,890**	**100.0%**	**-1,260**	**-1%**	**-33,870**	**-22%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 21.2 4A3 Sheep: CH_4 emissions of EU-27

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	16,608	13,313	12,904	76.4%	-409	-3%	-3,704	-22%		
Bulgaria	1,211	202	194	1.1%	-8	-4%	-1,018	-84%	T2	CS
Cyprus	49	50	51	0.3%	1	2%	3	5%	T1	D
Czech Republic	72	31	33	0.2%	2	8%	-39	-54%	T1	D
Estonia	23	13	13	0.1%	0	3%	-10	-44%	T1	D
Hungary	329	212	202	1.2%	-10	-5%	-127	-39%	T1	CS
Latvia	28	12	13	0.1%	1	9%	-15	-53%	T1	D
Lithuania	12	12	12	0.1%	0	3%	0	-3%	T2	D
Malta	1	2	2	0.0%	0	-4%	1	168%	CR	CR
Poland	677	47	43	0.3%	-5	-10%	-635	-94%	T2	CS
Romania	5,026	3,586	3,328	19.7%	-259	-7%	-1,699	-34%	T2	CS
Slovakia	125	78	81	0.5%	3	4%	-44	-35%	T2	CS
Slovenia	3	23	22	0.1%	-1	-6%	18	540%	T1	D
EU-27	**24,165**	**17,581**	**16,897**	**100.0%**	**-683**	**-4%**	**-7,268**	**-30%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

21.2.2 Manure management (CRF Source Category 4B) (EU-27)

Table 21.3 4B1 Cattle: CH_4 emissions of EU-27

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	20,589	19,972	19,768	90.6%	-205	-1%	-821	-4%		
Bulgaria	87	38	37	0.2%	0	-1%	-50	-57%	T2	CS
Cyprus	18	18	18	0.1%	-0.36	-2%	0	-1%	T1	D
Czech Republic	644	239	234	1.1%	-4	-2%	-410	-64%	T1	D
Estonia	73	29	29	0.1%	0.38	1%	-44	-60%	T2	CS,D
Hungary	127	61	59	0.3%	-1.09	-2%	-68	-53%	T2	CS
Latvia	138	53	55	0.3%	2	3%	-83	-60%	T1,T2	CS,D
Lithuania	425	229	221	1.0%	-8	-3%	-203	-48%	T2	CS
Malta	12	10	9	0.0%	-1	-8%	-2	-20%	CR	CR
Poland	755	935	932	4.3%	-3	0%	177	23%	T2	CS
Romania	540	187	124	0.6%	-63	-34%	-416	-77%	T2	CS
Slovakia	127	39	38	0.2%	0	-1%	-89	-70%	T1	D
Slovenia	212	295	300	1.4%	5	2%	88	42%	T2	CS
EU-27	**23,746**	**22,104**	**21,825**	**100.0%**	**-279**	**-1%**	**-1,920**	**-8%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 21.4 4B8 Swine: CH_4 emissions of EU-27

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	16,852	18,114	17,611	81.3%	-504	-3%	759	5%		
Bulgaria	4,086	587	578	2.7%	-10	-2%	-3,508	-86%	T2	CS
Cyprus	58	97	97	0.5%	0	0%	39	67%	T1	D
Czech Republic	302	124	120	0.6%	-4	-3%	-181	-60%	T1	D
Estonia	35	15	16	0.1%	1	9%	-19	-54%	T2	CS,D
Hungary	1,987	741	732	3.4%	-9	-1%	-1,255	-63%	T2	CS
Latvia	118	32	33	0.2%	1	4%	-85	-72%	T1	D
Lithuania	638	210	226	1.0%	15	7%	-412	-65%	T2	CS
Malta	13	14	15	0.1%	1	7%	2	15%	CR	CR
Poland	2,140	1,791	1,865	8.6%	74	4%	-275	-13%	T1	D
Romania	491	206	188	0.9%	-17	-8%	-303	-62%	T2	CS
Slovakia	212	62	58	0.3%	-5	-7%	-154	-73%	T1	D
Slovenia	249	125	121	0.6%	-3	-3%	-127	-51%	T1	CS
EU-27	**27,180**	**22,118**	**21,660**	**100.0%**	**-459**	**-2%**	**-5,520**	**-20%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 21.5 4B13 Solid Storage and Dry Lot: N_2O emissions of EU-27

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	19,595	15,905	15,885	64.1%	-19	0%	-3,710	-19%		
Bulgaria	1,313	467	445	1.8%	-21	-5%	-868	-66%	D	D
Cyprus	107	126	132	0.5%	6	5%	25	23%	T1	D
Czech Republic	1,583	626	614	2.5%	-12	-2%	-969	-61%	T1,T2	CS,D
Estonia	255	95	97	0.4%	2	2%	-158	-62%	T2	D
Hungary	1,724	894	896	3.6%	2	0%	-827	-48%	T1	CS,D
Latvia	564	135	125	0.5%	-10	-7%	-439	-78%	T1	CS,D
Lithuania	834	271	268	1.1%	-4	-1%	-566	-68%	T1	D
Malta	2	2	2	0.0%	-0.30	-13%	-0.48	-19%	CS	CS
Poland	7,869	5,138	5,167	20.9%	29	1%	-2,702	-34%	T2	CS,D
Romania	1,134	766	647	2.6%	-119	-15%	-487	-43%	D	D
Slovakia	1,055	368	366	1.5%	-2	-1%	-688	-65%	T2	D
Slovenia	252	140	130	0.5%	-11	-8%	-122	-48%	D	CS,D
EU-27	**36,288**	**24,933**	**24,775**	**100.0%**	**-158**	**-1%**	**-11,512**	**-32%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 21.6 4B14 Other: N_2O emissions of EU-27

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010	
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
EU-15	1,579	2,432	2,451	92.6%	18	1%	872	55%
Bulgaria	3	1	1	0.0%	-0.13	-11%	-2	-60%
Cyprus	6.893	11.823	11.917	0.5%	0.09	1%	5.02	73%
Czech Republic	44	35	33	1.2%	-2	-6%	-11	-26%
Estonia	NO	NO	NO	-	-	-	-	-
Hungary	18.186	6.386	6.381	0.2%	-0.01	0%	-11.81	-65%
Latvia	NO	0	0	-	0.47	-	0.48	-
Lithuania	27	11	11	0.4%	0	2%	-16	-59%
Malta	NO	NO	NO	-	-	-	-	-
Poland	NO	NO	NO	-	-	-	-	-
Romania	125	135	131	4.9%	-4	-3%	6	5%
Slovakia	NO	NO	NO	-	-	-	-	-
Slovenia	1	1	1	0.0%	-0.03	-3%	-0.11	-8%
EU-27	**1,804**	**2,633**	**2,646**	**100.0%**	**13**	**0%**	**842**	**47%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

21.2.3 Agricultural soils (CRF Source Category 4D) (EU-27)

Table 21.7 4D1 Direct soil emissions: N_2O emissions of EU-27

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	113,326	93,608	94,285	76.5%	676	1%	-19,042	-17%		
Bulgaria	4,400	1,939	2,110	1.7%	171	9%	-2,290	-52%	T1a,T1b	D
Cyprus	93	37	35	0.0%	-2	-4%	-58	-62%	T1,T1a	D
Czech Republic	4,984	2,818	2,703	2.2%	-115	-4%	-2,281	-46%	T1	D
Estonia	1,142	430	436	0.4%	6	1%	-706	-62%	T1,T1b	D
Hungary	4,059	2,852	2,822	2.3%	-30	-1%	-1,237	-30%	T1	D
Latvia	1,618	915	956	0.8%	41	5%	-662	-41%	T1,T1b	CS,D
Lithuania	2,415	1,348	1,353	1.1%	4	0%	-1,062	-44%	T1	D
Malta	14	13	12	0.0%	-1	-10%	-2	-17%	T2	D
Poland	15,640	12,627	12,196	9.9%	-432	-3%	-3,444	-22%	T1,T1b	CS,D
Romania	8,068	4,526	4,667	3.8%	141	3%	-3,401	-42%	T1,T1b	D
Slovakia	2,414	1,209	1,236	1.0%	27	2%	-1,178	-49%	T2	CS,D
Slovenia	412	386	381	0.3%	-6	-1%	-32	-8%	D,T1,T1b	CS,D
EU-27	**158,586**	**122,708**	**123,190**	**100.0%**	**482**	**0.4%**	**-35,396**	**-22%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 21.8 4D2 Pasture, Range and Paddock Manure: N_2O emissions of EU-27

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	32,985	28,339	28,075	91.9%	-264	-1%	-4,910	-15%		
Bulgaria	1,081	287	272	0.9%	-15	-5%	-810	-75%	T1	D
Cyprus	NO	NO	NO	-	-	-	-	-	NA	NA
Czech Republic	317	204	248	0.8%	44	22%	-69	-22%	T1	D
Estonia	192	74	75	0.2%	1.00	1%	-117	-61%	T2	D
Hungary	290	172	170	0.6%	-2	-1%	-120	-41%	T1	D
Latvia	358	89	87	0.3%	-2	-2%	-271	-76%	T1a	D
Lithuania	486	209	204	0.7%	-5.56	-3%	-282	-58%	T1	D
Malta	NO	NO	NO	-	-	-	-	-	NA	NA
Poland	1,317	455	454	1.5%	-1	0%	-864	-66%	T1	CS,D
Romania	1,771	959	822	2.7%	-137	-14%	-949	-54%	T1	D
Slovakia	222	92	93	0.3%	1.16	1%	-129	-58%	T2	CS
Slovenia	22	55	53	0.2%	-1.81	-3%	31	140%	D	D
EU-27	**39,042**	**30,934**	**30,552**	**100.0%**	**-382**	**-1%**	**-8,490**	**-22%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 21.9 **4D3 Indirect Emissions: N_2O emissions of EU-27**

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	80,498	63,992	64,207	82.0%	215	0%	-16,291	-20%		
Bulgaria	2,989	1,141	1,210	1.5%	69	6%	-1,779	-60%	T1b	D
Cyprus	179	176	182	0.2%	6	3%	3	2%	T1	D
Czech Republic	3,503	1,749	1,748	2.2%	-1	0%	-1,755	-50%	T1	D
Estonia	587	228	236	0.3%	8	4%	-351	-60%	T1b	D
Hungary	2,764	1,775	1,802	2.3%	26	1%	-962	-35%	T1	D
Latvia	1,034	356	388	0.5%	32	9%	-645	-62%	T1,T1a	D
Lithuania	1,879	902	952	1.2%	50	6%	-926	-49%	T1a	D
Malta	7	7	6	0.0%	-1	-13%	-1.05	-15%	T1	D
Poland	5,901	4,775	4,492	5.7%	-282	-6%	-1,408	-24%	T1b	D
Romania	4,808	2,501	2,393	3.1%	-108	-4%	-2,415	-50%	T1b	D
Slovakia	995	350	386	0.5%	35	10%	-609	-61%	T2	CS
Slovenia	314	301	293	0.4%	-8	-3%	-21	-7%	D,T1a	D
EU-27	**105,458**	**78,255**	**78,296**	**100.0%**	**41**	**0%**	**-27,162**	**-26%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

21.3 Methodological issues

21.3.1 Enteric Fermentation (CRF source category 4.A)

CH_4 emissions in the source category Enteric Fermentation stem for 7 EU-12 Member States to over 85% from the sub-category "Cattle" with a maximum of 96% in Lithuania. Substantial emissions from the sub-category "Sheep" (up to 44% of emissions in category 4.A. for Romania) are reported by Bulgaria, Cyprus, Hungary, Romania). Emissions accounting for more than 5% of the emissions in this category are further reported only for the sub-category "Goats" (Cyprus, 18%).

An overview of the CH_4 emissions, animal population and the corresponding implied emission factors for CH_4 emissions from enteric fermentation for the most important categories cattle and sheep (key source at EU-12-level) and also goats and swine are given in . Data are given for 2010 as the last inventory year and the base year 1990. The table shows that there is a general trend of decreasing animal numbers which are partly compensated by higher emissions per head due to intensification of livestock production in Europe. Compared to the trend in EU-15 countries, the reduction of animal numbers for cattle, sheep and swine is much stronger in the EU-12 countries.

Table 21.10: Total CH4 emissions in category 4A and implied Emission Factor at EU-12 level for the years 1990 and

1990[1)]	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine
CH_4 emissions [Gg CH_4]	1167	746	360	20	73
Animal population [1000 heads]	12777	15928	28119	1827	48464
Implied EF (kg CH_4/head/yr)	91	47	12.8	10.8	1.5

2010	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine
CH_4 emissions [Gg CH_4]	578	354	190	25	38
Animal population [1000 heads]	5724	6872	12095	2133	25582
Implied EF (kg CH_4/head/yr)	101	51	15.7	11.6	1.5

2010 value in percent of 1990	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine
CH4 emissions [Gg CH4]	50%	47%	53%	125%	52%
Animal population [1000 heads]	45%	43%	43%	117%	53%
Implied EF (kg CH4/head/yr)	111%	110%	123%	107%	99%

Information source: CRF for 1990 and 2010, submitted in 2012

21.3.1.1 Methodological Issues

CH_4 emissions from enteric fermentation is a key source category for cattle and sheep. For cattle, this is also true for all member states. Accordingly, most Member States have used Tier 2 methodology for calculating enteric CH_4 emissions, as shown in , even though the overall Tier-level for non-dairy cattle is with Tier 1.9 somewhat lower for EU-12 than for EU-15 (Tier 2.0). In addition to the methodology applied by the Member States for calculating CH_4 emissions, the table indicates also the total emissions in the category “enteric fermentation”, the contribution of the animal types considered (dairy and non-dairy cattle and sheep) to the total emissions, and whether the emissions from the animal class are belonging to the key source categories in the different Member States. On EU-12 level, 94% of the CH_4 emissions in category 4.A have been estimated with a Tier 2 approach compared to 97% for EU-15. For EU-27, this gives 97% of emissions estimated with a Tier 2 approach.

Table 21.11: Total CH4 emissions in category 4A and implied Emission Factor at EU-27 level for the years 1990 and

Member State	Total		Dairy Cattle		Non-dairy cattle		Cattle	Sheep		
	Gg CO_2-eq	b	a	b	a	b	c	a	b	c
Bulgaria	1,308	Tier 1.9	53%	Tier 2.0	20%	Tier 2.0	y	15%	Tier 2.0	y
Cyprus	180	Tier 1.0	27%	Tier 1.0	17%	Tier 1.0	y	29%	Tier 1.0	y
Czech Republic	1,999	Tier 1.5	46%	Tier 2.0	49%	Tier 1.0	y	2%	Tier 1.0	y
Estonia	447	Tier 2.0	59%	Tier 2.0	35%	Tier 2.0	y	3%	Tier 1.0	y
Hungary	1,599	Tier 1.8	43%	Tier 2.0	35%	Tier 2.0	y	13%	Tier 1.0	y
Latvia	672	Tier 2.0	60%	Tier 2.0	35%	Tier 2.0	y	2%	Tier 1.0	y
Lithuania	1,195	Tier 2.0	64%	Tier 2.0	32%	Tier 2.0	y	1%	Tier 2.0	y
Malta	29	Tier 1.0	46%	Tier 1.0	30%	Tier 1.0	y	7%	Tier 1.0	y
Poland	9,222	Tier 1.9	59%	Tier 2.0	34%	Tier 2.0	y	0%	Tier 1.0	y
Romania	7,529	Tier 1.9	29%	Tier 2.0	13%	Tier 2.0	y	44%	Tier 2.0	y
Slovakia	857	Tier 2.0	52%	Tier 2.0	35%	Tier 2.0	y	9%	Tier 2.0	y
Slovenia	666	Tier 2.0	35%	Tier 2.0	58%	Tier 2.0	y	3%	Tier 1.0	y
EU-12	**25,703**	**Tier 1.9**	**47%**	**Tier 2.0**	**29%**	**Tier 1.9**		**16%**	**Tier 1.9**	
EU-15	**122,420**	**Tier 1.9**	**36%**	**Tier 2.0**	**47%**	**Tier 2.0**		**11%**	**Tier 1.7**	
EU-27	**148,123**	**Tier 1.9**	**38%**	**Tier 2.0**	**44%**	**Tier 2.0**		**11%**	**Tier 1.8**	
EU-12: Tier 1	6%		1%		14%			9%		
EU-12: Tier 2	94%		99%		86%			91%		

a Contribution to CH_4 emissions from enteric fermentation
b Tier 1: default methodology; Tier 2: country-specific methodology
c Source category is key in the Member State's inventory (y/n). nr: not reported. Assessment for total cattle.

Details on the applied methodologies for the estimation of CH_4 emissions from enteric fermentation are given in Table 21.12.

Table 21.12: Methodology used by Member States for calculating CH4 emissions in category 4A

Member State	Methodology
Bulgaria	Cattle and sheep: Tier 2. Other animal types: Tier 1
Cyprus	Tier 1
Czech Republic	Cattle: Tier 2 method, other animal types: Tier 1
Estonia	Tier 2 method for the main cattle livestock sub-categories. A disaggregation on county level of Estonia was used. Tier 1 for other relevant animals. Disaggregation of the data on county level of Estonia.
Hungary	In the frame of the methodological development the conversion into the Tier 2 method is in progress, but a certain part of the country-specific information pertaining to the characteristics of livestock (body mass, net energy requirements, composition of feed rations, methane conversion rate, etc.) is to be confirmed as well as to be further elaborated for the entire time series. So it was decided that the simplified Tier 1 method is kept in order to maintain the consistency of time series in the current state of the methodology development.
Lithuania	CH_4 emissions from enteric fermentation by dairy cattle and non-dairy cattle, pigs and sheep were calculated using the IPCC Tier 2 methodology. For non-cattle categories, CH_4 emissions from enteric fermentation of goats, horses and other animals have been calculated using IPCC Tier1 methodology. The gross energy intake

Member State	Methodology
	is calculated using the detailed characterisation of livestock herds and the methane-conversion rate from the IPCC-GPG (2000) and from national data. Feed intake for non - dairy cattle was collect from national data.
Latvia	CH_4 emissions from Enteric Fermentation have been estimated using the Tier 1 methodology. In Tier 1 method, total emissions have been calculated by multiplying the number of the animals in each category with the IPCC default emission factor of each animal category.
Malta	Tier 1
Poland	Methane emissions from enteric fermentation of cattle and sheep were based on Tier 2 method. In case of goats, horses and swine the Tier 1 method and default Emission Factors for CH_4 was applied.
Romania	Tier 2
Slovenia	Tier 2 for dairy and non-dairy cattle. Tier 1 for other animals.
Slovakia	Tier 2 methodology based on national data about animal number in detailed categories (for dairy, non-dairy cattle and other cattle) and more advance characteristic about feed and milk conditions for category dairy cattle. Total methane emissions from enteric fermentation of sheep were estimated from 2004 by Tier 2 methodology based on detailed classification of animal to three categories: ewes, lambs and other sheep. The country specific data are available only from 2004. Tier 1 methodology for other animals categories (Horses, Goats).

Activity Data

Animal population of dairy and non-dairy cattle, sheep, goat, swine, and poultry in 2010 are given in Table 21.13. The characterization of the livestock population across the background tables 4.A, 4.B(a), and 4.B(b) is done in a consistent way by all Member States and will therefore be discussed only here. Estonia has chosen to use the option B for the classification of cattle. In order to allow the calculation of an EC implied emission factor for the categories listed under option A, these numbers were "converted" using the following rule: Mature Dairy Cattle → Dairy Cattle; Mature Non-dairy Cattle + Young Cattle → Non-dairy cattle.

Some information on the source of the animal numbers for the different Member States is given in Table 21.14.

Table 21.13: Animal population [1000 heads] in

Member State 2010	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine	Poultry
Bulgaria[1)]	605	478	1,384	359	697	15,934
Cyprus	23	30	305	307	464	3,816
Czech Republic	384	966	197	22	1,909	24,838
Estonia[1)]	193	280	79	4	372	2,046
Hungary	245	454	1,203	79	3,208	46,587
Latvia	164	215	77	14	390	4,949
Lithuania	355	353	56	16	929	9,466
Malta	6	9	12	5	71	970
Poland	2,656	3,068	258	108	14,865	132,196
Romania	1,179	775	8,000	1,158	1,594	48,685
Slovakia	204	263	394	35	687	12,992
Slovenia	109	361	130	26	396	4,618
EU-12	**6,123**	**7,251**	**12,095**	**2,133**	**25,582**	**307,098**
EU-15	**19,045**	**61,169**	**85,533**	**11,561**	**118,221**	**1,177,619**
EU-27	**25,168**	**68,420**	**97,628**	**13,695**	**143,803**	**1,484,717**

Information source: CRF for 1990 and 2010, submitted in 2012

[1)] Numbers for cattle have been calculated using the figure given under option B.

Table 21.14: Information on the source of animal population data

Member State	Methodology
Bulgaria	All domestic animals indicated in IPCC except for llamas and camels.
Cyprus	
Czech Republic	The Czech Statistical Office, see (Statistical Yearbooks, 1990 – 2006), provides detailed categorization of cattle (Calves younger than 6 months of age, Young cattle 6 – 12 months of age (young bulls, young heifers), Bulls over 1 year of age, including bullocks (1 – 2 years, over 2 years), Heifers 1 – 2 years of age, Heifers over 2 years of age, Cows. More disaggregated sub-categories given above in parenthesis are given in the study by external agricultural consultants of CHMI (Hons and Mudrik, 2003). In the calculation, it is also very important to distinguish between dairy and sucker cows (nursing cows).
Estonia	Activity data were used from official Estonian statistics (the Statistical Office of Estonia [ESO], Estonian Animal Recording Center (EARC). The number of livestock by sub-categories of cattle and by county of Estonia was obtained from the annual report of the ESO.
Hungary	Livestock population were obtained from the Department of Production Statistics, Main Department of Hungarian Central Statistical Office (HCSO). Since 2000, the HCSO has been registering the livestock three times a year (1 April, 1 August, 1 December), using a method which is equal to that of the EU.
Lithuania	The number of cattle, sheep, goats, horses and swine and milk production was received from the Statistical Yearbook “Agriculture in Lithuania”.

Member State	Methodology
Latvia	The number of cattle, sheep, horses, swine and goats were obtained from the Statistical yearbooks of Latvia. The source of data on the number of livestock in state farms and statutory companies are statistical surveys while sample surveys are used to collect information from peasant farms, household plots and private subsidiary farms. The survey was first launched in 1995 and since then it is conducted twice a year. The sample for 2006 covers 15.0 thsd. farms selected by economic size and specialisation.
Malta	National Statistics.
Poland	Activity data were obtained from national statistics (GUS R2 2007).
Romania	Total animal number data are provided by Romanian National Institute for Statistics (NIS) and expert judgement . Includes data on eight different livestock types: cattle (Dairy cattle and Non-dairy cattle), buffalo (buffalo milk and other buffalo), sheep (Ewes of milk and fitted, reproducers rams and other sheep), goats (Female goats for milk and females by first mount and other goats), horses, mules and asses, swine (pigs under 20 kg, pigs between 20 and 50 kg, pigs fattening, boars, breeding sows) and poultry (adult poultry for eggs, poultry for meat).
Slovenia	Statistical Office of Slovenia has published revised data on livestock numbers and production for the period 1991-2002. These data have been published in Rapid Reports No. 256. The main purpose of that revision was the methodological harmonisation of data and methods of estimating data for the mentioned period. This methodology is harmonised with recommendations of the Statistical Office of the European Communities.
Slovakia	Basic sources of data used for evaluations of emissions were published in Census of sowing areas of field crops in the SR; Annual census of domestic livestock in the SR; Green report of the SR 1998-2006, Ministry of Agriculture of the SR; Statistical Yearbook 1990-2006, Statistic Office of the SR. Detail input data about cattle and sheep according the regions are available from 1997 and published in the Green reports of the SR (www.land.gov.sk) and verified by district offices statistical farm information (bottom-up approach). In the FAO database, livestock numbers have been grouped in 12-month periods, ending on September 30 of the year stated in the tables. Our Statistical Office collects data on animal population in December and reports them in the current year. In the FAO database, these data are applied to the next year. Considering this explanation, all data on animals in the FAO database and in our statistical database are the same. The only difference is in the number of poultry, where our entire poultry population is shown in the FAO database as chicken population.

Emission Factors and other parameters

Considerable variation is found in the IEF for dairy and non-dairy cattle with values between 89 kg CH_4 head^{-1} yr^{-1} (Romania) and 134 kg CH_4 head^{-1} yr^{-1} (Hungary) for dairy cattle, and 48 kg CH_4 head^{-1} yr^{-1} (Czech Republic)) and 60 CH_4 head^{-1} yr^{-1} (Romania) for non-dairy cattle. The difference can mainly be explained by the different levels of intensity for dairy production. The IEF for the EU-12 Member States and the CH_4 conversion factors used are given in Table 21.15. For EU-12, the implied emission factor for dairy cattle in 2010 was 100.9 kg CH_4 head^{-1} yr^{-1} and lower than the value for EU-15 giving an overall IEF of 115.6 for EU-27.

More detailed information on the development of the emission factors for category 4A is given in Table 21.25.

Table 21.15: Implied Emission factors for CH4 emissions from enteric fermentation and CH4 conversion factors used in Member State's inventory

Member State	Implied EF (kg CH_4/head/yr) [1]					CH_4 conversion (%) [1]				
2010	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine
Bulgaria[1]	110.0	52.5	6.7	5.0	1.5	6.0	6.0	0.1	0.1	0.6
Cyprus	100.0	48.0	8.0	5.0	1.5	NA	NA	NA	NA	NA
Czech Republic	114.3	47.9	8.0	5.0	1.5	6.0	6.0	NA	NA	NA
Estonia[1]	130.4	54.0	8.0	5.0	1.0	6.0	6.1	6.0	5.0	0.6
Hungary	133.8	58.3	8.0	5.0	1.5	5.8	6.0	6.0	5.0	0.6
Latvia	117.6	52.2	8.0	5.0	1.5	6.0	6.0	NA	NA	NA
Lithuania	102.5	50.9	10.2	5.0	1.1	6.0	6.0	NA	NA	NA
Malta	100.0	48.0	8.0	5.0	1.5	NE	NE	NE	NE	NE
Poland	97.4	49.2	7.9	5.0	1.5	6.0	6.0	7.0	NA	NE
Romania	89.5	59.6	19.8	17.2	1.7	6.0	6.0	7.0	5.0	0.9
Slovakia	104.7	54.1	9.8	5.0	1.5	6.0	6.0	7.0	NE	NE
Slovenia	102.6	50.8	8.0	5.0	1.6	6.0	6.0	NA	NA	NA
EU-12	**100.9**	**51.5**	**15.7**	**11.6**	**1.5**	**6.0**	**6.0**	**6.0**	**3.9**	**0.7**
EU-15	**120.4**	**47.7**	**7.2**	**5.9**	**1.2**	**6.0**	**5.9**	**6.6**	**5.0**	**31.1**
EU-27	**115.6**	**48.1**	**8.2**	**6.8**	**1.2**	**6.0**	**5.9**	**6.5**	**4.8**	**25.7**

Information source: CRF for 1990 and 2010, submitted in 2012. Abbreviations explained in the Chapter 'Units and abbreviations'. 1) Numbers for cattle have been calculated using the figure given under option B.

Table 21.16: Implied Emission factors for CH4 emissions from enteric fermentation and CH4 conversion factors used in Member State's inventory

Member State	Methodology
Bulgaria	
Cyprus	IPCC default.
Czech Republic	IPCC Tier 2. The "daily food intake" for each subcategory of cattle is not measured directly, but is calculated from national zoo-technical inputs, mainly weight (including the final weight of mature animals), weight gain (for growing animals), daily milk production including the percentage of fat (for cows) and the feeding situation (stall, pasture). The national zoo-technical inputs were updated by expert

Member State	Methodology
	from the Czech University of Agriculture in Prague in 2006.
Estonia	IPCC default, excluding milk production per cow and milk fat content. Sheep, goats and horses: EF for developed countries. Data on feed digestibility are from (Kaasik et al., 2002).
Hungary	IPCC default for developed countries. Development of the country-specific emission factor for the entire time series will have been done by July 2007.
Lithuania	The IPCC Tier 2 EFs for Dairy and Non-Dairy Cattle were estimated based on national data based on: weight, feeding situation, milk production, fat content of milk, percentage of pregnant females, and feed digestibility. Feeding data was obtained from tables reported by the IPCC, milk production and fat content of milk were obtained from statistical databases. The productivity of the cows is established in accordance with the data of the Department of Statistics. Milk fat data is taken of the register of the herds in control. Determining CH_4 emission from swine, gross energy was also calculated on the basis of feed accumulation standards presented in the above mentioned national reference book for animal production. Most frequently used feedstuffs also were used for calculations: barley, wheat, triticale, dried pulses, rapeseed cake, soybean meal, milk replacers, fish meal, and oil. Determining CH_4 emission from sheep, gross energy was calculated same methods as for cattle,based on the feed accumulation standards. IPCC default emission factors were used for remaining animal categories (Tier 1 method). As no IPCC and national default emission factors for fur-bearing animals, rabbits and nutria are available, the Norwegian emission factor for fur-bearing animals and Russian emission factors for rabbits and nutria were used in calculations.
Latvia	IPCC default.
Malta	EF for cattle, sheep and goats, horses and swine from CORINAIR (2006). EF for poultry IPCC (1996), EF for rabbit APAT (2005)
Poland	Gross Energy Intake (GE) was calculated [IPCC 2000, equation 4.11] for dairy cattle and for and non-dairy cattle disaggregated for: calves under 1 year, young cattle 1-2 years and other matured cattle (over 2 years). Country specific parameters like pregnancy [GUS R1 2008], milk production (table 6.1), percent of fat in milk [GUS R 2008] come from national statistics. Digestible energy (DE – expressed as a percent of gross energy) was estimated by[Walczak 2006] and change from 58.6% in 1988 through 60% in 1995 up to 62.8% in 2004 and after for dairy cattle what was caused by diet improving.The emission factors were estimated for each livestock category within cattle according national study (Miczko 2001) and updating data about animal breeding (Walczak 2003, 2006). The characteristics like mean mass or daily mass gain of animals come from country case study [Walczak 2006], wool production come from national statistics [GUS R 2008].

Member State	Methodology
Romania	GE: based on an average rations, both in summer and in winter following the method of (I.Stoica, Nutrition and feedingstuffs, 1997). This rations can ensure the necessary of maintenance (allows normal animal organism functioning on basal metabolic level, providing vital functions), and a required for the productions elaboration in cattle, buffalo, sheep, goats and horses productions. At poultry and swine was proceeded similarly, taking into account mixed fodder prescriptions specific of categories of exploitation, according to nutritional requirements and standards in force. Digestible energy is calculated considering the digestible content and coefficients of specific digestibility of each feed and each species (I.Stoica-Nutrition and feedingstuffs, 1997, pg.518-522), then are propagated with the energy equivalents for digestible energy, which are different per species, in the table below (Popa O, Milos M, Halga P, Bunicelul El., EDP., 1980, pg.101- Livestock feeding). For default parameters, values for developing countries and Eastern Europe were used.
Slovenia	Dairy cattle: According to data on emission factors from period 1985-1996 an equation was developed that is based only on the data on average milk yield, where EM is methane emission in kg per animal per year, and the average annual milk yield of dairy cows. This equation has been applied for calculation of emissions for whole period 1985-2007. Other animals: default EFs. Milk recording data which is performed by the national Cattle breeding service (Verbi?, Sušin, Podgoršek 1999, p. 3). For the year 2007, more precise average daily gains for young bovine animals for fattening were obtained.
Slovakia	Dairy and non-dairy cattle: linear extrapolation from 1996 back to the base year 1990. The time series of EFs is based on average gross energy intake (AGEI) and detailed cattle categories analysis. The emission factor for enteric fermentation was estimated according to milk productivity for each year by interpolation when for milk productivity.

21.3.2 Manure Management CH_4 (CRF source category 4.B(a))

Table 21.17 shows in contrast to EU-15, where swine and catle contribute more or less equally to CH_4 emissions from manure management, swine are the main source of CH_4 emissions from manure management in EU-12 (77%). For cattle, the contributions of non-dairy cattle are slightly prevailing with percentages of total emissions in this category amounting to 15% and 8%, respectively. The highest contribution of cattle to CH_4 emissions from manure management are observed in Slovenia (70%) and the Czech Republic (59%); the lowest in Hungary and Cyprus, where cattle contribute with only 6% and 14%, respectively. This is compensated with the emissions from swine manure where Hungary has a share of 77%, while swine contributes only 28% in Slovenia. For EU-12 level, CH_4 emissions from manure management have decreased significantly for cattle and swine.

Table 21.17: Total CH4 emissions in category 4A and implied Emission Factor at EU-12 level for the years 1990 and 2010

	Dairy Cattle	Non-dairy cattle	Swine
	1990		
Total Emissions of CH_4 [Gg CH_4]	96	54	492
Total Population [1000 heads]	12777	15928	48464
Implied Emission Factor [kg CH_4 / head / year]	6.1	3.0	9.7
	Dairy Cattle	Non-dairy cattle	Swine
	2010		
Total Emissions of CH_4 [Gg CH_4]	68	30	193
Total Population [1000 heads]	5724	6872	25582
Implied Emission Factor [kg CH_4 / head / year]	11.0	4.2	7.2
	Dairy Cattle	Non-dairy cattle	Swine
	2010 value in percent of 1990		
Total Emissions of CH_4 [Gg CH_4]	70%	56%	39%
Total Population [1000 heads]	45%	43%	53%
Implied Emission Factor [kg CH_4 / head / year]	182%	142%	74%

Source of information: CRF Table4s1 and 4.B(a) for 1990 and 2010, submitted in 2012
Dairy cattle includes Mature Dairy cattle, Non-dairy cattle includes Mature Non-Dairy Cattle and Young Cattle

21.3.2.1 Methodological Issues

CH_4 emissions from manure management are a key source category for cattle and swine at EU-12 level. This is true also for many Member States. Table 21.18 shows the total emissions in category 4.B(a), how this is composed and the methodology used for calculating the emissions for cattle and swine by Member States. Also, it is reports whether the source category is a key source category for the Member States.

The method for calculation of CH_4 emissions from manure management has been done as described in Chapter 6.3.2.2. and 6.4.1. Overall, the quality of the emission estimates in category 4B(a) range between Tier 1.0 and Tier 1.8 with a Tier level for EU-12 of Tier 1.5 (corresponding to 55% of the emissions being calculated with country-specific data). Some additional information on the methodological approaches for some Member States is given in .

Table 21.18: Total emissions and contribution of the main sub-categories to CH4 emissions in category 4B(a), methodology applied and key source assessment by Member States for the sub-categories dairy cattle, non-dairy cattle and swine.

	Total		Dairy Cattle		Non-dairy cattle		Cattle	Swine		
	Gg CO_2-eq	b	a	b	a	b	c	a	b	c
Bulgaria	919	Tier 1.8	3%	Tier 1.9	1%	Tier 1.9	y	63%	Tier 1.9	y
Cyprus	128	Tier 1.0	7%	Tier 1.0	6%	Tier 1.0	y	76%	Tier 1.0	y
Czech Republic	397	Tier 1.0	28%	Tier 1.0	31%	Tier 1.0	y	30%	Tier 1.0	y
Estonia	49	Tier 1.7	43%	Tier 1.9	16%	Tier 1.9	y	33%	Tier 1.9	y
Hungary	956	Tier 1.6	4%	Tier 1.9	2%	Tier 1.9	y	77%	Tier 1.2	y
Latvia	96	Tier 1.7	38%	Tier 1.9	19%	Tier 2.0	y	34%	Tier 1.2	y
Lithuania	467	Tier 1.5	33%	Tier 1.9	14%	Tier 1.9	y	48%	Tier 1.9	y
Malta	27	Tier 1.0	22%	Tier 1.0	13%	Tier 1.0	y	55%	Tier 1.0	y
Poland	3,022	Tier 1.5	25%	Tier 2.0	5%	Tier 2.0	y	62%	Tier 1.3	y
Romania	425	Tier 1.8	22%	Tier 1.8	7%	Tier 1.8	y	44%	Tier 1.8	y
Slovakia	119	Tier 1.0	14%	Tier 1.0	18%	Tier 1.0	y	49%	Tier 1.0	y
Slovenia	430	Tier 1.8	31%	Tier 1.9	39%	Tier 1.8	y	28%	Tier 1.9	y
EU-12	**7,035**	**Tier 1.5**	**20%**	**Tier 1.9**	**9%**	**Tier 1.7**		**58%**	**Tier 1.4**	
EU-15	**40,156**	**Tier 1.5**	**26%**	**Tier 1.7**	**23%**	**Tier 1.5**		**44%**	**Tier 1.7**	
EU-27	**47,191**	**Tier 1.6**	**25%**	**Tier 1.7**	**21%**	**Tier 1.5**		**46%**	**Tier 1.6**	
EU-12: Tier 1	45%		14%			32%		57%		
EU-12: Tier 2	55%		86%			68%		43%		

a Contribution to CH_4 emissions from manure management
b Tier 1: default methodology; Tier 2: country-specific methodology
c Source category is key in the Member State's inventory (y/n)

Table 21.19: Methodology used by Member States for calculating CH4 emissions in category 4A

Member State	Methodology
Bulgaria	Cattle (dairy and non-dairy) and swine: Tier 2 method with country-specific parameters for the systems for management and storage of manure. Other animals: Tier 1
Cyprus	Tier 1
Czech Republic	Tier 1
Estonia	Tier 1. Swine manure management emissions for Hiiu and Lääne-Viru counties is not presented due to the absence of population data for the counties.
Hungary	Tier 1, except for the Dairy Cattle and the Non-Dairy Cattle categories, where country-specific emission factors were calculated on the basis of Tier 2 method. In the Dairy Cattle category gross energy intake was determined on the basis of the data of the Hungarian Nutrition Codex, 2004.
Lithuania	CH_4 emissions from manure management systems of cattle and swine were calculated using Tier 2 method, CH_4 emissions from horses, goats, sheep and poultry were calculated according to the Tier1 method.
Latvia	Dairy cattle: Tier 2. Other animal types: Tier 1
Malta	

Member State	Methodology
Poland	
Romania	Cattle, sheep and swine: Tier 2. Goats, horses and poultry: Tier 1.
Slovenia	For dairy cows IPCC Tier 2, on the basis of national publication (Tomši? et al., 2000), which enables a direct estimation of the amount of excreted decomposable organic matter on the basis of annual milk yield. Other categories of bovine animals: Tier 1.
Slovakia	Tier 1

Activity Data

Table 21.20 summarizes the allocation of the produced manure over the animal wastes management systems ‘liquid systems’, ‘solid storage and dry lot’ and ‘pasture, range and paddock’ for the animal categories dairy and non-dairy cattle and swine in 2010. While in EU-15 the liquid systems dominate for swind with 67%, only 48% of swine manure is treated in liquid management systems in EU-12, however, with very large shares of 25% in Hungary and the Czech Republic. Still the share of liquid system for swine is higher than that for cattle, but differently from the situation in EU-15, more manure from non-dairy cattle (15%) are managed in liquid systems than from dairy cattle (11%). Daily spread occurs for dairy cattle onley in the Czech Republic (1%). Pasture, range and paddock ranges up to 50% and 49% (Latvia) for dairy and non-dairy cattle, respectively.

Only few countries in EU-12 report dynamic shares of manure management systems. Substantial changes are reported for cattle in Slovenia, where liquid systems increased in importance between 1990 and 2010. In the Czech Republic, the share of manure in pasture, range and paddock increased signficantly for dairy cattle from 5% in 1990 to 7%, while the contribution for non-dairy cattle remained constant.

For some countries, background information on in addition to what is reported in Table 21.20 on the activity data used for the estimation of CH_4 emissions from manure management is given in the respective National Inventory Reports and is listed in Table 21.21.

Table 21.20: Animal population [1000 heads] in 2010

Member State 2010	Dairy Cattle - Allocation of AWMS (%)				Non-Dairy Cattle - Allocation of AWMS (%)				Swine - Allocation of AWMS (%)			
	Liquid system[1)]	Daily Spread	Solid storage and dry lot	Pasture range paddock	Liquid system[1)]	Daily Spread	Solid storage and dry lot	Pasture range paddock	Liquid system[1)]	Daily Spread	Solid storage and dry lot	Pasture range paddock
Bulgaria	NO	NO	83%	17%	NO	NO	83%	17%	79%	NO	21%	NO
Cyprus	no	no	99%	no	NO	NO	99%	no	NO	NO	NO	NO
Czech Republic	27%	1%	65%	7%	52%	1%	27%	20%	76%	NO	23%	NO
Estonia	25%	NO	40%	35%	18%	NO	40%	42%	82%	NO	18%	NO
Hungary	4%	NO	88%	8%	2%	NO	83%	15%	25%	NO	25%	NO
Latvia	25%	NO	52%	22%	19%	NO	33%	49%	83%	NO	16%	1%
Lithuania	18%	NO	42%	40%	21%	NO	52%	27%	711%	NO	21%	NO
Malta	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Poland	11%		79%	10%	5%		83%	12%	26%		74%	
Romania	2%	NO	48%	50%	1%	NO	53%	46%	35%	NO	17%	NO
Slovakia	5%	NO	75%	20%	5%	NO	85%	10%	87%	NO	13%	NO
Slovenia	57%	NO	31%	12%	57%	NO	31%	12%	61%	NO	26%	NO
EU-12	11%	0%	68%	21%	15%	0%	65%	20%	48%		42%	0%
EU-15	47%	3%	23%	26%	26%	2%	27%	43%	67%	1%	5%	1%
EU-27	38%	2%	34%	25%	25%	2%	31%	40%	63%	1%	13%	1%

Source of information: CRF 4.B(a) for 2010, submitted in 2012. Abbreviations explained in the Chapter 'Units and abbreviations'.

1) Anaerobic lagoon + Liquid system. Missing fraction belong to the category 'Other'

Table 21.21: Member State's background information on the emission factors and other parameters used for the calculation of CH4 emissions in category 4.B(a)

Member State	Methodology
Bulgaria	
Cyprus	Default distribution to AWMS
Czech Republic	As agricultural farming in the Czech Republic has not yet been classified according stable types. Collection of the relevant country specific AWMS parameters is under way. Default parameters from IPCC1997 and IPCC2000 are used.
Estonia	The data on cattle and swine livestock population and the data on location of manure management systems (MMS) were collected by SE in the framework of Agricultural Survey. The both databases contain data on village level. More than 30,500 holdings with different size of livestock herds and about 1,700 holdings, which have MMSs, were analyzed. The large difference in numbers of holdings keeping livestock and those, which have MMS, is explained by size of livestock herds. In Estonia, holdings with less than 10 livestock units are not under obligatory to build MMS for animal waste storage (Veeseadus, 2011), usually these holdings storage animal waste in cattle-shed or pigsty, in manure-heap, truck etc. i.e., there is typical for these farms to store animal waste in „solid manure management system? (according to the classification established under the IPCC). A share of small holdings keeping less than 10 heads of dairy cows was 93% of the total agricultural holdings with dairy cattle, these holdings kept about 24% of the total population of dairy cattle in 2000. A share of small holding keeping less than 10 livestock unit of pigs was 98% of the total number of holding, which kept pigs. The population of pigs in small swine holdings made up 13% of the total pig population in Estonia in 2000.
Hungary	As regards manure management, Hungarian conditions were analysed on the basis of expertconsultations (Mészáros, 2000) and a paper by Ráki (2003). This paper includes theprocessing of three databases:· General Agricultural Census 2000 (HCSO),· data from the legally required registration of agricultural producers in 2000

Member State	Methodology
	(thisincludes data for agricultural enterprises),· a survey of animal production holdings performed in October and November 2001,which covered the capacity, capacity exploitation and the conditions of buildings andequipment. This survey allows conclusions to be drawn in connection with the entireanimal keeping sector because it covers 70% to 100% of the livestock populationsdepending on the given category.
Lithuania	The information about manure management systems is given from the institute of Water of the University of Agriculture of the Republic of Lithuania.
Latvia	The distribution of different manure management systems received from research made by Latvian State Institute of Agrarian Economics (2005). Manure management systems reported in the inventory are liquid system, daily spread, solid storage and dry lot, pasture range and paddock and other.
Malta	
Poland	Country specific data on the fraction of manure managed per AWMS and animal type (Myczko 2001; Walczak 2003, 2006,2011). Cattle: annual basis for period 1988-2002 and 2004?2009, interpolation for 2003. The share of pastures and solid storage were assessed for the key years: 1988-1989 and for 2004-2009 and the values in between were interpolated. For swine estimation based on AWMS shares and pigs population for age categories for 1988 [Walczak 2006] and for 2004?2009 from [Walczak 2011]. Interpolation for the years 1988-2004. For other animals permanent shares of AWMS were taken [Walczak 2011].
Romania	Distribution of AWMS according expert opinion.
Slovenia	The fraction of individual manure management systems has been estimated on the basis of the results of a farm census done in 2000. Data published by the Statistical Office of the Republic of Slovenia allow a breakdown of the entire herd into commercial farms and family farms for the period 1985-2002. For the years 2003 and 2004 the herd was allocated to both segments on the basis of ratio in 2002. For poultry, floor system on bedding was assumed for broilers, and combined floor system (1/4) and battery-cage systems (3/4) were assumed for layers.
Slovakia	Knowledge on animal housing, pasture and production of manures and slurries was found on the base of questionnaires in the national paper. Some additional information was based on expert judgement. The fraction of individual manure management systems has been estimated on the basis of the results of a farm census done in 2000.

Emission Factors and other parameters

The implied emission factors for CH_4 emissions from manure management vary substantially among the EU-12 Member States, as shown in Table 21.22. The range of the implied emission factors for dairy cattle, non-dairy cattle and swine covers about one order of magnitude, as has already been observed for EU-15. The ratio of the highest and the smallest IEF used by the Member States is 14 for dairy cattle, and 14 for non-dairy cattle and 2, 2, and 19 for sheep, goats and swine, respectively. The highest IEF for dairy cattle is used by Slovenia with 57 kg CH_4/head/year (higher than the highest value found in EU-15) and the smallest by Slovakia with 4.0 kg CH_4/head/year.

The two most important factors influencing the amount of CH_4 emitted from manure management systems are the climate region and if solid or liquid systems are dominating. We have already discussed the large range of systems used in the EU-12 Member States. The other two factors, the excretion rate of volatile solids and the methane producing potential, are not significantly influencing the order of magnitude.

More detailed information on the development of the emission factors for category 4A is given in Table 21.23.

Table 21.22: Implied Emission factors for CH4 emissions from manure management used in Member State's inventory 2010

Member State	Implied EF (kg CH_4/head/yr)					
2010	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine	Poultry
Bulgaria	4.6	1.6	0.14	0.18	39.5	0.9
Cyprus	19.0	13.0	0.28	0.18	10.0	0.1
Czech Republic	14.0	6.0	0.19	0.12	3.0	0.1
Estonia	10.4	2.7	0.19	0.12	2.1	0.1
Hungary	7.7	2.1	0.19	0.12	10.9	0.2
Latvia	10.6	4.0	0.19	0.12	4.0	0.1
Lithuania	20.9	8.8	0.19	0.12	11.6	0.1
Malta	44.0	20.0	0.28	0.18	10.0	0.1
Poland	13.8	2.6	0.16	0.12	6.0	0.1
Romania	0.0	0.0	0.00	0.00	0.0	0.0
Slovakia	4.0	3.8	0.19	0.12	4.0	0.1
Slovenia	57.4	22.2	0.19	0.12	14.6	0.1
EU-12	**11.0**	**4.2**	**0.06**	**0.07**	**7.2**	**0.1**
EU-15	**28.3**	**7.7**	**0.25**	**0.24**	**7.2**	**0.1**
EU-27	**24.0**	**7.3**	**0.22**	**0.21**	**7.2**	**0.1**

Source of information: CRF 4.B(a) for 2010, submitted in 2012 Abbreviations explained in the Chapter ‘Units and abbreviations’.

Note: Data for Romania are reported in a wrong unit

Table 21.23: Implied Emission factors for CH4 emissions from enteric fermentation and CH4 conversion factors used in Member State's inventory

Member State	Methodology
Bulgaria	Dairy and beef cows and deer: Tier 2 calculation for VS. Other parameters IPCC default.

Member State	Methodology
Cyprus	
Czech Republic	Default EFs for Western Europe
Estonia	Dairy cattle, non-dairy cattle: country-specific data and default factors. Other animals - default parameters.
Hungary	Available parameters of animal production systems were compared to the criteria listed for the Tier 1 factors in the IPCC Guidelines. National conditions on the basis of expert consultations (Mészáros 2000) and a paper by Ráki (2003). In the case of Non-Dairy Cattle category the default values of Rev. 1996 IPCC Guidelines were used for the Tier 2 calculations. In the case of Buffalo, Sheep, Goats, Horses, Asses & Mules, Swine, Poultry and Rabbits categories GPG Tier 1 and IPCC default emission factors were used.
Lithuania	default. For animal manure treatment in a biogas device it is considered that all the biogas is collected and digested in the anaerobic digester, therefore, amount of CH_4 used as fuel is not included into the total emission
Latvia	For animals other than dairy cattle, default values for the cool climate region were chosen because annual temperature in Latvia is 6.0 ºC (reference period 1971-2000).
Malta	EF for cattle, sheep and goats, horses, swine and poultry from CORINAIR (2006). EF for rabbit APAT (2005)
Poland	country specific data for dairy and non-dairy cattle, sheep and swine
Romania	GE and DE as for enteric fermentation. Other parameters from IPCC (2000) for Eastern Europe and developing countries.
Slovenia	default
Slovakia	default

21.3.3 Manure Management N_2O (CRF source category 4.B(b))

Generally, GHG emissions (in $CO_{2\text{-eq}}$) from manure management are predominantly as CH_4 rather than as N_2O. For four countries in EU-12 (Slovakia, Estonia, Latvia, Poland), emissions from manure management are higher for N_2O than for CH_4. In Poland, the CH_4/N_2O ratio is 0.9. As Poland accounts for 57% of N_2O emissions and 43% of CH_4 emissions from manure management, the average ratio for EU-12 countries is 1.1 compared to the values of EU-15 (2.9) and EU-27 (2.4). In the EU-12 countries, only Slovenia and Malta are above the EU-15 average with ratios of 4.6 and 9.4, respectively.

The differences of the ratio across the countries can partly be explained by the implied emission factor used for CH_4 emissions in the manure management category (see discussion above), and partly by the nitrogen excretion factors. Total nitrogen excretion by Member State and manure management system are given in Table 21.24.

Table 21.24 shows that the implied emission factors used for N_2O emission from manure management are IPCC default for all countries are close to the default value and that only small changes in the IEF occurred in the time between 1990 and 2010 with a 1% increase of the IEF for solid systems and a
0% increase for liquid systems.

Table 21.24: Total N2O emissions in category 4B(b) and implied Emission Factor at EU-12 level for the years 1990 and 2010

	Anaerobic lagoon	Liquid systems	Solid storage and dry lots
	1990		
Total Emissions of N_2O [Gg N_2O-N]	0	1	54
Total Nitrogen excreted [Gg N]	70	409	1719
Implied Emission Factor [kg N_2O-N / kg N]	0.10%	0.10%	1.99%

	Anaerobic lagoon	Liquid systems	Solid storage and dry lots
	2010		
Total Emissions of N_2O [Gg N_2O-N]	0	0	29
Total Nitrogen excreted [Gg N]	18	250	920
Implied Emission Factor [kg N_2O-N / kg N]	0.10%	0.10%	1.98%

	Anaerobic lagoon	Liquid systems	Solid storage and dry lots
	2010 value in percent of 1990		
Total Emissions of N2O [Gg N2O-N]	25%	62%	53%
Total Nitrogen excreted [Gg N]	25%	61%	54%
Implied Emission Factor [kg N2O-N / kg N]	100%	101%	100%

21.3.3.1 Methodological Issues

Emissions of nitrous oxide are much higher from solid storage systems than from liquid systems, this is even more true for EU-12 countries (96%) than for EU-15 countries (78%); however, the range is large in EU-12 with lowest share of 47% in Malte, followed by 96% in Estonia and highest share of 99% in Poland.

Table 21.25 shows the total emissions in category 4B(b), how this is composed and the methodology used for calculating the emissions for cattle and swine by Member States. The table shows also that 'solid storage' is a key category for all Member States. Activity Data are the excretion of nitrogen per animal and the distribution over the manure management systems. The emission factor of N_2O per nitrogen managed in a certain manure management system is usually IPCC default.

The quality of the emission estimates are calculated from the Nex factor and the emission factor as described in Section 6.3.3.2 and 6.4.1.3.

Most countries use default factors for both nitrogen excretion rates for most animals and emission factors with the exception of Slovakia for the IEFs, and several countries for N-excretion rates; for all EU-12 countries, a level of Tier 2.0 is obtained for N excretion and Tier 1.0 for the emission factors. Thus, the overall quality level is Tier 1.6 for N_2O emissions from manure management in EU-12 countries. Nitrogen excretion is reported by animal type and not by manure management system in the CRF tables. To assign nevertheless a Tier level for the nitrogen excretion by manure management system, the allocation of animal waste to manure management systems from the calculation of CH_4 emissions from manure management is used.

Additional background information on the methodology, if available, is summarised in Table 21.26.

Table 21.25: Total emissions and contribution of the main sub-categories to N2O emissions in category 4B(b), methodology applied (EF) and key source assessment by Member States for the sub-categories solid storage and liquid systems

	Total		Solid Storage			Liquid Systems	
	Gg CO_2-eq	b	a	b	c	a	b
Bulgaria	450	Tier 0.0	99%	Tier 1.5	y	0%	NO
Cyprus	144	Tier 0.2	92%	NO	y	0%	NO
Czech Republic	682	Tier 1.5	90%	Tier 1.4	y	5%	Tier 1.6
Estonia	101	Tier 1.3	96%	Tier 1.7	y	4%	Tier 1.3
Hungary	910	Tier 1.4	98%	Tier 1.4	y	1%	Tier 1.4
Latvia	130	Tier 1.1	97%	Tier 1.3	y	3%	Tier 1.1
Lithuania	288	Tier 1.6	93%	Tier 1.7	y	3%	Tier 1.7
Malta	4	NO	47%	NO	y	53%	NO
Poland	5,210	Tier 1.7	99%	Tier 1.7	y	1%	Tier 1.7
Romania	785	Tier 0.9	82%	Tier 1.7	y	0%	Tier 1.0
Slovakia	374	Tier 1.7	98%	Tier 1.7	y	2%	Tier 1.7
Slovenia	140	Tier 1.5	93%	Tier 1.7	y	7%	Tier 1.5
EU-12	**9,218**	**Tier 1.6**	**96%**	**Tier 1.6**		**1%**	**Tier 1.6**
EU-15	**20,455**	**Tier 1.7**	**78%**	**Tier 1.4**		**10%**	**Tier 1.8**
EU-27	**29,674**	**Tier 1.7**	**83%**	**Tier 1.4**		**8%**	**Tier 1.7**
EU-12: Tier 1	35%		35%			40%	
EU-12: Tier 2	65%		65%			60%	

a Contribution to N_2O emissions from manure management
b Quality level (between Tier 1 and Tier 2)
c Source category is key in the Member State's inventory (y/n); nr: not reported

Table 21.26: Member State's background information on the methodology for estimating N2O emissions in category 4.B(b)

Member State	Methodology
Latvia	Tier 1 and local expert assumptions.
Malta	Tier 2 for cattle, swine and poultry. Tier 1 for other animal types
Romania	Tier 1. N_2O emissions from Daily spread and Pasture range and paddock AWMS are reported under 4D – Agricultural soils.

Member State	Methodology
Slovenia	Tier 1 with national specifications.
Slovakia	Tier 1 with national specifications regarding pasture.

Activity Data

In EU-12, a total of 1,564 Gg N was managed in manure management systems or excreted on pasture range and paddock in 2010. Together with the 7,958 Gg N from EU-15 countries, this gives a total of 9,522 Gg N for EU-27. The largest share of this manure-nitrogen was managed in solid storage systems (920 Gg N in EU-12), followed by liquid systems (250 Gg N) and manure excreted by grazing animals (252 Gg N). Compared with 1990, this was a decrease of manure-nitrogen by 48%. The decreases were similar for the different manure management systems. The decrease of nitrogen was particularly pronounced in Latvia and Bulgaria, where in 2010 only about 30% of manure was excreted as compared to 1990.

The nitrogen managed in the various manure management systems in 2010 is given in Table 21.27. Nitrogen excretion data per head will be discussed below. Some information on the source of the animal numbers for the different Member States is given in Table 21.14.

Table 21.27: Member State's nitrogen managed in the manure managed systems anaerobic lagoon, liquid systems, daily spread, and other systems, manure excreted on pasture range and paddock, and total nitrogen excreted in 2010

Member State 2010	Anaerobic lagoon	Liquid systems	Daily Spread	Solid storage and dry lot	Other	Pasture range paddock	Total
Bulgaria	5	2		46	2	28	83
Cyprus				21	8		29
Czech Republi		73	1	63	13	25	176
Estonia		7		10		8	25
Hungary		15		92	13	17	138
Latvia		8		13	1	9	31
Lithuania	1	19		27	5	21	73
Malta							
Poland		89		530		47	666
Romania	12	2	28	66	51	82	241
Slovakia		17		38		10	64
Slovenia	0	19		13	1	5	39
EU-12	**18**	**250**	**29**	**920**	**94**	**252**	**1,564**
EU-15	**20**	**2,492**	**161**	**1,989**	**561**	**2,736**	**7,958**
EU-27	**38**	**2,742**	**190**	**2,909**	**655**	**2,988**	**9,522**

Information source: CRF Table 4.B(b) for 2010, submitted in 2012. Abbreviations explained in the Chapter 'Units and abbreviations'.

Emission Factors and other parameters

As all countries are using IPCC default values for the IEF or values that are close to it (with the exception of the IEFs used by Slovakia (both liquid and solid systems) and Hungary for liquid systems.

Poland is the largest source of excreted manure in EU-12 accounting for 15% of nitrogen in manure for EU-12. An overview of the implied emission factors is given in .

Table 21.28: Implied Emission factors for N2O emissions from manure management used in Member State's inventory 2010

Member State	Implied EF (kg N_2O-N / kg N)			
2010	Anaerobic lagoon	Liquid system	Solid storage and dry lot	Other
Bulgaria	0.100%	0.100%	2.0%	0.1%
Cyprus	NO	NO	1.3%	0.3%
Czech Republic	NO	0.100%	2.0%	0.5%
Estonia	NO	0.100%	2.0%	NO
Hungary	NO	0.100%	2.0%	0.1%
Latvia	NA	0.100%	2.0%	0.10%
Lithuania	0.100%	0.100%	2.0%	0.5%
Malta	NO	NE,NO	NE,NO	NO
Poland	NO	0.100%	2.0%	NO
Romania	0.100%	0.100%	2.0%	0.5%
Slovakia	NO	0.100%	2.0%	NO
Slovenia	0.100%	0.100%	2.0%	0.2%
EU-12	**0.100%**	**0.102%**	**2.0%**	**0.4%**
EU-15	**0.100%**	**0.174%**	**1.6%**	**0.9%**
EU-27	**0.100%**	**0.167%**	**1.7%**	**0.8%**

Information source: CRF Table 4.B(b) for 2010, submitted in 2012
Abbreviations explained in the Chapter 'Units and abbreviations'.

An important parameter in the calculation of N_2O emissions from manure management is nitrogen excretion rate per head and year, which is given in Table 21.29 for EU12-countries and the main animal types. The table shows a range by a factor of up to 4.5 between the highest and the lowest value used is found. For example, for dairy cattle, we have a range of about 80 kg N head^{-1} y^{-1} from 54 kg N head^{-1} y^{-1} used in many countries to 133 kg N head^{-1} y^{-1} for Czech Republic. Very large ranges are found for non-dairy cattle with values between 38 (Romania) and 69 kg N head^{-1} y^{-1} (Czech Republic) and sheep with values between 4.5 kg N head^{-1} y^{-1} (Romania) and 20.0 kg N head^{-1} y^{-1} (Czech Republic).

Additional information on the development of the emission factor is available for some Member States and is summarized in Table 21.30. Additional background information on the calculation of nitrogen excretion rates are summarised in Table 21.31.

Table 21.29: Total Nitrogen excretion by AWMS [Gg N] for dairy and non-dairy cattle, sheep, swine, and poultry in 2010

Member State 2010	Dairy	Non-Dairy	Sheep	Swine	Poultry	Buffalo	Goats	Horses	Mules and Asses
Bulgaria	71.5	39.9	14.6	8.9	0.6	50.0	17.0	25.0	42.5
Cyprus	70.0	50.0	12.0	16.0	0.6	NO	40.0	40.0	IE
Czech Republic	132.6	68.8	20.0	20.0	0.6	NO	25.0	25.0	NO
Estonia	120.1	47.7	16.0	10.4	0.6	NA	25.0	25.0	NA
Hungary	114.4	49.2	20.0	8.2	0.6	70.0	18.0	60.0	25.0
Latvia	70.0	50.0	13.0	10.0	0.6	NA	13.0	48.0	NA
Lithuania	99.4	50.5	16.0	10.7	0.6	NO	16.0	25.0	NO
Malta	NE	NE	NE	NE	NE	NO	NE	NE	NE
Poland	86.7	58.1	6.8	13.6	0.3	NO	6.7	28.0	NO
Romania	53.6	38.2	4.5	17.7	1.1	53.6	5.3	55.4	36.5
Slovakia	100.0	60.0	16.0	15.9	0.7	NO	16.0	25.0	NO
Slovenia	110.4	42.6	20.0	12.0	0.6	NO	25.0	25.0	NO
EU-12	**85.0**	**53.4**	**8.3**	**13.3**	**0.6**	**53.9**	**12.6**	**43.2**	**41.1**
EU-15	**114.0**	**51.4**	**8.2**	**9.4**	**0.6**	**94.7**	**12.3**	**48.1**	**37.5**
EU-27	**106.8**	**51.6**	**8.2**	**10.1**	**0.6**	**91.1**	**12.3**	**46.8**	**38.7**

Information source: CRF Table 4.B(b) for 2010, submitted in 2012. Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 21.30: Member State's background information on the emission factor for calculation of N2O emissions in category 4.B(b)

Member State	Methodology
Bulgaria	Default IPCC for Eastern Europe
Czech Republic	Default EFs for Western Europe.
Hungary	The factors were selected on the basis of expert consultations (Gundel 2004, Várhegyi 2004) and the relevant literature (Walther et al. 1994; Várhegyiné et al. 1999; Babinszky et al. 2002; Borka 2003).

Table 21.31: Member State's background information for the development of nitrogen excretion rates used in the calculation of N2O emissions in category 4.B(b)

Member State	Methodology
Estonia	Nitrogen excretion rates for cattle livestock are calculated based on nitrogen balance. Nitrogen excretion rates for swine livestock were used from country-specific literature (Keskkonnaministri määrus nr 48, 5.12.2008).
Hungary	National data from source: HCSO (2000), Mészáros (2000), Ráki (2003). On the basis of expert consultations (Gundel 2004, Várhegyi 2004, Fébel 2007) and literature data (Várhegyiné et al. 1999, Babinszky et al. 2002, Fébel and Gundel 2007) it was asserted that production level and feeding technology of animal breeding in Hungary are close to the Western European standards, therefore the default IPCC factors for Western Europe were used.

Member State	Methodology
Latvia	Annual N excretion per animal until 2004 obtained from national studies. Since 2005, annual N excretion per anima is corrected according to results of newest studies on development of manure normative and livestock units carried out by the State Ltd." Agrochemical Research Centre". N excretion by farm livestock was estimated with the mass balance approach (N intake- N products).National studies showed that average Nex for sheep and goats in Latvia is very low as compared to IPCC default value. The reason is (i) sheep and goats nutrition is as they receive usually no feed additions; (ii) mainly local breeds are used which are not very productive. Commercial pig production in Latvia mainly includes four or five phases, to take account of changes in nutrient requirements with increasing age of the pig: piglets with live weight 7-30 kg, fattening pigs 30-100 kg or 7-100 kg, young breeding sows and breeding sows. There are no data on N excretion by young pigs with live weight 20-50 kg. N excretion for breeding sows is calculated taken into account N excretion by sucking piglets.
Malta	Country-specific values for cattle, swine and poultry from Sustech (2008)
Poland	Nitrogen excretion rate for cattle, horses and swine were calculated with the use of SFOm model, where the amount of animals manure were determined for livestock categories and utility subgroups based on quantity, sort and digestibility of fodder applied. Then the nitrogen content in livestock manure was assessed based on manure management systems of collection and storage used [Jadczyszyn i in. 2000]. For goats the weighted mean value estimated for sheep in 1988-2010 was used. For poultry Nex parameters come from publication [Jadczyszyn et al 2009]. Country specific Nex values are in line with parameters published in [UNECE 2001].
Slovenia	Dairy cows: nitrogen excretion has been linked to productivity, i.e. milk production. The nitrogen excretion rates for cattle and pigs were harmonized with the methodology for ammonia emissions (Verbi?, 2004).
Slovakia	Default nitrogen excretion factors. Direct measurements of nitrogen produced by domestic livestock showed that real amounts could be much higher. Based on data about management in 222 agriculture farms will be perform the total analysis of manure production in the SR.

21.3.4 Agricultural Soils - N_2O (Source category 4.D)

For EU-12, emissions from all sub-categories in the category 4.D have decreased since 1990 (see Table 21.32). This was most significant for emission related to manure application or manure excretion on pasture, range and paddock and is a direct consequence of decreasing animal numbers. The implied emission factor remains constant for all sub-categories and decreases only slightly for direct emissions from mineral fertilizer and manure application.

The decrease in the input of nitrogen to agricultural soils was significant for all sub-categories and was 37% for synthetic fertilizer application, 46% for application of manure, 11% of the area of histosols cultivated and 59% of nitrogen excreted by grazing animals. This translated to a reduction of volatilized and re-deposited nitrogen by 47% and of the amount of nitrogen leached by 43%.

Table 21.32: Total N2O emissions, Total Nitrogen input into agricultural soils and implied Emission Factor for category 4D at EU-12 level in 2010 and 1990 and relative changes

1990	Synthetic Fertilizer	Animal Wastes appl.	Cultiv. of Histosols[1)]	Animal Production	Atmospheric Deposition	Nitrogen Leaching and run-off
	Direct				Indirect	
Total Emissions of N_2O [Gg N_2O]	67	37	12	20	13	68
Total Nitrogen input [Gg N]	3432	2144	9741	622	808	1724
Implied Emission Factor [kg N_2O-N / kg N]	1.25%	1.10%	8.0	2.00%	1.00%	2.50%

2010	Synthetic Fertilizer	Animal Wastes appl.	Cultiv. of Histosols[1)]	Animal Production	Atmospheric Deposition	Nitrogen Leaching and run-off
	Direct				Indirect	
Total Emissions of N_2O [Gg N_2O]	42	20	11	8	7	39
Total Nitrogen input [Gg N]	2157	1159	8663	254	431	981
Implied Emission Factor [kg N_2O-N / kg N]	1.25%	1.10%	8.0	2.00%	1.00%	2.51%

2005 value in percent of 1990	Synthetic Fertilizer	Animal Wastes appl.	Cultiv. of Histosols	Animal Production	Atmospheric Deposition	Nitrogen Leaching and run-off
	Direct				Indirect	
Total Emissions of N_2O	63%	54%	89%	41%	53%	57%
Total Nitrogen input	63%	54%	89%	41%	53%	57%
Implied Emission Factor	100%	100%	100%	100%	100%	100%

Source of information: Tables 4.D for 1990 and 2010, submitted in 2012

[1)] Histosols unit AD: km^2; Unit for IEF: kg N_2O-N/ha

21.3.4.1 Methodological Issues

Methods

Due to the large uncertainty associated with the emission factors in this category and the lack of well-established alternatives, most Member States rely on the IPCC default emission factors (see below). In contrast to EU-15 countries, default factors are used also to estimate the emissions from indirect emissions. Table 21.33 gives an overview of the total N_2O emissions in category 4D and the contribution of the main sub-categories. Thus, the vast majority of the emissions are calculated with the Tier 1 approach with the important exception of the emission factor from synthetic fertilizer in Poland. Direct N_2O fluxes from synthetic fertilizer in Poland are the single largest emission flux in this category for EU-12 (13% of total emissions).

For each single sub-category we calculated a 'Tier-level' scoring between 1 and 2 according to the methodology described in Section 6.4.1.5. and 6.3.5.2. As a result, we estimate that a minimum of 22% of the emissions reported in category 4D are estimated with country-specific information. Highest share of country-specific calculations is obtained for direct N_2O emissions (22%). All countries in EU-12 use IPCC default methodology.

Table 21.33: Total emissions and contribution of the main sub-categories to N2O emissions in category 4D, methodology and key source assessment by Member States for the sub-categories direct emissions, animal production and indirect emissions for the year .

	Total		Direct			Animal Production			Indirect			Volatilization		Leaching	
Member State	Gg CO_2-eq	b	a	b	c	a	b	c	a	b	c	a	b	a	b
Bulgaria	3,592	Tier 1.1	59%	Tier 1.1	y	8%	Tier 1.0	y	34%	Tier 1.2	y	5%	Tier 1.0	29%	Tier 1.2
Cyprus	218	Tier 1.6	16%	Tier 1.9	y		NE	y	84%	Tier 1.5	y	14%	Tier 1.0	70%	Tier 1.6
Czech Republic	4,699	Tier 1.1	58%	Tier 1.1	y	5%	Tier 1.3	y	37%	Tier 1.1	y	6%	Tier 1.0	31%	Tier 1.1
Estonia	747	Tier 1.1	58%	Tier 1.1	y	10%	Tier 1.0	y	32%	Tier 1.0	y	5%	Tier 1.0	26%	Tier 1.1
Hungary	4,794	Tier 1.0	59%	Tier 1.0	y	4%	Tier 1.2	y	38%	Tier 1.0	y	6%	Tier 1.0	32%	Tier 1.1
Latvia	1,432	Tier 1.2	67%	Tier 1.4	y	6%	Tier 1.0	y	27%	Tier 1.0	y	4%	Tier 1.0	23%	Tier 1.0
Lithuania	2,509	Tier 1.1	54%	Tier 1.1	y	8%	Tier 1.4	y	38%	Tier 1.1	y	6%	Tier 1.0	32%	Tier 1.1
Malta	17	NE	67%	NE	y		NE	y	33%	NE	y	25%	NE	9%	NE
Poland	17,142	Tier 1.3	71%	Tier 1.2	y	3%	Tier 1.4	y	26%	Tier 1.5	y	3%	Tier 1.0	23%	Tier 1.6
Romania	7,882	Tier 1.3	59%	Tier 1.4	y	10%	Tier 1.0	y	30%	Tier 1.0	y	5%	Tier 1.0	25%	Tier 1.0
Slovakia	1,715	Tier 1.4	72%	Tier 1.3	y	5%	Tier 1.4	y	22%	Tier 1.5	y	6%	Tier 1.2	16%	Tier 1.6
Slovenia	726	Tier 1.2	52%	Tier 1.3	y	7%	Tier 1.2	y	40%	Tier 1.1	y	7%	Tier 1.0	33%	Tier 1.1
EU-12	**45,472**	**Tier 1.2**	**64%**	**Tier 1.2**	**y**	**5%**	**Tier 1.2**	**y**	**31%**	**Tier 1.2**	**y**	**5%**	**Tier 1.0**	**26%**	**Tier 1.3**
EU-15	**187,680**	**Tier 1.4**	**50%**	**Tier 1.4**	nr	15%	**Tier 1.6**	nr	34%	**Tier 1.3**	nr	6%	**Tier 1.4**	28%	**Tier 1.3**
EU-27	**233,152**	**Tier 1.4**	**53%**	**Tier 1.4**	y	13%	**Tier 1.5**	y	34%	**Tier 1.3**	y	6%	**Tier 1.4**	28%	**Tier 1.3**
EU-12: Tier 1	78%		78%			83%			77%			99%		73%	
EU-12: Tier 2	22%		22%			17%			23%			1%		27%	

a Contribution to N2O emissions from agricultural soils
b Tier 1: default methodology; Tier 2: country-specific methodology
c Source category is key in the Member State's inventory (y/n)

Activity Data

For the estimation of N_2O emissions from N-fixing crops and crop residues, most Member States use the amount of N input (in Gg N) as activity data in the CRF table; but some countries give the emission factor in kilogram of nitrogen emitted per kg of dry crop production (N-fixing crop or other crops, respectively). Therefore, the data given in Table 21.34 in the respective columns are not comparable.

Additional background information on the source of the data used in the Member States's inventories is given in Table 21.35.

Table 21.34: Member State's activity data to calculate direct and indirect N2O emissions in category 4D

Member States	Synthetic Fertilizer (Gg N)	Animal Wastes appl. (Gg N)	N-fixing crops (Gg N)	Crop residue (Gg N)	Cultiv. of Histosols (km^2)	Animal Production (Gg N)	Atmosph. Deposition (Gg N)	Nitrogen Leaching and run-off (Gg N)
2010	Direct						Indirect	
Bulgaria	179	44	1	122	NO	28	37	85
Cyprus	4	23	1	24	NE	NO	6	10
Czech Republic	203	120	4	116	NO	25	58	120
Estonia	26	14	9.3	9	210	8	8	16
Hungary	253	96	18	96	NO	17	56	126
Latvia	54	16	0	6	1,245	9	12	27
Lithuania	134	41	4	35	116	21	29	66
Malta	0	1	NE	NE	NO	NO	1	0
Poland	925	496	18	110	7,023	47	113	322
Romania	275	244	0	0	NO	84	79	165
Slovakia	78	38	20	67	NO	10	21	23
Slovenia	25	27	2	4	69	5	10	20
EU-12	**2,157**	**1,159**	**77**	**565**	**8,663**	**254**	**431**	**981**
EU-15	**7,490**	**3,756**	**887**	**2,411**	**20,195**	**2,872**	**2,235**	**4,072**
EU-27	**9,647**	**4,915**	**964**	**2,977**	**28,858**	**3,126**	**2,665**	**5,053**

Source of information: Tables 4.D for 2010, submitted in 2012. Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 21.35: Member State's background information on the activity data used for the calculation of N2O emissions in category 4.D

Member State	Methodology
Bulgaria	The synthetic fertilizers quantities are provided by the National Service for Plant Protection at the Ministry of Agriculture and Food Supplies.
Cyprus	The officially published statistical data for the annually used quantities were used, and the amount of nitrogen per type.
Czech Republic	All data were taken from the Statistical Yearbooks of the Czech Republic (Statistical Yearbooks, 1990 – 2005).
Estonia	Activity data for fertilisers and the production of N-fixing crops were used from official Estonian statistics (the Statistical Office of Estonia [ESO]).
Hungary	Activity data for the sector (total harvested production of plants, N-fertilizer) were obtained from the Agricultural Statistics Yearbook of HCSO.
Lithuania	Activity data is received from the Statistical Yearbooks "Agriculture in Lithuania" (crop and pulses yields) and "Production of commodities" (annual amount of N fertilisers sold).
Latvia	Activity data obtained from the CSB (animal numbers), use of N synthetic fertilizers and productions of crops. Other data sources are Latvian State Institute of Agrarian Economics (distribution of different manure management systems and researches made by local experts (area of cultivated organic soils).
Malta	Data for 1990 to 1994: FAOSTAT – Nitrogenous Fertiliser Consumption; for 1995 to 2001: SOER 2002 – Fertiliser Import Statistics for nitrogen based fertilisers; for 2002

Member State	Methodology
	to 2006: Nitrogen fertiliser import figures, National Statistics Office.
Poland	Activity data concerning crop production was taken from an experimental study (Gus, 2006). Based on national methodology (Mercik 2001) about sown area of N-fixing crops.
Romania	The amount of synthetic fertilizer applied to soils data are provided by Romanian National Institute for Statistics (NIS) being released through Statistical Yearbook 1989-2007.
Slovenia	The consumption of nitrogen from mineral fertilizers on agricultural soil in Slovenia has been obtained from the Statistical Yearbook. SORS collect data on fertilisers used in enterprises, companies and co-operatives involved in crop production. Likewise, they are taking into account the data on import, export, and production. The difference between all fertilizers sold in this country and the amount that is used by enterprises, is the consumption of mineral fertilizers on family farms. Fertilizers that are not appropriate for agricultural production (mineral fertilizers for balcony flowers, lawns and similar) are not included.
Slovakia	According to Statistical Yearbook and Green Report of Slovak Republic it is not possible to split fodder crops and grasslands into year subcategories. During 1986-1997 the crop and root residuals were observed from 29 crop species on three to seven different soil-climate sites in the Slovak Republic (partly on the small parcels production and partly an the large scale production. The sampling was provided according the plant specification (numbers of plants per hectare).

Emission Factors and other parameters

Table 21.36 and Table 21.37 give an overview of the emission factors and other parameters used for the calculation of N_2O emissions from agricultural soil in 2010 in EU-12 countries. As discussed already above, emission factors are largely IPCC default, while other parameters are more frequently country-specific. Most Member States use the IPCC default emission factors for the calculation of N_2O emissions from the application of mineral and organic fertiliser. Poland, Malte, Lithuana, and Cyprus use a different emission factor for synthetic fertilizer nitrogen and applied manure than IPCC default, Estonia only for synthetic fertilizer. Indirect emissions are estimated with default values for both volatilization/leaching fractions and emission factors, with the exception of FracGASM in Slovakia.

Table 21.36: Implied Emission Factors for the category 4D - N2O emissions from agricultural soils in 2010

Member States 2010	Synthetic Fertilizer	Animal Wastes appl.	N-fixing crops	Crop residue	Cultiv. of Histosols	Animal Production	Atmosph. Deposition	Nitrogen Leaching and run-off
	Direct						Indirect	
Bulgaria	1.25%	1.25%	1.25%	1.25%	NO	2.0%	1.00%	2.50%
Cyprus	1.12%	0.00%	0.10%	0.10%	NE	NO	1.00%	3.12%
Czech Republic	1.25%	1.25%	1.25%	1.25%	NO	2.0%	1.00%	2.50%
Estonia	1.25%	1.25%	1.25%	1.25%	8.0	2.0%	1.00%	2.50%
Hungary	1.25%	1.25%	1.25%	1.25%	NO	2.0%	1.00%	2.50%
Latvia	1.25%	1.41%	1.25%	1.25%	8.0	2.0%	1.00%	2.50%
Lithuania	1.25%	1.25%	1.25%	1.25%	8.0	2.0%	1.00%	2.50%
Malta	1.00%	2.00%	NE	NE	NO	NO	1.00%	0.75%
Poland	1.25%	1.25%	1.25%	1.25%	8.0	2.0%	1.00%	2.51%
Romania	1.25%	0.65%	1250.00%	1312.54%	NO	2.0%	1.00%	2.50%
Slovakia	1.25%	1.25%	1.25%	1.25%	NO	2.0%	1.00%	2.50%
Slovenia	1.25%	1.25%	1.25%	1.25%	8.0	2.0%	1.00%	2.50%
EU-12	**1.25%**	**1.10%**	**1.25%**	**1.25%**	**8.0**	**2.0%**	**1.00%**	**2.51%**
EU-15	**1.2%**	**1.19%**	**1.25%**	**1.25%**	**7.7**	**2.0%**	**1.05%**	**2.66%**
EU-27	**1.22%**	**1.17%**	**1.25%**	**1.25%**	**7.8**	**2.0%**	**1.04%**	**2.63%**

Source of information: Tables 4.D for 2010, submitted in 2012. Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 21.37: Relevant parameters for the calculation of N_2O emissions from agricultural soils in 2010

Member States	FracBURN	FracFUEL	FracGASF	FracGASM	FracGRAZ	FracLEACH	FracNCRBF	FracNCRO	FracR
Bulgaria	3%		10.0%	20%	34%	30%	3.0%	1.5%	45%
Cyprus	10%	NA	10.0%	20%	NA	30%	NA	NA	50%
Czech Republic	NO	NO	10.0%	20%	15%	30%	3.0%	1.5%	45%
Estonia	NO	NO	10.0%	20%	31%	30%	3.0%	1.5%	45%
Hungary	NO	NO	10.0%	20%	13%	30%	1.9%	0.9%	NO
Latvia	NO	NO	10.0%	20%	29%	30%	2.0%	3.0%	45%
Lithuania	NO	NO	10.0%	20%	29%	30%	3.0%	1.5%	45%
Malta	NE	NE	NE	NE	NE	NE	NE	NE	NE
Poland	3%	NO	10.0%	20%	7%	30%	2.6%	1.4%	53%
Romania	10.0%	NO	10.0%	20%	35%	30%	2.7%	1.6%	NA
Slovakia	NO	NO	10.0%	24%	15%	14%	7.1%	14.5%	NE
Slovenia	NO	NO	10.0%	20%	14%	30%	1.9%	0.7%	47%
EU-12	NA	NA	10.0%	20%	22%	29%	3.0%	1.6%	47%
EU-15	NA	NA	5.7%	22%	35%	25%	2.8%	1.3%	55%
EU-27	NA	NA	7.9%	21%	28%	27%	2.9%	1.5%	51%

Source of information: Tables 4.D for 2010, submitted in 2012. Abbreviations explained in the Chapter 'Units and abbreviations'.
1) Arithmetic average over the MS that reported.

22 LULUCF (CRF Sector 5)

EU-12 new EU MS have in place functional national systems. Ability of reporting GHG inventories of the new MS is higher for forestland and lower for all other land use categories, what explains generally low completeness when looking to entire LULUCF sector. The lack of an EU-27 fully harmonized GHG inventory system is mostly caused by historical differences in data type availability and different principles of resources management under different economic and political orientation, and also because of different economic progress over last two decades. Nevertheless, the new EU 12 MS benefit on experience gained in EU-15 MS by various common programs and projects (e.g. COST, JRC workshops, European Commissions financing).

Activity data datasets are available especially in forms of statistics and the data is often not of direct use in the GHG estimation (i.e. net data is only available, without land conversion information). For other pools, especially on soils, data is generally limited to maps and C stocks, with very poor information of C stock changes. Dead organic matter pool is particularly poorly estimated and often reported under Tier 1. Effort of developing of integrated systems for resources assessment, like the statistic national forest inventories, is slow with several countries having already finished or performing currently the first national forest inventory (NFI) cycle, is ongoing in several new Member States (e.g. Czech Republic, Latvia, Romania).

The contribution of LULUCF to total emission of each of EU-12 MS varies according the sink size and country's total emissions (Table 22.1). EU-12 aggregated offset of LULUCF is 18, with range among countries from only 5% to over 200 % of other national sectors emissions. These estimates have to be considered under the current completeness (see Table 22.3 Sector 5 LULUCF: Reporting of carbon pools for the most important land sub-categories for the year 2012 (from Tables 5A, 5B and 5C of MS's CRF 2012)

	Forest land								Cropland								
	FL-FL				L-FL				CL-CL				L-CL				
MS	Biom	DOM	SOC Min	SOC Org	Biom	DOM	SOC Min	SOC Org	Biom	DOM	SOC Min	SOC Org	Biom	DOM	SOC Min	SOC Org	Biom
Bulgaria	R								E		R		E				
Cyprus	R																
Czech R.	R				R				R		R		E	E	E		
Estonia																	
Hungary	R				R				R		R		R	E	E		
Latvia	R			E	R			E				E		E	E	E	
Lithuania	R	R		E	E			E	R			E	R		E		
Malta	R								R								
Poland	R	R	R		R	R	R		R		E	E			E		

Romania	R				R				R	R	R	E	E		R		
Slovakia	R				R	R			R				E	E	E		
Slovenia	R	R			R				E		E	E	E	E	E		

Pools: DOM – dead organic matter, Biom –biomass, SOCmin – mineral soils organic carbon, SOCorg – organic soils organic carbon

R: net Removal; E: net Emission

Empty cells = the pool was not reported or reported as zero (either "not estimated" (reported in CRF as "NE" alone or in combination with other keys), assumed as "no C stock change" (following IPCC tier 1), or assumed as "not occurring" (notation keys used "NO" and/or "NA")

ie means that the pools change is estimated but included elsewhere

Table 22.4).

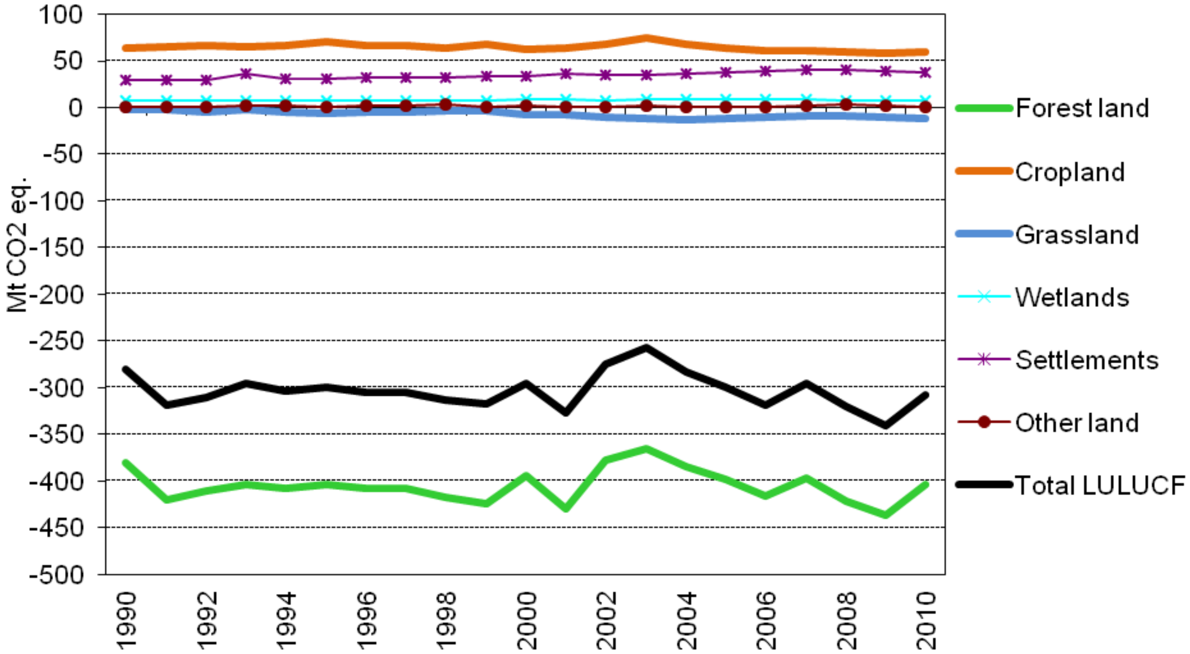
Table 22.1 Sector 5 LULUCF contributions to total national emissions of EU-12 (GgCO2eq)

MS	LULUCF removal	National emissions (without LULUCF)	National emissions (with LULUCF)	Share of emissions offset by LULUCF sector
Bulgaria	-11,566	69,029	57,463	-20%
Czech Republic	-6,863	132,925	126,062	-5%
Estonia	-7,035	16,837	9,802	-72%
Hungary	-3,042	66,727	63,685	-5%
Lithuania	-3,750	21,609	17,859	-21%
Latvia	-20,484	10,723	-9,761	210%
Malta	-61	2,866	2,806	-2%
Poland	-37,175	376,659	339,484	-11%
Romania	-36,533	130,828	94,295	-39%
Slovakia	-3,449	43,404	39,955	-9%
Slovenia	-8,458	19,339	10,881	-78%
Total EU-12	**-138,416**	**890,946**	**752,530**	**-18%**

22.1 Overview of the sector (EU-27)

At the EU-27 level, the LULUCF sector is a net sink with values ranging around 400,000 Gg CO_2 eq in 2010 (Figure 22.1), with a similar structure of removals and emissions across categories as EU-15. Overall for EU-27, only Forestland (5A) and Grassland (5C) are sinks. Compared to 1990 the annual removal increased 7 % on Forestland and 100 % for Grassland (which turned from source to sink). Emissions form Cropland (5B) decreased by 7%. Emissions from Wetland (5D) decreased by 2%, from Settlements (5E) increased by 33 % and Other Land (5F) by 61%.

Figure 22.1 **Sector 5 LULUCF: EU-27 net CO_2 emissions for 1990–2009 from CRF tables in CO_2 (Gg)**



Most of the methodological considerations expressed for EU-15 are also valid for the new 12 MS (Table 22.2, Table 22.3 Sector 5 LULUCF: Reporting of carbon pools for the most important land sub-categories for the year 2012 (from Tables 5A, 5B and 5C of MS's CRF 2012)

	Forest land								**Cropland**								
	FL-FL				**L-FL**				**CL-CL**				**L-CL**				
MS	Biom	DOM	SOC Min	SOC Org	Biom	DOM	SOC Min	SOC Org	Biom	DOM	SOC Min	SOC Org	Biom	DOM	SOC Min	SOC Org	Biom
Bulgaria	R								E		R		E				
Cyprus	R																
Czech R.	R				R				R		R		E	E	E		
Estonia																	
Hungary	R				R				R		R		R	E	E		
Latvia	R			E	R			E				E		E	E	E	
Lithuania	R	R		E	E			E	R			E	R		E		
Malta	R								R								
Poland	R	R	R		R	R	R		R		E	E			E		
Romania	R				R				R	R	R	E	E		R		
Slovakia	R				R	R			R				E	E	E		

Slovenia	R	R			R				E		E	E	E	E	E		

Pools: DOM – dead organic matter, Biom –biomass, SOCmin – mineral soils organic carbon, SOCorg – organic soils organic carbon

R: net Removal; E: net Emission

Empty cells = the pool was not reported or reported as zero (either "not estimated" (reported in CRF as "NE" alone or in combination with other keys), assumed as "no C stock change" (following IPCC tier 1), or assumed as "not occurring" (notation keys used "NO" and/or "NA")

ie means that the pools change is estimated but included elsewhere

Table 22.4). It should be considered in this regard that NFI are harmonized to a lesser degree in new 12 EU MS), which often utilize national statistics or forest planning & management data.

Table 22.2 Sector 5 LULUCF: Coverage of CO_2 emissions and removals of the new MS in the various subcategories for the year 2010

Member State	Reporting category											
	Forest land		Cropland		Grassland		Wetland		Settlements		Other land	
	5A1 F-F	5A2 L-F	5B1 C-C	5B2 L-C	5C1 G-G	5C2 L-G	5D1 W-W	5D2 L-W	5E1 S-S	5E2 L-S	5F1 O-O	5F2 L-O
Bulgaria	R	R	E	E		R		E		E		
Cyprus	R		NO		NO		NO				NO	
Czech R.	R	R	E	E	E	R		E		E		
Estonia	R	R	E		R	R	E	E				
Hungary	R	R	R	E	E	E				E		
Latvia	R	R	E	E	E		E	E		E		
Lithuania	R	E	E	R	E	E	E	E		E		E
Malta	R		R		NO		NO		NO		NO	
Poland	R	R	E	E	E	R	E	E	R	E		
Romani	R	R	R	R		R		R		E		E
Slovakia	R	R	R	E		R				E		E
Slovenia	R	R	E	E		E				E		

Legend: R: net Removal; E: net Emission; empty cells can be: IE: included elsewhere; NE: not estimated; NO: not occurring; NA: not applicable.

Furthermore, most new MS reported less sub-categories and pools than most of the EU-15 MS because of lack of national data, but more often because of lack of both national capacity of processing existing data (e.g. rich data related to forest management) and adapt and develop it according reporting requirements. Actions that the new MS have taken include: improving the coverage of activity data for more land use and land use change categories; adjusting and improve the NFI to reporting needs; improving the methodology of converting activity data to emissions and removals by the appropriate factors (e.g., adjustments of biomass expansion factors); frequent recalculations due to improved data reporting (e.g. Lithuania, Latvia); implementation of research projects on less reported pools (e.g. litter pool); efforts for estimating uncertainties and improving the transparency of the reporting and the active participation in European projects and actions aimed at improving the reporting. Several new MS indicate that additional changes and improvements are under way and will be implemented in their supplementary report under the Kyoto Protocol.
The change of the specific pools is shown in the Table 7.6.
Information on data and methods for estimation are reported in the Table 22.5.Table 22.3 Sector 5 LULUCF: Reporting of carbon pools for the most important land sub-categories for the year 2012 (from Tables 5A, 5B and 5C of MS's CRF 2012)

The following subcategories of the LULUCF sector are usual key categories in the inventory of new EU 12 MS (different from MS to another):

- 5A1 Forest Land remaining Forest Land: CO_2
- 5A2 Land converted to Forest Land: CO_2
- 5B1 Cropland remaining Cropland: CO_2

- 5B2 Land converted to Cropland: CO_2
- 5C1 Grassland remaining Grassland: CO_2
- 5C2 Land converted to Grassland: CO_2

Table 22.3 Sector 5 LULUCF: Reporting of carbon pools for the most important land sub-categories for the year 2012 (from Tables 5A, 5B and 5C of MS's CRF 2012)

	Forest land								Cropland								Grassland							
	FL-FL				L-FL				CL-CL				L-CL				GL-GL				L-GL			
MS	Biom	DOM	SOC Min	SOC Org	Biom	DOM	SOC Min	SOC Org	Biom	DOM	SOC Min	SOC Org	Biom	DOM	SOC Min	SOC Org	Biom	DOM	SOC Min	SOC Org	Biom	DOM	SOC Min	SOC Org
Bulgaria	R								E		R		E								E		R	
Cyprus	R																							
Czech R.	R				R				R		R		E	E	E				E		R	E	R	
Estonia																								
Hungary	R				R				R		R		R	E	E				E		E	E	R	
Latvia	R			E	R			E				E		E	E	E				E				
Lithuania	R	R		E	E			E	R			E	R		E					E				E
Malta	R								R															
Poland	R	R	R		R	R	R		R		E	E			E				E	E			R	
Romania	R				R				R	R	R	E	E		R									
Slovakia	R				R	R			R				E	E	E						E	E	R	
Slovenia	R	R			R				E		E	E	E	E	E						E	E	R	

Pools: DOM – dead organic matter, Biom –biomass, SOCmin – mineral soils organic carbon, SOCorg – organic soils organic carbon

R: net Removal; E: net Emission

Empty cells = the pool was not reported or reported as zero (either "not estimated" (reported in CRF as "NE" alone or in combination with other keys),

assumed as "no C stock change" (following IPCC tier 1), or assumed as "not occurring" (notation keys used "NO" and/or "NA")
ie means that the pools change is estimated but included elsewhere

Table 22.4 Sector 5 LULUCF: Reporting of carbon pools by the new MS for the most important categories for the year 2010, as derived from Table 5A, 5B and 5C of the CRF tables 2012

MS	Forestland								Cropland								Grassland							
	FL-FL				L-FL				CL-CL				L-CL				GL-GL				L-GL			
	BM	DOM (1)	SOC Min	SOC Org (2)	BM	DOM	SOC Min	SOC Org (2)	BM (3)	DOM	SOC Min (4)	SOC Org (2)	BM (5)	DOM	SOC Min	SOC Org (2)	BM	DOM	SOC Min (4)	SOC Org (2)	BM	DOM	SOC Min	SOC Org (2)
BG	CS	NO	NO	NO	CS	D	CS	NO	CS,D	CS	CS	NO	CS,D	NO	CS	NO	NO	NO	NO	NO	CS,D	NO	CS	NO
CY	CS	NE	NE	NE	NE	NE	NE	NE	NA	NA	NA	NA	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
CZ	CS	D	D	NO	CS	D	CS	NO	D	D	CS,D	NO	CS,D	CS	CS	NO	D	D	CS,D	NO	CS,D	CS	CS	NO
EE	CS	CS,D	D	CS,D	CS	CS,D	NE	CS,D	CS	NE	NE	CS,D	IEI,NO	NO	NE	CS,D	CS,D	CS	NE	CS,D	CS	CS	NE	CS,D
HU	CS	D	D	NO	CS	D	NE	NO	D	NO	D,D	NO	CS,D	D	D	NO	D	D	D,D	NO	CS	CS	D	NO
LV	CS	D	D	CS	CS	NE	NE	CS	NO	NO	NO	D	CS,NO	CS	CS	CS	NE	NO	NO	CS	NO	NO	NE	IE
LT	CS	CS	NA	CS	CS	NA	NA	NA	D	NA	NA	CS	D	NA	D	NA	NA	NA	NA	CS	D	NA	D	CS
MT	CS	NE	NO	NE	NA	NA	NA	NA	CS	NE	NE	NE	CS	NO	NO	NO	NO	NO	NO	NO	NO	NIO	NO	NO
PL	CS	CS	CS	NO	CS	CS	CS	NO	D	D	CS	CS	NA,NO	NO	CS	NO	NO	NO	CS	CS	NO	NO	CS	IE
RO	CS	NO,NE	NO	NO	CS	CS	CS	NO	D	CS	CS	NO	NO,CS	NO	CS	NO	NO	NO	NO	NO	NO, CS	NO	CS	NO
SK	CS	D	D	NO	CS	CS	CS	NO	D	D	NO	NO	CS,D	CS	CS	NO	D	D	NO	NO	CS	CS	CS	NO
SV	CS	CS	D	NA	CS	D	CS	NA,NO	CS	D	CS	CS	CS	CS	CS	NA,NO	D	D	CS	CS	CS	CS	CS	NA

Legend

"CS" country specific data, associated either with IPCC method (tier 2) or country-specific method (tier 3, if data are highly disaggregated). Note that sometimes not all parameters involved in the estimation are truly "CS" (e.g. root/shoot ratio and BEF are often taken by IPCC). However it is expected that if "CS" is reported, the most important parameters are truly "CS".

"D" means that the default IPCC emission factors are used in the estimation. D is typically associated with IPCC default method (tier 1). If the heading is in grey, D means that NO change in C stock is assumed (following IPCC tier 1).

"NE" means either country assumes the emission/removal is negligible or not enough data is available for estimation.

"NO" means emissions or removals "not occurring" in a country (it includes also "NA" - not applicable)

(1) for DOM under "FL r FL" the 2 notations separated by a comma mean: first one refers to DW (dead wood), second to LT (litter)

(2) for ORGANIC SOIL any notation key reported for a country showing some activity data of org soil for any land (sub)category is assumed as NE. D refers to the use of IPCC default emissions factors

(3) BIOMASS C stock change in CL-CL is assumed only for perennial woody crops. Biomass of annual crops is always assumed zero C stock change by definition.

(4) for SOM MIN on CL and GL the 2 notation keys separated by comma mean that the country uses IPCC default method (which is tier 1 if associated with D data or tier 2 if associated with CS data); in this case, the first notation key refers to "reference C stock", and second to "C stock change factor" (see IPCC-GPG for details). A cell with a single "CS" indicate a country-specific method and data (i.e. tier 3 if data are highly disaggregated)

(5) for BIOMASS under L - CL, "conversion to cropland", the 2 notation keys used mean: first one refers to FL-CL and second to GL-CL.

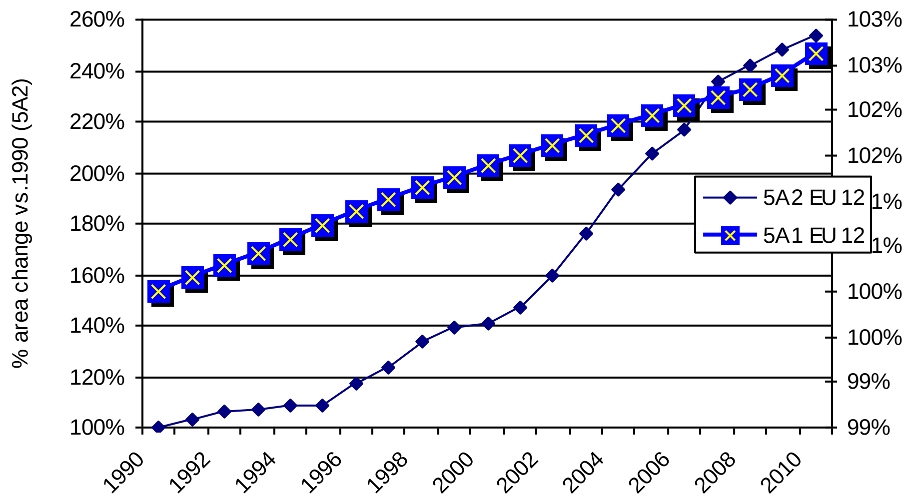
Grey heading means that for these pools IPCC TIER 1 allows to assume no change in the C stock of that pool (note that if the category is a key category, in theory higher tiers should be used)

22.2 Source and sink categories (EU-27)

22.2.1 Forest land (5A; EU-27)

According to the latest submissions, EU-27 has a forest area of about 161900 kha, out of which 35.700 kha are in EU-12 (22 % of total EU-27 forestland). Since 1990, all 12 MS have reported increase of forestland area, with an overall increase of 4 % as compared to 1990, due especially to Poland and Bulgaria and Hungary (Figure 22.2).

Figure 22.2 The percentage increase of the forest land area between 1990 and 2009 in the EU-12 (% compared to 1990)



In absolute terms Poland reports an increase of 611 kha, Hungary of 232 kha and Bulgaria 229 kha. As in EU-15, the category 5A contributes the most to the LULUCF sector GHG balance in the new MS. In 2010, 5A1 is a net sink of 354,000 GgCO_2 eq, roughly equal to that in 1990 and 9 % less than in the previous reported year 2009 (Table 22.5).

Table 22.5 **5A1 Forest Land remaining Forest Land: Net CO_2 emissions of EU-27**

Member State	Net CO_2 emissions (Gg)			Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010	(Gg CO_2)	(%)	(Gg CO_2)	(%)		
EU-15	-227,643	-251,988	-226,717	25,271	-10%	926	0%		
Bulgaria	-13,852	-9,676	-9,552	124	-1%	4,299	-31%	T1,T2	CS,D
Cyprus	-156	-178	-169	9	-5%	-13	8%		
Czech Republic	-4,777	-6,575	-5,273	1,302	-20%	-496	10%	CS,T1,T2	CS,D
Estonia	-9,269	-4,416	-1,609	2,807	-64%	7,659	-83%	T1,T2	D
Hungary	-2,249	-2,041	-1,995	47	-2%	254	-11%	T1,T2	CS,D
Latvia	-16,925	-21,051	-17,572	3,479	-17%	-647	4%	T1,T2	CS,D
Lithuania	-6,951	-11,504	-11,874	-369	3%	-4,923	71%	T1,T2	CS,D
Malta	-49	-49	-49	0	0%	0	0%	CS	D
Poland	-32,191	-40,933	-41,591	-658	2%	-9,399	29%	D,T2	CS,D
Romania	-21,956	-22,756	-22,157	598	-3%	-201	1%	T1,T2	CS,D
Slovakia	-7,445	-6,137	-4,872	1,265	-21%	2,573	-35%	T2	CS
Slovenia	-9,119	-10,771	-10,869	-99	1%	-1,750	19%	CS,D,T1,T3	CS,D
EU-27	**-352,582**	**-388,075**	**-354,300**	**33,775**	**-9%**	**-1,718**	**0%**		

The group of new EU MS reports a sink of some 130,000 GgCO_2 in 2010. Notable decreases of the annual removal by 5A1 are reported by Bulgaria, Estonia and Slovakia. A significant increase compared to 1990 is reported by Czech Republic and Poland.

The rate of removals has almost doubled compared to 1990 on the lands under conversion to forest land (new MS report increase of removal from 5A2, with only Slovakia reporting decreasing annual removal under less area converted to forestland over last decade (Table 22.6). Largest sink is estimated by Poland.

Table 22.6 **5A2 Land converted to Forest Land: Net CO_2 emissions of EU-27**

Member State	Net CO_2 emissions (Gg)			Change 2009-2010		Change 2009-2010		Method applied	Emission factor
	1990	2009	2010	(Gg CO_2)	(%)	(Gg CO_2)	(%)		
EU-15	-24,427	-32,535	-30,917	1,618	-5%	-6,490	27%		
Bulgaria	-977	-1,279	-1,335	-57	4%	-358	37%	T2	CS
Cyprus	0.00	0.00	0.00	0	-	0	-		
Czech Republic	-280	-295	-308	-14	5%	-28	10%	T1,T2	CS,D
Estonia	-20	-2,352	-2,404	-52	2%	-2,384	11857%	T1,T2	D
Hungary	-180	-1,127	-1,124	4	0%	-944	526%	T1,T2	CS,D
Latvia	1	-506	-494	12	-2%	-495	-78548%	T1,T2	CS
Lithuania	-256.72	188.29	-429.76	-618.04	-328%	-173.04	67%	T1	CS,D
Malta	NA,NO	NA,NO	NA,NO	-	-	-	-	NA	NA
Poland	-469	-10,016	-10,505	-490	5%	-10,037	2142%	D,T2	CS,D
Romania	-153	-2,381	-2,668	-287	12%	-2,515	1639%	T1,T2,T3	CS
Slovakia	-2,890	-470	-461	10	-2%	2,430	-84%	T2	CS
Slovenia	-269	-269	-269	0	0%	0	0%	D,T1,T2	CS,D
EU-27	**-29,921**	**-51,042**	**-50,915**	**127**	**0%**	**-20,995**	**70%**		

Concerning the methods applied, Tier 2 and country specific methods dominate in both subcategories. However, default data and Tier 1 default data is extensively used for root to shoot ratio and biomass expansion factors (BEFs). Regarding the methods, 5 of MS use “stock change” and other 5 use “gain loss” method (**Table 22-7**). Noteworthy, many rely on non-NFI data sources, especially on management planning database or forest inventory derived from that (a stand wise forest inventory).

Table 22-7 Estimation method used by 12 MS for the C stock change in Living Biomass pool is either **stock change** (bold) or gain-loss (thin letters). In *italics* there are non-NFI based estimation methods.

MS	Estimation method
Bulgaria	***Stock change method based on FMP database***
Czech Republic	*Gain-loss method based on FMP database and harvest statistics*
Estonia	***Stock change method based on FMP database (before 1993) and NFI data***
Hungary	***Stock change method based on FMP database***
Latvia	*Gain-loss method based on FMP (before 2004), NFI and harvest statistics*
Lithuania	***Stock change method based on FMP (before 2000) and NFI data***
Poland	*Gain-loss method based on FMP database and harvest statistics*
Romania	*Gain-loss method based on FMP database, national statistics and harvest statistics*
Slovakia	*Gain-loss method based on FMP database, harvest statistics and firewood estimate*
Slovenia	**Stock change method based on NFI data**

Comparative information on the data sources used for estimation under 5A1 and 5A2 (Table 7-17) shows a wide range of methods and approaches used to collect basic information (which is actually designed for forestry purpose).

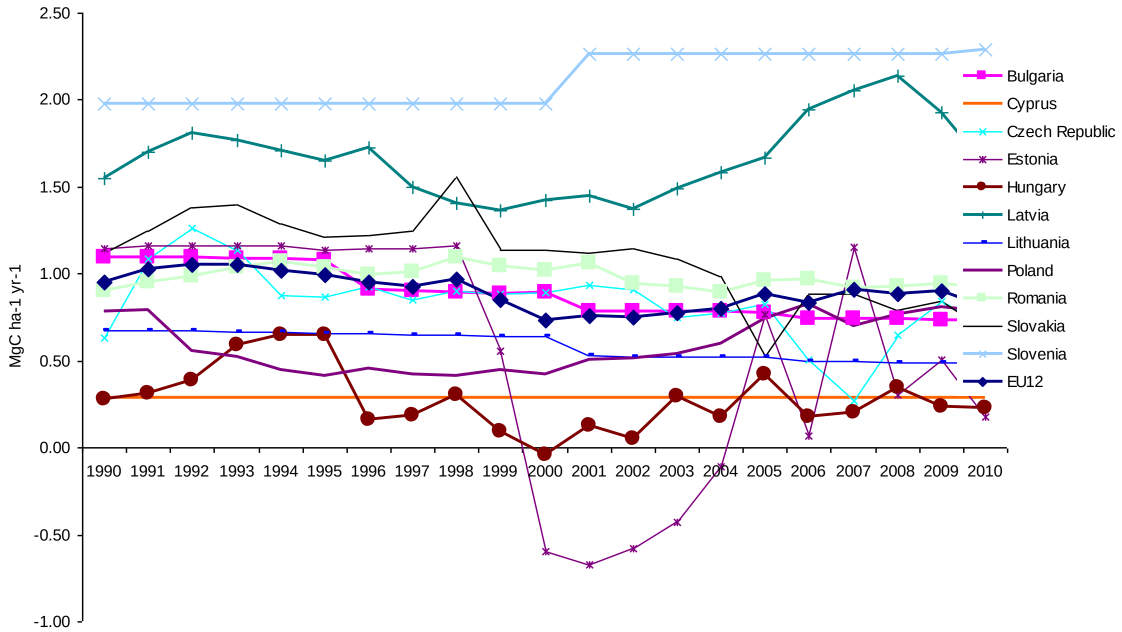
Table 22-8 **Relevant information on the Forest Inventories in the 12 MS** (FMP - Forest management plan, NFI - national forest inventory)

Country	Type of survey (for 1990 and the latest cycle): sampling design, country coverage of the grid, stand measurement plot area	Cycle length	Frequency / First NFI in …	Data source for 1990	Data source for 2008-2012
Bulgaria	Forest management planning purpose assessment of the whole territory of the country is carried out within 10 years with data collected annually and statistics updated annually (i.e. area) or every 5 years (i.e. standing stock).	10	-	FMP database	FMP database
Czech republic	Forest management planning database aggregated up in the permanent inventory and covering entire country in 10 years cycles. Grid cell of 2x2km with two 500m2 circular plots covering entire country.	10	Stand wise forest inventory since '50. First NFI 2001-2004	FMP database	FMP database
Estonia	Systematic sampling without pre-stratification Continuous inventory with 1/5 plots measured in a year in 5x5km grid. 25 % of the 800m side squares clusters with permanent plot of 10m radius and temporary with 7m radius. NFI follows FL conversions.	5	First NFI 1999-2002	FMP database (10 years cycles)	NFI 2009-2013
Hungary	Forest Inventory and Planning System is a GIS-based system contains geographical information on the distribution of existing forests, broad tree species categories, forest soils, designated nature and landscape areas, river catchments and archaeological sites.	10	Stand wise forest inventory database since 1970.	FMP database	FMP database
Latvia	Sampling inventory 4x4km grid of permanent clusters with four sampling plots and 2x2km grid temporary clusters with eight plots (temporary plots are 1/3 of total). Temporary clusters area is 4x that of permanent plots. Each year one fifth of the plots in the permanent sample plots are assessed. Conversions are followed. Plot consists in three concentric areas and a band within a total of 500m2.	5	First NFI 2004–2008.	FMP database	NFI 2009–2013

Lithuania	Continuous, multistage sampling and GIS technology based inventory since 1998. 4x4km systematic grid with a random starting point. 1/3 if plots are temporary. Four permanent plots are settled in cluster of 6250m2 and temporary plots are 4x larger. Plot consists in two concentric areas with a total of 500 m2.	5	Stand wise forest inventory database since 1922. First sampling based inventory in 1967–1969.	FMP database	NFI 2008-2012
Poland	Permanent sample plots in "L" shape clusters in 4x4km nationwide grid. A group of 5 clusters are further grouped into blocks, with one cluster measured annually. Plots consist in two concentric plots with max area of 500m2.	5	FMP database since 1946. First sampling based inventory in 1983	FMP database	NFI 2008-2012
Romania	Forest management planning database agregated up in 1985 and covering entire country in 10 years cycles. Continuous forest inventory with a 5-years cycle covering entire country in a year. 4 plots clustered in a grid is 4x4km grid (in plain areas 2x2 km). Plot consists in three concentric area of 2000 m2. Some 15 % of plots are temporary.	6	First statistic NFI 2007-2012	FMP in 1985 (for C stock change factors) and national statistics (for activity data)	National statistics (for activity data) and NFI 2007-2012 (for C stock change factors)
Slovakia	Forest management planning database aggregated up in the permanent inventory and covering entire country in 10 years cycles. Sample based forest inventory in a grid of 4x4 km. Plot consists in three concentric area of 500 m2.	2	First statistic NFI 2005-2006	FMP database	FMP database
Slovenia	Cluster of two/four of 6-tree sample plots on 8x8km/16k16km grid and one concentric permanent sample plot. Inventory is annually on the 16x16km grid and periodically on the 4x4km grid.	1/5–10 years	First statistic sampling 1985	Forest Ecosystem Condition Survey 2000	Forest Ecosystem Condition Survey 2012

For the new EU-12 MS, the average C stock change factor in the net change in living biomass rather equal to that in the EU-15. The highest net change in biomass is reported by Slovenia, under close to nature extensive forest management practiced there. The smallest values are shown by Cyprus and Hungary (Figure 22.4). IEF is negative, suggesting a source, in case of Hungary (in 2000) and Estonia (under high harvesting volume about twice higher than usual between 1999 and 2004 and wildfires in 2006 and 2008).

Figure 22.3 Implied net C stock change factor for the net change in biomass C pool in the EU-12

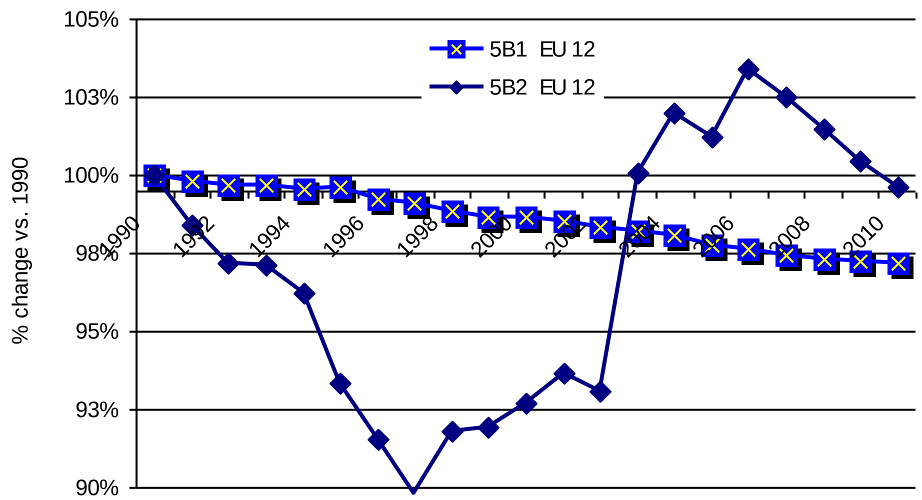


DOM is practically reported by only three MS with values across EU-12 range from 0.11 to 0.21 MgCha-1yr-1. C stock change in the mineral soils is poorly reported by only 2 countries, by Estonia showing values very close to zero and Poland reports IEF growing values form 0.25 to 0.5 MgCha-1yr-1in 2010. Average value for IEF for C stock change in organic soils is -0.35 MgCha-1yr-1 (reported by Latvia, Lithuania and Estonia). Despite large areas of organic soils under 5A1 (also under forest management) Poland does not report CO_2 emissions from these areas (issue highlighted by EU QA/QC).

22.2.2 Cropland (5B; EU-27)

In the new 12 EU MS, cropland area (5B) decreased by 4% since 1990, respectively by 2.456 kha, reaching a total in 2010 of 41,900kha. All MS report decreases of cropland area compared to 1990. In absolute terms, the highest reductions of cropland areas are in Latvia (some 607 kha) and Poland (477 kha). Area of land under conversion to cropland decreased over 1990-2000 followed by sharp increase (Figure 22.4).

Figure 22.4 The percentage increase of the cropland area between 1990 and 2010 in the EU-12 (% compared to 1990)



Subcategory 5B1, cropland remaining cropland is a source of GHGs of about 26,000 $GgCO_2eq$ (Table 22.9), which is 27% more than in 1990 and 9% more than in 2009. Bulgaria and Slovenia report increase of emissions compared to 1990, while Hungary and Romania report it as a sink. The methodologies are still largely based on Tier 1 in subcategory 5B1 and most new MS are still weak in reporting the emissions from subcategory 5B2 (other than conversions from forest land).

Table 22.9 **5B1 Cropland remaining Cropland: Net CO_2 emissions of EU-27**

Member State	Net CO_2 emissions (Gg)			Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010	(Gg CO_2)	(%)	(Gg CO_2)	(%)		
EU-15	20,032	25,466	25,401	-64	0%	5,370	27%		
Bulgaria	470	1,169	1,116	-53	-5%	646	137%	T1,T2	CS,D
Cyprus	NA	NA	NA	-	-	-	-	NA	NA
Czech Republic	1,089	40	38	-2	-4%	-1,051	-97%	CS,T1	D
Estonia	142	99	101	3	3%	-41	-29%	T1,T2	D
Hungary	215	-1,136	-1,165	-30	3%	-1,380	-642%	T1	D
Latvia	338	221	219	-2	-1%	-118	-35%	D,T1	D
Lithuania	358	54	20	-34	-63%	-339	-94%	T1	D
Malta	-8	-10	-10	0.00	0%	-2	30%	D	D
Poland	3,534	2,889	3,155	266	9%	-379	-11%	D,T1,T2	CS,D
Romania	-4,792	-4,269	-2,206	2,063	-48%	2,586	-54%	CS,T1,T2	CS,D
Slovakia	-937	-859	-854	5.63	-1%	83	-9%	T1,T2	CS,D
Slovenia	174	412	412	0	0%	238	136%	D,T1,T2	CS,D
EU-27	**20,615**	**24,074**	**26,227**	**2,153**	**9%**	**5,612**	**27%**		

Lands under conversion to cropland are reported as source with 22% less than in 1990 and 2% less than in previous year (Table 22.10**Fehler! Ungültiger Eigenverweis auf Textmarke.**).

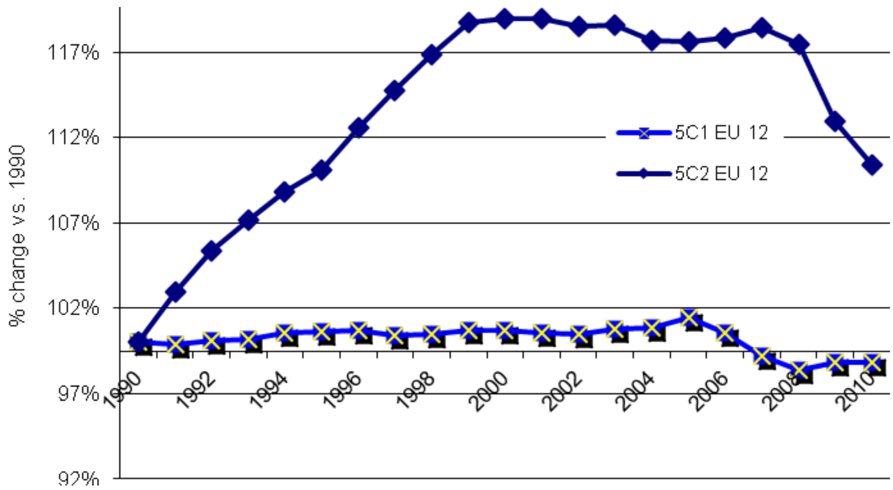
Table 22.10 **5B2 Land converted to Cropland: Net CO_2 emissions of EU-27**

Member State	Net CO_2 emissions (Gg)			Change 2009-2010		Change 2009-2010		Method applied	Emission factor
	1990	2009	2010	(Gg CO_2)	(%)	(Gg CO_2)	(%)		
EU-15	35,917	28,774	27,709	-1,064	-4%	-8,208	-23%		
Bulgaria	1,012	1,012	1,012	0.00	0%	0.00	0%		
Cyprus	0.00	0.00	0.00	0.00	-	0.00	-		
Czech Republic	226	74	95	20	27%	-132	-58%	T1,T2	CS,D
Estonia	NO	2	2	0	-	2	-	T1	D
Hungary	78	232	218	-15	-6%	139	178%	T1,T2	CS,D
Latvia	215	296	254	-42	-14%	38	18%	T2	CS
Lithuania	-4	-619	-50	569	-92%	-46	1302%	NA	NA
Malta	NO	NO	-1	-1	-	-1	-		
Poland	NA,NO	100	100	0	0%	100	-	T2	D
Romania	-17	43	18	-25	-58%	36	-206%	T1	CS
Slovakia	757	157	139	-18	-11%	-618	-82%	T2	CS
Slovenia	1,150	1,201	1,201	0.00	0%	51	4%	D,T1,T2	CS,D
EU-27	**39,334**	**31,272**	**30,696**	**-576**	**-2%**	**-8,638**	**-22%**		

22.2.3 Grassland (5C; EU-27)

Grassland remaining grassland (5C1) area decreased by 1 % compared to 1990 in the new 12 EU MS, with a 4% decrease for EU27. The highest decrease is shown by Latvia (179kha) and Poland (224kha)(Figure 22.5). Years 2005-2007 marked large conversion to forestland for many countries.

Figure 22.5 **The percentage increase of the grassland area between 1990 and 2010 in the EU-12 (% compared to 1990)**



Subcategory 5C1, grassland remaining grassland, is reported as a source of GHGs by the EU-12 countries, with a total emission of about 11,000 GgCO_2 in 2010, 37 % less than in 1990 and 1% more compared to previous year (Table 22.11). The methodologies are largely based on Tier 1 with default data; country specific values are available only in few new MS.

Table 22.11 **5C1 Grassland remaining Grassland: Net CO_2 emissions of EU-27**

Member State	Net CO_2 emissions (Gg)			Change 2009-2010		Change 2009-2010		Method applied	Emission factor
	1990	2009	2010	(Gg CO_2)	(%)	(Gg CO_2)	(%)		
EU-15	16,682	9,663	9,350	-314	-3%	-7,333	-44%		
Bulgaria	NO	NO	NO	-	-	-	-	NA	NA
Cyprus	0.00	0.00	0.00	0.00	-	0.00	-		
Czech Republic	59	3	2	-1	-28%	-57	-96%	CS,T1	CS,D
Estonia	-216	-273	182	456	-167%	398	-185%	T1,T2	D
Hungary	52	437	405	-32	-7%	353	678%	T1	D
Latvia	40	68	64	-4	-5%	24	60%	T1	D
Lithuania	466	565	558	-8	-1%	91	20%	T1	D
Malta	NO	NO	NO	-	-	-	-	NA	NA
Poland	457	570	546	-24	-4%	88	19%	D,T1,T2	CS,D
Romania	NO	NO	NO	-	-	-	-	NA	NA
Slovakia	NO	NO	NO	-	-	-	-	NA	NA
Slovenia	IE,NA,NO	IE,NA,NO	IE,NA,NO	-	-	-	-	NA	NA
EU-27	**17,541**	**11,033**	**11,107**	**74**	**1%**	**-6,434**	**-37%**		

Land conversion to grassland is reported as removal thus compensating emissions from 5C1, for entire time series since 1990 (Table 22.12).

Table 22.12 5C2 Land converted to Grassland: Net CO_2 emissions of EU-27

Member State	Net CO_2 emissions (Gg)			Change 2009-2010		Change 2009-2010		Method applied	Emission factor
	1990	2009	2010	(Gg CO_2)	(%)	(Gg CO_2)	(%)		
EU-15	-17,851	-19,987	-21,048	-1,062	5%	-3,198	18%		
Bulgaria	-787	-787	-787	0.00	0%	0.00	0%	T1	CS
Cyprus	0.00	0.00	0.00	0.00	-	0.00	-		
Czech Republic	-187	-374	-373	1	0%	-187	100%	T1,T2	CS,D
Estonia	IE,NE,NO	-341	-343	-2	1%	-343	-	T1,T2	D
Hungary	-20	40	39	-1	-3%	59	-293%	T1,T2	CS,D
Latvia	IE,NE,NO	IE,NE,NO	IE,NE,NO	-	-	-	-	NA	NA
Lithuania	-5	NA,NO	-22	-22	-	-17	377%	NA	NA
Malta	NO	NO	NO	-	-	-	-	NA	NA
Poland	-49	-116	-116	0.13	0%	-66	134%	T2	CS,D
Romania	-673	112	130	17.96	16%	803	-119%	T1	CS
Slovakia	-328	-410	-326	84	-20%	2	-1%	T2	CS
Slovenia	222	343	343	0.00	0%	121	54%	D,T1,T2	CS,D
EU-27	**-19,677**	**-21,518**	**-22,503**	**-985**	**5%**	**-2,827**	**14%**		

22.3 Wetlands, Settlements and Other land

Activity data is reported for all land use as derived from national scale land matrices for each of EU-12 MS. Wetland area in 2010 is around 4250kha, roughly unchanged compared to 1990. Wetland area is large in Poland (1,300 kha), Estonia (some 500 kha), Romania (800 kha). Area of conversions to wetland is some 22%. Flooded area is only reported by Poland (880 kha) for computation of CH_4 emissions.

Area of conversion to settlements is some 10%, relatively smaller comparative to homologous share in the EU-15. 34 % of converted land comes from cropland and 45 % from Other Land, with 9% from Forest Land.

Area reported under Other Land is 1,825kha in 2010, 12 % less than in 1990. Largest areas of Other Land is reported by Bulgaria (600 kha), and Poland (360kha), Romania (400 kha), while other MS reports very small areas under this land category.

Emissions of any GHG are mainly computed based on IPCC default factors, especially for conversions, with best estimated land subcategory being 5E2. Meanwhile for other land uses they are mainly reported as NE (planned to be estimated) or NO. In case of forestland conversions the emissions from biomass and DOM pools are estimated, but not always from the soil.

In 2010 there emissions are 5676 GgCO_2 eq on 5D, 2774 GgCO_2 on 5E and 1216 GgCO_2 on 5F, with majority of emissions associated with land conversions.

22.4 Non-CO_2 GHG emissions from land use

Direct N_2O emissions from N fertilization of Forest Land and Other are mainly reported and justified as NO, as activities of fertilization on forestland do not occur in the new 12 EU MS.

Non-CO_2 emissions from drainage of soils and wetlands are reported as NO (i.e. Bulgaria) or not estimated in case of drainage of peatlands (i.e. Estonia, Latvia and Lithuania). The largest area is reported by Latvia, while the other report partial area under drainage (often NE is also reported for the activity data). Nevertheless, they mainly report NE under missing method for estimation (especially for CH_4). All reporting MS use IPCC default emission factor for the emission estimation.

N_2O emissions from disturbance associated with land-use conversion to cropland are reported by Bulgaria as occurring on significant area (312 kha) under conversion of grassland to cropland. An inconsistency was highlighted by the EU QAQC regarding the areas reported under conversion from forestland or grassland to cropland were identified (i.e. Estonia). They all use IPCC default emission factor for the emission estimation.

CO_2 emissions from agricultural lime application are mainly reported as NO. Czech Republic, Estonia, Hungary, Latvia, Poland and Slovenia provide estimates. They all use IPCC default emission factor for the emission estimation.

All new MS report estimates from **biomass burning** on wild and controlled fire (despite often the areas are very small). Emissions from Biomass Burning are reported by Bulgaria as occurring on 6500ha, Poland on 2,200 ha in 2010. Other new EU MS report based on dry matter of biomass burnt (then difficult to compare).

22.5 Recalculations

Changes in activity data occurred for several new EU MS. In 5A1 Bulgaria, Estonia, Romania and Slovakia shown large recalculations compared to previous submission, with downward revised estimates for the EU 12. In 5A1 the EU 27 estimates are revised downward and 5A2 upward.

Overall effect of recalculations in 5A1 and 5A2 since submissions 2006 to date (Figure 22.6, Figure 22.7) show downward recalculation in time in both cases.

Figure 22.6 **Revision of annual estimates of C stock change in living biomass in 5A1 for 1990-2003 from 2006 to current submission to UNFCCC** (EU 15 aggregated level, submissions in 2011 and 2012 are highlighted in red, blue respectively)

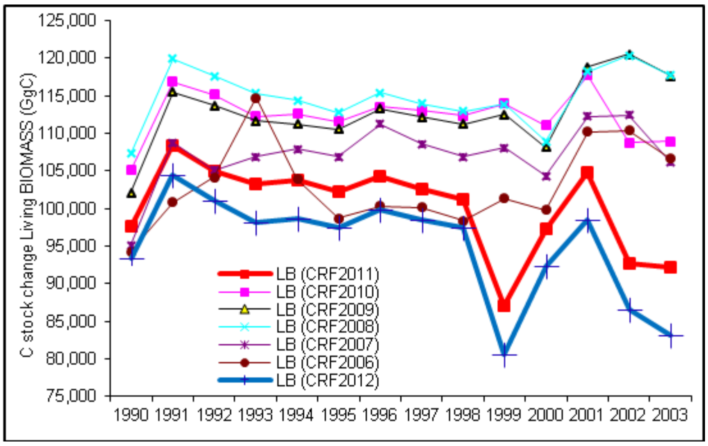
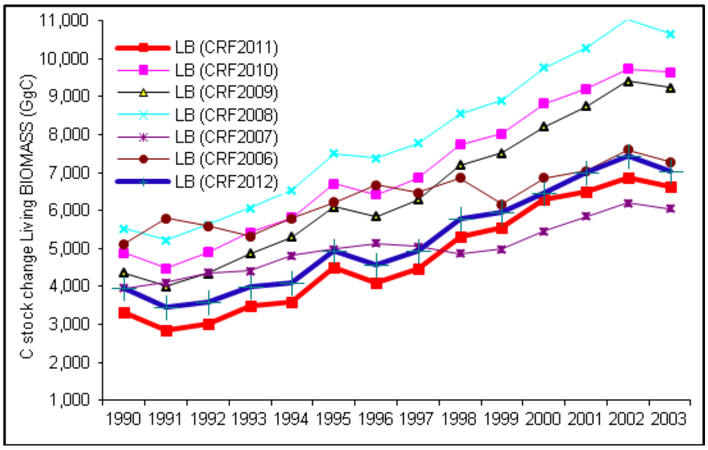


Figure 22.7 **Revision of annual estimates of C stock change in living biomass in 5A2 for 1990-2003 from 2006 to current submission to UNFCCC** (EU 15 aggregated level, submissions in 2011 and 2012 are highlighted in red, blue respectively)



23 Waste (CRF Sector 6)

23.1 Overview of sector (EU-27)

CRF Sector 6 Waste is the fourth largest sector in the EU-27, contributing 2.9 % to total EU-27 GHG emissions. Total emissions from Waste have been decreasing by 30 % from 203 Tg in 1990 to 142 Tg in 2010 (Figure 22.1).

Figure 23.1 Sector 6 Waste: EU-27 GHG emissions 1990–2010 from CRF in CO_2 equivalents (Tg)

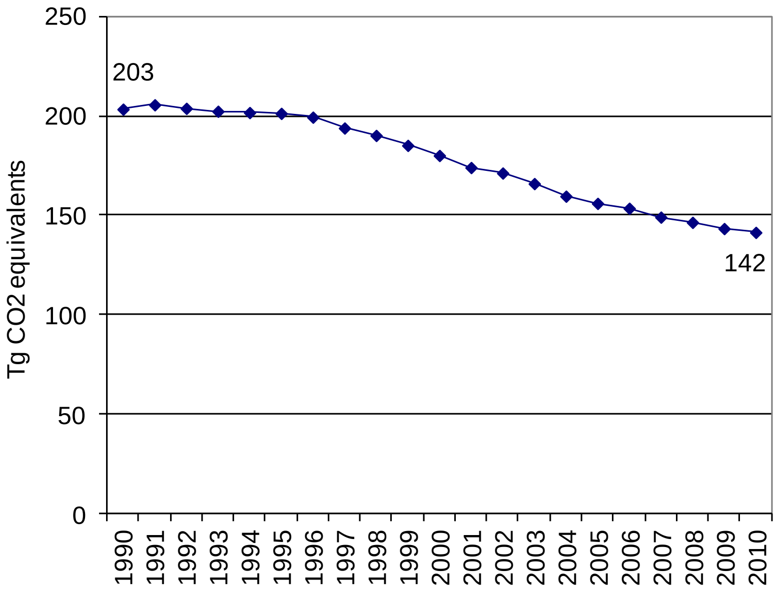
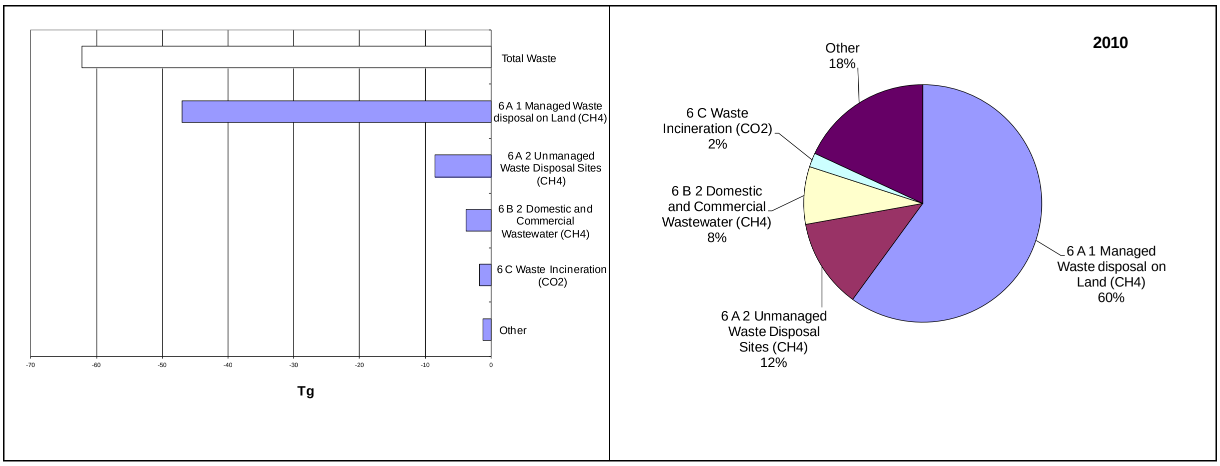


Figure 23.2 shows that CH_4 emissions from 6A1 Managed Waste Disposal on Land had the greatest decrease of all waste-related emissions, but still accounts for 60 % of waste-related GHG emissions in the EU-27.

Figure 23.2 Sector 6 Waste: Absolute change of GHG emissions by large key source categories 1990–2010 in CO_2 equivalents (Tg) and share of largest key source categories in 2010



23.2 Source categories (EU-27)

23.2.1 Solid waste disposal on land (CRF Source Category 6A) (EU-27)

Source category 6A Solid waste disposal on land includes two key sources: CH_4 from 6A1 Managed waste disposal on land and CH_4 from 6A2 Unmanaged waste disposal on land. The twenty largest EU key categories cover about 70 % of total GHG emissions of which emissions from managed waste disposal on land are included. More information on the 20 largest key categories of total GHG emissions of EU 27 and thus for 6A1 in EU-27 are provided in the following subchapters.

Table 22.2 provides information on emission trends of the key source CH_4 from 6A1 Managed Waste Disposal on Land by Member State. CH_4 emissions from this source account for 1.8 % of total EU-27 GHG emissions. Between 1990 and 2010, CH_4 emissions from managed landfills declined by 36 % in the EU-27.

Between 1990 and 2010, eleven out of the 27 Member States reduced their emissions from this source, France, Greece, Italy, Portugal, Spain, Bulgaria, Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Romania, Slovakia and Slovenia did not. In 2010, CH_4 emissions from landfills decreased by 2 % compared to 2009. A main driving force for CH_4 emissions from managed waste disposal on land is the amount of biodegradable waste going to landfills. Total municipal waste disposal on land declined by 38 % between 1990 and 2010. CH_4 emissions from landfills are also influenced by the amount of CH_4 recovered and utilized or flared. Compared to last year's inventory, the share of CH_4 recovery increased in all EU-12 Member States, except for the Estonia and Slovakia, see also Figure 23.7.

Member States contributing most to CH_4 emissions from this source were Hungary, the Czech Republic, Cyprus and Slovakia, accounting for 9 % of EU-27 emissions. Thus the new Member States only have a minor contribution to total EU-27 GHG emissions in 2010. A reduction of emissions between 1990 and 2010 could only be found for Poland; whereas Romania increased significantly its CH_4 emissions between 1995 and 2008, especially between 1998-1999, 2000-2001, 2004-2006, due to number of managed sites increasing along this period: from 1 site in 1995, 2 in 1999, 6 in 2001, to 20 at the end of 2006. The Czech Republic increased steadily its CH_4 emissions due to a rather constant generation of municipal waste on waste disposal sites. Nevertheless, emissions stopped increasing during 1996 and 1997, because new facilities recovering landfill gas started operation in that time. In following years this increase in recovery was offset by a growing trend of methane generation.

Hungary, responsible for 3.5 % of total EU-27 emissions from solid waste disposal on land steadily increased its emissions until 2006 and managed to reduce its emissions until now. This might also be due to a change in waste treatment: the rate of landfilled waste decreased from 83 % in 2001 (recycling 1 %) to 69 % in 2010, in favour of recycling (18 %), see Figure 23.4.

Almost all new MS used higher tier methodologies for estimating CH_4 emissions; the table suggests that 75 % of CH_4 emissions from managed waste disposal on land are calculated with higher tier methodologies.

Table 23.1 **6A1 Managed Waste Disposal on Land: CH_4 emissions of EU-27**

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	125,218	75,450	73,718	87.0%	-1,732	-2%	-51,500	-41%		
Bulgaria	NO	418	372	0.4%	-46	-11%	372	-	T2	CS,D
Cyprus	532	1,048	989	1.2%	-59	-6%	457	86%	D	D
Czech Republic	1,663	2,614	2,708	3.2%	95	4%	1,046	63%	T2	CS,D
Estonia	182	258	262	0.3%	4	2%	81	45%	T2	D
Hungary	2,264	2,990	2,947	3.5%	-44	-1%	683	30%	T2	D
Latvia	NO	75	99	0.1%	24	32%	99	-	T2	D
Lithuania	631	703	721	0.9%	18	3%	90	14%	T2	D
Malta	NA	67	80	0.1%	13	19%	80	-	M	M
Poland	840	845	805	1.0%	-40	-5%	-34	-4%	OTH	D
Romania	NO	568	664	0.8%	95	17%	664	-	T2	D
Slovakia	IE	1,027	984	1.2%	-43	-4%	984	-	T2	CS
Slovenia	345	361	356	0.4%	-5	-1%	11	3%	T2	CS,D
EU-27	**131,675**	**86,425**	**84,705**	**100.0%**	**-1,720**	**-2%**	**-46,970**	**-36%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

CH_4 emissions from managed solid waste disposal are key sources in all new Member States. Although it is good practice to calculate the emissions for key sources using the First Order Decay (FOD) method (Tier 2), one MS uses a lower tier methodology. For Cyprus, there are no sufficient historical data series available to estimate the amount of the collected waste. Table 23.2 summarizes the characteristics of the national methodologies for estimating CH_4 emissions from managed solid waste disposal sites.

Table 23.2 **6A1 Managed Waste Disposal: Description of national methods used for estimating CH_4 emissions in the new MS**

Managed Waste Disposal on Land new MS	
Member State	**Description of methods**
Bulgaria	Emissions from solid waste disposal on land have been calculated using the First Order Decay (FOD) method, which is the IPCC Tier 2 method given in the IPCC Good Practice Guidance (GPG 2000). Activity data for the whole period (1950-2010), according to IPCC GPG comes from NSI. [NIR 2012]
Cyprus	Methane emissions were calculated using the default method proposed by the revised IPCC 1996 guidelines. IPCC default values have been applied. For 1990-2006, the estimation of the portion of solid waste disposed on land going to managed disposal sites, it was assumed that all waste from urban areas were going to managed disposal sites, whereas the waste produced by rural population was going to unmanaged disposal sites. Data was available by the Waste Management unit of the Ministry of Interior for the year 2010. The years between 2006 and 2010 a linear trend was applied to estimate the portion of waste going to managed landfills. For managed waste disposal on land, Methane Conversion Factor (MCF) was assumed 1, while for unmanaged waste disposal on land MCF was assumed 0.4 (default IPCC1996 guidelines, pg 6.8 workbook). [NIR 2012]
Czech Republic	Key activity data for methane quantification from 6.A is amount of waste disposed in to landfills.The method we are using for estimation of methane emissions from this source category is tier 2 FOD approach (First order decay model). In new methodology it is actually basic tier for this category. First order decay (FOD) model assumes gradual decomposition of waste disposed to landfill. For calculation of GHG emissions from we used IPCC Spreadsheet for Estimating Methane emissions from Solid Waste Disposal Sites which is part of new methodology guidelines IPCC, 2007. [NIR 2012]

Estonia	Waste key categories in 2010 calculated with the Tier 2 method. The First Order Decay (the FOD) approach were employed (IPCC 2000).Calculating emissions from solid waste disposal sites the total amount generated and the quantity of municipal waste generated in 2010 (collected from Estonian Environment Information Centre (EEIC) and amount of recovered methane (obtained from the EEIC Air bureau) are used as activity data. Due to obtainable waste disposal activity data for the current inventory year and available waste disposal activity data for previous years, however country-specific key parameters are not available, the FOD method with default parameters and country-specific activity data was used. Emission factors (EFs) used in calculations of emissions from solid waste disposal sites are default emission factors from IPCC 2000. [NIR 2012]
Hungary	Emissions were calculated using a first order decay methodology, as response to the recommendations of the ERT in 2007. For the calculations, the IPCC Waste Model from the 2006 IPCC Guidelines was used. The FOD method produces a time-dependent emission profile which may better reflect the true pattern of the degradation process as it is claimed by the IPCC GPG. Activity data is obtained from the Waste Management Information System maintained by the Ministry of Environment and Water. This database is a new development and contains very detailed information on waste management practices in Hungary. [NIR 2012]
Latvia	IPCC GPG 2000 (Tier 2) method is used for CH_4 emissions calculation. All emission factors are default factors from IPCC GPG 2000, because Latvia hasn't national emission factors.To estimate CH_4 emissions with First Order Decay (Tier2) method from landfills, time series for disposed waste amounts till 1970 was developed. Disposed amounts for years 1970 – 1989 were estimated taking into account population and Grand domestic product (GDP). Landfills from 1970 – 2001 are estimated as unmanaged, Data about waste disposal on land for 2002 - 2010 are taken from database "3-Wastes". Starting from year 2002, according to data base information, biggest sites could be estimated as managed sites (polygons) and MCF-1 is starting to use.[NIR 2012]
Lithuania	Methane emissions from solid waste disposal sites were estimated using IPCC waste model based on the first order decay method provided in the 2006 IPCC Guidelines. Data on waste generation and disposal were collected in Lithuania only from 1991, data on disposal before 1991 are not available. The data provided by the Lithuanian Environmental Protection Agency (EPA) responsible for environmental statistics in Lithuania show that waste generation and disposal in 1991-1994 were fluctuating very substantially and were almost twice as high as in 1999-2010. [NIR 2012]
Malta	The IPCC 2006 Tier 2 First Order Decay (FOD) spreadsheet model has been used to work out methane emissions from the solid waste category. This Tier 2 method uses IPCC default parameters as well as country specific activity data. Prior to 1997 no weighing bridges were available at the Maltese landfills. Hence, the available solid waste statistics prior to 1997 may at best be considered as indicative. In the IPCC 2006 waste model, 1977 was chosen as the starting year for waste deposition into landfills. The year 1977 was chosen since at that time waste started being deposited into Maghtab and Wied Fulija in Malta. [NIR 2012]
Poland	The methane emissions from solid waste disposals were calculated using the IPCC Waste Model (Tier 2) published in [IPCC 2006]. The model establish multiyear series when methane is generated from organic matter decomposition in anaerobic conditions. The emission of CH_4 is diminished by recapturing of this gas. IPCC default values have been applied, only R methan erecovery was taken from a national study. [NIR 2012]
Romania	CH_4 emissions from managed and unmanaged SWDS were calculated using First Order Decay method, in accordance with IPCC GPG 2000. To estimate methane emissions from managed landfills historical data were not necessary, because the first managed landfill was opened in 1995 year. For unmanaged SWDS methane emissions were estimated between 1950 and 2010, according IPCC GPG 2000 to achieve an acceptably accurate result. [NIR 2012]
Slovak Republic	The estimation of methane emissions from SWDSs by FOD method were calculated using a spreadsheet model. The methane emissions for MSW are included into category Managed waste disposal on land (6A1) from 2001, before this year the waste disposal sites were uncategorized and emissions were included in category Other municipal waste uncategorized (6A3). [NIR 2012]
Slovenia	The First Order Decay (FOD) method is used to calculate emissions. Methane generation rate k has been taken from GPG, 2000 and is 0.05. [NIR 2012]

Source: NIR 2012

The Tier 2 FOD method requires data on current as well as historic waste quantities, composition and disposal practices for several decades. In the following section a detailed overview of the most important parameters and methodological aspects of the FOD method applied by the Member States are presented. The main factors influencing the quantity of CH_4 produced are the amount of waste disposed of on land and the concentration of biodegradable C in that waste.

Amount of waste disposed on SWDS: The FOD method requires historic data on waste generation over decades but it is difficult to achieve consistent time series for the activity data over such long periods. The data sources used for generating time series of activity data by the new Member States are summarized in Table 23.3.

Table 23.3 6A1 Managed Solid Waste Disposal: Data sources used for generating time series of activity data in new MS

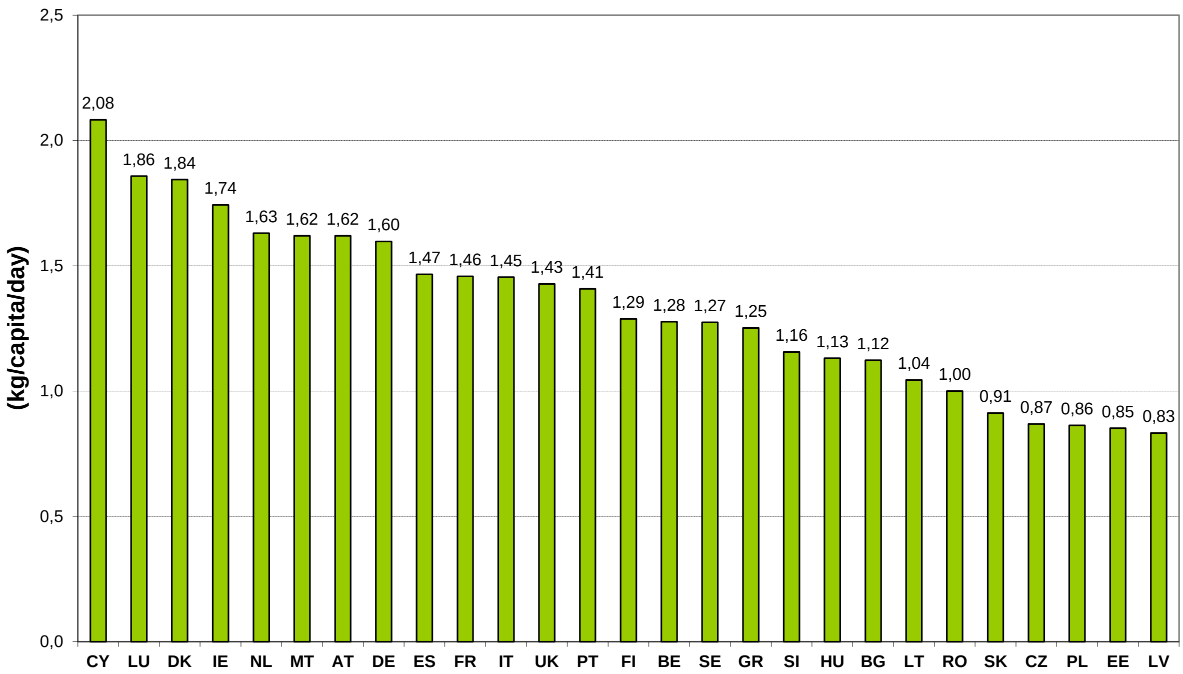
Managed Waste Disposal on Land new MS	
Member State	**Data sources used for generating time series (6A1)**
Bulgaria	The main source of activity data is NSI. Data on Municipal Solid Waste generation rate and on the quantity of MSW disposed to SWDSs and etc. are available and country specific data. Activity data for the whole period (1950-2010), according to IPCC GPG comes from NSI. NSI interpolate data for the waste before 1979 year; NSI has data on waste after 1979 year. From 1999 to 2010 waste generation data are reported by municipalities and supplemented with additional data for evaluation of non-performing locations derived from NSI. [NIR 2012]
Cyprus	Data for solid waste disposed land for 1994-2007 was available from the National Statistical Service. For 1990-1993, the trend of 1994-2007 was used to estimate the portion of the total solid waste production that is disposed of on land. For the years 2008-2010 data was available from the Waste Management unit of the Ministry of Interior. The composition of waste disposed on land was available for the period 1994-2007. For the years 1990-1993, it was assumed that the composition of the waste is the same as 1994 and for the years 2008-2010 it was assumed the same as 2007 [NIR 2012].
Czech Republic	Data for annual disposal are from mixed sources because for correct application of FOD model one needs data from 1950 to present days. These data are not available in the country therefore assumptions about past must be used. Activity data coming from national agencies and ministries. [NIR 2012]
Estonia	The main providers of activity data used in the estimates are Estonian Environment Information Centre (EEIC) and the Statistics Estonia (SE). Since 1992 the EEIC has started to collect data of inert and degradable waste in accordance with the Estonian waste classification, however in 1999 the adapted classification system was changed and the European Waste Catalogue was employed. The data for 1990-1991 were interpolated basing on the data of 1992-1998. The forcast function of the Excel software was used to calculate the quantities of waste generated in the period 1990–1991. The calculations with Forecast function based on the Estonian GDP in 1990, 1991–1998 and quantities of waste generated in 1991–1998. Source of GDP is Statsistics Estonia and source of data on waste generation in period 1992–1998 is Estonian Environment Information Centre.[NIR 2012]
Hungary	Formerly, as basic activity data the amount of removed municipal solid waste, which was published by the Hungarian Central Statistical Office in the Statistical Yearbook of Hungary and Environmental Statistical Yearbook of Hungary, were used. However, these publications do not contain this basic information any more, but make a reference to the Waste Management Information System maintained by the Ministry of Environment and Water. This database is a new development and contains very detailed information on waste management practices in Hungary. As the eldest data which can be found in statistical publications are for 1975 extrapolation had to be made. [NIR 2012]
Latvia	Amount of disposed wastes are estimated in different ways for time period since 1970. There are no other possibilities for Latvia, because waste statistics are available only from 2001. For some years primary data from National statistics is available. All other years are estimated. Disposed amount are estimated according to GDP and population changes. Population amounts for year 1971 -1978, 1982 – 1985, 1987 – 1988, 1991 – 1994 are calculated according to available amounts in nearest years. GDP data from 1970 – 1979 are estimated like the same decrease from 1985 - 1980. Data about waste disposal on land for 2002 - 2010 are taken from database “3-Wastes”. [NIR 2012]

Lithuania	Data on waste generation and disposal were collected in Lithuania only from 1991, data on disposal before 1991 are not available. The data is provided by the Lithuanian Environmental Protection Agency (EPA), which is responsible for environmental statistics in Lithuania. The amount of waste disposed of in landfills in 1950-1989 was evaluated on the basis of the several considerations. [NIR 2012]
Malta	Prior to 1997 no weighing bridges were available at the Maltese landfills. Hence, the available solid waste statistics prior to 1997 may at best be considered as indicative. Waste started being deposited into Maghtab and Wied Fulija in 1977. The opening of Qortin in Gozo came later in the 1980s. The waste generation figures for the years 1977 to 1989 have been estimated, using a backward extrapolation of waste generation statistics and population figures from 1990 to 1996. [NIR 2012]
Poland	Activities used for estimation of CH_4 emissions from solid waste disposals contain: • Population – number of population was taken from [GUS 2011] • Municipal Solid Wastes (MSW) – for years 1971-1973 data were interpolated on a basis of data from 1970 and 1974. The same method was used for 1976. In domestic statistics data were given in dam3. The percentage of waste generated, which goes to solid waste disposal sites – according to the GUS Statistical Yearbook, Environment 1990, in 1981-1990 there was no combustion of waste and the composting was on level of 0.1%. Because of the lack of data, for other years this value was assumed on level of 0.1%. Distribution of solid waste disposal sites for managed and unmanaged ones was made in accordance to elaboration [Gworek 2003]. [NIR 2012]
Romania	For 1995-2002 period, activity data on MSW disposed to managed landfills were provided by National Research and Development Institute for Environmental Protection but were revised for years: 1996, 1997, 1998 and 2000. For 2003-2009, the data on the amounts of MSW and percentage composition were provided by Waste Directorate from National Environmental Protection Agency, as a result of surveys conducted each year by NEPA and National Institute for Statistics (NIS). For switching to a higher level of CH_4 emissions estimates from unmanaged landfills were needed data for the period 1950-2002, but no records of historical data are in our country for this long period. In this case, the activity data on MSW disposed to unmanaged landfills were estimated by this study, since 1950, taking into account the existing data, the data reported to EUROSTAT, the database owned by other institutions, waste generation rate at the rural and urban level and population of rural and urban areas. [NIR 2012]
Slovak Republic	The Statistical office of the Slovak Republic publishes data on MSW generation and disposal since 1993. Although this creates a timeline of 15 years, this is not sufficient for the use of FOD method. A longer timeline of data is needed, thus it was decided to generate a MSW data from 1960, i.e. for 48 years. Latest indication on MSW generation in the Slovak Republic was found for 1960 and 1970. Since 1992, data from annual monitoring are available. Annual MSW generation was interpolated. [NIR 2012]
Slovenia	There are no data on the amount of waste prior to 1995. The first regulated municipal solid waste disposal site, the Ljubljana Barje SWDS, started its operation in 1964. An estimate for the period 1964 - 1994 arrived on presumption that in 1964 50% of population was included in municipal waste collection system and that this percentage have slightly increased end reach 60% in 1977 and 76% in 1995. The amount of waste in the period 1995 – 2000 is provided by the SURS (data submitted to EUROSTAT) The total annual amount of municipal waste and the fraction of landfilled municipal waste during 2001 and 2010, data of the Environmental Agency of the Republic of Slovenia, which on a regular basis collects data on the formation and handling all types of waste in Slovenia was used. [NIR 2012]

Source: NIR 2012

In the additional information box of the CRF tables, the waste generation rate is not very well defined. No clear definition is available on which waste fractions should be included for comparability; neither the UNFCCC reporting guidelines, nor the CRF, nor the IPCC Guidelines provide an exact definition which waste types and waste streams should be included in the estimation of the waste generation rate. Therefore Figure 23.3 provides an overview for EU-27 based on data derived from EUROSTAT. To conform to the Regulation on waste statistics (EC) No. 2150/2002, amended by Commission Regulation (EU) No. 849/2010, data on the generation and treatment of waste is collected from the Member States and prepared in a homogenous way.

Figure 23.3 **6A1 Managed Waste Disposal: Waste Generation Rate for EU-27**

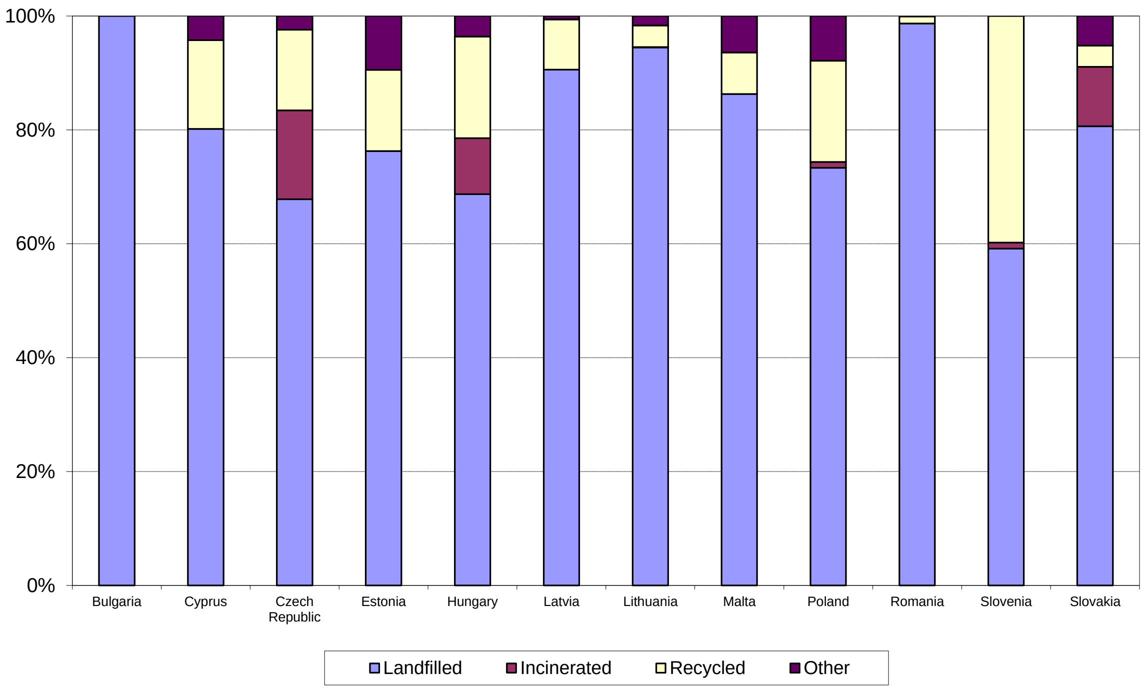


Source: EUROSTAT 2012

The waste generation rate per capita varies significantly among the new Member States (0.83 kg/capita/year for Latvia to 2.08 kg/capita/year for Cyprus).

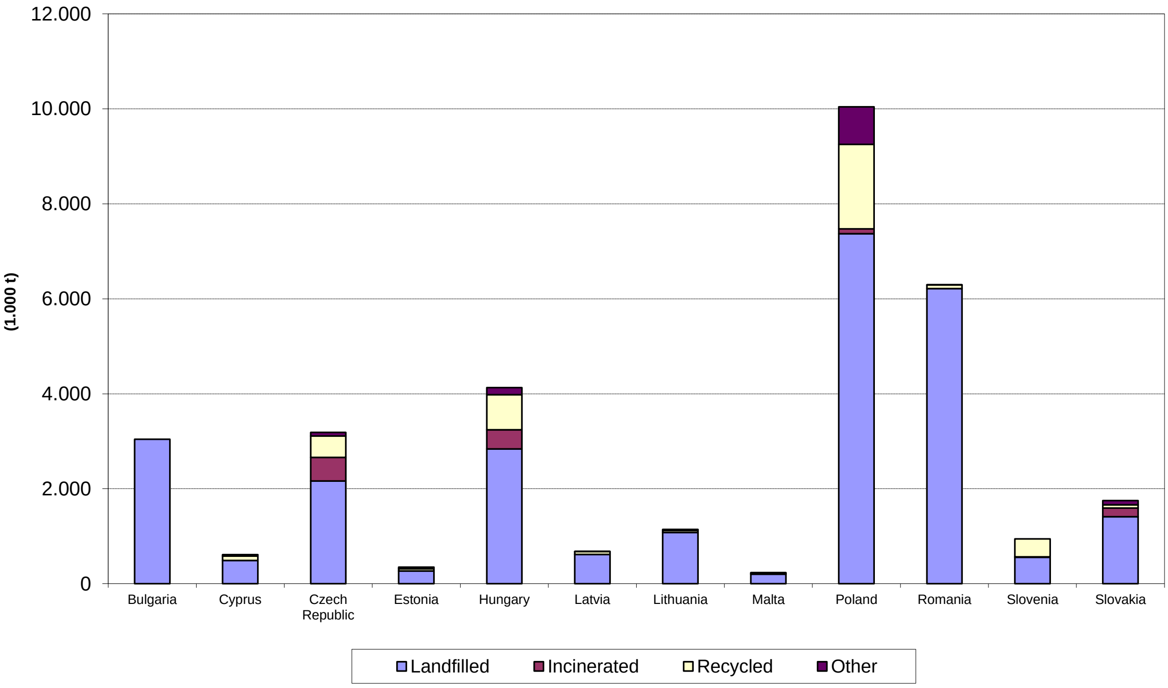
The amount of waste generated on SWDS is strongly influenced by the waste management practices or rather the share of waste incinerated, recycled and composted (Figure 23.4). Compared to the management practices in EU-15, recycling is still of minor importance in the new MS, only 12 % of municipal waste was recycled in EU-12 MS, compared to 27 % for the EU-15. The recycling rate of waste is highest in Slovenia (40 % of treated waste) and thus higher than the average rate for EU-27 (25 %). Figure 23.5 shows absolute values for waste management practices.

Figure 23.4 **6A1 Managed Waste Disposal: Waste management practices for the new EU-12 MS (shares) in 2010**



Source: EUROSTAT 2012

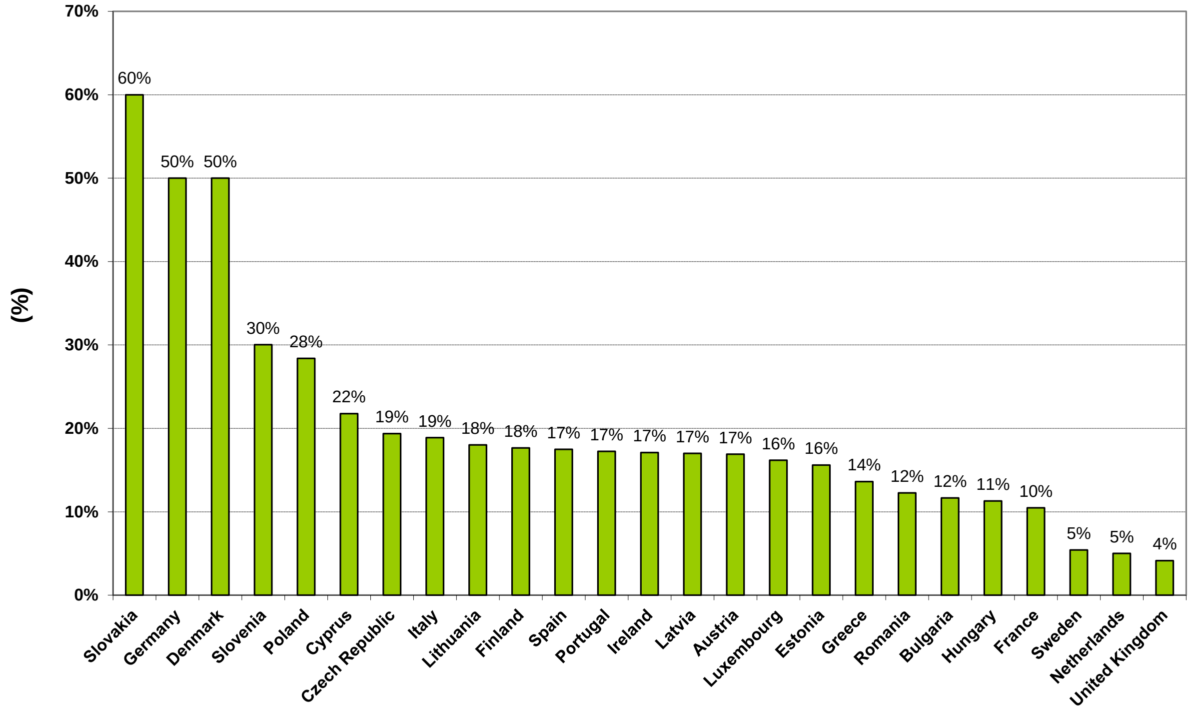
Figure 23.5 **6A1 Managed Waste Disposal: Waste management practices for the new EU-12 MS (absolute values) in 2010**



Source: EUROSTAT 2012

The amount of methane generated on SWDS depends on the Methane Correction Factor, the fraction of dissolved organic carbon (DOC) dissimilated, the fraction by volume of CH_4 in landfill gas and the waste composition, more precisely the fraction of DOC in waste. Last mentioned is likely to vary due to the strong influence of waste management practices and policies, whereas the first three parameters do not vary strongly among the Member States. The DOC content of landfill waste is based on the composition of waste and can be calculated from a weighted average of the carbon content of various components of the waste stream; different countries are known to have MSW with widely differing waste compositions. Figure 23.6 illustrates the average DOC value in MSW for EU-27.

Figure 23.6 6A1 Managed Solid Waste Disposal: Fraction of DOC in MSW for EU-27



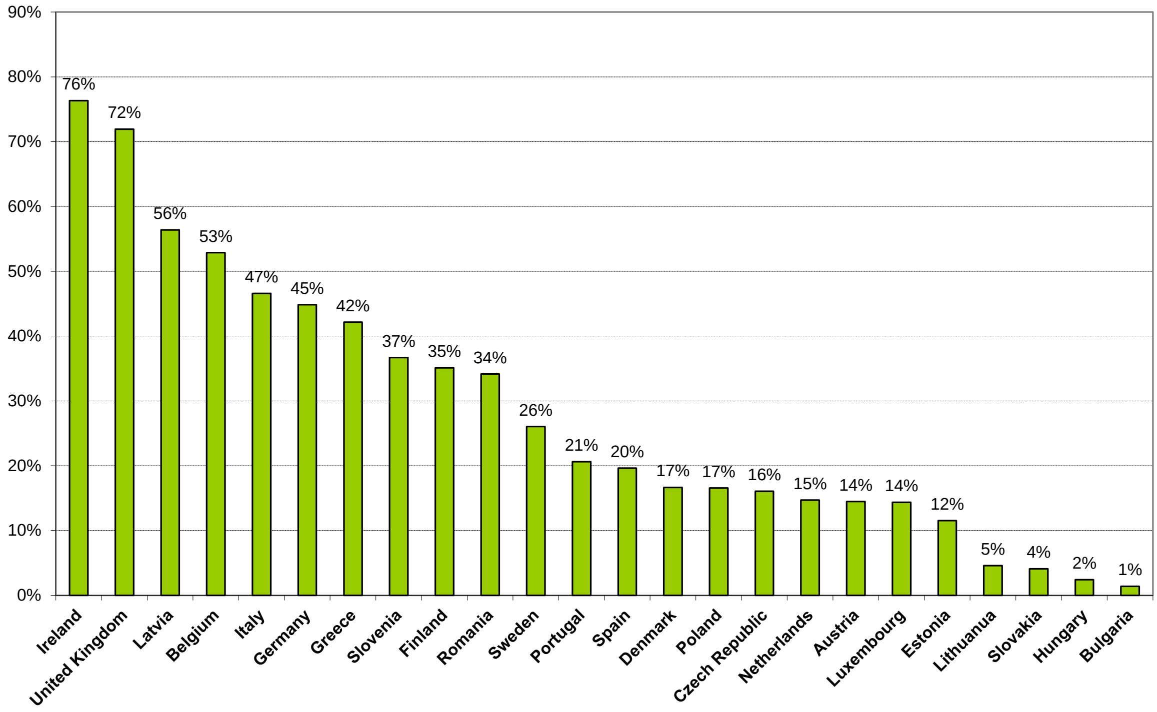
Source: CRF 2012 Table 6A,C Additional information.

Besides lower quantities of organic carbon deposited into landfills, the major determining factor for the decrease in net CH_4 emissions are increasing methane recovery rates from landfills. The recovered CH_4 is the amount of CH_4 that is captured for flaring or energy use and is a country-specific value which has significant influence on the emission level. The percentage of CH_4 recovered varies among the Member States, tending to be low in the new MS, except for Latvia, Slovenia and Romania. Compared to last year's inventory, two new MS significantly increased its recovery (Latvia: +39.2 %, Romania: +25.2 %). Romania collected data on methane recovered from landfill facilities from the operators. Eleven managed sites recovered methane for flaring.

Due changes in the activity data on methane recovery in years 2005-2009, the Czech Republic, recalculated these years, which resulted in an increase of methane recovery of about 1 % compared to last year's inventory.

Following Slovenian legislation the recovery has become obligatory on all SWDS in 2008. In the period 2005-2008 the process of adaptation of SWDS to the new legislation has been in place, resulting in a significant increase in methane recovery. Recovery in Estonia started in 1995. During 1995 and 2006 only one solid waste disposal site in Estonia collected and recovered methane (Pääsküla landfill in Tallinn). The amount of reused CH_4 changed due to the changes in the quantity of waste generation and the share of organic waste in the total amount of waste generated. In 2007 Jõelähtme solid waste disposal site started to collect methane, causing a significant increase of the amount of reused CH_4. Methane recovery was highest in 2009 because in 2009 Väätsa solid waste disposal site started to collect methane (Figure 23.7).

Figure 23.7 6A1 Managed Solid Waste Disposal: Methane recovery for EU-27



CH_4 recovery in% = CH_4recovery in Gg/ (CH_4 recovery in Gg + CH_4 emissions in Gg)*100
Source: CRF 2012 Table 6A,C

CH_4 emissions from 6A2 Unmanaged Waste Disposal on Land account for 0.36 % of total EU-27 GHG emissions in 2010. Between 1990 and 2010, CH_4 emissions from this source in the EU-15 decreased as in most new MS, except for Malta and Romania. In response to a recommendation by the ERT, Bulgaria estimated emissions from managed and unmanaged sites separately for the first time in its 2011 submission. Before 2000 year all sites are categorized as unmanaged and since 2000 the quantity of waste going to managed and unmanaged sites is calculated separately, leading to a reduced amount of waste treated in unmanaged waste disposal sites. In Lithuania, new landfills corresponding to EU requirements have been constructed and the share of waste treated in deep managed landfills increased.

Thus the overall reduction of CH_4 emissions from 6A2 Unmanaged Waste Disposal on Land for the EU-27 was lower than for EU-15 (-58 %), amounting to -33 % between 1990 and 2010 (Table 23.4). Emission reductions were highest in Cyprus and Bulgaria. In Bulgaria, this was due to the decrease in population and the increasing quantity of waste deposited on managed sites.

The share in EU-27 emissions 2010 was highest for Poland (29 %) and Bulgaria (20 %). Romania had the largest increase in absolute terms between 1990 and 2010. Table 23.4 suggests that 76 % of CH_4 emissions from 6A2 Unmanaged Waste Disposal on Land are calculated with higher tier methodologies.

Table 23.4 **6A2 Unmanaged Waste Disposal on Land: CH_4 emissions of EU-27**

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	13,775	6,113	5,776	33.7%	-337	-6%	-7,999	-58%		
Bulgaria	4,718	3,581	3,430	20.0%	-151	-4%	-1,288	-27%	T3	CS,D
Cyprus	102	97	70	0.4%	-27	-28%	-32	-31%	D	D
Czech Republic	NO	NO	NO	-	-	-	-	-	NA	NA
Estonia	NO	NO	NO	-	-	-	-	-	NA	NA
Hungary	NA,NO	NO	NO	-	-	-	-	-	NA	NA
Latvia	330	352	336	2.0%	-16	-4%	6	2%	T2	CS,D
Lithuania	276	257	233	1.4%	-23	-9%	-42	-15%	T2	D
Malta	36	97	92	0.5%	-5	-5%	56	156%	M	M
Poland	5,157	5,191	4,946	28.8%	-245	-5%	-211	-4%	OTH	D
Romania	1,275	2,254	2,267	13.2%	13	1%	991	78%	T2	D
Slovakia	NO	NO	NO	-	-	-	-	-	NA	NA
Slovenia	NO	NO	NO	-	-	-	-	-	NA	NA
EU-27	**25,669**	**17,942**	**17,151**	**100.0%**	**-791**	**-4%**	**-8,517**	**-33%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

23.2.2 Wastewater handling (CRF Source Category 6B) (EU-27)

CH_4 from 6B2 Domestic and Commercial Wastewater accounts for 0.23 % of total EU-27 GHG emissions. Between 1990 and 2010 EU-27 emissions decreased by 25 %. Large decreases in absolute terms are reported from Hungary, Poland and Romaina, only Slovenia reported an increase of emissions (35%) (Table 23.3).

Poland, Romania and Hungary are responsible for 27 % of the EU-27 emissions from this source in 2010. Emissions reductions in Poland are due to the availability of activity data only; a huge drop in emissions of 63 % between 1999 and 2000 could be found. Before and after 1999 and 2000, CH_4 emissions increased slightly. The inconsistency is a result of the application of various national data sets (based on case studies) for the following time periods 1988-1994, 1995-1999 and 2000-2008.

Between 2009 and 2010, CH_4 from 6B2 Domestic and Commercial Wastewater remained constant for the EU-27.

Table 23.5 also suggests that only one MS used higher tier methodologies to calculate CH_4 from 6B2 Domestic and Commercial Wastewater which corresponds to 2 % of total EU-12 emissions (Latvia: Tier 2).

Table 23.5 **6B2 Domestic and commercial wastewater: CH_4 emissions of EU-27**

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	9,001	6,613	6,645	60.0%	32	0%	-2,356	-26%		
Bulgaria	515	500	501	4.5%	1	0%	-14	-3%	D	D
Cyprus	7	3	3	0.0%	0	-6%	-4	-59%	D	D
Czech Republic	214	192	194	1.8%	2	1%	-20	-9%	T1,T2	CS,D
Estonia	8	1	1	0.0%	0	0%	-7	-91%	T1	D
Hungary	786	415	406	3.7%	-9	-2%	-380	-48%	D	D
Latvia	98	76	73	0.7%	-4	-5%	-25	-26%	D,T2	D
Lithuania	175	130	125	1.1%	-5	-4%	-50	-28%	T1	D
Malta	20	15	15	0.1%	0	3%	-5	-23%	D	CS
Poland	1,134	890	905	8.2%	15	2%	-230	-20%	D	CS,D
Romania	2,370	1,722	1,705	15.4%	-17	-1%	-664	-28%	D	CS
Slovakia	388	357	353	3.2%	-4	-1%	-34	-9%	T1	CS
Slovenia	107	135	144	1.3%	8	6%	37	35%	T1	CS,D
EU-27	**14,821**	**11,050**	**11,069**	**100.0%**	**20**	**0%**	**-3,752**	**-25%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

N_2O from 6B2 Domestic and Commercial wastewater accounts for 0.29 % of total EU-27 GHG emissions. Between 1990 and 2010 EU-27 emissions remained constant (Table 23.6). Four out of twelve new MS increased their emissions in that period (the Czech Republic, Malta, Poland and Romania), but these MS are responsible for only 17 % of EU-27 N_2O from 6B2 Domestic and Commercial wastewater in 2010.

Romania's emissions increased since 1990 (with few exceptions), following the trend in population connected to sewerage. The new MS contributed to keeping total emissions in EU-27 stable. Largest reductions in absolute terms could be found for Bulgaria, Slovakia and Estonia. Poland's share in EU-27 emissions in 2010 is highest among EU-12. The MS neither increased nor decreased its emissions significantly during the time series. According to Table 23.6, none of the new MS calculated N_2O emissions from Domestic and Commercial wastewater by applying higher tier methodologies.

The second largest decrease in N_2O emissions from commercial wastewater between 2009 and 2010 could be found for Estonia.

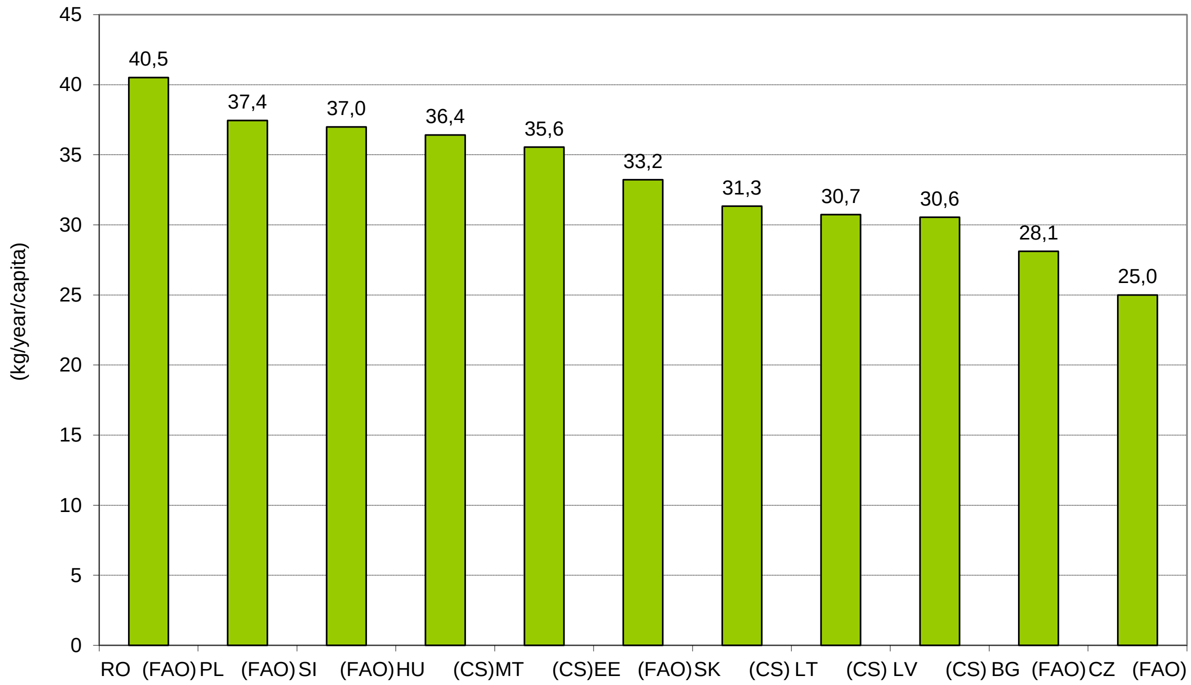
Table 23.6 6B2 Domestic and Commercial Wastewater: N_2O emissions of EU-27

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010		Method applied	Emission factor
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
EU-15	9,545	9,534	9,501	77.8%	-33	0%	-44	0%		
Bulgaria	224	166	164	1.3%	-1	-1%	-60	-27%	D	D
Cyprus	0	0	0	-	-	-	0	-	D	D
Czech Republic	162	204	205	1.7%	0	0%	43	27%	D	CS,D
Estonia	81	65	65	0.5%	-0.01	0%	-16	-20%	T1	D
Hungary	214	196	195	1.6%	0	0%	-18	-9%	D	D
Latvia	64	54	53	0.4%	-0.53	-1%	-10	-16%	D	D
Lithuania	80	79	80	0.7%	0.53	1%	0	0%	T1	D
Malta	10	11	12	0.1%	0.13	1%	2	15%	D	D
Poland	1,096	1,114	1,115	9.1%	0.95	0%	19	2%	D	D
Romania	601	678	678	5.6%	0	0%	77	13%	D	D
Slovakia	119	78	78	0.6%	0	0%	-41	-34%	T1	D
Slovenia	60	59	59	0.5%	0.09	0%	0	-1%	T1	D
EU-27	**12,255**	**12,238**	**12,206**	**100.0%**	**-33**	**0%**	**-49**	**0%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

Emissions are mainly driven by the annual per capita protein consumption, being one relevant component for the calculation of nitrous oxide emissions from household wastewater according to the IPCC method. For annual per capita protein consumption country-specific values are used by five new MS; an overview of the values is given in Figure 23.8.

Figure 23.8 6B Waste Water Handling: Protein consumption



Source: CRF 2012, Table 6 B; NIR 2012
CS= Country-specific value; FAO = FAO data basis

CS MT: Bellizzi et al. 1993; CS SK: Statistical Office of the Slovak Republic; CS LV: Latvian State Institute of Agrarian Economy; CS LT: Nutrition Centre under the Ministry of Health.

23.2.3 Waste incineration (CRF Source Category 6C) (EU-27)

This category includes incineration of waste, not including waste-to-energy facilities. Emissions from waste burnt for energy are reported under 1A Fuel combustion activities. Emissions from burning of agricultural wastes should be reported under 4 Agriculture. Table 23.7 summarizes greenhouse gas emission trends by Member State. CO_2 emissions from waste incineration account for 0.06 % of total EU-27 GHG emissions.

Between 1990 and 2010, CO_2 emissions from waste incineration decreased by 39 % in the EU-27. The Czech Republic, Malta and Slovenia increased their CO_2 emissions from waste incineration between 1990 and 2010. The largest increase in absolute terms could be found for the Czech Republic contributing the second most to EU-12 emissions (6.7 % of EU-27 emissions in 2010). This increase could be explained by the increased amount of municipal solid waste being incinerated (+676 % between 1990 and 2010). Consequently the share of waste going to waste incineration increased from 0 % (1995) to 16 % in 2010 (compare Figure 23.4).

Between 1990 and 2010, Poland and Slovakia had the largest decreases in absolute terms. Poland, has the largest share in EU-12 emissions, see Table 23.7. In Slovakia, the reduction in emissions was caused by the decrease of the number of incineration plants due to the expiration of transition period for selected incinerators in 2006, as defined in the EU accession agreement.

Table 23.7 6C Waste incineration: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2010	Change 2009-2010		Change 1990-2010	
	1990	2009	2010		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
EU-15	3,884	2,207	2,147	79.5%	-60	-3%	-1,737	-45%
Bulgaria	20	34	14	0.5%	-20	-58%	-6	-30%
Cyprus	NA	NA	NA	-	-	-	-	-
Czech Republic	23	199	180	6.7%	-19	-10%	157	676%
Estonia	NA	NA	NA	-	-	-	-	-
Hungary	NA	68	84	3.1%	16	24%	84	-
Latvia	NO	0	0	0.0%	0	0%	0	-
Lithuania	4	1	2	0.1%	1	200%	-2	-52%
Malta	0.37	0.47	0.52	0.0%	0	10%	0	40%
Poland	447	231	222	8.2%	-9	-4%	-225	-50%
Romania	NE,NO	8	8	0.3%	1	7%	8	-
Slovakia	63	5	37	1.4%	32	636%	-26	-41%
Slovenia	1	4	5	0.2%	1	18%	4	291%
EU-27	**4,442**	**2,758**	**2,700**	**100.0%**	**-57**	**-2%**	**-1,742**	**-39%**

Abbreviations explained in the Chapter 'Units and abbreviations'

24 Other (CRF Sector 7)

The 2010 GHG inventory does not include any GHG emissions in CRF sector 7.

25 Recalculations and improvements

25.1 Explanations and justifications for recalculations

Table 25.1 to Table 25.2 provide an overview of the main reasons for recalculating emissions in the year 1990 and 2009 for each Member State, which provided the relevant information, and by source categories, for the largest recalculations (>+/- 500 Gg). For more details see the information provided by the Member States' submissions in Annex 2.12.

Table 25.1 Main recalculations by source category for 1990 and Member States' explanations for recalculations given in the CRF or in the NIR

		1990		Main explanations
		Gg CO_2 equiv.	Percent	
1A2_Manufacturing Industries and Construction CO_2	Romania	33,558	105.0	- Tier 2 instead of Tier 1 estimation method was used based on a relevant study developed on 2011. - New Emission Factors determined by Study on EU-ETS reporting. - EUROSTAT instead of domestic version of the Romanian Energy Balance was used.
1A1_Energy Industries CO_2	Poland	6,368	2.8	Activity data corrected due to statistical data update
1A3_Transport CO_2	Romania	4,293	56.1	Change in methods; more use of country-specific emission factors, use of Eurostat activity data
4A_Enteric fermentation CH_4	Romania	4,266	41.2	- Tier 2 calculation methods were used for all livestock for estimating CH_4 emissions - National emission factors began to be used - More disaggregated livestock data, in the format the NIS uses to report them to Eurostat, began to be used
1A4_Other sectors CO_2	Romania	3,277	29.7	- Tier 2 instead of Tier 1 estimation method was used based on a relevant study developed on 2011. - New Emission Factors determined by Study on EU-ETS reporting. - EUROSTAT instead of domestic version of the Romanian Energy Balance was used.
4B_Manure management CH_4	Bulgaria	2,722	123.6	The full time series is recalculated due to the newly determined emission factors. The reasons for recalculations are changes in AWMS distribution and nitrogen excretion for cattle and swine.
2C_Metal production CO_2	Hungary	2,659	483.8	Review of activity data in 2.C.1.1. Reallocation from 1.A.2.a to 2.C.1.4.
1A5_Other CO_2	Romania	2,501	100.0	Tier 2 instead of Tier 1 estimation method was used based on a relevant study developed on 2011. New Emission Factors determined by Study on EU-ETS reporting. EUROSTAT instead of domestic version of the Romanian Energy Balance was used.
6B_Waste water handling CH_4	Romania	2,299	644.9	- Recalculations are due to the changes of EFs (WSix, MCFx for industrial and domestic/commercial wastewater and SSjy, MCFy for domestic/commercial sludge) and Ddom with country specific values provided by the study finished in 2011. - There are a few changes at the Activity Data level due to considering exclusively of the AD from beer, pulp and paper and petroleum refining industries for estimates CH_4 emissions from industrial wastewater.
1B2_Oil and natural gas CO_2	Romania	1,166	2,446.7	Tier 1 2000 IPCC GPG and 2006 IPCC GL EFs began to be used
4B_Manure management N_2O	Czech Republic	1,008	144.1	Solid storage and dry lot: Revised Nex values for cattle. More accurate animal population data and updated country-specific data (manure type distribution)
6B_Waste water handling CH_4	Bulgaria	803	47.6	Recalculations for whole time series was made for sub sector waste water, based on new detailed country specific data, achieved by planned project for completed the CS EF.
2C_Metal production CO_2	Poland	788	10.7	Data corrected due to update in statistical data on coke production
1A1_Energy Industries CO_2	Slovakia	711	4.4	Recalculations w ere based on new energy balance, w here the corrections w ere made in carbon balance in ref ineries, chemical industry and iron and steel industry. The energy balance was harmonised w ith statistical information. New aggregation of fuels into fuel's groups was introduced. New estimation of country specific EF for CO_2 (reflecting oxidation factors) and default EF for non-CO_2 emissions w as provided.
4D_Agricultural soils N_2O	Bulgaria	-500	-5.6	The parameters of manure processing were slightly modified in compliance with the IPCC Guidelines.
4D_Agricultural soils N_2O	Czech Republic	-554	-5.9	Tier 1; Revised Nex value for cattle; Updated country-specific activity data; Reallocation of emissions
6B_Waste water handling CH_4	Lithuania	-600	-77.5	Sewage sludge excluded from wastewater and included in solid waste disposal on land category
1B2_Oil and natural gas CH_4	Estonia	-610	-77.1	CH_4 EF from natural gas distribution 1B2B4 revised; CH_4 emissions from 1B2B5 removed

		1990		Main explanations
		Gg CO_2 equiv.	Percent	
4A_Enteric fermentation CH_4	Czech Republic	-650	-13.4	Tier 1, 2; EF changed due to reallocation; Updated country-specific activity data; Reallocation of emissions; More accurate milk production and animal population data
6A_Solid waste disposal on land CH_4	Romania	-1,118	-46.7	- It was recalculated CH_4 emissions from MSW disposed to Unmanaged deep and shallow Waste Disposal Sites using T2 method - Recalculation is based on change of AD regarding amounts of MSW disposed to Managed and Unmanaged Waste Disposal Sites and Methane recovery, through study finished in 2011.
2C_Metal production CO_2	Slovakia	-1,272	-22.0	2C2: The plant specific emission factors were calculated since 2002 (on the basis of carbon balance) and because of the time series consistency, the Overlap method described in Chapter 7 of 2000 Good Practice Guidance was adopted and new emissions factors were calculated for the time period 1990 – 2001. 2C3: Correction of the content of carbon in anodes, corrected by operator since 2006.
4B_Manure management N_2O	Romania	-1,472	-53.5	More disaggregated livestock data, in the format the National Institute for Statistics uses to report them to Eurostat, began to be used."National values for the Nitrogen excretion per head of animal per region (Nex) and for percentages of manure N produced in different Animal Waste Management Systems (MS) began to be used for calculating the N_2O emissions
2C_Metal production CO_2	Romania	-1,562	-14.4	2C1.2 The recalculations have been made due to finding an error in the formula used for calculating emissions in pig iron production.
1A2_Manufacturing Industries and Construction CO_2	Slovakia	-1,619	-8.2	Recalculations w ere based on new energy balance, w here the corrections w ere made in carbon balance in ref ineries, chemical industry and iron and steel industry. The energy balance was harmonised w ith statistical information. New aggregation of fuels into fuel's groups was introduced. New estimation of country specific EF for CO_2 (reflecting oxidation factors) and default EF for non-CO_2 emissions w as provided.
1A2_Manufacturing Industries and Construction CO_2	Hungary	-2,489	-17.5	Reallocation from 1.A.2.a to 2.C.1.4.
4B_Manure management CH_4	Romania	-2,639	-69.6	More disaggregated livestock data, in the format the National Institute for Statistics uses to report them to Eurostat, began to be used."National values for the Nitrogen excretion per head of animal per region (Nex) and for percentages of manure N produced in different Animal Waste Management Systems (MS) began to be used for calculating the N_2O emissions
1A3_Transport CO_2	Poland	-3,382	-13.6	2C1.2 The recalculations have been made due to finding an error in the formula used for calculating emissions in pig iron production.
1B2_Oil and natural gas CH_4	Romania	-3,654	-17.1	- Tier 2 calculation methods were used for all livestock for estimating CH_4 emissions - National emission factors began to be used for calculating the CH_4 emissions - More disaggregated livestock data, in the format the NIS uses to report them to Eurostat, began to be used.
4D_Agricultural soils N_2O	Romania	-11,246	-43.4	Activity data corrected due to statistical data update
1A1_Energy Industries CO_2	Romania	-26,793	-27.4	- Change Tier 1 method: 2006 IPCC GL Volume 2, Chapter 4, Methodology began to be used - Tier 1 2000 IPCC GPG and 2006 IPCC GL EFs began to be used

Table 25.2 Main recalculations by source category for 2009 and Member States' explanations for recalculations given in the CRF or in the NIR

		2009		Main explanations
		Gg CO_2 equiv.	Percent	
1A2_Manufacturing Industries and Construction CO_2	Czech Republic	7,427	47.6	AD recalculation 1995 -2009, 1990 - 1994 disaggregation of sum values
1A2_Manufacturing Industries and Construction CO_2	Romania	5,229	44.1	- Tier 2 instead of Tier 1 estimation method was used based on a relevant study developed on 2011. - New Emission Factors determined by Study on EU-ETS reporting. - EUROSTAT instead of domestic version of the Romanian Energy Balance was used.
2F_Consumption of halocarbons HFC	Poland	3,471	88.3	Data corrected due to availibility of new data on HFC 134a
1A2_Manufacturing Industries and Construction CO_2	Slovakia	3,208	50.8	Recalculations w ere based on new energy balance, w here the corrections w ere made in carbon balance in ref ineries, chemical industry and iron and steel industry. The energy balance was harmonised w ith statistical information. New aggregation of fuels into fuel's groups was introduced. New estimation of country specific EF for CO_2 (reflecting oxidation factors) and default EF for non-CO_2 emissions w as provided.
4A_Enteric fermentation CH_4	Romania	2,425	39.4	- Tier 2 calculation methods were used for all livestock for estimating CH_4 emissions - National emission factors began to be used - More disaggregated livestock data, in the format the NIS uses to report them to Eurostat, began to be used
1A3_Transport CO_2	Poland	1,868	4.3	Activity data corrected due to statistical data update
2C_Metal production CO_2	Hungary	1,717	951.7	Review of activity data in 2.C.1.1. Reallocation from 1.A.2.a to 2.C.1.4.
1A4_Other sectors CO_2	Poland	1,185	2.4	Activity data corrected due to statistical data update
6B_Waste water handling CH_4	Romania	1,180	132.4	- Recalculations are due to the changes of EFs (WSix, MCFx for industrial and domestic/commercial wastewater and SSjy, MCFy for domestic/commercial sludge) and Ddom with country specific values provided by the study finished in 2011. - There are a few changes at the Activity Data level due to considering exclusively of the AD from beer, pulp and paper and petroleum refining industries for estimates CH_4 emissions from industrial wastewater.
1A3_Transport CO_2	Romania	739	5.1	Change in methods; more use of country-specific emission factors, use of Eurostat activity data
6B_Waste water handling CH_4	Cyprus	729	1,590.8	Proportion of waste treated by anaerobic treatment revised
2F_Consumption of halocarbons HFC	Romania	678	2,698.6	2F - The revisions of estimate emissions have been done using the approach based on the cluster method. The next data were considered related with 1995-2009 period: total actual HFC emissions, total GDP, HFC emissions as a fraction of GDP. The GDP is used as the only driver.
1B2_Oil and natural gas CO_2	Romania	657	2,564.8	- Change Tier 1 method: 2006 IPCC GL Volume 2, Chapter 4, Methodology began to be used - Tier 1 2000 IPCC GPG and 2006 IPCC GL EFs began to be used - Activity data from the Energy balance as it is sent by NIS to Eurostat began to be used
6A_Solid waste disposal on land CH_4	Cyprus	574	100.4	6A1: - new data available from the Ministry of Interior monitoring the waste going to disposal sites - DOC assimilated changed from 0.6 to 0.77; DOC changed from 23.2 to 22.6 6A2.2: - In previous submissions, the data going to the disposal sites was kept constant for years for which data is not available (1990-1995); in this submission, the trend is used according to the information that is available after 1995 - DOC assimilated changed from 0.6 to 0.77
1A1_Energy Industries CO_2	Poland	-524	-0.3	Activity data corrected due to statistical data update

		2009		Main explanations
		Gg CO_2 equiv.	Percent	
2C_Metal production CO_2	Poland	-533	-9.0	Data corrected due to update in statistical data on coke production
1A2_Manufacturing Industries and Construction CO_2	Poland	-555	-1.8	Activity data corrected due to statistical data update
4B_Manure management N_2O	Romania	-652	-41.8	More disaggregated livestock data, in the format the National Institute for Statistics uses to report them to Eurostat, began to be used."National values for the Nitrogen excretion per head of animal per region (Nex) and for percentages of manure N produced in different Animal Waste Management Systems (MS) began to be used for calculating the N_2O emissions
1B1_Solid Fuels CH_4	Bulgaria	-671	-49.5	Recalculations are mainly related to new AD for coal and due to revision of the EFs for Oil and Natural gas. In coal mining: Due to different methods of reporting the AD for coals to National statistic institute, NIR 2011 had huge overestimation. For NIR 2012 the AD for Coal is updated and checked by experts of National statistic institute and now they are more reliable. There are no changes of the EF, all changes are related to the new AD. All changes will be explained in full version of NIR 2012.
1B1_Solid Fuels CH_4	Czech Republic	-811	-20.2	Update of emission factor
1B2_Oil and natural gas CH_4	Romania	-866	-10.7	Tier 1 2000 IPCC GPG and 2006 IPCC GL EFs began to be used
2C_Metal production CO_2	Slovakia	-1,159	-24.5	2C2: The plant specific emission factors were calculated since 2002 (on the basis of carbon balance) and because of the time series consistency, the Overlap method described in Chapter 7 of 2000 Good Practice Guidance was adopted and new emissions factors were calculated for the time period 1990 – 2001. 2C3: Correction of the content of carbon in anodes, corrected by operator since 2006.
1A1_Energy Industries CO_2	Slovakia	-1,193	-12.2	Recalculation of Industrial Solid Waste Incineration with energy recovery under Other Fuels. Correction of activity data.
2B_Chemical industries N_2O	Lithuania	-1,367	-67.5	Emission for 2009 have been recalcualted using average of emission factors, monitored after the catalyst installation.
4B_Manure management CH_4	Romania	-1,496	-74.4	- Tier 2 calculation methods were used for all livestock for estimating CH_4 emissions - National emission factors began to be used for calculating the CH_4 emissions - More disaggregated livestock data, in the format the NIS uses to report them to Eurostat, began to be used.
1B1_Solid Fuels CH_4	Romania	-1,510	0.0	- Change Tier 1 method: 2006 IPCC GL Volume 2, Chapter 4, Methodology began to be used - Tier 1 2006 IPCC GHG EFs for CH_4 began to be used - Activity data from the Energy balance as it is sent by NIS to Eurostat began to be used
1A2_Manufacturing Industries and Construction CO_2	Hungary	-1,700	-31.4	Reallocation from 1.A.2.a to 2.C.1.4.
6A_Solid waste disposal on land CH_4	Romania	-2,733	-49.2	- It was recalculated CH_4 emissions from MSW disposed to Unmanaged deep and shallow Waste Disposal Sites using T2 method - Recalculation is based on change of AD regarding amounts of MSW disposed to Managed and Unmanaged Waste Disposal Sites and Methane recovery, through study finished in 2011.
1A1_Energy Industries CO_2	Romania	-3,395	-8.7	- Tier 2 instead of Tier 1 estimation method was used based on a relevant study developed on 2011. - New Emission Factors determined by Study on EU-ETS reporting. - EUROSTAT instead of domestic version of the Romanian Energy Balance was used.
1A1_Energy Industries CO_2	Czech Republic	-5,224	-8.9	AD recalculation 1995 -2009

		2009		Main explanations
		Gg CO_2 equiv.	Percent	
4D_Agricultural soils N_2O	Romania	-7,471	-48.3	Tier 1b calculation method began to be used - More disaggregated livestock data, in the format the National Institute for Statistics uses to report them to Eurostat, began to be used. National values for the - Nitrogen excretion per head of animal per region (Nex) and for percentages of manure N produced in different Animal Waste Management Systems (MS) began to be used for calculating the N_2O emissions. A combination of national and default values for the fractions associated with the manure in the context of using a Tier 1b method was used. New information/data on crop productions were considered. New data/information on annual cultivated organic soils areas have been provided through a dedicated study; the recalculation is relevant.

25.2 Implications for emission levels

In the EU-27, 1990 GHG emissions excluding LULUCF have decreased by -5663 Gg (-0,1 %). For 2009, they decreased by -4646 Gg (-0,1 %) (Table 25.3).

Table 25.3 Overview of recalculations of EU-27 total GHG emissions (difference between latest submission and previous submission in Gg CO_2 equivalents)

	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Total CO_2 equivalent emissions including LULUCF (absolute)	52,926	54,059	64,302	58,253	65,098	87,641	83,044	80,156	85,114	89,721	92,347	85,724
Total CO_2 equivalent emissions including LULUCF (percent)	1.0%	1.1%	1.4%	1.2%	1.4%	1.8%	1.7%	1.7%	1.8%	1.9%	2.0%	2.0%
Total CO_2 equivalent emissions excluding LULUCF (absolute)	-5,663	-19,338	-7,685	-13,871	-18,863	-5,125	-3,275	-40	3,401	7,648	5,334	-4,646
Total CO_2 equivalent emissions excluding LULUCF (percent)	-0.1%	-0.4%	-0.2%	-0.3%	-0.4%	-0.1%	-0.1%	0.0%	0.1%	0.2%	0.1%	-0.1%

Table 25.4 and Table 25.5 give an overview of absolute and percentage changes of new Member States' emissions due to recalculations for 1990 and 2009. Large recalculations in absolute terms were made in Poland and Romania. Recalculations in relative terms of more than 2 % were made in Bulgaria, Cyprus, Slovakia, Estonia, Latvia, Lithuania and Romania.

Table 25.4 Contribution of Member States to EU-27 recalculations of total GHG emissions without LULUCF for 1990–2009 (difference between latest submission and previous submission Gg of CO_2 equivalents)

	1990	1995	2000	2005	2006	2007	2008	2009
EU-15	-15,567	-6,190	-526	2,688	5,009	3,602	1,064	-4,560
Bulgaria	2,896	721	-452	-748	-894	-855	-425	-598
Cyprus	1,195	3,333	996	1,491	1,790	1,564	1,223	1,702
Czech Republic	299	-3,290	-1,645	1,615	2,412	1,793	2,532	1,797
Estonia	-196	-56	-591	-600	-711	-474	-366	-446
Hungary	486	639	567	-9	-68	171	196	137
Latvia	-21	-97	-78	-170	-175	-173	-194	239
Lithuania	-126	95	197	309	-104	297	297	-1,649
Malta	-29	-24	-12	100	54	78	85	150
Poland	4,503	-7,756	-4,683	900	2,395	6,436	5,614	5,110
Romania	3,247	-6,628	-1,597	-6,849	-7,612	-5,970	-6,750	-7,446
Slovakia	-2,336	-90	136	1,126	1,176	1,034	1,912	787
Slovenia	-12	7	2	107	128	145	145	130
EU-27	**-5,663**	**-19,338**	**-7,685**	**-40**	**3,401**	**7,648**	**5,334**	**-4,646**

Table 25.5 Contribution of Member States to EU-27 recalculations of total GHG emissions without LULUCF for 1990–2009 (difference between latest submission and previous submission in percentage)

	1990	1995	2000	2005	2006	2007	2008	2009
EU-15	-0.4	-0.1	0.0	0.1	0.1	0.1	0.0	-0.1
Bulgaria	2.6	0.9	-0.7	-11	-13	-12	-0.6	-10
Cyprus	22.7	50.0	10.9	15.5	18.4	15.9	12.0	18.1
Czech Republic	0.2	-2.1	-11	11	17	12	18	14
Estonia	-0.5	-0.3	-3.3	-3.1	-3.8	-2.2	-18	-2.6
Hungary	0.5	0.8	0.7	0.0	-0.1	0.2	0.3	0.2
Latvia	-0.1	-0.8	-0.8	-15	-15	-14	-16	2.2
Lithuania	-0.3	0.4	10	14	-0.4	12	12	-7.6
Malta	-14	-10	-0.4	3.4	18	2.6	2.8	5.2
Poland	10	-18	-12	0.2	0.6	16	14	14
Romania	13	-3.5	-11	-4.4	-4.7	-3.8	-4.4	-5.7
Slovakia	-3.2	-0.2	0.3	2.2	2.4	2.2	4.0	18
Slovenia	-0.1	0.0	0.0	0.5	0.6	0.7	0.7	0.7
EU-27	**-0.1**	**-0.4**	**-0.2**	**0.0**	**0.1**	**0.2**	**0.1**	**-0.1**

25.3 Implications for emission trends, including time series consistency

As the recalculations were made for across all years in a similar order of magnitude, the trend was not affected by the recalculations. In the EU-27, the trend of GHG excluding LULUCF between 1990 and 2009 was – 17,4 % in the previous submission and -17,4 % in the latest submission (Figure 25.1).

Figure 25.1 Comparison of EU-27 GHG emission trends 1990–2009 (excl. LULUCF) of the latest and the previous submission

25.4 Recalculations, including in response to the review process, and planned improvements to the inventory

25.4.1 EU response to UNFCCC review

The EU-27 inventory has not been reviewed.

25.4.2 Member States' responses to UNFCCC review

Since the improvement of the EU inventory depends on Member States' efforts regarding completeness of estimation and improvement of methods and parameters used, Table 25.6 provides an overview of Member States' responses to the UNFCCC review (46). The table shows that a considerable amount of improvements were made compared since the previous submissions of Member States. In addition to the response to the UNFCCC review, a large number of additional improvements were implemented by Member States. However, an aggregation of all improvements conducted in all Member States would be too much information and too detailed to be included in this report.

Table 25.6 Improvements made by new Member States in response to the UNFCCC review

Member State	Cross-cutting issues as identified by the review team	Improvements in response to UNFCCC review as indicated in the NIR
Bulgaria	The ERT identified the following cross-cutting issues for improvement: (a) Addressing recommendations from the previous expert review in relation to transparency, accuracy, completeness, consistency and comparability of its annual submission;	In General: TACCC is improved per sector.
	(b) Transparency in relation to improved documentation of category-level methodologies, AD, EFs and other parameters used to estimate emissions, references to sources of AD and the rationale for selecting a methodology;	In General: Revision of the activity data per sector and use of the entire time series by using statistical and plant specific data. Default emission factors from the Revised 1996 IPCC Guidelines are used Improvements with regard to transparency, documentation and archiving of all information required in NIR, Background documentation and archive. [NIR, April 2012, written under subchapters of source specific recalculation]
	(c) Transparency in relation to the use of EU ETS data in the inventory and information demonstrating how its use is in line with the IPCC good practice guidance;	"Update of the National QA/QC Plan due to the newly implemented institutional, legal and procedural arrangements within the BGNIS. A new System for sector experts workflow organization, documentation and archiving has been implemented in the ExEA. Intensive cross-check with ETS, EPRTR, IPPC permits was undertaken. The relevant data was incorporated into the GHG inventory. " [NIR, April 2012, Implementation Action Plan, p. 427]
	(d) Transparency in relation to providing information that demonstrates that the use of an EF from the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (hereinafter referred	In General: Revision of the activity data per sector and use of the entire time series by using statistical and plant specific data. Default emission factors from the Revised 1996 IPCC

(46) Issues related to the NIR are not included in this table as already addressed in Table 1.11.

Member State	Cross-cutting issues as identified by the review team	Improvements in response to UNFCCC review as indicated in the NIR
	to as the 2006 IPCC Guidelines) instead of a corresponding EF from the Revised 1996 IPCC Guidelines and/or the IPCC good practice guidance better suits national circumstances;	Guidelines are used Improvements with regard to transparency, documentation and archiving of all information required in NIR, Background documentation and archive. [NIR, April 2012, written under subchapters of source specific recalculation]
	(e) Accuracy in relation to reporting the uncertainty analysis in line with the requirements of the UNFCCC reporting guidelines, the IPCC good practice guidance and the IPCC good practice guidance for LULUCF, including reporting of uncertainty estimates for KP-LULUCF;	" See Chapter 7.9 BG NIR 2011" " [NIR, April 2012, Implementation Action Plan, p. 434]
	(f) Exploring higher-tier methods for key categories;	Not yet addressed.
	(g) Consistency in relation to the inventory time series of some emission estimates (e.g. F-gases);	"Contract with external consultants Denkstatt For the NIR 2010 a complete new and changed estimation was carried out for CRF 2.F (F-gases) (complete time series). Incorporated results from completed Project 4 "F-gases" (CRF tables and NIR) Improved documentation and archiving of the inventory, including work sheets Adequately planned and implemented in 2010." [NIR, April 2012, Implementation Action Plan, p. 431]
	(h) Consistency in relation to addressing discrepancies between the NIR and CRF tables, including expanding QA/QC procedures to include explicit provisions for this activity;	"Most of the ERT recommendations are implemented in the preliminary 2011 GHGs inventory." [NIR, April 2012, Implementation Action Plan, p. 430]
	(i) Comparability in relation to ensuring that the allocation of emissions is in line with the Revised 1996 IPCC Guidelines and/or the IPCC good practice guidance (e.g. for limestone and dolomite use and soda ash use);	"Recalculated emissions based on revised AD in accordance with plant specific data submitted under EPRTR and ETS for productions of CRF 2.B.1 Ammonia, CRF 2.B.2, Nitric acid, CRF 2.A.1Cement, CRF 2.C.1 Iron and steel, 2.A.7 Glass and Bricks. Sector specific QA/QC procedures were implemented in 2010 submission. QA procedures have been performed by the Sector expert in the MoEW (Order № RD-218/05.03.2010 by the Minister of Environment and Water). Improved documentation and archiving of the inventory, including work sheets." [NIR, April 2012, Implementation Action Plan, p. 430]
	(j) Definition of the role and responsibilities of the many 'actors' in the QA/QC system, and to consider the outcomes of the key category analysis, uncertainty analysis and QA/QC procedures in the revision of the inventory improvement plan. (**FCCC/ARR/2010/BGR, para 60)**	"Update of the National QA/QC Plan due to the newly implemented institutional, legal and procedural arrangements within the BGNIS A new System for sector experts workflow organization, documentation and archiving has been implemented in the ExEA Intensive cross-check with ETS, EPRTR, IPPC permits was undertaken. The relevant data was incorporated into the GHG inventory." [NIR, April 2012, Implementation Action Plan, p. 427]
Cyprus	Not reviewed.	
Czech Republic	The ERT identifies the following cross-cutting issues for improvement: (a) The maintenance and enhancement of the capacity of the national system, in particular through: (i) The improved coordination of QA/QC procedures; and the updating and full implementation of the QA/QC plan, including the provision of enhanced documentation on the sectoral QA/QC procedures in the energy,	"Within the UNFCCC Review recommendations (v6) it is written that during the review, the Czech Republic explained that those improvements are included in its inventory improvement plan. Work on an updated QA/QC plan has been completed (see Chapter 1); the improvement plan, which includes also gradual implementation of higher Tiers, is presented in this chapter, together with an overview of the main improvements implemented so far in comparison with the 2011 submission." [NIR 2012, p. 268]

Member State	Cross-cutting issues as identified by the review team	Improvements in response to UNFCCC review as indicated in the NIR
	industrial processes and waste sectors;	
	(ii) The allocation of resources for the application of higher-tier methods for the key categories in all sectors;	See comment above.
	(iii) Ensuring the transition of expertise and the provision of training for newly appointed experts in the industrial processes sector;	Not mentioned in the NIR.
	(iv) The improvement of the archiving system by assembling all relevant information together in a centralized location;	"…Due to financial limitations and employment difficulties, development of the new archiving system has been delayed. However, during the improvement plan generation period in 2011 a new archiving scheme emerged. Full implementation is planned after April 2012 (the end of submission period)." [NIR 2012, p. 24]
	(v) The maintenance of an improvement plan prioritized by the key category and uncertainty analyses, and reviewed and managed through the coordination meetings of the national inventory system;	"Development of Improvement plan focused on gradual implementation of higher tiers methods." [NIR 2012, Tab. 10-9].
	(b) The improvement of the completeness of the inventory submission by completing CRF table 8(b);	"Information on recalculation provided not only in NIR, but also in CRF, Table 8(b)." [NIR 2012, Tab. 10-9].
	(c) The enhancement of the documentation on the expert judgement used for the uncertainty analysis; and the improvement of the quantitative uncertainty estimates for all categories. **(FCCC/ARR/2011/CZE, para 193)**	Only mentioned in the sub chapters of the sector agriculture. [NIR 2012, p. 175, 181, 187]
Estonia	The ERT identifies the following cross-cutting issues for improvement: (a) Enhance the completeness of the inventory for the LULUCF sector and the KP-LULUCF activities (see paras. 74, 111 and 115 above); Para 74: "The ERT notes that the LULUCF sector of the inventory is not complete, with emissions/removals for many subcategories and pools reported as "NE" and with an inconsistent use of notation keys for some years of the time series without clear explanation (e.g. the use of the notation keys "IE" (included elsewhere), "NO" for 1990–1994 and "IE" for 1995–2009 for the carbon stock change in dead organic matter in land converted to grassland)…." Para 111: "Estonia does not estimate emissions from biomass burning with the explanation that the AD did not allow for the separate allocation of emissions and removals to afforestation, reforestation and deforestation and other forest areas…" Para 115: "…In its submission of 17 October 2011, the Party submitted new CRF tables, where the values of the carbon stock change in organic soils	"Estonia has improved the completeness of the LULUCF estimates." [NIR 2012, Table 10.9.]

Member State	Cross-cutting issues as identified by the review team	Improvements in response to UNFCCC review as indicated in the NIR
	were corrected. The ERT recommends that the Party provide the description of the correction in its next annual submission.”	
	(b) Implement the use of the key category analysis as a driving force for setting priorities for the improvement of the quality of the inventory (see para. 16 above); Para 16: “The previous review report recommended that Estonia use the results of its key category analysis as a driving force for setting priorities for the improvement of the quality of the inventory….”	“The basis for assessment of key categories under Article 3.3 of the KP is the same as the assessment made for the UNFCCC inventory. Assessment of key categories has been revised in table NIR 3. Key categories assessment is also presented in NIR chapter 11.” [NIR 2012, Table 10.9. and Chapter 11.6.1]. “In 2012 submission, source category-specific QA of the NIR and the CRF tables using Tier 2 QC elements was carried out in key categories.” [NIR 2012, Table 10.9.]
	(c) Correct the uncertainty analysis calculation (see para. 17 above); Para 17: “…However, the results of the analysis are not presented in the main part of the NIR (chapter 1.7); only a reference to the tables contained in annex 7 to the NIR is provided….”	“1.7.1. GHG inventory The uncertainty estimates of the 2012 inventory has been done according to the Tier 1 method presented by the IPCC Good Practice Guidance 2000. The uncertainty analysis reporting table is presented in Annex 6 and detailed information about uncertainty evaluation is described in the sectoral chapters.” 1.7.2. KP-LULUCF inventory Uncertainty rates related to activity data and emission factors employed in the estimates under Article 3.3 are presented in the LULUCF greenhouse gases inventory. The method for uncertainty estimation will be further developed.” [NIR 2012, Chapter 1.7] “In 2012 submission, source category-specific QA of the NIR and the CRF tables using Tier 2 QC elements was carried out in key categories. This included also review of uncertainty estimates and available documentation. As a result, estimates have been improved in many sectors.” [NIR 2012, Table 10.9.]
	(d) Improve the transparency of the NIR for all sectors and in particular for the LULUCF sector (see para. 25 above); Para 25: “…In particular, the ERT recommends that Estonia provide clearer information on the energy sector (see paras. 34, 38, 46, 47–49 and 50–52 below), the industrial processes sector (see para. 62 below), the agriculture sector (see paras. 66, 68 and 69 below), the LULUCF sector (see paras. 75, 77, 83, 85, 89 and 91 below) and the waste sector (see paras. 98, 99, 103 and 104 below), as well as information on the activities under Article 3, paragraph 3, of the Kyoto Protocol (see paras. 107, 109 and 115 below).	“Some text have been added to the QA/QC chapter. The use of notation keys have been improved. More explanations have been added. See specific chapters.” . [NIR 2012, Table 10.9.]
	(e) Improve the QC procedures to minimize inconsistencies between the CRF tables and the NIR and in the use of notation keys and ensure the full implementation of the QA/QC plan (see paras. 35, 36, 44 and 92 above);	“Some text have been added to the QA/QC chapter. The use of notation keys have been improved.” [NIR 2012, Table 10.9.].
	(f) Provide an uncertainty analysis for the activities under Article 3, paragraph 3, of the Kyoto Protocol;	“1.7.2. KP-LULUCF inventory Uncertainty rates related to activity data and emission factors employed in the estimates under Article 3.3 are presented in the LULUCF greenhouse gases inventory. The method for uncertainty estimation will be further developed.” [NIR 2012, Chapter 1.7].

Member State	Cross-cutting issues as identified by the review team	Improvements in response to UNFCCC review as indicated in the NIR
	(g) Implement and report QA/QC procedures for the activities under Article 3, paragraph 3, of the Kyoto Protocol. **(FCCC/ARR/2011/EST, para 138)**	Is not explicitly addressed in the NIR 2012.
Hungary	The ERT identifies the following cross-cutting issues for improvement: (a) The review of the elements of the national system that would enable the timely submission of the annual submission, and the submission of the next annual submission by 15 April 2012 (see para. 6 above);	Submission was not in time.
	(b) The provision of a transparent overview of the annual inventory preparation process in the NIR of the next annual submission, including information on the responsibilities of the institutions involved in the preparation of the inventory and the provision of a timeline for the application of QA/QC procedures during the inventory preparation process (see para. 16 above);	Table with timeline and institution is presented. "The inventory cycle can be summarized with the following table based on our QA/QC plan:" [NIR, April 2012, p. 15]
	(c) The allocation of CO_2 emissions from non-energy use of fuels/feedstocks and coke as a reducing agent under the industrial processes sector in line with the IPCC good practice guidance and the UNFCCC reporting guidelines, taking into account the reporting of CO_2 emissions from combustion of secondary fuels under the relevant stationary combustion categories in the energy sector, and the inclusion of information, where relevant, on how the calculation and allocation of the CO_2 emissions was performed (see para. 61 above);	"Following the recommendations of the ERT, three main changes occurred in this source category: · Coke used as reducing agent has been removed from the energy sector and allocated to the industrial processes sector; · Emissions from coke oven gas has been added, where necessary; · We started the report emissions by non-ferrous metals separately from iron and steel. More details in chapter 10.2.2 and 10.2.3." [NIR, April 2012, p. 53]
	(d) The further improvement of the transparency of the inventory by including, where relevant, further information on the methodological tiers used, and justification and references for country-specific parameters and EFs, in particular for F-gas emissions under the industrial processes sector (see paras. 65, 66, and 67 above);	Not yet addressed.
	(e) The completion of the uncertainty analysis by including quantitative estimates for all categories, in particular for categories under the LULUCF sector;	New chapter '11.3.1.5 Uncertainty estimates' is included in the NIR, April 2012 p. 316- 323 with detailed descriptions.
	(f) The finalization of the archiving manual and reporting on the progress made thereon in the next annual submission (see para. 32 above);	Not yet addressed.
	(g) The inclusion, in annex 8 to the NIR or in the relevant section, a table describing Hungary's responses and follow-up actions to the recommendations of previous review reports. (**FCCC/ARR/2011/HUN, para 156)**	Not yet addressed.
Latvia	The ERT identifies the following cross-cutting issues for improvement: (a) Improve the use of notation keys in the CRF tables;	"7.2.7 Category-specific recalculations No recalculations were done in this category except minor updates in the notation keys." [NIR, April 2012, p. 252]
	(b) Resolve inconsistencies in the NIR and	Under the chapters source-specific QA/QC and verification

Member State	Cross-cutting issues as identified by the review team	Improvements in response to UNFCCC review as indicated in the NIR
	between the NIR and the CRF tables, as part of the implementation of the QA/QC procedures;	mentioned: "If errors or inconsistencies are found they are documented and corrected. The QC checklist is used during the inventory." [NIR, April 2012, p. 224, 230, 258, 263, 270]
	(c) Improve the use of country-specific EFs and parameters and move to higher tier methods for some categories, including energy (CH_4 emissions from oil and natural gas), industrial processes (CO_2 emissions from cement production, and HFCs and SF_6 from the production and use of fire extinguishers, consumption of halocarbons and SF_6), agriculture (CH_4 emissions from enteric fermentation, N_2O emissions from manure management, direct N_2O emissions from soils), and LULUCF (CO_2 emissions/removals from forest land remaining forest land, CO_2 emissions from cropland remaining cropland);	For agriculture: "As the milk yield is higher (according to national statistic) then ERT (2009) recommended using higher tier method for estimating emissions for dairy cattle. Latvia provided ERT with some background information available in country and therefore ERT recommended that Latvia utilize the available information to estimate the country specific EF that permit the use of a higher tier method in order to improve the accuracy of estimates. " [NIR, April 2012, p.216]
	(d) Improve transparency and provide further clarification for the methods and trends in emissions for subcategories in the following sectors: energy (road transportation: liquid fuels – CO_2 and N_2O, and stationary combustion: all fuels – CO_2, navigation: liquid fuels – CO_2, CH_4 and N_2O and civil aviation: liquid fuels – CO_2, CH_4 and N_2O); industrial processes (lime production and limestone and dolomite use – CO_2); agriculture (enteric fermentation – CH_4 , manure management – CH_4); LULUCF (cropland remaining cropland – CO_2, land converted to forest land – CO_2, grassland remaining grassland – CO_2); and waste (solid waste disposal on land – CH_4, wastewater handling – CH_4);	Details are described under chapter 10.4., Table 10.4, NIR, April 2012.
	(e) Improve the completeness and the transparency of the inventory in the LULUCF sector and for KP-LULUCF, specifically: report all mandatory categories in LULUCF and pools from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol (paying particular attention to the consistent representation of land area and changes in carbon stocks and emissions/removals from different pools);	"11.3.1.4 Changes in data and methods since the previous submission (recalculations) Two types of changes are included into this KP LULUCF reporting: updates of values, like use of the same number of decimal signs in representation of land areas in different years; correction of notation keys, setting of NE instead of NO in the land use categories, where absence of the emissions / removals are scientifically approved and where research work is initiated to obtain necessary values. Changes made to the KP LULUCF reporting are relevant to those implemented under the Convention reporting. More detailed information is available in section 7.2.7. Categoryspecific recalculations." [NIR, April 2012, p. 313]]
	(f) Implement a qualitative key category assessment; (g) Include the list of key categories for activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol and demonstrate that these key categories have been identified according to the IPCC good practice guidance for LULUCF;	"Article 3.3 Deforestation (CO_2): The associated UNFCCC subcategory CO_2 emissions from deforestation have been identified as key category. Total CO_2 emissions and removals from deforestation (Art. 3.3) is larger than the smallest UNFCCC key category. Therefore D is stated to be a key category. " [NIR, April 2012, p. 317]
	(h) Provide tier 2 uncertainty estimates;	Not yet addressed.
	(i) Conduct and report the uncertainty assessment associated with estimates of changes	"Latvia is still developing methods for estimation of emissions and removals of greenhouse gases and their

Member State	Cross-cutting issues as identified by the review team	Improvements in response to UNFCCC review as indicated in the NIR
	in carbon stocks in pools and emissions and removals from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol;	uncertainties. For that reason, the estimates presented in this submission for 2008-2009 might change for the final report of the commitment period." [NIR, April 2012, Chapter 11.3.1.6, p. 314]
	(j) Elaborate on changes in Regulation No. 157 in order to include activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, as well as QA/QC updates and other changes which improve the national system;	Not yet addressed.
	(k) Explore further steps in implementing the provisions under Article 3, paragraph 14, of the Kyoto Protocol and report on how Latvia is striving to implement its commitments under Article 3, paragraph 14, of the Kyoto Protocol;	Not yet addressed.
	(l) Enhance the reporting of changes in the national registry since the last annual submission, in accordance with section I.G of the annex to decision 15/CMP.1 by clearly stating whether each item was changed or not compared with information reported the previous year. (**FCCC/ARR/2010/LVA, para 27)**	"No significant technical, functional or documentary changes were made in Latvia's ETR during 2011." [NIR, April 2012, Chapter 14, p. 320]
Lithuania	The ERT identifies the following cross-cutting issues for improvement: (a) The transparency of reporting, particularly with regard to information on institutional arrangements; QA/QC activities implemented; the justification for recalculations; explanations of trend variations; and the rationale for selecting country specific EFs, AD and methods;	"List of improvements made in response to ERT recommendations in the 2010 individual review report is provided in the Annex VI (to be included after ARR 2011 will be received). Major changes in methodological descriptions compared to the previous year are summarized in the Table 10.1." [NIR 2012, chapter 10, p. 320].
	(b) The use of the key category analysis in setting priorities for the development and improvement of the inventory, including methodological choice and QA/QC activities, in line with the IPCC good practice guidance;	Key category analysis for KP LULUCF [see NIR 2012, chapter 1.5.2 and 11.7] and in Annex I has been prepared.
	(c) The consistency of the reporting in the NIR and the CRF tables, and for the entire time-series. (**FCCC/ARR/2011/LTU, para 203)**	"Consistency of data between NIR and CRF has been checked." [NIR 2012, chapter 8.2.4, p. 307].
	In the course of the review, the ERT formulated a number of recommendations relating to the timeliness of reporting, transparency and completeness of the information provided in the annual submission. The key recommendations are that Lithuania: (a) Improve the transparency of the information, ensure the consistency of the entire time-series, particularly in the LULUCF sector, and apply higher-tier methods and country-specific data to estimate emissions from the key categories;	"To improve transparency of the reporting in energy sector in the NIR the energy balance data for 1990, 1995 and 2000-2010 are provided in the Annex III." [NIR 2012, p.85]
	(b) Provide information on the additional spatial information available to ensure the appropriate use of the combination of approach 2 for land representation and reporting method 1;	"Information about land areas for estimating carbon stocks and emissions and removals of GHG associated with LULUCF activities is not complete. Additional collection and analysis of information available in various institutions are planned in order to avoid possible overlaps and omissions in reporting land areas." [NIR 2012, p. 287]
	(c) Implement the GHG Inventory Archive Improvement Plan and ensure that the additional efforts are made to strengthen the archiving	"In 2011 EPA prepared GHG inventory archive improvement plan which has to be implemented during the year 2012" [NIR 2012, p.43].

Member State	Cross-cutting issues as identified by the review team	Improvements in response to UNFCCC review as indicated in the NIR
	system in line with the requirements contained in the annex to decision 19/CMP.1;	
	(d) Implement the action plan to improve the reporting on the LULUCF sector and provide information on how the harmonization of data was carried out to help identify activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol since 1990;	"…in November 2011 Lithuania developed "Action plan to improve LULUCF reporting" which was approved by the ERT 2011 and endorsed by the Order of the Minister of Environment and Minister of Agriculture on Approval of Action plan to improve LULUCF reporting of Lithuania (adopted on 16-12-2011, No D1-987/3D-927)." [NIR 2012, chapter 13, p.350].
	(e) Provide, in the next NIR, information already included on the public website of the national registry related to information confidentiality and cite the regulation that supports its confidentiality;	"No change to the list of publicly available information occurred during 2011." [NIR 2012, p. 353].
	(f) Provide information on the changes related to reporting on the minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol;	Changes were not addressed in the NIR.
	(g) Improve the completeness of the inventory, particularly in the LULUCF sector;	See comment under d) Approval of the Action plan to improve LULUCF reporting by the ERT 2011.
	(h) Improve the timeliness of the reporting by making one official submission annually, by 15 April of each year, as required by decision 15/CMP.1. (**FCCC/ARR/2011/LTU, para 204)**	Submission of NIR LTU for the EU Inventory was in time.
Malta	Review report (Centralized review 2011) not yet available. 2010 not reviewed.	
Poland	The ERT identifies the following cross-cutting issues for improvement: (a) Improve the transparency of the NIR by explaining the changes and the factors contributing to the changes in the time series, the methods, the basic assumptions and the sources of EFs and parameters used;	Not yet addressed.
	(b) Include, in the NIR, category-specific uncertainty estimates, QA/QC and verification activities and further planned improvements for all sectors;	Implemented.
	(c) Develop country-specific values for EFs and parameters of key category emission estimates;	Partly implemented for agriculture and energy.
	(d) Complete the reporting of CRF table 8(b) on recalculations;	"Specific information on recalculation within CRF sectors are given in sectoral chapters 3?8 and in CRF table 8" [NIR, April 2012, p. 193]
	(e) Complete CRF table 9(a) on categories reported as "NE" and "IE";	Implemented.
	(f) Provide a key category tier 2 analysis according to the methodologies provided by the IPCC good practice guidance and the IPCC good practice guidance for LULUCF in future annual submissions;	Not yet addressed
	(g) Improve reporting of all mandatory information items on activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol so that the KP-LULUCF reporting is complete and consistent with the requirements of paragraphs 6–9 of the annex to decision 15/CMP.1.	Not yet addressed.

Member State	Cross-cutting issues as identified by the review team	Improvements in response to UNFCCC review as indicated in the NIR
	(**FCCC/ARR/2010/POL, para 30)**	
Romania	The ERT identifies the following cross-cutting issues for improvement: (a) Reviewing the elements of its national inventory system that would enable the timely submission of its inventory report, and submit its next annual submission by 15 April 2012.	Submission of NIR Romania for the EU Inventory was in time.
	(b) Continuing to ensure the functionality of the national system by allocating sufficient resources for the funding of specific medium- and long-term studies providing background data for the inventory (c) Ensuring the full implementation of the results of the ongoing studies and development plans	"The Romanian authorities in charge of the GHG emission reporting are the Ministry of Environment and Forests (MEF) and the National Environmental Protection Agency (NEPA), and thus both institutions will ensure that the studies will provide adequate information. The results of the studies will provide the necessary data for the national GHG emission inventory to fully comply with the IPCC reporting requirements. According to the specific provisions within the Romanian legislation, namely the Government Decision nr. 1635/2009, the MEF is the responsible institution with implementation of UNFCCC and KP. In addition, MEF is the coordinator of funds distribution for studies in the field of environment and forests." [NIR 2012, p.368]
	(d) Guaranteeing the proper and efficient training of new staff at NEPA	"The authority responsible with the technical verification of the results of studies is NEPA which will need to use the results in the inventory preparation and hence the interest of NEPA in participating in the process of contracting the best institution to perform the studies in a professional and timely manner." [NIR 2012, p.368]
	(e) Improving the transparency of reporting on the methodologies, assumptions and data used in the emission calculations, as well as the assumptions behind the uncertainty values and EFs (f) Continuing to improve the completeness of the inventory and applying higher-tier methods using the results of the key category analysis for the prioritization of the inventory improvements	"…in order to allow for their urgent implementation, the studies 1, 3, 4 and 5 in Table 13.1 have been grouped within the study "Elaboration and documentation of emission factors/other parameters values relevant for the NGHGI Sectors Energy, Industrial Processes, Agriculture and Waste, values which allow the implementation of higher tier calculation methods", the associated financing instrument has been changed from the Environmental Fund Administration budget to MEF budget and the budget has been supplemented; the specific pre-acquisition procedure is under implementation; …" [NIR, 2012, p. 371.372]
	(g) Ensuring the close collaboration between the external contractors, data providers and NEPA and among internal NEPA sectoral experts	"In addition, the national system will be strengthen by ensuring the proper functioning of the institutional structure and arrangements described in the existing legislation (Governmental Decision 1570/2007). In this process, MEF and NEPA have already started to analyze the functioning of the institutional arrangements and the involvement of other institutions responsible with providing information, data, methods, factors, parameters." [NIR, 2012, p.370]
	(h) Developing a sector-specific QA/QC plan and characterizing the data, EFs and parameters actually used in the sector/category estimation process so that the QA/QC procedures and verification activities may be	"The quality management from the initiation, throughout the completion of the studies themselves, and the quality assurance of the findings, will be ensured in a three step procedure." [NIR, 2012, p.369-370]

Member State	Cross-cutting issues as identified by the review team	Improvements in response to UNFCCC review as indicated in the NIR
	checked and/or implemented by experts other than the relevant sectoral ones	
	(i) Ensure consistency in methods, data and estimates between LULUCF reporting and the relevant KP-LULUCF activities. **(FCCC/ARR/2011/ROU, para 219)**	"..the LULUCF Sector relevant study is subject to the acquisition procedure …" [NIR, 2012, p. 371]
Slovakia	The ERT identifies the following cross-cutting issues for improvement: (a) The development of procedures and institutional arrangements in order to ensure the consistency of and harmonization between the AD used in the inventory, national statistical data and data reported under other international obligations and a reliable data flow for the preparation of the inventory (see paras. 21(b) and (e) above);	"Questions of implementation on national system and QA/QC procedures and two adjustments were identified by the ERT during the review. In the conclusions and recommendations summarized in the draft ARR the ERT concludes that the inventory submission has been prepared and reported mostly in accordance with the UNFCCC reporting guidelines but the national system of Slovakia does not fully comply with the guidelines for national systems under Article 5, paragraph 1, of the Kyoto Protocol (annex to decision 19/CMP.1). The annual submission is complete in terms of geographical coverage, years and sectors, as well as mostly complete in terms of categories and gases." [NIR, 2012, p. 268]
	(b) The establishment of clear communication channels with regard to the principles, purposes and procedures of the UNFCCC reporting guidelines and the review processes with external experts, ensuring that these experts fully understand the formal requirements of these guidelines and the importance of the timely submission of their contributions (see para. 21(d) above);	"During the 6 weeks period, sectoral expert for energy (Profing, Mr. Judak), national coordinator and the colleagues from the Dpt. of Climate Change Policy (Ministry of Environment) in cooperation with the Statistical Office of the Slovak Republic (SO SR) provided several comparisons of the national energy statistics, international energy statistics (IEA) and the fuel balance in the National Emission Information System (NEIS). The following steps were taken in order to increase transparency, consistency and comparability of the national reporting in energy sector." [NIR, 2012, Tab. 10.5, p. 269]
	(c) The implementation of a fully operational QA/QC system, including all the provisions of the QA/QC plan, and independent checks of the resulting emission estimates involving experts from collaborating institutions, particularly data providers and different data sources (e.g. EU ETS, NEIS, statistical data), prior to the submission of the inventory (see para. 21(a) and 38 above);	"In response to the ERT recommendation Slovakia prepared during the 6-weeks period detailed plan of action w ith proposed measures and deadlines to deliver results. Prioritizing the key sources, tier 2 key categories analyses were performed. updating QA/QC plan mostly for agriculture and LULUCF sectors" [NIR, 2012, Tab. 10.5, p. 269]
	(d) The improvement of the transparency of the emission estimates in the energy sector, in particular the information on the parameters and assumptions of the COPERT IV model methodology and the information on AD (e.g. by providing an energy balance in the NIR), and in the industrial processes sector, in particular with regard to the provision of a carbon mass balance covering activities related to the iron and steel category and clear information on the use of F-gases under the category consumption of halocarbons and SF_6 (see paras. 49, 57, 69 and 73 above). **(FCCC/ARR/2011/SVK, para 230)**	For the sector energy, road transport: please see under (b) and "New estimation of N_2O emissions for CNG fuel in the category 1.A.3b - Road Transportation using default EF. " [NIR, 2012, Tab. 10.5, p. 269] For the industrial processes: not yet addressed. For the use of F-gases: "New estimation of actual emissions HFC245ca and HFC365mfc f rom PUR foam in the category 2IIA.F.2.1 – Consumption of halocarbons and SF_6 (hard foam)." [NIR, 2012, Tab. 10.5, p. 269]
Slovenia	The ERT identifies the following cross-cutting	"All improvements have been done for the submission

Member State	Cross-cutting issues as identified by the review team	Improvements in response to UNFCCC review as indicated in the NIR
	issues for improvement: (a) The maintenance of time-series consistency when performing recalculations due to methodological improvements;	2012. See relevant chapters in the NIR." [NIR 2012, Table 10.7, p. 266]
	(b) The improvement of QC procedures in order to minimize inconsistencies in the CRF tables and the NIR, and between them;	"All improvements have been done for the submission 2012. See relevant chapters in the NIR." [NIR 2012, Table 10.7, p. 266]
	(c) The further improvement of the transparency of the NIR (see para. 24 above). **(FCCC/ARR/2011/SVN, para 123)**	"See para 41, 42, 44, 59, 60, 67, 78, 80, 81, 82, 89, and 92. See relevant chapters in the NIR". [NIR 2012, Table 10.7, p. 265]

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Units and abbreviations

t	1 tonne (metric) = 1 megagram (Mg) = 106 g
Mg	1 megagram = 106 g = 1 tonne (t)
Gg	1 gigagram = 109 g = 1 kilotonne (kt)
Tg	1 teragram = 1012 g = 1 megatonne (Mt)
TJ	1 terajoule

AWMS	animal waste management systems
BEF	biomass expansion factor
BKB	lignite briquettes
C	confidential
CCC	Climate Change Committee (established under Council Decision No 280/2004/EC)
CH_4	methane
CO_2	carbon dioxide
COP	conference of the parties
CRF	common reporting format
CV	calorific value
EC	European Community
EEA	European Environment Agency
EF	emission factor
Eionet	European environmental information and observation network
EMAS	Ecomanagement and Audit Scheme
ETC/ACC	European Topic Centre on Air and Climate Change
ETS	European Emissions Trading System
EU	European Union

FAO	Food and Agriculture Organisation of the United Nations
GHG	greenhouse gas
GPG	good practice guidance and uncertainty management in national greenhouse gas inventories (IPCC, 2000)
GWP	global warming potential
HFCs	hydrofluorocarbons
JRC	Joint Research Centre
F-gases	fluorinated gases (HFCs, PFCs, SF_6)
IE	included elsewhere
IPCC	Intergovernmental Panel on Climate Change
KP	Kyoto Protocol
LULUCF	land-use, land-use change and forestry
MNP	Milieu-en Natuurplanbureau
MS	Member State
MRG	monitoring and reporting guidelines
N	nitrogen
NH_3	ammonia
N_2O	nitrous oxide
NA	not applicable
NE	not estimated
NFI	national forest inventory
NIR	national inventory report
NO	not occurring
PFCs	perfluorocarbons
QA	quality assurance
QA/QC	quality assurance/quality control
QM	quality management
QMS	quality management system

RIVM	National Institute of Public Health and the Environment (The Netherlands)
SF_6	sulphur hexafluoride
SNE	Single National Entity
UNFCCC	United Nations Framework Convention on Climate Change
VOCs	Volatile Organic Compounds

Abbreviations in the source category tables in Chapters 3 to 9 and 18-24

Methods applied	**EF: methods applied for determining the emission factor**	**AD: methods applied for determining the activity data**	**Estimate: assessment of completeness**	**Quality: assessment of the uncertainty of the estimates**
C — Corinair	C — Corinair	AS — associations, business organizations	All — full	H — high
CS — country-specific	CS — country-specific	IS — international statistics	F — full	M — medium
COPERT X — Copert Model X = version	D — default	NS — national statistics	Full — full	L — low
D — default	M — model	PS — plant specific data	IE — included elsewhere	
M — model	MB — mass balance	Q — specific questionnaires, surveys	NE — not estimated	
NA — not applicable	PS — plant-specific	RS — regional statistics	NO — not occurring	
RA — reference approach			P — partial	
T1 — IPCC Tier 1			Part — partial	
T1a — IPCC Tier 1a				
T1b — IPCC Tier 1b				
T1c — IPCC Tier 1c				

T2 — IPCC Tier 2				
T3 — IPCC Tier 3				