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Annual European Community greenhouse gas inventory 1990–2005 and inventory report 2007

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Executive summary

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

The European Community (EC), as a party to the United Nations Framework Convention on Climate Change (UNFCCC), reports annually on greenhouse gas (GHG) inventories within the area covered by its Member States.

The legal basis of the compilation of the EC inventory is Council Decision No 280/2004/EC concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol ([1]). 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 Community 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 Community and its Member States to the UNFCCC Secretariat.

The EC GHG inventory is compiled on the basis of the inventories of the EC Member States for EU-15 and EU-27. It is the direct sum of the national inventories. For EU-15 energy data from Eurostat is 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 the compilation of the EC GHG inventory are the Member States, the European Commission (DG ENV), the European Environment Agency (EEA) and its European Topic Centre on Air and Climate Change (ETC/ACC), Eurostat, and the Joint Research Centre (JRC).

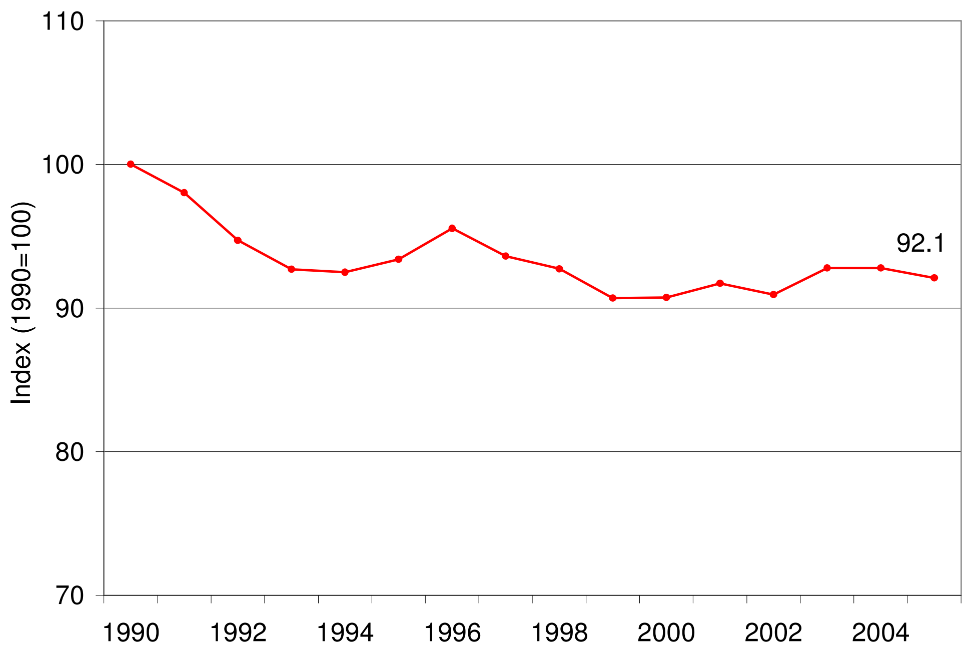
The process of compiling the EC GHG inventory is as follows: Member States submit their annual GHG inventories by 15 January each year to the European Commission, DG Environment. Then, the EEA's ETC/ACC, Eurostat and JRC perform initial checks on the submitted data. The draft EC GHG inventory and inventory report are circulated to Member States for reviewing and commenting by 28 February. Member States check their national data and information used in the EC GHG inventory report, send updates, if necessary, and review the EC inventory report itself by 15 March. The final EC GHG inventory and inventory report are prepared by the ETC/ACC by 15 April for submission by the European Commission to the UNFCCC Secretariat; a resubmission is prepared by 27 May, if needed.

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

EU-27: Total GHG emissions without LULUCF in the EU-27 decreased by 7.9 % between 1990 and 2005 (Figure ES.1). Emissions decreased by 0.7 % (+38 million tonnes) between 2004 and 2005.

([1]) 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 inventory report 2004 started under the previous Council Decision 1999/296/EC.

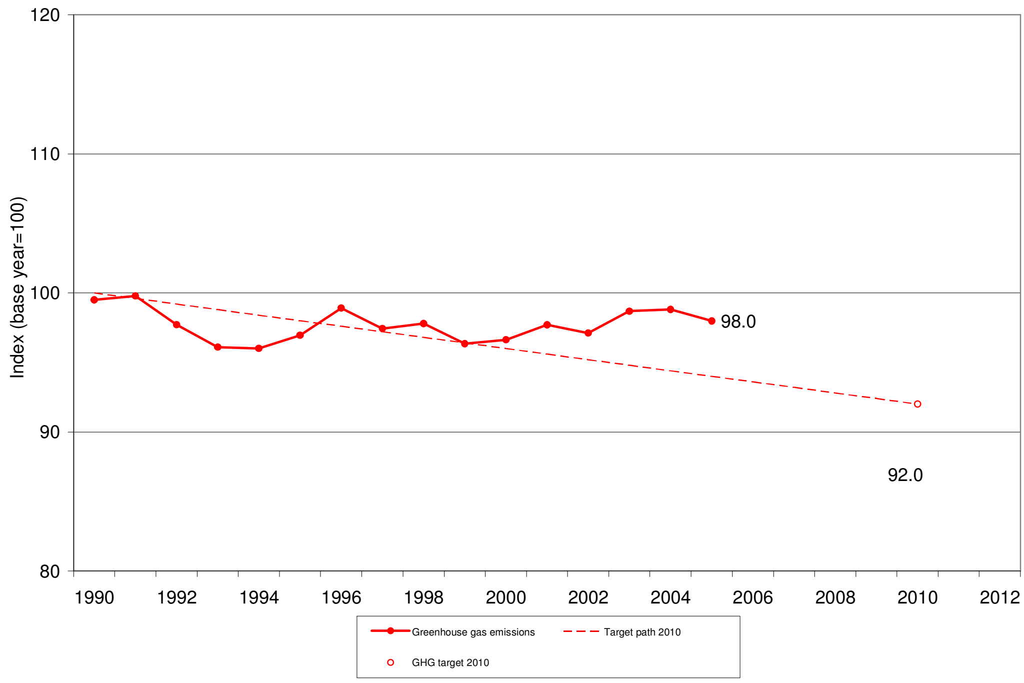
Figure ES.1 EU-27 GHG emissions 1990–2005 (excl. LULUCF)



EU-15: In 2005 total GHG emissions in the EU-15, without LULUCF, were 1.5 % (65 million tonnes CO_2 equivalents) below 1990. Compared to the base year[2], emissions in 2005 were 2.0 % or 86 million tonnes CO_2 equivalents lower. In the Kyoto Protocol, the EC agreed to reduce its GHG emissions by 8 % by 2008–12, from base year levels. Assuming a linear target path from 1990 to 2010, in 2005 total EU-15 GHG emissions were 4.1 index points above this target path (Figure ES.2).

[2] For EU-15 the base year for CO_2, CH_4 and N_2O is 1990; for the fluorinated gases 12 Member States have selected 1995 as the base year, whereas Austria, France and Italy have chosen 1990. As the EC inventory is the sum of Member States' inventories, the EC 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 due to deforestation for the Netherlands, Portugal and the UK (see EC Initial report, EEA, 2006c).

Figure ES.2 EU-15 GHG emissions 1990–2005 compared with target for 2008–12 (excl. LULUCF)



Notes: The linear target path is not intended as an approximation of past and future emission trends. It provides a measure of how close the EU-15 emissions in 2005 are to a linear path of emissions reductions from 1990 to the Kyoto target for 2008–12, assuming that only domestic measures will be used. Therefore, it does not deliver a measure of (possible) compliance of the EU-15 with its GHG targets in 2008–12, but aims at evaluating overall EU-15 GHG emissions in 2005. The unit is index points with base year emissions being 100.

GHG emission data for the EU-15 as a whole do not include emissions and removals from LULUCF. In addition, no adjustments for temperature variations or electricity trade are considered.

For the fluorinated gases the EU-15 base year is the sum of Member States base years. 12 Member States have selected 1995 as the base year under the Kyoto Protocol, Austria, France and Italy use 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 due to deforestation for the Netherlands, Portugal and the UK (see EC Initial report, EEA, 2006c).

The index on the y axis refers to the base year (1995 for fluorinated gases for all Member States except Austria, France and Italy, 1990 for fluorinated gases for Austria, France and Italy and for all other gases). This means that the value for 1990 needs not to be exactly 100.

Compared to 2004, EU-15 GHG emissions decreased by 0.8 % or 35.2 million tonnes CO_2 equivalents in 2004.

The decrease in GHG emissions between 2004-2005 was mainly due to:

- Lower CO_2 emissions from Public Electricity and Heat Production (-9.6 million tonnes or -0.9 %) mainly in Finland and Germany.
  According to EUROSTAT data in Finland and Denmark total electricity generation decreased and net imports increased, while Sweden and Norway had major increases in electricity from hydropower generation and increased export. This explains the decrease in emissions for Sweden, Finland and Denmark. In Germany the total electricity production from fossil thermal power stations did not change, although the fuel input decreased. In addition, the fuel switch from solid to liquid and gaseous fuels contributed to emission reductions.
- Lower CO_2 emissions from households and services (-7.0 million tonnes or -1.7 %).
  Important decreases in CO_2 emissions from household and services were reported by Germany, the United Kingdom and the Netherlands, while Italy reported substantial increases. One reason for the decrease in Germany and the Netherlands is the warmer weather conditions (warmer winter) compared to the previous year.

- Lower CO_2 emissions from road transport (-6.0 million tonnes or -0.8 %).
  The decrease in CO_2 emissions from road transport is mainly caused by Germany, which is due to reduced specific fuel consumption, increased amount of diesel oil driven cars, and effects of the eco-tax as well as fuel buying abroad.
- Lower N_2O emissions from agricultural soils (-4.0 million tonnes or -2.0 %) mainly in Spain, Italy and Germany.
  The reduction from N_2O emissions from agricultural soils is partly due to a reduction in synthetic fertiliser use in Spain and Italy, and the reduction of the use of nitrogen fixing crops in Germany.
- Lower CH_4 emissions from solid waste disposal (-2.1 million tonnes or -2.7 %).
  CH_4 emissions from solid waste disposal decreased most in Germany, the Netherlands and the UK.
- Lower fugitive CH_4 emissions from coal mining (-2.5 million tonnes or -17.4 %) mainly in France and the UK due todeclinig coal mining.

Substantial increases in GHG emissions between 2004-2005 took place in the following source categories:

- HFC emissions from Refrigeration and Air Conditioning (+3.2 million tonnes or +9.9 %)
- N_2O emissions from Nitric Acid Production (+2.1 million tonnes or 6.9 %)
- CO_2 emissions from petroleum refining (+1.9 million tonnes or +1.6%)
- CO_2 emissions from civil aviation (+1.7 million tonnes or +7.2 %).

Table 2.1 shows that between 2004 and 2005, Spain saw the largest emission increases in absolute terms (+15.4 million tonnes CO_2 equivalents). On the positive side, 2005 saw emission reductions from Germany (-23.5 million tonnes CO_2 equivalents), Finland (-11.9 million tonnes CO_2 equivalents), and the Netherlands (-6.3 million tonnes CO_2 equivalents):

- Spanish emission increases mainly occurred in CO_2 from electricity and heat production (+10.4 million tonnes), CO_2 from iron and steel production (+0.7 million tonnes, both energy and process related emissions), CO_2 from cement production (+0.5 million tonnes) and CH_4 solid waste disposal (+0.2 million tonnes,). The increase in energy related emissions is due to an increase in electricity generation from fossil thermal power stations (17 %) and a decrease in electricity generation from hydropower plants (-33 %).

- The German emission reductions occurred primarily in CO_2 from public electricity and heat production (-8.1 million tonnes), CO_2 from road transport (-7.8 million tonnes) and CO_2 from household and services (-5.3 million tonnes), whereas N_2O emissions from nitric acid production increased by 3.5 million tonnes.

- In Finland and the Netherlands emission reductions are mainly due to CO_2 in public electricity and heat production (-10.7 and –2.8 million tonnes respectively) and in the Netherlands also CO_2 emission reduction in households and services play an important role.

In 2005, 15 Member States (including Cyprus and Malta, which do not have a Kyoto target) had GHG emissions above base year levels whereas the remaining 12 Member States had emissions below base year levels.

Table ES.1 Greenhouse gas emissions in CO_2 equivalents (excl. LULUCF) and Kyoto Protocol targets for 2008–12

MEMBER STATE	Base year [1) (million tonnes)	2005 (million tonnes)	Change 2004–2005 (million tonnes)	Change 2004–2005 (%)	Change base year–2005 (%)	Targets 2008–12 under Kyoto Protocol and "EU burden sharing" (%)
Austria	79.0	93.3	2.1	2.3%	18.1%	-13.0%
Belgium	146.9	143.8	-3.8	-2.6%	-2.1%	-7.5%
Bulgaria	132.1	69.8	0.9	1.3%	-47.2%	-8.0%
Cyprus	6.0	9.9	0.0	0.2%	63.7%	-
Czech Republic	196.3	145.6	-1.5	-1.0%	-25.8%	-8.0%
Denmark	69.3	63.9	-4.3	-6.3%	-7.8%	-21.0%
Estonia	43.0	20.7	-0.5	-2.3%	-52.0%	-8.0%
Finland	71.1	69.3	-11.9	-14.6%	-2.6%	0.0%
France	563.9	553.4	-2.7	-0.5%	-1.9%	0.0%
Germany	1232.5	1001.5	-23.5	-2.3%	-18.7%	-21.0%
Greece	111.1	139.2	1.6	1.2%	25.4%	25.0%
Hungary	123.0	80.5	1.0	1.2%	-34.5%	-6.0%
Ireland	55.8	69.9	1.3	1.9%	25.4%	13.0%
Italy	519.5	582.2	1.7	0.3%	12.1%	-6.5%
Latvia	25.9	10.9	0.2	1.5%	-58.0%	-8.0%
Lithuania	48.1	22.6	1.5	7.2%	-53.1%	-8.0%
Luxembourg	12.7	12.7	-0.1	-0.4%	0.4%	-28.0%
Malta [2)]	2.2	*3.4*	0.2	6.1%	54.8%	-
Netherlands	214.6	212.1	-6.3	-2.9%	-1.1%	-6.0%
Poland	586.9	399.0	2.3	0.6%	-32.0%	-6.0%
Portugal	60.9	85.5	0.9	1.0%	40.4%	27.0%
Romania	282.5	153.7	-6.4	-4.0%	-45.6%	-8.0%
Slovakia	73.4	48.7	-0.8	-1.6%	-33.6%	-8.0%
Slovenia	20.2	20.3	0.4	2.1%	0.4%	-8.0%
Spain	289.4	440.6	15.4	3.6%	52.3%	15.0%
Sweden	72.3	67.0	-2.7	-3.9%	-7.4%	4.0%
United Kingdom	779.9	657.4	-3.0	-0.5%	-15.7%	-12.5%
EU-15	**4278.8**	**4192.0**	**-35.2**	**-0.8%**	**-2.0%**	**-8.0%**

([1]) For EU-15 the base year for CO_2, CH_4 and N_2O is 1990; for the fluorinated gases 12 Member States have selected 1995 as the base year, whereas Austria, France and Italy have chosen 1990. As the EU-15 inventory is the sum of Member States' 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 due to deforestation for the Netherlands, Portugal and the UK (see EC Initial report, EEA, 2006c).

([2]) Malta did not provide GHG emission estimates for 2005, therefore the data provided in this table is based on gap filling (see Chapter 1.8.2.).

Note: Malta and Cyprus do not have Kyoto targets.

In 2005 the EU Emission Trading Scheme (EU ETS) covered ca 47% of the total CO_2 emissions and ca. 39% of total greenhouse gas emissions in EU-15. The EU ETS covered ca 49% of the total CO_2 emission and 41% of total greenhouse gas emissions in EU-25. In general, EU ETS information has been used by EU Member States as one input for calculating total CO_2 emissions for the sectors Energy and Industrial Processes in this report. However, an explicit quantification of the contribution of the EU ETS to total CO_2 emissions on sectoral and sub-sectoral level is not yet available for EU-15 or EU-25.

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

EU-27: Table ES.2 gives an overview of the main trends in EU-27 GHG emissions and removals for 1990–2005. The most important GHG by far is CO_2, accounting for 82 % of total EU-27 emissions in 2005 excluding LULUCF. In 2005, EU-27 CO_2 emissions without LULUCF were 4 269 Tg, which was 3.5 % below 1990 levels. Compared to 2004, CO_2 emissions decreased by 0.7 %.

Table ES.2 Overview of EU-27 GHG emissions and removals from 1990 to 2005 in CO_2 equivalents (Tg)

GREENHOUSE GAS EMISSIONS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Net CO_2 emissions/removals	4,057	3,918	3,787	3,702	3,680	3,726	3,830	3,748	3,748	3,669	3,697	3,741	3,711	3,844	3,858	3,815
CO_2 emissions (without LULUCF)	4,426	4,359	4,213	4,130	4,122	4,165	4,280	4,188	4,175	4,103	4,122	4,201	4,176	4,289	4,298	4,269
CH_4	604	588	568	556	543	541	536	519	505	492	479	463	452	441	429	420
N_2O	536	509	490	470	475	476	483	481	459	437	436	430	420	420	423	419
HFCs	28	28	29	30	34	41	47	54	55	49	47	46	48	53	54	57
PFCs	21	19	16	15	15	14	13	11	10	10	8	8	9	8	6	6
SF_6	11	11	12	13	14	16	16	14	13	11	11	11	10	9	9	9
Total (with net CO_2 emissions/removals)	**5,257**	**5,073**	**4,902**	**4,786**	**4,761**	**4,814**	**4,924**	**4,826**	**4,790**	**4,667**	**4,679**	**4,698**	**4,649**	**4,774**	**4,779**	**4,726**
Total (without CO2 from LULUCF)	**5,626**	**5,514**	**5,328**	**5,214**	**5,203**	**5,253**	**5,374**	**5,266**	**5,216**	**5,102**	**5,104**	**5,159**	**5,115**	**5,219**	**5,219**	**5,180**
Total (without LULUCF)	**5,621**	**5,509**	**5,324**	**5,210**	**5,199**	**5,249**	**5,370**	**5,262**	**5,212**	**5,098**	**5,100**	**5,155**	**5,111**	**5,215**	**5,215**	**5,177**

EU-15: Table ES.3 gives an overview of the main trends in EU-15 GHG emissions and removals for 1990–2005. Also in the EU-15 the most important GHG is CO_2, accounting for 83 % of total EU-15 emissions in 2005. In 2005, EU-15 CO_2 emissions without LULUCF were 3 482 Tg, which was 3.7 % above 1990 levels. Compared to 2004, CO_2 emissions decreased by 0.7 %. The largest four key sources account for 79 % of total CO_2 emissions in 2005. Figure 2.4 shows that the main reason for increases between 1990 and 2005 was growing road transport demand. The large increase in road transport-related CO_2 emissions was only partly offset by reductions in energy-related emissions from Manufacturing Industries and from Other. The largest reductions of Other occurred in 1A1c Manufacture of Solid Fuels and Other Energy Industries and in 1A5 Other.

Table ES.3 Overview of EU-15 GHG emissions and removals from 1990 to 2005 in CO_2 equivalents (Tg)

GREENHOUSE GAS EMISSIONS	Base year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Net CO_2 emissions/removals	3,135	3,135	3,101	3,041	2,983	2,963	2,993	3,054	3,004	3,061	3,026	3,062	3,105	3,084	3,175	3,203	3,164
CO_2 emissions (without LULUCF)	3,357	3,357	3,380	3,305	3,251	3,249	3,282	3,359	3,306	3,351	3,326	3,354	3,422	3,413	3,492	3,508	3,482
CH_4	440	440	437	430	428	416	414	409	397	387	378	367	354	343	331	320	312
N_2O	409	409	403	395	381	387	388	394	393	374	355	353	346	339	338	339	335
HFCs	41	28	28	29	30	34	41	47	53	54	47	46	44	46	49	50	53
PFCs	15	17	15	13	12	12	11	11	10	9	9	7	7	8	7	5	5
SF_6	14	11	11	12	13	14	16	16	14	13	11	11	10	10	9	9	9
Total (with net CO_2 emissions/removals)	**4,054**	**4,040**	**3,995**	**3,921**	**3,847**	**3,826**	**3,863**	**3,930**	**3,871**	**3,898**	**3,825**	**3,846**	**3,867**	**3,829**	**3,909**	**3,926**	**3,877**
Total (without CO2 from LULUCF)	**4,276**	**4,262**	**4,273**	**4,185**	**4,115**	**4,111**	**4,152**	**4,236**	**4,172**	**4,188**	**4,126**	**4,138**	**4,184**	**4,158**	**4,226**	**4,231**	**4,195**
Total (without LULUCF)	**4,272**	**4,257**	**4,269**	**4,180**	**4,111**	**4,108**	**4,148**	**4,232**	**4,169**	**4,184**	**4,122**	**4,134**	**4,180**	**4,155**	**4,222**	**4,227**	**4,192**

The increase of CO_2 emissions was compensated by decreases in CH_4 and N_2O in the same period: CH_4 decreased by 128 Tg CO_2 equivalents and N_2O by 74 Tg CO_2 equivalents between 1990 and 2005. The main reasons for declining CH_4 emissions were reductions in solid waste disposal on land, the decline of coal-mining and falling cattle population. The main reason for large N_2O emissions cuts were reduction measures in the adipic acid production. Fluorinated gas emissions are subject to two opposing trends. While HFCs from consumption of halocarbons showed large increases between 1990 and 2005 (mainly due to the replacement of ozone depleting substances), HFC emissions from production of halocarbons decreased substantially.

ES.4 Summary of emissions and removals by main source category

EU-27: Table ES.4 gives an overview of EU-27 GHG emissions in the main source categories for 1990–2005. The most important sector by far is Energy accounting for 80 % of total EU-27 emissions in 2005. The second largest sector is Agriculture (9 %), followed by Industrial Processes (8 %).

Table ES.4 Overview of EU-27 GHG emissions in the main source and sink categories 1990 to 2005 in CO_2 equivalents (Tg)

GHG SOURCE AND SINK	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
1. Energy	4,320	4,276	4,132	4,058	4,023	4,059	4,186	4,077	4,064	3,999	4,004	4,089	4,060	4,166	4,162	4,131
2. Industrial Processes	475	439	425	408	435	454	450	459	432	393	404	392	389	399	408	411
3. Solvent and Other Product Use	13	12	11	11	11	11	11	11	11	11	11	10	10	10	10	10
4. Agriculture	595	562	538	518	516	515	517	517	514	510	502	494	487	482	481	476
5. Land-Use, Land-Use Change and Forest	-364	-436	-421	-424	-438	-436	-446	-436	-423	-431	-421	-457	-462	-441	-436	-450
6. Waste	219	220	217	215	213	211	207	198	192	185	179	170	165	158	153	149
7. Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total (with net CO_2 emissions/removals)	**5,257**	**5,073**	**4,902**	**4,786**	**4,761**	**4,814**	**4,924**	**4,826**	**4,790**	**4,667**	**4,679**	**4,698**	**4,649**	**4,774**	**4,779**	**4,726**
Total (without LULUCF)	**5,621**	**5,509**	**5,324**	**5,210**	**5,199**	**5,249**	**5,370**	**5,262**	**5,212**	**5,098**	**5,100**	**5,155**	**5,111**	**5,215**	**5,215**	**5,177**

EU-15: Table ES.5 gives an overview of EU-15 GHG emissions in the main source categories for 1990–2005. More detailed trend descriptions are included in Chapters 3 to 9.

Table ES.5 Overview of EU-15 GHG emissions in the main source and sink categories 1990 to 2005 in CO_2 equivalents (Tg)

GHG SOURCE AND SINK	Base year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
1. Energy	3,263	3,263	3,296	3,226	3,179	3,155	3,185	3,270	3,205	3,247	3,225	3,243	3,314	3,303	3,377	3,384	3,357
2. Industrial Processes	390	375	363	351	339	360	373	370	380	359	328	331	323	320	325	331	332
3. Solvent and Other Product Use	10	10	10	10	9	9	9	9	9	9	9	9	9	9	8	8	8
4. Agriculture	434	434	423	417	409	410	412	417	417	417	415	412	403	397	393	391	386
5. Land-Use, Land-Use Change and Forest	-217	-217	-274	-260	-265	-282	-285	-302	-298	-286	-297	-288	-313	-326	-314	-301	-315
6. Waste	176	176	177	176	174	173	169	166	157	152	145	139	131	125	119	113	109
7. Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total (with net CO_2 emissions/removals)	**4,054**	**4,040**	**3,995**	**3,921**	**3,847**	**3,826**	**3,863**	**3,930**	**3,871**	**3,898**	**3,825**	**3,846**	**3,867**	**3,829**	**3,909**	**3,926**	**3,877**
Total (without LULUCF)	**4,272**	**4,257**	**4,269**	**4,180**	**4,111**	**4,108**	**4,148**	**4,232**	**4,169**	**4,184**	**4,122**	**4,134**	**4,180**	**4,155**	**4,222**	**4,227**	**4,192**

ES.5 Summary of the emission trends by EU Member States

Table ES.6 gives an overview of Member States' contributions to the EC GHG emissions for 1990–2005. Member States show large variations in GHG emission trends.

Table 2.6 Overview of Member States' contributions to EC GHG emissions excluding LULUCF from 1990 to 2005 in CO_2 equivalents (Tg)

Member State	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Austria	79	83	76	76	77	80	84	83	83	81	81	85	87	93	91	93
Belgium	146	149	147	146	151	152	156	148	153	147	148	147	145	148	148	144
Bulgaria	116	95	85	86	83	87	85	82	73	67	67	67	64	70	69	70
Cyprus	6	6	7	7	7	7	8	8	8	8	9	9	9	10	10	10
Czech Republic	196	183	166	160	154	154	161	154	150	142	149	149	144	148	147	146
Denmark	69	80	73	76	79	76	90	80	76	73	68	70	69	74	68	64
Estonia	44	41	31	24	25	23	24	24	21	19	20	20	19	22	21	21
Finland	71	69	67	69	75	72	77	76	72	72	70	75	77	85	81	69
France	564	586	580	554	550	559	575	568	582	565	560	562	554	556	556	553
Germany	1,228	1,180	1,130	1,116	1,098	1,096	1,115	1,078	1,052	1,021	1,020	1,037	1,018	1,031	1,025	1,001
Greece	109	108	109	109	112	113	117	122	127	127	132	133	133	137	138	139
Hungary	99	92	82	83	83	81	83	81	81	81	79	81	79	82	80	81
Ireland	55	56	56	57	58	59	61	63	66	67	69	71	69	69	69	70
Italy	519	521	519	513	505	533	525	532	543	549	554	560	560	575	580	582
Latvia	26	24	20	16	14	12	13	12	11	11	10	11	11	11	11	11
Lithuania	48	50	30	24	23	22	23	22	23	20	19	20	20	20	21	23
Luxembourg	13	13	13	13	12	10	10	9	8	9	10	10	11	11	13	13
Malta	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Netherlands	213	218	217	222	222	225	233	226	228	215	214	216	216	217	218	212
Poland	486	471	458	440	452	453	474	462	433	419	405	402	387	402	397	399
Portugal	60	62	66	65	67	71	69	72	77	85	82	83	88	83	85	86
Romania	249	196	186	184	179	187	193	173	154	136	139	143	151	158	160	154
Slovakia	73	63	58	54	51	53	54	54	52	51	48	52	50	50	49	49
Slovenia	18	17	17	18	18	18	19	19	19	18	19	20	20	20	20	20
Spain	287	294	301	290	306	318	311	332	342	370	384	385	402	409	425	441
Sweden	72	73	72	72	75	74	77	73	73	70	68	69	70	71	70	67
United Kingdom	771	778	754	733	720	710	731	708	703	672	674	677	657	663	660	657
EU-27	**5,621**	**5,509**	**5,324**	**5,210**	**5,199**	**5,249**	**5,371**	**5,262**	**5,213**	**5,098**	**5,100**	**5,155**	**5,111**	**5,215**	**5,215**	**5,177**
EU-15	**4,257**	**4,269**	**4,180**	**4,111**	**4,108**	**4,148**	**4,232**	**4,169**	**4,184**	**4,122**	**4,134**	**4,180**	**4,155**	**4,222**	**4,227**	**4,192**

Note: For some countries the data provided in this table is based on gap filling (see Chapter 1.8.2 for details.).

The overall EC 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 340 million tonnes CO_2 euqivalents compared to 1990 ([3]).

The main reasons for the favourable trend in Germany are increasing efficiency in power and heating plants and the economic restructuring of the five new *Länder* after the 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 adipic acid production.

Italy and France are the third and fourth largest emitters both with a shares of 11 %. Italy's GHG emissions were about 12% above 1990 levels in 2005. Italian GHG emissions increased since 1990 primarily from road transport, electricity and heat production and petrol-refining. France's emissions were 2 % below 1990 levels in 2005. In France, large reductions were achieved in N_2O emissions from the adipic acid production, but CO_2 emissions from road transport increased considerably between 1990 and 2005.

([3]) The EU-15 as a whole needs emission reductions of total GHG of 8 %, i.e. 342 million tonnes on the basis of the 2006 inventory in order to meet the Kyoto target.

Spain and Poland are the fifth and sixth largest emitters in the EU-27 each accounting for about 9 % and 8 % of total EU-27 GHG emissions respectively. Spain increased emissions by 53 % between 1990 and 2005. This was largely due to emission increases from road transport, electricity and heat production, and manufacturing industries. Poland decreased GHG emissions by 18 % between 1990 and 2005 (-32 % 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.

ES.6 Information on Indirect Greenhouse Gas Emissions for EU-15

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 ES.7 shows the total indirect GHG and SO_2 emissions in the EU-15 between 1990–2005. All emissions were reduced significantly from 1990 levels: the largest reduction was achieved in SO_2 (– 70 %) followed by CO (– 49 %) NMVOC (– 41 %) and NO_x (– 30 %).

Table ES.7 Overview of EU-15 indirect GHG and SO_2 emissions for 1990–2005 (Gg)

GREENHOUSE GAS EMISSIONS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
	(Gg)															
NOx	13,428	13,226	12,922	12,340	12,008	11,796	11,486	11,045	10,860	10,550	10,203	9,994	9,683	9,583	9,345	9,015
CO	52,203	50,114	47,943	45,588	42,968	41,249	39,869	37,801	36,268	34,266	31,760	30,298	28,314	27,321	26,460	24,507
NMVOC	16,271	15,681	15,319	14,683	13,883	13,384	13,025	13,286	12,311	11,749	11,093	10,663	10,195	9,861	9,656	9,318
SO2	16,308	14,828	13,633	12,423	11,227	9,928	8,876	8,131	7,596	6,772	6,060	5,833	5,615	5,181	4,964	4,638

1 Introduction to the EC greenhouse gas inventory

This report is the annual submission of the European Community (EC) to the United Nations Framework Convention on Climate Change (UNFCCC). It presents the greenhouse gas (GHG) inventory of the EC, the process and the methods used for the compilation of the EC inventory as well as GHG inventory data of the individual EC Member States for 1990 to 2005. The GHG inventory data of the Member States are the basis of the EC 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 EC GHG inventory. It addresses the relevant aspects at EC level, but does not describe particular 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 12. Note that all Member States' submissions (CRF tables and inventory reports), which are included in Annex 12 and made available at the EEA website, are considered to be part of the EC 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 EC 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 ([4]).The emissions compiled in the EC GHG inventory are the sum of the respective emissions in the respective 15 or 27 national inventories, except for the IPCC reference approach for CO_2 from fossil fuels. Since the data are revised and updated for all years, they replace EC data previously published, in particular, in the 2006 submission by the European Commission to the UNFCCC Secretariat of the *Annual European Community greenhouse gas inventory 1990–2004 and inventory report 2006* (EEA, 2006a) and in the report entitled *Greenhouse gas emission trends and projections in Europe 2006* (EEA, 2006b).

This inventory report includes data for the EU-15 and for the EU-27 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. The 12 new Member States are Bulgaria, Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia and Slovenia. Most chapters and annexes of this report refer to EU-15 only, i.e. chapters 3-9 and annexes 1,2,4-10. Chapters 1, 2 and 10 and also annexes 11 and 12 refer to the EU-27 where relevant (for more detail see Section 1.8.5). This means that all the detailed information provided in previous reports for the EU-15 is also available in this report. In addition, basic information on data availability, QA/QC, uncertainty estimates, completeness and emission trends are provided for the EU-27.

1.1 Background information on greenhouse gas inventories and climate change

The annual EC GHG inventory is required for two purposes.

Firstly, the EC, 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

([4]) OJ L 49, 19.2.2004, p. 1.

by its Member States.

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 EC'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 EC inventory is the basis for the evaluation of actual progress.

The legal basis of the compilation of the EC inventory is Council Decision No 280/2004/EC concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol ([5]). 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 Community 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 Community 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 monoxide (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 Community 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 monitor-ing Community greenhouse gas emissions and for implementing the Kyoto Protocol ([6]). According to the Council decision and the Commission decision the reporting requirements are exactly the same as for the UNFCCC, regarding content and format. The EC 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

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([5]) OJ L 49, 19.2.2004, p. 1.

([6]) OJ L 55, 1.3.2005, p. 57.

information.

In accordance with UNFCCC guidelines, the EC 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.

1.2 A description of the institutional arrangements for inventory preparation

Figure 1.1 shows the inventory system of the European Community. The DG Environment of the European Commission is responsible for preparing the inventory of the European Community (EC) while each Member State is responsible for the preparation of its own inventory which is the basic input for the inventory of the European Community ([7]). DG Environment 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 and Climate Change (ETC/ACC) as well as the following other DGs of the European Commission: Eurostat, and the Joint Research Centre (JRC) ([8]).

Figure 1.1 Inventory system of the European Community

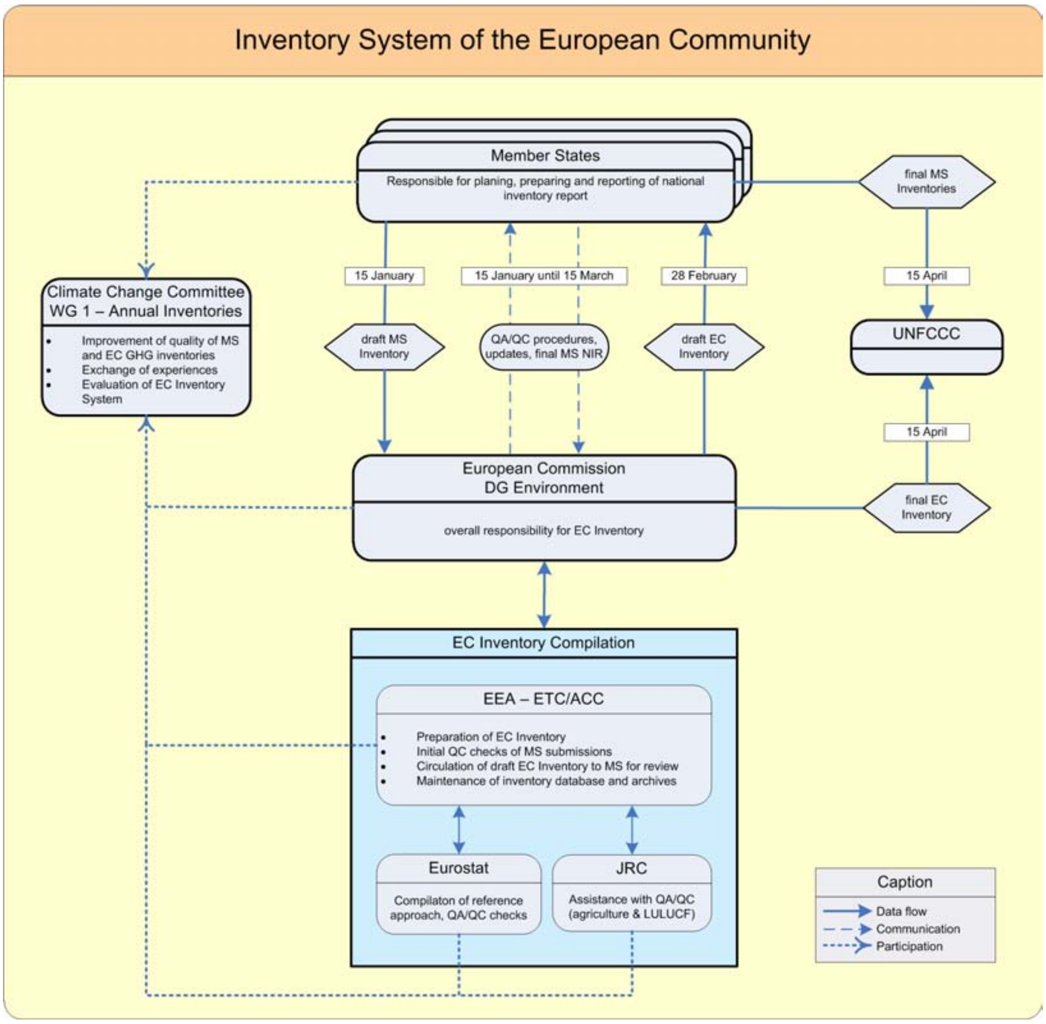


Table 1.1 shows the main institutions and persons involved in the compilation and submission

([7]) A draft Staff Working Paper laying down the Community Inventory System will be adopted soon. This paper will specify in more detail the responsibilities of the institutions involved in the preparation of the EC inventory, the preparation of the EC inventory, identification of key categories, estimation of uncertainties, recalculations, response to the UNFCCC review process and QA/QC of the EC inventory report.

([8]) 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.

of the EC inventory.

Table 1.1 List of institutions and experts responsible for the compilation of Member States' inventories and for the preparation of the EC 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 Pachecolaan 19 PB 5, B-1010 Brussels
Bulgaria	Hristo Vassilev Energy Institute JSCo. 20, F. J. Courie Str., Sofia 1113
Cyprus	Christos Malikkides Head, Industrial Pollution Control Section, Department of Labour Inspection Ministry of Labour and Social Insurance 12, Apellis Street, 1493 Nicosia
Czech Republic	Pavel Fott Czech Hydrometeorological Institute (CHMI) Na Sabatce 17, CZ 14306 Prague 4
Denmark	Jytte Boll Illerup Danish National Environmental Research Institute PO Box 358, DK-4000 Roskilde
Finland	Riitta Pipatti Statistics Finland PB 6 A, FIN-00022 Statistics Finland
France	Ministère de l'Ecologie et du Développement Durable (MEDD) 20 avenue de Ségur, F-75007 Paris Jean-Pierre Fontelle Centre Interprofessionel Technique d'Etudes de la Pollution Atmosphérique (CITEPA) 7 Cité Paradis, F-75010 Paris
Estonia	Jaan-Mati Punning Institute of Ecology at TPU Kevade 2, Tallinn 10137
Germany	Michael Strogies Federal Environmental Agency Bismarckplatz 1, D-14193 Berlin
Greece	Dimitra Koutendaki Institute of Environmental Research and Sustainable Development Athens, Greece
Hungary	László Gáspár Ministry of Environment and Water, department of Climate Policy Fõ u. 44-50, Budapest, 1011 Hungary
Ireland	Michael McGettigan, 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
Latvia	Agita Gancone Latvian Environment, Geology and Meteorology Agency Maskavas street 165, Riga, LV-1019
Lithuania	Vytautas Krusinskas Lithuanian Ministry of Environment A. Jaksto 4/9, LT 01105 Vilnius
Luxembourg	Frank Thewes Administration de l'Environment, Division Air-Bruit 16 rue Eugène Ruppert, L-2453 Luxembourg
Malta	Sharon.Micallef Malta Environment Planning Authority P.O. Box 200, Marsa GPO 01, Malta
Netherlands	Laurens Brandes Netherlands Environmental Assessment Agency PO Box 303, 3720 AH Bilthoven, The Netherlands
Poland	Krzysztof Olendrzynski Institute of Environmental Protection, National Emission Centre Kolektorska 4, 01-692 Warszawa
Portugal	Teresa Costa Pereira Direccao-Geral do Ambiente Rua da Murgueira — Bairro do Zambujal, P-2721-865 Amadora
Romania	Vlad Trusca Ministry of Waters and Environmental Protection 12 Libertatii Blvd., sector 5, 70005 Bucharest

Member State/EU institution	Contact address
Slovakia	Ministry of Environment SR, Department of Air Protection, director Ing. Lubomir ZIAK namestie L. Stura 1, 812 35 Bratislava
Slovenia	Tajda Mekinda Majaron Environmental Agency of the Republic of Slovenia Vojkova 1/b, SI-1000 Ljubljana
Spain	Ángleles Cristóbal Ministerio de Medio Ambiente Plaza de San Juan de la Cruz s/n, E-28071 Madrid
Sweden	Anna Forsgren Ministry of the Sustainable Development, S-103 33 Stockholm
United Kingdom	JD Watterson National Environmental Technology Centre AEA Technology plc, The Gemini Building, Fermi Avenue, Harwell, Didcot Osfordshire, OX11 0QR
European Commission	Erasmia Kitou European Commission, DG Environment Rue de la Loi 200, B-1049 Brussels, Belgium
European Environment Agency (EEA)	Andre Jol, Andreas Barkman European Environment Agency Kongens Nytorv 6, DK-1050 Copenhagen, Denmark
European Topic Centre on Air and Climate Change (ETC/ACC)	Bernd Gugele, Elisabeth Kampel, Katarina Mareckova, Manfred Ritter European Topic Centre on Air and Climate Change Umweltbundesamt Spittelauer Laende 5, A-1090 Vienna, Austria
Eurostat	Nikolaos Roubanis Statistical Office of the European Communities (Eurostat), Jean Monnet Building, L-2920 Luxembourg, Luxembourg
Joint Research Centre (JRC)	Frank Raes, Giacomo Grassi, Adrian Leip Joint Research Centre, Institute for Environment and Sustainability, Climate Change Unit Via Enrico Fermi, I-21020 Ispra (VA), Italy

1.2.1 The Member States

All Member States are Annex I parties to the UNFCCC except Cyprus and Malta. Therefore, all Member States except Cyprus and Malta 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 and Malta) 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 Community's inventory is based on the inventories supplied by Member States. The total estimate of the Community's 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 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 Community 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 EC inventory report, which is sent to the Member States by 28 February each year. The purpose of circulating the draft EC inventory report is to improve the quality of the EC inventory. The Member States check their national data and information used in the EC inventory report and send updates, if necessary. In addition, they comment on the general aspects of the EC 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 EC

Member States.

Table 1.2 Summaries of institutional arrangments/national systems of EC Member States

MS	Content	Source
Austria	**Administration of Austria's reporting obligations*: Federal Ministry of Agriculture, Forestry, Environment and Water Management (BMLFUW).*** **Single national entity** (with overall responsibility for preparation of Austria's National GHG Inventory as well as the NIR): ***Umweltbundesamt*** **Legal basis of the national inventory system Austria (NISA):** main basis for NISA is the Austrian Environmental Control Act (ECA) (Umweltkontrollgesetz)(Federal Law Gazette 152/1998), which regulates responsibilities of environmental control in Austria and lists the tasks of the Umweltbundesamt (UBA) as well as sets the responsibility for inventory preparation. The ECA is also the basis for the outsourcing of the "*Umweltbundesamt GmbH*" (Austrian federal environment agency ltd.) in 1999. Relevant paragraphs for NISA are para 6, 7 and 11. Thus the Umweltbundesamt (Department of Air Emissions) prepares and annually updates the Austrian air emissions inventory ("Österreichische Luftschadstoff-Inventur OLI"), which covers GHG and emissions of other air pollutants as stipulated in further reporting obligations. The "Inspection body for GHG inventory" within the Umweltbundesamt is responsible for the compilation of the GHG inventory. "Sector experts" within UBA are responsible for collecting activity data, emission factors, selection of methods and estimating the emissions. The QS is maintained relevant and current under the responsibility of the Quality Manager. The Quality Manager within the "Inspection body for GHG inventory" has irrespective of other duties defined authority and responsibility for quality assurance within the inspection body. The Quality Manager has direct access to top management. **Legal arrangements and other agreements:** Besides the Environmental Control Act there are some other legal and institutional arrangements in place as the main basis for the national system: Ordinance regarding Monitoring and Reporting of Greenhouse Gas Emissions This ordinance pertains to the Austrian Emissions Certificate Trading Act6 that regulates monitoring and reporting in the context of the EU Emissions Trading scheme in Austria. Paragraph 15 of this ordinance is designed to ensure consistency of emission trading data with the national inventory. It states that the *Umweltbundesamt* has to incorporate, as far as necessary, the emission reports of the emissions trading scheme into the national greenhouse gas inventory in order to comply with requirements of the EU Monitoring Mechanism Decision (280/2004/EC) and the UNFCCC. This is not only important for emissions from combustion of fuels, where more detailed information than provided in the national energy balance is available, but also for emissions from industrial processes, where the ordinance ensures data availability for most key sources (see Chapter 4 for details). First data from the EU Emissions Trading scheme were available for the year 2005; these data were considered in this submission. • The Austrian statistical office (Statistik Austria) is required by contract with the Federal Ministry of Agriculture, Forestry, Environment and Water Management (BMLFUW) and with the Federal Ministry of Economics and Labour (BMWA) to annually prepare the national energy balance (the contracts also cover some quality aspects). The energy balance is prepared in line with the methodology of the Organisation for Economic Co-operation and Development (OECD) and is submitted annually to the International Energy Agency (IEA) (IEA/EUROSTAT Joint Questionnaire (JQ) Submission). The national energy balance is the most important data basis for the Austrian Air Emissions Inventory. • According to national legislation (Bundesstatistikgesetz7), the Austrian statistical office has to prepare annual import/export statistics, production statistics and statistics on agricultural issues (livestock counts etc.), providing an important data basis for calculating emissions from the sectors *Industrial Processes*, *Solvents and Other Product Use* and *Agriculture*. • In order to comply with the reporting obligations, the *Umweltbundesamt* has the possibility to obtain confidential data from the national statistical institute (of course these data have to be treated confidentially). The legal basis for this data exchange is the "Bundesstatistikgesetz"7 (federal statistics law), which allows the national statistical office to provide confidential data to authorities that have a legal obligation for the processing of these data. • According to para 17 (1) of the (EG-K)8 each licencee of an operating boiler with a thermal capacity of 2 megawatts (MW) or more is obligated to report the emissions to the competent authority. The *Umweltbundesamt* can request copies of these emission declarations. These data are used to verify the data from the national energy balance for the Energy sector. • According to the Landfill Ordinance (Deponieverordnung)9, which came into force in 1997, the operators of landfill sites have to report their activity data annually to the *Umweltbundesamt*, where they are stored in a landfill database for solid waste disposals (*Deponiedatenbank*). This data provide the main data basis for calculating emissions from the sector *Waste*. • Since 2004 there is a reporting obligation to the BMLFUW under the Austrian Fluorinated Compounds (FC) Ordinance10 for users of FCs for the following applications: refrigeration and air-conditioning, foam blowing, semiconductor manufacture, electrical equipment, fire extinguishers and aerosols. These data are used for estimating emissions from the consumption of fluorinated compounds (*IPCC sector 2 F*).	Austria's National GHG Inventory Report 2007 Mar 2007- pp. 19-27

MS	Content	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 UNFCCC guidelines for the common reporting format. The emission inventories of the three regions are subsequently combined to form 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 duties of the Working Group on « Emissions » of the *Co-ordination 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. 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 Conference of the Parties to 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 National GHG Inventory (1990 – 2005) Mar 2007 pp.1-2
Bulgaria	All activities on preparation of GHG inventories in Bulgaria are coordinated and managed on a state level by the Ministry of Environment and Water. The Executive Environment Agency (EEA) is a subsidiary authority to the Ministry of Environment and Water. It coordinates all activities, related to collecting data on fuels and other sources of GHG emissions. EEA is the core body for collecting inventory data, aggregated on a national level by the following state authorities: • National Statistical Institute (NSI); • Road Control Department (RCD) within the Ministry of Internal Affairs; • Statistics Department within Ministry of Agriculture and Forestry (MAF); • Ministry of Economy and Energy; • Forestry Department within MAF; • Soil Resource Executive Agency within MAF; • National Service for Plant Protection, Quarantine and Agro chemistry; • Energy Efficiency Agency. The NSI plays a special role in data collection system for the inventory. Data for energy and material balances of the country, as well as major part of the calculations on the national inventory under the CORINAIR methodology are prepared in NSI. All data, related to solid waste and waste water, is also collected there. NSI uses up-to-date statistical methods and procedures for data summarizing and structuring, harmonized with the provisions and methods of EUROSTAT. The GHG inventory used data, received directly from large GHG emissions sources in the energy sector and the industry. This data was summarized by EEA and the organization, preparing the inventory - Energy Institute (EI). The Ministry of Environment and Water (MoEW) is responsible to the Secretariat to the UNFCCC for the annual GHG inventory report. The Ministry, together with EEA, organizes preparation of the inventory. All activities, related to the calculations of GHG emissions, drawing up and structuring of the results and analyses in the National Inventory Report and the CRF-Tables are assigned to an independent organization. The last one prepares the necessary materials, submits them for review by independent experts and reports to the High Expert Council of MoEW.	National Inventory Report 2004 Mar 2007, pp.28-29
Cyprus	The Ministry of Agriculture, Natural Resources and Environment (MANRE) is the main governmental body responsible for the development and implementation of environmental policy in Cyprus, as well as for the provision of information concerning the state of the environment in Cyprus in compliance with relevant requirements defined in international conventions, protocols and agreements. In this context and by a Presidential Decision, the Ministry of Agriculture, Natural Resources and Environment, and more specifically the Environment Service has been assigned the overall responsibility for the national GHG inventory. Within this framework and for the establishment of the National System foreseen in the Decision 280/2004/EC, the Ministry for the Environment is responsible for the following regarding GHG emissions inventory preparation which consists of the preparation/compilation of the annual national inventory, i.e. the selection of methodologies, data collection (activity data and emission factors, provided by statistical services and other organizations), data processing and archiving, as well as the implementation of general quality control procedures; and the development of an inventory QA/QC plan, in accordance with the provisions of the IPCC Good Practice Guidance. The present report has been developed through the co-operation of the Environment Service (Ministry of Agriculture, Natural Resources and Environment) with the government agencies, as these agencies maintain statistical data necessary for the inventory.	(Short) National Inventory Report Mar 2007 pp. 16

MS	Content	Source
Czech Republic	The Czech Hydrometeorological Institute (CHMI), under the supervision of the Ministry of Environment (ME), is responsible for preparation of the national inventory. The national inventory system (NIS) as required under Kyoto Protocol (Article 5.1) and by Decision No. 280/2004/EC, which demands allocation of sectoral responsibilities to more specialised and competent co-operating institutions possessing a higher level of sectoral skill and expertise, should now be in place. As approved by the Ministry of Environment, the established institutional arrangement is as follows: The Czech Hydrometeorological Institute, under the supervision of the Ministry of Environment (the single national entity with overall responsibility for the national greenhouse gas inventory, the founder of CHMI and is its superior institution), is designated as the coordinating and managing organisation responsible for the compilation of the national GHG inventory and reporting its results. The mains tasks of CHMI consist in inventory management, general, and cross cutting issues, QA/QC, communication with the relevant UNFCCC and EU bodies, etc. Sectoral inventories are prepared by sectoral compilers (sectoral experts) from sector-specialist institutions, which are coordinated and controlled by CHMI. The responsibilities for GHG inventory compilation form individual compilation form individual sectors are allocated in the following way. • 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).	Reporting under Article 3.1 , 2007 May 2007 pp. 15-16
Denmark	**Designated entity & responsible for the preparation and submission***:* National Environmental Research Institute (NERI), University of Aarhus, under the ***Danish*** *Ministry of Science Technology and Innovation* NERI participates in meetings in the Conference of Parties (COP) to the UNFCCC and its subsidiary bodies, where the reporting rules are negotiated and settled. Furthermore NERI participates in the EU MM on GHG, where the guidelines and methodologies on inventories to be prepared by the EU Member States are regulated. The work concerning the annual greenhouse emission inventory is carried out in co-operation with other Danish ministries, research institutes, organisations and companies: a) *Danish Energy Authority,* The Ministry of Transport **and Energy***:* Annual energy statistics in a format suitable for the emission inventory work and fuel use data for the LCPs. b) *Danish Environmental Protection Agency, The Ministry of the Environment:* Database on waste and emissions of the F-gases c) *Statistics Denmark, The Ministry of Economic and Business Affairs:* Statistical yearbook, Sales Statistics for manufacturing industries and agricultural statistics. d) *Danish Institute of Agricultural Sciences, The Ministry of Food, Agriculture and Fisheries*: Data on use of mineral fertiliser, feeding stuff consumption, nitrogen turnover in animals. e) *The Road Directorate,* The Ministry of Transport **and Energy***:* Number of vehicles grouped in categories corresponding to the EU classification, mileage, trip speed. f) *Danish Centre for Forest, Landscape and Planning, The Royal Veterinary and Agricultural University:* Background data for Forestry and CO_2 uptake by forest. g) Civil Aviation Agency of Denmark, The Ministry of Transport **and Energy**: City-pair flight data (aircraft type and origin and destination airports) for all flights leaving major Danish airports. h) *Danish Railways,* The Ministry of Transport **and Energy***:* Fuel related emission factors for diesel locomotives. i) *Danish companies:* Audited Green accounts and direct information gathered from producers and agency enterprises Formerly the providing of data was on a voluntary basis but more formal agreements are now being worked out.	Denmark's National GHG Inventory Report 2007 pp .23-24 Direct Communication Mar 2007

MS	Content	Source
Estonia	The Ministry of the Environment organises the practical providing of GHG inventories. Financial resources for this purpose are planned in the State Budget. Practical work is done on the basis of contracts. The Institute of Ecology at Tallinn University has been responsible for the inventories under contract to the Ministry of the Environment in Estonia until summer 2006. Since 2006 autumn 2 departments of Tallinn University of Technology (TTU) prepare the inventory (Department of Thermal Engineering and Department of Chemistry) and Climate and Ozone Bureau of Estonian Environment Information Centre (EEIC) co-ordinates the process of the inventory preparation. Three specialists are involved in the preparation of the 2005 year inventory: 2 specialists from TTU and 1 specialist from EEIC. Department of Thermal Engineering of TTU is responsible for the preparation of energy and industrial processes inventory sectors including Common Reporting Format (CRF) tables and relevant chapters of the national inventory report. The expert on energy and industrial processes sectors has a long experience in the inventory preparation since 1993. TTU Department of Chemistry is responsible for the preparation of agriculture, waste and LULUCF sectors including CRF tables and relevant chapters of the report. These 3 sectors are prepared by new experts. Inventory compilation takes place in Climate and Ozone Bureau of EEIC. The Ministry of the Environment submits them to the UNFCCC Secretariat and to the European Commission. Methodological improvements in accordance with the "Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories", "Revised 2000 IPCC Guidelines for National Greenhouse Gas Inventories" and the Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, and according to the recommendations by the Expert Review Teams, have been implemented in the present inventory as far as possible and will be implemented in their entirety as soon as possible. The estimation of GHG emissions in Estonia is based on Intergovernmental Panel on Climate Change (IPCC 1996, 2000) tier 1 and tier 2 methods, default emission factors (EFs) and available Estonian data. In deriving emissions/removals estimates for LULUCF IPCC Good Practice Guidance for Land Use, Land-use Change and Forestry (LULUCF) (hereinafter referred to as the IPCC good practice guidance for LULUCF) and the requirements of decision 14/CP.11 were accounted.	Greenhouse Gas Emissions in Estonia 1990-2005 NIR 2007 May 2007 p. 14
Finland	According to the Government resolution of 30 January 2003 on the organisation of climate policy activities of Government authorities Statistics Finland assumes the responsibilities of the National Authority for Finland's greenhouse gas inventory from the beginning of 2005. In Finland the National System is established on a permanent footing in place of the previous, workgroup-based emission calculation and it guides the development of emission calculation in the manner required by the agreements. The national system is based on regulations concerning Statistics Finland, on agreement between the inventory unit and expert organisations on the production of emission estimates and reports as well as on co-operation between the responsible ministries. 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. **Statistics Finland as the National Authority for the inventory** Statistics Finland is the general authority of the official statistics of Finland and is independently responsible for greenhouse gas emission inventory preparation, reporting and submission to the United Nations Framework Convention on Climate Change (UNFCCC). In its activity as the National Authority for the greenhouse gas inventory the Statistics Finland Act and the Statistics Act are applied. Statistics Finland defines the placement of the inventory functions in its working order. An advisory board of the greenhouse gas inventory set up by the Statistics Finland reviews the achieved quality of the inventory and decides about changes to the inventory's division of labour as agreed for the reporting sectors. In addition, the advisory board supervises longer term research and review projects related to the development of the inventory and reporting, as well as the responsibilities of international co-operation in this area (UNFCCC, IPCC, EU). The advisory board is composed of representatives from the expert organisations and the responsible Government ministries. Statistics Finland is in charge of the compilation of the national emission inventory and its quality management in the manner intended in the Kyoto Protocol. As the National Authority Statistics Finland also bears the responsibility for the general administration of the inventory and communication with the UNFCCC, coordinates participation in reviews, and publishes and archives the inventory results. **Responsibilities of expert organisations** Finland's inventory system includes in addition to Statistics Finland the expert organisations that have previously taken part in the emission calculation. With regard to this co-operation, separate agreements are made with the Finnish Environment Institute, MTT Agrifood Research Finland and the Finnish Forest research Institute. Statistics Finland also acquires parts of the inventory as a purchased service. The agreements confirm the division of responsibilities recorded in so-called reporting protocols and they specify the procedures for the annual emission calculation and quality management co-ordinated by Statistics Finland. The reporting protocols are based on the areas of responsibility of the different expert organisations and on Finland's established practice for the preparation and compilation of the GHG emission inventory. The reporting sectors for which Statistics Finland is responsible are also defined in the protocols. **The role of responsible ministries in the national system:** The resources of the National System for the participating expert organisations are channelled through the relevant ministries. performance guidance (Ministry of the Environment and Ministry of Agriculture and Forestry). In addition, other ministries participating in preparation of the climate policy advance in their administrative branch that the data collected in management of public administration duties can be used in the emission inventory. In accordance with the Government resolution, the ministries produce the data needed for international reporting on the content, enforcement and effects of the climate strategy. Statistics Finland assists in the technical preparation of the policy reporting. Statistics Finland also compiled technically the fourth National Communication for the UNFCCC. Separate agreements have been made on division of responsibilities and cooperation between Statistics Finland and the ministries.	GHG Emissions in Finland 1990-2005 National Inventory Report to the European Union Mar 2007- pp. 13-14

MS	Content	Source
France	The responsibility of the definition and control of the National emission inventory (Système National d'Inventaire des Emissions de Polluants dans l'Atmosphère (SNIEPA)) is pertained by the **Ministère de l'Ecologie et du Développement Durable** (MEDD). The MEDD coordinates with other relevant ministries the concerned decisions and relating to SNIEPA the institutional, juridical and the procedural arrangements. This way, it defines the responsibilities to different involved organisations. It carries out the arrangements, which assure the realisation of processes related to the determination of calculation methods, data collection, processing of data, archiving, quality assurance and control, the dissemination according to national and international arrangements. The different requirements lead to the elaboration of an emission inventory often carrying the similar substances and sources justified by the concern for coherence, quality and effectiveness to hold the principle of uniqueness of the inventory. This strategy corresponds to the recommendations of international requests, like the European Commission and the United Nations. The emissions inventories must guarantee quality coherence, comparability, transparency, exactness, punctuality, completeness, which requests the organisation of an administrative as well as technical system. The present chapter describes the organisation of the actual system, which was dealt with in the inter-ministerial decree of 29th decembre 2006 relating to SNIEPA. The responsibilities are as following: The coordination for the realisation of the inventory is assured by MEDD. Other ministries and public organisations contribute by supplying data and statistical information. The elaboration of the inventory concerning methods, the collection and processing of data, archiving and writing of reports and quality issues done by CITEPA (Centre Interprofessionnel Technique d'Etudes de la Pollution Atmosphérique) through MEDD. CITEPA assists MEDD with the coordination of the whole national inventory system, which comprises also emission registries like EPER and other aspects to ensure coherence of information. MEDD makes all information within the existing regulation frame available to CITEPA (like annually emission declarations of classified installations). MEDD guides the GCIIE (Groupe de concertation et d'information sur les inventaires d'émission). GCIIE consists of the following representants: Mission Interministérielle à l'Effet de Serre (MIES), Ministry of Agriculture, notably the Service central des enquêtes et études statistiques (SCEES), Direction générale des politiques économique, européenne et internazionale (DGPEEI), Ministère chargé de l'économie et de l'industrie (MINEFI), Direction générale de la forêt et des affaires rurales (DGFAR), Direction générale de l'INSEE, Direction générale de l'Energie et des Matières Premières (DGEMP), Direction générale du Trésor et de la politique économique (DGTPE), Direction générale des entreprises (DGE), Ministère chargé de l'équipement, de l'urbanisme et des transports (MTETM), Direction des affaires économiques et internationales (DAEI), Direction générale de l'aviation civile (DGAC), Direction générale de la mer et des transports (DGMT), Direction de la sécurité et de la circulation routières (DSCR), Direction générale de l'urbanisme, de l'habitat et de la construction (DGUHC), Centre d'études sur les réseaux, les transports, l'urbanisme et les constructions publiques (CERTU), Ministère de l'Ecologie et du Développement Durable (MEDD), Direction de la prévention des pollutions et des risques (DPPR), la Direction des etudes économiques et de l'évaluation environnementale (D4E); The dissemination of the emissions inventory is split between different organisations which receive the approved inventory by MEDD.	Rapport d'Inventaire National – Organisation et Méthodes des Inventaires nationaux des emissions atmospheriques en France, 1990-2005, Dec 2006 pp. 19-20 (submitted in French, translated)

MS	Content	Source
Germany	According to paragraph 10 (c) and 12 (a) of the *Guidelines for National Systems* a responsible body for the inventory has to be named, in Germany this is the Umweltbundesamt (UBA). **Single National Entity (SNE)**: ***Federal Environmental Agency (UBA), Section I 4.6*** ▪ enacted by the directive of the UBA (Hausanordnung) 11/2005 ▪ is the co-ordinating office of the National System; is charged with serving as the central point of contact and information for all participants in the National System. **Involved institutions and agencies:** (1) *Federal Environmental Agency (UBA)* • Working Gr. on Emissions Inventories: co-ordinates relevant work within the UBA and will incorporate all UBA employees who are involved in inventory preparation. • Working Gr. on Emissions Reporting: founded within "CO_2 Reduction Interministerial Work. Gr." (2002)(implementing emissions-reporting requirements within federal agencies. (2) *Federal Ministry of the Environment, Nature Conservation and Nuclear Safety (BMU)* • Coordinates interministerial discussion on central tasks in emissions inventories. Plans call for *Working Group on Emissions Reporting* to meet three times annually. • Working Group VI will focus on discussing possibilities for institutionalising the Kyoto requirements – for example via an act on implementation. (3) *Federal Ministry for Consumer Protection, Food and Agriculture (BMVEL)* and *German Federal Agricultural Research Centre (FAL)*: provides data on agriculture and forestry (relevant specialised competence)(Rahmen-Ressortvereinbarung BMELV / BMU). (4) *Länder Committee on Immission Protection (LAI):* presents German Länder. This is required for validation of the Energy Balance of Germany with the energy balances of the Länder, as well as for the process for verification of Federal and Länder emissions inventories. (5) *German Institute for Economic Research (DIW)*, which prepares the Energy Balance of Germany on behalf of the *Working Group on Energy Balances* (AGEB). (6) Involvement of *associations* and *other independent organisations* has been achieved via the sections of UBA divisions I and III; specialist departments are supported by SNE in discussion of reporting requirements and in determination of requirements for data-sharing by associations. **Agreements as well as research and development projects:** • Framework departmental agreement (02.04.2001) between *Federal Ministry of Consumer Protection, Food and Agriculture (BMVEL)* and *BMU* marked the first-ever inter-departmental agreement on co-operation in calculation of emissions (data and information exchange and the operation of a joint database on emissions from agriculture). • UFOPLAN framework: Inventory preparation has always made use of the expertise of research institutions (overarching projects on specific issues. Since UFOPLAN 2002, SNE has had a global project on updating emissions-calculation methods; individual measures for improving inventories are initiated and financed via establishment of sub-projects. • Separate budget position for the National System has been established within the UBA as of 2005 (Title 526 02, Chapter 1605, No. 4.15) for research/studies within a short-time. F**ramework conditions for inventory preparation**: establishing a Quality System for Emissions Inventories (QSE); operating the database of the UBA Central System on Emissions (CSE) (central storage of all information required for emissions calculation, main instrument for documentation and quality assurance at the data level); binding schedule.	Nationaler Inventarbericht Zum Deutschen Treibhausgasinventar 1990 - 2005 Apr 2007 pp.50-65 (submitted in German, translated, bases on 2006 NIR))

MS	Content	Source
Greece	The Ministry for the Environment, Physical Planning and Public Works (MEPPPW) 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 Ministry for the Environment 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 Ministry for the Environment (Focal point: Ms. Elpida Politi, Division of Air Pollution Abatement and Noise Control, e-mail: epoliti@minenv.gr, tel.: ++30 210 8677012, fax: ++ 210 8646939, Address: 147, Patission avenue, 11251 Athens, Greece), has the overall responsibility for the national GHG inventory. In this framework and in order to establish the National System foreseen in the Kyoto Protocol and the Decision 280/2004/EC, the Ministry for the Environment is responsible for the following regarding GHG emissions inventory preparation: • the preparation/compilation of the annual national inventory, i.e. the choice of methodologies, data collection (activity data and emission factors, provided by statistical services and other organizations), data processing and archiving, as well as the implementation of general quality control procedures. • the development of an inventory QA/QC plan, in accordance with the provisions of the IPCC Good Practice Guidance (see Chapter 1.4 for a short description of the QA/QC plan). The co-operation with the following government agencies and other entities for the preparation of the inventory as those agencies and entities develop and maintain statistical data necessary for the estimation of GHG emissions / removals. • The *National Statistical Service of Greece*, supervised by the Ministry of Economy and Finance, represents the main source of information for the estimation of emissions / removals from most of the IPCC source / sink categories. • The *Ministry for Development* that is responsible for reporting and maintaining annual statistical data for energy consumption and production as well as for providing those data to international organizations such as the International Energy Agency (IEA), the European Statistical Service EUROSTAT, etc. • The *Ministry of Rural Development and Food* regarding information and data for the main indices and parameters of the rural economy (e.g. animal population, cultivated areas, crops production, etc.) • The *Ministry of Transport and Communication* regarding information and data for the vehicle fleet and its technical characteristics. • The *Civil Aviation Agency*. • The *Public Power Corporation* with a view to improve the representation of the power plants as electricity generation is the main source of GHG emissions in Greece. • *Industrial installations* in order to handle confidentiality issues (e.g. aluminium production, production of chemical compounds) • Information and data concerning Large Combustion Plants, solid waste management and domestic wastewater handling practices are available within the MEPPPW. Further development of formal arrangements for the specification of the roles of and the co-operation between government agencies and other entities involved in the preparation of annual inventory is in progress. The Ministry for the Environment is responsible for the official consideration and approval of the inventory prior to its submission. A committee has been set up within the Ministry, aiming at the monitoring of the inventory preparation/compilation process so as to officially consider and approve the GHG inventory prior to its submission to the European Commission and to the UNFCCC Secretariat and ensure its timely submission. Additionally, procedures involving the Ministry and, if necessary, any government agency or other entity involved, have been established for providing responses to any issues raised by the inventory review process. Finally, an inventory QA/QC plan has been developed, in accordance with the provisions of the IPCC Good Practice Guidance (see Paragraph 1.4 for a short description of the QA/QC plan).	Emission Inventory Information under article 3(1) of the decision 2080/204/EC Jan 2007 pp. 3-4
Hungary	After several reorganisations (see NIR for 2004 for more details), the inventory for 2005 has been prepared by Climate Change and Energy Department of the Ministry of Environment and Water with the contribution of external institutions and experts. As stated in the Initial Report, the National System is based now in the Hungarian Meteorological Service where a core expert team will take over the task of inventory preparation using the same network of outside experts. Some of the employees making the inventory have a decade of experience in preparing emissions inventories. The current inventory has been prepared by experts working in the ministry and the meteorological service and also outside consultants were involved.	NIR for 2005, draft Jan 2007, p 9-10

MS	Content	Source
Ireland	In 2005, UK consultants 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 report (Thistlethwaite et al, 2005) describes how institutional arrangements among the EPA, DEHLG and other stakeholders may be reorganised, extended and legally consolidated across all participating institutions to strengthen inventory capacity within the Agency and ensure that more formal and comprehensive mechanisms of data collection and processing are established for long term implementation. The report sets out the extent of institutional participation, resource requirements and the form of legal arrangements necessary to perform the functions prescribed in the guidelines for national systems and enable Ireland to meet the objectives specified in those guidelines. The consultants' proposals for system development were benchmarked on systems in operation in other EU Member States and they prescribed how the arrangements in place could be enhanced within the existing statutory framework. The scoping report also made recommendations on internal inventory review and proposed a database system to facilitate more efficient data management and reporting. The development of Ireland's national inventory system was largely completed during 2006 and early 2007, building on the framework that has been applied for many years. It establishes 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. This was achieved through extensive discussions with the key data providers leading to the adoption of Memoranda of Understanding between them and the inventory agency stipulating the scope, timing and quality of the inputs necessary for inventory compilation in accordance with the guidelines for national systems. The EPA remains as the inventory agency and is designated as the single national entity with overall responsibility for the annual greenhouse gas inventory. As a formal management system, the national system aims for continuous improvement to increase the quality and robustness the national atmospheric inventory over time.	Ireland National Inventory Report 2007 May 2007 p.7
Italy	Responsible for the compilation of the National Air Emission Inventory: Agency for the Protection of the Environment and for Technical Services (APAT) recognized by the competent Ministries and Administrations. In particular, as National Reference Centre of the European Environment Agency (EEA), APAT is required to prepare the national atmospheric emission inventory in order to ensure compliance with international commitments concerning the protection of the environment. The Italian GHG inventory is compiled and updated annually by the APAT and officially communicated to the UNFCCC and EU, after endorsement by the Ministry for the Environment and Territory. APAT, on behalf of the Ministry for the Environment and Territory, is establishing a robust national system building upon the Sistan, with a sound legal basis. As part of a National Statistical System (Sistan), there are different institutions responsible for annual update of statistical basic data, which provides national official statistics for inventory compilation. The National Statistical System assures 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 by the Italian Decree No 322/89. The system is coordinated by the Italian National Institute of Statistics (ISTAT) whereas other bodies belonging to the National Statistical System are the statistical offices of ministries, national agencies, regions and autonomous provinces, provinces, municipalities, research institutes, chambers of commerce, local governmental offices, some private agencies and private subjects who have specific characteristics determined by law. The main Sistan products, which are primarily used 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 MAP (Ministry of Production Activities); • Transport Statistics Yearbooks, by MINT (Ministry of Transportation); • Annual Statistics on Electrical Energy in Italy, by GRTN (National Independent System Operator); • Annual Report on Waste, by APAT. The national emission inventory itself is also a Sistan product.	Italian Greenhouse Gas Inventory 1990-2004 - National Inventory Report 2006 p. 18 no report for 2007 submission
Latvia	Responsible institutions are designated by the Ordinance of the Cabinet of Ministers No 220 approving the Climate change mitigation programme 2005 - 2010. Institutions responsible for the Latvian GHG inventory: *LEGMA* is a governmental institution under the supervision of the *Ministry of Environment of the Republic of Latvia* and is responsible for preparing GHG inventory. Activity data, mainly collected from other institutions, is used by *LEGMA (Division of Environmental pollution)* to calculate emissions. a. *Central Statistical Bureau of Latvia (CSB)* is the main data supplier for the air emission inventory; *LEGMA* has signed a special agreement with CSB about exchange of information and supply of necessary data. b. The *Ministry of Agriculture (MoA)* is responsible for performing emission calculations for the LULUCF sector. c. *The Ministry of Transport (MoT)* is the main data supplier for road transport sector. d. *Enterprises* Schedule: deadline 1st of November for submitting data (activity data, description, CO_2 removals, emissions from LULUCF) to *LEGMA* for all institutions involved in NIS; only final data regarding fuel consumption was received until 30 of November when CSB prepared Energy balances for EUROSTAT according to additional agreement.	Latvia's National Iventory Report 1990 – 2005 pp.11-12 Direct communica tion Mar 2007

MS	Content	Source
Lithuania	The single entity responsible for the establishment of the yearly GHG inventory and it's submission to European Commission and UNFCCC is the Ministry of Environment, Environmental Quality Department, Air Division. The Head of that Division is the Focal Point for all matters related to the UNFCCC and for the climate change activities under the EC. The national system for the estimation of greenhouse gas emissions is established setting up of inventory preparation group (Inventory Group), which consists of experts from various branches of economy as well as institutions of science and studies. The Group's work is coordinated by the Institute of Ecology. Institute of Ecology is responsible for coordination of the process of annual greenhouse gas inventory, compilation of results, data management and archiving, QA/QC procedures. For estimation of GHG emissions and removals in the LULUCF sector extensive use is made of annual statistics with the aim to obtain the most exact and newest data available in Lithuania. Ministry of Environment annually submits GHG inventory reports to European Commission and UNFCCC secretariat. Before submission, reports are forwarded to the National Climate Change Committee for final approval. A National Committee on Climate Change has been set up in 2001. It consists of experts from academia, government and non-governmental organizations (NGOs) and has an advisory role. The main objective of the Committee is to ensure attaining the goals related to the restriction of GHG emissions as set in the National Sustainable Development Strategy and implementing the measures for attaining such goals. The Committee also has to organize the implementation of the provisions of the UNFCCC and coordinate compliance with the requirements of the Kyoto Protocol and EU legal acts related to the UNFCCC.	National GHG Emission Inventory Report of the Republic of Lithuania 2007, Mar 2007 p. 10
Luxembourg	The Ministry of the Environment acts as the 'National Inventory Compiler' (*NIC*). In this respect, the Ministry is responsible for transmitting the inventories (and its associated NIR) to the European Commission and to the UNFCCC Secretariat. However, in conformity with the law of 27 November 1980, which created an Environment Agency, the national GHG inventories, as well as the NIR, are prepared by the Air/Noise department of this Agency. All the material, estimates and calculation sheets, as well as the documentation on scientific papers and the basic data needed for the inventories compilation, are stored and archived within the Agency; the Ministry keeping only copies of the inventories (CRF tables) and of the related reports (such as the NIR) in its archives. It is worth noticing that the Environment Agency is also responsible for preparing emission inventories under the Convention on Long Range Transboundary Air Pollution (*CLRTAP*) and the EU emission ceilings Directive (*NEC*). Acting as the NIC, the Ministry is controlling the data delivered by the Agency, notably with the help of the CRF Reporter software that helps performing the completeness and inventory checks. It is also the Ministry that generates the final MS Excel CRF tables and prepares the official submission using CRF Reporter. Submission v1.1 of March 2007 is the first one that has been realized by transferring all the data tables into – and therefore using – CRF Reporter. The version of the software that has been used is 3.1.11. Annex III indicates the issues and problems encountered by Luxembourg while transferring data into and using this version of CRF Reporter. During the year 2007, and with the help of a consultant, it is intended to develop further the national GHG inventory system allowing for a full observance of the obligations of the Kyoto Protocol. This work will be realized concomitantly with the verification and the completion of GHG inventories to be carried out in line with the IPCC Good Practice Guidance and Uncertainty Management in National GHG Inventories as well as the IPCC Good Practice Guidance for LULUCF Data used to produce the annual air emission (including GHG) inventories are mainly: • taken from official statistical datasets calculated by the National Statistics Office (*STATEC*); • coming from information supplied directly by the operators of industrial or other activities; • extracted from statistical information received from other ministries (for example Ministry of Economic Affairs and External Trade for energy). However, some of the information necessary to prepare the inventories is not available in Luxembourg. In these cases, data from other European countries or from the literature were taken as default data.	National Inventory Report 1990-2004 Luxembourg Apr 2007 p.1-2 (no report for 2007 submission)
Malta		no report for 2007 submission
Netherlands	Overall responsibility: The Ministry of Housing, Spatial Planning and the Environment (VROM) has overall responsibility for climate change policy issues. The ministry is also responsible for forwarding the NIR and CRF to the EU and UNFCCC. The Netherlands Environmental Assessment Agency (MNP) has been contracted by the Ministry of VROM to compile and maintain the pollutants emission register/ inventory (PER system) and to co-ordinate the preparation of the NIR and filling the CRF. Responsibility for 'designing the National System':In August 2004 the Ministry of VROM assigned SenterNovem executive tasks bearing on the National Inventory Entity (NIE), the single national entity required under the Kyoto Protocol; in December 2005, SenterNovem was designated by law as the NIE. In addition to co-ordinating the establishment of a National System, the tasks of SenterNovem include the overall co-ordination of (improved) QC/QA 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 SenterNovem et al. (2005c). Responsibility for emission estimates: A Pollutant Emission Register (PER) has been in operation in The Netherlands since 1974. This system encompasses the process of data collection, data processing and the registering and reporting of emission data for some 170 policy-relevant compounds and compound groups that are present in the air, water and soil. The emission data are produced in an annual (project) cycle (MNP, 2005). This system is also the basis for the national greenhouse gas inventory. In April 2004 full co-ordination of the PER was outsourced by the Ministry of VROM to the MNP. This has resulted in a clearer definition and separation of responsibilities as well as a clustering of tasks. The main objective of the PER is to produce an annual set of unequivocal emission data that are up-to-date, complete, transparent, comparable, consistent and accurate. In addition to MNP, various external agencies contribute to the PER by performing calculations or submitting activity data (see following section), these include: CBS (Statistics Netherlands), TNO (Netherlands Organisation for Applied Scientific Research), SenterNovem, RIZA (Institute for Inland Water Management) and several institutes related to the Wageningen University and Research Centre (WUR). Responsibility for reporting: The NIR is prepared by MNP. Since mid-2005, the NIR has been part of the PER project. Most institutes involved in the PER also contribute to the NIR (including CBS and TNO, among others). In addition, SenterNovem is involved in its role as NIE.	MNP report 500080 00x Greenhouse Gas Emissions in the Netherlands 1990-2005 National Inventory report 2007 Mar 2007 p20-21

MS	Content	Source
Poland	GHG inventory presented below has been compiled by the National Emission Centre (NEC) established in 2000 at the Institute of Environmental Protection in Warsaw. NEC has been commissioned by the Polish Ministry of Environment to carry out inventories for the GHGs and other pollutants. Since 2006 NEC is located within the National Administrator of Emissions Trading Scheme established also in the Institute of Environmental Protection. When compiling the inventory, NEC have been collaboration with a number of individual experts as wells institutions. Among the latter are: Central Statistical Office (GUS), Agency of Energy Market (ARE), Institute of Ecology of Industrial Areas in Katowice (IETU), Institute of Automobile Transport (ITS) as well as Office for Forest Planning and Management (BULGiL).	National Inventory Report 2005 Poland, Jan 2007 p.6
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 system is to prepare in a timely fashion 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: The Responsible Body appointed is the Institute for the Environment (IA), being responsible for: 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; The sectoral Focal Points work with IA in the preparation of INERPA, and are responsible for fostering intra and inter-sectoral cooperation to ensure a more efficient use of resources; and 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.	Portugese National Inventory report on GHGs, 1990-2005, May 2007, pp5-6
Romania	**Institutional arrangements** **1) Overall responsibility for climate change policy issues: The Ministry of Environment and Water Management (MEWM)** is responsible for reporting the National Greenhouse Gas Inventory (CRF, NIR) to the European Commission and to the Secretariat of United Nations Framework Convention on Climate Change; **2) Authority responsible for preparation/compilation of National Greenhouse Gas Inventory - National Environmental Protection Agency (NEPA):** - designated by Ministry of Environment and Water Management; - NEPA is required to prepare the National GHG Inventory according to the provisions in 1996 Revised IPCC Guidelines for National Greenhouse Gas Inventories, in 2000 IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, to those in 2003 IPCC Good Practice Guidance for Land Use, Land Use Change and Forestry, using the CRF Reporter software; - in order to prepare the National GHG Inventory, NEPA has to follow the next steps: • identifying the key categories and collecting the activity and emissions factors data; • preparation of the estimates of emissions and uptakes levels and of uncertainty analysis; • implementing the QA/QC procedures and recalculating the estimates of emissions/uptakes when needed; • inventory and related primary data archiving **Legal arrangements** According to the provisions in Art. 5 (1) of the Kyoto Protocol, all institutional and procedural aspects needed for estimating the GHG emissions and uptakes levels are reglemented through the Governmental Decision for establishing the National System for estimation of anthropogenic Kyoto GHG emissions levels	Romanian National GHG Inventory Report 2007 v. 1, March 2007, pp. 23-29 Direct communication Mar 2007

MS	Content	Source
Slovakia	**Legal guarantor of report : *Ministry of the Environment*** and **Expert guarantor of report: *Slovak Hydrometeorological Institute*** Setting up a NI system (NIS) of emissions in compliance with the KP and CD 280/2004/EC is the priority of capacity development in Slovakia at all levels identified also as a middle-term objective (2003-2007) of the Strategy towards the Kyoto commitments. The basic characteristics of the capacity building the NIS are follows: • to define a NIS (institutions, competences), which will group the experts from all sectors according to IPCC (NFP, SNE, scientific institutions, universities, research institutes, private sector, non-governmental organisations, Statistical Office...), • to establish an independent working unit entitled the Single National Entity (SNE), which will coordinate the NIS and have competencies and responsibilities stipulated by law. The SNE will be controlled directly by NFP (MŽP SR), including financial resources, • the SNE should interlink all stakeholders at the horizontal level with regard to expert, financial, legal and information issues. The SNE should also be responsible for achieving the commitments under the UNFCCC and KP in the field of reporting, assessment and providing information to all stakeholders, administration of national databases (NEIS, IPPC – air, NEC directive, EPER), implementation of QA/QC process, accreditation and certification, organisation of „cross-country“ meetings and communication with international organisations, • to appoint experts or organisations for each IPCC sector or gas, and explicitly determine their responsibilities; to appoint a team for the work on national communications, modeling and projections of emissions (RAINS, CAFE) in the sense of keeping consistency, reproducibility and transparency, • to obtain dedicated continuous financial sources also for further improvements from the state budget for sustainable fulfilling of commitments (UNFCCC and KP) • to determine the competencies of the NIS and the operators of polluting sources, with regard to the manipulation and dissemination of information. Actually under development (already prepared Terms of Reference and allocated financial resources) the project of the *Slovak Ministry of the Environment* aimed at proposal of national integrated system of inventory and projections of GHG emissions. The project will be carried out in two phases – after the first phase focused on methodological and organisational aspects will in the second one the project aimed at proposal and implementation of required QA/QC parameters and procedures for GHG emission inventory.	Slovak Republic, Annual Report 2006 p.5 no report for Submission 2007
Slovenia	In the Republic of Slovenia, the institution charged with the responsibility for making 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 laid-down time-limit. To this effect, the Environmental Agency has increased the number of its staff. 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 making the inventories. The chief sources of data are the Statistical Office of the Republic of Slovenia and the Ministry of Environment, Spatial Planning and Energy; however, the Environmental Agency obtains much of its data through other activities, which it performs under the Environmental Protection Act. Emissions from two sectors are calculated by two external institutions: emissions from Agriculture are calculated by the Slovenian Agriculture Institute, sinks in the Land Use Change and Forestry sector by the Slovenian Forestry Institute. Owing to the ever increasing obligations of the Republic of Slovenia with regard to reporting, the Environmental Agency of the Republic of Slovenia has decided to implement a unified system of collecting data for the purposes of making inventories, as well as secure reliable financing in accordance with the annual program of its work. The ability to fulfil its obligations with regard to reporting was also improved by the participation of Environmental Agency in the GEF project “Capacity building for improving GHG inventories”, which has finished in June 2006, and thus the Republic of Slovenia has in due time made the inventories and sent them in the required form to the UNFCCC Secretariat. A Memorandum of Understanding has been concluded with institutions that participate in the preparation, binding these institutions to submit quality and verified data to the Environmental Agency in due time, because the time limits for making inventories and the NIR have shortened with the entry of Slovenia into EU, since inventories and part of the NIR for the year before last must be made until 15 January with ability for corrections and final submission of NIR until 15 March. In view of this, an agreement has been reached with the participating institutions for them to shorten the time limits for submitting data. For reasons of complexity, attention was mostly focused on Joint Questionnaires of the Statistical Office of the Republic of Slovenia, on the basis of which the Statistical Office produces the energy balance of the Republic of Slovenia, wherein the most important date on energy sector are to be found.	Slovenia’s National Inventory Report 2007 Mar 2007 pp. 9-13

MS	Content	Source
Spain	In accordance with the provisions of NIS guidelines, each State must designate a single national entity with overall responsibility for the inventory. Although Spain already had an executive centre in charge of preparing inventories, as indicated above, in order to comply specifically with the NIS requirements, the Ministry of the Environment order MAM/1444/2006, dated May 9th, 2006, designated the Directorate-General for Environmental Quality and Evaluation at the Ministry of the Environment as the National Authority for the National Air Pollutant Emissions Inventory System. For the inventory preparation process it is necessary to appoint the obligations for the supply of information to the different Ministries and to establish the competence of their approval. On February 8th 2007 a procedure was decided by the Comisión Delegada del Gobierno para Asuntos Económicos for the mechanism and schedule to obtain this information. A guideline will be elaborated that specifies the type of data that will be requested from the different Ministries and public bodies. This guideline will be periodically updated, especially if methodological changes in the inventory require a different level of detail in the data, in order to ensure time series consistency. Regulatory framework: 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 for the preparation of statistics for State purposes. 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 the 2005-2008 National Statistical Plan, approved by Royal Decree 1 911 dated September 17th, 2004. 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. Within this regulatory framework, inventories have been prepared up until now by the Subdirectorate General for Air Quality and Risk Prevention at the Directorate-General for Environmental Quality and Evaluation in the Spanish Ministry of the Environment in collaboration with different Government Ministries and public bodies with sectorial jurisdiction over activities generating air-polluting emissions.	Inventario de Emisiones de gases de efecto invernadero de Espana, 1990-2005 Apr 2007, pp. 19-20 (submitted in Spanish, translated)
Sweden	*Swedish Ministry of Environment* has the **overall responsibility** and submits the inventory report to the EC and to the UNFCCC. **Co-ordination of activities for developing the inventory report** is by the *Swedish Environmental Protection Agency (Swedish EPA),* which is also responsible for the final quality control and quality assurance of the data before the report is submitted. a) ***Consortium called Swedish Environmental Emissions Data*** *(SMED):* composed of *Statistics Sweden, the Swedish Meteorological and Hydrological Institute (SMHI), the Swedish Environmental Research Institute AB (IVL) and The Swedish University of Agricultural Sciences (SLU)* collects data and calculates emissions for the sectors: energy, industrial processes, solvents and other product use, agriculture, waste and Land Use, Land Use Change and Forestry (LULUCF). a. National Road Administrtaion, the National Rail Administration, The Civil Aviation Administration and the Swedish Military provides data which are combined with national statistics to calculate emissions b. Industrial processes: Operators perfoming hazardous activities are required by law to compile and send annual environmental reports. c. Swedish Chemical Inspectroate provides AD and EF for Solvent and Other product use. d. Swedish Association for Waste Management (RVF) provides statistics on deposited waste quantities, methan recovery and nitrogen emissions from waste water handling. e. The Swedish University of Agricultural Sciences (SLU) is involved in calculating emissions and removals for the sector Land Use, Land Use Change and Forestry (LULUCF). Data storage: 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. A national system meeting the requirements of Art 5.1 Kyoto protocol is fully operational since 2006.	Sweden's National Inventory Report 2007 Dec 2006 pp.25-38 direct communica tion Mar 2007

MS	Content	Source
UK	The UK Government Department for Environment, Food and Rural Affairs (Defra) has been appointed as the Single National Entity for the UK and this has been confirmed in writing to the UN Executive Secretary. Defra has overall responsibility for the UK Greenhouse Gas Inventory and the UK National System and carries out this function on behalf of Her Majesty's Government and the Devolved Administrations (Wales, Scotland and Northern Ireland). Defra is responsible for the institutional, legal and procedural arrangements for the national system and for the strategic development of the national inventory. AEA Energy and Environment compiles the GHGI on behalf of Defra, and produces disaggregated estimates for the Devolved Administrations within the UK. Key Data Providers include other Government Departments such as Department for Trade and Industry (DTI) 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) and UK Offshore Oil Association (UKOOA). Within Defra, the Climate Energy Science Analysis (CESA) Division administers this responsibility. CESA coordinates expertise from across Government and manages research contracts to ensure that the UK Greenhouse Gas Inventory meets international standards set out in the UNFCCC reporting guidelines, the Kyoto Protocol and the IPCC 1996 Guidelines and IPCC Good Practice Guidance. As the designated Single National Entity for the UK GHG NIS, Defra has the following roles and responsibilities: *National Inventory System Management & Planning* ▶ Overall control of the NIS development & function; ▶ Management of contracts & delivery of GHG inventory; ▶ Definition of performance criteria for NIS key organisations. *Development of Legal & Contractual Infrastructure* ▶ Review of legal & organisational structure; ▶ Implementation of legal instruments and contractual developments as required to meet guidelines. Defra manages three main contracts that underpin the preparation and development of the national inventory, covering greenhouse gas emissions and removals; these contracts are currently with AEA Energy and Environment, CEH and IGER. AEA Energy and Environment is contracted by Defra to perform the role of Inventory Agency and is responsible for all aspects of national inventory preparation, reporting and quality management. AEA Energy and Environment prepares the national atmospheric emissions inventory (NAEI) which is the core air emissions database from which the greenhouse gas inventory (GHGI) is extracted to ensure consistency in reporting across all air emissions for different reporting purposes (UNFCCC, UNECE etc). Activities include: collecting and processing data from a wide range of sources; selecting appropriate emission factors and estimation methods according to IPCC guidance; compiling the inventory; managing all aspects of inventory QA/QC including QC of raw data and data management tools, documentation and archiving, prioritisation of methodology and raw data improvements; carrying out uncertainty assessments; delivering the NIR (including CRF tables) by deadlines set to the EU Monitoring Mechanism (EUMM) and the UNFCCC on behalf of Defra; assisting with Article 8 reviews.	UK GHG Inventory, 1990-2005 for submission under the UNFCCC Draft Report Mar 2007 pp.4-9

1.2.2 The European Commission, Directorate-General for the Environment

The European Commission's DG Environment in consultation with the Member States has the overall responsibility for the EC 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 Environment; and the European Commission, DG Environment itself submits the inventory and inventory report of the EC to the UNFCCC Secretariat. In the actual compilation of the EC inventory and inventory report, the European Commission, DG Environment, is assisted by the EEA including its ETC/ACC and by Eurostat and the JRC.

The consultation between the DG Environment 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 Environment. 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 EC inventory and the preparation of proposals for improvements where needed.

1.2.3 The European Environment Agency

The European Environment Agency assists the European Commission, DG Environment, in the compilation of the annual EC inventory through the work of the ETC/ACC. The activities of the ETC/ACC 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 EC inventory and inventory report by 28 February based on Member States' submissions;
- preparation of the final EC 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/ACC 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.eu.int/). 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/ACC (see http://cdr.eionet.eu.int/).

1.2.4 The European Topic Centre on Air and Climate Change

The European Topic Centre on Air and Climate Change (ETC/ACC) was established by a contract between the lead organisation Milieu-en Natuurplanbureau (MNP) in the Netherlands and EEA in March 2001. The ETC/ACC involves 11 organisations and institutions in eight European countries. The technical annex for the 2007 work plan for the ETC/ACC and an implementation plan specify the specific tasks of the ETC/ACC partner organisations with regard to the preparation of the EC inventory. Umweltbundesamt Austria is the task leader for the compilation of the EC annual inventory in the ETC/ACC, including all tasks mentioned above.

The ETC/ACC 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/ACC adapts the tools regularly to the latest changes in reporting requirements. The tools are available at http://etc-acc.eionet.eu.int/.

1.2.5 Eurostat

Based on Eurostat energy balance data, Eurostat compiles annually by 31 March estimates of the EC 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 EC project aimed at improving estimates of GHG emissions from international aviation.

1.2.6 Joint Research Centre

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 EC-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 EC inventory.

1.3 A description of the process of inventory preparation

The annual process of compilation of the EC 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 Environment. Then, the ETC/ACC, Eurostat and the JRC perform initial checks of the submitted data up to 28 February. The ETC/ACC transfers the nationally submitted data from the spreadsheet format of the common reporting format (CRF) tables into spreadsheets. From these spreadsheets the data is transferred into the EC CRF tables and into the ETC/ACC database. The ETC/ACC has developped a software for using the xml-files created by the new UNFCCC CRF reporter software for aggregating the EC submission (CRF aggregator). This software is currently being tested intensively in order to be ready for use for the next submission.

Table 1.3 Annual process of submission and review of Member States inventories and compilation of the EC 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 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 EC inventory	Commission (incl. Eurostat, the JRC), assisted by the EEA	up to 28 February	Draft EC inventory (by EEA), based on Member States' inventories and additional information where needed.
4. Circulation of draft EC inventory	Commission (DG Environment) assisted by the EEA	28 February	Circulation of the draft EC 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 Environment) 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 EC inventory (incl. Community inventory report)	Commission (DG Environment) assisted by EEA	15 April	Submission to UNFCCC of the final annual EC inventory. This inventory will also be used to evaluate progress as part of the monitoring mechanism.
9. Circulation of initial check results of the EC submission to Member States	Commission (DG Environment) assisted by EEA	As soon as possible after receipt of initial check results	Commission circulates the initial check results of the EC 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 EC 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.

Element	Who	When	What
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 EC resubmission. As the EC 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 EC 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 EC 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 EC inventory report and send updates, if necessary, and review the EC inventory report by 15 March. This procedure should assure the timely submission of the EC GHG inventory and inventory report to the UNFCCC Secretariat and it should guarantee that the EC submission to the UNFCCC Secretariat is consistent with the Member State UNFCCC submissions.

The final EC GHG inventory and inventory report is prepared by the ETC/ACC by 15 April for submission to the UNFCCC Secretariat. Resubmissions of the EC GHG inventory and inventory report are prepared by 27 May, if needed. Within five weeks after 15 April, Member States should provide to the Commission any resubmission in response to the UNFCCC initial checks which affects the EC inventory, in order to guarantee that the EC resubmission to the UNFCCC Secretariat is consistent with the Member States' resubmissions. In June the inventory and the inventory report are published on the EEA website (http://www.eea.eu.int) and the data are made available through the EEA data warehouse (http://dataservice.eea.eu.int/dataservice). In addition, the EC inventory report is published by the EEA as a printed report, with a CD-ROM including the data.

1.4 General description of methodologies and data sources used

The EC 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 ([9]). 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 EC GHG inventory, Council Decision No 280/2004/EC and the Commission Decision 2005/166/EC.

The EC GHG gas inventory is compiled on the basis of the inventories of the 15 or 27 Member States. The emissions of each source category are the sum of the emissions of the respective source and sink categories of the 15 or 27 Member States. This is also valid for the base year estimate of the EU-15 GHG inventory. Table 1.4 shows the base year emissions for EC Member States and EU-15.

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

EC MS	CO_2, CH_4, N_2O	HFC, PFC, SF_6	Base year emissions [1] (Tonnes CO_2 equivalents)
EU-15 Member States			
Austria	1990	1990	78,959,404
Belgium	1990	1995	146,890,526
Denmark	1990	1995	69,323,336
Finland	1990	1995	71,096,195
France	1990	1990	563,925,328
Germany	1990	1995	1,232,536,951
Greece	1990	1995	111,054,072
Ireland	1990	1995	55,780,237
Italy	1990	1990	519,464,323
Luxembourg	1990	1995	12,686,610
Netherlands	1990	1995	214,588,451
Portugal	1990	1995	60,938,032
Spain	1990	1995	289,385,637
Sweden	1990	1995	72,281,599
United Kingdom	1990	1995	779,904,144
EU-15	1990	1990 (AT, FR, IT) 1995 (other MS)	4,278,814,845
New Member States			
Bulgaria [2]	1988	1988	132,303,158
Cyprus	Not relevant	Not relevant	
Czech Republic	1990	1995	196,280,576
Estonia	1990	1995	43,022,295
Hungary	1985-87	1995	123,034,090
Latvia	1990	1995	25,894,218
Lithuania	1990	1995	48,103,464
Malta	Not relevant	Not relevant	
Poland	1988	1995	586,902,634
Romania	1989	1989	282,467,184
Slovakia	1990	1990	73,360,100
Slovenia	1986	1995	20,203,252

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.
2) For Bulgaria no initial reports is available. Therefore this tables includes GHG emissions excluding LULUCF as reported in the latest GHG inventory for the base year.

Source: The European Community's initial report under the Kyoto Protocol, EEA Technical report No. 10/2006, Romania’s Initial Report under the Kyoto Protocol and GHG inventoriy submission for Bulgaria (2007)

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 due to deforestation for the Netherlands, Portugal and the UK (see EC Initial report, EEA, 2006c).

The reference approach is calculated for the EU-15 on the basis of Eurostat energy data (see Section 3.6) and the key source 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 EC GHG inventory data. The EC believes that it is consistent with the UNFCCC reporting guidelines and the IPCC good practice guidelines to use different methodologies for one source category across the EC 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 guidelines.

In general, no separate methodological information is provided at EC level except summaries of methodologies used by Member States. However, for some sectors quality improvement projects have

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

been started 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 agriculture and waste.

The EU-15 CRF Table Summary 3 in Annex 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. Annex 1 shows the information on methods used, emission factors and activity data as provided by the Member States in accordance with Commission Decision 2005/166/EC. In addition, also the sector-specific chapters list the methodologies and emission factors used by the Member States for each EC key source.

Annex 12 includes the CRF Table Summary 3 for those Member States that submitted these tables in 2005. Detailed information on methodologies used by the Member States is available in the Member States national inventory reports, which are included in Annex 12. Note that all Member States' submissions (CRF tables and national inventory reports), which are included in Annex 12 and made available at the EEA website, are considered to be part of the EC submission.

Internal consistency of the EU-15 CRF tables

There are some consistency problems when compiling the EC 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. This often is due to confidentiality issues and mainly refers to the source categories 2.E and 2.F. 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, Annexes 4-10 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 EC CRF tables. Table 1.5 lists the procedures applied (and marked in yellow in the respective annexes):

Table 1.5 Internal consistency of the EU-15 CRF tables and reallocation of sources

Energy:	
• Table 1A(a): • Table 1B1: • Table 1C:	- for some Member States additional information provided by the Member States during the consultation process was used.
Industrial processes	
• Table 2(I):	- the sum of 2B was included in 2B5 when a MS reports only notation keys - the sum of 2E was included in 2E1 when a MS reports only notation keys - the sum of 2F was included in 2F9 when a MS reports only notation keys
• Table 2(II):	- This table was made consistent for those MS who reported notation keys or did not report this table. In these cases emissions were transferred into columns 'unspecified mix of …'.
• Table 2.(II).F	- 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.
• Table 2.(I): • Table 2(I).A-G: • Table 2.(II):	- for some Member States additional information provided by the Member States during the consultation process was used.
Solvent use	
• Table 3	- the sum of 3D was included in 3D5 when a MS reports only notation keys
Agriculture	
• Table 4	- the sum of 4D was included in 4D4 when a MS reports only notation keys - SO_2 emissions from 4F were included in 4G - CH_4 removals are missing the CRF tables because CRF Reporter software does not allow entry of negative emissions in this source category
• Table 4A: • Table 4.B(a): • Table 4.B(b): • Table 4D:	- for some Member States additional information provided by the Member States during the consultation process was used.

LULUCF	
• Table 5	NMVOC and SO_2 emissions from 5G were included in sector 7 'Other' because the CRF Reporter does not allow entry of these emissions in sector 5
Waste	
• Table 6 • Table 6A: • Table 6B: • Table 6C:	N_2O and SO_2 emissions of 6A were included in sector 6D, because the CRF Reporter software does not allow N_2O and SO_2 emissions under 6A. - for some Member States additional information provided by the Member States during the consultation process was used.

1.5 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 level[11]. 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 source 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 EC level. The Member States use their key category analysis for improving the quality of emission estimates at Member State level.

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 all years between the base year and 2005 and a trend assessment was performed for the base year to 2005. The assessment was carried out for emissions excluding LULUCF and including LULUCF.

- The key category analysis excluding LULUCF resulted in the identification of 81 key categories for the EU-15 and cover 97 % of total EU-15 GHG emissions in 2005. The key category analysis including LULUCF resulted in 85 key categories. More details related to the key category analysis are included in Annex 1.

In Chapters 3 to 9 for each key source overview tables are presented which include the Member States' contributions to the EU-15 key source in terms of level and trend.

[11] 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.

1.6 Information on the quality assurance and quality control plan

1.6.1 Quality assurance and quality control of the European Community inventory

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

The EC QA/QC programme describes the quality objectives and the inventory quality assurance and quality control plan for the EC 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 EC QA/QC programme will be reviewed annually and modified or updated as appropriate.

The European Commission (Directorate General for Environment) is responsible for coordinating QA/QC activities for the EC 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 EC inventory.

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

- to provide an EC 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 EC 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 EC 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 EC 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 Community 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 the Community level. Secondly, checks are carried out to ensure that the data are compiled correctly at the Community 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 EC 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 EC 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 EC manual is that the EC 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 EC quality manual the EC 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 EC quality management system.

The EC quality management manual is structured along three main processes (management processes, inventory compilation processes, supporting processes) of the quality management system (See Table 1.6).

Table 1.6 Structure of the EC quality management manual

Chapter		**Chapter description**
Management processes		
ETC 01	EC inventory system	Describes the organisation and responsibilities within the EC GHG inventory system
ETC 02	QA/QC programme	Describes the preparation and evaluation of the EC 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 EC 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 EC Member States
ETC 09	QC EC inventory compilation	Describes the quality control activities performed during the compilation of the EC GHG inventory including checks of database integrity
ETC 10	QC EC inventory report	Describes the checks carried out during and after the compilation of the EC 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:

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-ACC 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 3 of this report.

The consistency checks of Member States data primarily aim at identifying main problems in time series or sub-category sums. For the time series checks the algorithms of the UNFCCC secretariat are used. In addition, the ETC/ACC identifies problems by comparison with the previous year's inventory submission of the Member States and checks the availability of the CRF tables needed for the compilation of the EC inventory. The results of these checks are documented in the consistency reports and are also sent to the Member States by 28 February, in order to obtain, if needed, revised emission estimates or additional information.

For the sectors energy, industrial processes, agriculture, LULUCF and waste sector-specific checks are performed by the sector experts and documented in sector-specific forms/checklists. In addition, sector experts receive the results of checks with the UNFCCC outlier tool before they are sent to the Member States. The main findings of the sector specific checklists are transferred to/also documented in the consistency reports.

For every updated inventory submission provided by the MS by 15 March follow-up checks are performed and the status reports are completed; for new submissions a consistency report is prepared. In addition it is checked if issues identified in the status reports and in the consistency reports (initial checks), which are relevant for the EC inventory (report) have been clarified by the MS. If this is not the case MS are contacted for clarification.

Quality control EC inventory compilation

After the initial checks of the emission data, the ETC/ACC transfers the national data from the CRF tables into spreadsheets and into the ETC/ACC database on emissions of GHG and air pollutants. The version of the data received by ETC/ACC are numbered, in order to be traced back to their source. The ETC/ACC database is a relational database (MS Access) and maintained and managed by Umweltbundesamt Austria.

As the EC GHG inventory is compiled on the basis of the inventories of the EC Member States, the focus of the quality control checks performed during the compilation of the EC 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 EC 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'.

Quality checks EC inventory report

The checks carried out during and after the compilation of the EC GHG inventory report are specified in the checklist 'EC 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 EC inventory and inventory report on 28 February to the EC Member States for reviewing and commenting also aims to improve the quality of the EC inventory and inventory report. The Member States check their national data and information used in the EC inventory report and send updates, if necessary, and review the EC inventory report. This procedure should assure the timely submission of the EC GHG inventory and inventory report to the UNFCCC Secretariat and it should guarantee that the EC submission to the UNFCCC Secretariat is consistent with the Member States UNFCCC submissions.

Finally, also the detailed analysis of GHG emission trends of the EC and each EC Member State after the submission of the EC inventory to the UNFCCC also contributes to improving the quality of the EC GHG inventory. This analysis is carried out in the annual EC GHG trend and projections report (see EEA, 2006b); the report identifies sectoral indicators, for socioeconomic driving forces of greenhouse gas emissions, by using data from Eurostat or from Member States' detailed inventories. In addition, it compares and analyses Member States' emission trends in the EC key sources and provides main explanations, either socioeconomic developments or policies and measures, for these trends in some Member States.

EC internal review

A collaborative internal review mechanism is established within the European Community 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/ACC 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 EC level.

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 EC 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'.

UNFCCC reviews

In addition, European Community 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:

(a) 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;

(b) 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;

(c) Reviews of the extent to which issues identified through this procedure in previous years have been addressed by Member States;

(d) Ongoing investigations of ways to produce a more transparent inventory for the unique circumstances of the European Community.

Improvement plan

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

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

As the EC GHG inventory is based on the annual inventories of the EC Member States, the quality of the EC inventory depends on the quality of the Member States’ inventories and their QA/QC procedures. The following Table 1.7 gives an overview of QA/QC procedures in place at Member State level. The information is taken from the Member State national inventory reports 2006 and 2007.

Table 1.8 Overview of quality assurance and quality control procedures in place 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 International Standard ISO 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 17020 are met, which include strict independence, impartiality and integrity. 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 2006. Since the last submission, a successful accreditation audit of the Umweltbundesamt as inspection body has taken place. Formal accreditation took place in January 2006.	Austria's National Inventory Report 2007 Submission under the EC MM (2007) Apr 2007 p. 37-40
Belgium	The Working Group on « Emissions » of the *Co-ordination Committee for International Environmental Policy* (CCIEP) has conducted intern quality insurance and quality control work by continuously exchanging information about methodologies used and estimated results. Feedback is given and extra controls are made by the responsible person for compiling the Belgian emission inventory of greenhouse gases. As a consequence this all gives extra checks of the regional emission inventories as well. Independent audits of the greenhouse gas inventories of the regions and the national inventory have started in the course of 2002 and all the results of the 3 regions in Belgium became available in 2003. The purpose of these audits was to analyse the difficulties encountered while compiling the regional and national emission inventories in order to improve the quality and completeness of the Belgian national emission inventory and to evaluate the differences met between the present process of information and the IPCC Guidelines and the obligations need to be fulfilled in the framework of the Kyoto Protocol. The results of these audits of greenhouse gases show clearly that - taking into account the limitations in available time, manpower and means – the Belgian national inventory is of qualitative good value. The difference between the actual situation in Belgium and the fulfilling of the IPCC Guidelines is mainly the absence of the complete implementation of the IPCC Good Practice Guidance [10] for the Belgian emission inventory. 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 try to limit the inconsistencies between the 3 regional emission inventories in Belgium as much as possible. The overall conclusion in the different technical working groups was that the regional and the national inventories in Belgium are set up to the best of the ability, that appropriate methods are used for all sectors and in accordance with the IPCC Good Practice Guidance. *Regional level - QA/QC in Flanders:* In Flanders, the procedures to prepare the Flemish energy balance are part of a certified ISO 9001 system since July 2000. The certificate number is 08376-2003-AQ-ROT-BELCERT. This certificate is currently applicable to the development and implementation of complete evaluation methods and management concepts for the sustainable use of materials, energy and environment, including the electronic distribution of information on energy and environmental information (EMIS). The quality system consists of quality procedures and planning activities. Specific for the preparation of the energy balance, there are 7 procedures in place. In the beginning of 2004, in Flanders a study started to calculate the uncertainties (both on Tier 1 and Tier 2 level) and to guide in the implementation of a quality system (QA/QC-plan) of the emission inventory of greenhouse gases. Final results of this study became available in May 2004. A complete development of the QA/QC system (among others further description in detail of all the procedures involved) as well as a first internal review became operational in the course of 2005, this means that the full implementation for all sectors and on the most detailed level is started in the beginning of 2006. The quality system set up in Flanders is completely based on the standardized norm ISO 9001:2000. In the process of development of the quality management system in Flanders, a gap-analysis was carried out, a quality structure and different standardized procedures were set up. A quality handbook was published which includes all aspects of a technical and organizational level to set up the emission inventory of GHG. Standardized procedures of different levels are defined. *Regional level - QA/QC in Wallonia:* In Wallonia, the inventory is conducted by the Air Cell, which is part of the General Directorate for Natural Resources and Environment, and the latter has now obtained its EMAS certification. An ISO 9001 certification is also foreseen. For what concerns the measurements used to determine country-specific emission factors, it can be mentioned that in Wallonia, before performing any air emissions measurements, all the laboratories must first be agreed by ISSEP, which conducts a review of material and methodologies used and check the compliance with the requirements of a legal decree (Arrêté royal du 13 décembre 1966 relatif aux conditions et modalités d'agrément des laboratoires et organismes chargés des prélèvements, analyses et recherches dans le cadre de la lutte contre la pollution atmosphérique (M.B. 14.02.1967)) .The updated list of agreed laboratories is published on the website of DGRNE, the responsible institut in Wallonia. Regional level - QA/QC in Brussels Capital Region: In the Brussels region, the energy balance is established by an independent institute, ICEDD (Institut de Conseil et d'Etudes en Développement Durable), who is certified ISO 9001 for its internal procedures. For information, the emissions from energy consumption constitute nearly all the emissions of this urban region.	Belgium's Greenhouse Gas Inventory (1990-2005), Mar 2007, pp. 8-10

MS	Description of the national QA/QC activities	Source
Bulgaria	Drawing up the GHG inventory is an aggregate of activities, subject of quality assessment and quality control. The systems for quality assessment and quality control (QA/QC) are part of working procedures in the Bulgarian companies and organizations, and are subject of international quality control certification. discussed herein: preparation of initial data and calculation of the GHG emissions; and compiling of original CRF Tables and the National Inventory Report. Quality Management of the Sources of Initial Data Each organization – data source, solves the quality management issues in accordance with its internal rules and provisions. With some of the sources as NSI, MOI, etc., those rules follow strictly the international practices. For example, quality assessment/quality control procedures with NSI have been harmonized with the relevant instructions and provisions of EUROSTAT. Strict rules on data processing and storage, harmonized with international organizations such as Interpol, the US and European intelligent services, have been introduced within MOI. Some of the large enterprises – GHG emission sources, have well arranged and effective quality management systems. Most of them have introduced quality management systems on the basis of ISO 9001:2000 standard. Quality Management of the National Inventory Report and the CRF Tables The main point of the inventory process is focused on the final results to be reported in the National Inventory Report and the CRF Tables. The Quality Management System (QMS) is responsible for obtaining the final results. Such a system, certified on ISO 9001:2000 standard, has been introduced in the Energy Institute. The QMS contains all rules and procedures for management and control of the entire inventory process. Furthermore, specific checks are to be made at different inventory stages, thus additionally verifying the data, received by the original sources. Together with development of National monitoring system for air pollutants including GHG emissions would be assessed the anthropogenic GHG emissions (requirement of Art. 5 of the Kyoto Protocol). The development of the system will started in 2006.	National Inventory Report 2004, Submission 2006; p. 35-36
Cyprus	During the last year, quality assurance and quality control procedures for the preparation of the national emission inventory have been established in Cyprus. These procedures are considered to be preliminary as it is the first time they have been implemented. In the following years our efforts will focus on the implementation of a more effective QA/QC procedure. 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 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. Data provided by the Statistical Service of Cyprus are characterised by independence, integrity and accountability. Hence, these data are not subjected to any checking.	Emissions Inventory, Mar 2007; p.18-19

MS	Description of the national QA/QC activities	Source
Czech Republic	Preparation of a QA/QC plan is one of the most important parts of the NIS. Elaboration of the QA/QC plan reflects the institutional arrangements and each sectoral compiler should elaborate its own system of QA/QC procedures, incl. designation of a responsible QA/QC expert for each sector. Sectoral QA/QC plans are integral parts of the overall NIS QA/QC plan being elaborated by the NIS manager. Quality control procedures (QC): QC is designed to provide routine technical checks to measure and control the quality of the inventory, to ensure consistency, integrity, correctness, and completeness of the data and to identify and address errors and omissions. Its scope covers a wide range of inventory processes, from data acquisition and handling and application of the approved procedures and methods to calculation of estimates and documentation. These procedures are performed according to the IPCC Good Practice Guidance, 2000 (GPG). QC procedures are carried out both by sectoral compilers and by the NIS manager. Sectoral compilers concentrate more on activity data and the sector-specific methods used; the NIS manager mostly checks appropriate use of methodologies, provides trend analyses and compares data from other possible sources. After completing the sectoral inventories, the NIS manager performs a final detailed check. In accordance with GPG, all the described procedures correspond mainly to the Tier 1 QC approach. The Tier 2 approach has so far been used only in some specific cases (e.g. in the transport sub-sector, where activity data based on energy statistics are combined with activity data based on transport statistics). Appropriate use of EFs is discussed in a similar way. Quality assurance procedures (QA): QA generally consists of independent third-party review activities to ensure that the inventory represents the best possible estimates of emissions and removals and to support the effectiveness of the QC program. Experts from the Slovak Hydrometeorological Institute (responsibility for the GHG inventory in Slovakia) regularly perform a detail review of the draft GHG estimates in December. As part of the approval process, the MoE also reviews the draft of the GHG inventory. All the procedures are recorded and archived. The results of reviews, together with the findings of the review process performed by an international review team organized by UN FCCC, are utilized in the process of inventory planning for the coming years. The relevant findings are analysed by the NIS manager in co-operation with the sectoral compilers to eliminate possible omissions and imperfections.	National Greenhous Gas Inventory (1990-2005) May 2007, pp. 20
Denmark	The implementing plan for a QC/QA for GHG emission inventories is performed by the Danish National Environmental Research Institute NERI. The plan is in accordance with the GPG. The ISO 9000 standards are also used as important input for the plan. In the preparation of Denmark's annual emission inventory several quality control (QC) procedures are carried out already as described in GPG chapters 3-8. The QA/QC plan will continuesly 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 a setting up a system for the process of the inventory work. The product specification for the inventory is a data set of emission figures and the process is thus identical with the data flow in the preparation of the inventory. Quality Procedures are defined for data storage and data processing at different levels, points of measurements for each sector are defined. There exist several topics for making priority sources listing as (1) The contribution to the total emission figure (key source listing); (2) The contribution to the total uncertainty; (3) Most critical sources in relation to implementation of new methodologies and thus highest risk for miscalculations. All the points of measurements are necessary for different aspects of the quality work. The listing of points will be used continuously to secure implementation of the full quality scheme on the most relevant sources. Verification in relation to other countries has been undertaken for priority sources a report in draft has been prepared.	Denmark's National Inventory Report 2007 Section 1.6 (direct communication)
Estonia	This section presents the general QA/QC programme 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. During preparation of the Estonian 2005 national greenhouse gases (GHG) inventory, "Estonia's National Greenhouse Gas Inventory Quality Control Plan" was implemented. Specific checks were completed. Quality assurance/quality control plan is under development. General (Tier 1) Quality Control (QC) procedures are applied to all categories as following: activity data are compiled and Cross-checked; mostly default factors are used; all units are checked. The Ministry of the Environment bears the responsibility of archiving the quality manual and the 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. To meet the inventory QA system a specialist was hired in 2006 to Estonian Environment Information Centre in the Climate and Ozone Bureau. This specialist is hired to put together and review the National Inventory report. Tallinn Technical University produces the national GHG inventories under contract to the Ministry of the Environment in Estonia. Inventory capacity is severely limited as inventory experts are engaged only on a part-time basis and there is little direct involvement of other, external experts. At this moment Estonia doesn't have external experts, who are independent from the inventory preparation, to review the inventory report. The expert organisation contributing to the production of emission or removal estimates are responsible for the quality of their own inventory calculations. Also to verify the completeness of the CRF tables, the completeness checks are carried out in the CRF Reporter. Tier 1 QC checks for key sources of Energy, Industrial Processes, Waste, Agriculture and LULUC sectors were carried out. The checks incorporated in the CRF reporter were undertaken for the period 1990 – 2005 (checklists of QC are presented in Annex 2 in the Estonian NIR).	GHG Emissions in Estonia 1990–2005 NIR to UNFCCC, p. 19-21 Apr 2007

MS	Description of the national QA/QC activities	Source
Finland	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. The principles and elements of the quality management system are congruent both with international agreements and guidelines concerning greenhouse gas inventories and with the ISO 9001:2000 standard. ISO 9001- certification is under consideration. As the national entity, Statistics Finland bears the responsibility and has the resources for the co-ordination of the quality management measures for the partners of the national system and for the quality management of the greenhouse gas inventory at the national level. The expert organisations contributing to the production of emission or removal estimates are responsible for the quality of their own inventory calculations. The quality of the inventory is ensured in the course of the compilation and reporting, that consists of four main stages: planning, preparation, evaluation and improvement. The quality management of inventory is a continuous process that starts from the consideration of the inventory principles. The setting of concrete annual quality objectives is based on this consideration. The next step is elaboration of the QA/QC plan and implementing the appropriate quality control measures (e.g. routine checks, documentation) focused on meeting the quality objectives set and fulfilling the requirements. In addition, the quality assurance procedures are planned and implemented. In the improvement phase of the inventory, conclusions are made on the basis of the realised QA/QC process and its results. A clear set of documents is produced on the different work phases of the inventory. The documentation ensures the transparency of the inventory: it enables external evaluation of the inventory and, where necessary, its replication. A quality manual of the national greenhouse gas inventory system including guidelines, annual plans, templates, documentation of methodologies and work processes and checklists of QA/QC procedures is in preparation and will be in place in 2007. Statistics Finland bears the responsibility of archiving the quality manual and the 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..	GHG Emissions in Finland 1990-2005 National Inventory Report to the EU 2007 Apr 2007 pp. 20-26
France	The national system of emission inventory is established by integrating the usual criteria applicable to quality systems (Systèmes de Management de la Qualité, SMQ). The CITEPA, which has the responsibility of carry out the technical level the national emission inventories set up such a system based on the ISO9001- version 2000. This provision is confirmed by the certificate issued by the AFAQ in 2004. The realization of the national emission inventories is covered by the SMQ through several specific processes set down in the quality manual unpublished. Within this framework, several processes relating to QA/QC of the inventories are integrated in the various processes and procedures implemented, corresponding to the various phases and actions. The global objective of QA/QC is to support the realisation of national inventories and to be conform with the of different national and international requirements by SNIEPA. The set criteria are completeness, accuracy, consistency, comparability, transparency, timeliness and confidentiality. Quality control is integrated in different phases. CITEPA is responsible for the technical coordination and the compilation of the inventory and required to follow quality control procedures, formulate recommendation for improvement and develop the necessary procedures. This corresponds to the accuracy of information, the conformity of methods, adequacy of tools and the format of communication. There are different ways to check these, e.g. check-list, simulation. Quasi all requirements outlined in the Good Practise Guidance are realised. Quality Assurance is assured by reviews, comments and public evaluations. The specific action to assure quality are listed in the NIR.	Inventaire des émissions de gaz à effet de serre en France de 1990 à 2005 Dec 2006, pp.28-30
Germany	Pursuant to the IPCC Good Practice Guidance requirements, the necessary QC/QA measures for emissions reporting should be summarised in a QC/QA plan. Such a QC/QA plan is to serve the primary purpose of organising, planning and monitoring such QC/QA measures. The international requirements for quality assurance and quality control measures in emissions reporting for the National System of Emissions Inventories (NaSE) in Germany have been specified in the "Manual for quality control and quality assurance in preparation of emissions inventories and reporting under the UN Framework Convention on Climate and EU Decision 280/2004/EC" ("Handbuch zur Qualitätskontrolle und Qualitätssicherung bei der Erstellung von Emissionsinventaren und der Berichterstattung unter der Klimarahmenkonvention der Vereinten Nationen sowie der EU Entscheidung 280/2004/EG" (Federal Environmental Agency, unpublished, 2005). This document, which is binding for the Federal Environmental Agency, describes the Quality System of Emissions Inventories (QSE). A first systematic evaluation of all inventory data with regard to their quality in 2002 was carried out in research project 202 42 266 (UBA, 2004), which was designed to support implementation of requirements from the Good Practice Guidance in inventory preparation and which was charged both with preparing the QSE Handbuch and determining relevant uncertainties (cf. Chapter 1.7). In this framework, a central quality assurance and control plan for the German inventory was also prepared. The QC plan was combined, in its document structure, with checklists for reviewing successful execution of quality controls. As a result, the checklists no longer require checking only; they also require documentation of achievement of specified quality targets (QC plan). Such quality control checklists are to be filled out by NaSE participants12 along with inventory preparation. They are designed to provide information about the quality of the data and methods on which the inventory is based. In 2005, the Federal Environmental Agency carried out systematic quality control, in the form of checklists, with the NaSE participants, for the first time. At the same time, this effort included only routine QC measures in keeping with Tier 1. In early 2006, a subset of the improvement plan (Verbesserungsplan - VP) is to be integrated within the binding inventory plan (IP), which includes binding deadlines and competencies. The two plans and the QC checklists taken together thus are an instrument for reviewing fulfillment of international requirements, and they make it possible to control inventory quality via initiation of quality assurance measures.	Berichterstattung unter der Klimarahmenkonvention der Vereinten Nationen 2007, Apr 2007, p. 52-53 (submitted in German, translated, based on NIR 2006))

MS	Description of the national QA/QC activities	Source
Greece	The development and the implementation of an inventory Quality Assurance / Quality Control (QA/QC) plan represents a key tool for meeting the objectives of National Systems under Article 5(1) of the Protocol as described in Decision 20/CP.7. With the Protocol into force, it is expected that the pressure upon national GHG emissions inventories will increase and therefore quality management would be essential to comply with the requirements of (a) producing transparent, consistent, comparable, complete and accurate emissions estimates, (b) establishing a reliable central archiving system concerning all necessary information for GHG emissions inventories development and (c) compiling national reports according to the provisions of the adopted decisions. In this framework, an inventory QA/QC system has been developed that is being implemented since April 2004. 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 QA/QC system developed covers the following processes: • QA/QC system management, comprising all activities which are necessary for the management and control of the inventory agency (to ensure the accomplishment of the quality objectives). • QC 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 GPG, (c) QC checks for data from secondary sources and (d) record keeping. • Archiving of inventory information, comprising activities related to centralised archiving of inventory information and the compilation of the national inventory report. • QA, 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. QA/QC activities since April 2004 were focused on the improvement of the archiving of information and the development of a long term improvement plan. A second internal review was carried out in June 2005 focused on the evaluation of the progress made in relation to the centralised archiving of information.	Greece Climate Change Emission Inventory 2007 pp. 16-17
Hungary	The expert team preparing the National Inventory have participated in the preparation of (other) national databases (emission databases, pollution databases) for several years. The experts have "expert permissions" issued by the Ministry of Environment and Water, which were only granted to staff members with sufficient experience and trustworthiness. An overall QA/QC system covering the entire process of inventory preparation is under development in the Hungarian Meteorological Service (OMSz) where the National System is based. This QA/QC system will be partly incorporated in the accredited and audited ISO 9001:2000 system of OMSz but also inventory specific requirements and guidelines will be taken into account. For the first time, a QA/QC plan is being drown up which will be updated in summer before the next inventory cycle starts. Other QA/QC activities: Activity data: The major part of the basic data related to key source categories was obtained directly from the plants, therefore, we use the latest and most reliable data. Where such data are not available, those from the Central Statistical Office are used. In order to prepare an inventory of appropriate quality, the data were checked in several ways (e.g., production plant and professional association). The results were controlled by comparing the time series, which was much more possible now, upon having a complete time series available. In order to ensure data accuracy, cross-checks were performed. In response to our request, several data suppliers made declarations as regards quality assurance systems in place during the collection of the data. However, only a few could provide factual information on the reliability of the data supplied. Emission factors: The emission factors were selected in accordance with the Revised Guidelines. The quality of the inventory has been greatly improved by the use of national factors in increasing numbers. The shift to annual average livestock in agriculture and the use of factors better reflecting the Hungarian conditions have greatly improved the quality of the inventory. Checking: The results of the calculations and the implied emission factors are checked and considerable differences, if any, are revised again. The modifications and improvements from the previous year are documented and recorded in the NIR. Another factor improving the quality is that most of the corrections proposed by the UNFCCC ERT reports have been completed.	Hungary - National Inventory Report for 2005, Jan. 2007 p.15-16

MS	Description of the national QA/QC activities	Source
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 has been substantially completed in delivering the 2007 submission. This involved the allocation of responsibilities linked to the national system mentioned in section 1.3.2 and the use of a template spreadsheet system to record the establishment and maintenance of general inventory checking and management activities covering the overall compilation process, as well as the undertaking of specific annual activities and any necessary periodic activities in response to specific events or outcomes in inventory reporting and review. 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. The review for Agriculture was performed by a technical inspector in the Department of Agriculture and Food using the new calculation files with a view to assessing the consistency of the time series which had been subject to considerable improvement and recalculation in the 2006 reporting cycle to account for higher tier methods and advice from the Department on various aspects of input data and calculation parameters. The ETS returns to the Agency's Office of Licence and Guidance (OLG) provided for the complete coverage of CO_2 estimates for categories 1.A.1, 2.A.1, 2.A.2 and 2.A.3 in 2005. When the allocation to these categories from the ETS raw data was completed, the output was returned to the ETS administrator in OLG for final checking against the source data. The participation of Irish inventory experts in the internal review of sector 1.A.1 for the EU and its Member States during 2006 was another useful contribution to external review procedures affecting the present submission.	Ireland National Inventory Report 2007, May 2007 pp.14-15
Italy	A specific *QA/QC system is being developed* in the framework of the establishment of the Nat. System, but QA/QC techniques and different verification procedures are already applied as part of the inventory estimation process. The inventory quality has improved over the years and further investigations are planned for relevant sectors (contribution to CO_2eq_{total} emissions / high uncertainty). In addition to *routine* control activities related to completeness, consistency in the time series and correctness in the sum of sub-categories, specific QC activities regard the accurate check of figures and documentation of those cases where methodological and data changes result in recalculations. Particular attention is also paid to the archiving and storing of all inventory data, supporting information, inventory records as well as all the reference documents. Data entries are checked several times during the compilation of the inventory; special attention is paid to sources which show significant changes. Final checks involve a consistency check on the whole time series. When revisions of estimation methodologies are applied, emissions are recalculated for the entire time series as a matter of course. 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 as well as methodologies are referenced to their data sources, while all information and documentation are stored at the Agency so as to be consulted whenever needed. After each reporting cycle, all database files, spreadsheets and electronic documents are archived and documentation and estimates could be consulted during the new year inventory compilation. QA procedures regard some verification activities of the inventory as a whole and at sectoral level. Drawbacks derive from the communication of data to different institutions and/or at local level. In order to verify of the effectiveness of policies and measures undertaken by Italy to reduce GHG emissions, a study was carried out by *Ecofys.* In this framework an independent review and checks on emission levels were carried out (also controls on transparency and consistency of methodological approaches). The quality of the inventory is also improved by (A) organisation and participation in sector specific workshops; (B) follow-up processes set up in the framework of WGI; (C) international reviews and centralised review by the UNFCC Secretariat; (D) establishment of national expert panels (specifically, in road transport, land use change and forestry and energy production sectors). Specific actions relating to improvements of the inventory and QA/QC carried out in the last year were: • *Waste sector emissions review* • *Energy Balance Verification* • *MeditAIRaneo Project.* • *Solvent and Other Product Use* • *Road Transport Emissions Review.* • *Data from the Italian Pollutant Emission Register (EPER)* *Energy-Indusrty C balance* • *At the national level: meetings with industry representatives* • *Local inventories.* (top-down approach for preparation of local inventories Future planned improvements are also part of the QA/QC plan and are prepared, for each sector, by the relevant inventory compiler (APAT, 2006). Each expert individuates area for sectoral improvement based on his own knowledge and in response to inventory UNFCCC review and other kind of processes.	Italian Greenhouse Gas Inventory 1990-2004 - National Inventory Report 2006 pp. 23 -24

MS	Description of the national QA/QC activities	Source
Latvia	The implementation of Quality Assurance and Quality Control (QA/QC) procedures in the development of national GHG inventory is required by IPCC GPG 2000. LEGMA is responsible for coordination of the process of annual greenhouse gas inventory, and also for development and implementation of the QA/QC plan. QC activities were carried out at the various stages of the inventory compilation process: processing, handling, documenting, cross-checking, recalculations. These activities are implemented by sector experts and inventory compiler. QA/QC program is developed and will be approved by Director of LEGMA. The QA/QC program consists of aims related GHG inventory, QA/QC plan and defined responsibilities. The plan includes Tier 1 General Inventory Level QC procedures outlined in Table 8.1 of IPCC GPG 2000. QC system includes various activities aimed to ensuring transparent data flow through all inventory process. The general QC checks include: Assumptions and criteria for the selection of activity data and emission factors are documented; Transcription errors in data input and reference; Correctness of calculations of emissions; Correctness of emission parameters, units, conversion factors; Integrity of database files; Consistency in data between source categories. Every annual inventory is archived. Quality Assurance (QA) activities include a planned system of review procedures conducted by personnel not directly involved in the inventory compilation/development process.	Latvia's National Inventory Report 1990-2005, Mar 2007, p.17
Lithuania	Institute of Ecology is responsible for coordination of the process of annual greenhouse gas inventory, compilation of results, data management and archiving, and also for development and implementation of the QA/AC plan. Several QC activities were carried out each year at the various stages of the inventory compilation process - processing, handling, documenting, cross-checking, recalculations and visual inspections. Those activities are implemented by sectoral experts and inventory compiler. Inventory quality checking procedures became more efficient now when complete time series 1990-2005 of GHG inventory were compiled. GHG inventory review and checking are also performed by Air Division of the Ministry of Environment as a part of inventory approval process. In order to improve further data integrity, correctness, and completeness, QA/AC plan will be developed and implemented. The plan will include Tier 1 General Inventory Level QC procedures outlined in Table 8.1 of IPCC Good Practice Guidance, and a peer review of the inventory estimates. QC system incorporates various activities aimed at ensuring transparent data flow through all inventory process including data collection and processing, documentation, archiving and reporting. There are general QC checks to be performed during the inventory. QC activities also include review of internal documentation, supporting data, comparison of emission estimates to previous estimates, consistency and completeness of time series, etc. Activity data required for compilation of GHG inventory are provided mainly by Lithuanian Statistics and some other institutions involved in collection of statistical data such as Lithuanian Environmental Protection Agency, Lithuanian State Forest Survey Service, Lithuanian Geological Survey etc. Such institutions are providing official national statistical data and have established their own QC procedures. Institute of Ecology as the GHG inventory compiler should obtain necessary information about QC procedures used in statistical institutions in order to confirm that adequate QC procedures have been implemented. Both the central database at the Institute of Ecology and databases at the agencies/experts responsible for inventories in separate sectors comprise all information required to produce the national emissions inventory. The documentation for every annual inventory will be archived in such a way that every inventory estimate can be fully documented and reproduced if necessary. Tracing back of each separate data item to its original source should be possible including any changes or updating of activity data or emission factors. Quality Assurance (QA) activities include a planned system of review procedures conducted by personnel not directly involved in the inventory compilation/development process. Key source categories should be reviewed every year to ensure that the inventory represents the best possible estimates of emissions and sinks given the current state of scientific knowledge and data available. Non-key categories should also be reviewed at least once in several years taking into consideration changing methodologies, data sources, etc.	National GHG Emission Inventory Report of Lithuania Mar 2007, p. 14-15
Luxembourg	As regards quality control, it is worth noticing that Luxembourg has not yet developed a fully operational QA/QC system. However, for verification of the country-specific emission factors the default emission factors of the Revised 1996 IPCC Guidelines for National Greenhouse gas Inventories have been used.	National Inventory Report 1990-2004, May 2007 p.7
Malta	—	-

MS	Description of the national QA/QC activities	Source
Netherlands	As one of the results of a comprehensive inventory improvement programme, a National System fully in line with the Kyoto requirements was finalised and established by the end of 2005. As part of this system also an Act on Monitoring of Greenhouse Gases has become effective in December 2005. This Act determines the establishment of the National System for monitoring of greenhouse gases and empowers the Minister of Housing, Spatial Planning and the Environment (VROM) to appoint an authority responsible for the National System and the National Inventory. The Act also determines that the National Inventory be based on methodologies and processes as laid down in the monitoring protocols. With a regulation following to that the Minister has appointed SenterNovem as NIE (national inventory entity) and published a list of the protocols. Adjustments to the protocols will require official publication of the new protocols and announcement of publication in the official Government Gazette (Staatscourant). As part of its National System, The Netherlands has developed and implemented a QA/QC programme. This programme is yearly assessed and updated, if needed. The key elements of the current programme (SenterNovem, 2006) are briefly summarised in this section, notably those related to the current NIR. **1.2.1 QA/QC activities for the CRF/NIR 2007** • 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. • General QC checks are performed. To facilitate these general QC checks, a checklist was developed and implemented. A number of general QC checks have also been introduced as part of the annual work plan of the PER respectively of the monitoring protocols.The QC checks build into the work plan aim at covering such issues as consistency, completeness, correctness of the CRF data, among others. • Quality Assurance for the current NIR includes the following activities: peer and public review of latest NIR, consideration of former UNFCCC reviews, internal audits The QA/QC activities generally aim at a high-quality output of the PER and the National System, taking into account the ISO 9001/2000 certification of MNP and the international QA/QC requirements (IPPC Good Practice). Furthermore, the system should operate within the available means (capacity, finances). Within those boundaries, the main focal points of the QA/QC activities are: - *The QA/QC programme* (SenterNovem, 2005) has been developed and implemented as part of the National System. This programme includes *quality objectives* for the National System, the *QA/QC plan* and *a time schedule* for implementation of the activities. It will updated annually as part of a yearly 'evaluation and improvement cycle' for the inventory and National System and be held available for review. - *The annual activity programme* of the PER (MNP, 2005) that is part of the *requirements under the MNP ISO 9001/200 certification*. The work plan describes tasks and responsibilities of the parties involved in the PER process, products and the time schedule (planning), emission estimation methods – among which are the monitoring protocols for the greenhouse gases – as well as the members of several task forces. The annual work plan also describes the general QC activities to be performed by the task forces before the annual database is fixed. In addition, the work plan consists of an inventory and QA/QC improvement programme. - *The responsibility* for the quality of data in annual environmental reports (MJVs) lies with *the companies themselves*, while validation of the data is the responsibility of the competent authorities. It is the responsibility of the institutes involved in the PER to judge whether or not to use the validated data of individual companies to assess the national total emissions (CO_2 emissions, however, are based on energy statistics and standard emission factors, and only qualified specific emission factor from environmental reports are used). - *Agreements/ covenants* between MNP and institutes ('outside agencies') that are involved in the annual PER process. The general agreement is that by accepting the annual work plan, the involved institutes commit themselves to deliver capacity for the products specified in that work plan. The role and responsibility of each institute have been described (and agreed upon) within the framework of the PER work plan. • The following *specific procedures and agreements* have been set out and described in the QA/QC plan and the *annual PER work plan*: *QC on data input and data processing*, *Documentation of consistency, completeness and correctness* of the CRF data, *Peer reviews* of CRF and NIR by the SenterNovem (acting as NIE) and institutions not basically involved in the PER process. *Public review* of the draft NIR, *Mutual reviews*, *Audits:* in the context of the annual work plan, it has been agreed upon that the involved institutions send the report of internal audits to MNP as coordinating agency for the CRF/NIR. *Archiving and documentation:* internal procedures are agreed upon in the PER work plan for general data collection and the storage of fixed datasets in the MNP database. *Evaluation and improvement*: those persons involved in the annual inventory tasks are invited once yearly to evaluate the process. *Source-specific QC*: comparison of emissions with independent data sources was one of the study topics in the inventory improvement programme.	Greenhouse Gas Emissions in the Netherlands 1990-2005 National Inventory report 2007 Mar 2007, p. 25-27

MS	Description of the national QA/QC activities	Source
Poland	Comprehensive QA/QC system in Poland is still under development but general procedures are in place to ensure appropriate quality of national inventories. Activities underlying the QC procedures within Polish GHG inventory system contain routine and consistent checks to ensure data integrity within entire time series, correctness as well as completeness. Potential error and omissions are addressed through routinely checks. An extended QC procudre is carried out for higher tier methods inclufing reviews of activity and emissions factor data, and methods. QA consisting activities aiming at external reviews are performed occasionally under the auspices of Ministry of Environment. Generally the first draft of the inventory in form of IPCC tables and draft CRf, is usually produced 12-14 months after the end of the given year depending primarily on the availability of required activity data. The most of activity data comes from national statistic undergoing internal revision and checking process before using it in the inventory. But still extensive check are done in form of consultations with data providers. The consultation cover both correctneess of data and their proper interpretation. The most important institutional sources include: Central Statistical Office, Agency of Energy Market, and a number of collaborationg individual experts and institutions. Wherever possible various different datasets are used for comparison purposes. All activity data, parameteres and factors used for emission estimates for a given year are examinded in comparison to entire time serires to detect doubtful figures. Outliers are scrutinizied in more detail. After the checking period is completed, the final CRF is prepared together with the accompanying report. The CRF Reporter is also used as one of the checking tool for detecting potential errors and omissions within domestic inventory..	Polands National Iventory Report 2007, Mar 2007 pp. 8-9
Portugal	A plan for QA/QC has been developed. The Institute for the Environemnt is the national responsible entity for the QA and QC System of the inventroy. The conceptualisation of the system has been however done under an external consultancy with Ecoprogresso. The QA/QC system is an integral part of the National System for the inventory of Emission by Sources and Removal by Sinks of Air pollutants (SNIERPA), which was created by the March, 17th Resolution of the Council of Ministers nr.68/2005, and includes three technical instruments: 1) Quality control and Quality Assurance System (SCGQ), 2) Methodological Development Programme (PDM); 3) Integrated Management System (SIGA). The SCGQ is composed of a QA/QC progamme and a procedures Manual. The first schedules the application of the general (QC1) and specific (QC2), QA/QC procedures, described in detail in the Manual. The procedures were defined according to IPCC GPG (2000) and adapted to the specifc National Inventory (INERPA) characteristics. QC tier 1 procudures defined in the QA/QC manual include a series of checklists, which consider basic checks on the accuracy of data acquisition processess and checks on calculation procedures, data and parametres. 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 procedures, on the other hand, include technical verifications of emission factors, activity data, comparions of results among different approaches.	Portuguese NIR on GHGs 1990-2005, May 2007 p. 13-14
Romania	QC activities: The expert team involved in the inventory preparation process, performed some general QC activities related to the processing, archiving and reporting of data. Some basic QC activities made are: checking for transcription errors in data input, checking whether the parameters and emission units are correctly recorded, comparing within the time series, in order to obtain consistent trends. The GHG emissions inventories for the whole period 1989-2004 have been archived in the NEPA database. QA activities: No QA activities were performed beyond the UNFCCC annual reviews (in-country review in 2003, desk review in 2004 and centralized review in 2005). In some cases, the 42 local environmental protection agencies were used as a source of bottom-up data for some source categories and data were checked against the data provided in national statistics. There are also conducted activity data series checking by comparing with similar data from FAO and Eurostat databases. Comparisons made show the correlation of the two data series.	Romanian National GHG Inventory Report 2007, March 2007, p. 28
Slovakia	The emission estimates elaborated for individual sectors by external consultants are controlled and recalculated at the DoAQ on the SHMI. Activity data for major sources are compared with national statistics and with previous year's submitted data (e.g. change in fuel base, respectively fuel quality characters, technology, separation technique, etc.). Energy balance from energy statistics is compared with summary fuel consumption reported by sources. Fuel consumption in transport based on fuels sold is compared with the model results. External reviewers (from the Czech Republic) are regularly invited to comment the inventory results. Control procedures are continuously developed and built in to the National Emission System. Structural changes of the current national inventory system, in accordance with the new air protection act (transposition of EU air pollution legislation), is ongoing process. Harmonisation of all pollutant inventories and ISO9001 are introducing. In accordance with these requirements the inventory results for the year N are completed to the 31 December (N+1) and the inventory results of the basic pollutants for the year N are completed to the 15 January (N+2) draft and 15 April (N+2) final version.	Greenhouse Gas Emission Inventory in Slovak Republic 1990-2004 p.15

MS	Description of the national QA/QC activities	Source
Slovenia	The Republic of Slovenia has not yet fully developed and implemented a Quality Assurance and Quality Control plan as recommended by IPCC Good Practice Guidelines (IPCC 2000). Quality control procedures are described in the Manual of Procedures which has already been elaborated. Certain data control procedures covered by the Manual of Procedures are already in use in developing inventories. The items verified are input data at the level of sectoral activity data, the appropriateness of chosen emission factors, the applied methodology as well as intermediate and final calculations of emissions where deviations between real life emission factors and factors as calculated from the CRF table are reviewed, too. In 2006 additional quality control check point was introduced by forwarding assessment of verified emission reports from installations included in National Allocation Plan to the Statistical Office of the Republic of Slovenia (SORS). Role of SORS is to compare data from installations included in EU-ETS with data from their reporting system and to propose, if necessary, correctional measures. Outcome of data consistency checks is used as preliminary information for the Ministry of the Environment and Spatial Planning to perform on site inspections. However first iteration of data comparison showed that differences are significantly lower than 5%. Together with a team who is preparing other pollutants inventory (CLRTAP) and our information management service we are in the middle of establishing the joint database. This will finally enable us to prepare all necessary reports to conventions and EU from the same set of data. The database is going to contain all activity data, emission factors and other parameters including description of sources from 1980 on for other pollutants, and from 1986 on for GHG emissions. On defined control points QC procedures will be included and documented. At a final stage we are going to develop a direct bulk import file from database to CRF Reporter. Majority of database will be prepared until end of 2006, next submission calculations will be prepared on both ways what will enable us to check for possible errors. The whole process is planned to be finished in March 2007. After finishing this project a lot of time consuming manual work for preparing GHG inventory will not be required any more. The staff working on GHG and other pollutant inventory will join together to perform some common work and common QC procedures like: raw data collection, acquisition, and handling (e.g., completeness, accuracy of data sources and units, consistency of activity data trend, etc.); data input into database (e.g., transcription errors, accuracy of units, etc.) and uncertainty estimates of AD. QA generally consists of independent third-party review activities to ensure that the inventory represents the best possible estimates of emissions and removals and to support the effectiveness of the QC program. In the past we have performed only one peer-review. In 2006 during preparation of our Forth NC Report, we have got many useful comments from team preparing our Forth National Communication Report. Although those comments were not presented as official report, we have accepted many suggestions and corrected some mistakes. We are planning to prepare official peer review for 2007 inventory.	Slovenia's National Inventory Report 2007 Mar. 2007 p. 18

MS	Description of the national QA/QC activities	Source
Spain	The implementation of the Quality Assurance and Monitoring System ensures the traceability, exhaustiveness, consistency, comparability and punctuality of the whole process, as an integral part of the National Inventory System itself. Its main objectives are: - To ensure the preparation of the different reports required by the various forums to which it renders services, with optimum exactness and uncertainty, and in accordance with the criteria of contents, formats and deadlines required and to - To supply the databases required in different formats, including explanations and duly justifying the possible retrospective alterations and adjustments. For this purpose, a special effort has been made to develop monitoring procedures: - In the compilation, processing and validation of the databases. - In the choice of methods, procedures and factors to be used in the estimates. - In the determination of uncertainties in the estimates. - In seeking out and eliminating inconsistency and errors. - In the filing and preservation of information. Considering the IPCC guidance on good practices and uncertainty management in the national greenhouse gas inventories, the Quality Assurance and Monitoring System is organized in the following manner: **Body responsible:** The Directorate-General for Environmental Quality and Evaluation (Ministry of Environment) can call on specific technical assistance to perform the tasks entailed by the National Inventory System and this body has certain responsibilities and tasks clearly assigned to it as well as specific qualified personnel devoted to the implementation of the quality assurance and monitoring system. **Quality Plan:** A quality plan is applied to the pollutants inventory with the aim of following the general principles of good practice commonly accepted to ensure consistency, precision, transparency, comparability and confidentiality, as well as availability of the data for consultation and archiving. The development and implementation of this plan requires greater efforts in its initial stages, as well as more intensity in the verifications. After this first stage and once put in place, the period between revisions may be lengthened, although a more detailed follow-up should be performed on those categories undergoing significant technological changes. The quality plan affects all the blocks of the process for carrying out the inventory and contains the objectives, the standard calculation methods, the design for carrying out the inventory (stages and methods, as well as bibliography to be used in each stage) and a calendar distributing the available time and resources. **Quality Assurance System**: The inventory's quality assurance is based on its objective revisions, preferably by personnel unconnected to it, evaluating its quality and taking advantage of this process to identify the areas susceptible to improvement within a process of continuous optimization. During the preparation of the inventory, personnel are specifically dedicated to revision and quality monitoring, concentrating on the major source categories or those that have undergone alterations in data or estimation methods. The goal of these revisions is to identify and correct possible problems before presenting the inventory. In addition, in-depth revisions are made by experts participating in inventory organizations in similar countries, reference work groups for the major source categories or the Secretariats or Panels of the Conventions or Protocols in question. The inventory sent to the Framework Convention on Climate Change was revised in depth during the week of September 29th to October 3rd, 2003, by a team of experts from the Secretariat. Moreover, the inventory submitted to the Geneva Convention for revision was voluntarily presented for review in 2006. Furthermore, institutional arrangements are in place to ensure that external audits are performed regularly to evaluate compliance with the specifications of the aforesaid quality checks from time to time. Moreover, geographical comparisons against inventories from other countries are carried out in co-operation with inventory working groups in other European countries.	Inventarop de emisiones de gases de efecto invernadero de Espana Anos 1990-2005 Apr 2007- p. 35-42 (submitted in Spanish, translation bases on NIR 2006)
Sweden	The current system complies with the Tier 1 procedures outlined in the Good Practice Guidance (IPCC, 2000). A quality system as part of the National System has been developed and is fully in operation since January 2006. The Swedish EPA is responsible for the QA/QC plan for the inventory. The national GHG emissions are compiled by the Swedish Environmental Emission Data (SMED). Other contractors are also involved in the inventory preparations process. The QA/QC plan consists of quality procedures and checklists specified for each reporting CRF-code (or group of codes). The plan is updated annually and lists all quality control steps that must be undertaken during inventory work (Tier 1 and where appropriate Tier 2). The QA/QC plan also includes descriptions of roles and responsibilities, of databases and models and documented procedures for uncertainty and key source analysis, as well as procedures for handling and responding to UNFCCC´s review of the Swedish inventory. The QA/QC plan handles follow-up and improvement by procedures of non-conformity reporting and collection of improvement needs from all stages of the annual inventory cycle. This results in a planning document, which is used as a basis for planning and selecting further actions to improve the inventory. QA: Key sources should be subject to external peer review according to the Tier 2 of the Good Practice Guidance. The new QA/QC system includes national peer reviews by sectoral authorities. The procedures are described in Appendix 7. The peer reviews include methodology and emissions factors used, as well as comparisons of activity and emission data with other national statistics. The reviewers also identify areas of improvement, which consolidates the basis for improvements in coming submissions. QC: In this inventory, general Tier 1 QC measures, according to Table 8.1 in IPCC Guidelines, have been carried out, as have the source specific Tier 2 QC measures listed in NIR(Table 1.5). All QC measures performed are documented in QC checklists for each CRF code or group of codes. After completion of the initial compilation of the inventory, a QC-team reviews all QC checklists. Quality control for the overall inventory: When the reporting tables and the NIR are completed, a quality coordinator performs a final quality control before delivery of the inventory to the Swedish EPA.	Sweden's National Inventory Report 2007 Jan 2007, pp. 33-34

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 the National Environmental Technology Centre (AEA Energy and Environment), 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. IGER 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, from which the UK emissions are extracted and reported in CRF format. The QC within this system has evolved over many years. Numerous stages of 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 9001:2000. 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 ten 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.* The National Environmental Technology Centre is currently accredited to BS EN ISO 9001:2000, and was last audited in May 2003 by Lloyds. For the following points detailed procedures for QA/QC checks can be found in the NIR: *Documentation, Database, Checking, Recalculation, Uncertainties, Archiving.* The system outlined complies with the Tier 1 procedures outlined in Table 8.1 of the Good Practice Guidance (IPCC, 2000). A review of the QA/QC procedures was carried out in 2001 (Salway, 2001) and each year work continues to refine the procedures used. Further elaborated are the following issues in the NIR: Special QA/QC activities undertaken in 2006-2007, Future development of the QA/QC system, Compliance of National Statistical Agencies, Documentation and review, External Peer Review and Internal Reviews, Verification, Treatment of confidentiality	UK GHG Inventory 1990 to 2005 Mar 2007 p. 21- 28

1.6.3 *Further improvement of the QA/QC procedures*

One of the most important activities for improving the quality of national and EC GHG inventories is the organisation of workshops and expert meetings under the EC 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/ACC and an observer from the UNFCCC secretariat. For details of the workshop see the workshop report available on the website of the ETA/ACC:
http://air-climate.eionet.eu.int/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 1.8 lists the most important workshops.

Table 1.8 Overview of workshops and expert meetings organised under the EC GHG Monitoring Mechamism

Workshop/expert meeting	Date and venue
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 Community	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

All the workshop reports are available at the website of the EEA/ETC-ACC: http://air-climate.eionet.eu.int/meetings/past_html

1.7 Uncertainty evaluation

By 15 April 2007 Tier 1 uncertainty analyses were available from 13 EU-15 Member States. These Member States cover about 95 % of total EU-15 GHG emissions. Table 1.9shows the availability of Table 6.1 of the Tier 1 uncertainty analysis. For nine Member States Tier 1 uncertainty analyses were available for 2005, for three Member States the latest year available was 2004, for two Member States 2003 is the latest year. Most Member States cover all source categories in their uncertainty estimates. An update of the EC uncertainty estimates will be made for the resubmission due end of May 2007.

Table 1.9 Availability of Table 6.1 of the Tier 1 uncertainty analysis as of May 2007 (excluding LULUCF)

Member State	Year	Coverage	Member State	Year	Coverage
Austria	2005	96%	Ireland	2005	100%
Belgium	2003	100%	Italy	2005	100%
Denmark	2005	100%	Netherlands	2005	100%
Finland	2005	100%	Portugal	2005	100%
France	2005	100%	Spain	2004	100%
Germany	2003	100%	Sweden	2005	100%
Greece	2005	99%	United Kingdom	2005	100%

The EU-15 Tier 1 uncertainty analysis was made on basis of the Tier 1 uncertainty estimates of the Member States. Uncertainties were estimated for six sectors ‘Stationary fuel combustion’, ‘Transport’, ‘Fugitive emissions’, Industrial processes’, ‘Agriculture’ 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 EC 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

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

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 1.10 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 1.10 Trend uncertainty for EU-15 emissions 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 EC 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 EC 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 1.11, 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 independent[12].

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 1.11, 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 1.11 Comparison of trend uncertainty estimates for EU-15 Waste Sector using the modified Tier 1 method and Monte Carlo simulation (Tier 2). Trend uncertainty is presented as percentage points

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:

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

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 EC 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 EC inventory.

Table 1.12 shows the main results of the uncertainty analysis for the EU-15. The lowest level uncertainty estimates are for stationary fuel combustion (1 %) and transport (3 %), the highest estimates are for agriculture (38 % - 77 %). For agriculture a range of level uncertainties is provided

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

depending on the assumption on N_2O emissions from soils. The lower bound assumes that all MS uncertainty estimates of N_2O from agricultural soils are uncorrelated, the upper bound assumes that all uncertainty estimates are correlated. Overall level uncertainty estimates of all EU-15 GHG emissions is calculated to be between 4 % and 8 %.

With regard to trend uncertainty estimates the lowest uncertainty estimates are for stationary fuel combustion and transport (+/- 1 percentage point each), the highest estimates are for agriculture (6-13 percentage points). Overall trend uncertainty of all EU-15 GHG emissions is estimated to be between 1 and 2 percentage points.

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

Table 1.12 Tier 1 uncertainty estimates of EU-15 GHG emissions

Source category	Gas	Emissions 1990	Emissions 2005 1)	Emission trends 1990-2005	Emissions for which MS uncertainty estimates are available 2)	Share of emissions for which MS uncertainty estimates are available	Level uncertainty estimates based on MS uncertainty estimates	Trend uncertainty estimates based on MS uncertainty estimates
Fuel combustion stationary	all	2,466,341	2,423,141	-2%	2,397,226	99%	1%	1
Transport	all	700,313	879,721	26%	867,743	99%	3%	1
Fugitive emissions	all	96,079	54,530	-43%	51,867	95%	11%	8
Industrial processes	all	374,971	331,868	-11%	260,420	78%	7%	5
Agriculture	all	433,654	385,618	-11%	409,143	106%	38% - 77%	6 - 13
Waste	all	175,641	109,104	-38%	105,719	97%	18%	8
Total	**all**	**4,257,165**	**4,192,000**	**-2%**	**4,092,118**	**98%**	**4% - 8%**	**1 - 2**

Note: Emissions are in Gg CO_2 equivalents; trend uncertainty is presented as percentage points.

1) The sum of the source category emissions may not be the total sector emissions because uncertainty estimates are not available for all source categories.

2) Includes for some Spain and Greece 2004 data and for Belgium and Germany 2003 data

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 EC inventory. The workshop brought together experts from 16 Member States, the European Commission (DG ENV, JRC), ETC-ACC, 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) EC Uncertainty assessment and implications on Member State uncertainty assessment and b) Uncertainty assessment at Member State level (see workshop report http://air-climate.eionet.eu.int/meetings/past_html).

The relevant recommendations with regard to the EC uncertainty assessment and implications on MS uncertainty assessment were:

1. Level of detail of EC uncertainty assessment

- Aggregation of the EC uncertainty should be made to the level where most MS can be combined

2. Method and assumptions to be used to combine uncertainties at the EC level

- Tier 1 is appropriate for EC estimate, but Tier 2 can be used for certain categories and for trend
- No gap filling of uncertainties should be made
- "Rule" for correlations between MS in different sectors: default methods correlate unless there is a good reason to assume uncorrelated data

3. Improving EC uncertainty estimate

- Trend and LULUCF uncertainty should be included (feedback from the UNFCCC review process). These could not be included because of significant gaps in Member States' information.
- In EC uncertainty estimate, data provided by MS will be used taking into account MS contributions to the total uncertainty
- Feedback from EC to MS is important - e.g. are uncertainty estimates low or high compared to

other MS and related to problems with EC inventory compilation.

4. Timing of EC uncertainty estimate

- Recent year estimate and 1990 estimate needed next year
- Uncertainty estimate of the EC will be carried out annually - information from MS should be available

Table 1.13 gives an overview of information provided by Member States on uncertainty estimates in their national inventory reports 2006 or 2007 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 1.13 Overview of uncertainty estimates available from Member States (from Member States' national inventory reports 2006 and 2007)

Member State	Austria		Belgium	Bulgaria	Cyprus	Czech Republic	Denmark	Estonia	Finland	
Citation	Austrian NIR Mar 2007, p.46-50		Belgian NIR 2006, p. 15-22	No NIR provided	No uncertainty estimates provided	Czech NIR 2007, p. 24-25	Danish NIR 2007 p. 51-54	NIR Apr 2006	Finnish NIR Mar 2007 p. 27-28	
Method used	Tier 1, Tier 2		Tier 1			Tier 1	Tier 1		Tier 1, Tier 2	
Documentation in NIR (according to Table 6.1/6.2 of GPG)	Annex 6 (planned for April version)		Yes			Yes: Table 1.3	Yes	No information provided	Yes: Annex 1	
Years and sectors included	Tier 1: base year and 2004 - Key sources Tier 2: 1990, 1997 (from year 1999) – All sectors		2003-All sectors except LULUCF; for Flanders, a complete uncertainty study was conducted both on Tier 1 and Tier 2 level			1990, 2005 - All sources (key sources and "others")	1990, 2005 - The sources included in the uncertainty estimate cover 99.9% of the total Danish greenhouse gas emission (CO2 eq., without CO2 from LUCF).		1990, 2005 – All sources [percentages below are calculated by EEA on basis of the NIR]	
Uncertainty (%)	Tier 1	Tier 2	Tier 1			Tier 1	Tier 1	Tier 1	Tier 1 (including LULUCF)	Tier 2 (excluding LULUCF)
CO_2	Base year: 0.9% 2004: 0.9%	1990: 2.3% 1997: 2.1%	1.9%				2005: 2.3%			1990: -4%/+2% 2005: -4%/+2%
CH_4	Base year: 13.1% 2004: 11.6%	1990: 48.3% 1997: 47.4%	24.0%				2005: 23%			1990: -25%/+25% 2005: -24%/+22%
N_2O	Base year: 24.6% 2004: 26.8%	1990: 89.6% 1997: 85.9%	27.0%				2005: 42%			1990: -47%/+113% 2005: -31%/+69%
F-gases	Base year: 33.5% 2004: 32.8%		100				2005: 49%			1990: -44%/+44% 2005: -11%/+11%
Total	Base year: 2.42% 2004: 1.81%	1990: 9.8% 1997: 8.9%	7.5%			6.7%	2005: 5.4%		2005: 58.8%	1990: -7%/+13% 2005: -4%/+7%
Uncertainty in trend (%)	Tier 1		Tier 1			Tier 1	Tier 1		Tier 1 (including LULUCF)	Tier 2 (excluding LULUCF)
CO_2							1.9 percentage points			
CH_4							10.2 percentage points			
N_2O							11.6 percentage points			
F-gases							64 percentage points			
Total	2.97%		2.7%			3.0%	2.2 percentage points		15.5%	-12/+8 percentage points

Member State	France	Germany	Greece	Hungary	Ireland	Italy	Latvia	Lithuania	Luxembourg	Malta
Citation	French NIR 2007, p. 30-31	German NIR April 2007, p. 90-94	Greek Short-NIR 2007, p. 17-18.	Hungarian short NIR 2007, p. 16	Irish NIR 2007, p. 15-16, 21-22 (Tab. 1.8)	Italian NIR Aug 2006, p. 18, Annex 1	Latvian NIR Mar 2007, p. 16-17	Lithuanian NIR 2007, p.14	Luxembourg NIR 2006	No NIR provided
Method used	Tier 1	Tier 2	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: Annex 2	Yes: Annex [Anhang] 7 (according to Table 6.2 of GPG)	No	No	Yes: Table 1.8	Yes Annex 1 (Table A1.2)	Yes: Annex 2	Yes: Annex 2	No	
Years and sectors included	1990, 2005 – All sources	2005 - All sources	1990, 2005 - Almost all sources (not included sources represent less than 1% of total emissions)	1985-2004	1990, 2004 – All sources	1990, 2004 – All sources	1990-2004, All sources	1990-2005 (1995-2005 for F-gases), all source categories (except LULUCF and solvent sector)		
Uncertainty (%)	Tier 1	Tier 2	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1
CO_2		2005: +3.31%/-2.85%	4% (without LUCF)	+/- 2 to 4%	1.5%		3.4%	+/- 3.1%		
CH_4		2005: +.4.52%/-4.51%	33% (without LUCF)	+/- 15 to 25%	4.1%		16%	+/-10.2%		
N_2O		2005: +.109.13%/-45.82%	104% (without LUCF)	+/- 80 to 90%	32.7%		28%	+/-77.9%		
F-gases			113,7% (without LUCF)		0.02%			+/-0,0%		
Total	+-17.7%	2005: +11.68%/-5.77%	11% (without LUCF)	4.92%	6.2%	3,3% net 8,3% with LULUCF	5.1%	+/-9,55%		
Uncertainty in trend (%)	Tier 1		Tier 1	Tier 1	Tier 1	Tier 1	Tier 1			
CO_2					3.3%		1.3%			
CH_4					3.2%		8%			
N_2O					6.3%		13%			
F-gases					0.04%					
Total	3.0%		10.0%	2.45%	3.6%	2,6% net 7,9% with LULUCF	2.1%	+/-2,1%		

Member State	Netherlands	Poland	Portugal	Romania	Slovakia	Slovenia	Spain	Sweden	United Kingdom	
Citation	Dutch NIR 2007, Mar 2007 p.29-33	Polish NIR Apr 2007, p. 5	Portuguese NIR 2007, p. 14-16	Romania NIR Mar 2007, p.28	Slovakian NIR July 2006, p.15	Slovenian NIR Mar 2007 p. 19	Spanish NIR Mar 2007, p. 1.26 -1.30	Swedish NIR 2007, p. 34-36	UK NIR April 2007, p. 68	
Method used	Tier 1	Tier 1	Tier 1			Tier 1	Tier 1	Tier 1	Tier 1, Tier 2	
Documentation in NIR (according to Table 6.1/6.2 of GPG)	Annex 7, Table A7.1 and A7.2	Partially in Annex 5	Yes: Annex B	No information provided	No	Yes: Annex 7	Yes: Table A7.1 and A7.2	Partially (Annex 2)	Yes: Tables in Annex 7 p. 417ff	
Years and sectors included	1990/95, 2004 – All sources	2005 - All sources	1990-2005 - All sources			1986, 2002, 2003 - All sources	Base year, 2003, 2004 - All sources	1990 and 2005 for all sectors and gases	1990, 2005 – All sources, AD, EF	
Uncertainty (%)	Tier 1	Tier 1	Tier 1 2005		Tier 1	Tier 1	Tier 1	Tier 1	Tier 1 2005	Tier 2 2005
CO_2	3%	7.3%	5%				-	2,4% (1990) 2,2% (2005)		2.1%
CH_4	25%	22.2%	27%				-	2,8% (1990) 2,1% (2005)		21.2% (net)
N_2O	50%	47.1%	103%				-	5,3 % (1990) 5,1% (2005)		233%
F-gases	50%	HFC 44.1% PFC 20% SF6 100%	65%					0,2% (1990) 0,3% (2005)		HFC 15% PFCs 5.8% SF6 24.5%
Total	5%		9.3%		9.7%	1986: 16% 2002: 13,1% 2003: 12%	Base year: +/-9.0% 2003: +/-6.9% 2004: +/- 7.0%	6,4% (1990) 6% (2005)	16.5%	14.3%
Uncertainty in trend (%)	Tier 1		Tier 1		Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 2 (range)
CO_2	+/- 2.5%									-8.9 to -3.7%
CH_4	+/- 10%									-65 to -34%
N_2O	+/- 15%									-89 to 215%
F-gases	+/- 7%									HFC 10 to 68%, PFCs -68 to -63%, SF6 -15 to 71%
Total	+/- 3%		13.2%		3.6%	2002: 4% 2003: 3%	2003: +/-3.3% 2004: +/- 4.2%		2.6 %	-28.7 to 0%

1.8 General assessment of the completeness

1.8.1 *Completeness of Member States' submissions*

The EC GHG inventory is compiled on the basis of the inventories of the EC Member States. Therefore, the completeness of the EC inventory depends on the completeness of the Member States' submissions.

Table 1.14 summarises timeliness and completeness of the Member States' submissions in 2007. It shows that GHG inventories for 2005 were submitted by 26 Member States. All Member States submitted all or almost all tables (i.e. more than 90 %) of the CRF tables for 1990–2005. The completeness of national submissions with regard to individual CRF tables can be found in the status reports in Annex 3. In addition, EU-15 Member State information on the completeness of their emission estimates at source level can be seen from Table 1.16 below.

Table 1.14 Date of latest submission or update, years covered and CRF tables available from Member States in 2007

MS	Submission dates	Latest data available	CRF Tables[1)]	New LULUCF tables	Old LUCF tables	NIR
Austria	15 Jan 2007	2005	All, XML	1990-2005	-	15 Jan 2007 (Short NIR)
	15 Mar 2007	2005	All, XML	1990-2005	-	15 Mar 2007
	-	-	-	-	-	13 Apr 2007
Belgium	14 Feb 2007	2005	All (full CRF only for 1991-2005)	-	1990-2005	-
	20 Mar 2007	-	-	-	-	20 Mar 2007
	26 Mar 2007	-	-	1990-2005	-	-
	8 May 2007	2005	All, XML	1990-2005	-	14 May 2007
Bulgaria	15 Apr 2007	2005	All	-	2005	-
	20 Apr 2007	2005	All	1988-2005	-	-
Cyprus	7 Feb 2007	2004	All	-	1990-2004	-
	22 Mar 2007	2005	All	-	1990-2005	22 Mar 2007 (Short NIR)
Czech Republic	11 Jan 2007	2005	All, XML	1990-2005	-	11 Jan 2007 (Short NIR)
	11 May 2007	2005	All	1990-2005	-	11 May 2007
Estonia	15 Jan 2007	-	-	-	-	15 Jan 2007 (Short NIR)
	15 Mar 2007	2005	All, XML	1990-2005	-	-
	13 Apr 2007	2005	All, XML	1990-2005	-	13 Apr 07
Denmark	15 Jan 2007	2005	All, XML	1990-2005	-	15 Jan 2007 (Short NIR)
	15 Mar 2007	2005	All, XML	1990-2005	-	15 Mar 2007
	13 Apr 2007	2005	All, XML	1990-2005	-	13 Apr 2007
Finland	15 Jan 2007	2005	All, XML	1990-2005	-	15 Jan 2007
	15 Mar 2007	2005	All, XML	1990-2005	-	15 Mar 2007
	16 Apr 2007	2005	All, XML	1990-2005	-	16 Apr 2007
France	12 Jan 2007	2005	All	1990-2005	-	-
	16 Mar 2007	2005	All, XML	1990-2005	-	16 Mar 2007
Germany	20 Mar 2007	2005	All, XML	1990-2005	-	-
	-	-	-	-	-	30 Mar 2007
	16 Apr 2007	2005	All, XML	1990-2005	-	16 Apr 2007
Greece	30 Jan 2007	2005	All (no XML)	1990-2005	-	30 Jan 2007 (Short NIR)
Hungary	16 Jan 2007	2005	All, (no XML)	1985-2005	-	16 Jan 2007 (Short NIR)
	20 Apr 2007	2005	All, XML	1985-2005	-	-
Ireland	14 Feb 2007	2005	All, XML	1990-2005	-	-
	15 Mar 2007	2005	All, XML	1990-2005	-	-
	11 May 2007	-	-	-	-	11 May 2007
Italy	23 Mar 2007	2005	All, XML	1990-2005	-	-
	17 Apr 2007	2005	All, XML	1990-2005	-	-
Latvia	12 Jan 2007	2005	All, XML	1990-2005	-	12 Jan 2007 (Short NIR)
	15 Mar 2007	2005	All, XML	1990-2005	-	15 Mar 2007

	12 Apr 2007	2005	All, XML	1990-2005	-	15 Apr 2007
Lithuania	15 Jan 2007	2005	All	1990-2005	-	-
	23 Jan 2007	2005	All, XML	1990-2005	-	23 Jan 2007
	16 Mar 2007	-	-	-	-	16 Mar 2007
Luxembourg	27 Mar 2007	2004	All, XML	1990-2004	-	-
	17 Apr 2007 (same as 27 Mar 2007)	2004	All, XML	1990-2004	-	17 Apr 2007 (NIR 2006)
	17 May 2007	2005	All, XML	1990-2005	-	-
Malta	-	-	-	-	-	-
Netherlands	15 Jan 2007	2005	All, XML	1990-2005	-	15 Jan 2007
	15 Mar 2007	2005	All, XML	1990-2005	-	15 Mar 2007
	13 Apr 2007	2005	All, XML	1990-2005	-	13 Apr 2007
Poland	14 Mar 2007	2005	Full CRF only for 2005.	1988-2005	-	14 Mar 2007
	20 Mar 2007	2005	All (no XML)	1988-2005	-	20 Mar 2007
Portugal	23 Jan 2007	2005	All	1990-2005	-	-
	25 Jan 2007	2005	Full CRF only for 2004 and 2005.	1990-2005	-	-
	9 Feb 2007	-	-	-	-	9 Feb 2007 (Short NIR)
	15 Mar 2007	2005	All, XML	1990-2005	-	-
	16 Apr 2007	2005	All, XML	1990-2005	-	16 Apr 2007
Romania	16 Jan 2007	2005	All, XML	1989-2005		-
	20 Mar 2007	2005	All (no XML)	1989-2005	-	20 Mar 2007
Slovakia	16 Jan 2007	2005	All, XML	1990-2005	-	-
Slovenia	11 Jan 2007	2005	All, XML	1986, 1990-2005	-	11 Jan 2007 (Short NIR)
	15 Mar 2007	2005	All, XML	1986, 1990-2005	-	15 Mar 2007
	13 Apr 2007	2005	All	1986, 1990-2005	-	13 Apr 2007
Spain	9 Mar 2007	2005	All, XML	1990-2005	-	-
	15 Mar 2007	2005	All, XML	1990-2005	-	15 Mar 2007
	18 Apr 2007	2005	All	1990-2005	-	18 Apr 2007
Sweden	12 Jan 2007	2005	All, XML	1990-2005	-	12 Jan 2007
	13 Apr 2007	2005	All, XML	1990-2005	-	13 Apr 2007 (same as 12 Jan 07)
United Kingdom	15 Jan 2007	2005	All, XML	1990-2005	-	-
	15 Mar 2007	2005	All, XML	1990-2005	-	15 Mar 2007
	13 Apr 2007	2005	All, XML	1990-2005	-	13 Apr 2007

([1]) All = all or almost all (approx. more than 90 %) of the CRF tables; Limited = Sectoral Report Tables, Table 1A(a), Summary 1A, Summary 3 (see Annex 3 for more details).

The following tables refer to EU-15 only. Table 1.15 compiles the characterisation of the 2006 and 2007 NIRs of Member States as well as the findings from the individual review of Member States' inventories conducted by the UNFCCC Secretariat in 2005 (no UNFCCC inventory reviews in 2006 conducted) and compares those findings with the NIRs submitted in 2007 by Member States. This analysis intends to increase information on completeness of methodological descriptions, underlying data and key parts of the inventory submission by Member States that form the basis of the EC submission.

Table 1.15 Characterisation of Member States' national inventory reports 2005 and changes in 2006 and 2007

Member State	Characterisation of the report in the 2005 UNFCCC inventory review	Changes to the report in 2006/2007 in response to the review
Austria	**UNFCCC Status and Review report 2005:** The organization of chapters in the NIR follows the structure as outlined in the revised UNFCCC reporting guidelines (decision 18/CP.8). However, some of the information required in the annexes is not provided, e.g. tables 6.1 and 6.2 of the IPCC good practice guidance**.** Austria's submission is in a very good order. Clear and detailed information is provided in the NIR. Some issues, mainly concerning time series consistencies are identified by the ERT. (para 7) FCCC/ARR/2005/AUT	Several improvements in response to the UNFCCC review 2005 have been made, including the addition of table 6.1 in the Annexes.
Belgium	**UNFCCC Status and Review report 2005**: The organization of the NIR, in general, follows the structure as outlined in the revised UNFCCC reporting guidelines (decision 18/CP.8). However, the Executive Summary and some of the required sub-chapters and annexes (e.g. tables 6.1 and 6.2 of the IPCC good practice guidance, and methodological information relevant for the energy sector) are not provided. The NIR discusses quality assurance/quality control (QA/QC) but as yet the Party has no QA/QC plan; this will be a very useful development given the significant challenges in integrating the different methodological approaches as between Flanders, Wallonia and Brussels. (para 6) FCCC/ARR/2005/BEL	IPCC Uncertainty tables provided in Annex 3, additional methodological information for energy provided. QA/QC activities established that addresses methodological differences in three regions. Details only reported for certified QA/QC system in Flanders.
Denmark	**UNFCCC Status and Review report 2005:** The organization of the NIR follows the structure outlined in the revised UNFCCC reporting guidelines adopted by decision 18/CP.8. The inventory is generally complete, except of the LULUCF chapter, where some estimates are missing and methodological development is underway. (para 6) FCCC/ARR/2005/DNK	Several improvements and recalculations have been made. Especially in the LULUCF sector, where mineral soils from cropland, grasland and wetland are for the first time included in the inventory in 2006 and where additional descriptions were added in 2006 and further expanded in 2007.
Finland	**UNFCCC Status and Review report 2005:** The organization of the NIR follows the structure as outlined in the revised UNFCCC reporting guidelines (decision 18/CP.8). NIR and CRF are largely complete and transparent. More detailed explanations should be provided in some sectoral sections. An improved estimation of non-energy fuel use has not been done so far and should be resolved in the 2006 submission. (FCCC/ARR/2005/FIN, para 6)	Improvements have been taken place in different sectors. Many recalculations because of updated data or new emission factors have been done. Recalculation of emissions from feedstocks and non-energy use of fuels was performed.
France	**UNFCCC Status and Review report 2005:** The organization of the NIR, in general, follows the outline of the revised UNFCCC reporting guidelines (decision 18/CP.8). However, the report only provides summary information on the methodologies for all sectors. France's NIR is concise and well-structured in terms of chapters, sections and paragraphs. However, in many places explanations of why particular emission factors have been used or why specific recalculations have been performed are not provided. The complete and final OMINEA report should be submitted together with the NIR to the UNCCC secretariat. (FCCC/ARR/2005/FRA, para 8).	The OMINEA report has been updated and was expanded to 950 pages. However, the report in 2007 does not include a usual system of page numbers linked with a table of content.
Germany	**UNFCCC status and Review report 2005:** The organization of the chapters in the NIR follows the structure as outlined in the revised UNFCCC reporting guidelines adopted by decision 18/CP.8. The NIR provides clear and detailed information on the methods applied, the activity data (AD) and the emission factors (EFs) used. The German submission is therefore generally very transparent and well organized, and almost all necessary information is provided. A number of details could, however, be further improved. (para 6) FCCC/ARR/2005/DEU	Work on inventory improvement is still ongoing and NIR was further improved, especially with regard to the complete implementation of the IPCC Good Practice Guidance.
Greece	**UNFCCC status and Review report 2005:** The organization of chapters in the NIR in general follows the structure as outlined in the revised UNFCCC reporting guidelines (decision 18/CP.8). However, some of the recommended annexes are not provided. The ERT noted that the NIR could be improved by the inclusion of additional explanations on data and choices of methodologies, and that the inventory would benefit from the use of higher-tier (tier 2) methods for some key categories. However, it recognizes that the Greek inventory team is aware of these deficiencies and is currently examining how best to address them. The NIR and the CRF tables are for the most part consistent. The ERT also noted that the Greek inventory, while showing improvement, still suffers from a lack of recent data (see table 1.8 in the NIR, which indicates that almost all the	Greece improved its inventory submission. Tier 2 methods have been applied for most key categories and completeness has also been improved.

Member State	Characterisation of the report in the 2005 UNFCCC inventory review	Changes to the report in 2006/2007 in response to the review
	estimates for the year 2003 are provisional or only partial). (para 6) FCCC/ARR/2005/GRC	
Ireland	**UNFCCC status and Review report 2005:** The organization of the NIR does not follow the structure as outlined in the revised UNFCCC reporting guidelines (decision 18/CP.8). The NIR contains information on key sources, recalculations, QA/QC, uncertainties, trends, completeness and planned improvements. The inventory is generally transparent and comprehensive. Some emission categories are not included in the inventory and some key categories are estimated on the basis of the tier1 methodology. Data for the LULUCF sector have not been estimated and reported. The establishment of QA/QC activities is planned. (para 7) FCCC/ARR/2005/IRL	The majority of the recommendations in the 2003 review report have been implemented, e.g. development of an inventory report in line with the UNFCCC reporting guidelines and complete coverage of the LULUCF sector. Much work was done to apply more appropriate methods and emission factors. Previously reported inventories from 1990-2003 have been recalculated.
Italy	**UNFCCC status and review report 2005:** The Italian inventory is fairly complete, consistent and transparent, and is in a process of continuous improvement year by year. The national inventory report (NIR) is detailed and well documented, with the exception of certain categories, especially those for which country-specific methodologies and emission factors (EFs) are used, and these need further documentation.(para 4,9) FCCC/ARR/2005/ITA	Improved descriptions are provided
Luxembourg	**UNFCCC status report 2005:** An NIR has not been submitted in 2005.	NIR submitted for the first time in 2006 and imporved NIR with more methodological descriptions provided in 2007.
Netherlands	**UNFCCC status and review report 2005:** The organization of chapters in the NIR follows the structure as outlined in the revised UNFCCC reporting guidelines (decision 18/CP.8). The Netherlands inventory is on an advanced stage of development. Some data from industrial processes sector is reported as confidential. The ERT recommends that more can be done to facilitate an assessment of estimates of such sources. (para 7) FCCC/ARR/2005/NLD	Some missing sources from the industrial processes sector are included in the 2006 and 2007 submissions.
Portugal	**UNFCCC review report 2005:** In general the NIR is transparent and comprehensive. A well functioning institutional and QA/QC system have been developed. The CRF and the NIR include sufficient information for a thorough review of the methodologies and assumptions used. However, the structure of the NIR is not fully consistent with the structure outlined in the revised UNFCCC reporting guidelines. Some emissions sources are not included in the inventory. (para 6) FCCC/ARR/2005/PRT	In order to make the inventory internal consistend recalculations of the entire time series took place. Changes of methodologies, source coverages or scope of the data are reflected in this recalculations.
Spain	**UNFCCC status and review report 2005:** The organization of the NIR does not follow the structure as outlined in the revised UNFCCC reporting guidelines (decision 18/CP.8). The NIR contains information on methodologies used, inventory principles, trends and recalculations, uncertainty analysis and key sources, and discussion of key sources under each IPCC sector including information on activity data and factors used in the calculation of estimates. The inventory is largely complete apart from the LUCF sector, which only has estimates for category 5A Changes in Forest and Other Woody Biomass Stocks. The emissions estimates and trends are reasonable but in many cases are not transparent, either methodologically or in the activity data (AD), emission factors (EFs) or other parameters used. There appears to be a continuing need to improve coordination between the agencies which provide the data used for the estimation of emissions. The NIR should make more obvious the use of key category and uncertainty analyses for methodological choice and in the Party's strategy for improving its emissions estimates.(para 8) FCCC/ARR/2005/ESP	Report follows NIR structure and improved methodological descriptions are provided. Clearer references to key categories in methodological information provided.
Sweden	**UNFCCC status and review report 2005:** The organization of the NIR, in general, follows the structure as outlined in the revised UNFCCC reporting guidelines (decision 18/CP.8). However, some of the recommended annexes are not provided (e.g., tables 6.1 and 6.2 of the IPCC good practice guidance). The ERT notes that the NIR is very good, but could be improved somewhat with additional explanations about data and methodological choices and a more detailed analysis of factors underlying the trends. (para 6,7) FCCC/ARR/2005/SWE	In response to the review more information on recalculations and quality assurance and transparent explanations on uncertainty estimates for activity data, emission factors etc. is included in the NIR.
United Kingdom	**UNFCCC status and review report 2005:** The organization of the chapters in the NIR follows the structure outlined in the revised UNFCCC reporting guidelines (decision 18/CP.8). In general, both the NIR and the	Most of the questions on transparency and consistency were

Member State	Characterisation of the report in the 2005 UNFCCC inventory review	Changes to the report in 2006/2007 in response to the review
	CRF are largely complete and transparent. The ERT noted some minor questions of transparency and consistency, which are described in the sectoral sections of this report. It is evident that the inventory system of the United Kingdom is seeking to address many of the questions raised by previous review reports.	addressed.

In order to get more specific information on the relevant omissions in MS' GHG inventories, the information on completeness was compiled from UNFCCC inventory review reports of Member States (Table 1.16). However, in a number of cases, those reports only provide a list of incomplete source categories without a clarification whether these emissions are considered as relevant in quantitative terms. The last column of Table 1.16 indicates if Member States introduced changes to their NIRs regarding the completeness issues addressed during the review in 2005.

Table 1.16 Completeness of Member States' inventories as indicated in UNFCCC review reports and responses in 2006 and 2007

Member State, type and year of UNFCCC review	Findings related to completeness from UNFCCC review report	Response in 2006/2007 submission
Austria, centralised review 2005	Austria's 2005 submission is generally complete. A complete time series of all categories and sinks for the territory of Austria is provided. (para 8) **LULUCF:** The CRF for 2003 includes only estimates for CO_2, no other gases are estimated. Also estimates on net removals and emissions from soils are not complete and no changes of carbon stocks in dead organic matter have been reported for category 5A. Also some cells have not been filled in correctly as they are left blank or are filled with 0. (para 63, 64) FCCC/ARR/2005/AUT	As recommended by the ERT missing source and sink categories such as carbon stock changes in dead organic matter, emission from land use changes and N_2O and CH_4 emissions from biomass burning have been included since the 2006 inventory submission..
Belgium	Data are provided for all gases, sectors and years. CRF tables 7 (Overview), 8(b) (Recalculation – Explanatory Information) and 9 (Completeness) have not been provided, and table 10 (Trends) is provided only in the CRF tables for 2003. The notation keys are used in some sectoral and background tables in a limited way. Belgium has provided the new LULUCF reporting tables as required by decision 13/CP.9 of the Conference of the Parties for the years 1990–2003, although estimates are only provided for Forest Land Remaining Forest Land. Source category coverage sometimes varies between regions. (para 7) **Waste:** The reporting is complete except for 6B1 Industrial Wastewater Handling and CH_4 recovery in the waste-water treatment plants. CRF table 8(b) provides all the recalculated estimates performed in the Waste sector and brief explanations are provided in the NIR but not in the CRF. Belgium is encouraged to fill in the CRF tables by using the appropriate notation keys where emissions estimates are not reported, and providing fuller information on recalculations performed. (para 70) FCCC/ARR/2005/BEL	Table 8(b) is provided, table 10 provided for most recent year. Changes have been made in the LULUCF sector, where estimates were provided for tables 5A, 5B and 5C. Use of notation keys improved.
Denmark, centralised review 2005	Inventory data for the years 1990-2003 is provided, including all required tables. The inventory is complete apart from minor omissions noted below under Industrial Processes and Agriculture. Denmark intends to include these in its next inventory. Waste-water handling has been introduced into this submission in response to earlier reviews.(para 7)	Inventory was considered as complete, no recommendations for additions of sources.
Finland, centralised review 2005	Finland has submitted an almost complete inventory, including CRF tables from 1990-2003 and a comprehensive NIR. The geographical coverage is complete and all sectors and relevant categories are covered. Only few gases and emission sources are not reported in the CRF tables. Fugitive emissions of N_2O from the extraction and handling of peat are not estimated. (para 7) **LULUCF:** The submission does not include estimates for Wetlands (in category 5D), Settlements (in category 5.E) and Other Land (in category 5.F). The ERT notes that not all subcategories under these three categories are mandatory to report. Complete reporting of area of all land-use categories and changes over time would be preferable.(para 54) **Waste:** Finland does not estimate emissions from composting and therefore underestimates current CH_4 and N_2O emissions. The ERT strongly recommends that Finland include these emission sources in the inventory as their relevance may grow in the future. (para 62) FCCC/ARR/2005/FIN	In the LULUCF sector carbon stock changes in forest soils and dead organic matter pool have been included for the first time. Complete areas are reported in LULUCF tables. Emissions from composting have been included in the waste sector in this submission.
France	France has provided inventory data for the years 1990–2003. The ERT	Notation keys used instead of empty

Member State, type and year of UNFCCC review	Findings related to completeness from UNFCCC review report	Response in 2006/2007 submission
	noted that in a number of tables France leaves data cells empty. Table 9 – Completeness has not been provided. (para 12-14) **Energy:** For several sources no emissions of CH_4 and N_2O are not estimated, although activity data are available. (para 26). **Industrial processes:** Potential emissions of HFCs, PFCs and SF_6 are reported as "NE" for all years. (para 54) **LULUCF:** France has not provided the CRF tables for LULUCF as required by decision 13/CP.9. Thus, background data are reported in the CRF tables for LUCF, which are based on the categories of the Revised 1996 IPCC Guidelines. Consequently, France's inventory in the LUCF sector cannot be considered complete. (para 66) **Waste:** All the sectoral CRF tables have been completed. (para 72) FCCC/ARR/2005/FRA	cells. Table 9 (completeness) is provided.. **Energy:** CH_4 and N_2O estimates for all relevant source categories provided. **LULUCF:** The LULUCF tables are provided as required by decision 13/CP.9.
Germany	Germany has provided inventory data for the years 1990–2003 and included all the required tables.The LULUCF reporting tables are provided as required by decision 13/CP.9 for the years 1990–2003. However, data are not included in the following tables of the LULUCF CRF: Summary 3 (1990–2002), and tables 7, 9 and 10 (1990–2003).(para 7) **Energy:** CO_2 emissions from biomass are generally reported as "0.00". The Party is recommended to include the estimates for CO_2 emissions from biomass in the CRF tables.(para 20) **Waste**: The ERT recommends that Germany provide estimates for N_2O emissions from Waste-water Handling and complete the additional information tables in CRF tables 6A and 6B, as required by the revised UNFCCC reporting guidelines. (para 75) FCCC/ARR/2005/DEU	According to the recommendations of the review CO_2 emissions from biomass are included in the CRF tables. Sumary 3 and tables 9 and 10 are provided. CO_2 emissions from Calcium Carbide and Methanol and 2C2 are reported in the CRF tables. 2A3 and 2A4 are included elsewhere. In the waste sector N_2O emissions from domestic and commercial wastewaterhandling are reported. Additional information in table 6A,C provided.
Greece	Overall, the Greek inventory is complete. The NIR identifies known sources that are missing and provides detailed explanations for this in most cases. Missing sources include Electrical Equipment – SF_6, CO_2 and N_2O emissions from Fugitive Emissions from Fuels, Soda Ash Production, Asphalt Roofing and Road Paving, which are not included either because of inconsistencies in data sources or because of lack of data. A number of other minor sources, such as Foam Blowing – F-gases, Solvents – N_2O, Agricultural Soils – CH_4, Wastewater Handling: Industrial – N_2O and Sludge – CH_4, are also not reported due to lack of activity data (AD) or estimation methodologies. (para 7)	Improvement of the completeness of the inventory will be further investigated. Recommendations not clear in relation to the necessity to include additional sources.
Ireland, centralized review 2005	Ireland's inventory is complete for all years with regard to geographical coverage and is generally complete in terms of coverage of sources and gases. However, in the LULUCF sector a wrong reporting format is used and some important sources are not included in the inventory: Being emissions from the Industrial processes sector and Forest and Grassland Conversion – CO_2; Abandonment of Managed Lands – CO_2; Emissions and Removals from Soil – CO_2 (except for emissions from lime application); Agriculture Soils – CH_4; and Wastewater Handling – N_2O. Ireland believes that many of these categories are minor, with the probable exception of the LULUCF categories. (para 8-10) **LULUCF:** Ireland has not submitted LULUCF reporting tables, but has used the reporting format for Land-use Change and Forestry (LUCF), as contained in decision 18/CP.8. For the LULUCF sector Ireland notes that, due to the high level of uncertainty in annual estimates, until the results of major national research in this area become available, it has not included categories other than Forest Land.(para 61, 63) **Waste:** Emissions from waste water handling are assumed to be negligible and not estimated. Also waste incineration is not estimated due to minor emissions and confidential data. For terms of completeness these emissions should be included in the next submission. (para 71) FCCC/ARR/2005/IRL	Several improvements have been made in response to the review process. F-gases for the years 1990-1994 have been estimated. In the LULUCF sector the reporting format has been changed according to the requirements of decision 13 CP/9 all sources of emissions and removals in the LULUCF sector are covered. Some CH_4 and N_2O emissions from waste water handling are included in this inventory.
Italy, In country review 2005	The 2005 inventory submission is fairly complete. CRF tables including full geographical coverage, all sectors and almost all gases and sources/sinks. Some gaps still exist. In the energy sector some emissions from manufacturing industries and constructions are not estimated. In industrial processes and solvent use sector potential HFC emissions are not reported and N_2O emissions from other use are not calculated. Notation keys are used, but some blank cells still exist. (para 15,16) **Energy:** Description of recalculations in CRF table 8(b) is missing. **Agriculture:** Application of sewage sludge to agricultural soils is not included in estimated emissions.(para 85) **LULUCF:** Revised table 7 is not included in the CRFs. Emissions from grassland fires are not reported. Deforestation should be reported, even	Energy. CO_2 emissions from the iron and steel sector have been revised. The full carbon cycle has been accounted for and emissions have been balanced between the energy and the industrial processes sectors. CH_4 fugitive emissions from production of gas and oil post mining activities have been revised following the Good Practice Guidance and new information supplied by industry

Member State, type and year of UNFCCC review	Findings related to completeness from UNFCCC review report	Response in 2006/2007 submission
	when assumed to be negligible. (para 114-116) FCCC/ARR/2005/ITA	Industrial sector. CO_2 emissions from mineral products and metal production have been recalculated. For mineral products changes has concerned the revision of activity data time series on lime production. The revision which affected metal production has already been explained by a more accurate split of emissions from iron and steel between the energy and industrial processes sectors. N_2O emissions from nitric acid production, in the chemical industry, have been revised and recalculated on account of new information made available by industry. LULUCF. The entire time series has been recalculated deleting CO_2 emissions from cropland and grassland remaining cropland and grassland because not related to a real change in carbon content in soils. Moreover, estimates of soil carbon stock changes resulting from transition of cropland and grassland to settlement have been provided. Waste sector. CH_4 emissions from solid waste disposal have been recalculated on the basis of an in depth analysis on basic parameters used for estimation.
Luxembourg	Was not reviewed due to lack of 2004 NIR	
Netherlands, centralized review 2005	The inventory covers all gases for the whole time series 1990–2003, and is complete in terms of geographical coverage. Some gaps still remain in the inventory. Fugitive emissions from distribution of oil products, CO_2 from lime production, CO_2 from asphalt roofing and paving, CH_4 from poultry, N_2O from industrial waste water and potential emissions from PFCs and SF_6. The party considers some sources to be negligible. The ERT recommends that the Netherlands further explain the rationale for this assessment. (para 9,10) **Energy:** The CRF tables for 2003 are largely complete. Emissions not included are emissions of CO_2 and N_2O from solid and other fuels from Manufacturing Industries and Construction, as well as emissions from the Refining sector. (para 23) **Land use change and forestry:** Not all pools are included for all land categories and it is not always clear whether they are assumed not to change or are not estimated. For the category cropland AD is reported, but emissions are stated as NE. Information on carbon stock changes is not yet available. Emissions from biomass burning are not estimated. (para 64-66) FCCC/ARR/2005/NLD	Emissions from Manufacturing Industries have been estimated in this submission. Further improvements have been made in the LULUCF sector with regard to emission estimates from cropland. CH_4 emissions are not relevant for poultry according to IPCC Guidelines. CO_2 and N_2O emissions from solid fuels in Manufacturing Industries and Construction are estimated. For cropland removals in mineral soils are reported. Biomass burning is reported as NO.
Portugal, centralized review 2005	Portugal's inventory is generally complete in terms of geographical coverage and coverage of sources and gases. The LULUCF sector does not include emissions and removals from the two autonomous regions of Madeira and the Azores Islands. Some sources are not estimated ("NE") in the inventory, the most important being Solvent and Other Product Use – N_2O; and Potential Emissions of HFCs, PFCs and SF_6. With regard to LULUCF, the NIR and the CRF only provide estimates for Forest Land. Emissions and removals from other LULUCF categories are reported as "NE" or not occurring ("NO"). (para 7,8) **Industrial processes:** CO_2 emissions from asphalt roofing and N_2O emissions from solvent and other product use are reported as not estimated. (para 36) **Land use change and forestry:** Emissions and removals from Forest Land have been estimated only for the living biomass pool. (para 56,57) FCCC/ARR/2005/PRT	Improvements have been made in the LULUCF sector. Net CO_2 emissions and removals have been reported for most categories. Estimates for potential PFCs, HFCs and SF_6 emissions are reported.
Spain	The inventory covers all gases and sectors, although not always completely, particularly in the LUCF sector, for which coverage is restricted to category 5A Forest and Other Woody Biomass Stocks. Emissions of CO_2 from limestone and dolomite and of CH_4 from ethylene and styrene production have been added to the inventory for	QA/QC system is implemented. Revised LULUCF tables used for forest land, but work on completion of LULUCF tables is ongoing. Transparency improved.

Member State, type and year of UNFCCC review	Findings related to completeness from UNFCCC review report	Response in 2006/2007 submission
	the first time in response to the results of previous reviews. (para 9) **Energy:** The inventory covers all significant Energy sector sources for all years and all gases.(SO_2).(para 18) **Industrial processes and solvent use:** Potential emissions of HFCs, PFCs and SF_6 are not provided, mainly because of the current lack of information on imports and exports per gas. As observed in the 2004 review, CRF tables 7 and 9 have not been completed. (para 41) **LULUCF:** Categories 5B Forest and Grassland Conversion, 5C Abandonment of Managed Lands and 5D CO_2 Emissions and Removals from Soils are not estimated due to lack of reliable basic data. Emissions from soils and deforestation, and carbon stock changes in the dead organic matter pool, are not reported.(para 68) **Waste:** Emissions have been estimated for most of the source categories except for the incineration of industrial waste.(para 76) FCCC/ARR/2005/ESP	CRF table 9(a) partially filled. Additional sources for waste incineration included.
Sweden	Overall, the Swedish inventory is complete. Only some minor sources have been identified in the NIR. (para 8) **LULUCF**: In its 2005 submission, Sweden reported the LUCF sector in accordance with the Revised 1996 IPCC Guidelines and relevant CRF tables. The ERT encourages Sweden to report emissions and removals from the LULUCF sector in accordance with decision 13/CP.9, including the LULUCF CRF tables. (para 60,62)	In response to the review, the new LULUCF reporting format is used for the LULUCF sector including CRF tables.
United Kingdom	In general, both the NIR and the CRF are largely complete and transparent. **Industrial Processes:** The estimates for the sector are mostly complete except for a small number of minor sources which are noted as "NE" (CH_4 from ammonia, iron and steel, and ferroalloys and aluminium production). The United Kingdom has commented in previous reviews and inventory submissions that these sources have been excluded either because of a lack of methodology or because they are assumed to be negligible.	Inventory was considered as complete, no recommendations for additions of sources.

1.8.2 Data gaps and gap-filling

The EC GHG inventory is compiled by using the inventory submissions of the EC Member States. If a Member State does not submit all data required for the compilation of the EC 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 Community 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 EC.

For data gaps in Member States' inventory submissions, the following procedure is applied by the ETC/ACC 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' ([13]) 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 Community inventory and Member States' inventories.

The methods used for gap filling include interpolation, extrapolation and clustering. These methods are consistent with the adjustment methods dscribed in UNFCCC Adjustment Guidelines (Table 1) and in the IPCC GPG 2000.[14]

Gap filling in GHG inventory submissions 2007

For the EC Member States 2005 inventories are missing from Malta. In addition, for Cyprus F-gas emissions are missing (Table 1.17). Member States affected by gap filling have the opportunity to provide feedback and incorporated the estimates in their national submissions.

Table 1.17 Overview of missing data by May 2007

Member State	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
Cyprus				1990-2005	1990-2005	1990-2005
Malta	2001-05	2001-05	2001-05	1990-2005	1990-2005	1990-2005

On the basis of the general approaches mentioned above the following concrete methodologies were used for each sector/gas:

[14] ETC ACC technical note on gap filling procedures , December 2006

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.

The following country-specific methods for gap filling were used:

Cyprus
HFC
Emissions estimated on basis of average per capita emissions of ES, GR, IT; PT for 2F1 'Refrigeration and air conditioning equipment' for 1990-2003 and extrapolated to 2004 and 2005
SF_6
Emissions estimated on basis of average emissions per electricity consumption of ES, IT; PT for 2F7 'Electrical equipment' for 1990-2003 and extrapolated to 2004 and 2005
Malta
CO_2, CH_4, N_2O: fuel combustion related
Extrapolation on basis of percentage change of Eurostat CO2 emissions for 2001-2005
CO_2, CH_4, N_2O: non-fuel combustion related
Linear trend extrapolation 1994-2000 for 2001-2005; in a some cases previous year values were used.
HFC
Emissions estimated on basis of average per capita emissions of ES, GR, IT; PT for 2F1 'Refrigeration and air conditioning equipment' for 1990-2003 and extrapolated to 2004
SF_6
Emissions estimated on basis of average emissions per electricity consumption of ES, IT; PT for 2F7 'Electrical equipment' for 1990-2003 and extrapolated to 2004

Data on CO_2 emissions were provided by Eurostat in March 2007. Note that all estimates which were derived from the gap filling approaches described above are marked grey in the tables of the next chapter.

1.8.3 Data basis of the European Community greenhouse gas inventory

The 2007 EC GHG inventory data consist of:

- the GHG submissions of the Member States to the Commission in 2007;
- previous GHG submissions, in cases where Member States did not provide the complete time series for each gas in 2007;
- emission estimates derived from data gap-filling in cases where no data were available for a specific gas and year (used only in few cases).

Table 1.18 shows the sources of GHG emissions data by Member State and type of submission.

Table 1.18 Sources of GHG emissions data for CRF Table Summary 1A by Member State and type of submission

EC MS	Years	Inventories used
Austria	1990-2005	Inventory 2007

Belgium	1990-2005	Inventory 2007
Bulgaria	1990-2005	Inventory 2007
Cyprus	1990-2005	Inventory 2007
Czech Republic	1990-2005	Inventory 2007
Denmark	1990-2005	Inventory 2007
Estonia	1990-2005	Inventory 2007
Finland	1990-2005	Inventory 2007
France	1990-2005	Inventory 2007
Germany	1990-2005	Inventory 2007
Greece	1990-2005	Inventory 2007
Hungary	1990-2005	Inventory 2007
Ireland	1990-2005	Inventory 2007
Italy	1990-2005	Inventory 2007
Latvia	1990-2005	Inventory 2007
Lithuania	1990-2005	Inventory 2007
Luxembourg	1990-2005	Inventory 2007
Malta	1990-2000	Inventory 2004
	2001-05	Gap filling
Netherlands	1990-2005	Inventory 2007
Poland	1990-2005	Inventory 2007
Portugal	1990-2005	Inventory 2007
Romania	1990-2005	Inventory 2007
Slovakia	1990-2005	Inventory 2007
Slovenia	1990-2005	Inventory 2007
Spain	1990-2005	Inventory 2007
Sweden	1990-2005	Inventory 2007
United Kingdom	1990-2005	Inventory 2007

Note: This table indicates the source of GHG emission data and whether data were available for specific years. It does not indicate whether the submission for a year covers all gases, categories or CRF tables.

Tables 1.19 to 1.22 show the data basis of the 2007 EC GHG inventory. Values in white cells without a frame are data provided by Member States in 2007 in the CRF Table Summary 1.A. Framed cells indicate that the emission data has been taken from the EC GHG inventory 2006. Shaded values are derived from gap-filling. 'NE' ('not estimated') indicates that data is not available and that no gap-filling has been made.

Table 1.19 Data basis of CO_2 emissions excluding LULUCF (Tg)

EC Member State	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Austria	62	65	60	60	61	64	67	67	67	65	66	70	72	78	77	80
Belgium	119	122	121	119	123	124	128	122	128	123	124	124	123	127	127	123
Bulgaria	86	68	61	64	62	66	65	63	55	51	50	52	49	54	53	55
Cyprus	5	5	5	6	6	6	6	6	6	6	7	7	7	7	8	8
Czech Republic	165	155	140	137	131	132	140	133	129	122	129	129	124	128	127	126
Denmark	53	63	58	60	63	60	74	64	60	58	53	55	54	59	54	50
Estonia	38	36	27	21	22	20	21	21	18	17	17	17	17	19	19	18
Finland	57	55	54	56	62	58	64	63	60	59	57	62	65	73	69	57
France	393	415	408	388	384	390	404	398	418	408	404	410	404	409	413	412
Germany	1,032	995	947	937	923	921	943	913	905	879	883	901	886	901	897	873
Greece	84	84	85	85	87	87	90	94	99	98	104	106	106	110	110	112
Hungary	73	69	63	64	63	62	63	62	61	61	59	60	59	62	60	62
Ireland	33	33	33	33	35	35	37	39	41	42	45	47	46	45	46	47
Italy	435	434	434	428	421	446	439	443	454	459	464	469	471	487	491	493
Latvia	19	18	14	12	10	9	9	9	8	8	7	7	7	8	8	8
Lithuania	36	38	21	16	16	15	16	15	16	13	12	13	13	13	13	14
Luxembourg	12	12	12	13	12	9	9	9	8	8	9	9	10	10	12	12
Malta	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3
Netherlands	159	164	162	167	167	171	178	171	173	168	170	175	176	180	181	176
Poland	397	389	382	365	376	377	399	386	357	345	333	331	318	331	325	327
Portugal	43	45	49	48	49	53	50	53	58	65	64	65	69	64	66	68
Romania	173	133	131	132	129	135	140	126	112	95	97	102	110	116	117	111
Slovakia	61	52	48	45	42	44	44	45	44	43	40	42	40	41	40	40
Slovenia	15	14	14	14	14	15	16	16	16	15	15	16	16	16	16	17
Spain	229	235	242	233	245	256	243	263	271	296	308	312	331	335	352	368
Sweden	56	57	57	56	59	58	62	57	57	55	53	54	55	56	55	53
United Kingdom	590	597	581	567	559	550	572	549	551	542	550	561	546	558	558	558
EU-27	**4,426**	**4,359**	**4,213**	**4,130**	**4,122**	**4,165**	**4,280**	**4,188**	**4,175**	**4,103**	**4,122**	**4,201**	**4,176**	**4,289**	**4,298**	**4,269**
EU-15	**3,357**	**3,380**	**3,305**	**3,251**	**3,249**	**3,282**	**3,359**	**3,306**	**3,351**	**3,326**	**3,354**	**3,422**	**3,413**	**3,492**	**3,508**	**3,482**

Note: Values in white cells without a frame are data provided by Member States in 2007 in the CRF Table Summary 1.A. Framed cells indicate that the emission data has been taken from the EC GHG inventory 2006. Shaded values are derived from gap-filling. 'NE' ('not estimated') indicates that data is not available and that no gap-filling has been made.

Table 1.20 Data basis of CH_4 emissions in CO_2 equivalents (Tg)

EC Member State	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Austria	9	9	9	9	9	9	8	8	8	8	8	7	7	7	7	7
Belgium	11	11	11	11	11	11	10	10	10	10	9	9	8	8	8	8
Bulgaria	20	19	17	16	15	15	14	13	13	12	12	11	11	11	11	10
Cyprus	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Czech Republic	19	17	16	15	14	14	13	13	12	12	12	11	11	11	11	11
Denmark	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Estonia	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2
Finland	6	6	6	6	6	6	6	6	6	6	5	5	5	5	5	5
France	69	70	69	70	69	70	69	66	66	65	64	63	61	59	58	57
Germany	99	94	90	89	85	81	78	75	69	69	65	61	58	54	50	48
Greece	9	9	9	9	9	9	9	9	9	9	9	9	9	8	8	8
Hungary	9	9	9	8	8	8	8	8	8	8	8	8	8	8	8	8
Ireland	13	13	14	14	14	14	14	14	14	14	13	13	13	14	13	13
Italy	42	43	42	43	43	44	44	45	44	44	44	43	42	41	40	40
Latvia	4	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2
Lithuania	6	6	5	4	4	4	4	4	4	3	3	3	3	3	3	3
Luxembourg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Malta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Netherlands	25	26	25	25	24	24	23	22	21	20	19	19	18	18	17	17
Poland	49	47	44	42	43	43	43	43	43	42	40	38	38	38	38	38
Portugal	11	12	12	12	12	13	13	13	13	14	13	12	13	13	12	11
Romania	45	39	33	31	30	31	32	29	26	25	26	25	26	26	26	26
Slovakia	6	5	5	5	5	5	5	5	5	5	5	5	5	5	4	4
Slovenia	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Spain	28	28	29	29	30	31	32	33	34	34	35	36	37	37	37	37
Sweden	7	7	7	7	7	7	7	7	6	6	6	6	6	6	6	6
United Kingdom	104	103	101	98	91	90	88	83	78	73	69	63	60	54	52	50
EU-27	**604**	**588**	**568**	**556**	**543**	**541**	**536**	**519**	**505**	**492**	**479**	**463**	**452**	**441**	**429**	**420**
EU-15	**440**	**437**	**430**	**428**	**416**	**414**	**409**	**397**	**387**	**378**	**367**	**354**	**343**	**331**	**320**	**312**

Note: Values in white cells without a frame are data provided by Member States in 2007 in the CRF Table Summary 1.A. Framed cells indicate that the emission data has been taken from the EC GHG inventory 2006. Shaded values are derived from gap-filling. 'NE' ('not estimated') indicates that data is not available and that no gap-filling has been made.

Table 1.21 Data basis of N_2O emissions in CO_2 equivalents (Tg)

EC Member State	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Austria	6	7	6	6	7	7	6	6	6	6	6	6	6	6	5	5
Belgium	12	12	12	12	12	13	13	13	13	13	13	12	12	11	11	11
Bulgaria	10	8	6	6	6	6	6	5	4	4	5	5	4	4	4	4
Cyprus	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Czech Republic	13	11	10	9	8	9	8	8	8	8	8	8	8	8	8	8
Denmark	11	10	10	10	10	10	9	9	9	9	9	8	8	8	8	7
Estonia	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1
Finland	8	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
France	96	95	96	91	92	94	95	96	89	83	82	80	78	75	73	72
Germany	85	80	81	78	78	78	79	76	63	59	60	61	60	63	65	67
Greece	14	14	14	13	13	13	14	13	13	13	13	13	13	13	13	13
Hungary	16	13	11	11	12	11	12	11	11	11	11	12	11	11	11	10
Ireland	9	9	9	9	10	10	10	10	11	11	10	10	9	9	9	9
Italy	41	41	41	41	40	41	41	42	42	43	43	43	43	43	45	43
Latvia	4	4	3	2	2	1	1	1	1	1	1	1	1	1	1	1
Lithuania	6	6	4	4	3	3	3	3	4	3	3	4	4	4	4	5
Luxembourg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Malta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Netherlands	21	22	22	23	22	22	22	22	22	21	20	19	18	17	18	18
Poland	39	34	32	31	32	33	32	32	32	31	31	31	30	30	30	31
Portugal	5	5	5	5	6	6	6	6	6	6	6	6	6	6	6	6
Romania	29	22	21	20	19	19	19	18	16	15	15	15	15	15	17	17
Slovakia	6	5	5	4	4	4	4	4	4	4	4	4	4	4	5	4
Slovenia	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Spain	28	27	26	24	27	27	30	29	30	32	33	31	30	32	31	30
Sweden	9	9	8	9	9	9	9	9	9	8	8	8	8	8	8	8
United Kingdom	64	64	57	53	54	53	53	55	54	44	44	41	40	40	40	40
EU-27	**536**	**509**	**490**	**470**	**475**	**476**	**483**	**481**	**459**	**437**	**436**	**430**	**420**	**420**	**423**	**419**
EU-15	**409**	**403**	**395**	**381**	**387**	**388**	**394**	**393**	**374**	**355**	**353**	**346**	**339**	**338**	**339**	**335**

Note: Values in white cells without a frame are data provided by Member States in 2007 in the CRF Table Summary 1.A. Framed cells indicate that the emission data has been taken from the EC GHG inventory 2006. Shaded values are derived from gap-filling. 'NE' ('not estimated') indicates that data is not available and that no gap-filling has been made.

Table 1.22 Data basis of actual HFCs, PFCs and SF_6 emissions in CO_2 equivalents (Gg)

Member State		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Austria	HFC	23	45	49	157	207	267	347	427	495	542	596	695	782	865	900	912
	PFC	1,079	1,087	463	53	59	69	66	97	45	65	72	82	87	103	115	118
	SF_6	503	653	698	794	986	1,139	1,218	1,120	908	684	633	637	641	594	513	287
Belgium	HFC	434	434	434	434	434	434	513	621	751	787	893	1,028	1,245	1,399	1,461	1,454
	PFC	1,753	1,678	1,830	1,759	2,113	2,335	2,217	1,211	669	348	361	223	82	209	306	141
	SF_6	1,663	1,576	1,744	1,677	2,035	2,205	2,120	525	270	120	109	105	94	75	51	43
Bulgaria	HFC	IA,NE,NO	IA,NE,NO	IA,NE,NO	IA,NE,NO	IA,NE,NO	3	109	188	577	103	96	98	90	121	217	387
	PFC	IA,NE,NO	IA,NE,NO	IA,NE,NO	IA,NE,NO	IA,NE,NO	IA,NE,NO	IA,NE,NO	IA,NE,NO	IA,NE,NO	IA,NE,NO	IA,NE,NO	IA,NE,NO	IA,NE,NO	IA,NE,NO	IA,NE,NO	IA,NE,NO
	SF_6	0	0	0	0	0	1	1	2	2	2	2	2	3	3	4	4
Cyprus	HFC	0	0	0	0	1	2	4	6	10	14	19	25	31	38	44	50
	PFC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SF_6	1	1	1	1	2	2	3	3	3	2	2	2	3	4	4	4
Czech Republic	HFC	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	1	101	245	317	268	263	393	391	590	600	594
	PFC	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0	4	1	1	3	9	12	14	25	17	10
	SF_6	0	0	0	0	0	75	78	96	64	77	142	169	68	101	52	86
Denmark	HFC	IA,NE,NO	IA,NE,NO	3	94	135	218	329	324	411	503	605	647	672	695	749	805
	PFC	IA,NE,NO	IA,NE,NO	IA,NE,NO	NA,NO	0	1	2	4	9	12	18	22	22	19	16	14
	SF_6	44	64	89	101	122	107	61	73	59	65	59	30	25	31	33	22
Estonia	HFC	0	0	0	0	0	0	1	1	2	3	4	5	6	7	7	8
	PFC	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
	SF_6	0	0	0	0	0	0	0	1	1	1	1	2	4	5	5	6
Finland	HFC	0	0	0	0	7	29	77	168	245	319	502	657	463	652	695	864
	PFC	0	0	0	0	0	0	0	0	0	28	22	20	13	15	12	10
	SF_6	94	67	37	34	35	69	72	76	53	52	51	55	51	42	23	20
France	HFC	3,657	4,228	3,635	2,381	1,886	3,349	5,362	5,727	5,918	6,746	7,410	8,206	9,092	9,955	10,402	10,958
	PFC	4,293	3,973	4,048	3,954	3,527	2,562	2,338	2,425	2,846	3,529	2,487	2,191	3,477	3,164	2,266	1,801
	SF_6	2,070	2,109	2,149	2,189	2,230	2,272	2,309	2,237	2,309	2,030	1,848	1,485	1,309	1,331	1,460	1,354
Germany	HFC	4,369	4,013	4,098	4,225	4,357	6,476	5,858	6,391	6,960	7,202	6,480	7,890	8,554	8,394	8,681	9,363
	PFC	2,708	2,333	2,102	1,961	1,650	1,750	1,714	1,369	1,473	1,243	786	723	795	858	830	718
	SF_6	4,785	5,118	5,634	6,405	6,694	7,238	7,154	7,144	6,988	5,588	5,400	5,199	4,410	4,455	4,548	4,740
Greece	HFC	935	1,107	908	1,607	2,144	3,421	4,113	4,538	5,132	6,123	5,282	5,203	5,298	5,559	5,709	5,911
	PFC	258	258	252	153	94	83	72	165	204	132	148	91	88	77	72	72
	SF_6	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4	4
Hungary	HFC	NA,NO	NA,NO	0	0	1	2	2	45	125	347	206	281	404	499	526	518
	PFC	271	234	135	146	159	167	159	161	193	210	211	199	203	190	201	209
	SF_6	40	53	49	52	68	70	69	68	68	127	140	107	120	162	178	201
Ireland	HFC	1	5	6	9	21	45	76	132	189	195	229	252	277	350	384	431
	PFC	0	0	0	0	75	75	103	131	62	196	305	296	212	229	187	174
	SF_6	35	36	37	38	82	83	102	132	94	69	56	69	70	119	67	96
Italy	HFC	351	355	359	355	482	671	450	756	1,182	1,524	1,986	2,550	3,100	3,796	4,515	5,267
	PFC	1,808	1,452	850	707	477	491	243	252	270	258	346	451	424	498	350	361
	SF_6	333	356	358	370	416	601	683	729	605	405	493	795	738	465	492	460
Latvia	HFC	IA,NE,NO	IA,NE,NO	IA,NE,NO	IA,NE,NO	IA,NE,NO	0	1	2	5	7	9	10	12	13	16	19
	PFC	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
	SF_6	0	0	0	0	0	0	0	1	1	1	1	2	3	4	5	8
Lithuania	HFC	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	45	91	19	42	158	30	14	34	22	37	19
	PFC	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
	SF_6	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	1
Luxembourg	HFC	14	14	14	14	14	14	14	14	14	14	43	43	43	43	43	83
	PFC	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
	SF_6	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4	4
Malta	HFC	0	0	0	0	1	1	2	4	5	8	11	14	17	21	24	27
	PFC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SF_6	0	1	1	1	1	1	2	2	1	1	1	1	2	2	2	2
Netherlands	HFC	4,432	3,452	4,447	4,998	6,480	6,020	7,678	8,300	9,341	4,859	3,824	1,469	1,541	1,380	1,515	1,354
	PFC	2,264	2,245	2,043	2,068	1,990	1,938	2,155	2,344	1,829	1,471	1,581	1,489	2,186	620	285	265
	SF_6	217	134	143	150	191	301	312	345	329	317	335	356	332	309	328	337
Poland	HFC	0	0	0	0	0	26	97	154	167	206	595	1,073	1,523	1,825	2,436	2,750
	PFC	829	825	821	816	812	250	236	249	251	240	224	270	287	278	285	261
	SF_6	2	2	2	2	2	13	8	9	12	14	16	18	21	20	23	24
Portugal	HFC	IA,NE,NO	IA,NE,NO	IA,NE,NO	1	2	10	19	34	55	95	141	172	208	287	335	391
	PFC	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
	SF_6	3	3	4	4	5	5	5	5	6	5	5	8	8	8	8	10
Romania	HFC	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	0	0	1	2	2	3	3	3	5	7	4
	PFC	2,116	1,942	1,352	1,409	1,491	1,774	1,769	390	416	415	413	429	445	472	513	570
	SF_6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Slovakia	HFC	NA,NO	NA,NO	NA,NO	NA,NO	3	22	38	61	41	65	76	83	103	133	154	175
	PFC	271	267	248	155	132	114	35	35	25	14	12	16	14	22	20	20
	SF_6	0	0	0	0	9	10	11	11	12	13	13	14	15	15	16	17
Slovenia	HFC	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	29	27	33	27	24	31	38	50	64	80	95
	PFC	257	303	243	251	282	286	240	194	149	106	106	106	116	119	120	124
	SF_6	10	10	10	11	11	12	12	12	13	16	16	16	17	18	18	19
Spain	HFC	2,403	2,179	2,763	2,258	3,458	4,645	5,197	6,126	5,809	7,164	8,170	5,284	3,892	5,033	4,680	5,011
	PFC	883	827	790	831	819	833	797	820	769	704	412	240	264	267	272	244
	SF_6	67	73	76	80	89	108	115	130	139	175	205	183	207	208	254	272
Sweden	HFC	4	8	10	30	73	126	205	313	384	478	550	595	644	686	739	777
	PFC	440	433	336	351	349	389	344	317	306	330	272	268	296	292	291	296
	SF_6	107	109	108	97	100	127	108	153	99	102	94	111	104	69	81	142
United Kingdom	HFC	11,375	11,854	12,324	13,001	14,015	15,500	16,734	19,200	17,293	10,861	9,117	9,714	9,945	10,256	8,948	9,221
	PFC	1,402	1,171	574	491	491	471	493	417	421	399	498	426	323	287	336	351
	SF_6	1,030	1,078	1,124	1,167	1,183	1,239	1,267	1,226	1,262	1,426	1,798	1,425	1,509	1,324	1,128	1,143
	HFC	27,998	27,694	29,049	29,566	33,719	41,358	47,446	53,829	55,500	48,617	47,170	46,442	48,422	52,687	53,906	57,447

Note: Values in white cells without a frame are data provided by Member States in 2007 in the CRF Table Summary 1.A. Framed cells indicate that the emission data has been taken from the EC GHG inventory 2006. Shaded values are or will be derived from gap-filling. 'NE' ('not estimated') indicates that data is not available and that no gap-filling has been made.

1.8.4 *Geographical coverage of the European Community inventory*

Table 1.23 shows the geographical coverage of the Member States' national inventories. As the EC inventory is the sum of the Member States' inventories, the EC inventory covers the same geographical area as the inventories of the Member States.

Table 1.23 Geographical coverage of the EC inventory

Member State	Geographical coverage
Austria	Austria
Belgium	Belgium consisting of Flemish Region, Walloon Region and Brussels Region
Bulgaria	Bulgaria
Cyprus	Cyprus
Czech Republic	Czech Republic
Denmark	Denmark (excluding Greenland and the Faeroe Islands)
Estonia	Estonia
Finland	Finland including Åland Islands
France	France and the overseas departments (Guadeloupe, Martinique, Guyana and Reunion) and the overseas territories (New Caledonia, Wallis and Futuna, French Polynesia, Mayotte, Saint-Pierre and Miquelon)
Germany	Germany
Greece	Greece
Hungary	Hungary
Ireland	Ireland
Italy	Italy
Latvia	Latvia
Lithuania	Lithuania
Luxembourg	Luxembourg
Malta	Malta
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.
Poland	Poland
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.
Romania	Romania
Slovakia	Slovakia
Slovenia	Slovenia
Spain	Spanish part of Iberian mainland, Canary Islands, Balearic Islands, Ceuta and Melilla
Sweden	Sweden
United Kingdom	The geographical coverage of the UK inventory has been extended from January 2006 onwards to include emissions from the UK Crown Dependencies (Jersey, Guernsey and the Isle of Man) and a number of the UK Overseas Territories (OTs). These OTs are the Cayman Islands, Falkland Islands, Bermuda, Montserrat and Gibraltar

1.8.5 *Completeness of the European Community submission*

National inventory report

The EC GHG submission provides GHG emission data for EU-27 and for EU-15. Most chapters and annexes of this report refer to EU-15 only, i.e. Chapters 3-9 and Annexes 1,2,4-10. Chapters 1, 2 and 10 and also Annexes 3, 11 and 12 refer to the EU-27 where relevant. This means that all the detailed information provided in previous reports for the EU-15 is also available in this report. In addition, basic information on institutional arrangements, data availability, QA/QC, uncertainty estimates, completeness, recalculations and emission trends are provided for the EU-27. Table 1.24 shows which information is provided for EU-27 and which chapters refer to EU-15 only.

Table 1.24 Coverage of EC national inventory report (EU-27 or EU-15 only)

Chapter/Annex		EU-27	EU-15 only
Chapter 1	**Introduction**		
1.1	Background information	√	
1.2	Institutional arrangements	√	
1.3	Process of inventory preparation	√	
1.4	General description of methods and data sources	√	
1.5	Key source categories		√

Chapter/Annex		EU-27	EU-15 only
1.6	QA/QC	√	
1.7	Uncertainty evaluation	√	
1.8	Completeness	√ (not Tables 1-15-1.16)	Tables I-15-1.16
Chapter 2	**Emission trends**		
2.1	Aggregated GHG emissions	√	
2.2	Emission trends by gas	√	
2.3	Emission trends by sector	√	
2.4	Emission trends by Member States	√	
2.5	Emission trends for indirect GHG and SO_2		√
Chapter 3	**Energy**		√
Chapter 4	**Industrial processes**		√
Chapter 5	**Solvent use**		√
Chapter 6	**Agriculture**		√
Chapter 7	**LUCF**		√
Chapter 8	**Waste**		√
Chapter 9	**Other**		√
Chapter 10	**Recalculations and improvements**	√	
Annex 1	**Key sources**		√
Annex 2	**EC CRF tables**		√
Annex 3	**Status reports**	√	
Annex 4	**CRF tables summary 1.A and 8(a)**		√
Annex 5	**CRF tables Energy**		√
Annex 6	**CRF tables Industrial processes**		√
Annex 7	**CRF tables Solvent use**		√
Annex 8	**CRF tables Agriculture**		√
Annex 9	**CRF tables LULUCF**		√
Annex 10	**CRF tables Waste**		√
Annex 11	**CRF table 10 for EU-25**	√	
Annex 12	**MS CRF and NIR**	√	

The EC NIR follows the outline of the UNFCCC reporting guidelines with the exception of the annexes. The main resaon for this is the nature of the EC inventory being the sum of Member States' inventories. Therefore the main purpose of the annexes is to make transparent the EC emission estimates by providing the basic basic Member States tables for every CRF table. Table 1.25 provides explanations for not including the annexes as required by the UNFCCC reporting guidelines.

Table 1.25 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 EC NIR
Annex 2: Detailed discussion of methodology and data for estimating CO_2 emissions from fossil fuel combustion	Due to the nature of the EC 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 EC NIR for the EC key sources.
Annex 3: Other detailed methodological descriptions for individual source or sink categories (where relevant)	Due to the nature of the EC 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 EC NIR for the EC 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 EC NIR. Due to the nature of the EC 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 EC NIR in Table 1.20. In addition, for the EC 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 EC considers the Member States CRF and NIR as part fo the EC submission.
Annex 7: Tables 6.1 and 6.2 of the IPCC good practice guidance	Due to the nature of the EC inventory EC 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 EC. Tier 2 uncertainty analysis has not yet been carried out.

Annex 8: Other annexes - (Any other relevant information – optional).	

CRF tables in Annex 2

Although the completeness of EU-15 CRF tables in Annex 2 has improved again this year, not all data in the sectoral background tables can be provided by the European Community. 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 (e.g. cement or clinker production). 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 EC GHG inventory submission (see Annex 12, which is available at the EEA website http://www.eea.eu.int) and in the sector annexes.

Table 1.26 provides an overview of sectoral report and sectoral background tables available in Annex 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 1.26 Inclusion of CRF tables in Annex 2

Table	Included in Annex 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 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	Partly	Emissions are included, activity data is not estimated because type of activity data used by the MS varies
Table 5. B	Partly	Emissions are included, activity data is not estimated because type of activity data used by the MS varies

Table	Included in Annex 2	Comment
Table 5. C	Partly	Emissions are included, activity data is not estimated because type of activity data used by the MS varies
Table 5. D	Partly	Emissions are included, activity data is not estimated because type of activity data used by the MS varies
Table 5. E	Partly	Emissions are included, activity data is not estimated because type of activity data used by the MS varies
Table 5. F	Partly	Emissions are included, activity data is not estimated because type of activity data used by the MS varies
Table 5 (I)	Yes	
Table 5 (II)	Yes	
Table 5 (III)	Partly	Emissions are included, activity data is not estimated because type of activity data used by the MS varies
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	Partly	Due to the use of the new CRF reporter software this information must be included at the most detailed level for every source/sink category. The most detailed level is only available for the EC key sources. With the use of the new software 'CRF aggregator' the EC will be able to complete this table.
Other Tables		
Table 7	Yes	
Table 8(a)	Yes	
Table 8(b)	No	Every recalculation of any single EC source category is the result of the respective recalculations in the Member States' inventories. In order to make this transparent the explanations for recalculations are provided in the EC NIR for the EC key sources together with the contribution of every MS to the EC recalculations. Summary information is also provided in Chapter 10 (Tables 10.1 and 10.2).
Table 9	No	Information on completeness as reported by Member States in CRF Table 9 is included in the NIR (Table 1.20). In addition, for the EC key sources explanations for the NE and IE are included in the sector chapters of the NIR, where relevant.
Table 10	Yes	

Table 1.27 provides for specific sectoral background tables an overview of activity data used by Member States in order to explain why this acitivity data cannot be reported at EU-15 level.

Table 1.27 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

Table	Source category		Activity data reported by MS
		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 Cement production
		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

Table	**Source category**		**Activity data reported by MS**
		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
	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
Table 2(II) C	C. PFCs and SF_6 from Metal Production		
		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)

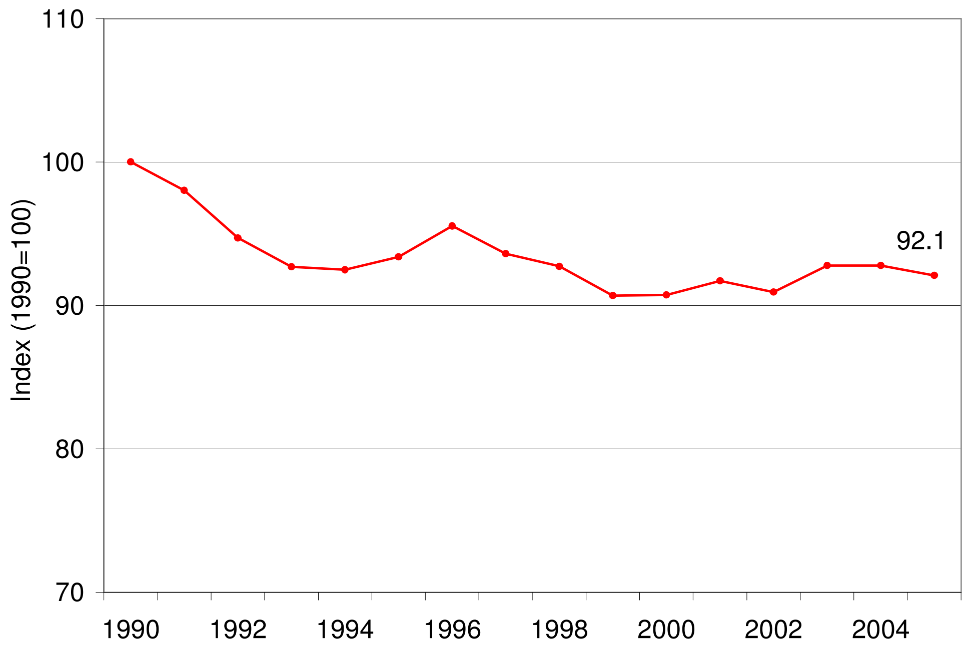
2 European Community greenhouse gas emission trends

This chapter presents the main GHG emission trends in the EC. Firstly, aggregated results are described for EU-27 and EU-15 as regards total GHG emissions and progress towards fulfilling the EC 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 EC GHG trends is given. Finally, also the trends of indirect GHGs and SO_2 emissions are also presented for EU-15 only.

2.1 Aggregated greenhouse gas emissions

EU-27: Total GHG emissions without LULUCF in the EU-27 decreased by 7.9 % between 1990 and 2005 (Figure 2.1). Emissions decreased by 0.7 % (+38 million tonnes) between 2004 and 2005.

Figure 2.1 EU-27 GHG emissions 1990–2005 (excl. LULUCF)



EU-15: In 2005 total GHG emissions in the EU-15, without LULUCF, were 1.5 % (65 million tonnes CO_2 equivalents) below 1990. Compared to the base year[15], emissions in 2005 were 2.0 % or 86 million tonnes CO_2 equivalents lower. In the Kyoto Protocol, the EC agreed to reduce its GHG emissions by 8 % by 2008–12, from base year levels. Assuming a linear target path from 1990 to 2010, in 2005 total EU-15 GHG emissions were 4.1 index points above this target path (Figure 2.2).

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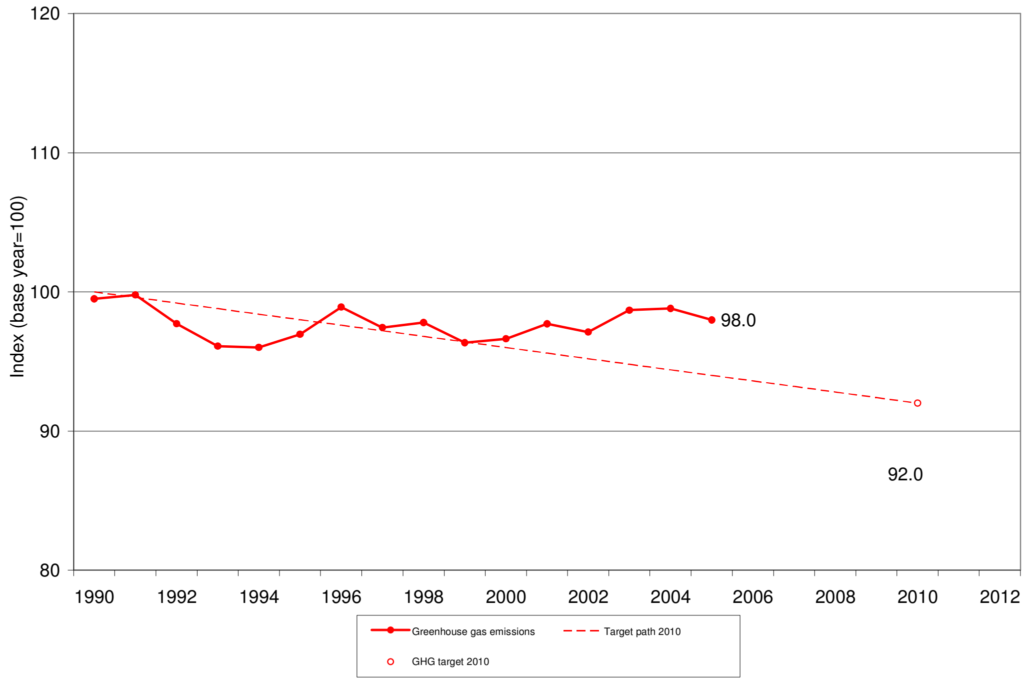
[15] For EU-15 the base year for CO_2, CH_4 and N_2O is 1990; for the fluorinated gases 12 Member States have selected 1995 as the base year, whereas Austria, France and Italy have chosen 1990. As the EC inventory is the sum of Member States' inventories, the EC base year estimates for fluorinated gas 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 due to deforestation for the Netherlands, Portugal and the UK (see EC Initial report, EEA, 2006c).

Figure 2.2 **EU-15 GHG emissions 1990–2005 compared with target for 2008–12 (excl. LULUCF)**



Notes: The linear target path is not intended as an approximation of past and future emission trends. It provides a measure of how close the EU-15 emissions in 2005 are to a linear path of emissions reductions from 1990 to the Kyoto target for 2008–12, assuming that only domestic measures will be used. Therefore, it does not deliver a measure of (possible) compliance of the EU-15 with its GHG targets in 2008–12, but aims at evaluating overall EU-15 GHG emissions in 2005. The unit is index points with base year emissions being 100.

GHG emission data for the EU-15 as a whole do not include emissions and removals from LULUCF. In addition, no adjustments for temperature variations or electricity trade are considered.

For the fluorinated gases the EU-15 base year is the sum of Member States base years. 12 Member States have selected 1995 as the base year under the Kyoto Protocol, Austria, France and Italy use 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 due to deforestation for the Netherlands, Portugal and the UK (see EC Initial report, EEA, 2006c).

The index on the y axis refers to the base year (1995 for fluorinated gases for all Member States except Austria, France and Italy, 1990 for fluorinated gases for Austria, France and Italy and for all other gases). This means that the value for 1990 needs not to be exactly 100.

Compared to 2004, EU-15 GHG emissions decreased by 0.8 % or 35.2 million tonnes CO_2 equivalents in 2004.

The decrease in GHG emissions between 2004-2005 was mainly due to:

- Lower CO_2 emissions from Public Electricity and Heat Production (-9.6 million tonnes or -0.9 %) mainly in Finland and Germany.
  According to EUROSTAT data in Finland and Denmark total electricity generation decreased and net imports increased, while Sweden and Norway had major increases in electricity from hydropower generation and increased export. This explains the decrease in emissions for Sweden, Finland and Denmark. In Germany the total electricity production from fossil thermal power stations did not change, although the fuel input decreased. In addition, the fuel switch from solid to liquid and gaseous fuels contributed to emission reductions.

- Lower CO_2 emissions from households and services (-7.0 million tonnes or -1.7 %).
  Important decreases in CO_2 emissions from household and services were reported by

Germany, the United Kingdom and the Netherlands, while Italy reported substantial increases. One reason for the decrease in Germany and the Netherlands is the warmer weather conditions (warmer winter) compared to the previous year.

- Lower CO_2 emissions from road transport (-6.0 million tonnes or -0.8 %).
  The decrease in CO_2 emissions from road transport is mainly caused by Germany, which is due to reduced specific fuel consumption, increased amount of diesel oil driven cars, and effects of the eco-tax as well as fuel buying abroad.
- Lower N_2O emissions from agricultural soils (-4.0 million tonnes or -2.0 %) mainly in Spain, Italy and Germany.
  The reduction from N_2O emissions from agricultural soils is partly due to a reduction in synthetic fertiliser use in Spain and Italy, and the reduction of the use of nitrogen fixing crops in Germany.
- Lower CH_4 emissions from solid waste disposal (-2.1 million tonnes or -2.7 %).
  CH_4 emissions from solid waste disposal decreased most in Germany, the Netherlands and the UK.
- Lower fugitive CH_4 emissions from coal mining (-2.5 million tonnes or -17.4 %) mainly in France and the UK due todeclinig coal mining.

Substantial increases in GHG emissions between 2004-2005 took place in the following source categories:

- HFC emissions from Refrigeration and Air Conditioning (+3.2 million tonnes or +9.9 %)
- N_2O emissions from Nitric Acid Production (+2.1 million tonnes or 6.9 %)
- CO_2 emissions from petroleum refining (+1.9 million tonnes or +1.6%)
- CO_2 emissions from civil aviation (+1.7 million tonnes or +7.2 %).

Table 2.1 shows that between 2004 and 2005, Spain saw the largest emission increases in absolute terms (+15.4 million tonnes CO_2 equivalents). On the positive side, 2005 saw emission reductions from Germany (-23.5 million tonnes CO_2 equivalents), Finland (-11.9 million tonnes CO_2 equivalents), and the Netherlands (-6.3 million tonnes CO_2 equivalents):

- Spanish emission increases mainly occurred in CO_2 from electricity and heat production (+10.4 million tonnes), CO_2 from iron and steel production (+0.7 million tonnes, both energy and process related emissions), CO_2 from cement production (+0.5 million tonnes) and CH_4 solid waste disposal (+0.2 million tonnes,). The increase in energy related emissions is due to an increase in electricity generation from fossil thermal power stations (17 %) and a decrease in electricity generation from hydropower plants (-33 %).

- The German emission reductions occurred primarily in CO_2 from public electricity and heat production (-8.1 million tonnes), CO_2 from road transport (-7.8 million tonnes) and CO_2 from household and services (-5.3 million tonnes), whereas N_2O emissions from nitric acid production increased by 3.5 million tonnes. Germany's reduction are the effect of switching from solid fuels to liquid and gaseous fuels.

- In Finland and the Netherlands emission reductions are mainly due to CO_2 in public electricity and heat production (-10.7 and –2.8 million tonnes respectively) and in the Netherlands also CO_2 emission reduction in households and services play an important role.

In 2005, 15 Member States (including Cyprus and Malta, which do not have a Kyoto target) had GHG emissions above base year levels whereas the remaining 12 Member States had emissions below base year levels.

Table 2.1 **Greenhouse gas emissions in CO_2 equivalents (excl. LULUCF) and Kyoto Protocol targets for 2008–12**

MEMBER STATE	Base year [1)] (million tonnes)	2005 (million tonnes)	Change 2004–2005 (million tonnes)	Change 2004–2005 (%)	Change base year–2005 (%)	Targets 2008–12 under Kyoto Protocol and "EU burden sharing" (%)
Austria	79.0	93.3	2.1	2.3%	18.1%	-13.0%
Belgium	146.9	143.8	-3.8	-2.6%	-2.1%	-7.5%
Bulgaria	132.1	69.8	0.9	1.3%	-47.2%	-8.0%
Cyprus	6.0	9.9	0.0	0.2%	63.7%	-
Czech Republic	196.3	145.6	-1.5	-1.0%	-25.8%	-8.0%
Denmark	69.3	63.9	-4.3	-6.3%	-7.8%	-21.0%
Estonia	43.0	20.7	-0.5	-2.3%	-52.0%	-8.0%
Finland	71.1	69.3	-11.9	-14.6%	-2.6%	0.0%
France	563.9	553.4	-2.7	-0.5%	-1.9%	0.0%
Germany	1232.5	1001.5	-23.5	-2.3%	-18.7%	-21.0%
Greece	111.1	139.2	1.6	1.2%	25.4%	25.0%
Hungary	123.0	80.5	1.0	1.2%	-34.5%	-6.0%
Ireland	55.8	69.9	1.3	1.9%	25.4%	13.0%
Italy	519.5	582.2	1.7	0.3%	12.1%	-6.5%
Latvia	25.9	10.9	0.2	1.5%	-58.0%	-8.0%
Lithuania	48.1	22.6	1.5	7.2%	-53.1%	-8.0%
Luxembourg	12.7	12.7	-0.1	-0.4%	0.4%	-28.0%
Malta [2)]	2.2	*3.4*	0.2	6.1%	54.8%	-
Netherlands	214.6	212.1	-6.3	-2.9%	-1.1%	-6.0%
Poland	586.9	399.0	2.3	0.6%	-32.0%	-6.0%
Portugal	60.9	85.5	0.9	1.0%	40.4%	27.0%
Romania	282.5	153.7	-6.4	-4.0%	-45.6%	-8.0%
Slovakia	73.4	48.7	-0.8	-1.6%	-33.6%	-8.0%
Slovenia	20.2	20.3	0.4	2.1%	0.4%	-8.0%
Spain	289.4	440.6	15.4	3.6%	52.3%	15.0%
Sweden	72.3	67.0	-2.7	-3.9%	-7.4%	4.0%
United Kingdom	779.9	657.4	-3.0	-0.5%	-15.7%	-12.5%
EU-15	**4278.8**	**4192.0**	**-35.2**	**-0.8%**	**-2.0%**	**-8.0%**

([1]) For EU-15 the base year for CO_2, CH_4 and N_2O is 1990; for the fluorinated gases 12 Member States have selected 1995 as the base year, whereas Austria, France and Italy have chosen 1990. As the EU-15 inventory is the sum of Member States' 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 due to deforestation for the Netherlands, Portugal and the UK (see EC Initial report, EEA, 2006c).

([2]) Malta did not provide GHG emission estimates for 2005, therefore the data provided in this table is based on gap filling (see Chapter 1.8.2.).

Note: Malta and Cyprus do not have Kyoto targets.

In 2005 the EU Emission Trading Scheme (EU ETS) covered ca 47% of the total CO_2 emissions and ca. 39% of total greenhouse gas emissions in EU-15. The EU ETS covered ca 49% of the total CO_2 emission and 41% of total greenhouse gas emissions in EU-25. In general, EU ETS information has been used by EU Member States as one input for calculating total CO_2 emissions for the sectors Energy and Industrial Processes in this report. However, an explicit quantification of the contribution of the EU ETS to total CO_2 emissions on sectoral and sub-sectoral level is not yet available for EU-15 or EU-25.

2.2 Emission trends by gas

EU-27: Table 2.2 gives an overview of the main trends in EU-27 GHG emissions and removals for 1990–2005. The most important GHG by far is CO_2, accounting for 82 % of total EU-27 emissions in 2005 excluding LULUCF. In 2005, EU-27 CO_2 emissions without LULUCF were 4 269 Tg, which was 3.5 % below 1990 levels. Compared to 2004, CO_2 emissions decreased by 0.7 %.

Table 2.2 Overview of EU-27 GHG emissions and removals from 1990 to 2005 in CO_2 equivalents (Tg)

GREENHOUSE GAS EMISSIONS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Net CO_2 emissions/removals	4,057	3,918	3,787	3,702	3,680	3,726	3,830	3,748	3,748	3,669	3,697	3,741	3,711	3,844	3,858	3,815
CO_2 emissions (without LULUCF)	4,426	4,359	4,213	4,130	4,122	4,165	4,280	4,188	4,175	4,103	4,122	4,201	4,176	4,289	4,298	4,269
CH_4	604	588	568	556	543	541	536	519	505	492	479	463	452	441	429	420
N_2O	536	509	490	470	475	476	483	481	459	437	436	430	420	420	423	419
HFCs	28	28	29	30	34	41	47	54	55	49	47	46	48	53	54	57
PFCs	21	19	16	15	15	14	13	11	10	10	8	8	9	8	6	6
SF_6	11	11	12	13	14	16	16	14	13	11	11	11	10	9	9	9
Total (with net CO_2 emissions/removals)	**5,257**	**5,073**	**4,902**	**4,786**	**4,761**	**4,814**	**4,924**	**4,826**	**4,790**	**4,667**	**4,679**	**4,698**	**4,649**	**4,774**	**4,779**	**4,726**
Total (without CO2 from LULUCF)	**5,626**	**5,514**	**5,328**	**5,214**	**5,203**	**5,253**	**5,374**	**5,266**	**5,216**	**5,102**	**5,104**	**5,159**	**5,115**	**5,219**	**5,219**	**5,180**
Total (without LULUCF)	**5,621**	**5,509**	**5,324**	**5,210**	**5,199**	**5,249**	**5,370**	**5,262**	**5,212**	**5,098**	**5,100**	**5,155**	**5,111**	**5,215**	**5,215**	**5,177**

EU-15: Table 2.3 gives an overview of the main trends in EU-15 GHG emissions and removals for 1990–2005. Also in the EU-15 the most important GHG is CO_2, accounting for 83 % of total EU-15 emissions in 2005. In 2005, EU-15 CO_2 emissions without LULUCF were 3 482 Tg, which was 3.7 % above 1990 levels (Figure 2.3). Compared to 2004, CO_2 emissions decreased by 0.7 %. The largest four key sources account for 79 % of total CO_2 emissions in 2005. Figure 2.4 shows that the main reason for increases between 1990 and 2005 was growing road transport demand. The large increase in road transport-related CO_2 emissions was only partly offset by reductions in energy-related emissions from Manufacturing Industries and from Other. The largest reductions of Other occurred in 1A1c Manufacture of Solid Fuels and Other Energy Industries and in 1A5 Other.

Table 2.3 Overview of EU-15 GHG emissions and removals from 1990 to 2005 in CO_2 equivalents (Tg)

GREENHOUSE GAS EMISSIONS	Base year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Net CO_2 emissions/removals	3,135	3,135	3,101	3,041	2,983	2,963	2,993	3,054	3,004	3,061	3,026	3,062	3,105	3,084	3,175	3,203	3,164
CO_2 emissions (without LULUCF)	3,357	3,357	3,380	3,305	3,251	3,249	3,282	3,359	3,306	3,351	3,326	3,354	3,422	3,413	3,492	3,508	3,482
CH_4	440	440	437	430	428	416	414	409	397	387	378	367	354	343	331	320	312
N_2O	409	409	403	395	381	387	388	394	393	374	355	353	346	339	338	339	335
HFCs	41	28	28	29	30	34	41	47	53	54	47	46	44	46	49	50	53
PFCs	15	17	15	13	12	12	11	11	10	9	9	7	7	8	7	5	5
SF_6	14	11	11	12	13	14	16	16	14	13	11	11	10	10	9	9	9
Total (with net CO_2 emissions/removals)	**4,054**	**4,040**	**3,995**	**3,921**	**3,847**	**3,826**	**3,863**	**3,930**	**3,871**	**3,898**	**3,825**	**3,846**	**3,867**	**3,829**	**3,909**	**3,926**	**3,877**
Total (without CO2 from LULUCF)	**4,276**	**4,262**	**4,273**	**4,185**	**4,115**	**4,111**	**4,152**	**4,236**	**4,172**	**4,188**	**4,126**	**4,138**	**4,184**	**4,158**	**4,226**	**4,231**	**4,195**
Total (without LULUCF)	**4,272**	**4,257**	**4,269**	**4,180**	**4,111**	**4,108**	**4,148**	**4,232**	**4,169**	**4,184**	**4,122**	**4,134**	**4,180**	**4,155**	**4,222**	**4,227**	**4,192**

Figure 2.3 CO_2 emissions without LULUCF 1990 to 2005 in CO_2 equivalents (Tg) and share of largest key source categories in 2005 for EU-15

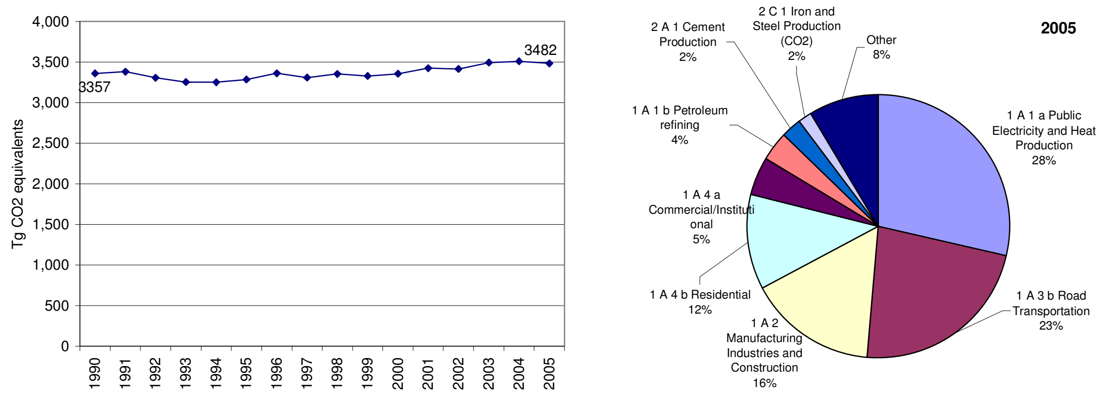
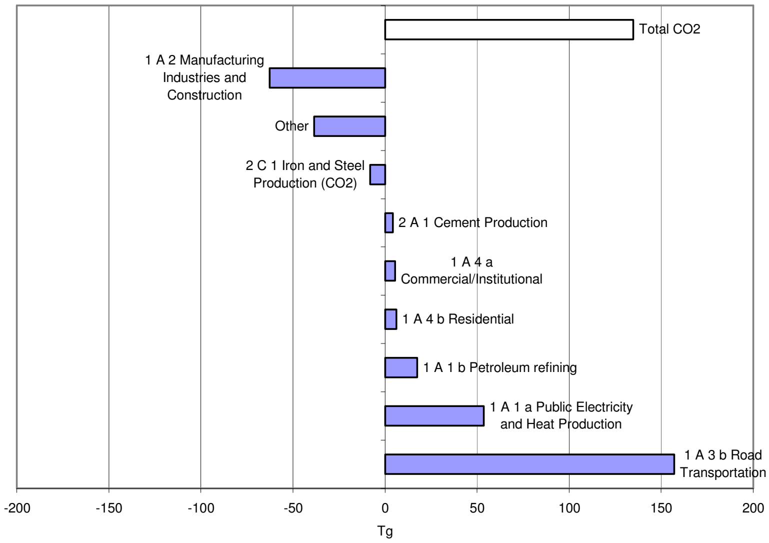


Figure 2.4 **Absolute change of CO_2 emissions by large key source categories 1990 to 2005 in CO_2 equivalents (Tg) for EU-15**



CH_4 emissions account for 7.4 % of total EU-15 GHG emissions and decreased by 29. 1 % since 1990 to 312 Tg CO_2 equivalents in 2005 (Figure 2.5). The two largest key sources account for 53 % of CH_4 emissions in 2005. Figure 2.6 shows that the main reasons for declining CH_4 emissions were reductions in solid waste disposal on land and falling sheep and cattle population.

Figure 2.5 **CH_4 emissions 1990 to 2005 in CO_2 equivalents (Tg) and share of largest source categories in 2005 for EU-15**

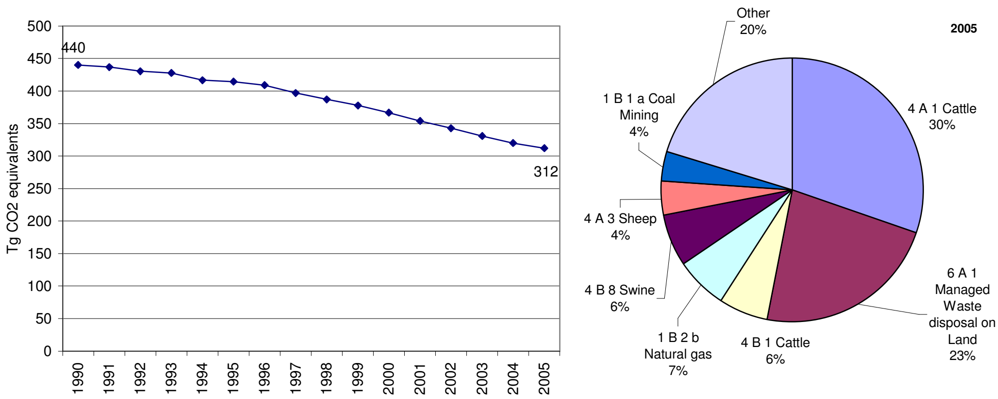
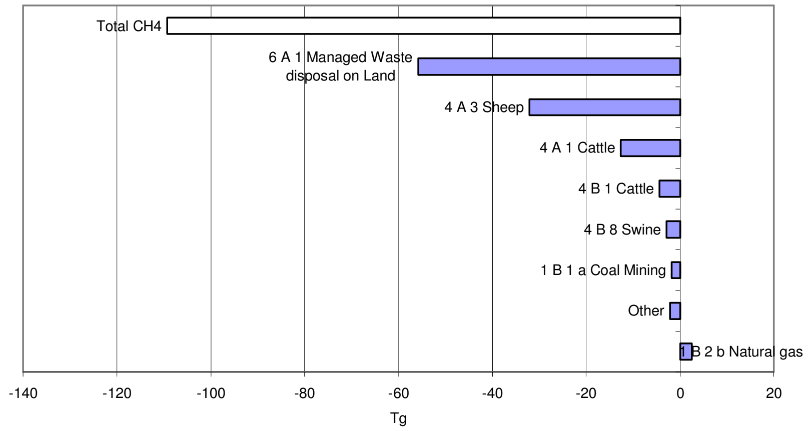


Figure 2.6 Absolute change of CH_4 emissions by large key source categories 1990 to 2005 in CO_2 equivalents (Tg) for EU-15



N_2O emissions are responsible for 8 % of total EU-15 GHG emissions and decreased by 18.1 % to 335 Tg CO_2 equivalents in 2005 (Figure 2.7). The two largest key sources account for about 49 % of N_2O emissions in 2005. Figure 2.8 shows that the main reason for large N_2O emission cuts were reduction measures in the adipic acid production.

Figure 2.7 N_2O emissions 1990 to 2005 in CO_2 equivalents (Tg) and share of largest source categories in 2005 for EU-15

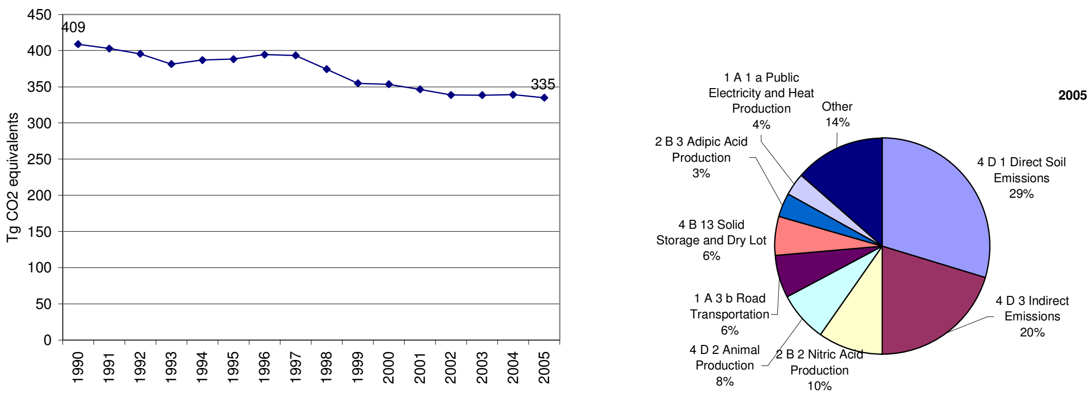
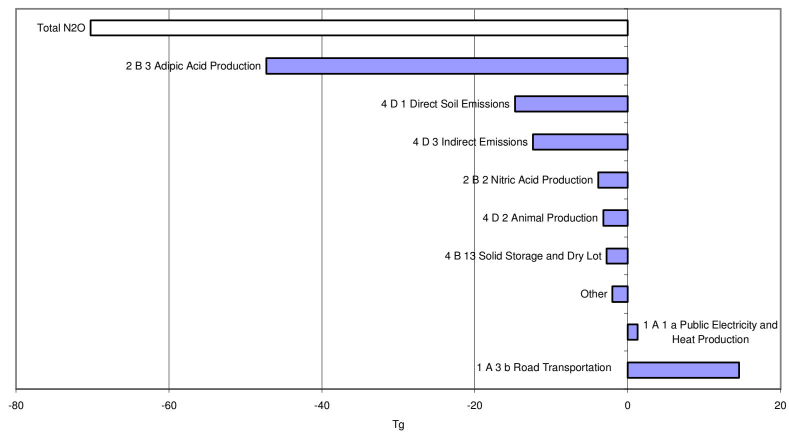


Figure 2.8 Absolute change of N_2O emissions by large key source categories 1990 to 2005 in CO_2 equivalents (Tg) for EU-15



Fluorinated gas emissions account for 1.6 % of total EU-15 GHG emissions. In 2005, emissions were 66 Tg CO_2 equivalents, which was 19 % above 1990 levels (Figure 2.9). The two largest key sources account for 81 % of fluorinated gas emissions in 2005. Figure 2.10 shows that HFCs from consumption of halocarbons showed large increases between 1990 and 2005. 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.

Figure 2.9 **Fluorinated gas emissions 1990 to 2005 in CO_2 equivalents (Tg) and share of largest source categories in 2005 for EU-15**

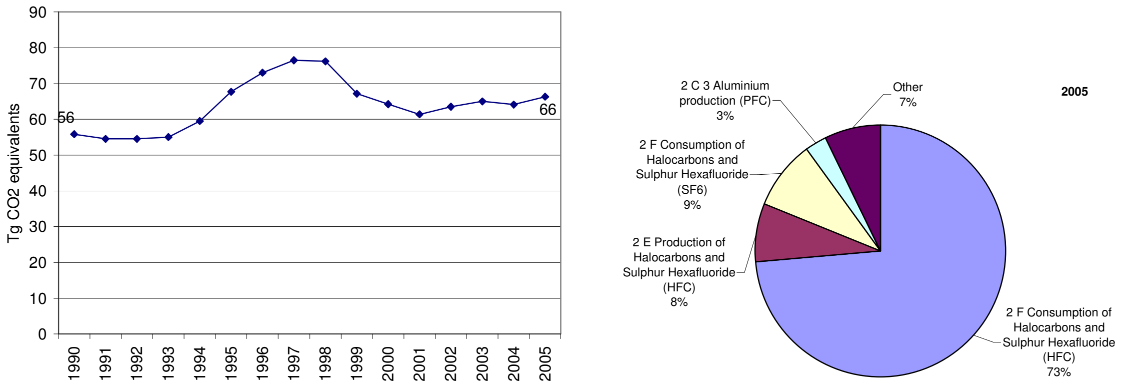
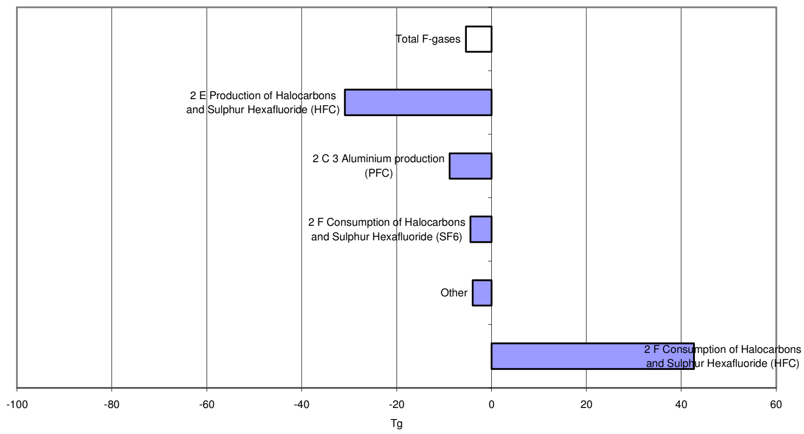


Figure 2.10 **Absolute change of fluorinated gas emissions by large key source categories 1990 to 2005 in CO_2 equivalents (Tg) for EU-15**



2.3 Emission trends by source

EU-27: Table 2.4 gives an overview of EU-27 GHG emissions in the main source categories for 1990–2005. The most important sector by far is Energy accounting for 80 % of total EU-27 emissions in 2005. The second largest sector is Agriculture (9 %), followed by Industrial Processes (8 %).

Table 2.4 **Overview of EU-27 GHG emissions in the main source and sink categories 1990 to 2005 in CO_2 equivalents (Tg)**

GHG SOURCE AND SINK	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
1. Energy	4,320	4,276	4,132	4,058	4,023	4,059	4,186	4,077	4,064	3,999	4,004	4,089	4,060	4,166	4,162	4,131
2. Industrial Processes	475	439	425	408	435	454	450	459	432	393	404	392	389	399	408	411
3. Solvent and Other Product Use	13	12	11	11	11	11	11	11	11	11	11	10	10	10	10	10
4. Agriculture	595	562	538	518	516	515	517	517	514	510	502	494	487	482	481	476
5. Land-Use, Land-Use Change and Forest	-364	-436	-421	-424	-438	-436	-446	-436	-423	-431	-421	-457	-462	-441	-436	-450
6. Waste	219	220	217	215	213	211	207	198	192	185	179	170	165	158	153	149
7. Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total (with net CO_2 emissions/removals)	**5,257**	**5,073**	**4,902**	**4,786**	**4,761**	**4,814**	**4,924**	**4,826**	**4,790**	**4,667**	**4,679**	**4,698**	**4,649**	**4,774**	**4,779**	**4,726**
Total (without LULUCF)	**5,621**	**5,509**	**5,324**	**5,210**	**5,199**	**5,249**	**5,370**	**5,262**	**5,212**	**5,098**	**5,100**	**5,155**	**5,111**	**5,215**	**5,215**	**5,177**

EU-15: Table 2.5 gives an overview of EU-15 GHG emissions in the main source categories for

1990–2005. 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 2005 in CO_2 equivalents (Tg)

GHG SOURCE AND SINK	Base year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
1. Energy	3,263	3,263	3,296	3,226	3,179	3,155	3,185	3,270	3,205	3,247	3,225	3,243	3,314	3,303	3,377	3,384	3,357
2. Industrial Processes	390	375	363	351	339	360	373	370	380	359	328	331	323	320	325	331	332
3. Solvent and Other Product Use	10	10	10	10	9	9	9	9	9	9	9	9	9	9	8	8	8
4. Agriculture	434	434	423	417	409	410	412	417	417	417	415	412	403	397	393	391	386
5. Land-Use, Land-Use Change and Forest	-217	-217	-274	-260	-265	-282	-285	-302	-298	-286	-297	-288	-313	-326	-314	-301	-315
6. Waste	176	176	177	176	174	173	169	166	157	152	145	139	131	125	119	113	109
7. Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total (with net CO_2 emissions/removals)	**4,054**	**4,040**	**3,995**	**3,921**	**3,847**	**3,826**	**3,863**	**3,930**	**3,871**	**3,898**	**3,825**	**3,846**	**3,867**	**3,829**	**3,909**	**3,926**	**3,877**
Total (without LULUCF)	**4,272**	**4,257**	**4,269**	**4,180**	**4,111**	**4,108**	**4,148**	**4,232**	**4,169**	**4,184**	**4,122**	**4,134**	**4,180**	**4,155**	**4,222**	**4,227**	**4,192**

2.4 Emission trends by Member State

Table 2.6 gives an overview of Member States' contributions to the EC GHG emissions for 1990–2005. Member States show large variations in GHG emission trends.

Table 2.6 Overview of Member States' contributions to EC GHG emissions excluding LULUCF from 1990 to 2005 in CO_2 equivalents (Tg)

Member State	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Austria	79	83	76	76	77	80	84	83	83	81	81	85	87	93	91	93
Belgium	146	149	147	146	151	152	156	148	153	147	148	147	145	148	148	144
Bulgaria	116	95	85	86	83	87	85	82	73	67	67	67	64	70	69	70
Cyprus	6	6	7	7	7	7	8	8	8	8	9	9	9	10	10	10
Czech Republic	196	183	166	160	154	154	161	154	150	142	149	149	144	148	147	146
Denmark	69	80	73	76	79	76	90	80	76	73	68	70	69	74	68	64
Estonia	44	41	31	24	25	23	24	24	21	19	20	20	19	22	21	21
Finland	71	69	67	69	75	72	77	76	72	72	70	75	77	85	81	69
France	564	586	580	554	550	559	575	568	582	565	560	562	554	556	556	553
Germany	1,228	1,180	1,130	1,116	1,098	1,096	1,115	1,078	1,052	1,021	1,020	1,037	1,018	1,031	1,025	1,001
Greece	109	108	109	109	112	113	117	122	127	127	132	133	133	137	138	139
Hungary	99	92	82	83	83	81	83	81	81	81	79	81	79	82	80	81
Ireland	55	56	56	57	58	59	61	63	66	67	69	71	69	69	69	70
Italy	519	521	519	513	505	533	525	532	543	549	554	560	560	575	580	582
Latvia	26	24	20	16	14	12	13	12	11	11	10	11	11	11	11	11
Lithuania	48	50	30	24	23	22	23	22	23	20	19	20	20	20	21	23
Luxembourg	13	13	13	13	12	10	10	9	8	9	10	10	11	11	13	13
Malta	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Netherlands	213	218	217	222	222	225	233	226	228	215	214	216	216	217	218	212
Poland	486	471	458	440	452	453	474	462	433	419	405	402	387	402	397	399
Portugal	60	62	66	65	67	71	69	72	77	85	82	83	88	83	85	86
Romania	249	196	186	184	179	187	193	173	154	136	139	143	151	158	160	154
Slovakia	73	63	58	54	51	53	54	54	52	51	48	52	50	50	49	49
Slovenia	18	17	17	18	18	18	19	19	19	18	19	20	20	20	20	20
Spain	287	294	301	290	306	318	311	332	342	370	384	385	402	409	425	441
Sweden	72	73	72	72	75	74	77	73	73	70	68	69	70	71	70	67
United Kingdom	771	778	754	733	720	710	731	708	703	672	674	677	657	663	660	657
EU-27	**5,621**	**5,509**	**5,324**	**5,210**	**5,199**	**5,249**	**5,371**	**5,262**	**5,213**	**5,098**	**5,100**	**5,155**	**5,111**	**5,215**	**5,215**	**5,177**
EU-15	**4,257**	**4,269**	**4,180**	**4,111**	**4,108**	**4,148**	**4,232**	**4,169**	**4,184**	**4,122**	**4,134**	**4,180**	**4,155**	**4,222**	**4,227**	**4,192**

Note: For some countries the data provided in this table is based on gap filling (see Chapter 1.8.2 for details.).

The overall EC 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 340 million tonnes CO_2 euqivalents compared to 1990 ([16]).

The main reasons for the favourable trend in Germany are increasing efficiency in power and heating plants and the economic restructuring of the five new *Länder* after the 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 adipic acid production.

Italy and France are the third and fourth largest emitters both with a shares of 11 %. Italy's GHG emissions were about 12% above 1990 levels in 2005. Italian GHG emissions increased since 1990 primarily from road transport, electricity and heat production and petrol-refining. France's emissions were 2 % below 1990 levels in 2005. In France, large reductions were achieved in N_2O emissions from the adipic acid production, but CO_2 emissions from road transport increased considerably

([16]) The EU-15 as a whole needs emission reductions of total GHG of 8 %, i.e. 342 million tonnes on the basis of the 2006 inventory in order to meet the Kyoto target.

between 1990 and 2005.

Spain and Poland are the fifth and sixth largest emitters in the EU-27 each accounting for about 9 % and 8 % of total EU-27 GHG emissions respectively. Spain increased emissions by 53 % between 1990 and 2005. This was largely due to emission increases from road transport, electricity and heat production, and manufacturing industries. Poland decreased GHG emissions by 18 % between 1990 and 2005 (-32 % 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.

2.5 Emission trends for indirect greenhouse gases and sulphur dioxide (EU-15)

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 1990–2005. All emissions were reduced significantly from 1990 levels: the largest reduction was achieved in SO_2 (– 70 %) followed by CO (– 49 %) NMVOC (– 41 %) and NO_x (– 30 %).

Table 2.7 Overview of EU-15 indirect GHG and SO_2 emissions for 1990–2005 (Gg)

GREENHOUSE GAS EMISSIONS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
	(Gg)															
NOx	13,428	13,226	12,922	12,340	12,008	11,796	11,486	11,045	10,860	10,550	10,203	9,994	9,683	9,583	9,345	9,015
CO	52,203	50,114	47,943	45,588	42,968	41,249	39,869	37,801	36,268	34,266	31,760	30,298	28,314	27,321	26,460	24,507
NMVOC	16,271	15,681	15,319	14,683	13,883	13,384	13,025	13,286	12,311	11,749	11,093	10,663	10,195	9,861	9,656	9,318
SO2	16,308	14,828	13,633	12,423	11,227	9,928	8,876	8,131	7,596	6,772	6,060	5,833	5,615	5,181	4,964	4,638

Table 2.8 shows the NO_x emissions of the EU-15 Member States between 1990–2005. The largest emitters, the United Kingdom, Spain, and Germany made up 51 % of total NO_x emissions in 2005. The United Kingdom and Germany reduced their emissions from 1990 levels. This was counterbalanced by increases from Spain, Greece, Portugal and Austria. All other Member States reduced emissions.

Table 2.8 Overview of EU-15 Member States' contributions to EU-15 NO_x emissions for 1990–2005 (Gg)

Member State	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Austria	211	222	209	202	194	192	212	199	212	200	205	214	220	229	225	225
Belgium	352	358	351	345	356	349	325	319	325	298	306	295	284	281	278	267
Denmark	274	324	281	279	279	264	303	259	238	223	207	204	202	210	195	186
Finland	294	277	266	267	267	245	248	239	224	220	210	210	209	217	203	176
France	1,826	1,897	1,859	1,753	1,708	1,656	1,626	1,561	1,542	1,470	1,403	1,355	1,301	1,266	1,239	1,213
Germany	2,792	2,573	2,412	2,308	2,162	2,108	2,002	1,930	1,937	1,914	1,817	1,774	1,683	1,626	1,578	1,443
Greece	280	290	295	295	301	298	302	309	324	314	305	317	320	320	317	332
Ireland	122	125	133	122	121	123	127	127	132	129	131	132	123	117	116	117
Italy	1,943	2,001	2,020	1,921	1,841	1,808	1,732	1,655	1,554	1,453	1,374	1,352	1,258	1,250	1,192	1,115
Luxembourg	14	14	13	14	13	11	12	12	11	9	10	9	10	10	8	8
Netherlands	559	461	447	429	412	470	457	417	406	411	396	385	378	376	355	329
Portugal	251	265	282	270	268	278	269	265	271	279	273	273	279	262	258	262
Spain	1,229	1,267	1,294	1,271	1,304	1,330	1,292	1,336	1,348	1,420	1,439	1,423	1,476	1,475	1,507	1,511
Sweden	314	316	307	287	296	280	271	261	253	242	231	223	219	215	209	205
United Kingdom	2,966	2,837	2,753	2,577	2,487	2,384	2,308	2,157	2,082	1,969	1,897	1,827	1,721	1,728	1,664	1,627
EU-15	**13,428**	**13,226**	**12,922**	**12,340**	**12,008**	**11,796**	**11,486**	**11,045**	**10,860**	**10,550**	**10,203**	**9,994**	**9,683**	**9,583**	**9,345**	**9,015**

Table 2.9 shows the CO emissions of the EU-15 Member States between 1990–2005. The largest emitters, France, Italy and Germany that made up 57 % of the total CO emissions in 2005, reduced their emissions from 1990 levels substantially. Also all other Member States reduced emissions.

Table 2.9 Overview of EU-15 Member States' contributions to EU-15 CO emissions for 1990–2005 (Gg)

Member State	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Austria	1,221	1,241	1,197	1,154	1,102	1,010	1,021	955	915	866	802	789	756	761	737	720
Belgium	1,339	1,316	1,298	1,196	1,109	1,080	1,050	863	840	936	1,017	954	935	903	868	682
Denmark	771	800	788	779	727	712	701	640	600	561	559	581	571	596	596	611
Finland	711	681	671	655	644	635	624	623	617	610	588	581	572	560	541	511
France	12,061	12,036	11,583	11,010	10,288	10,174	9,614	9,091	8,912	8,367	7,793	7,377	7,107	6,720	6,771	6,205
Germany	12,118	9,888	8,570	7,775	6,833	6,534	6,146	6,025	5,633	5,276	5,009	4,785	4,516	4,412	4,307	4,035
Greece	1,295	1,307	1,338	1,338	1,334	1,328	1,354	1,355	1,384	1,310	1,356	1,266	1,230	1,193	1,155	1,075
Ireland	406	403	391	360	339	313	322	312	326	297	277	271	249	239	232	221
Italy	7,183	7,477	7,678	7,623	7,403	7,167	6,868	6,607	6,197	5,897	5,164	5,085	4,468	4,383	4,205	3,832
Luxembourg	132	140	129	141	114	69	63	40	15	17	17	18	15	15	13	15
Netherlands	1,137	1,026	982	925	896	862	851	772	759	739	716	680	648	627	617	546
Portugal	944	995	964	920	877	920	854	806	829	782	796	722	727	883	688	718
Spain	3,701	3,751	3,785	3,591	3,574	3,259	3,391	3,225	3,224	2,946	2,735	2,644	2,521	2,452	2,422	2,329
Sweden	968	987	962	919	924	901	874	824	759	735	703	666	653	643	609	602
United Kingdom	8,216	8,067	7,609	7,202	6,803	6,284	6,135	5,663	5,257	4,928	4,228	3,879	3,345	2,935	2,700	2,406
EU-15	**52,203**	**50,114**	**47,943**	**45,588**	**42,968**	**41,249**	**39,869**	**37,801**	**36,268**	**34,266**	**31,760**	**30,298**	**28,314**	**27,321**	**26,460**	**24,507**

Table 2.10 shows the NMVOC emissions of the EU-15 Member States between 1990–2005. The largest emitters France, Germany and Italy that made up 57 % of the total NMVOC emissions in 2005, reduced their emissions from 1990 levels. All Member States except for Portugal reduced emissions.

Table 2.10 Overview of EU-15 Member States' contributions to EU-15 NMVOC emissions for 1990–2005 (Gg)

Member State	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Austria	285	272	243	239	220	218	211	197	183	170	170	172	167	163	157	154
Belgium	321	307	304	292	280	268	251	866	214	227	212	206	191	186	168	117
Denmark	170	171	168	164	160	158	156	147	138	133	131	126	122	119	119	118
Finland	229	217	210	202	197	192	185	180	176	171	165	162	156	151	147	136
France	3,978	4,022	3,954	3,849	3,668	3,578	3,514	3,377	3,326	3,227	3,134	3,046	2,886	2,791	2,711	2,635
Germany	3,612	3,067	2,799	2,559	2,085	1,972	1,882	1,847	1,807	1,657	1,489	1,404	1,334	1,274	1,286	1,259
Greece	308	318	327	333	341	343	348	348	357	353	354	350	347	339	332	289
Ireland	103	104	106	101	101	98	104	104	106	86	77	74	67	64	60	58
Italy	2,150	2,211	2,293	2,261	2,198	2,168	2,115	2,048	1,942	1,850	1,665	1,593	1,497	1,459	1,426	1,373
Luxembourg	8	9	9	9	9	8	8	8	7	6	6	6	6	6	6	6
Netherlands	466	412	389	361	340	333	293	264	263	249	235	213	202	187	180	170
Portugal	713	735	756	758	778	746	747	748	746	738	730	728	732	729	729	728
Spain	1,171	1,205	1,211	1,139	1,162	1,109	1,129	1,145	1,201	1,195	1,167	1,141	1,125	1,127	1,123	1,100
Sweden	373	327	312	288	281	268	261	250	238	230	220	208	206	205	203	199
United Kingdom	2,384	2,303	2,238	2,128	2,065	1,926	1,821	1,757	1,608	1,457	1,337	1,235	1,157	1,062	1,008	976
EU-15	**16,271**	**15,681**	**15,319**	**14,683**	**13,883**	**13,384**	**13,025**	**13,286**	**12,311**	**11,749**	**11,093**	**10,663**	**10,195**	**9,861**	**9,656**	**9,318**

Table 2.11 shows the SO_2 emissions of the EU-15 Member States between 1990–2005. The largest emitters, Spain and the United Kingdom, that made up 42 % of the total SO_2 emissions in 2005, reduced their emissions from 1990 levels. All other Member States except for Greece reduced emissions.

Table 2.11 Overview of EU-15 Member States' contributions to EU-15 SO_2 emissions for 1990–2005 (Gg)

Member State	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Austria	74	71	55	53	48	47	45	40	36	34	31	33	32	33	27	26
Belgium	313	317	321	327	284	256	242	199	183	169	165	164	152	148	154	144
Denmark	178	236	183	148	146	136	171	99	77	56	29	27	26	32	26	22
Finland	249	202	158	138	123	105	110	101	93	91	81	90	91	101	83	68
France	1,357	1,464	1,284	1,127	1,065	997	974	829	849	734	640	587	543	536	519	497
Germany	5,203	3,931	3,209	2,863	2,397	1,725	1,452	1,214	968	791	638	640	603	614	590	561
Greece	472	513	529	525	516	539	529	522	530	548	499	504	516	554	548	545
Ireland	183	181	169	160	174	160	149	166	177	158	137	130	100	78	72	71
Italy	1,795	1,677	1,578	1,478	1,388	1,320	1,210	1,134	997	900	755	705	623	526	495	417
Luxembourg	14	15	14	15	12	7	7	5	3	3	3	3	2	2	3	3
Netherlands	190	141	133	126	119	128	121	102	94	88	72	73	67	63	64	65
Portugal	317	308	370	316	296	332	270	291	341	341	304	294	294	201	207	218
Spain	2,166	2,168	2,120	1,996	1,942	1,783	1,553	1,727	1,570	1,584	1,445	1,419	1,523	1,256	1,300	1,254
Sweden	109	104	97	86	83	71	69	62	59	48	46	45	45	46	41	40
United Kingdom	3,687	3,500	3,412	3,066	2,634	2,322	1,973	1,641	1,619	1,227	1,215	1,119	1,002	991	836	706
EU-15	**16,308**	**14,828**	**13,633**	**12,423**	**11,227**	**9,928**	**8,876**	**8,131**	**7,596**	**6,772**	**6,060**	**5,833**	**5,615**	**5,181**	**4,964**	**4,638**

3 Energy (CRF Sector 1)

This chapter starts with an overview on emission trends in CRF Sector 1 Energy. 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 chapter includes also sections on uncertainty estimates, sector-specific QA/QC, recalculations, the reference approach, and international bunkers. The main improvements compared to the inventory report 2006 are more detailed information on activity data and emission factors for all EC key sources and additional analysis for some source categories.

3.1 Overview of sector

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 increased by 2.9 % from 3 263 Tg in 1990 to 3 357 Tg in 2005 (Figure 3.1). In 2005, emissions decreased by 0.8 % compared to 2004.

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 a Public Electricity and Heat Production: Solid Fuels (N_2O)
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: Gaseous 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 (CO_2)
1 A 3 b Road Transportation: Gasoline (N_2O)
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 3 e Other Transportation: Gaseous Fuels (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: Biomass (CH_4)
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)
1 B 2 c Venting and flaring: (CO_2)

Figure 3.1 CRF Sector 1 Energy: EU-15 GHG emissions in CO_2 equivalents (Tg) for 1990–2005

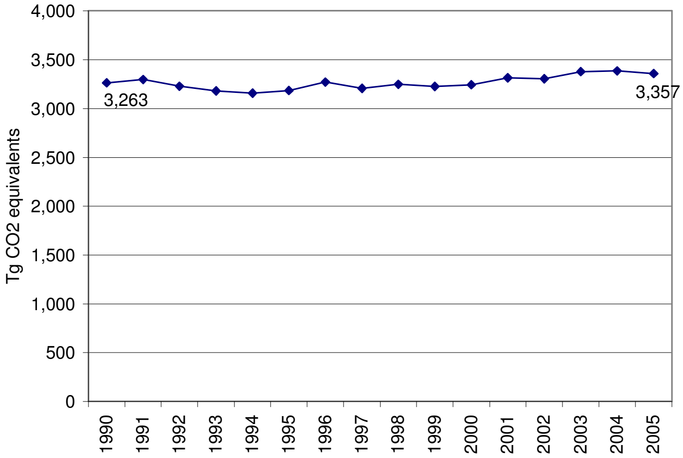
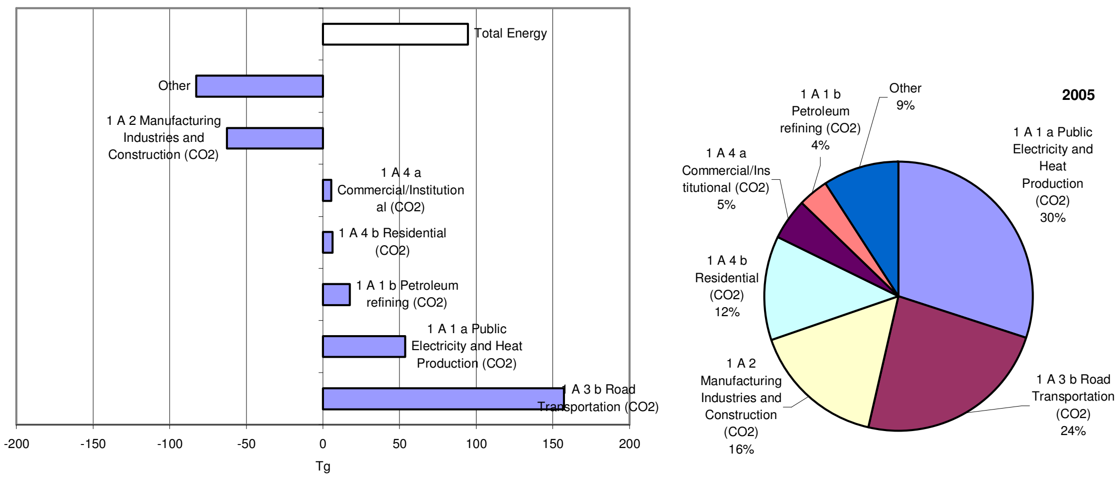


Figure 3.2 shows that CO_2 emissions from road transport had the highest increase in absolute terms of all energy-related emissions, while CO_2 emissions from 1A2 Manufacturing Industries decreased substantially between 1990 and 2005. The increases in road transport occurred in almost all Member States, 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 and 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 91 % 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 1990–2005 and share of largest key source categories in 2005



3.2 Source categories

3.2.1 Energy industries (CRF Source Category 1A1)

Energy industries (CRF 1A1) comprises emissions from fuels combusted by the fuel extraction or energy-producting industries. For the EU-15, this source category includes three key sources: CO_2 from '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 2005, which is mainly dominated by CO_2 emissions from public electricity and heat production. CO_2 from 1A1a currently represents about 84 % of greenhouse gas emissions in 1A1 (i.e. including methane and nitrous oxide).

Total greenhouse gas emissions from 1A1 increased, in net terms, by about 35 Tg CO_2 equivalent, or 3 %, between 1990 and 2005. Three quarters of the gross increase was accounted for by emissions from public electricity and heat production (54 Tg) and the remaining quarter by petroleum refining (18 Tg). Greenhouse gas emissions from the manufacturing of solid fuels fell by 38 Tg over the 1990-2005 period.

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

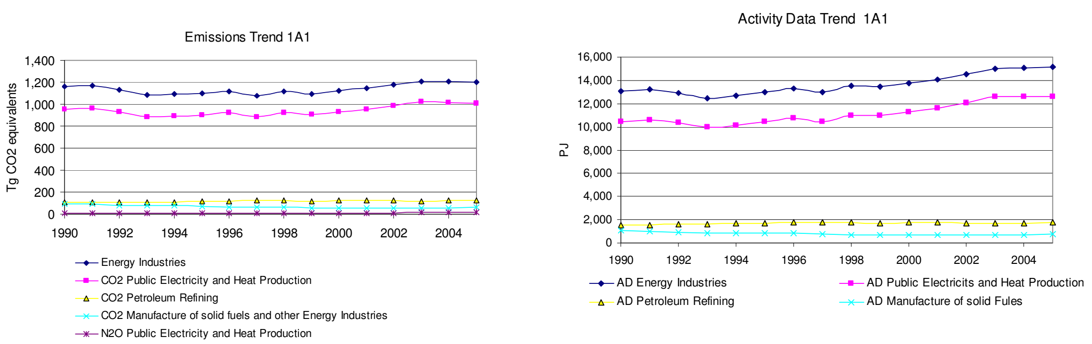


Table 3.1 summarises the information by Member State. Greenhouse gas emissions from energy industries increased in nine Member States and fell in six. Of the nine countries where emissions were higher in 2005 than in 1990, 60 % of the increase was accounted for by Spain and Italy alone. Of the six countries were emissions fell over the 1990-2005 period, more than 90 % of the reductions came from Germany and the UK. The change in the EU-15 was a net increase of 35 Tg, as explained above. The table also shows the contributions 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 2005 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO_2 emissions in 2005 (Gg)	N_2O emissions in 1990 (Gg CO_2 equivalents)	N_2O emissions in 1990 (Gg CO_2 equivalents)
Austria	13,710	15,902	13,659	15,834	48	63
Belgium	30,076	29,939	29,863	29,709	209	218
Denmark	26,315	22,565	26,173	22,130	119	142
Finland	19,185	21,918	19,055	21,672	122	226
France	66,941	64,336	66,135	63,168	732	1,132
Germany	419,829	365,958	415,082	361,952	4,568	3,878
Greece	44,986	60,498	43,199	58,179	1,779	2,309
Ireland	11,575	16,207	11,159	15,657	416	549
Italy	136,093	162,329	134,092	159,877	1,684	2,049
Luxembourg	1,268	360	1,268	356	0	3
Netherlands	52,692	67,643	52,492	67,355	128	143
Portugal	16,010	23,881	15,944	23,762	61	112
Spain	77,694	126,003	77,357	125,161	283	748
Sweden	10,414	11,676	10,050	11,185	342	419
United Kingdom	238,454	211,065	236,429	209,235	1,884	1,574
EU-15	**1,165,243**	**1,200,279**	**1,151,957**	**1,185,231**	**12,375**	**13,564**

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 Greece and Germany. 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 2005

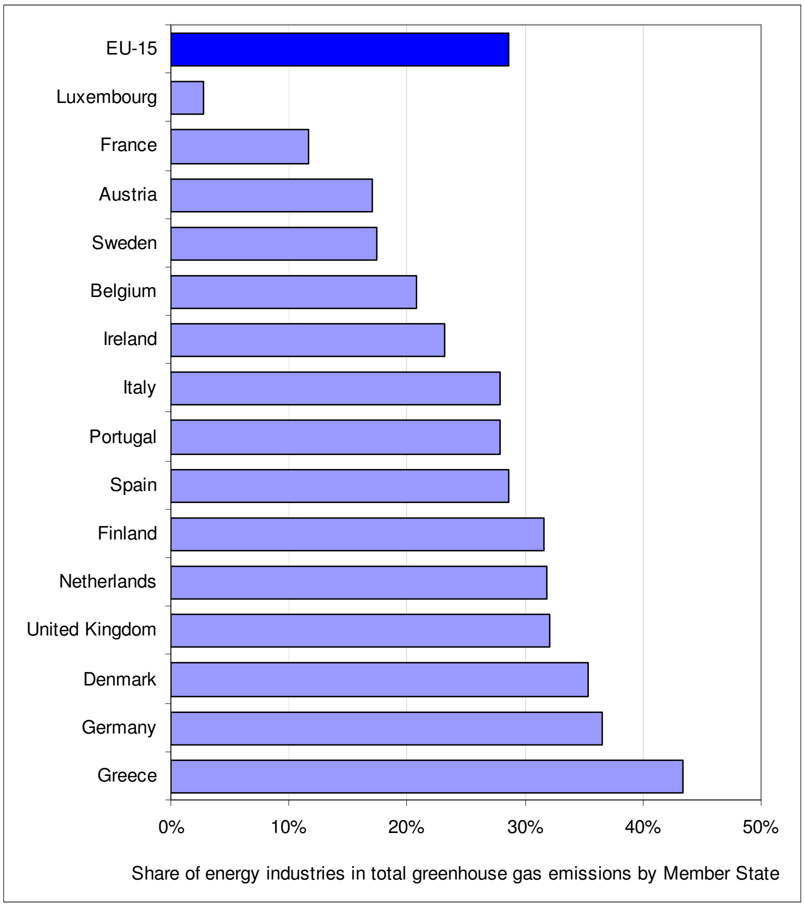
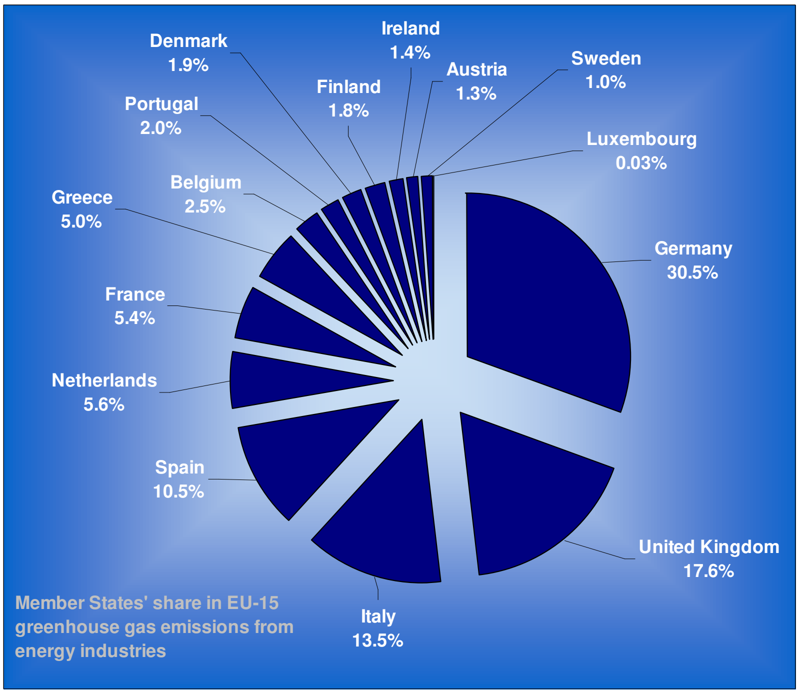


Figure 3.5: Member States' share of greenhouse gas emissions from energy industries in EU-15



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. The fuel mix can explain to a large extent differences in the greenhouse gas intensity of heat and electricity production by Member States. The relative 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 46 % of the fuel used in energy industries comes from solid fuels, although its contribution has been declining in favour of relatively cleaner natural gas, whose share stood at about 30 % in 2005.

Table 3.2 provides information on the contribution of Member States to EU-15 recalculations in CO_2 from 1A1 Energy Industries for 1990 and 2004 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 2004 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2004		Main explanations
	Gg	Percent	Gg	Percent	
Austria	-4	0.0	505	3.3	update of activity data according to revised energy balance
Belgium	0	0.0	466	1.6	In the Flemish region most recalculations in the energy sector of the emission inventory 1990-2005 are performed in the last years (2003 and 2004) because more accurate information became available for these years. The year 2004 has undergone a complete revision because the emissions of 2004 reported last year were reported on a temporary basis.
Denmark	0	0.0	0	0.0	
Finland	-193	-1.0	-255	-0.8	Update of time series consistency, activity data and emission factors; corrections of errors
France	-2	0.0	-1,136	-1.8	correction of energy consumption, update of activity data
Germany	-1,852	-0.4	6,168	1.7	updated activity data
Greece	0	0.0	0	0.0	
Ireland	59	0.5	65	0.4	Application of the revised and expanded energy balance for years 1991-2003; Inclusion of estimates for the sub-category 1.A.1(c) Manufacture of Solid Fuel and Other Energy Industries for years 1991-2003; Reallocation of all heavy fuel oil consumption from the commercial sector under 1.A.4 Other Sectors to 1.A.2 Manufacturing Industries and Construction;
Italy	0	0.0	-3,170	-2.0	Change in emission factor: Coal and natural gas emission factors have been updated Change in Activity Data: Activity data reported in the National energy balance have been updated
Luxembourg	0	0.0	0	0.0	
Netherlands	0	0.0	-527	-0.7	Re-calculation of CO2 emissions from refineries based on detailed information from annual environmental reports of the companies. This results in recalculated emissions (0.4 to 1.1 Tg higher CO2 emissions for the years 2002 – 2004) in category 1A1b from 2002 onwards; In category 1A1c, Manufacture of solid fuels and other energy industries information from the annual environmental reports was used to determine the emission factor of 'own energy use' in oil and gas production from 2003 onwards (in the precedent NIR, the general emission factor for natural gas of 56.8 was applied). part of the emissions formerly allocated in category 1Ab1, are now allocated in category 1B2. This change is based on detailed information from annual environmental reports of refineries
Portugal	0	0.0	235	1.1	data updates
Spain	0	0.0	-111	-0.1	updated activity data according to revised energy balance (2004), error correction (1991, 2003)
Sweden	0	0.0	-36	-0.3	CRF 1A and 1B:Thermal values for coal and coke were revised for 2004. CRF 1A1a: Combustion of waste (solid fuel) was added for one plant in 2004 (earlier missing), this increased the CO2 emissions with about 4.5 Gg. A minor error concerning calculation of emissions of NOX in 1999 and 2000 was corrected, the changes in emissions are insignificant. CRF 1A1b:Residual fuel oil in Petroleum refining was redefined as refinery oil and emission factors for NOX and SO2 were revised for all years. Emission factors for NOX and SO2 for refinery gas were revised for all years. Activity data for three refinery plants were corrected in 2001, 2003 and 2004 due to new and better information, resulting in increasing CO2 emissions in 2001 with about 26 Gg, increasing CO2 emissions with about 4 Gg in 2003 and decreasing CO2 emissions with about 62 Gg in 2004. Emissions of SO2, NOX, CO from petroleum coke were excluded for refineries for all years, in order to avoid double-counting of emissions.
UK	0	0.0	-634	-0.3	Revision of UK energy statistics for fuel oil (1A1a), gas oil and natural gas (1A1b). Revision to emission factors for coke oven gas, blast furnace gas and landfill methane
EU-15	**-1,992**	**-0.2**	**1,571**	**0.1**	

Table 3.3 provides information on the contribution of Member States to EU-15 recalculations in N_2O from 1A1 Energy Industries for 1990 and 2004 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 2004 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)**

	1990		2004		Main explanations
	Gg	Percent	Gg	Percent	
Austria	2	3.9	4	5.3	update of activity data according to revised energy balance
Belgium	0	0.0	-119	-34.7	In the Flemish region most recalculations in the energy sector of the emission inventory 1990-2005 are performed in the last years (2003 and 2004) because more accurate information became available for these years. The year 2004 has undergone a complete revision because the emissions of 2004 reported last year were reported on a temporary basis.
Denmark	0	0.0	0	0.2	Update of fuel rates according to the latest energy statistics. The up-date includes the years 1980-2004.
Finland	-83	-40.5	6	2.0	Update of time series consistency, activity data and emission factors; corrections of errors
France	0	0.0	2	0.2	correction of energy consumption, update of activity data
Germany	38	0.8	49	1.3	updated activity data
Greece	0	0.0	0	0.0	
Ireland	-1	-0.1	-19	-3.5	Application of the revised and expanded energy balance for years 1991-2003; Inclusion of estimates for the sub-category 1.A.1(c) Manufacture of Solid Fuel and Other Energy Industries for years 1991-2003; Reallocation of all heavy fuel oil consumption from the commercial sector under 1.A.4 Other Sectors to 1.A.2 Manufacturing Industries and Construction;
Italy	0	0.0	-67	-3.1	Change in Activity Data: Activity data reported in the National energy balance have been updated
Luxembourg	0	-	0	-	
Netherlands	0	0.0	-20	-11.7	Re-calculation of CO2 emissions from refineries based on detailed information from annual environmental reports of the companies. This results in recalculated emissions (0.4 to 1.1 Tg higher CO2 emissions for the years 2002 – 2004) in category 1A1b from 2002 onwards; In category 1A1c, Manufacture of solid fuels and other energy industries information from the annual environmental reports was used to determine the emission factor of 'own energy use' in oil and gas production from 2003 onwards (in the precedent NIR, the general emission factor for natural gas of 56.8 was applied). part of the emissions formerly allocated in category 1Ab1, are now allocated in category 1B2. This change is based on detailed information from annual environmental reports of refineries
Portugal	0	0.0	-1	-0.8	data updates
Spain	0	0.0	11	1.7	updated activity data according to revised energy balance (2004), error correction (1991, 2003)
Sweden	0	0.0	1	0.2	CRF 1A and 1B:Thermal values for coal and coke were revised for 2004. CRF 1A1a: Combustion of waste (solid fuel) was added for one plant in 2004 (earlier missing), this in-creased the CO2 emissions with about 4.5 Gg. A minor error concerning calculation of emissions of NOX in 1999 and 2000 was corrected, the changes in emissions are insignificant. CRF 1A1b:Residual fuel oil in Petroleum refining was redefined as refinery oil and emission factors for NOX and SO2 were revised for all years. Emission factors for NOX and SO2 for refinery gas were revised for all years. Activity data for three refinery plants were corrected in 2001, 2003 and 2004 due to new and better information, resulting in increasing CO2 emissions in 2001 with about 26 Gg, increasing CO2 emissions with about 4 Gg in 2003 and decreasing CO2 emissions with about 62 Gg in 2004. Emissions of SO2, NOX, CO from petroleum coke were excluded for refineries for all years, in order to avoid double-counting of emissions.
UK	0	0.0	-2	-0.2	Revision of UK energy statistics for fuel oil (1A1a), gas oil and natural gas (1A1b). Inclusion of emissions from straw burning in 1A1a, and a revision to the activity statistics and emission factor for poultry litter.
EU-15	**-44**	**-0.4**	**-154**	**-1.1**	

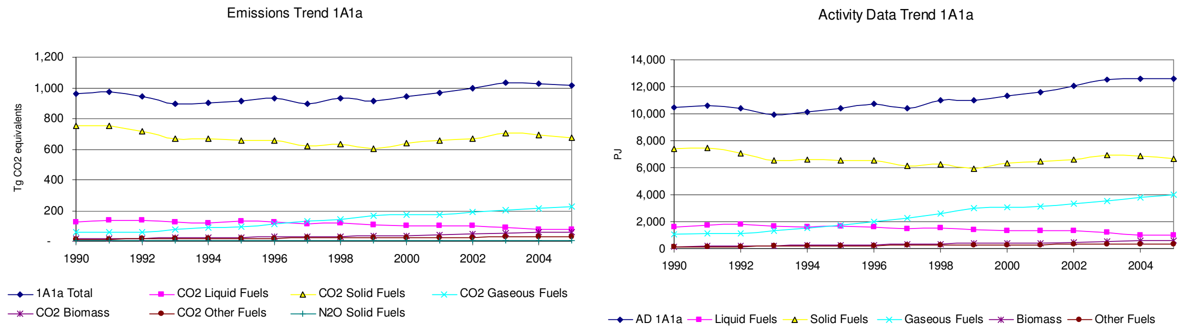
3.2.1.1. Public Electricity and Heat Production (1A1a)

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.

As explained above, CO_2 emissions from electricity and heat production is the largest key source in the EU-15 accounting for about one quarter of total greenhouse gas emissions in 2005 and for 99 % of greenhouse gas emissions from public heat and electricity production. Between 1990 and 2005, CO_2 emissions from electricity and heat production increased, on average, by 6 % in the EU-15.

Figure 3.6 shows the trends in emissions originating from the production of public heat and electricity by fuel in the EU-15 between 1990 and 2005. It also shows the activity data behind the emissions[17].

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

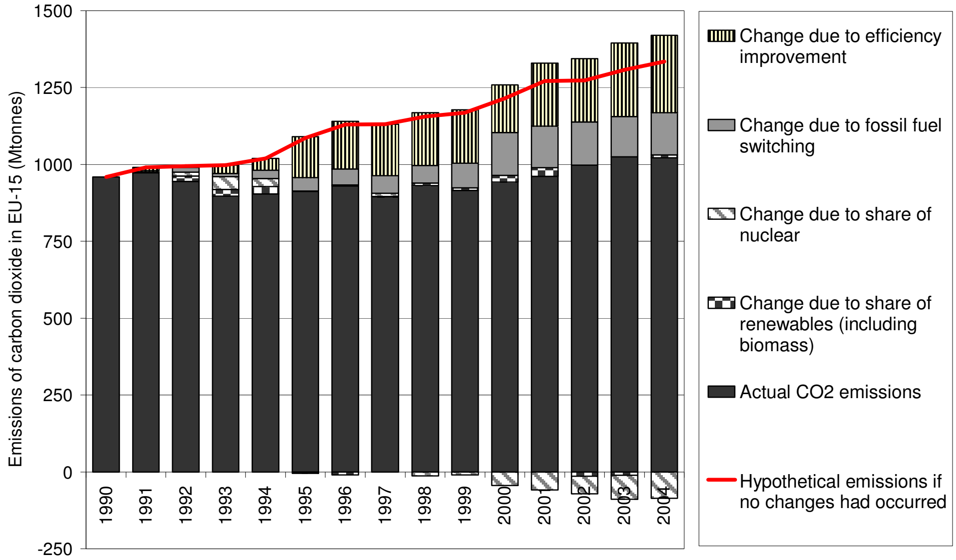


Fuel used for public heat and electricity production increased by more than 20 % in the EU-15 between 1990 and 2005. Solid fuels still represent more than half of the fuel used in public conventional thermal power plants, although its share in the fuel mix has been declining. Gas has increased very rapidly, by a factor of almost 4 between 1990 and 2005, and its share stands at about one third of all the fuel used for the production of heat and electricity in the EU. Liquid fuels still account for some 8 % but its use has declined gradually during the past 15 years. The use of biomass has increased as rapidly as the use of gas, but its share in the fuel mix is relatively small, at around 5 %.

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 1990–2004. The main explantory factors at the EU-15 level during the past 15 years have been improvements in energy efficiency and (fossil) fuel switching from coal to gas.

[17] 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 2004.**



Note: The chart show 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 2004, 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 black 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 increased by about 6 % during 1990-2004, but emissions would have risen by close to 40 %, 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. The relationship between the increase in electricity generation and the actual reduction in emissions during 1990-2004 can be explained by the following factors:

- An improvement in the thermal efficiency of electricity and heat production. During 1990-2004, there was a 12 % 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 18 % reduction in the CO_2 emissions per unit of fossil-fuel input during 1990-2004.

- The lower combined share of nuclear and renewable energy for electricity and heat production in 2004 compared to 1990[18]. During 1990-2004, the share of electricity from fossil fuels in total electricity production increased by 6 %.

[18] 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.

These three factors interact with each other in a multiplicative way: Actual CO_2 emissions change = 1.39 (increase in electricity production) X 0.88 (efficiency improvement) X 0.82 (fossil fuel switching) X 1.06 (lower nuclear-renewable share) = 1.06. The combined effect was an increase of about 6 % in CO_2 emissions in 2004 compared to the 1990 level.

Returning to the 2007 inventory, table 3.4 summarises emissions arising from the production of public heat and electricity by Member State. CO_2 emissions increased in ten Member States and fell in five. Of the ten countries where emissions were higher in 2005 than in 1990, close to half of the increase was accounted for by Spain alone. Of the remaining five countries, were emissions fell, more than 60 % of the reduction came from the UK. The change in the EU-15 was a net increase of about 54 Tg.

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

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005	
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	10,888	12,939	12,736	1.3%	-203	-2%	1,848	17%
Belgium	23,420	24,231	24,624	2.5%	393	2%	1,204	5%
Denmark	24,736	22,832	19,606	2.0%	-3,226	-14%	-5,130	-21%
Finland	16,448	29,354	18,651	1.9%	-10,704	-36%	2,203	13%
France	47,925	43,328	45,788	4.6%	2,460	6%	-2,137	-4%
Germany	336,368	333,531	325,398	32.4%	-8,133	-2%	-10,970	-3%
Greece	40,632	53,897	54,342	5.4%	445	1%	13,710	34%
Ireland	10,876	14,737	15,136	1.5%	400	3%	4,260	39%
Italy	107,135	122,597	120,589	12.0%	-2,009	-2%	13,453	13%
Luxembourg	1,268	383	356	0.0%	-27	-7%	-912	-72%
Netherlands	39,923	56,807	53,961	5.4%	-2,847	-5%	14,037	35%
Portugal	13,960	18,951	21,174	2.1%	2,223	12%	7,214	52%
Spain	64,341	99,637	110,032	11.0%	10,395	10%	45,690	71%
Sweden	7,691	9,389	8,436	0.8%	-954	-10%	744	10%
United Kingdom	204,608	170,894	173,071	17.2%	2,177	1%	-31,537	-15%
EU-15	**950,221**	**1,013,508**	**1,003,898**	**100.0%**	**-9,610**	**-1%**	**53,677**	**6%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.8 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 Greece 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.

Figure 3.8: Share of CO_2 emissions from public electricity and heat production in total greenhouse gas emissions by Member State in 2005

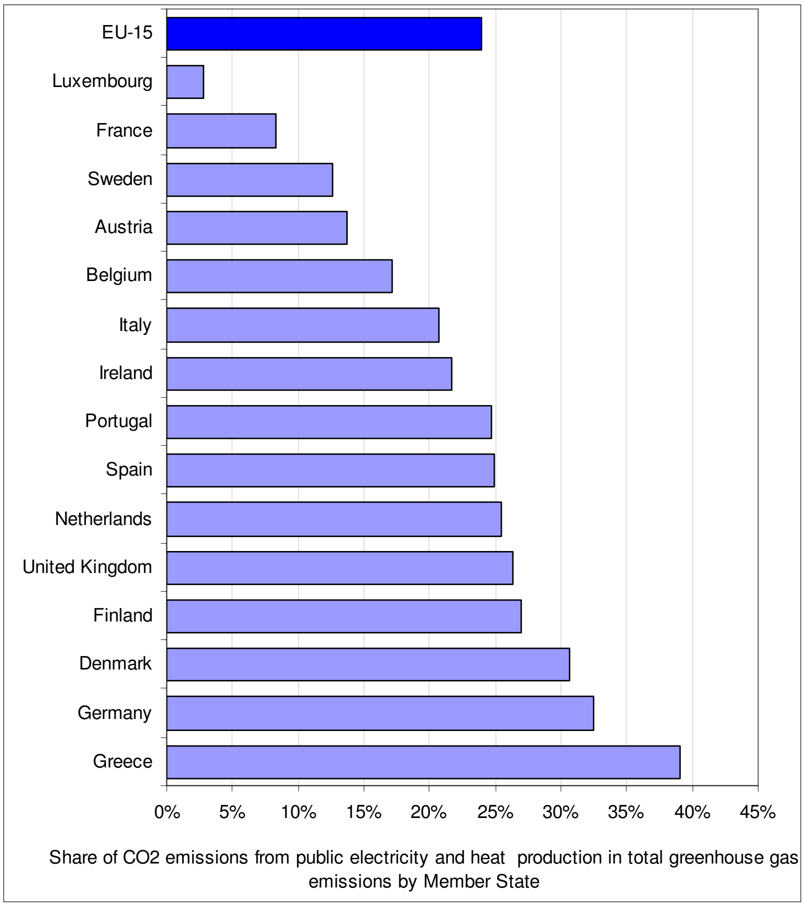
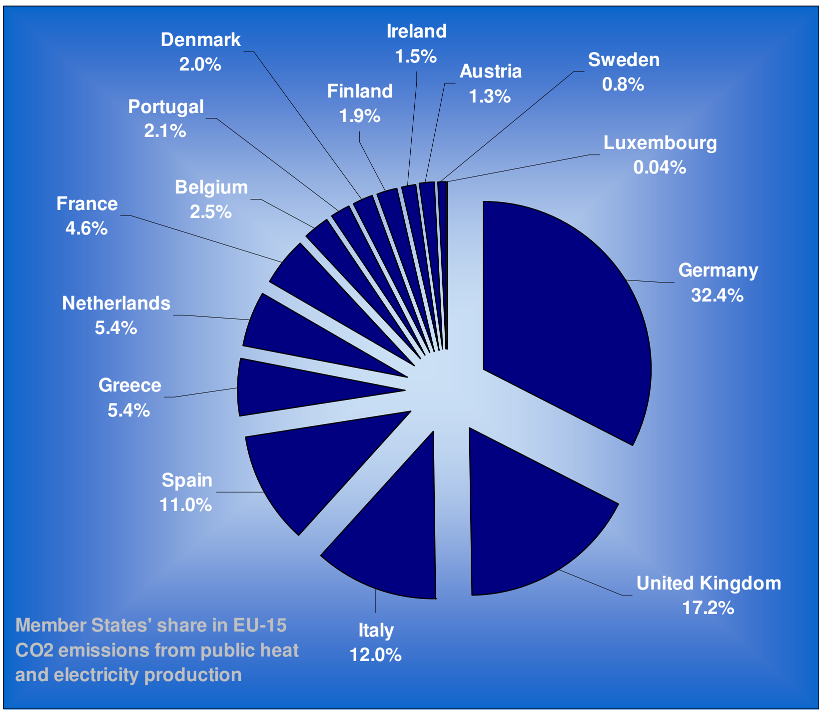


Figure 3.9: Member States' share of CO_2 emissions from public heat and electricity production in EU-15



Finally, N_2O emissions currently represent about 1 % of greenhouse gas emissions from public electricity and heat production. They increased by 12 % between 1990 and 2005 (Table 3.5). Emissions from this source category only declined in the United Kingdom, Germany and Belgium.

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

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005	
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	43	72	57	0.5%	-15	-21%	14	33%
Belgium	79	63	62	0.5%	-1	-1%	-17	-22%
Denmark	103	125	113	1.0%	-12	-10%	10	10%
Finland	104	282	204	1.7%	-79	-28%	100	96%
France	591	950	992	8.4%	42	4%	401	68%
Germany	3,658	3,654	3,587	30.2%	-68	-2%	-72	-2%
Greece	1,688	2,157	2,171	18.3%	14	1%	483	29%
Ireland	410	505	539	4.5%	34	7%	128	31%
Italy	1,530	1,886	1,837	15.5%	-48	-3%	307	20%
Luxembourg	0	3	3	0.0%	0	-	3	-
Netherlands	120	138	130	1.1%	-8	-6%	10	9%
Portugal	52	96	101	0.9%	5	5%	49	96%
Spain	197	580	631	5.3%	51	9%	434	220%
Sweden	305	383	376	3.2%	-7	-2%	71	23%
United Kingdom	1,665	1,026	1,058	8.9%	32	3%	-607	-36%
EU-15	**10,546**	**11,919**	**11,860**	**100.0%**	**-59**	**0%**	**1,314**	**12%**

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 7 % of all greenhouse gas emissions from 1A1a. Within the EU-15, emissions fell by about 40 % between 1990 and 2005 (Table 3.6).

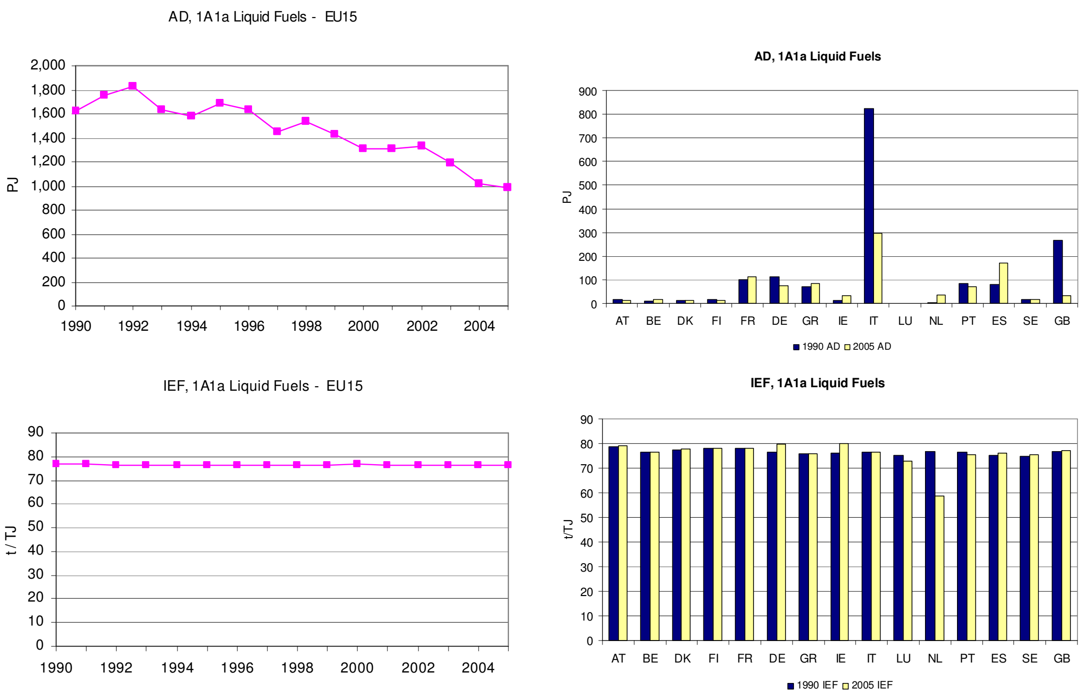
Table 3.6: 1A1a Public Electriciy and Heat Production, liquid fuels: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	1,229	1,174	1,083	1.4%	-91	-8%	-146	-12%	T2	NS, PS	CS
Belgium	659	1,047	1,126	1.5%	79	8%	467	71%	CS	PS,RS	CS,PS
Denmark	947	1,204	1,072	1.4%	-132	-11%	126	13%	C	NS/PS	CS/C
Finland	1,242	1,002	981	1.3%	-20	-2%	-260	-21%	T3	PS	CS
France	7,894	7,947	8,827	11.8%	880	11%	933	12%	C	PS	CS
Germany	8,507	4,852	5,911	7.9%	1,059	22%	-2,596	-31%	CS	NS/AS	CS
Greece	5,375	5,705	6,265	8.4%	560	10%	890	17%	C	NS	D
Ireland	1,087	2,540	2,563	3.4%	23	1%	1,476	136%	T3	NS, PS	PS
Italy	63,047	30,572	22,765	30.4%	-7,807	-26%	-40,282	-64%	T3	NS, PS	CS
Luxembourg	9	12	12	0.0%	0	0%	3	37%	C	-	C, CS
Netherlands	207	2,198	2,150	2.9%	-48	-2%	1,943	939%	T2	NS/Q	CS
Portugal	6,301	3,214	5,417	7.2%	2,203	69%	-884	-14%	T2	PS,NS	D,C,PS
Spain	6,007	11,876	12,931	17.3%	1,056	9%	6,925	115%	T2	PS	PS, C
Sweden	1,278	1,574	1,258	1.7%	-316	-20%	-20	-2%	T1,T2,T3	PS	CS
United Kingdom	20,691	2,875	2,507	3.3%	-367	-13%	-18,184	-88%	T2	NS, AS	CS
EU-15	**124,477**	**77,790**	**74,870**	**100.0%**	**-2,921**	**-4%**	**-49,608**	**-40%**			

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 rather gradually since 1992. The implied emission factor has remained broadly stable at the EU-15 level (76 t/Tj). The largest emiters in 2005 were Italy and Spain, together responsible for almost half the EU emissions, although emissions have fallen markedly in Italy compared to 1990.

Figure 3.10: 1A1a-Public Electriciy 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 10 % between 1990 and 2005 (Table 3.7).

Table 3.7: 1A1a Public Electriciy and Heat Production, solid fuels: Member States' contributions to CO_2 emissions

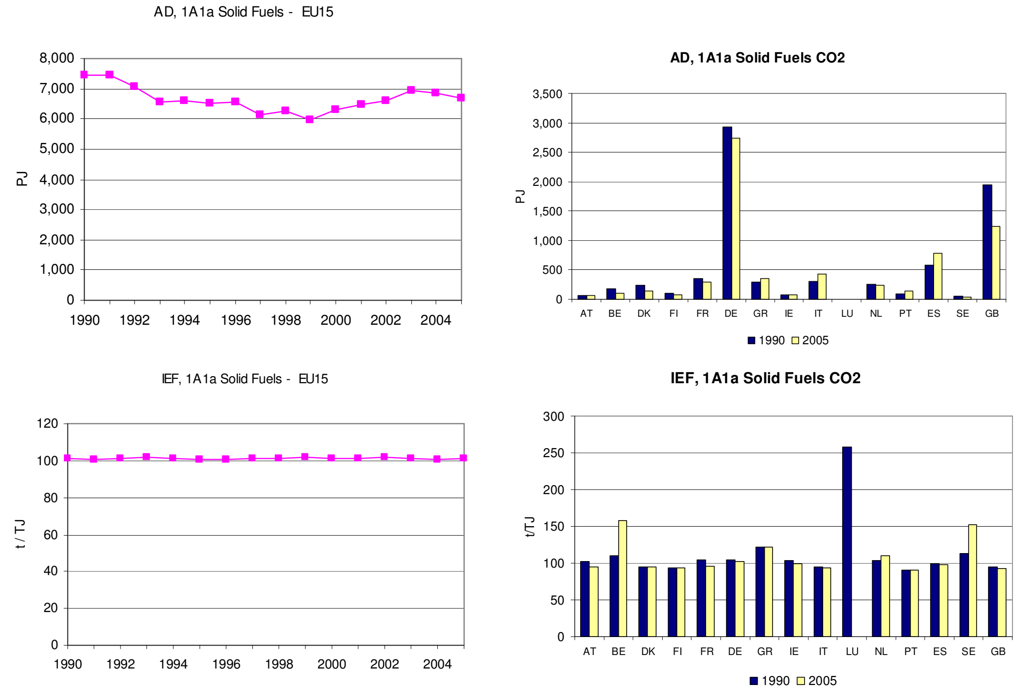
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	6,247	6,674	5,844	0.9%	-830	-12%	-403	-6%	T2	NS, PS	CS
Belgium	19,345	12,484	15,317	2.3%	2,834	23%	-4,028	-21%	CS	PS,RS	CS,PS
Denmark	22,462	16,384	13,687	2.0%	-2,698	-16%	-8,775	-39%	C	NS/PS	CS/C
Finland	9,281	15,100	6,854	1.0%	-8,246	-55%	-2,426	-26%	T3	PS	CS, D
France	36,565	26,666	27,672	4.1%	1,006	4%	-8,893	-24%	C	PS	CS
Germany	305,278	291,705	281,126	41.6%	-10,579	-4%	-24,152	-8%	CS	NS/AS	CS
Greece	35,257	44,486	43,968	6.5%	-518	-1%	8,710	25%	C	NS	D, CS
Ireland	7,909	7,078	7,910	1.2%	831	12%	0	0%	T3	NS, PS	PS
Italy	28,148	41,409	39,614	5.9%	-1,795	-4%	11,467	41%	T3	NS, PS	CS
Luxembourg	1,234	NO	NO	-	-	-	-1,234	-100%	-	-	-
Netherlands	25,776	26,919	25,734	3.8%	-1,186	-4%	-42	0%	T2	NS/Q	CS
Portugal	7,659	11,961	12,157	1.8%	195	2%	4,497	59%	T2	PS	D,C,PS
Spain	57,787	75,245	76,013	11.3%	768	1%	18,225	32%	T2	PS	PS
Sweden	5,376	6,195	5,477	0.8%	-718	-12%	101	2%	T1,T2,T3	PS	CS
United Kingdom	183,150	110,022	114,121	16.9%	4,099	4%	-69,029	-38%	T2	NS, AS	CS
EU-15	**751,475**	**692,329**	**675,494**	**100.0%**	**-16,835**	**-2%**	**-75,981**	**-10%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.11 shows the relevant activity data and implied emission factors. The weight of solid fuels fell gradually up to 1999 and increased thereafter, although it picked up again in the last two years. The EU-15 implied emission factor has remained fairly stable (101 t/Tj in 2005). The largest emiters in 2005 were Germany and the UK, jointly responsible for almost 60 % of EU emissions. In both countries, however, emissions have fallen compared to 1990, particularly in the UK.

Solid fuels used in public heat and electricity production in Luxembourg are insignificant after 1997. Before then, the emission factor was the highest of EU countries because of the use of blast furnace technology. There has also been a sharp increase in the emission factor in Sweden. This is explained by the increase in the use of blast furnace gas since 1996 (SCB, Tomas Gustafsson, 2007-03-12).

Figure 3.11: 1A1a- Public Electriciy 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 1 % of all greenhouse gas emissions in the power sector. For the EU-15, emissions in 2005 remained at the same level as in 1990, although this is the net effect of averaging Member States' trends (Table 3.8) . In Spain, emissions more than doubled whereas in Austria, Belgium and Sweden emissions more than halved. The Uk showed the largest reduction in absolute terms.

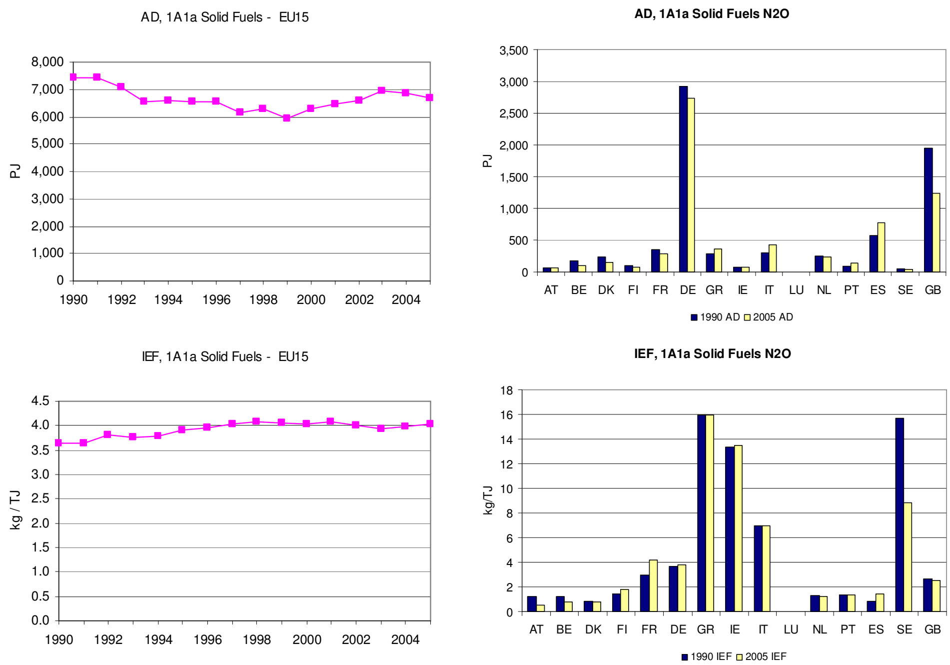
Table 3.8: 1A1a Electricity and heat production, solid fuels: Member States' contributions to N_2O emissions

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	23	29	10	0.1%	-20	-67%	-13	-58%	T2	NS, PS	CS
Belgium	66	26	24	0.3%	-2	-9%	-42	-64%	CS	PS,RS	CS
Denmark	63	43	36	0.4%	-7	-16%	-27	-43%	C	NS/PS	CS/C
Finland	43	72	41	0.5%	-30	-42%	-1	-3%	T2	NS, PS	CS
France	321	354	378	4.5%	24	7%	57	18%	C	PS	CS
Germany	3,335	3,328	3,261	39.1%	-67	-2%	-74	-2%	T2	NS/AS	Cs
Greece	1,426	1,801	1,780	21.3%	-21	-1%	354	25%	C	NS	C
Ireland	318	296	335	4.0%	38	13%	17	5%	T3	NS, PS	C
Italy	645	961	922	11.0%	-39	-4%	278	43%	T3	NS, PS	C, D
Luxembourg	NO	NO	NO	-	-	-	-	-	-	-	-
Netherlands	101	97	91	1.1%	-6	-7%	-10	-10%	T1, T2	Q	CS,D
Portugal	36	57	58	0.7%	1	2%	21	59%	T2	PS	C,D
Spain	146	366	349	4.2%	-17	-5%	204	140%	T2	PS	D, C, OTH
Sweden	233	131	99	1.2%	-32	-24%	-134	-57%	T1,T2,T3	PS	CS
United Kingdom	1,604	930	964	11.6%	35	4%	-640	-40%	T2	NS, AS	CS, D, C
EU-15	**8,358**	**8,490**	**8,348**	**100.0%**	**-143**	**-2%**	**-10**	**0%**			

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 increased since 1990 reaching 4 kg/Tj in 2005. The largest emiters in 2005 were Germany and Greece, accounting for about 60 % of EU emissions.

Figure 3.12 1A1a Public Electriciy 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 about 22 % of all greenhouse gas emissions from public electricity and heat generation in 2005. Emissions increased by a factor of almost four in the EU-15 between 1990 and 2005 (Table 3.9). In all EU Member States the consumption of gas was higher in 2005 than in 1990.

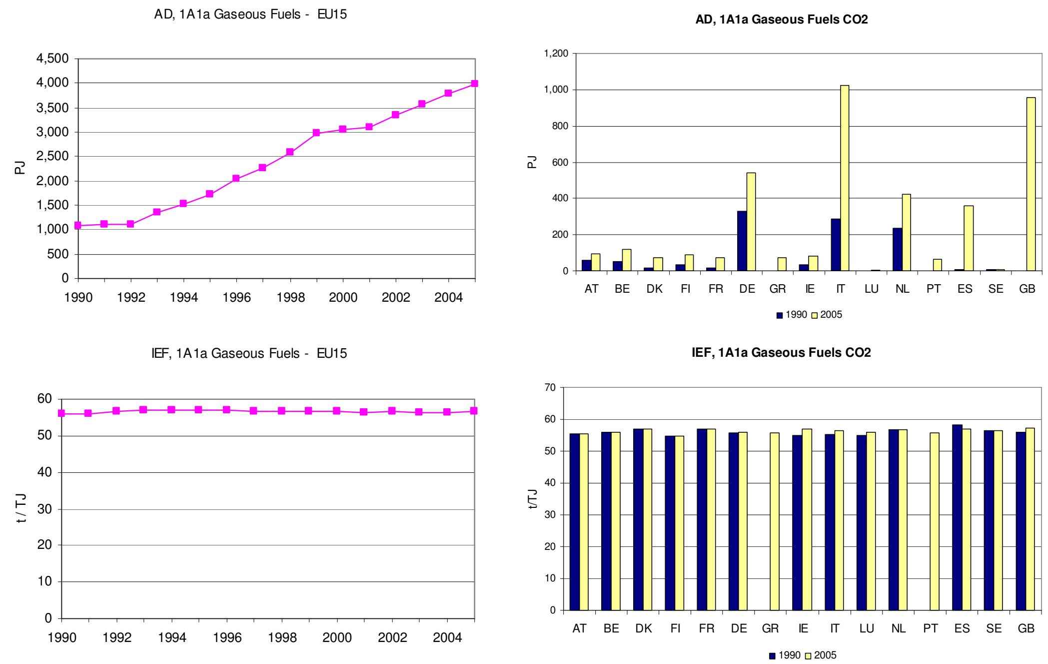
Table 3.9 1A1a Electricity and heat production, gaseous fuels: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	3,294	4,542	5,319	2.4%	777	17%	2,025	61%	T2	NS, PS	CS
Belgium	2,751	9,337	6,607	2.9%	-2,729	-29%	3,856	140%	CS	PS,RS	CS,PS
Denmark	1,000	4,645	4,234	1.9%	-412	-9%	3,234	323%	C	NS/PS	CS/C
Finland	1,976	5,273	4,856	2.2%	-416	-8%	2,881	146%	T3	PS	CS
France	984	3,264	4,204	1.9%	940	29%	3,221	327%	C	PS	CS
Germany	18,462	28,923	30,308	13.4%	1,385	5%	11,846	64%	CS	NS/AS	CS
Greece	NO	3,707	4,109	1.8%	403	11%	4109	-	C	NS	D
Ireland	1,881	5,119	4,664	2.1%	-455	-9%	2,783	148%	T3	NS, PS	PS
Italy	15,787	50,380	57,898	25.6%	7,518	15%	42,111	267%	T3	NS, PS	CS
Luxembourg	25	371	344	0.2%	-27	-7%	320	1297%	C	-	C, CS
Netherlands	13,348	25,576	23,976	10.6%	-1,600	-6%	10,628	80%	T2	NS/Q	CS
Portugal	NO	3,776	3,600	1.6%	-176	-5%	3,600	-	T2	PS	D,C,PS
Spain	427	11,873	20,365	9.0%	8,491	72%	19,938	4668%	T2	PS	PS, CS
Sweden	485	651	556	0.2%	-95	-15%	71	15%	T1,T2,T3	PS	CS
United Kingdom	16	56,318	54,770	24.3%	-1,548	-3%	54,754	343430%	T2	NS	CS
EU-15	**60,435**	**213,756**	**225,811**	**100.0%**	**12,055**	**6%**	**165,376**	**274%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.13 shows the activity data and implied emission factors for CO_2 emissions from gaseous fuels. Gas use in the power generating sector increased strongly after 1992. The EU-15 implied emission factor has remained fairly stable (57 t/Tj in 2005). 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 and by a significant 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 largests emitters in 2005 were the UK and Italy, jointly responsible for about half the EU emissions.

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



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

In 2005, the share of CO_2 emissions from other fuels stood at about 3 % of total greenhouse gas emissions from public electricity and heat generation. Emissions more than doubled at the EU level and increased in all countries where the emission source occurs (Table 3.10).

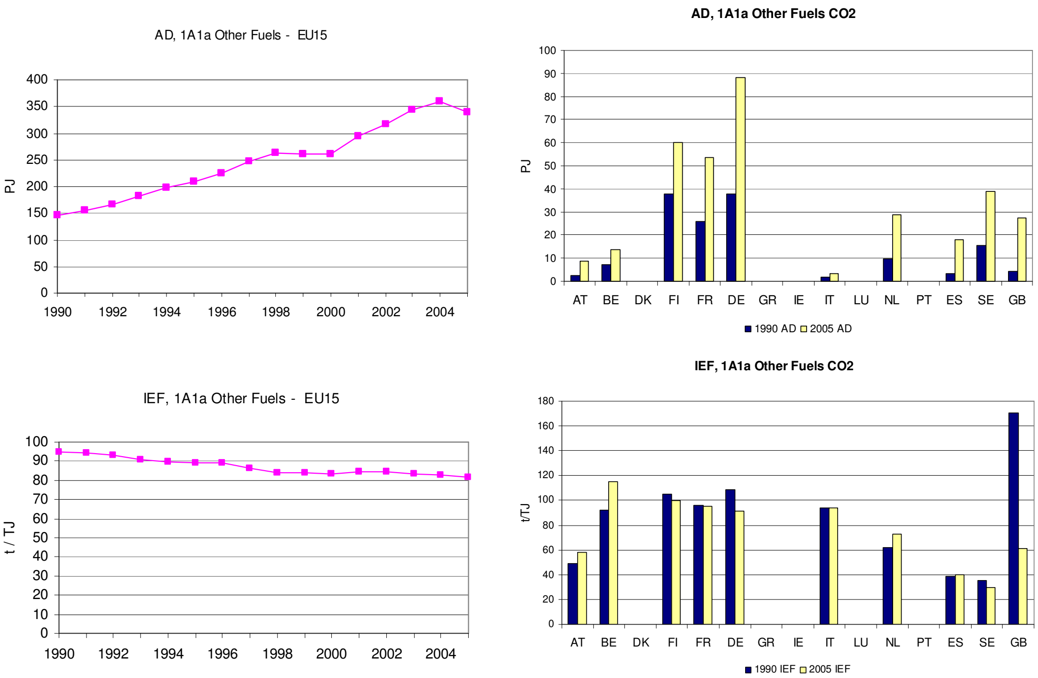
Table 3.10: 1A1a Public Electriciy and Heat Production, other fuels: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	118	548	490	1.8%	-58	-11%	372	315%	T2	NS, PS	CS(MSW) D(Ind. Waste)
Belgium	665	1,363	1,573	5.7%	210	15%	908	137%	CS	PS,RS	CS,PS
Denmark	328	598	613	2.2%	15	3%	285	87%	C	NS/PS	CS/C
Finland	3,950	7,980	5,959	21.5%	-2,021	-25%	2,009	51%	T3	PS	CS
France	2,483	5,451	5,084	18.3%	-367	-7%	2,602	105%	C	PS	CS
Germany	4,121	8,051	8,053	29.0%	2	0%	3,932	95%	CS	NS/AS	CS
Greece	NO	NO	NO	-	-	-	-	-	-	-	-
Ireland	NO	NO	NO	-	-	-	-	-	-	-	-
Italy	153	236	311	1.1%	75	32%	157	103%	T3	NS, PS	CS
Luxembourg	IE	IE	IE	-	-	-	-	-	-	-	-
Netherlands	592	2,114	2,101	7.6%	-13	-1%	1,508	255%	T2	NS/Q	CS
Portugal	NO	NO	NO	-	-	-	-	-	T2	PS	D,C,PS
Spain	120	643	723	2.6%	80	12%	602	502%	T2	PS	PS, CS, C
Sweden	553	969	1,144	4.1%	175	18%	592	107%	T1,T2,T3	PS	CS
United Kingdom	751	1,679	1,673	6.0%	-6	0%	922	123%	T2	NS	CS
EU-15	**13,834**	**29,633**	**27,724**	**100.0%**	**-1,909**	**-6%**	**13,890**	**100%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.14 shows the activity data and implied emission factors for the EU and for each Member State. The EU-15 implied emission factor has fallen gradually since 1990, standing at about 80 t/Tj in 2005. The chart does not show the emission factor for Denmark. CO_2 emissions from the combustion of the plastic content of municipal waste are reported under other fuels but the split is not applied to the activity data, and so the full consumption of municipal waste is included under biomass. The largest emitters in 2005 were Germany, Finland and France, which together accounted for more than two thirds of EU emissions.

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



3.2.1.2. Petroleum Refining (1A1b)

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 sixth largest key source in the EU-15 accounting for 2.9 % of total greenhouse gas emissions in 2005. Between 1990 and 2005, EU CO_2 emissions increased by 17 % (Table 3.11). Emissions in 2005 were above 1990 levels in all Member States, with the exception of the UK.

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 2005	Change 2004-2005		Change 1990-2005	
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	2,463	2,844	2,827	2.3%	-17	-1%	364	15%
Belgium	4,299	5,113	4,656	3.8%	-456	-9%	357	8%
Denmark	897	988	932	0.8%	-57	-6%	34	4%
Finland	2,260	2,793	2,626	2.1%	-166	-6%	366	16%
France	13,239	14,093	13,554	11.0%	-540	-4%	315	2%
Germany	19,648	20,014	20,639	16.7%	625	3%	990	5%
Greece	2,465	3,452	3,757	3.0%	305	9%	1,292	52%
Ireland	182	366	411	0.3%	45	12%	229	126%
Italy	16,337	24,703	26,491	21.5%	1,788	7%	10,154	62%
Luxembourg	NO	NO	NO	0.0%	-	-	-	-
Netherlands	11,041	11,296	11,338	9.2%	42	0%	296	3%
Portugal	1,910	2,540	2,588	2.1%	48	2%	679	36%
Spain	10,906	13,398	13,092	10.6%	-306	-2%	2,186	20%
Sweden	1,997	2,505	2,399	1.9%	-106	-4%	402	20%
United Kingdom	18,275	17,486	18,174	14.7%	688	4%	-101	-1%
EU-15	**105,919**	**121,590**	**123,483**	**100.0%**	**1,892**	**2%**	**17,564**	**17%**

Figure 3.15 shows the trends in emissions originating from the refining of petroleum by fuel in the EU-15 between 1990 and 2005. More than 90 % of greeenhouse gas emissions from this source category are accounted for by CO_2 emissions from liquid fuels. The figure also shows the activity data behind the emissions.

Fuel used for petroleum refining increased by about 13 % in the EU-15 between 1990 and 2005. Liquid fuels represent over 90 % of all fuel used in the refining of petroleum. Gasesous fuels almost fully account for the remaining part and their use has more than doubled since 1990. There remains a small amount of solid fuels used in petroleum refining, mainly in France and Germany.

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

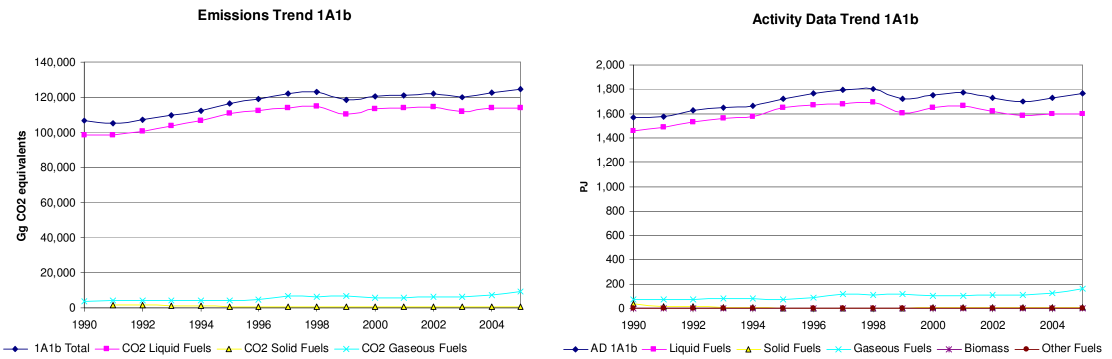


Figure 3.16 shows the relative importance of CO_2 emissions from petroleum refining in total greenhouse gas emissions by Member State, ranging from the relatively low share in Ireland to relatively high share in the Netherlands. Figure 3.17 shows the absolute contributions to EU-15 CO_2 emissions from petroleum refining. Italy was the largest EU emitter in 2005, accounting for more than 20 % of all EU emissions.

Figure 3.16: Share of CO_2 emissions from petroleum refining in total greenhouse gas emissions by Member State in 2005

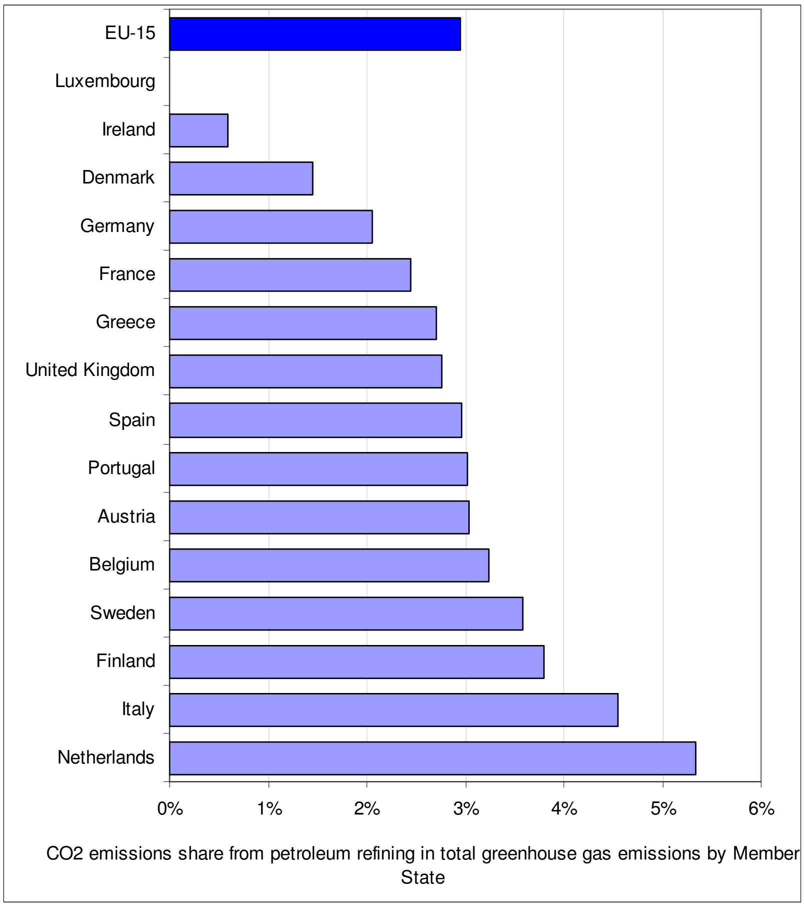
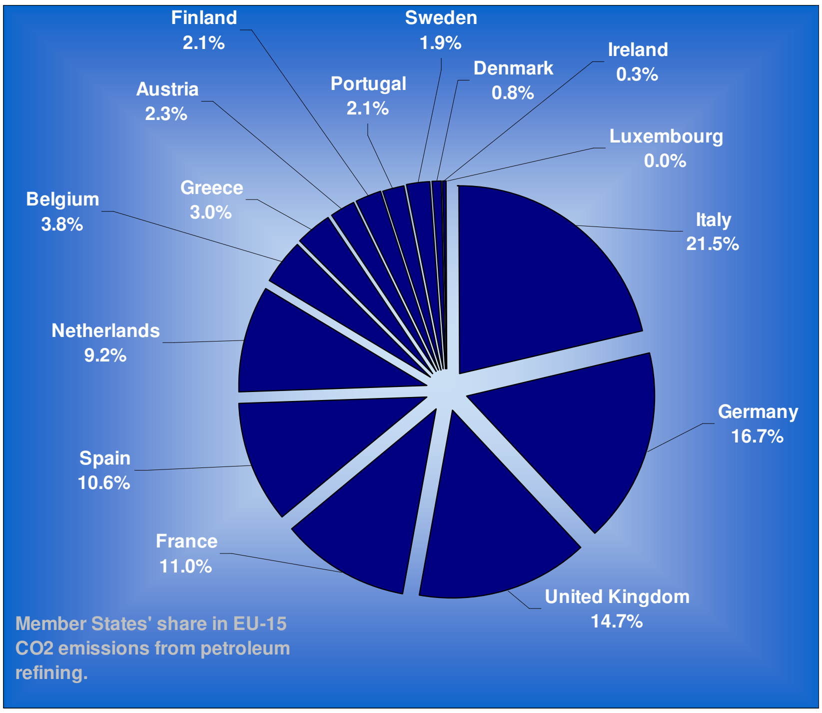


Figure 3.17: Member States' share of CO_2 emissions from petroleum refining in EU-15



1A1b Petroleum Refining - Liquid Fuels (CO_2)

CO_2 emissions from the combustion of liquid fuels used for petroleum refining accounted for over 90 % of all greenhouse gas emissions from petroleum refining in 2005. Emissions increased by 15 % between 1990 and 2005 (Table 3.12). With the exception of France, the Netherlands and the UK, Member State emissions from liquid fuels were higher in 2005 than in 1990. More than half of the increase in EU-15 emissions between 1990 and 2005 is due to Italy alone.

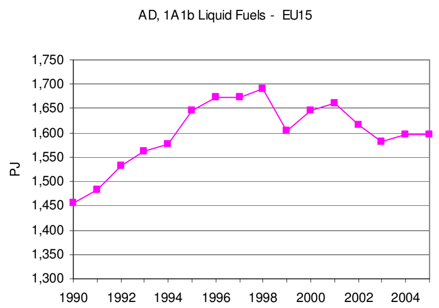
Table 3.12 1A1b Petroleum Refining, liquid fuels: Member States' contributions to CO_2 emissions

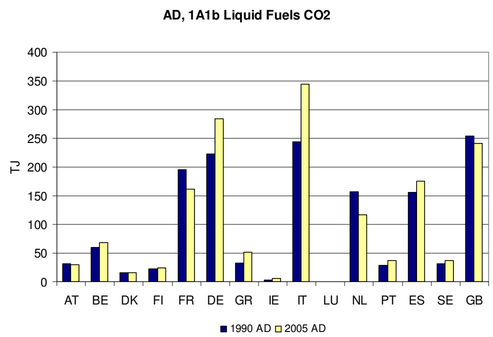
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	1,957	2,508	2,151	1.9%	-357	-14%	195	10%	T2	NS	PS
Belgium	4,285	4,945	4,445	3.9%	-499	-10%	160	4%	CS	RS	CS
Denmark	897	988	932	0.8%	-57	-6%	34	4%	C	NS/PS	CS/C
Finland	1,603	1,847	1,763	1.5%	-84	-5%	160	10%	T3	PS	CS, PS
France	12,732	13,338	11,975	10.5%	-1,363	-10%	-757	-6%	C	PS	CS
Germany	15,315	19,084	19,640	17.3%	556	3%	4,325	28%	CS	NS/AS	CS
Greece	2,465	3,452	3,757	3.3%	305	9%	1,292	52%	C	NS	D
Ireland	182	366	411	0.4%	45	12%	229	126%	T3	NS, PS	PS
Italy	16,178	24,183	25,723	22.6%	1,540	6%	9,545	59%	T3	NS, PS	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	-	-	-
Netherlands	9,999	9,029	8,851	7.8%	-178	-2%	-1,148	-11%	T2	NS/Q	CS
Portugal	1,910	2,529	2,577	2.3%	48	2%	668	35%	T2	PS	D,C,PS
Spain	10,861	12,057	11,529	10.1%	-528	-4%	668	6%	T2	PS	PS, C
Sweden	1,997	2,423	2,329	2.0%	-94	-4%	332	17%	T1,T2,T3	PS	CS
United Kingdom	18,226	17,126	17,721	15.6%	595	3%	-504	-3%	T2	NS	CS
EU-15	**98,606**	**113,876**	**113,805**	**100.0%**	**-71**	**0%**	**15,199**	**15%**			

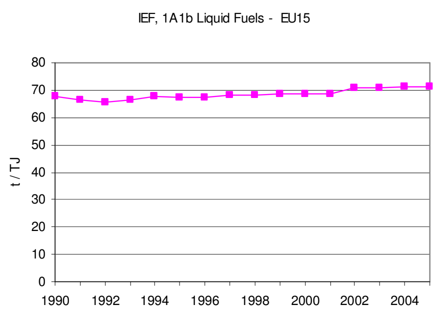
Abbreviations explained in the Chapter 'Units and abbreviations'.

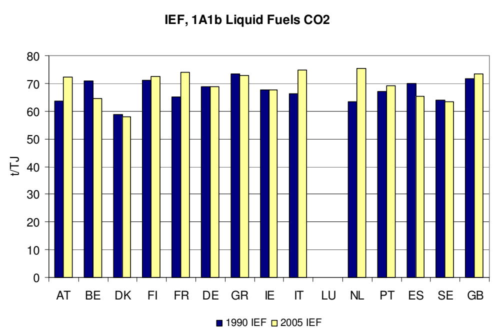
Figure 3.18 shows the activity data and implied emission factors for CO_2 emissions from liquid fuels. The use of liquid fuels increased rapidly from 1990 to 1998 and fell somewhat thereafter. The EU-15 implied emission factor has varied between 65 t/Tj and 71 t/Tj. The increase in the EU-15 factor can be partly explained by the growing Italian share in EU activity and emissions and by the increase in Italy's implied emission factor during the period. The largest emitters in 2005 were Italy, Germany and the UK, which together contributed to about 55 % of EU 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 about 1 % of all greenhouse gas emissions from 1A1b in 2005. There are only three countries reporting emissions in the EU-15, 99 % of which find their origin in France and Germany. EU-emissions fell by about 80 % on average between 1990 and 2005 (Table 3.13).

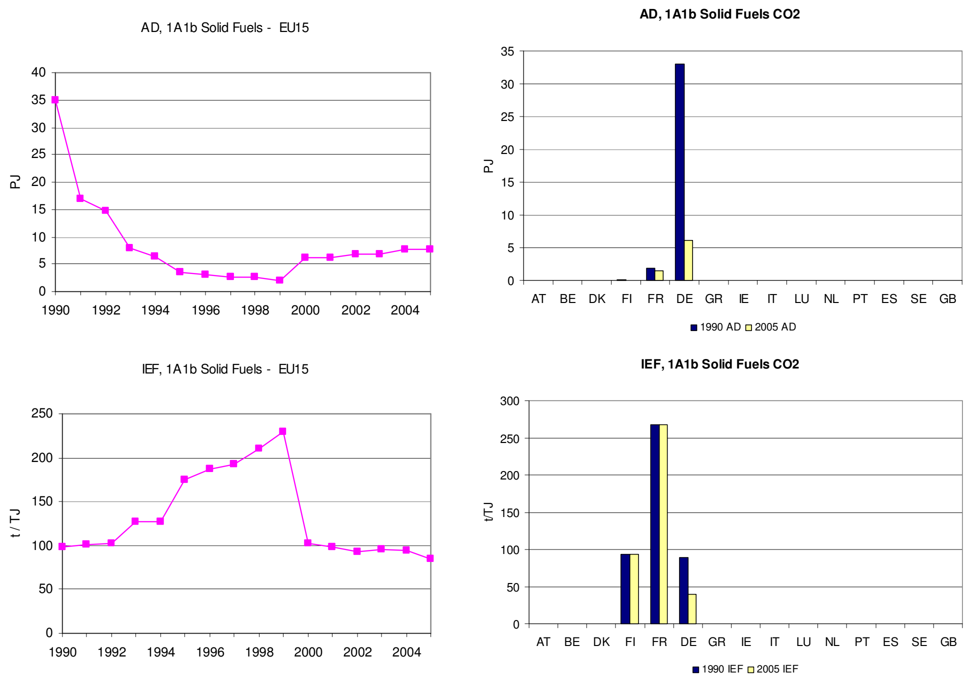
Table 3.13 1A1b Petroleum Refining, solid fuels: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	NO	NO	NO	-	-	-	-	-	-	-	-
Belgium	NO	NO	NO	-	-	-	-	-	-	-	-
Denmark	NO	NO	NO	-	-	-	-	-	-	-	-
Finland	12	1	4	0.5%	2	192%	-9	-71%	T3	-	CS
France	492	499	402	61.8%	-97	-19%	-90	-18%	C	PS	CS
Germany	2,956	237	245	37.7%	9	4%	-2,711	-92%	CS	NS/AS	CS
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	**3,461**	**737**	**651**	**100.0%**	**-86**	**-12%**	**-2,809**	**-81%**			

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 has changed very significantly, and stood at 85 t/Tj in 2005. 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.

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 2005, CO_2 emissions from the combustion of gaseous fuels used for petroleum refining accounted for about 7 % of total greenhouse gas emissions from 1A1b. Emissions in the EU-15 increased by a factor of 2.5 between 1990 and 2005 (Table 3.14). Emissions only fell in Germany. More than 70 % of the gross increase in EU-15 emissions between 1990 and 2005 was due to France, Spain and the Netherlands.

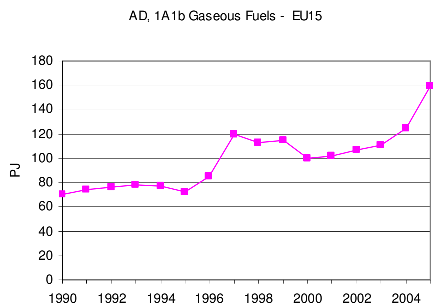
Table 3.14 1A1b Petroleum Refining, gaseous fuels: Member States' contributions to CO_2 emissions

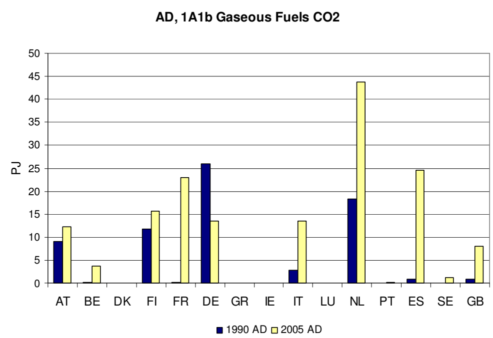
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	506	336	676	7.5%	340	101%	169	33%	T2	NS	CS
Belgium	14	168	211	2.3%	43	26%	197	1426%	CS	PS	CS
Denmark	NO	NO	NO	-	-	-	-	-	-	-	-
Finland	644	944	859	9.5%	-85	-9%	215	33%	T3	-	CS
France	14	257	1,177	13.0%	920	358%	1,163	8193%	C	PS	CS
Germany	1,203	693	753	8.3%	61	9%	-450	-37%	CS	NS/AS	CS
Greece	NO	NO	NO	-	-	-	-	-	-	-	-
Ireland	NO	NO	NO	-	-	-	-	-	-	-	-
Italy	159	520	768	8.5%	248	48%	609	382%	T3	NS, PS	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	-	-	-
Netherlands	1,042	2,267	2,487	27.6%	220	10%	1,445	139%	T2	NS/Q	CS
Portugal	NO	11	11	0.1%	0	-	11	-	T2	PS	D,C,PS
Spain	45	1,341	1,563	17.3%	222	17%	1,518	3367%	D, C, CS	Q	D, C, PS
Sweden	NO	81	69	0.8%	-12	-15%	69	-	T2, T3	PS	CS, D
United Kingdom	49	359	452	5.0%	93	26%	403	815%	T2	NS	CS
EU-15	**3,678**	**6,977**	**9,026**	**100.0%**	**2,049**	**29%**	**5,348**	**145%**			

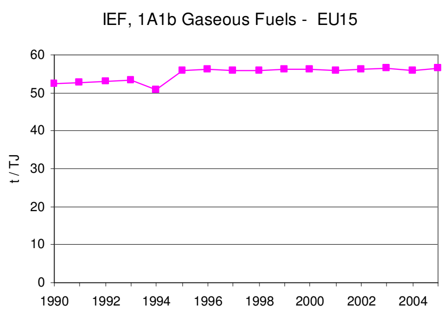
Abbreviations explained in the Chapter 'Units and abbreviations'.

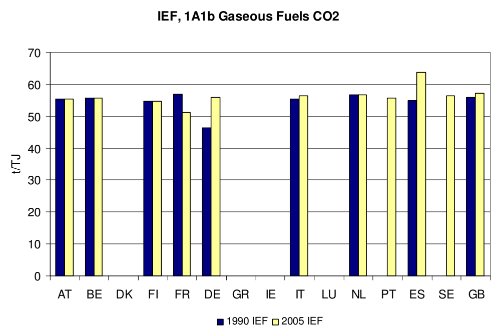
Figure 3.20 shows the activity data and implied emission factors for CO_2 emissions from gaseous fuels. The use of gasesous fuels increased by over a factor of 2 between 1990 and 2005. The EU-15 implied emission factor has remained broadly stable since 1995, reaching 57 t/Tj in 2005. Before then, the trend mirrors to some extent the evolution of the factor in Germany, whose share in the early 1990s was about one third of EU emissions. The largest emitter in 2005 was the Netherlands with 28 % of all EU emissions, followed by Spain and France.

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)

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. Emissions from own on-site fuel use should be included. It also includes combustion for the generation of electricity and heat for own use in these industries

CO_2 emissions from the manufacture of solid fuels accounted for 1.4 % of total greenhouse gas emissions in 2005. Between 1990 and 2005, CO_2 emissions fell by 40 % in the EU-15 (Table 3.15). Emissions from solid fuels fell gradually during the 1990s, but picked up again in the last few years. On the other hand, emissions from gaseaous fuels have been steadily increasing during the 15-year period.

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 2005	Change 2004-2005		Change 1990-2005	
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	308	258	272	0.5%	14	5%	-37	-12%
Belgium	2,144	481	429	0.7%	-52	-11%	-1,716	-80%
Denmark	540	1,567	1,593	2.8%	25	2%	1,053	195%
Finland	347	418	394	0.7%	-23	-6%	47	14%
France	4,971	4,020	3,826	6.6%	-194	-5%	-1,145	-23%
Germany	59,066	16,448	15,916	27.5%	-532	-3%	-43,151	-73%
Greece	102	109	80	0.1%	-29	-27%	-22	-22%
Ireland	100	180	110	0.2%	-71	-39%	9	9%
Italy	10,620	10,432	12,797	22.1%	2,365	23%	2,178	21%
Luxembourg	NO	NO	NO	-	-	-	-	-
Netherlands	1,528	1,987	2,057	3.6%	69	3%	529	35%
Portugal	75	NO	NO	0.0%	-	-	-75	-100%
Spain	2,110	2,010	2,037	3.5%	28	1%	-72	-3%
Sweden	361	361	350	0.6%	-10	-3%	-11	-3%
United Kingdom	13,545	18,927	17,990	31.1%	-937	-5%	4,445	33%
EU-15	**95,818**	**57,198**	**57,850**	**100.0%**	**653**	**1%**	**-37,967**	**-40%**

Figure 3.21 shows the trends in emissions from this source category by fuel in the EU-15 between 1990 and 2005. Almost 90 % of greeenhouse gas emissions from the manufacture of solid fuels can be accounted for by CO_2 emissions from solid (53 %) and gaseous (38 %) fuels. The figure also shows the activity data behind the emissions.

Fuel used for manufacturing solid fuels fell by 30 % in the EU-15 between 1990 and 2005. In 2005, solid fuels represented 38 % of all fuel use, whereas gaseous fuels took a share of almost 50%.

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

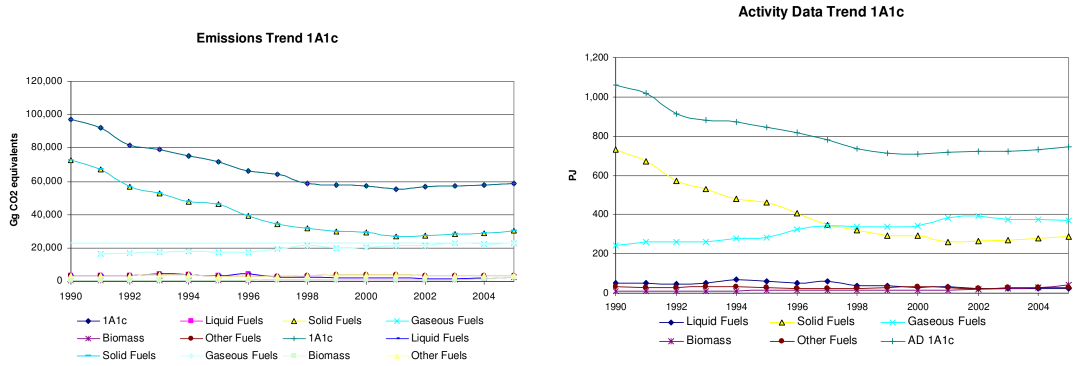


Figure 3.22 shows the relative importance of CO_2 emissions from the manufacture of solid fuels in total greenhouse gas emissions by Member State. The country shares range from the highest in the UK to the lowest of Luxembourg and Portugal, which do not have emissions from this source category. Figure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

Figure 3.22: **Share of CO_2 emissions from the manufacture of solid fuels in total greenhouse gas emissions by Member State in 2005**

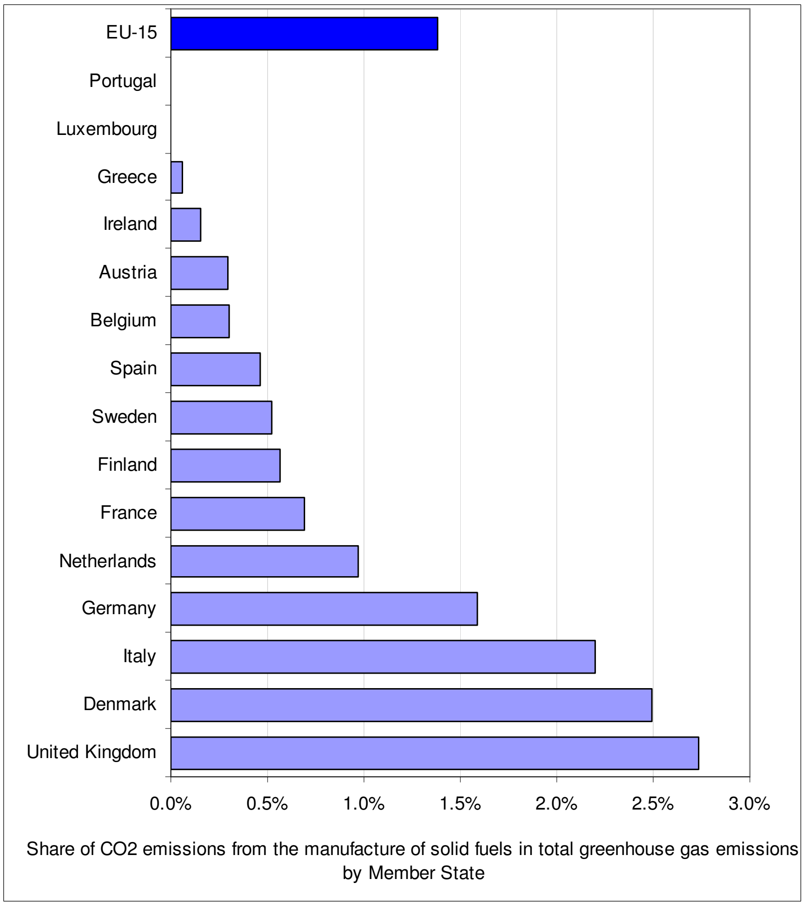
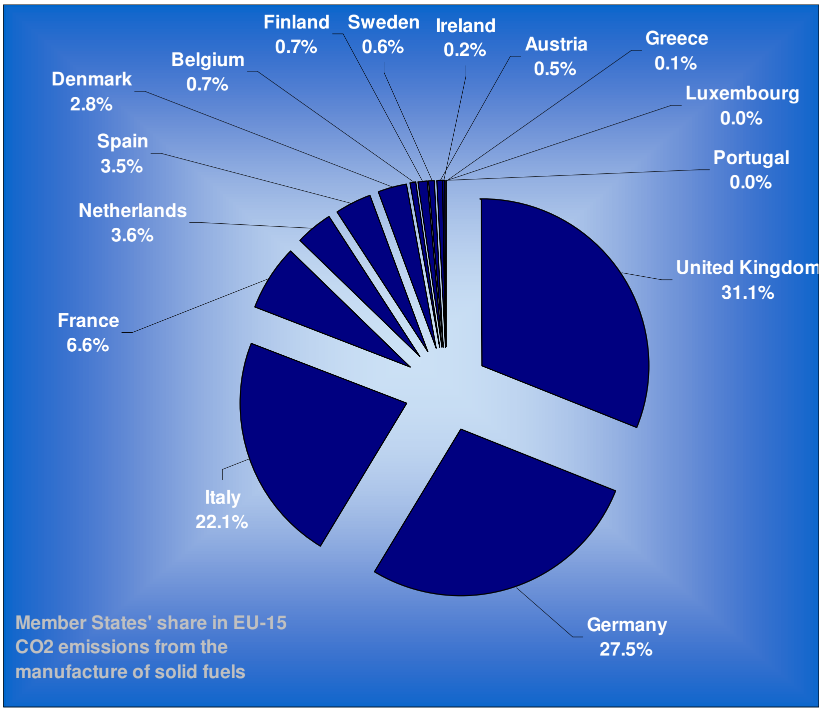


Figure 3.23: Member States' share of CO_2 emissions from the manufacture of solid fuels in EU-15



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 just above half the total greenhouse gas emissions from 1A1c in 2005. Emissions in the EU-15 increased steadily by over 30 % (Table 3.16). About 80 % of the increase in EU-15 emissions between 1990 and 2005 was due to the UK alone, and a combined 20 % due to Denmark and the Netherlands.

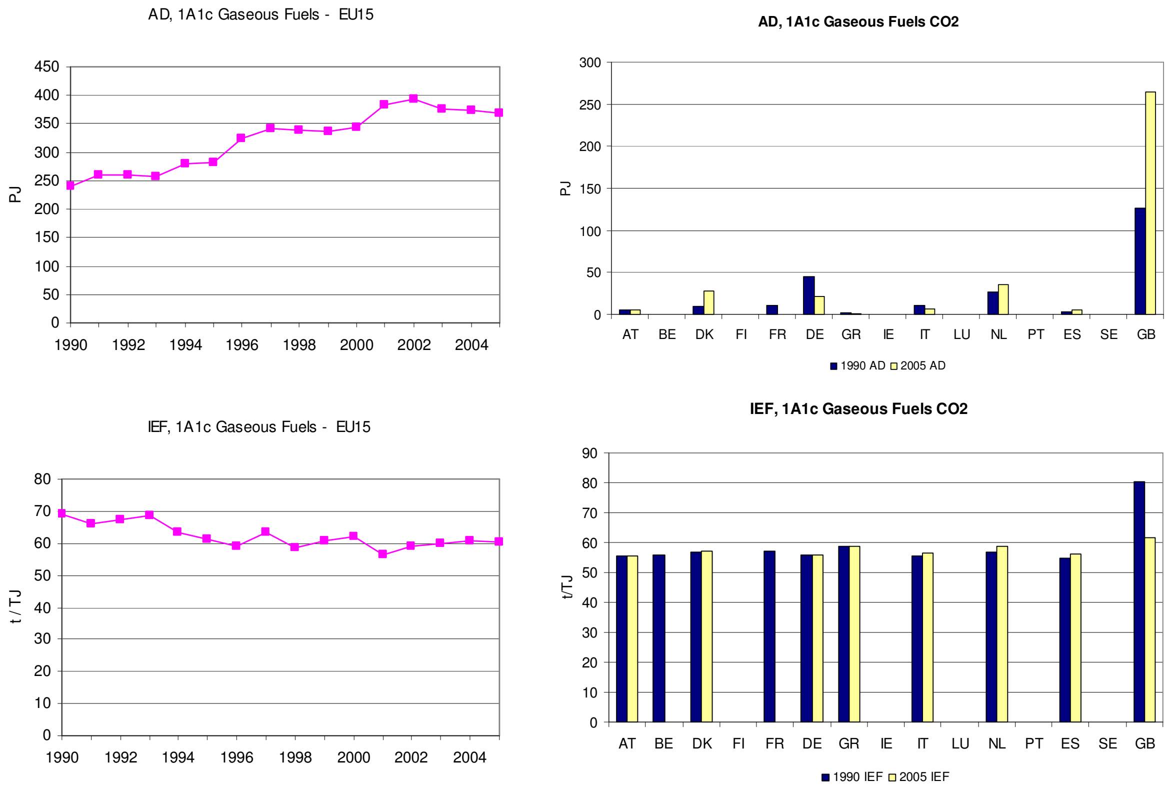
Table 3.16 1A1c Manufacture of Solid Fuels and Other Energy Industries, gaseous fuels: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	304	258	272	1.2%	14	5%	-33	-11%	T2	NS	CS
Belgium	3	NO	NO	-	-	-	-3	-100%	-	-	-
Denmark	540	1,567	1,593	7.2%	25	2%	1,053	195%	C	NS	CS/C
Finland	NO	NO	NO	-	-	-	-	-	-	-	-
France	586	NO	NO	-	-	-	-586	-	-	-	-
Germany	2,501	1,100	1,172	5.3%	72	7%	-1,329	-53%	CS	NS/AS	CS
Greece	102	109	80	0.4%	-29	-27%	-22	-22%	C	NS	CS
Ireland	NO	NO	NO	-	-	-	-	-	-	-	-
Italy	615	373	382	1.7%	9	2%	-233	-38%	T2	NS	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	-	-	-
Netherlands	1,526	1,987	2,056	9.3%	69	3%	530	35%	T2	NS/Q	CS
Portugal	NO	NO	NO	-	-	-	-	-	-	-	-
Spain	205	196	305	1.4%	109	56%	100	49%	T2	PS, NS	CS
Sweden	NO	NO	NO	-	-	-	-	-	-	-	-
United Kingdom	10,124	17,231	16,317	73.6%	-914	-5%	6,193	61%	T2	NS	CS
EU-15	**16,506**	**22,821**	**22,177**	**100.0%**	**-644**	**-3%**	**5,670**	**34%**			

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 gasesous fuels increased by a factor of 1.5 between 1990 and 2005. The EU-15 implied emission factor has declined gradually since 1990 to about 60 t/Tj. 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. By far, the largest emitter in 2005 was the UK, which represened almost 75 % of all EU-15 emissions.

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 38 % of total greenhouse gas emissions from 1A1c in 2005. Emissions in the EU-15 more than halved, most of it during the 1990s (Table 3.17). This was almost-entirely due to a strong decline in emissions in Germany.

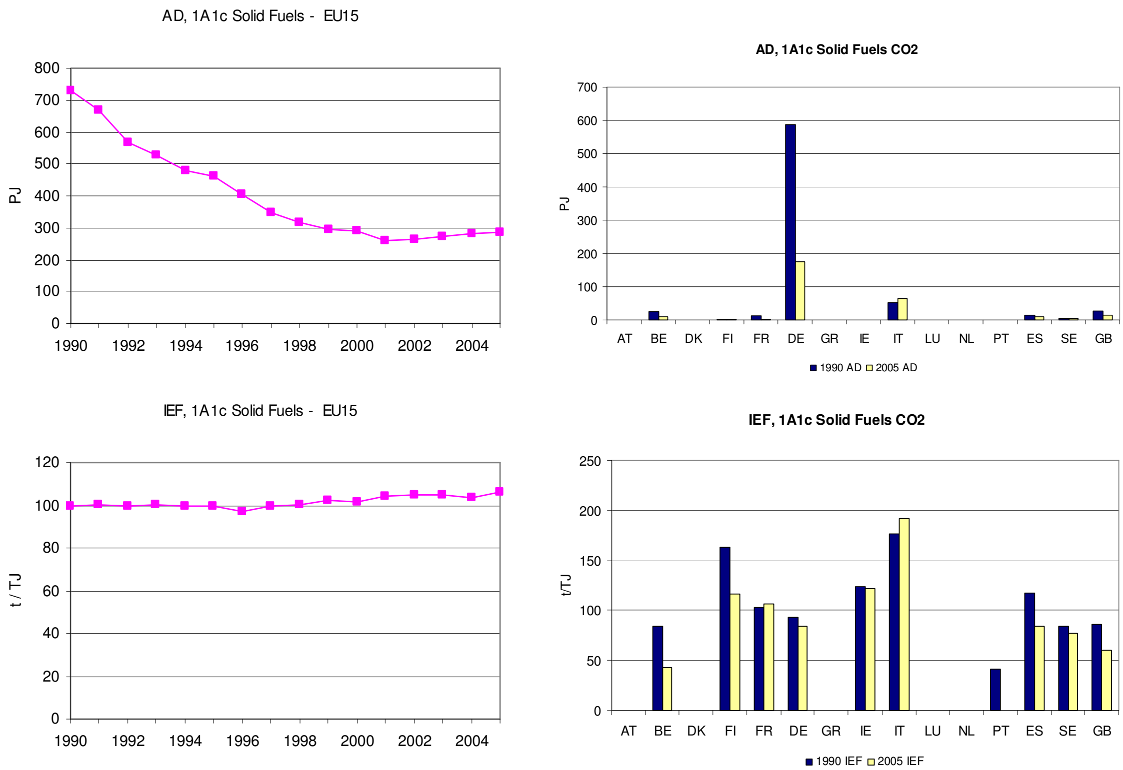
Table 3.17 1A1c Manufacture of Solid Fuels and Other Energy Industries, solid fuels: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	NO	NO	NO	-	-	-	-	-	-	-	-
Belgium	2,137	481	429	1.4%	-52	-11%	-1,709	-80%	CS	PS,RS	CS
Denmark	NO	NO	NO	-	-	-	-	-	-	-	-
Finland	347	418	394	1.3%	-23	-6%	47	14%	T3	PS	CS
France	1,315	315	315	1.0%	0	0%	-1,000	-76%	C	AS/ PS	CS
Germany	54,999	15,213	14,591	48.0%	-621	-4%	-40,408	-73%	CS	NS/AS	CS
Greece	NO	NO	NO	-	-	-	-	-	-	-	-
Ireland	100	180	110	0.4%	-71	-39%	9	9%	T1	NS, PS	C
Italy	9,062	9,978	12,336	40.6%	2,358	24%	3,275	36%	T2	NS	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	-	-	-
Netherlands	IE	NO	NO	-	-	-	-	-	-	-	-
Portugal	25	NO	NO	-	0	-	-25	-100%	T2	PS	D,C,PS
Spain	1,847	1,105	943	3.1%	-163	-15%	-905	-49%	T2	PS, NS, AS, Q	PS, CS
Sweden	360	360	349	1.1%	-10	-3%	-11	-3%	T1,T2,T3,NA	PS/NA	CS, NA
United Kingdom	2,326	931	908	3.0%	-23	-2%	-1,418	-61%	T2	NS	CS
EU-15	**72,520**	**28,981**	**30,375**	**100.0%**	**1,395**	**5%**	**-42,144**	**-58%**			

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 the 1990 level. The EU-15 implied emission factor has somewhat increased to reach 106 t/Tj in 2005. This increase is mainly due to a decline in the German share in EU emissions and a parallel increase in the share of Italy, which has a significantly higher implied emission factor. The largests emiters in 2005 were Italy and Germany, jointly responsible for about 90 % of all EU emissions.

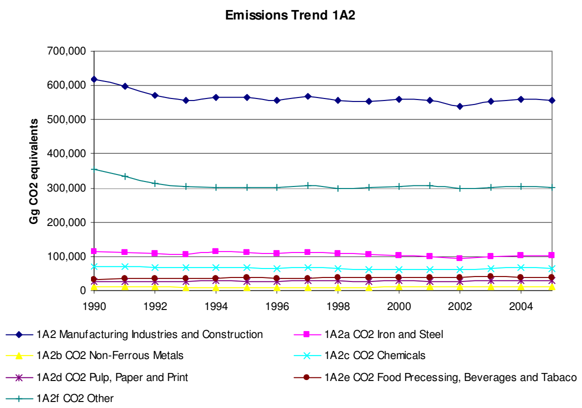
Figure 3.25 1A1c Manufacture of Solid Fuels and Other Energy Industries, solid fuels: Activity Data and Implied Emission Factors for CO_2



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

Figure 3.26 shows the emission trends within source category 1A2, which is mainly dominated by CO_2 from 1A2f Other contributing by 54% and 1A2a Iron and steel by 18%. 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



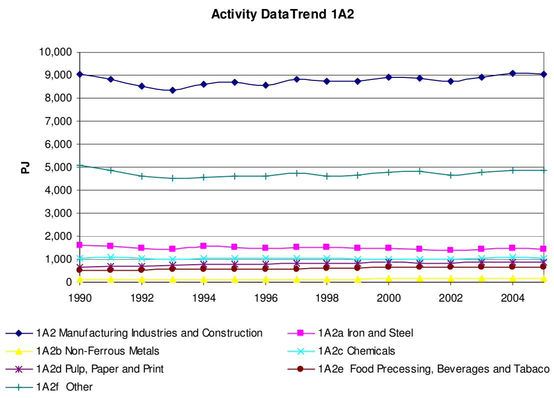


Table 3.18 summarises information by Member State on GHG emission trends and CO_2 emissions from 1A2 Manufacturing Industries and Construction.

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 2005 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO_2 emissions in 2005 (Gg)
Austria	13,749	15,708	13,579	15,538
Belgium	33,303	27,964	32,852	27,682
Denmark	5,493	5,659	5,423	5,571
Finland	13,464	11,589	13,278	11,407
France	83,274	82,420	82,329	81,448
Germany	156,320	103,819	154,482	102,781
Greece	10,891	8,792	10,457	8,430
Ireland	4,108	5,661	3,970	5,454
Italy	90,703	83,803	88,937	81,960
Luxembourg	5,301	2,299	5,291	2,295
Netherlands	33,135	27,250	33,045	27,182
Portugal	9,263	10,668	9,158	10,515
Spain	46,729	71,977	46,266	71,179
Sweden	11,619	10,980	11,062	10,403
United Kingdom	101,496	86,772	99,554	85,093
EU-15	**618,847**	**555,362**	**609,684**	**546,938**

Abbreviations explained in the Chapter 'Units and abbreviations'.

CO_2 emissions from 1A2 Manufacturing Industries and Construction is the third largest key source in the EU-15 accounting for 13 % of total GHG emissions in 2005. Between 1990 and 2005, CO_2 emissions from manufacturing industries declined by 10 % in the EU-15. The emissions from this key source are due to fossil fuel consumption in manufacturing industries and construction, which was almost the same in 2005 as in 1990. Shift from solid fuels to gas took place.

Between 1990 and 2005, Germany shows by far the largest emission reductions in absolute terms. Also United Kingdom, the Netherlands, Belgium, Greece and Luxembourg show emission reductions of more than two million tonnes, 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.

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 2004 and main explanations for the largest recalculations in absolute terms.

Table 3.19 1A2 Manufacturing Industries and Construction: Contribution of MS to EU-15 recalculations in CO_2 for 1990 and 2004 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

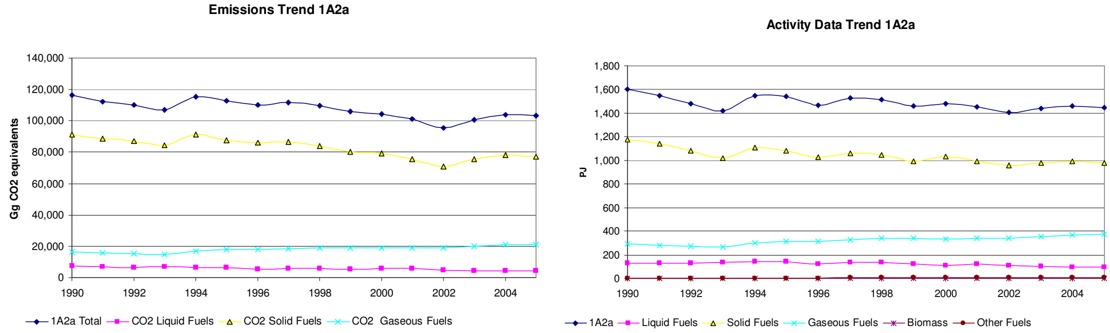
	1990		2004		Main explanations
	Gg	Percent	Gg	Percent	
Austria	126	0.9	-212	-1.4	update of activity data according to revised energy balance, Update of statistical energy data, particularly the biodiesel consumption
Belgium	0	0.0	-194	-0.7	In the Flemish region most recalculations in the energy sector of the emission inventory 1990-2005 are performed in the last years (2003 and 2004) because more accurate information became available for these years. The year 2004 has undergone a complete revision because the emissions of 2004 reported last year were reported on a temporary basis.
Denmark	0	0.0	-44	-0.8	New data material has made it possible to update the disaggregation of sector 1A2 into subsectors. This has not influenced the total emission from sector 1A2 only the distribution on sectors 1A2a-1A2f.
Finland	241	1.8	510	4.6	Update of time series consistency, activity data and emission factors; corrections of errors
France	20	0.0	4,564	5.9	consideration of emission data per site, update of consumption of GIC
Germany	1,745	1.1	2,254	2.3	updated activity data
Greece	0	0.0	0	0.0	
Ireland	-142	-3.5	735	15.6	Reallocation of all heavy fuel oil consumption from the commercial sector under 1.A.4 Other Sectors to 1.A.2 Manufacturing Industries and Construction; Upward revision of coal consumption in 1.A.2 Manufacturing Industries and Construction in 2003 and 2004 following comparison of energy balance data and ETS energy data for 2005.
Italy	0	0.0	765	0.9	Change in emission factor: Coal, natural gas and LPG emission factors have been updated Change in activity data: Activity data reported in the National energy balance have been updated
Luxembourg	0	0.0	0	0.0	
Netherlands	0	0.0	0	0.0	
Portugal	0	0.0	229	2.2	data updates
Spain	0	0.0	-2,791	-3.8	updated activity data according to revised energy balance (2004), error correction (1991, 2003)
Sweden	0	0.0	-27	-0.2	CRF 1A2b: Process activity data for coke in 1991 has previously been reported incorrectly under CRF 1A2b instead of CRF 2C3. About 17 Gg CO2 was reallocated from 1A2b to 2C3 in 1991 due to this correction. CRF 1A2c:Exclusion of data (liquid, solid and biomass) for one plant during 2003 and 2004 due to earlier double-counting and better information from the plant. This resulted in a decrease in CO2 emissions with about 31 Gg each year. CRF 1A2d:Correction of emission factors for SO2 and NOX in 1995 for biomass due to errors in calculations submission 2006. CRF 1A2f: Adjustment of diesel consumption for all years following an update of the ARTEMIS model resulted in 1-5% higher emissions for all substances. Emission factors for SO2 were revised for all years.
UK	490	0.5	-3,295	-3.7	Revision to time series of emission factors for coke, coke oven gas and blast furnace gas in 1A2a and 1A2f, and revisions to activity statistics for coke oven gas. Revision to DTI statistics for fuel oil, gas oil, natural gas, petrol and LPG. Revision to natural gas use for ammonia production, based on data supplied by producers. Revision to coal use data and emission factor supplied by the British Cement Association, for coal use in the cement industry. Revision to DTI coal use statistics, and a change to the emission factor based on a revision to the GCV value.
EU-15	**2,480**	**0.4**	**2,494**	**0.5**	

3.2.2.1. Iron and Steel (1A2a)

In this chapter information about emission trends, Member States contribution, activity data and emission factors is provided for category 1A2a on a fuel base. CO_2 emissions from 1A2a Iron and Steel account for 18.4% of 1A2 source category and 2.4 % of total GHG emissions in 2005.

Figure 3.27 shows the emission trend within the category 1A2a, which is mainly dominated by CO_2 emissions from solid fuels. Total emissions decreased by 11 %, mainly due to increased share of gaseous fuels and biomass. Emissions from solid fuels decreased by 16 % and from liquid fuels by 45%. As follow up increasing emissions were reported for gaseous fuels (+28 %).

Figure 3.27 1A2a Iron and Steel: Total, CO_2 and N_2O emission and activity trends



Between 1990 and 2005, CO_2 emissions from 1A2a Iron and Steel decreased by 11 % in the EU-15 (Table 3.20), mainly due to decreases in the United Kingdom, Italy, Belgium and Luxembourg. Between 2004 and 2005 emissions slightly decreased (by -1 %).

Table 3.20 1A2a Iron and Steel: Member States' contributions to CO_2 emissions in 1990, 2004 and 2005

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005	
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	4,942	5,855	6,393	6.3%	539	9%	1,451	29%
Belgium	14,213	11,012	9,470	9.3%	-1,543	-14%	-4,743	-33%
Denmark	441	523	524	0.5%	1	0%	83	19%
Finland	2,555	3,520	3,627	3.5%	106	3%	1,071	42%
France	17,060	17,674	17,694	17.3%	19	0%	633	4%
Germany	12,578	14,850	16,544	16.2%	1,695	11%	3,966	32%
Greece	475	231	207	0.2%	-23	-10%	-268	-56%
Ireland	175	2	2	0.0%	0	0%	-173	-99%
Italy	20,729	16,948	15,607	15.3%	-1,341	-8%	-5,123	-25%
Luxembourg	3,235	252	252	0.2%	0	0%	-2,983	-92%
Netherlands	4,011	4,717	4,538	4.4%	-178	-4%	528	13%
Portugal	623	162	180	0.2%	18	11%	-443	-71%
Spain	8,726	7,715	8,107	7.9%	391	5%	-620	-7%
Sweden	1,176	1,277	1,186	1.2%	-92	-7%	9	1%
United Kingdom	24,101	18,409	17,866	17.5%	-543	-3%	-6,235	-26%
EU-15	**115,041**	**103,147**	**102,196**	**100.0%**	**-951**	**-1%**	**-12,845**	**-11%**

1A2a Iron and Steel - Liquid Fuels (CO_2)

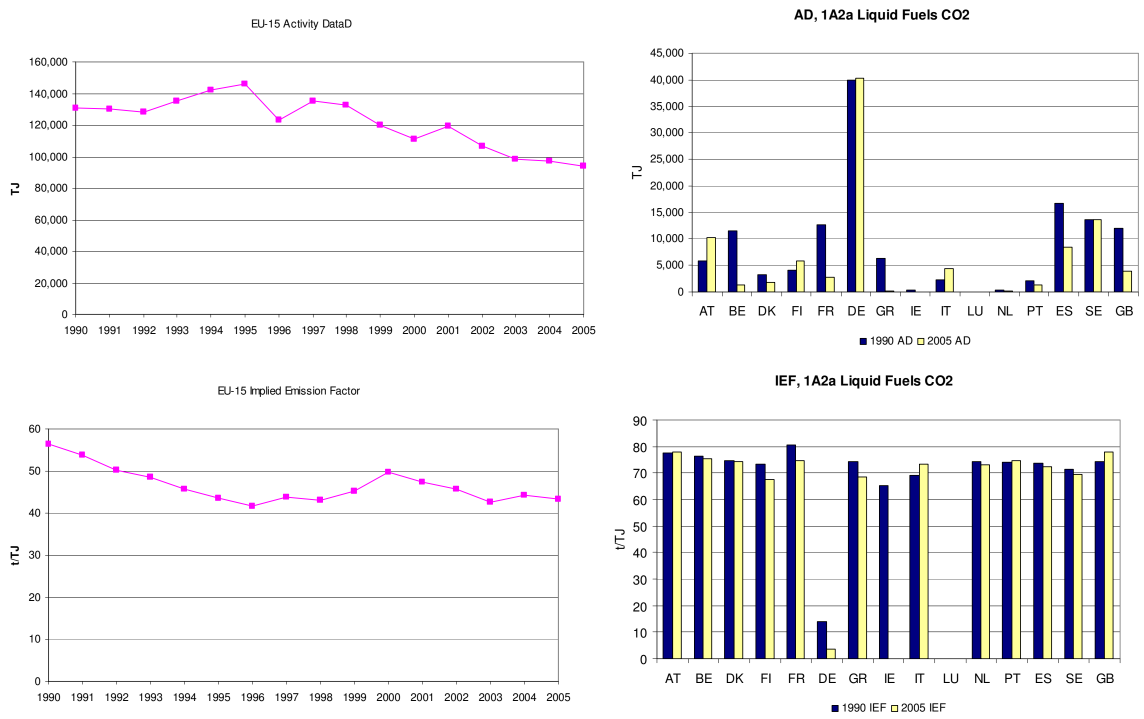
In 2005 CO_2 from liquid fuels had a share of 4 % within this category compared to 6 % in 1990. Between 1990 and 2005 emissions decreased by 45 % (Table 3.21). Significant absolute decreases could be achieved in Belgium, France, Greece, Spain and the United Kingdom. Italy, Finland, and Austria reported increases in this period.

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

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	448	702	792	19.4%	91	13%	344	77%	T2	NS, PS	D
Belgium	879	94	103	2.5%	9	10%	-775	-88%	C	-	C, CS
Denmark	238	141	133	3.3%	-8	-5%	-105	-44%	C	NS	CS/C
Finland	303	359	391	9.6%	32	9%	88	29%	T3	PS	CS
France	1,024	142	204	5.0%	62	43%	-821	-80%	C	NS/ AS/ PS	CS
Germany	560	146	146	3.6%	0	0%	-414	-74%	T2	NS/AS	CS
Greece	475	77	14	0.3%	-63	-82%	-461	-97%	C	CS	D
Ireland	16	NO	NO	-	-	-	-16	-100%	-	-	-
Italy	153	378	324	7.9%	-53	-14%	171	111%	T2	NS	CS
Luxembourg	NE	NE	NE	-	-	-	-	-	-	-	-
Netherlands	21	12	11	0.3%	0	-3%	-9	-45%	T2	NS/Q	CS
Portugal	154	94	97	2.4%	3	3%	-58	-37%	T2	PS,NS	D,C,PS
Spain	1,231	653	613	15.0%	-40	-6%	-618	-50%	T2	-	C, CS
Sweden	969	1,024	946	23.2%	-79	-8%	-23	-2%	T1, T2, T3	-	CS
United Kingdom	894	497	307	7.5%	-190	-38%	-587	-66%	T2	NS, AS	CS
EU-15	**7,366**	**4,318**	**4,081**	**100.0%**	**-237**	**-5%**	**-3,285**	**-45%**			

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 28 % between 1990 and 2005. The implied emission factor of EU-15 was 43.3 t/TJ in 2005.

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 2005, CO_2 from solid fuels had a share of 75 % within this category and 79 % in 1990. Between 1990 and 2005 the emissions decreased by 16 % (Table 3.22). Between 1990 and 2005 major decreases show the United Kingdom, Spain, Luxembourg, Belgium and Italy. Between 2004 and 2005, Germany reported a substantial increase of 16 %.

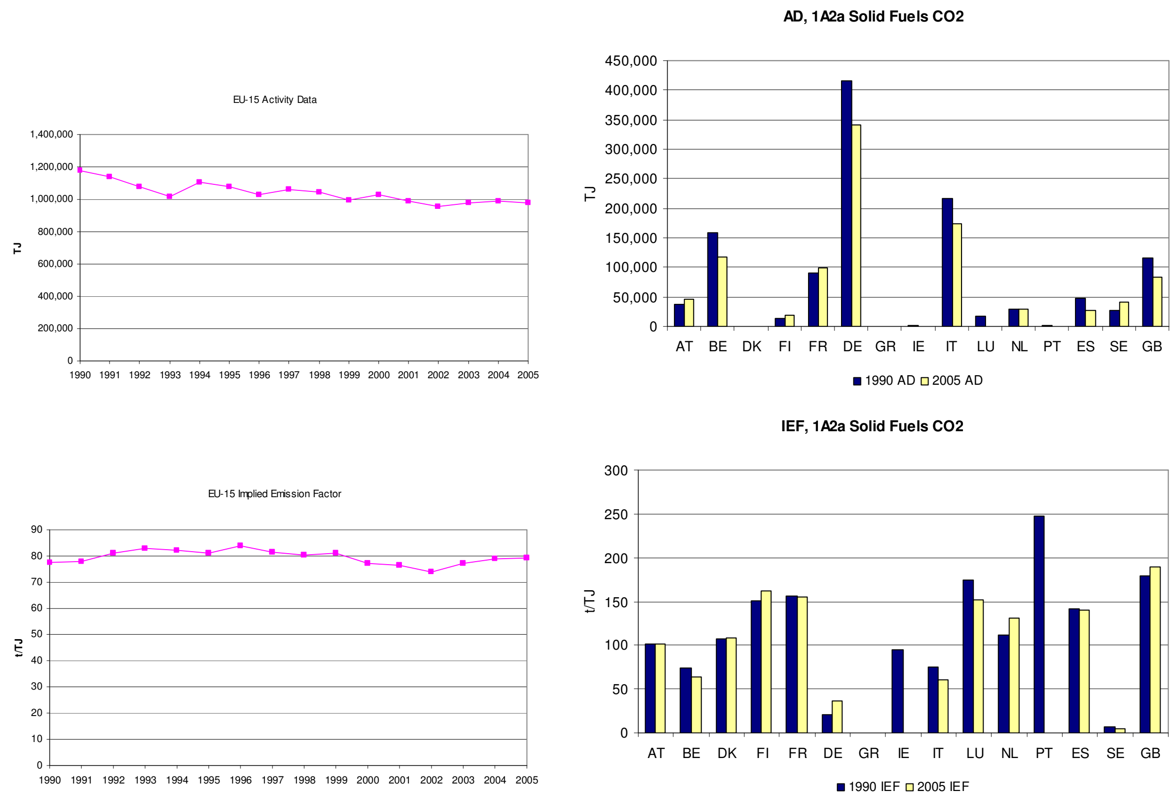
Table 3.22 1A2a Iron and Steel, solid fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	3,844	4,166	4,614	6.0%	448	11%	770	20%	T2	NS, PS	D
Belgium	11,849	9,036	7,578	9.8%	-1,458	-16%	-4,271	-36%	C	-	C, CS
Denmark	17	0	0	0.0%	0	-16%	-17	-100%	C	NS	CS/C
Finland	2,146	3,021	3,104	4.0%	83	3%	959	45%	T3	PS	CS
France	14,119	15,243	15,316	19.8%	73	0%	1,197	8%	C	NS/ AS/ PS	CS
Germany	8,518	10,765	12,459	16.1%	1,695	16%	3,942	46%	T2	NS/AS	CS
Greece	NO	NO	NO	-	-	-	-	-	-	-	-
Ireland	115	NO	NO	-	-	-	-115	-100%	T1	0	C
Italy	16,300	11,998	10,638	13.8%	-1,360	-11%	-5,662	-35%	T2	NS	CS
Luxembourg	2,957	2	2	0.0%	0	0%	-2,955	-100%	C	-	C, CS, PS
Netherlands	3,323	4,026	3,816	4.9%	-210	-5%	493	15%	T2	NS/Q	CS
Portugal	466	NO	NO	-	-	-	-466	-100%	-	-	-
Spain	6,771	3,670	3,720	4.8%	50	1%	-3,051	-45%	T2	-	C, CS, PS
Sweden	182	185	173	0.2%	-12	-6%	-9	-5%	T1, T2, T3	-	CS
United Kingdom	20,744	15,911	15,756	20.4%	-155	-1%	-4,988	-24%	T2	NS, AS	CS
EU-15	**91,350**	**78,022**	**77,176**	**100.0%**	**-846**	**-1%**	**-14,174**	**-16%**			

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 Belgium, France, Germany, Italy and the United Kingdom; together they cause more than 80% of the CO_2 emissions from solid fuels in 1A2a. Fuel combustion in the EU-15 decreased by 17 % between 1990 and 2005. The implied emission factor in 2005 of EU-15 was 79.1 t/TJ in 2005.

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 2005 CO_2 from gaseous fuels had a share of 20 % within source category 1A2a (compared to 14 % in 1990). Between 1990 and 2005 the emissions increased by 28 % (Table 3.23). Between 1990 and 2005 all Member States except Ireland, Luxembourg and the United Kingdom reported increases. The highest increase occurred in Spain(+421 %), Sweden (+165 %) and Denmark (+111 %).

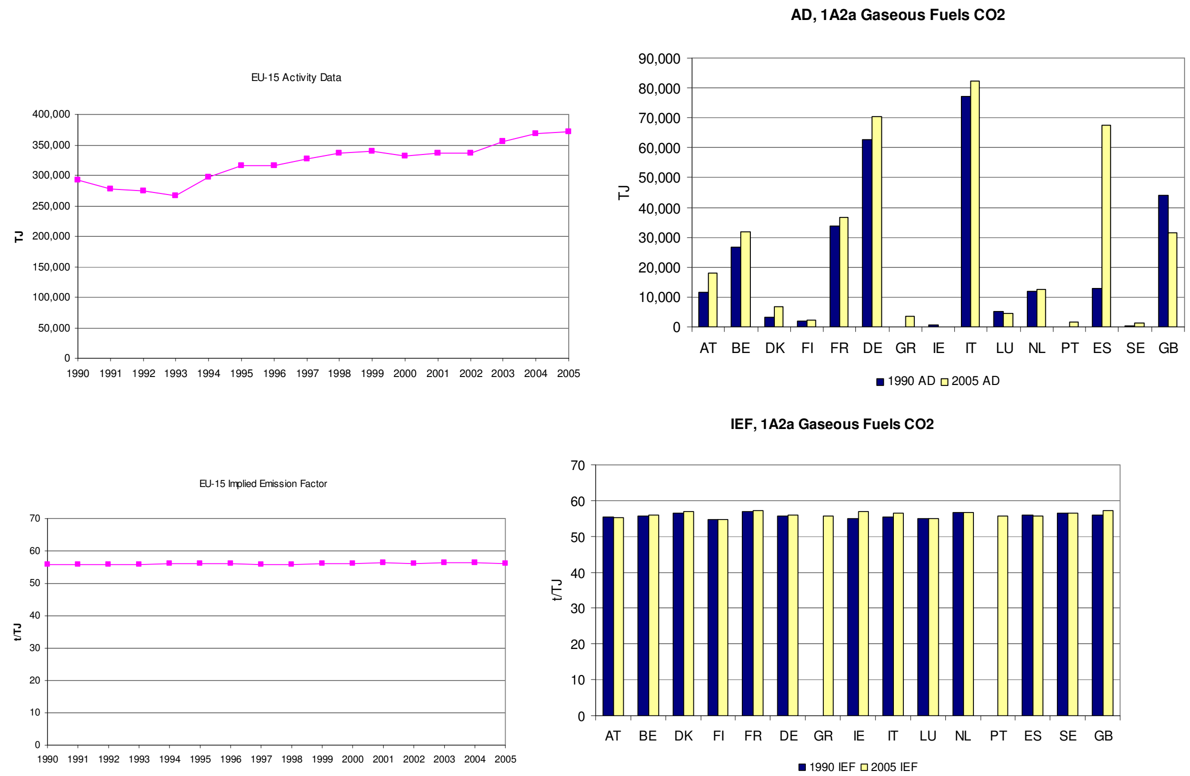
Table 3.23 1A2a Iron and Steel, gaseous fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	650	987	987	4.7%	0	0%	338	52%	T2	NS, PS	D
Belgium	1,485	1,882	1,788	8.6%	-94	-5%	303	20%	C	-	C, CS
Denmark	185	382	391	1.9%	9	2%	206	111%	C	NS	CS/C
Finland	107	141	132	0.6%	-9	-7%	24	23%	T3	PS	CS
France	1,917	2,221	2,098	10.1%	-122	-6%	181	9%	C	NS/ AS/ PS	CS
Germany	3,500	3,939	3,939	18.9%	0	0%	439	13%	T2	NS/AS	CS
Greece	NO	154	193	0.9%	40	26%	193	-	C	CS	D
Ireland	44	2	2	0.0%	0	-	-41	-95%	T1	-	C
Italy	4,276	4,572	4,644	22.3%	72	2%	368	9%	T2	NS	CS
Luxembourg	279	250	250	1.2%	0	0%	-28	-10%	C	-	C, CS, PS
Netherlands	667	679	711	3.4%	32	5%	44	7%	T2	NS/Q	CS
Portugal	NO	68	83	0.4%	15	22%	83	-	T2	PS,NS	D,C,PS
Spain	724	3,392	3,774	18.1%	381	11%	3,050	421%	T2	-	CS
Sweden	25	68	67	0.3%	-1	-2%	42	165%	T1, T2, T3	-	CS
United Kingdom	2,463	2,001	1,803	8.6%	-198	-10%	-660	-27%	T2	NS, AS	CS
EU-15	**16,322**	**20,738**	**20,862**	**100.0%**	**125**	**1%**	**4,540**	**28%**			

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, Spain and the United Kingdom; together they cause more than 78% of the CO_2 emissions from solid fuels in 1A2a. Gaseous fuel consumption in the EU-15 increased by 27 % between 1990 and 2005. The implied emission factor of EU-15 was 56.3 t/TJ in 2005.

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

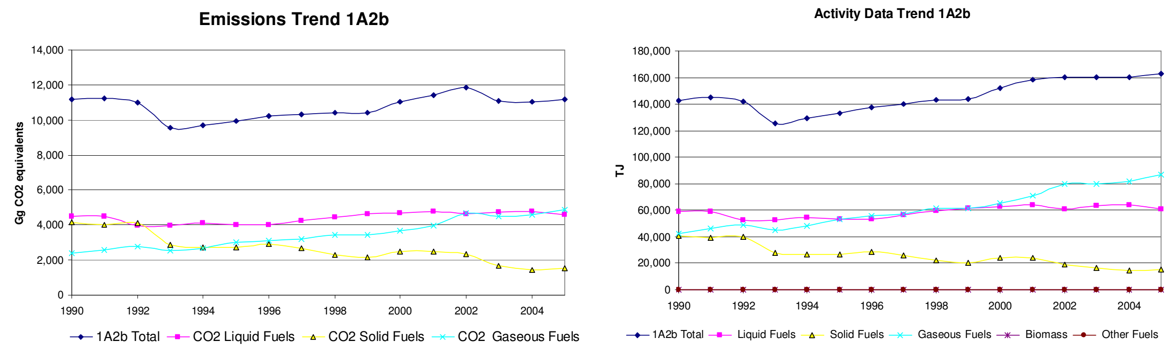


3.2.2.2. Non Ferrous Metals (1A2b)

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 account for 2.0% of 1A2 source category and 0.3 % of total GHG emissions in 2005.

Figure 3.31 shows the emission trend within the category 1A2b, which is in 2005 mainly dominated by CO_2 emissions from liquid, and gaseous fuels. The share of solid fuels emissions decreased from 37% in 1990 to 13 % in 2005. Total GHG emissions reached the same level as in 1990. Increasing emissions were reported for gaseous fuels (+103 %).

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



Although the EU-15 emissions of 1990 and 2005 are at the same level, the Member States' emissions show changes. In absolute term France reported the highest decrease, while Spain Spain reported a substantial increase in this period of 125 % (Table 3.24).

Table 3.24 1A2b Non ferrous Metals: Member States' contributions to CO_2 emissions in 1990, 2004 and 2005

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005	
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	132	216	406	3.7%	190	88%	274	208%
Belgium	624	518	478	4.4%	-41	-8%	-146	-23%
Denmark	17	15	15	0.1%	0	0%	-2	-12%
Finland	336	112	98	0.9%	-15	-13%	-239	-71%
France	4,010	2,073	2,050	18.7%	-23	-1%	-1,960	-49%
Germany	1,600	936	936	8.5%	0	0%	-663	-41%
Greece	1,261	1,668	1,650	15.0%	-18	-1%	390	31%
Ireland	810	1,428	1,368	12.5%	-61	-4%	558	69%
Italy	738	1,189	1,184	10.8%	-6	0%	446	60%
Luxembourg	38	41	NE	-	-41	-100%	-38	-100%
Netherlands	216	234	230	2.1%	-5	-2%	14	6%
Portugal	IE,NO	IE	IE	0.0%	-	-	-	-
Spain	1,095	2,313	2,463	22.5%	150	6%	1,368	125%
Sweden	142	91	89	0.8%	-2	-2%	-53	-37%
United Kingdom	IE	IE	IE	-	-	-	-	-
EU-15	**11,018**	**10,836**	**10,966**	**100.0%**	**131**	**1%**	**-52**	**0%**

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

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

In 2005 CO_2 from solid fuels had a share of 13 % within source category 1A2b category (compared to 37 % in 1990). Between 1990 and 2005 the emissions decreased by 64 % (Table 3.25). Portugal and the United Kingdom report emissions as 'Included elsewhere', the Netherlands, Luxembourg and Denmark report emissions as 'Not occuring' or 'Not estimated'. Substantial decreases between 1990 and 2005 were reported by France and Germany. The only Member State showing increase in this period is Greece (+25 %).

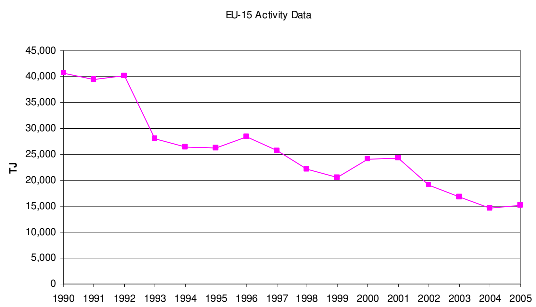
Table 3.25 1A2b Non ferrous Metals, solid fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

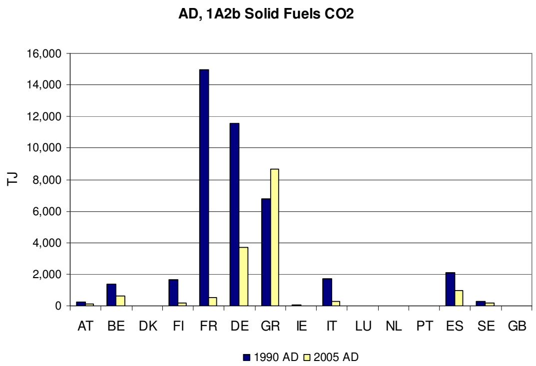
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	22	16	14	0.9%	-3	-18%	-8	-38%	T2	NS, PS	D
Belgium	146	80	67	4.5%	-13	-16%	-79	-54%	C	-	C, CS
Denmark	NO	NO	NO	-	-	-	-	-	-	-	-
Finland	155	24	20	1.3%	-4	-17%	-136	-87%	T3	PS	CS
France	1,548	108	48	3.2%	-60	-56%	-1,500	-97%	C	NS/ PS	CS
Germany	1,205	390	390	25.9%	0	0%	-815	-68%	CS	NS/AS	CS
Greece	653	698	819	54.4%	121	17%	166	25%	C	CS	D
Ireland	4	NO	NO	-	-	-	-4	-100%	-	-	-
Italy	163	28	31	2.1%	3	11%	-132	-81%	T2	NS	CS
Luxembourg	NE	NE	NE	-	-	-	-	-	-	-	-
Netherlands	0	NO	NO	-	-	-	-0.4	-100%	-	-	-
Portugal	IE	IE	IE	-	-	-	-	-	T2	NS	D,C
Spain	221	88	101	6.7%	13	15%	-119	-54%	T2	-	CS
Sweden	22	17	17	1.1%	0	1%	-5	-23%	T1, T2, T3	-	CS
United Kingdom	IE	IE	IE	-	-	-	-	-	T2	NS, AS	CS
EU-15	**4,140**	**1,449**	**1,506**	**100.0%**	**57**	**4%**	**-2,634**	**-64%**			

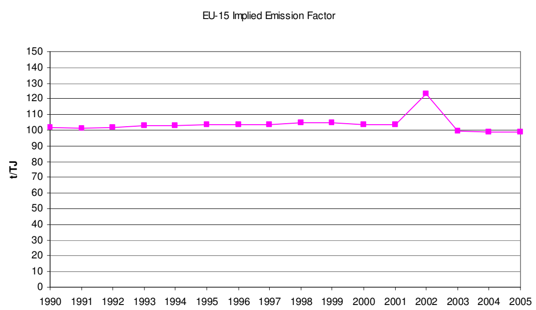
UK includes emissions under 1A2f.
Portugal includes emissions under 1A2f because the separation of AD between ferrous and non-ferrous industry not available
Abbreviations explained in the Chapter 'Units and abbreviations'.

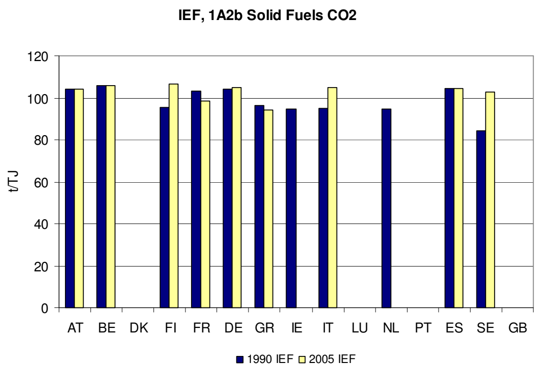
Figure 3.32 shows activity data and implied emission factors for CO_2 comparing the EU-15 average and the Member States. The largest emissions are reported by Germany, Greece and Spain; together they cause more than 87 % in 2005) of the CO_2 emissions from solid fuels in 1A2b, in 1990 also France was the largest emitter. Consumption of solid fuels in the EU-15 decreased by 64 % between 1990 and 2005. The implied emission factor of EU-15 was 98.7 t/TJ in 2005.

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 2005 CO_2 from gaseous fuels had a share of 44 % within source category 1A2b (compared to 21 % in 1990). Between 1990 and 2005 the emissions increased by +103 % (Table 3.26). Between 1990 and

2005 all Member States except Ireland reported increases. The highest increase ocurred in Spain (+1 539 %). Also between 2004 and 2005 emissions increased in all Member States except Belgium, the Netherlands, and Sweden.

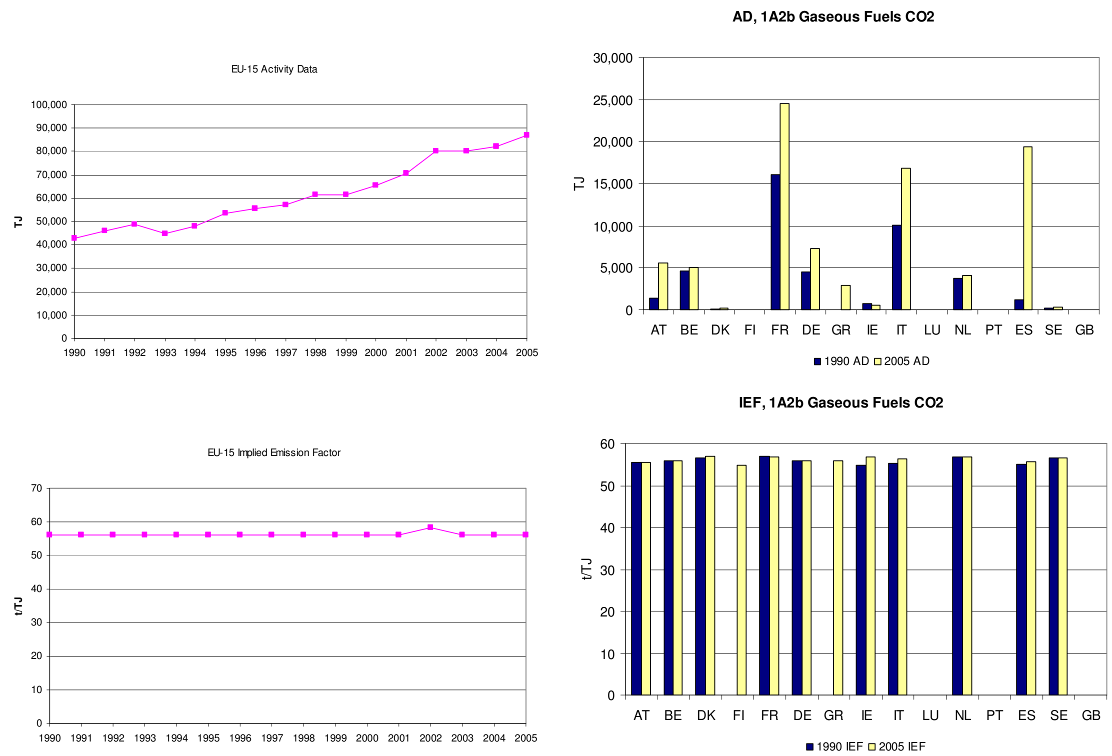
Table 3.26 1A2b Non ferrous Metals, gaseous fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	75	163	309	6.3%	146	90%	234	313%	T2	NS, PS	D
Belgium	260	344	284	5.8%	-60	-18%	24	9%	C	0	C, CS
Denmark	7	10	10	0.2%	0	2%	3	39%	C	NS	CS/C
Finland	NO	NO	1	-	-	-	-	-	T3	PS	CS
France	919	1,344	1,395	28.6%	51	4%	475	52%	C	NS/ AS/ PS	CS
Germany	253	411	411	8.4%	0	0%	157	62%	T2	NS/AS	CS
Greece	NO	129	164	3.4%	35	27%	164	-	C	CS	D
Ireland	40	33	32	0.6%	-1	-	-8	-21%	T1	-	C
Italy	558	934	951	19.5%	16	2%	393	70%	T2	NS	CS
Luxembourg	NE	NE	NE	-	-	-	-	-	-	-	-
Netherlands	213	234	230	4.7%	-4	-2%	16	8%	T2	NS/Q	CS
Portugal	NO	IE	IE	-	-	-	-	-	T2	PS,NS	D,C,PS
Spain	66	980	1,077	22.1%	97	10%	1,011	1539%	T2	0	CS
Sweden	10	21	17	0.4%	-4	-18%	7	64%	T1, T2, T3	0	CS
United Kingdom	IE	IE	IE	-	-	-	-	-	T2	NS, AS	CS
EU-15	**2,401**	**4,602**	**4,879**	**100.0%**	**276**	**6%**	**2,478**	**103%**			

UK includes emissions under 1A2f.
Portugal includes emissions under 1A2f because the separation of AD between ferrous and non-ferrous industry not available
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.33 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 and Spain; together they cause around 70 % of the CO_2 emissions in 2005 from gaseous fuels in 1A2b. Consumption of gaseous fuels in the EU-15 rose by 103 % between 1990 and 2005. The implied emission factor of EU-15 was 56.2 t/TJ in 2005.

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

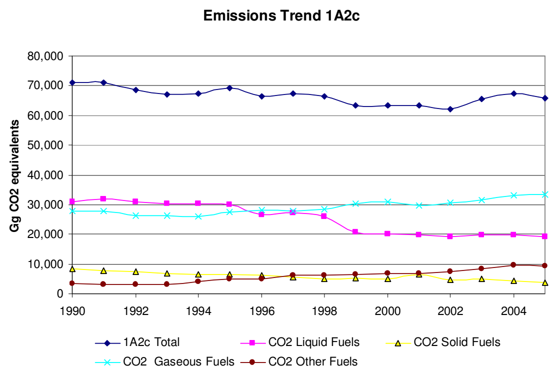


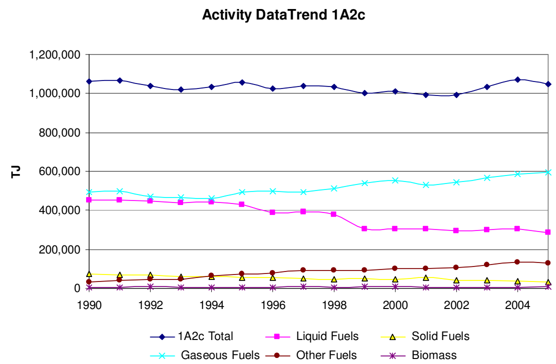
3.2.2.3. Chemicals (1A2c)

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 account for 11.7% of 1A2 category and 1.6 % of total GHG emissions in 2005.

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 7 %, mainly due to decreases in emissions from solid (-56 %) and liquid (-38 %) fuels. Increasing emissions were reported for gaseous fuels and other fuels.

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





Between 1990 and 2005, CO_2 emissions from 1A2c Chemicals decreased by 7 % in the EU-15 (Table 3.27), mainly due to decreases in Italy and the Netherlands; Spain reported a substantial increase of 71 % in this period. Between 2004 and 2005 emissions in all Member States decreased except Belgium, Finland and Greece.

Table 3.27 1A2c Chemicals: Member States' contributions to CO_2 emissions in 1990, 2004 and 2005

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005	
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	961	1,742	1,361	2.1%	-382	-22%	400	42%
Belgium	6,311	7,634	7,781	11.9%	147	2%	1,470	23%
Denmark	360	524	517	0.8%	-7	-1%	157	44%
Finland	1,343	1,350	1,456	2.2%	106	8%	113	8%
France	14,177	16,282	15,866	24.3%	-417	-3%	1,688	12%
Germany	IE,NO	IE,NO	IE,NO	-	-	-	-	-
Greece	1,391	1,083	1,155	1.8%	72	7%	-237	-17%
Ireland	411	434	412	0.6%	-22	-5%	1	0%
Italy	20,052	12,717	12,175	18.7%	-542	-4%	-7,876	-39%
Luxembourg	NE	NE	NE	-	-	-	-	-
Netherlands	17,176	11,771	11,738	18.0%	-33	0%	-5,438	-32%
Portugal	1,479	1,881	1,827	2.8%	-54	-3%	349	24%
Spain	5,458	9,647	9,355	14.3%	-292	-3%	3,898	71%
Sweden	1,183	1,696	1,588	2.4%	-108	-6%	405	34%
United Kingdom	IE	IE	IE	-	-	-	-	-
EU-15	**70,301**	**66,762**	**65,231**	**100.0%**	**-1,531**	**-2%**	**-5,070**	**-7%**

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

1A2c Chemicals - Liquid Fuels (CO_2)

In 2005, CO_2 from liquid fuels had a share of 29 % within source category 1A2c (compared to 43 % in 1990). Between 1990 and 2005 the emissions decreased by 38 % (Table 3.28). Eight of the EU-15

Member States reported decreasing CO_2 emissions from this source category; Italy shows the highest reduction in absolute terms. The Netherlands contributing most to EU-15 emissions in 2005, reports a minor decrease between 1990 and 2005.

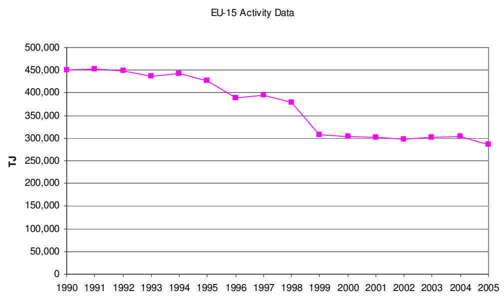
Table 3.28 1A2c Chemicals, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

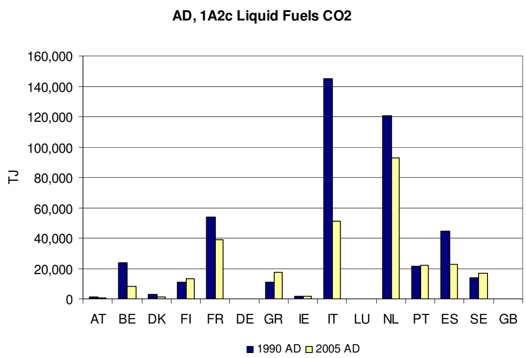
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	83	52	42	0.2%	-10	-19%	-41	-50%	T2	NS, PS	D
Belgium	1,835	841	602	3.2%	-238	-28%	-1,233	-67%	C	-	C, CS
Denmark	205	88	84	0.4%	-5	-5%	-122	-59%	C	NS	CS/C
Finland	824	903	943	5.0%	39	4%	119	14%	T3	PS	CS
France	4,063	2,955	2,840	14.9%	-115	-4%	-1,223	-30%	C	NS/ PS	CS
Germany	NO	NO	NO	-	-	-	-	-	-	-	-
Greece	584	810	810	4.3%	0	0%	226	39%	C	CS	D
Ireland	131	152	149	0.8%	-3	-2%	18	14%	T1	-	C
Italy	10,956	3,879	3,756	19.7%	-123	-3%	-7,200	-66%	T2	NS	CS
Luxembourg	NE	NE	NE	-	-	-	-	-	-	-	-
Netherlands	6,613	5,949	5,821	30.6%	-128	-2%	-792	-12%	T2	NS/Q	CS
Portugal	1,372	1,343	1,363	7.2%	20	1%	-9	-1%	T2	PS,NS	D,C
Spain	3,295	1,706	1,580	8.3%	-126	-7%	-1,716	-52%	T2	-	C, CS
Sweden	885	1,148	1,049	5.5%	-99	-9%	164	19%	T1, T2, T3	-	CS
United Kingdom	IE	IE	IE	-	-	-	-	-	T2	NS, AS	CS
EU-15	**30,846**	**19,826**	**19,038**	**100.0%**	**-788**	**-4%**	**-11,808**	**-38%**			

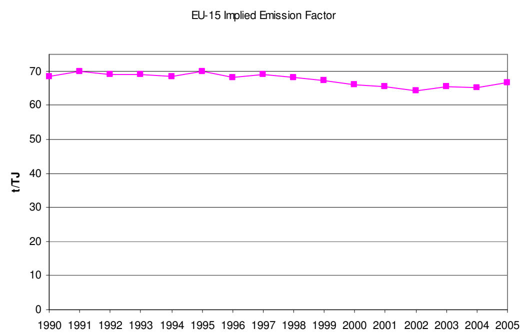
Emissions of the UK are included in 1A2f
Abbreviations explained in the Chapter 'Units and abbreviations'.

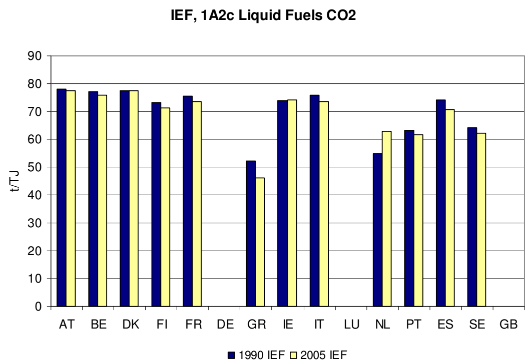
Figure 3.35 shows activity data and implied emission factors for CO_2 comparing the EU-15 average and the Member States. The largest emissions are reported by France, Italy, the Netherlands and Spain; together they cause around 74 % of the CO_2 emissions from liquid fuels in 1A2c. Fuel combustion in the EU-15 decreased by 37 % between 1990 and 2005. The implied emission factor of EU-15 was 66.6 t/TJ in 2005.

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









1A2c Chemicals - Solid Fuels (CO_2)

In 2005, solid fuels had a share of 6 % within source category 1A2c (compared to 12 % in 1990). Between 1990 and 2004 the emissions decreased by 56 % (Table 3.29). Between 1990 and 2005 France and the Netherlands reported significant decreases in absolute terms. Germany and the UK include emissions from this source category in source category 1A2f.

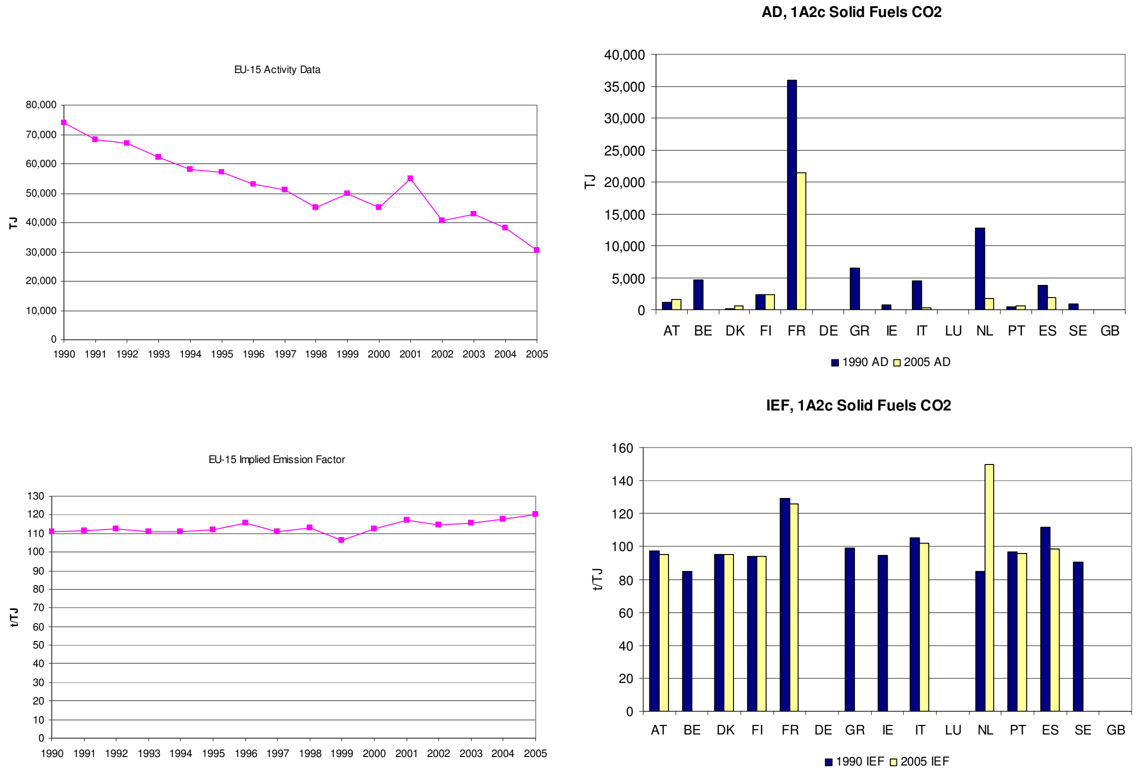
Table 3.29 1A2c Chemicals, solid fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	111	237	149	4.1%	-88	-37%	38	34%	T2	NS, PS	D
Belgium	397	5	NO	-	-5	-100%	-397	-100%	C	-	C, CS
Denmark	7	65	55	1.5%	-11	-16%	47	638%	C	NS	CS/C
Finland	214	213	223	6.1%	10	5%	9	4%	T3	PS	CS
France	4,643	2,805	2,695	74.0%	-110	-4%	-1,948	-42%	C	NS/ PS	CS
Germany	IE	IE	IE	-	-	-	-	-	-	-	-
Greece	648	NO	NO	-	-	-	-648	-100%	C	CS	D
Ireland	72	NO	NO	-	-	-	-72	-100%	T1	-	C
Italy	478	21	24	0.7%	3	14%	-453	-95%	T2	NS	CS
Luxembourg	NE	NE	NE	-	-	-	-	-	-	-	-
Netherlands	1,087	261	255	7.0%	-5	-2%	-832	-77%	T2	NS/Q	CS
Portugal	44	63	59	1.6%	-4	-6%	15	33%	T2	NS	D,C
Spain	424	792	183	5.0%	-610	-77%	-241	-57%	T2	-	C, CS
Sweden	79	NO	NO	-	-	-	-79	-100%	T1, T2, T3	-	CS
United Kingdom	IE	IE	IE	-	-	-	-	-	T2	NS, AS	CS
EU-15	**8,205**	**4,463**	**3,643**	**100.0%**	**-820**	**-18%**	**-4,562**	**-56%**			

Emissions of Germany and the UK 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, the Netherlands and Spain; together they cause almost 86 % of the CO_2 emissions from solid fuels in 1A2c. Fuel combustion in the EU-15 decreased by 59 % between 1990 and 2005. The implied emission factor of EU-15 was 119.9 t/TJ in 2005.

Figure 3.36 1A2c Chemicals, solid fuels: Activity Data and Implied Emission Factors for CO_2



1A2c Chemicals – Gaseous Fuels (CO_2)

In 2005, CO_2 from gaseous fuels had a share of 51 % within source category 1A2c (compared to 39 % in 1990). Between 1990 and 2005 the emissions increased by 20 % (Table 3.30). Between 1990 and 2005 all Member States except the Netherlands, Italy and Finland reported increases. The highest increase ocurred in Spain. The United Kingdom include emissions from this source category in source category 1A2f.

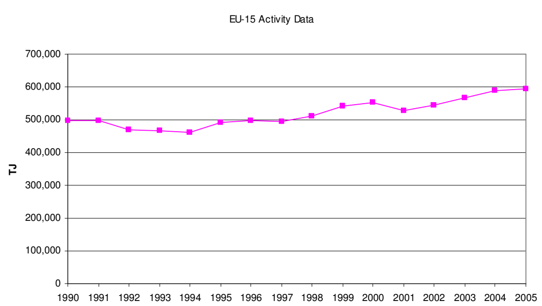
Table 3.30 1A2c Chemicals, gaseous fuels: Member States' contributions to CO_2 and information on method applied, activity data and emission factor

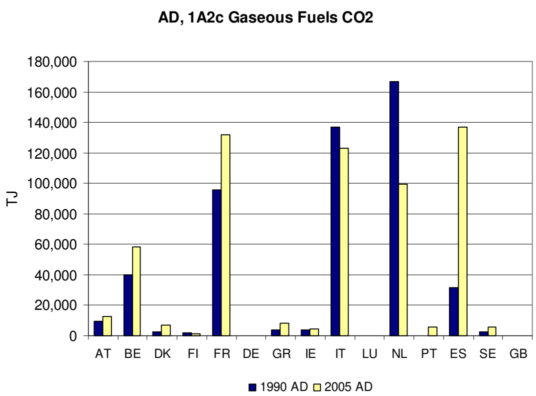
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	530	901	706	2.1%	-196	-22%	176	33%	T2	NS, PS	D
Belgium	2,246	2,930	3,246	9.7%	316	11%	1,000	45%	C	-	C, CS
Denmark	147	370	379	1.1%	9	2%	232	158%	C	NS	CS/C
Finland	103	36	62	0.2%	26	73%	-41	-40%	T3	PS	CS
France	5,471	7,548	7,507	22.5%	-41	-1%	2,035	37%	C	NS/ PS	CS
Germany	NO	NO	NO	-	-	-	-	-	-	-	-
Greece	159	272	344	1.0%	72	26%	185	116%	C	CS	D
Ireland	208	282	263	0.8%	-19	-7%	55	27%	T1	-	C
Italy	7,561	7,215	6,946	20.8%	-270	-4%	-616	-8%	T2	NS	CS
Luxembourg	NE	NE	NE	-	-	-	-	-	-	-	-
Netherlands	9,476	5,562	5,662	17.0%	100	2%	-3,814	-40%	T2	NS/Q	CS
Portugal	NO	388	320	1.0%	-68	-18%	320	-	T2	NS	D,C
Spain	1,739	7,149	7,593	22.8%	444	6%	5,854	337%	T2	-	CS
Sweden	154	298	323	1.0%	25	8%	169	110%	T1, T2, T3	-	CS
United Kingdom	IE	IE	IE	-	-	-	-	-	T2	NS, AS	CS
EU-15	**27,795**	**32,953**	**33,351**	**100.0%**	**399**	**1%**	**5,556**	**20%**			

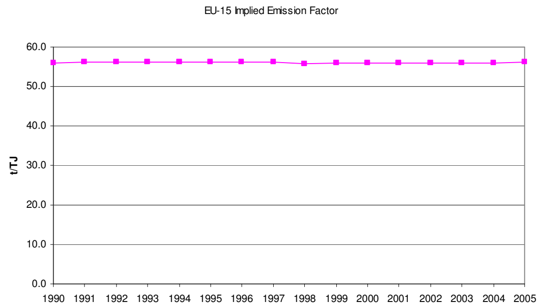
Emissions of the UK are inlcuded in 1A2f.
Abbreviations explained in the Chapter 'Units and abbreviations'.

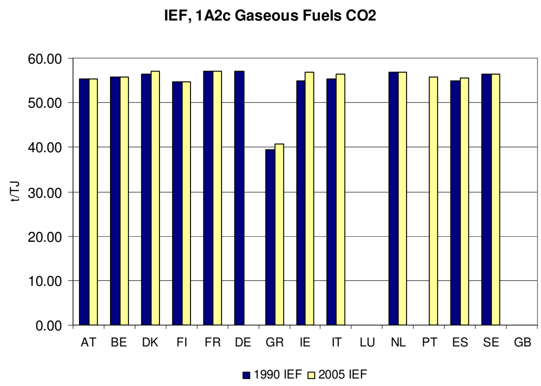
Figure 3.37 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by France, Italy, the Netherlands and Spain; together they cause more than 83 % of the CO_2 emissions from gaseous fuels in 1A2c. Gaseous fuel consumption in the EU-15 rose by 20 % between 1990 and 2005. The implied emission factor of EU-15 was 56.1 t/TJ in 2005.

Figure 3.37 1A2c Chemicals, gaseous fuels: Activity Data and Implied Emission Factors for CO_2









1A2c Chemicals - Other Fuels (CO_2)

In 2005, CO_2 from other fuels had a share of 14 % within source category 1A2c (compared to 5 % in 1990). Between 1990 and 2005 the emissions increased by 166 % (Table 3.31). Germany, Greece, Ireland, Denmark, Luxembourg, the Netherlands and Spain report emissions as 'Not occuring', 'Not applicable' or 'Not estimated', the UK includes emissions in 1A2f. Major absolute increases were reported by Belgium and France between 1990 and 2005.

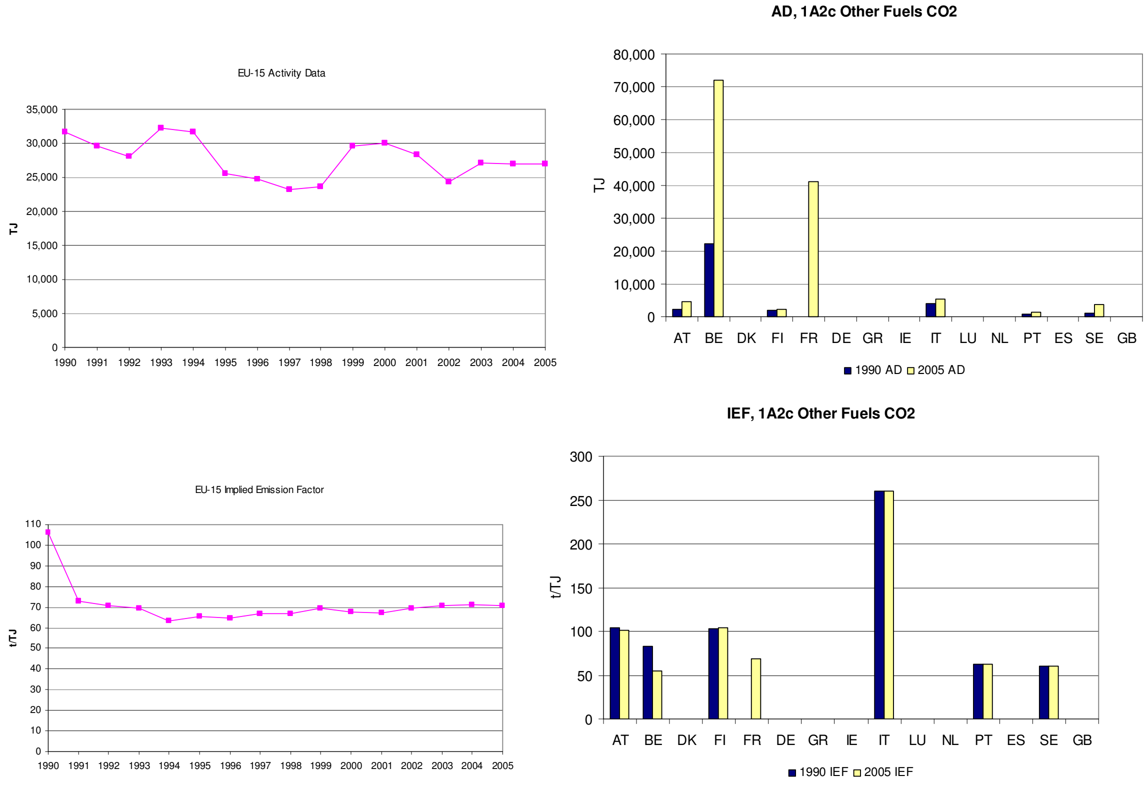
Table 3.31 1A2c Chemicals, other fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	236	552	464	5.0%	-88	-16%	227	96%	T2	NS, PS	D
Belgium	1,834	3,858	3,933	42.8%	75	2%	2,099	114%	C	-	C, CS
Denmark	NO	NO	NO	-	-	-	-	-	-	-	-
Finland	202	198	229	2.5%	31	15%	27	13%	T3	PS	CS
France	NO	2,975	2,824	30.7%	-151	-5%	2,824	-	C	NS/ PS	CS
Germany	NO	NO	NO	-	-	-	-	-	-	-	-
Greece	NO	NO	NO	-	-	-	-	-	-	-	-
Ireland	NO	NO	NO	-	-	-	-	-	-	-	-
Italy	1,057	1,602	1,449	15.8%	-153	-10%	392	37%	T2	NS	CS
Luxembourg	NE	NE	NE	-	-	-	-	-	-	-	-
Netherlands	NO	NO	NO	-	-	-	-	-	-	-	-
Portugal	63	87	85	0.9%	-1	-2%	23	36%	T2	PS,NS	D,C
Spain	NA	NA	NA	-	-	-	-	-	-	-	-
Sweden	64	250	215	2.3%	-34	-14%	151	236%	T1, T2, T3	-	CS
United Kingdom	IE	IE	IE	-	-	-	-	-	T2	NS, AS	CS
EU-15	**3,456**	**9,521**	**9,199**	**100.0%**	**-322**	**-3%**	**5,743**	**166%**			

Emissions of the UK are inlcuded 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 more than 90 % of the CO_2 emissions from other fuels in 1A2c. Other fuel consumption in the EU-15 was by 15 % lower in 2005 than 1990. The implied emission factor of EU-15 was 70.5 t/TJ in 2005.

Figure 3.38 1A2c Chemicals, other fuels: Activity Data and Implied Emission Factors for CO_2

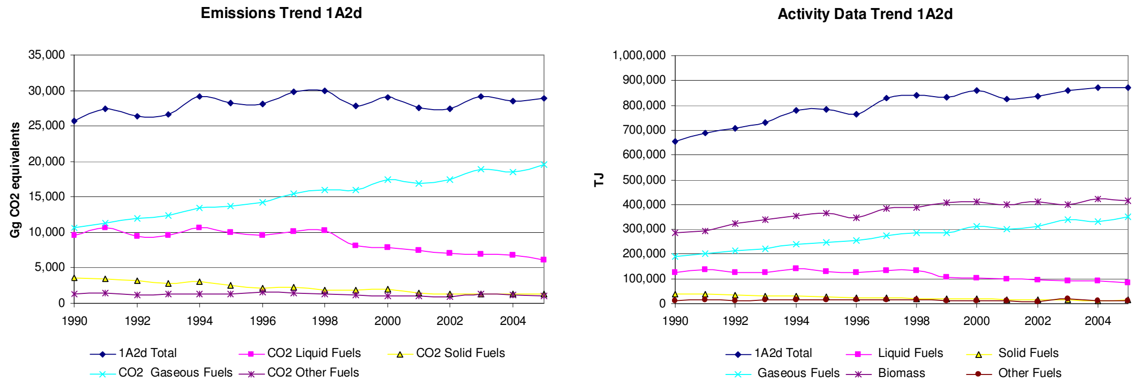


3.2.2.4. Pulp, Paper and Print (1A2d)

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 account for 5.1% of 1A2 source category and 0.7 % of total GHG emissions in 2005.

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 increased by 13 %. The share of gaseous fuels is gradualy increasing from 1990.

Figure 3.39 1A2d Pulp, Paper and Print: Total and CO_2 emission trends



Between 1990 and 2005, CO_2 emissions from 1A2d Pulp, Paper and Print increased by 13 % in the EU-15 (Table 3.32), mainly due to increases in Italy and Spain; Finland reported a relevant decrease in this period. Between 2004 and 2005 emissions increased by 2 %.

Table 3.32 1A2d Pulp, Paper and Print: Member States' contributions to CO_2 emissions in 1990, 2004 and 2005

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005	
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	2,268	1,978	2,283	8.1%	305	15%	15	1%
Belgium	637	607	605	2.1%	-2	0%	-32	-5%
Denmark	363	219	223	0.8%	3	1%	-140	-39%
Finland	5,326	3,936	3,509	12.4%	-427	-11%	-1,817	-34%
France	5,206	5,563	5,713	20.2%	149	3%	506	10%
Germany	4	15	16	0.1%	1	8%	12	338%
Greece	301	253	238	0.8%	-15	-6%	-63	-21%
Ireland	28	72	72	0.3%	-1	-1%	43	152%
Italy	3,076	4,615	4,636	16.4%	21	0%	1,560	51%
Luxembourg	NE	NE	NE	-	-	-	-	-
Netherlands	1,743	1,463	1,690	6.0%	228	16%	-53	-3%
Portugal	743	1,108	1,168	4.1%	60	5%	425	57%
Spain	3,212	5,611	5,998	21.2%	387	7%	2,786	87%
Sweden	2,186	2,399	2,124	7.5%	-276	-11%	-63	-3%
United Kingdom	IE	IE	IE	-	-	-	-	-
EU-15	**25,095**	**27,840**	**28,274**	**100.0%**	**434**	**2%**	**3,179**	**13%**

Emissions of the UK are inlcuded in 1A2f.
Abbreviations explained in the Chapter 'Units and abbreviations'.

1A2d Pulp, Paper and Print - Liquid (CO_2)

In 2005 CO_2 from liquid fuels had a share of 21 % within source category 1A2d (compared to 38 % in 1990). Between 1990 and 2005 the emissions decreased by 36 % (Table 3.33). Between 1990 and 2005 all Member States except Portugal and Sweden reported decreasing CO_2 emissions from this source category.

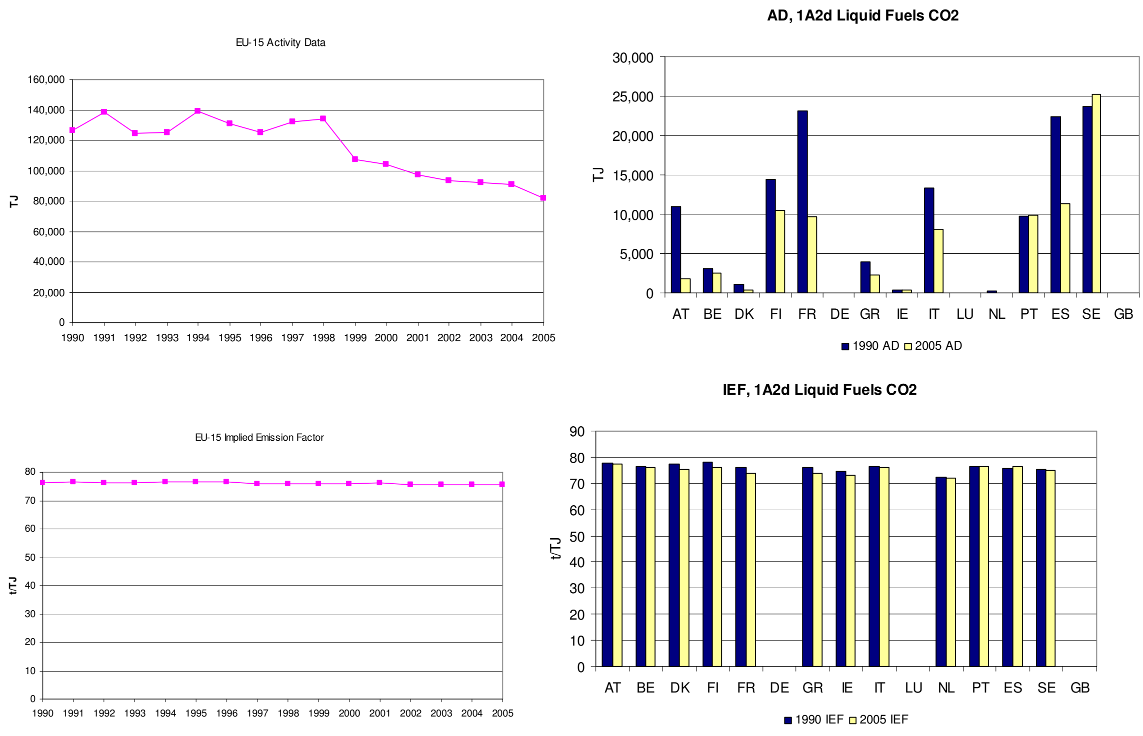
Table 3.33 1A2d Pulp, Paper and Print, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	852	130	137	2.2%	6	5%	-716	-84%	T2	NS, PS	D
Belgium	232	207	189	3.1%	-18	-9%	-43	-19%	C	-	C, CS
Denmark	86	24	23	0.4%	-1	-5%	-63	-73%	C	NS	CS/C
Finland	1,122	948	802	13.0%	-146	-15%	-319	-28%	T3	PS	CS
France	1,755	740	712	11.5%	-27	-4%	-1,043	-59%	C	NS/ PS	CS
Germany	NO	NO	NO	-	-	-	-	-	-	-	-
Greece	297	181	169	2.7%	-12	-6%	-128	-43%	C	CS	D
Ireland	28	23	23	0.4%	0	-1%	-5	-19%	T1	-	C
Italy	1,015	639	617	10.0%	-22	-3%	-398	-39%	T2	NS	CS
Luxembourg	NE	NE	NE	-	-	-	-	-	-	-	-
Netherlands	20	2	2	0.0%	0	-11%	-18	-89%	T2	NS/Q	CS
Portugal	743	774	751	12.1%	-23	-3%	8	1%	T2	PS,NS	D,C
Spain	1,693	969	865	14.0%	-103	-11%	-827	-49%	T2	-	C, PS
Sweden	1,786	2,189	1,896	30.6%	-293	-13%	109	6%	T1, T2, T3	-	CS
United Kingdom	IE	IE	IE	-	-	-	-	-	T2	NS, AS	CS
EU-15	**9,630**	**6,826**	**6,187**	**100.0%**	**-639**	**-9%**	**-3,444**	**-36%**			

Emissions of the UK are inlcuded 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 almost 70% of the CO_2 emissions from liquid fuels in 1A2d. Fuel consumption in the EU-15 decreased by 35 % between 1990 and 2005. The implied emission factor of EU-15 was 75.4 t/TJ in 2005.

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 2005 CO_2 from solid fuels had a share of 5 % within source category 1A2d (compared to 14 % in 1990). Between 1990 and 2005 the emissions decreased by 61 % (Table 3.34). Only seven of the EU-15 Member States reported CO_2 emissions from this source category. All reporting Member States show decreases except Austria and Belgium.

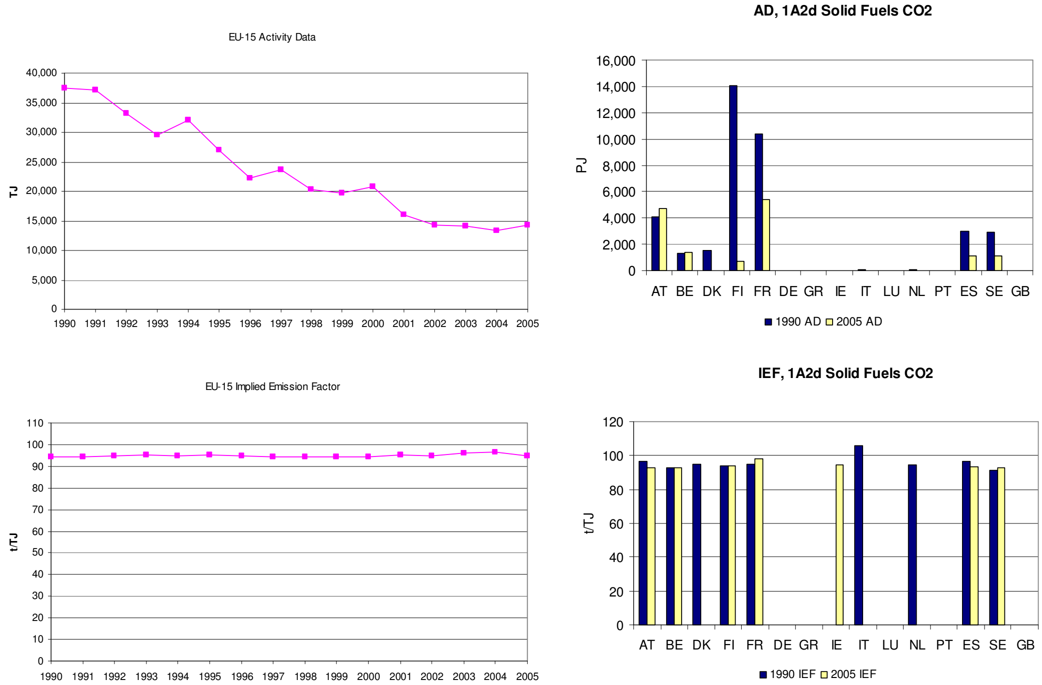
Table 3.34 1A2d Pulp, Paper and Print, solid fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	393	405	438	32.1%	33	8%	44	11%	T2	NS, PS	D
Belgium	125	121	131	9.6%	10	8%	6	5%	C	-	C, CS
Denmark	143	NO	NO	-	-	-	-143	-100%	C	NS	CS/C
Finland	1,318	62	62	4.6%	0	0%	-1,255	-95%	T3	PS	CS
France	990	508	528	38.8%	20	4%	-462	-47%	C	NS/ PS	CS
Germany	NO	NO	NO	-	-	-	-	-	-	-	-
Greece	NO	NO	NO	-	-	-	-	-	-	-	-
Ireland	NO	2	2	-	-	-	2	-	T1	-	C
Italy	6	NO	NO	-	-	-	-6	-100%	-	-	-
Luxembourg	NE	NE	NE	-	-	-	-	-	-	-	-
Netherlands	8	NO	NO	-	-	-	-8	-100%	T2	NS/Q	CS
Portugal	NO	NO	NO	-	-	-	-	-	T2	PS,NS	D,C
Spain	286	115	103	7.5%	-12	-10%	-184	-64%	T2	-	C, PS
Sweden	263	68	100	7.3%	32	48%	-163	-62%	T1, T2, T3	-	CS
United Kingdom	IE	IE	IE	-	-	-	-	-	T2	NS, AS	CS
EU-15	**3,532**	**1,280**	**1,363**	**100.0%**	**83**	**7%**	**-2,169**	**-61%**			

Emissions of the UK are inlcuded 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 and France; together they cause around 71 % of the CO_2 emissions from solid fuels in 1A2d. Solid fuel consumption in the EU-15 decreased by 62 % between 1990 and 2005. The implied emission factor of EU-15 was 94.9 t/TJ in 2005.

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 2005, CO_2 from gaseous fuels had a share of 68 % within source category 1A2d (compared to 42 % in 1990). Between 1990 and 2005 the emissions increased by 84 % (Table 3.35). In all EU-15 Member States emissions increased between 1990 and 2005 except in the Finland and Netherlands. Germany reports emissions as 'Not occuring', the United Kingdom includes emissions in 1A2f.

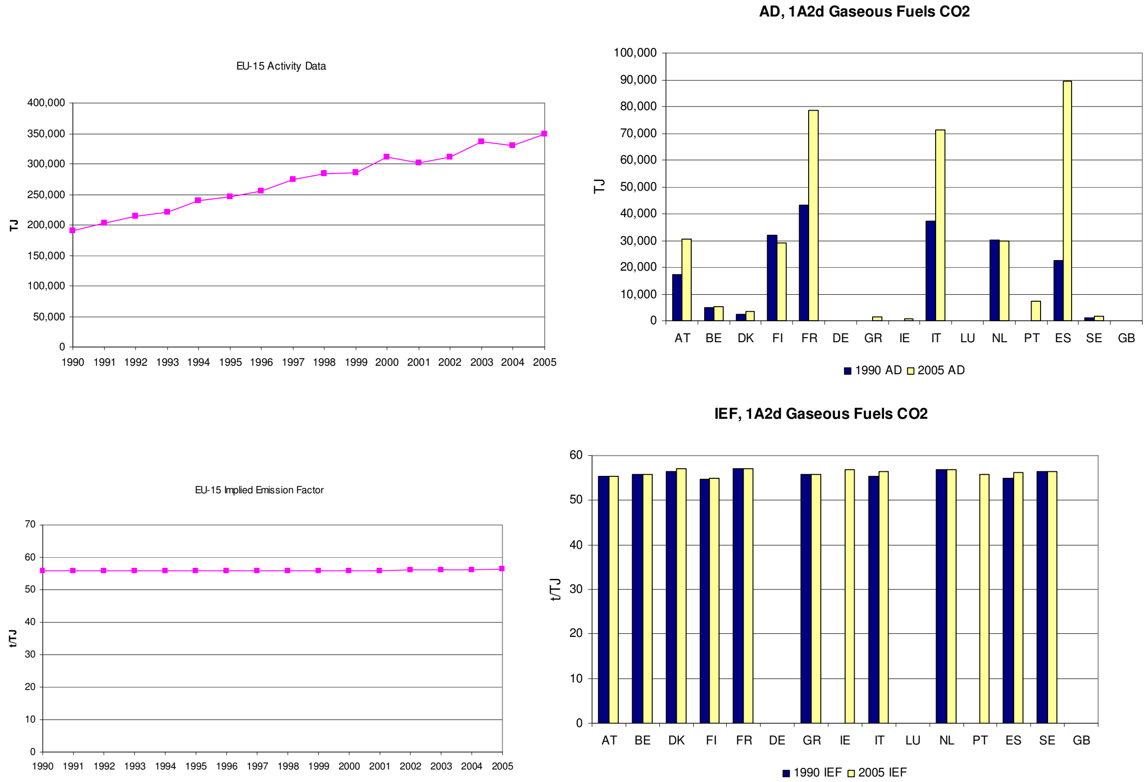
Table 3.35 1A2d Pulp, Paper and Print, gaseous fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	954	1,422	1,694	8.6%	272	19%	741	78%	T2	NS, PS	D
Belgium	280	279	285	1.5%	7	2%	5	2%	C	-	C, CS
Denmark	134	195	200	1.0%	5	2%	65	49%	C	NS	CS/C
Finland	1,748	1,816	1,604	8.2%	-213	-12%	-144	-8%	T3	PS	CS
France	2,461	4,314	4,471	22.8%	157	4%	2,010	82%	C	NS/ PS	CS
Germany	NO	NO	NO	-	-	-	-	-	T2	NS/AS	CS
Greece	5	73	69	0.4%	-3	-4%	65	1356%	C	CS	D
Ireland	NO	47	47	0.2%	-1	-	47	-	T1	-	C
Italy	2,055	3,976	4,019	20.5%	43	1%	1,964	96%	T2	NS	CS
Luxembourg	NE	NE	NE	-	-	-	-	-	-	-	-
Netherlands	1,715	1,460	1,688	8.6%	228	16%	-27	-2%	T2	NS/Q	CS
Portugal	NO	334	417	2.1%	83	25%	417	-	T2	PS,NS	D,C
Spain	1,233	4,527	5,030	25.6%	502	11%	3,797	308%	T2	-	CS
Sweden	66	89	92	0.5%	2	3%	26	39%	T1, T2, T3	-	CS
United Kingdom	IE	IE	IE	-	-	-	-	-	T2	NS, AS	CS
EU-15	**10,651**	**18,533**	**19,616**	**100.0%**	**1,083**	**6%**	**8,965**	**84%**			

Emissions of the UK are inlcuded 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 France, Italy and Spain; together they cause around 69 % of the CO_2 emissions from gaseous fuels in 1A2d. Fuel consumption in the EU-15 rose by 83 % between 1990 and 2005. The implied emission factor of EU-15 was 56.3 t/TJ in 2005.

Figure 3.42 1A2d Pulp, Paper and Print, gaseous fuels: Activity Data and Implied Emission Factors for CO_2

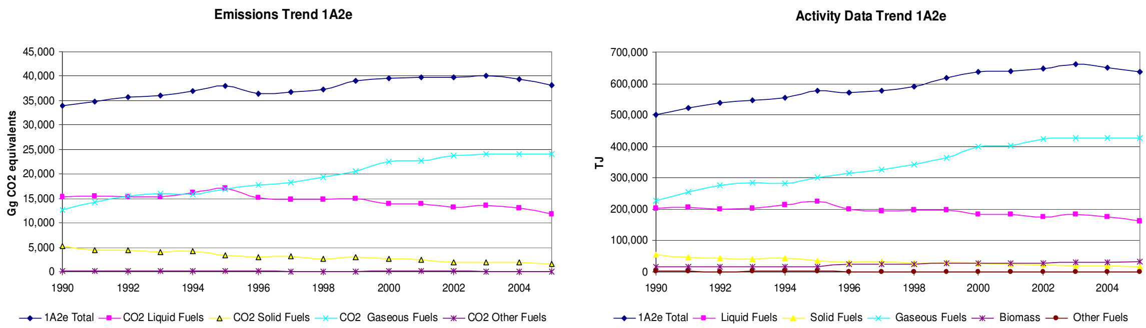


3.2.2.5. Food Processing, Beverages and Tobacco (1A2e)

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 account for 6.8% of 1A2 source category and for 0.9 % of total GHG emissions in 2005.

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 increased by 13 %, mainly due to increases in emissions from gaseous fuels (+90 %), 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 2005, CO_2 emissions from 1A2e Food Processing, Beverages and Tobacco increased by 13 % in the EU-15 (Table 3.36), mainly due to increases in France, Italy and Spain. Between 2004 and 2005 emissions decreased by 3 %.

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 2005	Change 2004-2005		Change 1990-2005	
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	870	987	768	2.0%	-219	-22%	-102	-12%
Belgium	2,998	2,289	2,190	5.8%	-98	-4%	-808	-27%
Denmark	1,534	1,263	1,218	3.2%	-45	-4%	-316	-21%
Finland	815	244	218	0.6%	-26	-11%	-597	-73%
France	10,156	12,344	12,334	32.8%	-10	0%	2,178	21%
Germany	1,989	1,032	1,032	2.7%	0	0%	-957	-48%
Greece	902	878	801	2.1%	-77	-9%	-101	-11%
Ireland	1,018	979	985	2.6%	6	1%	-33	-3%
Italy	3,853	6,898	6,550	17.4%	-348	-5%	2,696	70%
Luxembourg	NE	NE	NE	-	-	-	-	-
Netherlands	4,079	4,019	3,918	10.4%	-101	-3%	-162	-4%
Portugal	822	943	776	2.1%	-167	-18%	-45	-5%
Spain	3,376	6,215	6,255	16.6%	40	1%	2,880	85%
Sweden	949	770	612	1.6%	-159	-21%	-337	-36%
United Kingdom	IE	IE	IE	-	-	-	-	-
EU-15	**33,361**	**38,861**	**37,657**	**100.0%**	**-1,204**	**-3%**	**4,296**	**13%**

Emissions of the UK are inlcuded in 1A2f.
Abbreviations explained in the Chapter 'Units and abbreviations'.

1A2e Food Processing, Beverages and Tobacco - Liquid (CO_2)

In 2005 CO_2 from liquid fuels decreased to 31 % within source category 1A2e (compared to 45 % in 1990). Between 1990 and 2005 the emissions decreased by 23 % (Table 3.37). Between 1990 and 2005 all Parties show emission reductions except Italy.

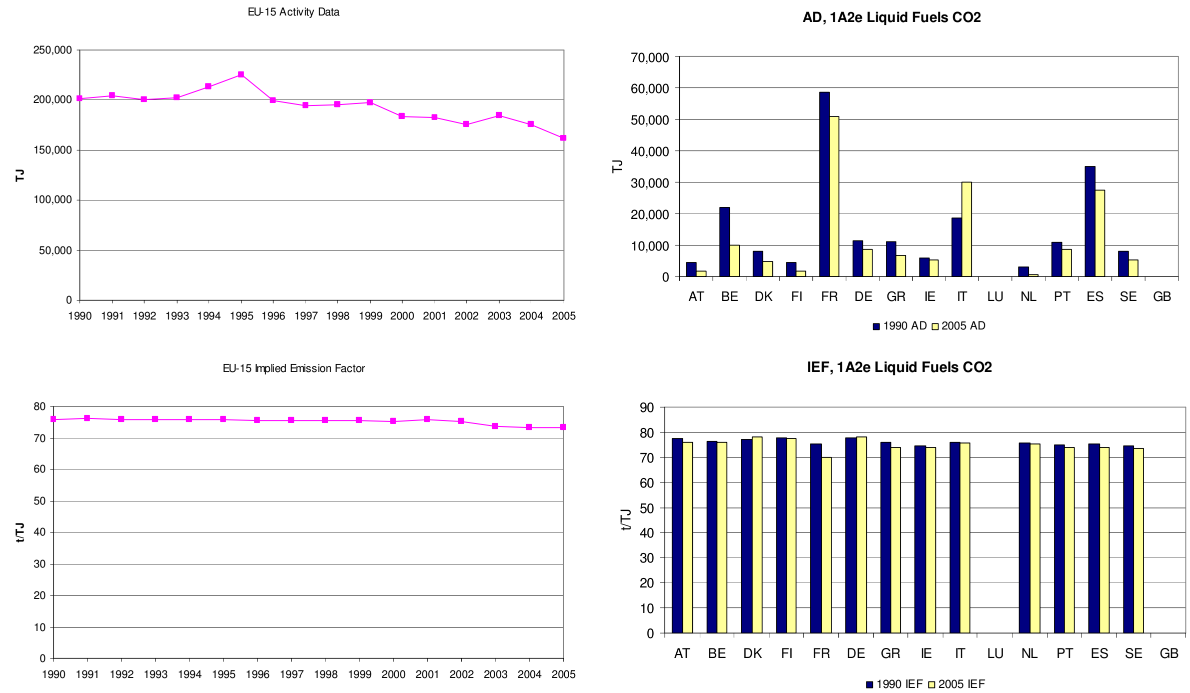
Table 3.37 1A2e Food Processing, Beverages and Tobacco, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	345	162	128	1.1%	-34	-21%	-217	-63%	T2	NS, PS	D
Belgium	1,671	838	762	6.4%	-76	-9%	-909	-54%	C	-	C, CS
Denmark	613	393	372	3.1%	-21	-5%	-241	-39%	C	NS	CS/C
Finland	353	145	127	1.1%	-17	-12%	-225	-64%	T3	PS	CS
France	4,427	3,734	3,541	29.9%	-193	-5%	-887	-20%	C	NS/ PS	CS
Germany	889	666	666	5.6%	0	0%	-223	-25%	CS	NS/AS	CS
Greece	847	670	490	4.1%	-179	-27%	-357	-42%	C	CS	D
Ireland	433	393	385	3.3%	-7	-2%	-48	-11%	T1	-	C
Italy	1,421	2,378	2,262	19.1%	-116	-5%	841	59%	T2	NS	CS
Luxembourg	NE	NE	NE	-	-	-	-	-	-	-	-
Netherlands	235	26	50	0.4%	24	91%	-185	-79%	T2	NS/Q	CS
Portugal	820	695	636	5.4%	-59	-9%	-184	-22%	T2	NS	D,C
Spain	2,636	2,303	2,031	17.1%	-272	-12%	-605	-23%	T2	-	C
Sweden	597	526	396	3.3%	-130	-25%	-201	-34%	T1, T2, T3	-	CS
United Kingdom	IE	IE	IE	-	-	-	-	-	T2	NS, AS	CS
EU-15	**15,288**	**12,929**	**11,847**	**100.0%**	**-1,082**	**-8%**	**-3,441**	**-23%**			

Emissions of the UK are inlcuded in 1A2f.
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 66 % of the CO_2 emissions from liquid fuels in 1A2e. Fuel consumption in the EU-15 decreased by 20 % between 1990 and 2005. The implied emission factor of EU-15 was 73.5 t/TJ in 2005.

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 2005 solid fuels had a share of 4 % within source category 1A2e (compared to 15 % in 1990). Between 1990 and 2005 the emissions decreased by 69 % (Table 3.38) and all Member States reported decreasing CO_2 emissions from this source category.

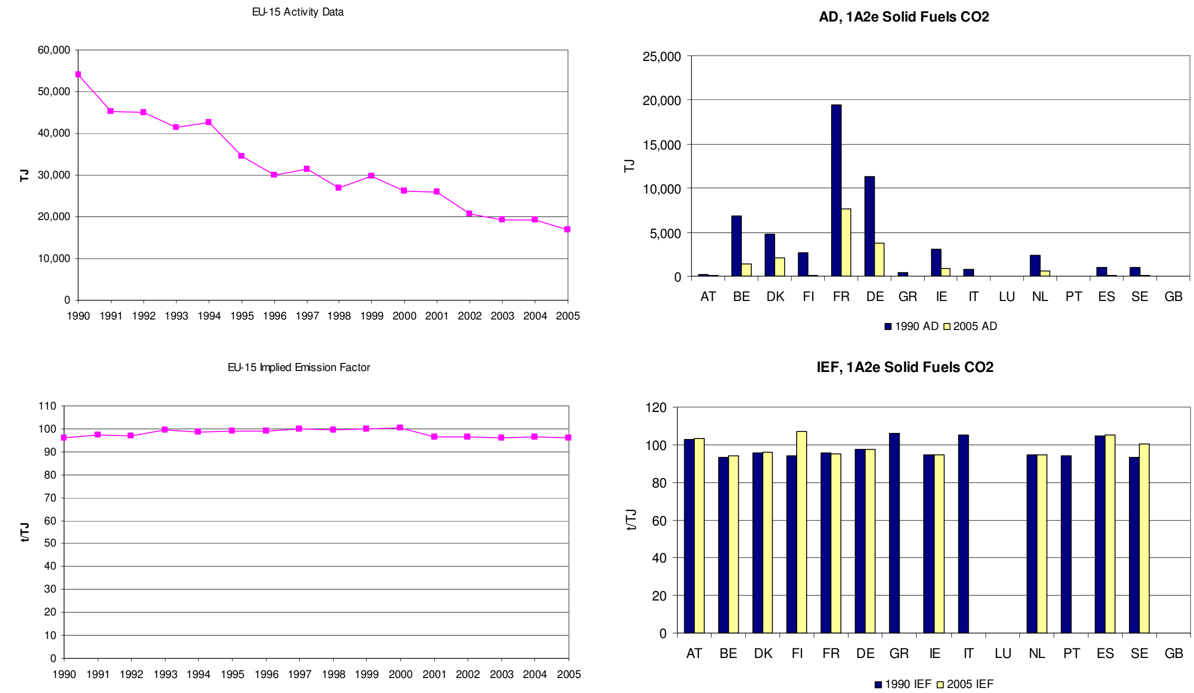
Table 3.38 1A2e Food Processing, Beverages and Tobacco, solid fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	18	26	13	0.8%	-12	-47%	-5	-26%	T2	NS, PS	D
Belgium	638	156	132	8.2%	-24	-15%	-506	-79%	C	-	C, CS
Denmark	455	238	199	12.4%	-39	-16%	-255	-56%	C	NS	CS/C
Finland	257	7	7	0.4%	0	-2%	-250	-97%	T3	PS	CS
France	1,868	836	730	45.3%	-106	-13%	-1,137	-61%	C	NS/ PS	CS
Germany	1,100	367	367	22.8%	0	0%	-734	-67%	CS	NS/AS	CS
Greece	47	NO	NO	-	-	-	-47	-100%	C	CS	D
Ireland	292	70	87	5.4%	18	-	-204	-70%	T1	-	C
Italy	86	NO	NO	-	-	-	-86	-100%	T2	NS	CS
Luxembourg	NE	NE	NE	-	-	-	-	-	NA	0	NA
Netherlands	227	49	55	3.4%	6	11%	-172	-76%	T2	NS/Q	CS
Portugal	1	NO	NO	-	-	-	-1	-100%	-	-	-
Spain	109	104	8	0.5%	-96	-92%	-101	-92%	T2	-	C
Sweden	90	11	11	0.7%	0	-4%	-79	-88%	T1, T2, T3	-	CS
United Kingdom	IE	IE	IE	-	-	-	-	-	T2	NS, AS	CS
EU-15	**5,186**	**1,864**	**1,610**	**100.0%**	**-254**	**-14%**	**-3,576**	**-69%**			

Emissions of the UK are inlcuded in 1A2f.
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 and Germany; together they cause around 68 % of the CO_2 emissions from solid fuels in 1A2e. Fuel consumption in the EU-15 decreased by 69 % between 1990 and 2005. The implied emission factor of EU-15 was 95.8 t/TJ in 2005.

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 2005 CO_2 from gaseous fuels had a share of 63 % within source category 1A2e (compared to 38 % in 1990). Between 1990 and 2005 the emissions increased by 90 % (Table 3.39). Between 1990 and 2005 all Member States except Finland and Sweden reported increasing CO_2 emissions from this source category. Major absolute increases ocurred in Spain, Italy and France.

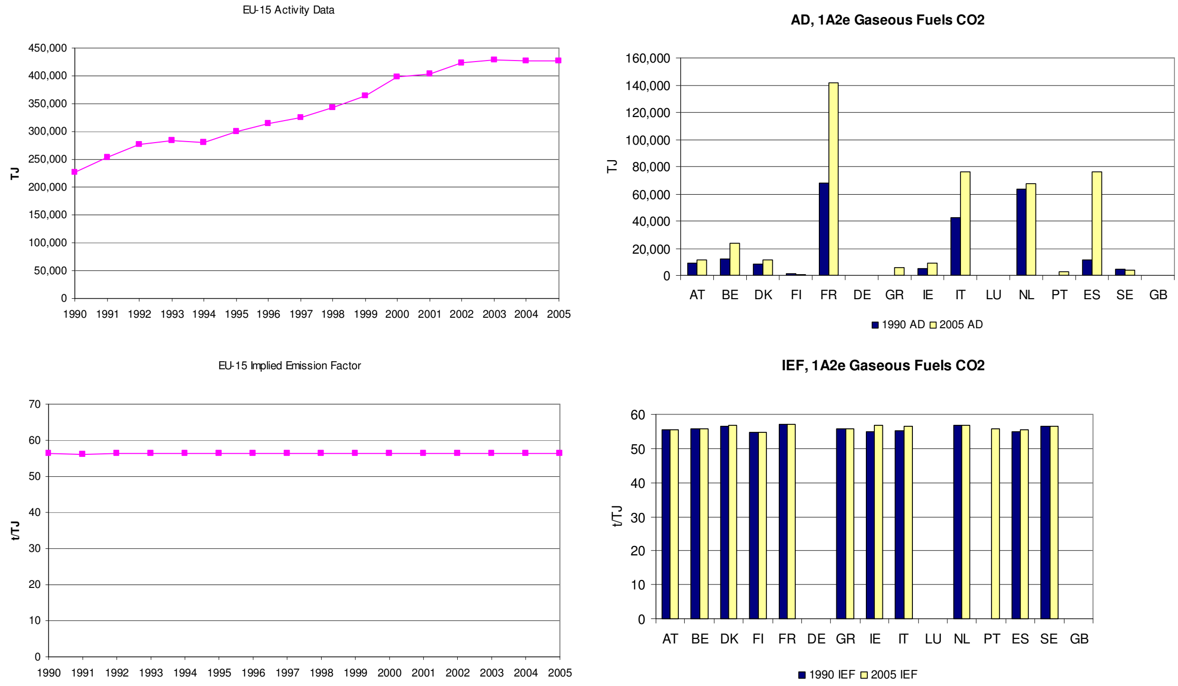
Table 3.39 1A2e Food Processing, Beverages and Tobacco, gaseous fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	507	799	626	2.6%	-173	-22%	120	24%	T2	NS, PS	D
Belgium	681	1,294	1,296	5.4%	1	0%	615	90%	C	-	C, CS
Denmark	466	631	646	2.7%	15	2%	180	39%	C	NS	CS/C
Finland	67	35	32	0.1%	-3	-10%	-35	-52%	T3	PS	CS
France	3,861	7,773	8,057	33.4%	284	4%	4,196	109%	C	NS/ PS	CS
Germany	NO	NO	NO	-	-	-	-	-	-	-	-
Greece	9	208	311	1.3%	103	49%	302	3359%	C	CS	D
Ireland	294	516	512	2.1%	-4	-1%	219	74%	T1	-	C
Italy	2,346	4,520	4,288	17.8%	-232	-5%	1,941	83%	T2	NS	CS
Luxembourg	NE	NE	NE	-	-	-	-	-	-	-	-
Netherlands	3,617	3,943	3,812	15.8%	-131	-3%	195	5%	T2	NS/Q	CS
Portugal	NO	248	140	0.6%	-108	-43%	140	-	T2	NS	D,C
Spain	631	3,808	4,216	17.5%	408	11%	3,585	568%	T2	-	CS
Sweden	253	226	198	0.8%	-28	-12%	-56	-22%	T1, T2, T3	-	CS
United Kingdom	IE	IE	IE	-	-	-	-	-	T2	NS, AS	CS
EU-15	**12,731**	**24,003**	**24,134**	**100.0%**	**131**	**1%**	**11,403**	**90%**			

Emissions of the UK are inlcuded 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 Spain; together they cause about 89 % of the CO_2 emissions from gaseous fuels in 1A2e. Fuel consumption in the EU-15 rose by 89 % between 1990 and 2005. The implied emission factor of EU-15 was 56.5 t/TJ in 2005.

Figure 3.46 1A2e Food Processing, Beverages and Tobacco, gaseous fuels: Activity Data and Implied Emission Factors for CO_2

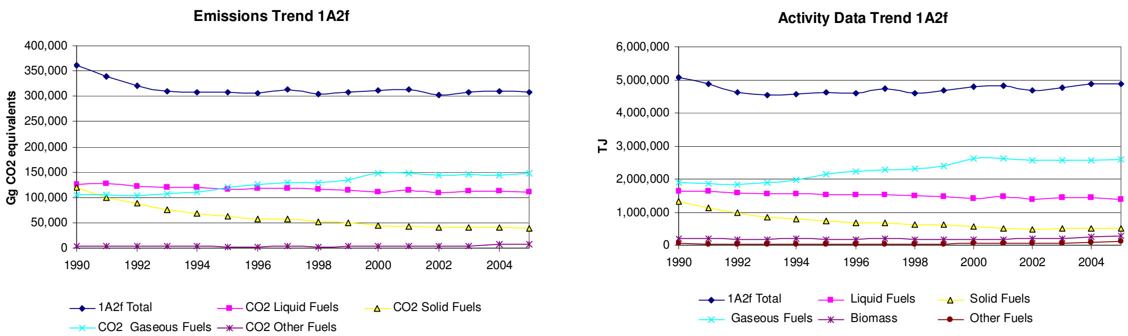


3.2.2.6. Other (1A2f)

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 account for 54% for 1A2 source category and for 7.2 % of total GHG emissions in 2005.

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 15 %, mainly due to decreases in emissions from solid (-68 %) and liquid (-13 %) fuels.

Figure 3.47 1A2f Other: Total and CO_2 emission trends



Between 1990 and 2005, CO_2 emissions from 1A2f Other decreased by 15 % in the EU-15 (Table 3.40), mainly due to decreases in Germany (-39 %). Spanish emissions increased by 60 % in the same period.

Table 3.40 1A2f Other: Member States' contributions to CO_2 emissions in 1990, 2004 and 2005

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005	
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	4,407	4,339	4,327	1.4%	-12	0%	-80	-2%
Belgium	8,069	7,101	7,158	2.4%	57	1%	-911	-11%
Denmark	2,709	3,253	3,075	1.0%	-178	-5%	366	14%
Finland	2,902	2,537	2,500	0.8%	-38	-1%	-403	-14%
France	31,720	27,500	27,793	9.2%	292	1%	-3,927	-12%
Germany	138,312	84,901	84,252	27.8%	-649	-1%	-54,060	-39%
Greece	6,126	5,293	4,379	1.4%	-915	-17%	-1,748	-29%
Ireland	1,527	2,529	2,615	0.9%	86	3%	1,088	71%
Italy	40,489	43,749	41,809	13.8%	-1,940	-4%	1,321	3%
Luxembourg	2,018	2,236	2,043	0.7%	-193	-9%	25	1%
Netherlands	5,820	4,962	5,067	1.7%	105	2%	-752	-13%
Portugal	5,491	6,752	6,563	2.2%	-189	-3%	1,072	20%
Spain	24,399	38,206	39,001	12.9%	795	2%	14,602	60%
Sweden	5,427	5,174	4,805	1.6%	-369	-7%	-621	-11%
United Kingdom	75,452	66,186	67,227	22.2%	1,041	2%	-8,226	-11%
EU-15	**354,867**	**304,718**	**302,613**	**100.0%**	**-2,105**	**-1%**	**-52,254**	**-15%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A2f Other - Liquid (CO_2)

In 2005 liquid fuels had a share of 36 % within source category 1A2f (compared to 35 % in 1990). Between 1990 and 2005 the emissions decreased by 13 % (Table 3.41). Between 1990 and 2005 the highest absolute decrease achieved Germany, the United Kingdom and France. The highest increase is reported by Spain (+41 %).

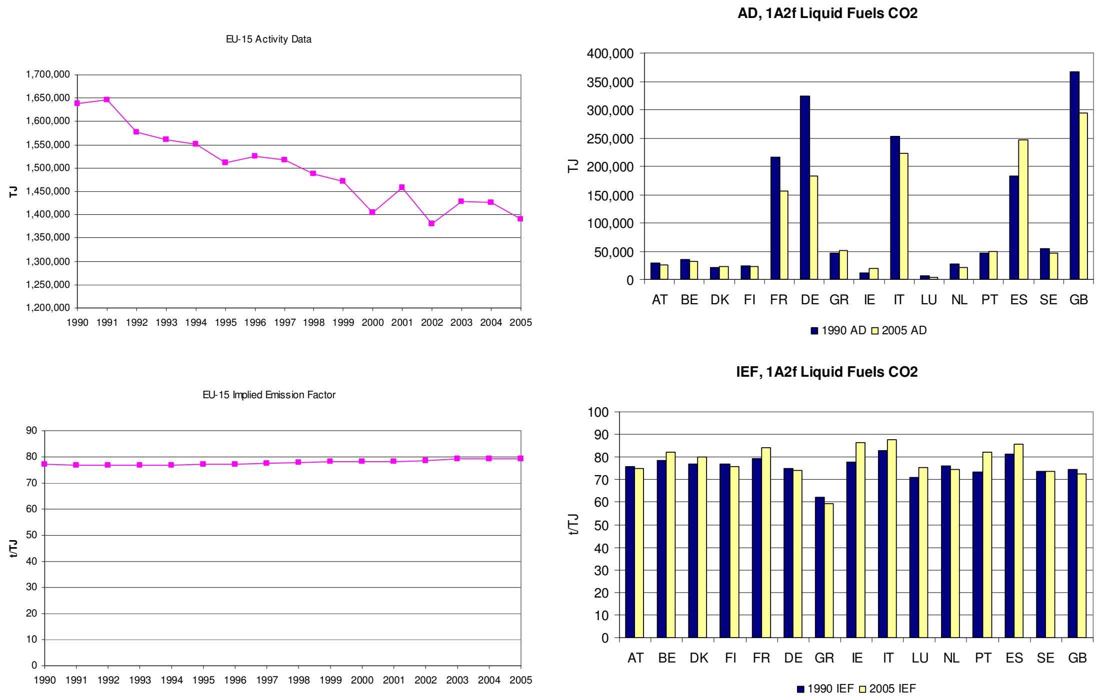
Table 3.41 1A2f Other, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	2,139	2,059	1,899	1.7%	-159	-8%	-239	-11%	T2	NS, PS	D
Belgium	2,698	2,639	2,644	2.4%	5	0%	-54	-2%	C	-	C, CS
Denmark	1,532	1,851	1,750	1.6%	-101	-5%	218	14%	C	NS	CS/C
Finland	1,808	1,713	1,681	1.5%	-32	-2%	-127	-7%	T3	PS	CS
France	17,045	13,176	13,037	11.8%	-139	-1%	-4,008	-24%	C	NS/ PS	CS
Germany	24,307	15,195	13,581	12.3%	-1,614	-11%	-10,726	-44%	CS/T2	NS/AS	CS
Greece	2,828	3,443	3,008	2.7%	-435	-13%	180	6%	C	CS	D
Ireland	850	1,661	1,698	1.5%	37	2%	848	100%	T1	-	C
Italy	20,965	21,352	19,513	17.7%	-1,839	-9%	-1,452	-7%	T2	NS	CS
Luxembourg	423	329	261	0.2%	-67	-20%	-161	-38%	-	-	-
Netherlands	2,101	1,292	1,493	1.4%	200	16%	-608	-29%	T2	-	CS
Portugal	3,368	4,118	3,982	3.6%	-136	-3%	614	18%	T2	NS	D,C
Spain	14,856	21,244	20,988	19.0%	-256	-1%	6,132	41%	-	-	-
Sweden	4,019	3,788	3,424	3.1%	-364	-10%	-595	-15%	T1, T2, T3	-	CS
United Kingdom	27,305	19,413	21,297	19.3%	1,884	10%	-6,008	-22%	T2	NS, AS	CS
EU-15	**126,244**	**113,271**	**110,256**	**100.0%**	**-3,015**	**-3%**	**-15,988**	**-13%**			

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 80 % of the CO_2 emissions from liquid fuels in 1A2f. Fuel consumption in the EU-15 decreased by 15 % between 1990 and 2005. The implied emission factor of EU-15 was 79.3 t/TJ in 2005.

Figure 3.48 1A2f Other, liquid fuels: Activity Data and Implied Emission Factors for CO_2



1A2f Other - Solid (CO_2)

In 2005 CO_2 from solid fuels had a share of 12 % within source category 1A2f (compared to 33 % in 1990). Between 1990 and 2005 the emissions decreased by 68 % (Table 3.42). Between 1990 and 2005 all Member States except Ireland reported significantly decreased emissions. Between 2004 and 2005 EU-15 emissions declined by 4 % .

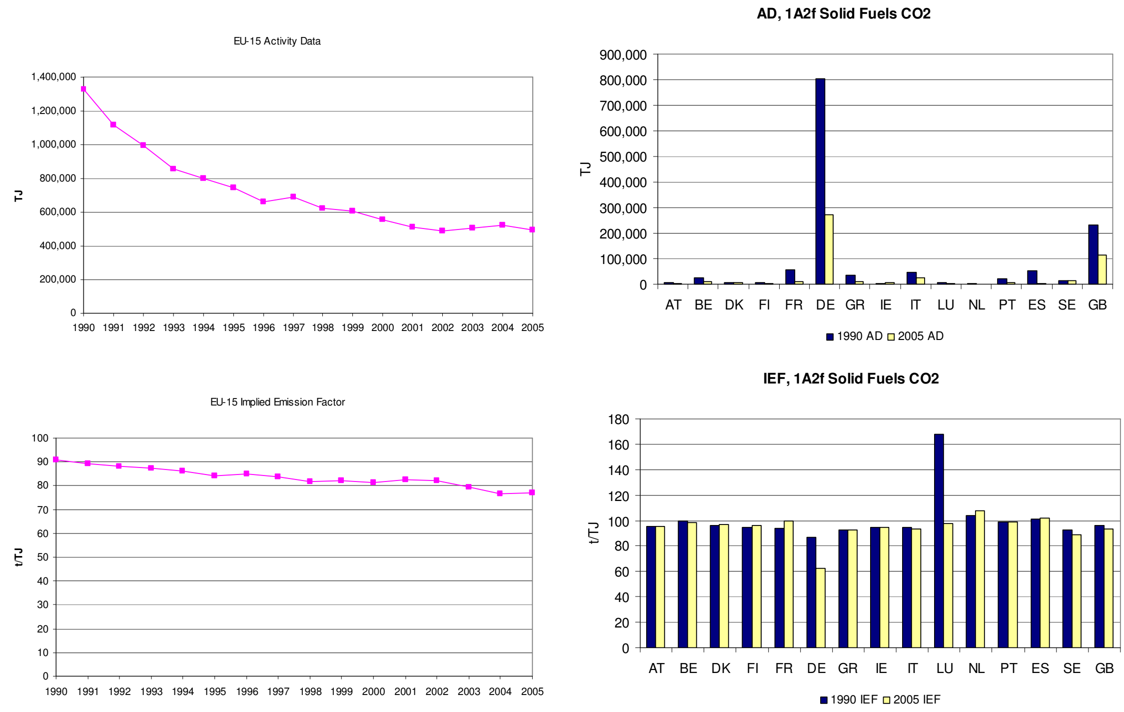
Table 3.42 1A2f Other, solid fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	625	272	374	1.0%	101	37%	-252	-40%	T2	NS, PS	D
Belgium	2,600	1,039	1,120	2.9%	82	8%	-1,480	-57%	C	-	C, CS
Denmark	822	671	562	1.5%	-109	-16%	-260	-32%	C	NS	CS/C
Finland	815	493	488	1.3%	-4	-1%	-326	-40%	T3	PS	CS
France	5,369	1,246	1,199	3.1%	-46	-4%	-4,170	-78%	C	NS/ PS	CS
Germany	69,322	17,445	17,015	44.5%	-430	-2%	-52,307	-75%	CS/T2	NS/AS	CS
Greece	3,295	1,589	1,094	2.9%	-495	-31%	-2,200	-67%	C	CS	D
Ireland	389	528	582	1.5%	54	10%	193	50%	T1	-	C
Italy	4,233	2,326	2,416	6.3%	90	4%	-1,817	-43%	T2	NS	CS
Luxembourg	1,285	334	290	0.8%	-43	-13%	-995	-77%	-	-	-
Netherlands	388	179	172	0.4%	-7	-4%	-216	-56%	T2	-	CS
Portugal	2,103	539	539	1.4%	0	0%	-1,565	-74%	T2	NS	D,C
Spain	5,497	671	514	1.3%	-157	-23%	-4,982	-91%	-	-	-
Sweden	1,229	1,163	1,219	3.2%	56	5%	-11	-1%	T1, T2, T3	-	CS
United Kingdom	22,312	11,318	10,663	27.9%	-656	-6%	-11,650	-52%	T2	NS, AS	CS
EU-15	**120,284**	**39,812**	**38,248**	**100.0%**	**-1,564**	**-4%**	**-82,036**	**-68%**			

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 reported by Germany and the United Kingdom; together they cause about 72 % of the CO_2 emissions from solid fuels in 1A2f. Fuel consumption in the EU-15 decreased by 63 % between 1990 and 2005. The implied emission factor of EU-15 was 77.0 t/TJ in 2005.

Figure 3.49 1A2f Other, solid fuels: Activity Data and Implied Emission Factors for CO_2



1A2f Other - Gaseous (CO_2)

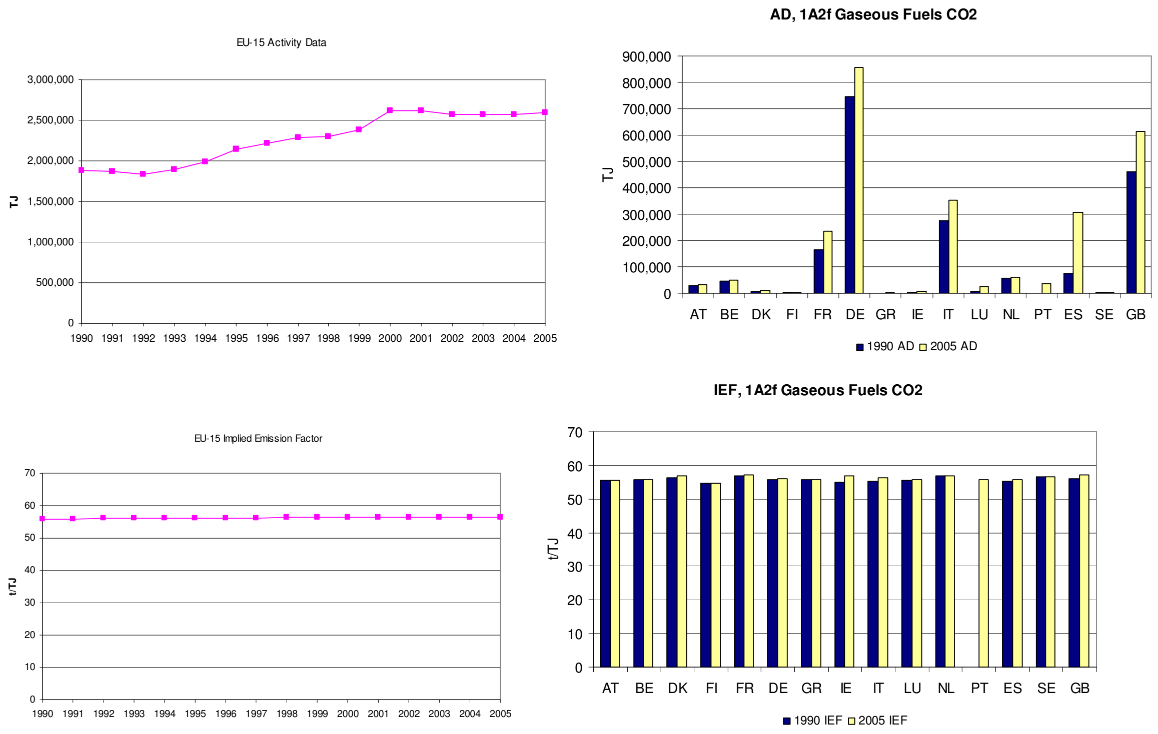
In 2005 CO_2 from gaseous fuels had a share of 48 % within source category 1A2f (compared to 29 % in 1990). Between 1990 and 2005 the emissions increased by 40 % (Table 3.43). Between 1990 and 2005, all Member States show increasing emissions except Sweden. The United Kingdom, Spain and Germany show the highest absolute increases.

Table 3.43 1A2f Other, gaseous fuels: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	1,573	1,685	1,683	1.1%	-2	0%	110	7%	T2	NS, PS	D
Belgium	2,559	2,868	2,817	1.9%	-51	-2%	258	10%	C	-	C, CS
Denmark	354	678	694	0.5%	16	2%	340	96%	C	NS	CS/C
Finland	171	201	201	0.1%	0	0%	30	18%	T3	PS	CS
France	9,305	13,078	13,556	9.2%	477	4%	4,251	46%	C	NS/ PS	CS
Germany	41,787	46,797	47,947	32.7%	1,150	2%	6,161	15%	CS/T2	NS/AS	CS
Greece	4	261	276	0.2%	15	6%	272	6948%	C	CS	D
Ireland	288	340	335	0.2%	-5	-2%	47	16%	T1	-	C
Italy	15,290	20,070	19,880	13.6%	-191	-1%	4,589	30%	T2	NS	CS
Luxembourg	310	1,573	1,491	1.0%	-82	-5%	1,181	381%	-	-	-
Netherlands	3,331	3,491	3,403	2.3%	-88	-3%	72	2%	T2	-	CS
Portugal	NO	2,066	2,012	1.4%	-54	-3%	2,012	-	T2	NS	D,C
Spain	4,046	16,015	17,153	11.7%	1,138	7%	13,106	324%	-	-	-
Sweden	178	211	143	0.1%	-68	-32%	-35	-20%	T1, T2, T3	-	CS
United Kingdom	25,833	35,254	35,022	23.9%	-232	-1%	9,189	36%	T2	NS, AS	CS
EU-15	**105,028**	**144,590**	**146,612**	**100.0%**	**2,022**	**1%**	**41,584**	**40%**			

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 82 % of the CO_2 emissions from gaseous fuels in 1A2f. Fuel combustion in the EU-15 rose by 38 % between 1990 and 2005. The implied emission factor of EU-15 was 56.4 t/TJ in 2005.

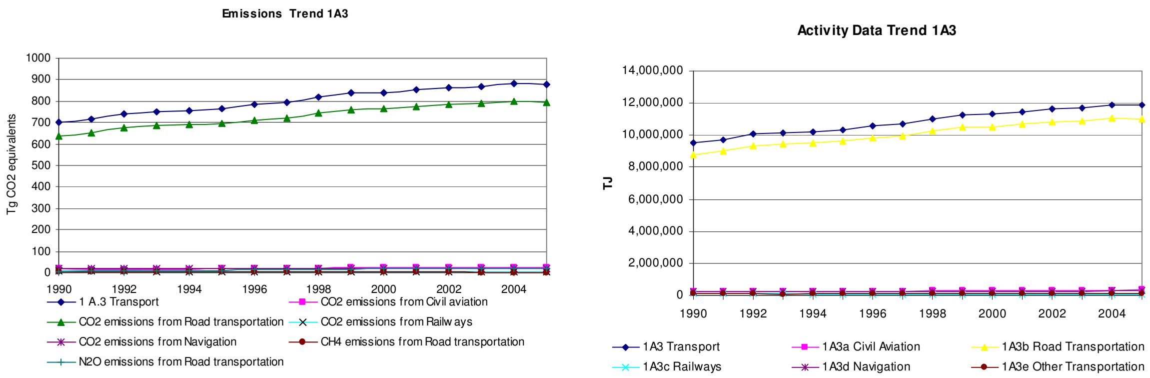
Figure 3.50 1A2f Other, gaseous fuels: Activity Data and Implied Emission Factors for CO_2



3.2.3. Transport (CRF Source Category 1A3)

Greenhouse gas emissions from 1A3 Transport are shown in Figure 3.51. CO_2 emissions from this source category account for 20 %, CH_4 for 0.1 %, N_2O for 0.5 % of total GHG emissions. Between 1990 and 2005, greenhouse gas emissions from Transport increased by 26 % in the EU-15.

Figure 3.51 1A3 Transport: Greenhouse gas emissions in CO_2 equivalents (Tg) and Activity Data in TJ



This source category includes ten key sources:

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 (N_2O)
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 3 e Other Transportation: Gaseous Fuels (CO_2)

Table 3.44 shows total GHG, CO_2 and N_2O emissions from 1A3 Transport.

Table 3.44 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 2005 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO_2 emissions in 2005 (Gg)	N_2O emissions in 1990 (Gg CO_2 equivalents)	N_2O emissions in 1990 (Gg CO_2 equivalents)
Austria	12,725	24,321	12,400	24,029	263	273
Belgium	20,402	26,416	19,947	25,517	352	837
Denmark	10,540	13,558	10,344	13,065	138	443
Finland	12,824	14,148	12,551	13,492	174	605
France	120,613	144,412	118,195	139,537	1,651	4,431
Germany	164,447	165,704	162,487	164,207	674	1,311
Greece	15,645	23,091	15,355	22,347	175	586
Ireland	5,182	13,461	5,045	12,942	101	473
Italy	103,952	131,502	101,461	126,891	1,717	4,005
Luxembourg	2,789	7,478	2,724	7,182	47	276
Netherlands	26,439	35,213	26,009	34,686	272	476
Portugal	10,041	19,956	9,828	19,293	140	612
Spain	57,536	105,323	56,512	102,436	783	2,711
Sweden	18,439	20,275	18,174	20,041	160	196
United Kingdom	118,739	134,866	116,841	129,254	1,278	5,438
EU-15	**700,313**	**879,721**	**687,873**	**854,919**	**7,927**	**22,674**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.45 provides information on the contribution of Member States to EU-15 recalculations in CO_2 from 1A3 Transport for 1990 and 2004 and main explanations for the largest recalculations in absolute terms.

Table 3.45 1A3 Transport: Contribution of MS to EU-15 recalculations in CO_2 for 1990 and 2004 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2004		Main explanations
	Gg	Percent	Gg	Percent	
Austria	0	0.0	-172	-0.7	The splitting of the energy data into national and international aviation for the years 2001 – 2005 has been updated according to the energy balance; update of activity data according to revised energy balance
Belgium	0	0.0	-34	-0.1	In the Flemish region most recalculations in the energy sector of the emission inventory 1990-2005 are performed in the last years (2003 and 2004) because more accurate information became available for these years. The year 2004 has undergone a complete revision because the emissions of 2004 reported last year were reported on a temporary basis.
Denmark	8	0.1	1	0.0	A revision of the 1985-2004 time-series of emissions has been made, based on revised mileage data from the Danish Road Directorate (de-rived from the Danish vehicle inspection and maintenance programme) and updated emission factors from the latest version of the European road transport emission model - COPERT IV.
Finland	10	0.1	57	0.4	Update of TYKO model for non-road machinery and ILMI model for domestic aviation
France	0	0.0	189	0.1	
Germany	1	0.0	139	0.1	updated activity data
Greece	0	0.0	0	0.0	
Ireland	9	0.2	9	0.1	
Italy	0	0.0	344	0.3	Activity data reported in the National energy balance have been updated
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	179	0.2	updated activity data according to revised energy balance (2004), error correction (1991, 2003)
Sweden	0	0.0	-2	0.0	CRF 1A3a:CH4 emissions for 2003 were adjusted due to correction of errors in earlier submissions. EF SO2 was adjusted for 1990 due to correction of errors in earlier submissions. CRF 1A3b:New activity data for biogas 1998-2004, earlier constant consumption data have been re-placed by consumption data from the Swedish Biogas Association. The use of a new and updated road traffic emission model (ARTEMIS) lead to revised fuel consumption data and revised emission data for all substances 1990-2004. Emission factors for SO2 were revised for all years. CRF 1A3c: New data from the Swedish Rail Administration lead to revised emission for all substances for 2004.Revised data from the Swedish Rail Administration lead to revised NOX emissions for 1990-2004. Revised data from the Swedish Rail Administration regarding diesel consumption lead to a 1% increase in activity data for 1998. CRF 1A3d and 1A3e:Adjustment of diesel consumption for all years following an update of the ARTEMIS model, lead to 0-1%(1A3d) and 1-5% (1A3e) higher emissions for all substances 1990-2004.Emission factors for SO2 for gasoline used by small boats were revised for all years.
UK	-692	-0.6	-821	-0.6	Revision to fuel use statistics from the DTI for aviation, road transport and shipping. Reallocation of Overseas Territories aviation from domestic to international Revisions to rail fuel use statistics provided by ATOC
EU-15	**-665**	**-0.1**	**-110**	**0.0**	

Table 3.46 provides information on the contribution of Member States to EU-15 recalculations in N_2O from 1A3 Transport for 1990 and 2004.

Table 3.46 **1A3 Transport: Contribution of MS to EU-15 recalculations in N_2O for 1990 and 2004 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)**

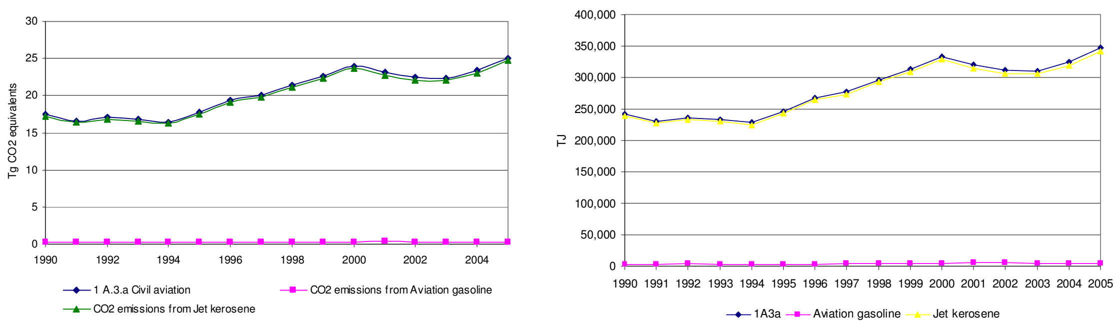
	1990		2004		Main explanations
	Gg	Percent	Gg	Percent	
Austria	0	-0.1	2	0.7	The splitting of the energy data into national and international aviation for the years 2001 – 2005 has been updated according to the energy balance; update of activity data according to revised energy balance
Belgium	0	0.0	1	0.1	In the Flemish region most recalculations in the energy sector of the emission inventory 1990-2005 are performed in the last years (2003 and 2004) because more accurate information became available for these years. The year 2004 has undergone a complete revision because the emissions of 2004 reported last year were reported on a temporary basis.
Denmark	-2	-1.7	2	0.4	A revision of the 1985-2004 time-series of emissions has been made, based on revised mileage data from the Danish Road Directorate (de-rived from the Danish vehicle inspection and maintenance programme) and updated emission factors from the latest version of the European road transport emission model - COPERT IV.
Finland	0	-0.2	0	0.0	Update of TYKO model for non-road machinery and ILMI model for domestic aviation
France	-4	-0.3	3	0.1	correction of emission factor (1A3c)
Germany	3	0.4	9	0.6	updated activity data
Greece	0	0.0	0	0.0	
Ireland	14	16.1	4	1.0	
Italy	0	0.0	31	0.8	Activity data reported in the National energy balance have been updated
Luxembourg	0	0.0	0	0.0	
Netherlands	0	0.0	0	0.0	
Portugal	-12	-8.0	38	6.7	
Spain	0	0.0	4	0.2	updated activity data according to revised energy balance (2004), error correction (1991, 2003)
Sweden	0	0.0	0	-0.1	CRF 1A3a:CH4 emissions for 2003 were adjusted due to correction of errors in earlier submissions. EF SO2 was adjusted for 1990 due to correction of errors in earlier submissions. CRF 1A3b:New activity data for biogas 1998-2004, earlier constant consumption data have been re-placed by consumption data from the Swedish Biogas Association. The use of a new and updated road traffic emission model (ARTEMIS) lead to revised fuel consumption data and revised emission data for all substances 1990-2004. Emission factors for SO2 were revised for all years. CRF 1A3c: New data from the Swedish Rail Administration lead to revised emission for all substances for 2004.Revised data from the Swedish Rail Administration lead to revised NOX emissions for 1990-2004. Revised data from the Swedish Rail Administration regarding diesel consumption lead to a 1% increase in activity data for 1998. CRF 1A3d and 1A3e:Adjustment of diesel consumption for all years following an update of the ARTEMIS model, lead to 0-1%(1A3d) and 1-5% (1A3e) higher emissions for all substances 1990-2004.Emission factors for SO2 for gasoline used by small boats were revised for all years.
UK	-99	-7.2	-113	-2.1	Minor revisions to fuel consumption statistics and emission factors for road transport and shipping. Revisions to rail fuel use statistics provided by ATOC Revisions to fuel consumption data for aviation, and reallocation of Overseas Territories aviation from domestic to international.
EU-15	**-102**	**-1.3**	**-20**	**-0.1**	

3.2.3.1. Civil Aviation (1A3a)

CO_2 emissions from 1A3a Civil Aviation account for 3 % of total GHG emissions in 2005. Between 1990 and 2005, CO_2 emissions from civil aviation increased by 44 % in the EU-15 (Table 3.47).

CO_2 emissions from Jet Kerosine account for 99 % of total CO_2 emissions from 1A3a Civil Aviation. Between 2004 and 2005, CO_2 emissions from civil aviation increased by 7 % in the EU-15 (Figure 3.52).

Figure 3.52 1A3a Civil Aviation: CO_2 Emissions in CO_2 equivalents (Tg) and Activity data in TJ



The Member States France, Spain and Germany contributed the most to the emissions from this source (67 %). Most Member States increased emissions from civil aviation between 1990 and 2005. The Member States with the highest increases in absolute terms were Germany, Italy, Spain and the UK. The countries with most reductions were Greece and Denmark (Table 3.47).

Table 3.47 1A3a Civil Aviation: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005	
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	32	192	217	0.9%	25	13%	185	579%
Belgium	12	8	9	0.0%	1	13%	-3	-26%
Denmark	243	127	133	0.5%	7	5%	-109	-45%
Finland	385	332	329	1.3%	-3	-1%	-56	-15%
France	4,483	4,964	4,830	19.3%	-134	-3%	347	8%
Germany	2,897	4,408	5,072	20.2%	664	15%	2,174	75%
Greece	1,455	1,227	1,238	4.9%	11	1%	-216	-15%
Ireland	59	108	108	0.4%	0	0%	49	82%
Italy	1,597	2,668	2,652	10.6%	-16	-1%	1,055	66%
Luxembourg	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Netherlands	41	41	41	0.2%	0	0%	0	0%
Portugal	165	401	401	1.6%	0	0%	236	143%
Spain	4,135	5,925	6,905	27.5%	980	17%	2,769	67%
Sweden	673	667	663	2.6%	-5	-1%	-11	-2%
United Kingdom	1,272	2,302	2,465	9.8%	163	7%	1,193	94%
EU-15	**17,450**	**23,370**	**25,063**	**100.0%**	**1,693**	**7%**	**7,613**	**44%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A3a Civil Aviation – Jet Kerosene (CO_2)

CO_2 emissions resulting from jet kerosene within the category 1A3a were in 2005 responsible for 99 % of CO_2 emissions in 1A3a. Within the EU-15 the emissions increased between 1990 and 2005 by 43,5 % (Table 3.48). The largest absolute increase occurred in Spain, Germany and UK. Between 2004 and 2005, the emissions increased by 7 %.

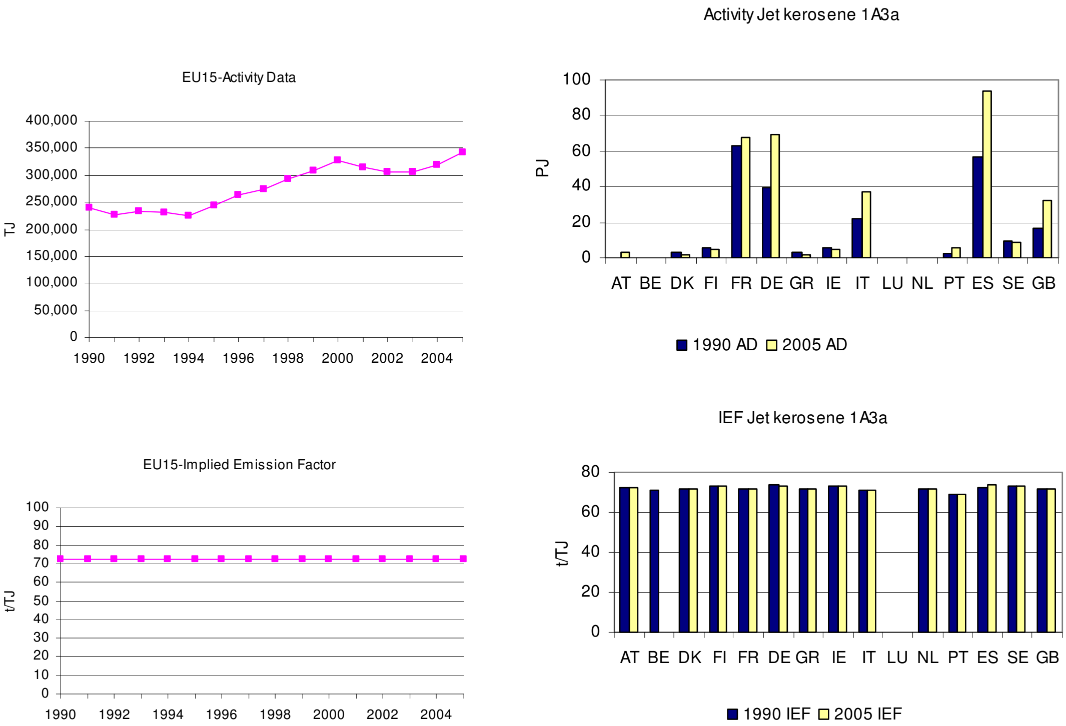
Table 3.48 1A3a Civil Aviation, jet kerosine: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	24	185	209	0.8%	24	13%	184	763%	CS	NS	CS
Belgium	5	IE	IE	-	-	-	-5	-100%	C,M	PS	C
Denmark	234	120	126	0.5%	7	6%	-108	-46%	C	NS	C
Finland	377	329	326	1.3%	-3	-1%	-51	-14%	T2b	NS	CS
France	4,483	4,964	4,830	19.5%	-134	-3%	347	8%	M	NS	M
Germany	2,897	4,408	5,072	20.5%	664	15%	2,174	75%	T1	NS/AS	CS
Greece	1,430	1,166	1,194	4.8%	29	2%	-236	-16%	T2a	NS, AS	T2a
Ireland	59	108	108	0.4%	0	0%	49	82%	T2a	NS	CS
Italy	1,563	2,625	2,608	10.5%	-16	-1%	1,046	67%	T1, T2a	NS	CS
Luxembourg	NO	NO	NO	0.0%	-	-	-	-	-	-	-
Netherlands	16	16	16	0.1%	0	0%	0	0%	T2	NS	CS
Portugal	164	400	400	1.6%	0	0%	236	144%	T2	NS,AS	D
Spain	4,135	5,925	6,905	27.9%	980	17%	2,769	67%	T2	NS	D
Sweden	668	664	660	2.7%	-4	-1%	-8	-1%	T1	NS	CS
United Kingdom	1,191	2,147	2,302	9.3%	155	7%	1,111	93%	T3	NS, AS	CS
EU-15	17,247	23,056	24,756	100.0%	1,700	7%	7,509	44%			

Abbreviations explained in the Chapter 'Units and abbreviations'.

France, Germany, Italy, Spain and the UK account for 88 % of activity data and 88 % of CO_2 emissions from Jet kerosene in 2005 (Figure 3.53). The IEF for the EU-15 is 72.3 t/TJ Jet kerosene in 2005.

Figure 3.53 1A3a Civil Aviation, jet kerosine: Activity data and implied emission factors for CO_2



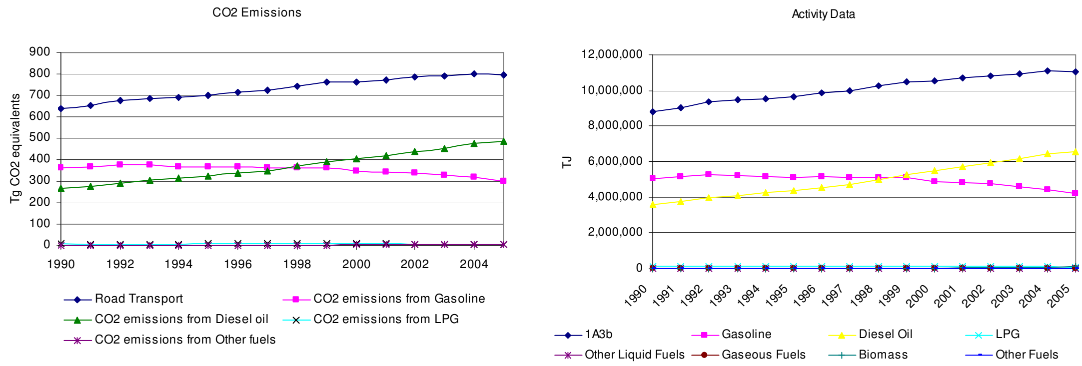
3.2.3.2. Road Transportation (1A3b)

CO_2 emissions from 1A3b Road Transportation

CO_2 emissions from 1A3b Road Transportation is the second largest key source of all categories in the EU-15 accounting for 19 % of total GHG emissions in 2005. Between 1990 and 2005, CO_2 emissions from road transportation increased by 25 % in the EU-15 (Table 3.49). The emissions from this key source are due to fossil fuel consumption in road transport, which increased by 25 % between 1990 and 2005.

Figure 3.54 gives an overview of the CO_2 trend caused by different fuels. The trend is mainly dominated by emissions resulting from gasoline and diesel oil. The decline of gasoline and the strong increase of diesel shows the switch from gasoline passenger cars to diesel in several EU-15 Member States.

Figure 3.54 1A3b Road Transport: CO_2 Emission Trend and Activity Data



The Member States Germany, France, Italy and the United Kingdom contributed most to the CO_2 emissions from this source (65 %). All Member States increased emissions from road transportation between 1990 and 2005. The Member States with the highest increases in absolute terms were Spain, France and Italy. The countries with the lowest increase in relative terms were Finland, Germany and United Kingdom (Table 3.49).

Table 3.49 1A3b Road Transport: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005	
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	11,924	22,390	23,037	2.9%	647	3%	11,113	93%
Belgium	19,270	25,799	24,928	3.1%	-871	-3%	5,658	29%
Denmark	9,250	12,024	12,157	1.5%	133	1%	2,907	31%
Finland	10,872	11,811	11,796	1.5%	-15	0%	923	8%
France	110,738	131,871	130,441	16.4%	-1,430	-1%	19,703	18%
Germany	150,358	159,993	152,231	19.2%	-7,762	-5%	1,873	1%
Greece	11,873	18,135	18,887	2.4%	752	4%	7,015	59%
Ireland	4,700	11,622	12,454	1.6%	832	7%	7,753	165%
Italy	93,616	118,389	117,042	14.7%	-1,347	-1%	23,427	25%
Luxembourg	2,693	6,960	7,156	0.9%	195	3%	4,463	166%
Netherlands	25,472	33,841	33,902	4.3%	61	0%	8,430	33%
Portugal	9,249	18,708	18,549	2.3%	-158	-1%	9,300	101%
Spain	50,442	90,513	92,666	11.7%	2,153	2%	42,224	84%
Sweden	16,629	18,244	18,502	2.3%	257	1%	1,873	11%
United Kingdom	109,688	119,612	120,135	15.1%	523	0%	10,447	10%
EU-15	**636,776**	**799,913**	**793,884**	**100.0%**	**-6,029**	**-0.8%**	**157,108**	**25%**

1A3b Road Transportation – Diesel Oil (CO_2)

CO_2 emissions from Diesel oil account for 61 % of CO_2 emissions from 1A3b Road Transport in 2005 (Figure 3.54). All Member States increased emissions from Diesel oil between 1990 and 2005 (Table 3.50). Member States with the highest increase in percent were Austria, Luxembourg, and Ireland (in the wake of tanktourism). The countries with the lowest increase were Finland and Germany.

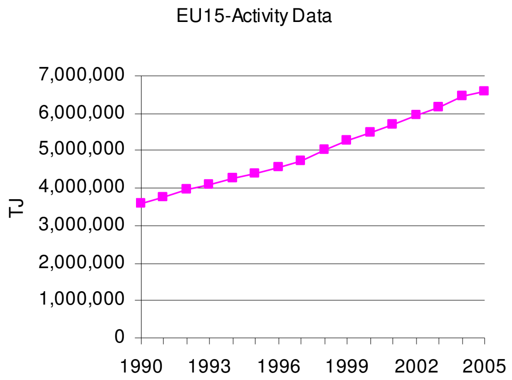
Table 3.50 1A3b Road Transport, diesel oil: Member States' contributions to CO_2 emissions

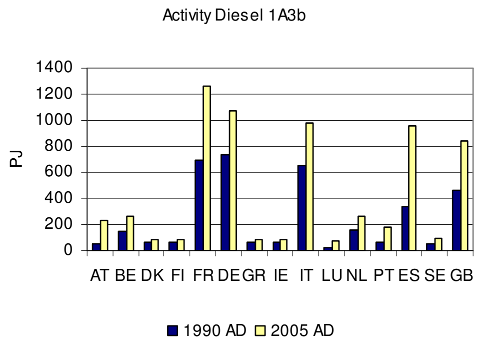
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	4,013	15,803	16,645	3.4%	841	5%	12,632	315%	CS	NS	CS
Belgium	10,892	19,741	19,396	4.0%	-345	-2%	8,504	78%	C,M,CS	NS	C,CS
Denmark	4,436	6,231	6,547	1.3%	316	5%	2,111	48%	COPERT3	NS	C
Finland	4,956	6,278	6,338	1.3%	60	1%	1,382	28%	T3	NS	CS
France	52,074	93,816	94,806	19.5%	989	1%	42,732	82%	M	NS	M
Germany	54,458	82,480	79,447	16.4%	-3,033	-4%	24,989	46%	T3	NS/AS	CS
Greece	4,326	6,537	7,074	1.5%	537	8%	2,748	64%	COPERT III	NS	D
Ireland	1,922	6,537	7,108	1.5%	570	9%	5,186	270%	T1	NS	CS
Italy	48,020	69,718	71,695	14.8%	1,977	3%	23,675	49%	COPERT 3	NS, AS	CS
Luxembourg	1,378	5,183	5,627	1.2%	444	9%	4,249	308%	C	-	C
Netherlands	11,832	19,542	19,863	4.1%	321	2%	8,030	68%	T2	NS	CS
Portugal	4,947	12,714	12,854	2.6%	139	1%	7,907	160%	T2	NS	C
Spain	24,436	65,742	69,416	14.3%	3,674	6%	44,981	184%	C	NS, Q	C
Sweden	4,204	6,549	6,953	1.4%	404	6%	2,749	65%	T1	NS	C2
United Kingdom	33,717	58,554	61,471	12.7%	2,917	5%	27,755	82%	T3	NS, AS	CS
EU-15	**265,611**	**475,428**	**485,239**	**100.0%**	**9,811**	**2.1%**	**219,628**	**83%**			

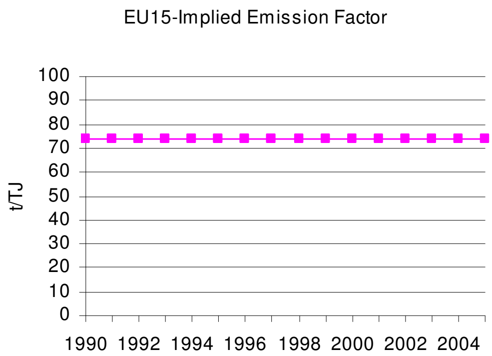
Abbreviations explained in the Chapter 'Units and abbreviations'.

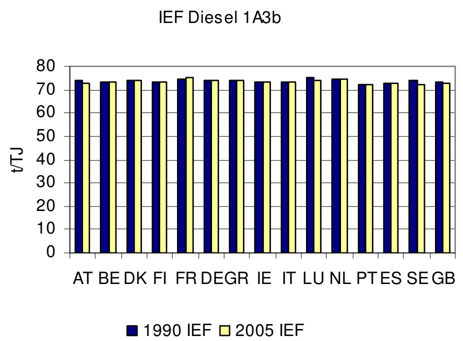
France, Germany, Italy, Spain and the UK account for 78 % of activity data and CO_2 emissions from Diesel oil in 2005 (Figure 3.55). The IEF for the EU-15 is 73.6 t/TJ Diesel in 2005.

Figure 3.55 1A3b Road Transport, diesel oil: Activity Data and Implied Emission Factor for CO_2 emission









1A3b Road Transportation – Gasoline (CO_2)

Between 1990 and 2005, CO_2 emissions from gasoline decreased by 17 % in the EU-15. The countries with the highest decrease in relative terms were Belgium and France (Table 3.51). Countries with the highest increase were Greece, Ireland, and Portugal.

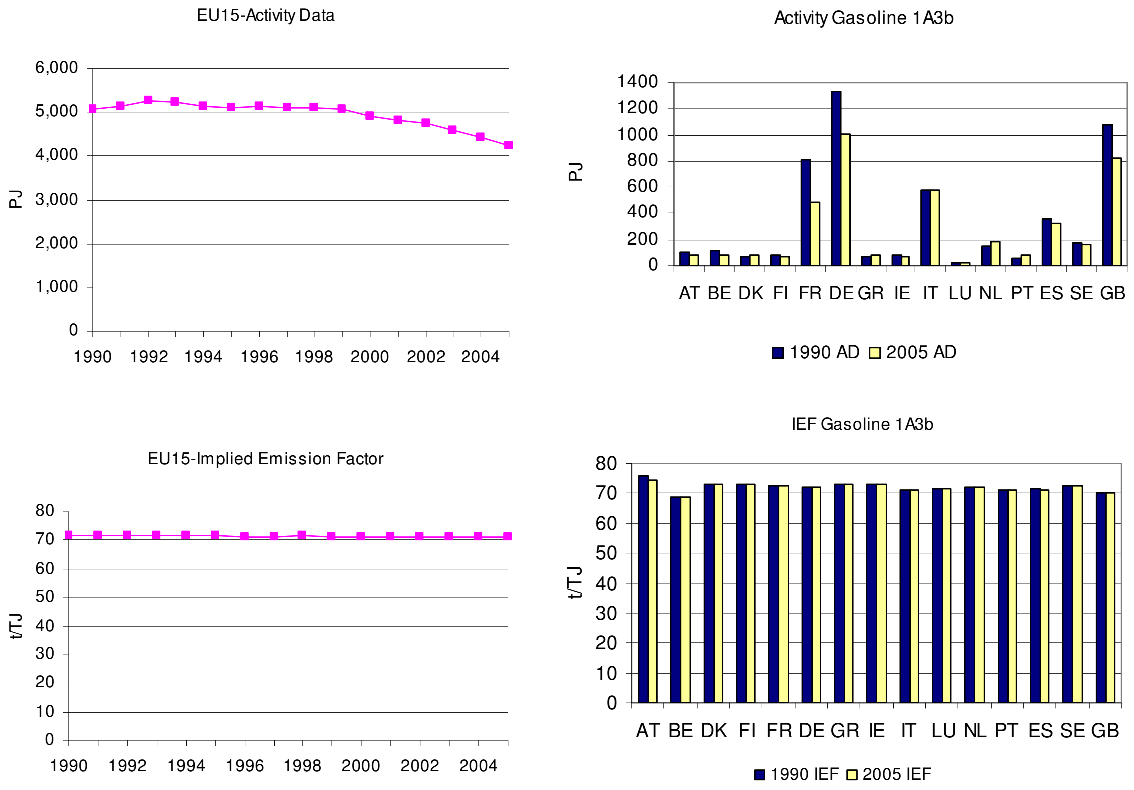
Table 3.51 1A3b Road Transport, gasoline: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	7,911	6,587	6,393	2.1%	-194	-3%	-1,518	-19%	CS	NS	CS
Belgium	8,223	5,827	5,313	1.8%	-514	-9%	-2,910	-35%	C,M,CS	NS	C,CS
Denmark	4,814	5,793	5,610	1.9%	-183	-3%	796	17%	COPERT3	NS	C
Finland	5,916	5,526	5,452	1.8%	-75	-1%	-465	-8%	T3	NS	CS
France	58,481	37,500	35,126	11.7%	-2,375	-6%	-23,355	-40%	M	NS	M
Germany	95,794	77,337	72,602	24.1%	-4,735	-6%	-23,193	-24%	T3	NS/AS	CS
Greece	7,294	11,464	11,670	3.9%	205	2%	4,376	60%	COPERT III	NS	D
Ireland	2,761	5,072	5,334	1.8%	262	5%	2,574	93%	T1	NS	CS
Italy	41,084	44,479	41,329	13.7%	-3,150	-7%	245	1%	COPERT 3	NS, AS	CS
Luxembourg	1,303	1,772	1,525	0.5%	-246	-14%	222	17%	C	-	C
Netherlands	10,902	13,168	12,970	4.3%	-198	-2%	2,068	19%	T2	NS	CS
Portugal	4,303	5,908	5,601	1.9%	-307	-5%	1,298	30%	T2	NS	C
Spain	25,928	24,556	23,114	7.7%	-1,442	-6%	-2,814	-11%	C	NS, Q	C
Sweden	12,422	11,651	11,499	3.8%	-152	-1%	-923	-7%	T1	NS	C2
United Kingdom	75,430	60,268	57,889	19.2%	-2,379	-4%	-17,542	-23%	T3	NS, AS	CS
EU-15	**362,567**	**316,909**	**301,426**	**100.0%**	**-15,482**	**-4.9%**	**-61,141**	**-17%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

France, Germany, Italy, Spain and the United Kingdom account for 77 % of activity data and CO_2 emissions (Figure 3.56). The IEF for the EU-15 is 71,3 t/TJ Gasoline in 2005.

Figure 3.56 1A3b Road Transport, gasoline: Activity data and implied emission factors for CO_2



1A3b Road Transportation –LPG (CO_2)

Between 1990 and 2005, CO_2 emissions from LPG decreased by 25 % in the EU-15. Five Member States report emissions as 'Not occuring' "NE" or '0'. Of the remaining eleven Member States, Belgium, France, Portugal Spain and the UK show increases, the other decreases. Between 2004 and 2005 emissions declined by 7 % (Table 3.52).

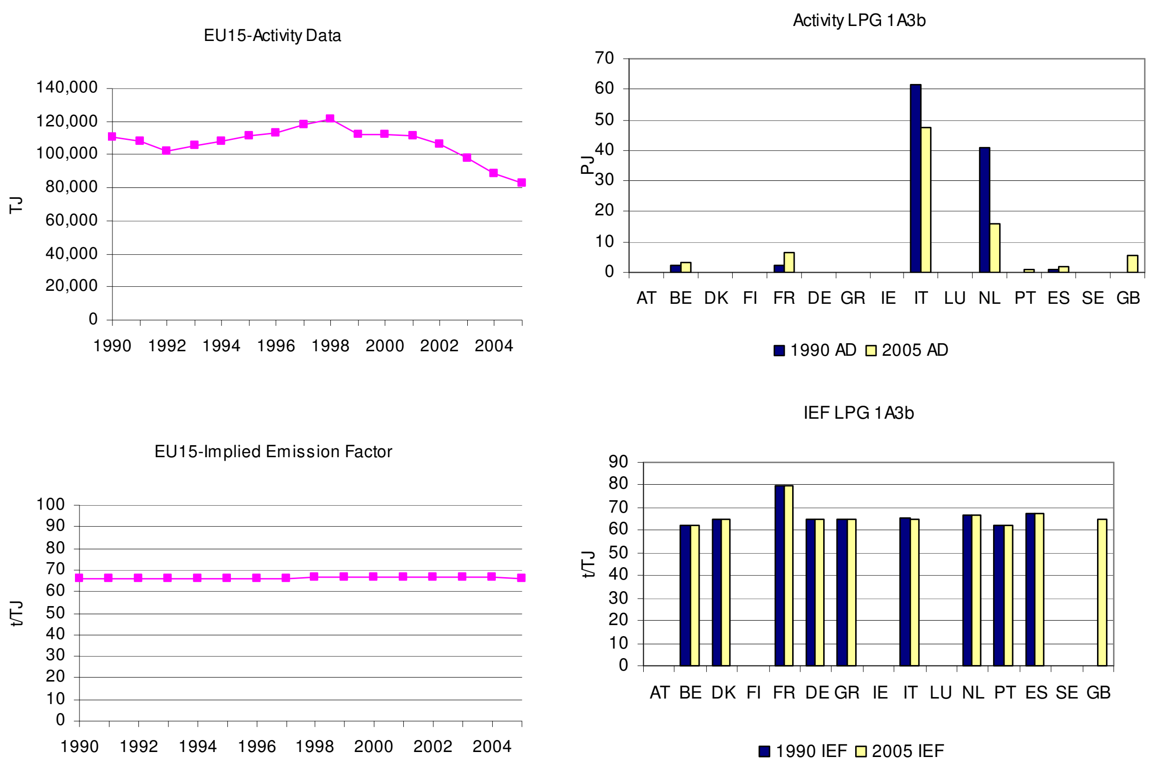
Table 3.52 1A3b Road Transport, LPG: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005	
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	NO	NO	NO	-	-	-	-	-
Belgium	154	231	219	4.0%	-12	-5%	64	42%
Denmark	1	0	0	0.0%	0	-4%	-1	-97%
Finland	NO	NO	NO	-	-	-	-	-
France	183	554	509	9.3%	-44	-8%	326	178%
Germany	9	NE	7	0.1%	7	-	-2	-28%
Greece	110	40	26	0.5%	-14	-36%	-84	-76%
Ireland	18	12	12	0.2%	0	0%	-6	-33%
Italy	4,020	3,312	3,081	56.3%	-231	-7%	-939	-23%
Luxembourg	NE	NE	NE	-	-	-	-	-
Netherlands	2,738	1,131	1,069	19.5%	-62	-5%	-1,669	-61%
Portugal	0	52	58	1.1%	6	11%	58	98619%
Spain	79	215	136	2.5%	-79	-37%	57	73%
Sweden	NO	NO	NO	-	-	-	-	-
United Kingdom	NO	330	354	6.5%	24	7%	354	-
EU-15	**7,312**	**5,877**	**5,471**	**100.0%**	**-406**	**-7%**	**-1,841**	**-25%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Belgium, France, Italy, the Netherlands and the United Kingdom account for 95 % of emission and for 95 % of activity data (Figure 3.57). The IEF for the EU-15 is 66.3 t/TJ LPG in 2005.

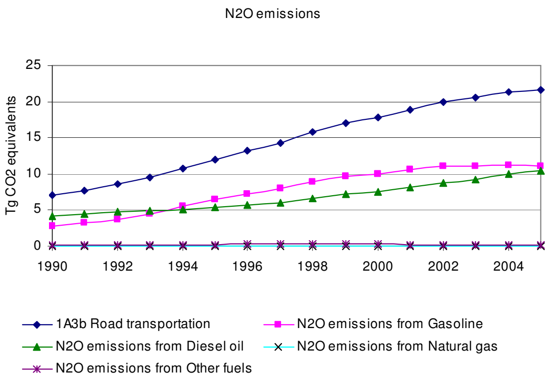
Figure 3.57 1A3b Road Transport, LPG: Activity data and implied emission factors for CO_2

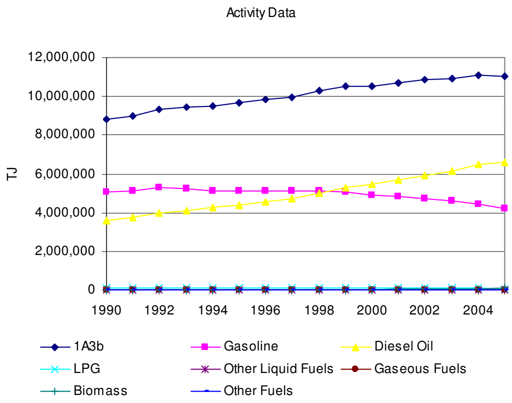


N_2O emissions from 1A3b Road Transportation

N_2O emissions from 1A3b Road Transportation account for 0.5 % of total EU-15 GHG emissions in 2005. Figure 3.58 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 3.58 1A3b Road Transport: N_2O Emissions Trend and Activity Data





N_2O emissions increased between 1990 and 2005 by 206 % (Table 3.53). The emissions have been increasing through the 1990s as the number of cars equipped with a catalytic converter (with higher emission factors than cars without a catalytic converter) has increased. All Member States except Austria, Germany, the Netherlands and Sweden had an increase higher than 100 %. Between 2004 and 2005 four Member States (Austria, Germany, the Netherlands and Sweden) reported a slight decrease in N_2O emissions. The reason for this different trends is due to the different estimates of N_2O emissions factors. Principle 2 different models are being used in EU-15 countries to estimate N_2O emissions. The Emission Handbook (Austria, Germany, the Netherlands and Sweden) estimates that the N_2O emission factors decrease for every technology generation (Euro 1, Euro 2 etc.). The COPERT model has a constant N_2O emission factor for cars with catalytic converters, independently of the legislation class.

Table 3.53 1A3b Road Transport: Member States' contributions to N_2O emissions

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005	
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	252	279	260	1.2%	-18	-7%	8	3%
Belgium	300	781	789	3.7%	8	1%	490	163%
Denmark	122	422	429	2.0%	7	2%	307	251%
Finland	160	559	592	2.7%	32	6%	432	271%
France	1,584	4,324	4,346	20.1%	22	1%	2,762	174%
Germany	608	1,266	1,175	5.4%	-91	-7%	567	93%
Greece	123	452	542	2.5%	90	20%	419	341%
Ireland	71	411	443	2.0%	33	8%	372	522%
Italy	1,605	3,877	3,891	18.0%	15	0%	2,286	142%
Luxembourg	43	257	273	1.3%	16	6%	229	529%
Netherlands	271	486	474	2.2%	-12	-2%	203	75%
Portugal	125	602	601	2.8%	-1	0%	476	380%
Spain	679	2,482	2,585	12.0%	104	4%	1,906	281%
Sweden	99	141	139	0.6%	-2	-2%	40	40%
United Kingdom	1,025	5,033	5,087	23.5%	54	1%	4,062	396%
EU-15	**7,069**	**21,372**	**21,627**	**100.0%**	**256**	**1%**	**14,559**	**206%**

1A3b Road Transportation – Diesel Oil (N_2O)

N_2O emissions from Diesel oil account for 48 % of N_2O emissions from 1A3b "Road Transportation" in 2005. N_2O emissions from Diesel oil increased in all Member States between 1990 and 2005; within the EU-15 the emission increased by 150 %. The smallest increase in absolute terms is reported by Sweden, Finland and Greece. Between 2004 and 2005, EU-15 emissions rose by 5 %, the only Member State reporting a stagnancy is Greece (Table 3.54).

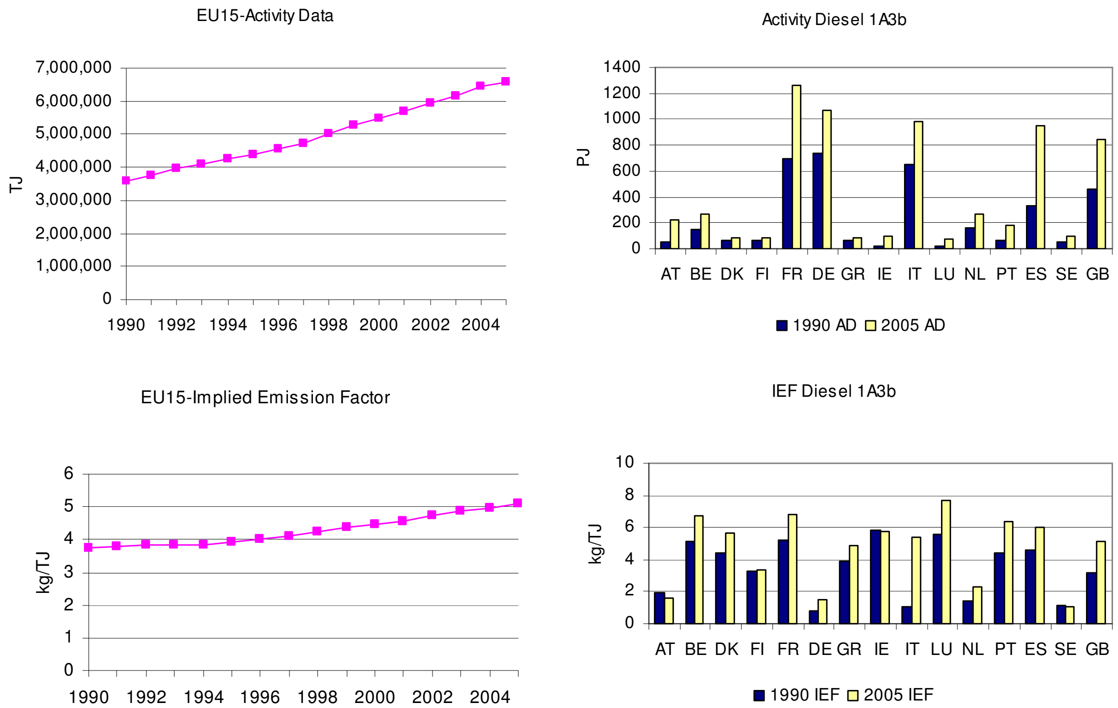
Table 3.54 1A3b Road Transport, diesel oil: Member States' contributions to N_2O emissions

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	33	109	112	1.1%	3	3%	78	236%	CS	NS	CS
Belgium	237	534	549	5.3%	16	3%	312	131%	C,M,CS	NS	C, CS
Denmark	82	144	155	1.5%	12	8%	73	89%	COPERT3	NS	C
Finland	68	86	89	0.9%	3	4%	21	30%	T3	NS	CS
France	1,137	2,632	2,682	25.8%	50	2%	1,545	136%	M	NS	M
Germany	188	493	493	4.7%	0	0%	305	163%	T3	NS/AS	CS/M
Greece	72	111	135	1.3%	25	22%	64	88%	COPERT III	NS	C
Ireland	47	157	173	1.7%	15	10%	125	264%	T3	NS	COPPERT3
Italy	1,155	2,004	2,111	20.3%	107	5%	956	83%	COPERT 3	NS, AS	CS
Luxembourg	32	163	183	1.8%	20	12%	152	478%	C	-	C
Netherlands	72	182	188	1.8%	6	3%	117	163%	T2	NS/Q	CS
Portugal	93	342	353	3.4%	10	3%	260	279%	T3	NS,AS	C
Spain	481	1,665	1,777	17.1%	112	7%	1,296	270%	C	NS, Q	C
Sweden	19	31	33	0.3%	2	5%	13	69%	T2	NS	CS
United Kingdom	450	1,278	1,350	13.0%	72	6%	900	200%	T3	NS, AS	COPERT III
EU-15	**4,166**	**9,931**	**10,382**	**100.0%**	**451**	**5%**	**6,216**	**149%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Belgium, France, Germany, Italy, Spain and the United Kingdom account for 82 % of the emissions and 82 % of activity data (Figure 3.59). The IEF for the EU-15 is 5.0 kg/TJ Diesel in 2005.

Figure 3.59 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 51 % of N_2O emissions from 1A3b "Road Transportation" in 2005. Between 1990 and 2005, N_2O emissions from gasoline increased by 304 % in the EU-15, all Member States except Austria reported increased emissions. The United Kingdom, Italy and France had the highest absolute increase. Between 2004 and 2005, nearly all Member States show a decreasing trend, except Finland, Greece, and Ireland. The EU-15 total sank by 2 % (Table 3.55).

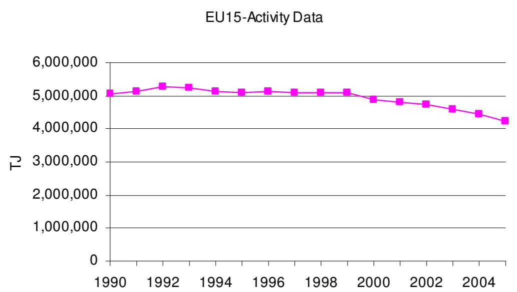
Table 3.55 1A3b Road Transport, gasoline: Member States' contributions to N_2O emissions

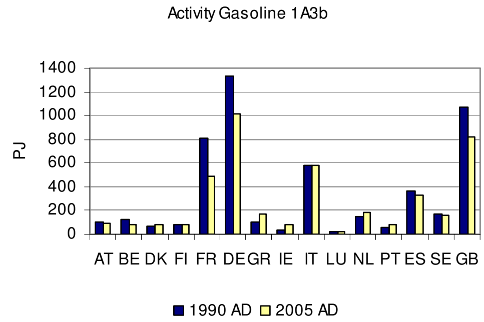
Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	219	170	149	1.4%	-21	-13%	-71	-32%	CS	NS	CS
Belgium	60	242	235	2.1%	-7	-3%	175	289%	C,M,CS	NS	C,CS
Denmark	40	279	274	2.5%	-5	-2%	234	588%	COPERT3	NS	C
Finland	91	474	503	4.6%	29	6%	411	450%	T3	NS	CS
France	443	1,646	1,612	14.7%	-34	-2%	1,169	264%	M	NS	M
Germany	421	753	649	5.9%	-104	-14%	229	54%	T3	NS/AS	CS/M
Greece	48	340	406	3.7%	65	19%	357	739%	COPERT III	NS	C
Ireland	23	253	271	2.5%	17	7%	247	1064%	T3	NS	COPPERT3
Italy	327	1,753	1,665	15.1%	-88	-5%	1,338	409%	COPERT 3	NS, AS	CS
Luxembourg	12	94	90	0.8%	-5	-5%	78	666%	C	-	C
Netherlands	156	273	257	2.3%	-15	-6%	101	64%	T2	NS/Q	CS
Portugal	32	258	247	2.2%	-11	-4%	215	665%	T3	NS,AS	C
Spain	197	812	805	7.3%	-6	-1%	608	309%	C	NS, Q	C
Sweden	80	110	106	1.0%	-4	-4%	27	33%	T2	NS	CS
United Kingdom	573	3,750	3,732	33.9%	-18	0%	3,159	551%	T3	NS, AS	COPERT III
EU-15	**2,724**	**11,206**	**11,000**	**100.0%**	**-206**	**-2%**	**8,276**	**304%**			

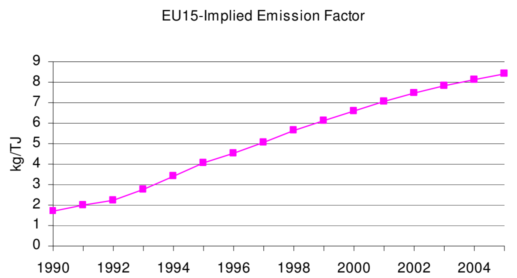
Abbreviations explained in the Chapter 'Units and abbreviations'.

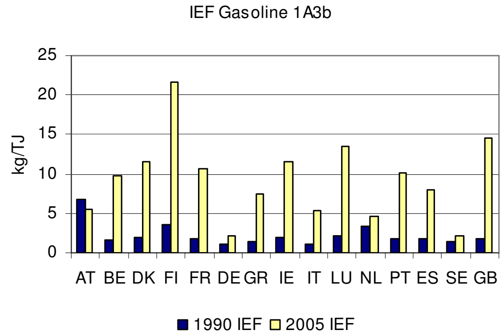
France, Germany, Italy, Spain and the United Kingdom account for 76% of emission and for 76 % of activity data (Figure 3.60). The IEF for the EU-15 is 8.39 kg/TJ Gasoline in 2005.

Figure 3.60 1A3b Road Transport, gasoline: Activity data and implied emission factors for N_2O







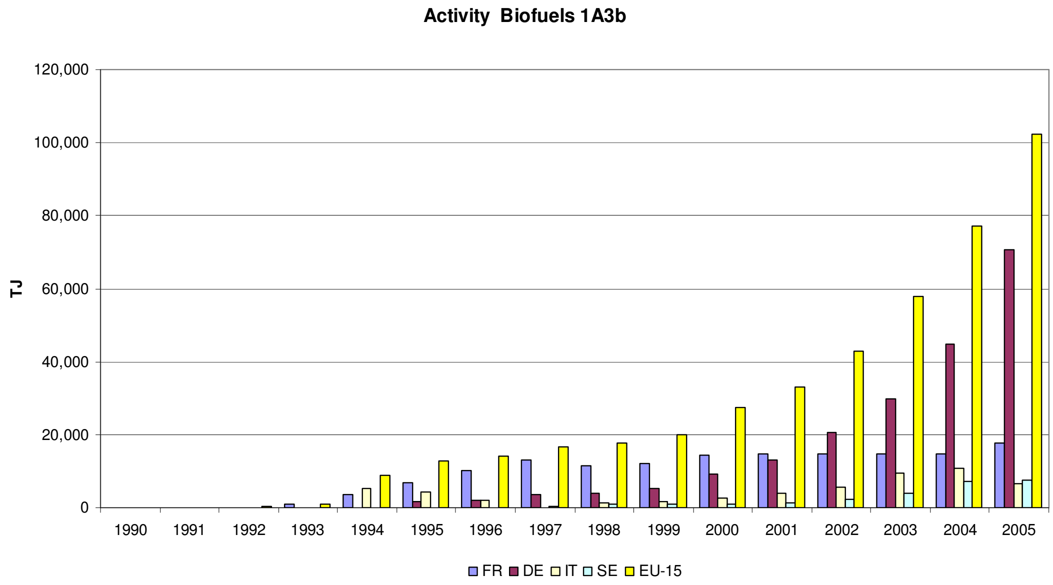


1A3b Road Transportation – Activity Data Biofuels

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 2005, activity data of biofuel increased from 25 TJ to 102.317 TJ in the EU-15 (Figure 3.61). France, Germany, Italy, and Sweden have already reported biofuels in their CRF inventories. Germany reports most of total amount of biofuels (69 % of total EU-15 activity in 2005) over the last view years, followed by France. Other countries have also placed biofuels on their markets, but they do not report biofuels separately from gasoline or gas/diesel oil.

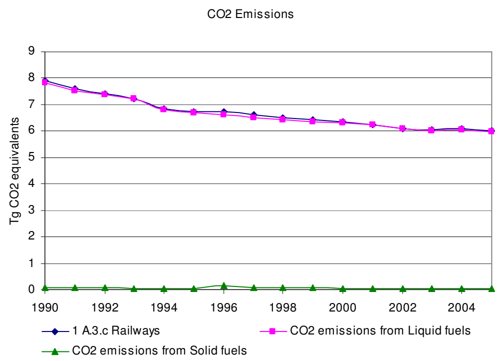
Figure 3.61 1A3b Road Transport, biofuels: Trend of Activity data of biofuels

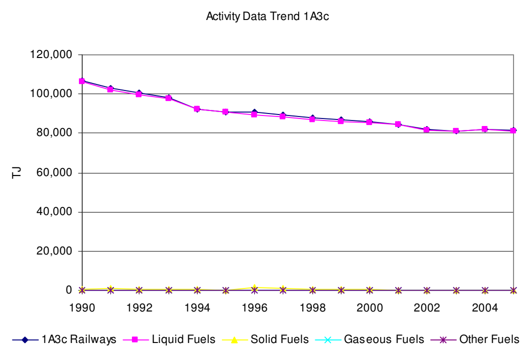


3.2.3.3. Railways (1A3c)

CO_2 emissions from 1A3c Railways account for 0.1 % of total EU-15 GHG emissions in 2005. Between 1990 and 2005, CO_2 emissions from rail transportation decreased by 24 % in the EU-15. The total trend is dominated by CO_2 emissions from liquid fuels (99,6%) (Figure 3.62). The emissions from this key source are due to fossil fuel consumption in rail transport, which decreased by 24 % between 1990 and 2005.

Figure 3.62 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 %). Nearly all Member States decreased emissions from rail transportation between 1990 and 2005, only Ireland, the Netherlands, and theUnited Kingdom increased their emissions. The Member States with the highest decreases in absolute terms were Germany and France (Table 3.56).

Table 3.56 1A3c Railways: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005	
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	168	182	148	2.5%	-34	-19%	-19	-11%
Belgium	202	114	115	1.9%	0	0%	-88	-43%
Denmark	297	216	232	3.9%	16	7%	-65	-22%
Finland	191	140	127	2.1%	-13	-9%	-64	-34%
France	1,070	700	700	11.7%	0	0%	-370	-35%
Germany	2,879	1,544	1,484	24.7%	-60	-4%	-1,395	-48%
Greece	203	129	126	2.1%	-3	-2%	-77	-38%
Ireland	139	177	158	2.6%	-18	-10%	19	14%
Italy	441	359	303	5.0%	-56	-16%	-138	-31%
Luxembourg	26	21	21	0.3%	0	0%	-5	-21%
Netherlands	91	109	106	1.8%	-4	-3%	15	16%
Portugal	173	86	80	1.3%	-6	-7%	-93	-54%
Spain	414	303	305	5.1%	2	1%	-109	-26%
Sweden	103	66	66	1.1%	0	0%	-37	-36%
United Kingdom	1,491	1,929	2,032	33.9%	103	5%	541	36%
EU-15	**7,888**	**6,076**	**6,003**	**100.0%**	**-72**	**-1%**	**-1,885**	**-24%**

1A3c Railways –Liquid Fuels (CO_2)

Between 1990 and 2005, CO_2 emissions from liquid fuels decreased by 24 % in the EU-15. In the United Kingdom, the Netherlands and Ireland emissions increased. A substantial decrease occurred in Germany (-48 %) and in Portugal (-54 %). Between 2004 and 2005, total EU-15 emissions changed marginally (-1 %) (Table 3.57).

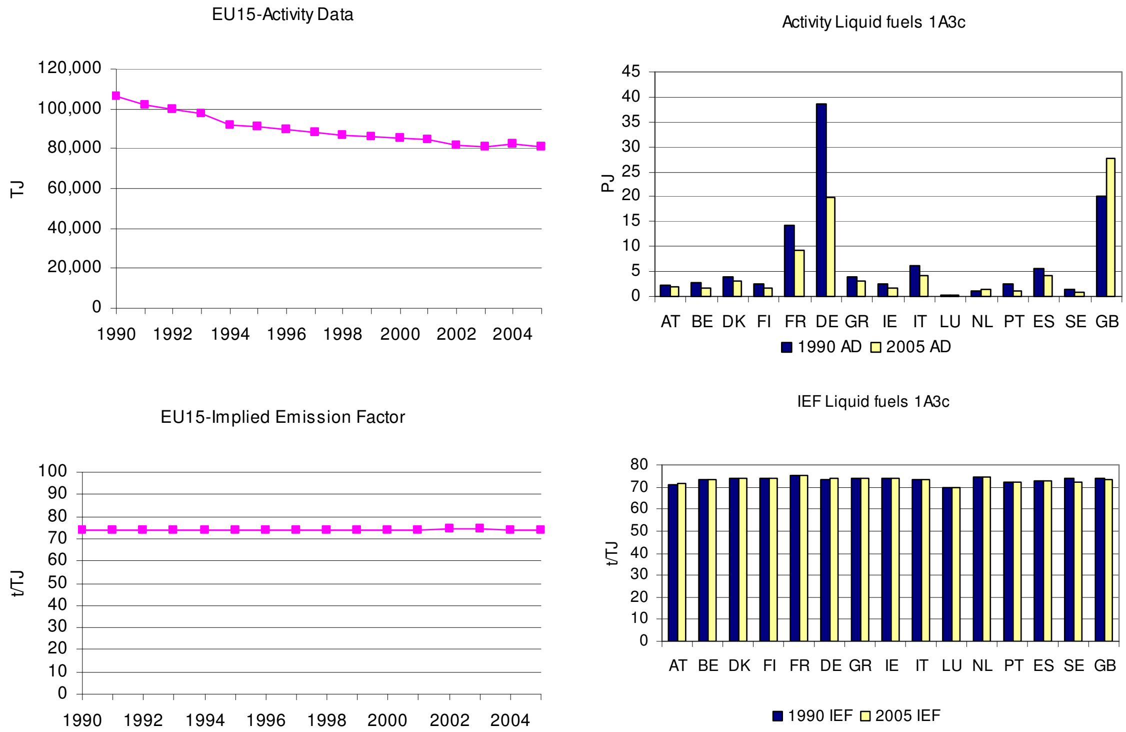
Table 3.57 1A3c Railways, liquid fuels: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	161	180	146	2.4%	-34	-19%	-15	-9%	CS	NS	CS
Belgium	202	114	115	1.9%	0	0%	-88	-43%	C,M	RS	C
Denmark	297	216	232	3.9%	16	7%	-65	-22%	C	NS	C
Finland	191	140	127	2.1%	-13	-9%	-64	-34%	T2	NS	CS
France	1,070	700	700	11.7%	0	0%	-370	-35%	C	NS	CS
Germany	2,826	1,523	1,462	24.5%	-60	-4%	-1,363	-48%	T1	NS/AS	CS
Greece	200	129	126	2.1%	-3	-2%	-75	-37%	C	NS	D
Ireland	139	177	158	2.6%	-18	-10%	19	14%	T1	NS	CS
Italy	441	359	303	5.1%	-56	-16%	-138	-31%	D	NS	CS
Luxembourg	26	21	21	0.3%	0	0%	-5	-21%	C	-	C
Netherlands	91	109	106	1.8%	-4	-3%	15	16%	CS	AS	CS
Portugal	173	86	80	1.3%	-6	-7%	-93	-54%	T1	NS	OTH
Spain	414	303	305	5.1%	2	1%	-109	-26%	T2	Q	C
Sweden	103	66	66	1.1%	0	0%	-37	-36%	CS	NS	CS
United Kingdom	1,491	1,929	2,032	34.0%	103	5%	541	36%	T2	NS, AS	CS
EU-15	**7,825**	**6,052**	**5,979**	**100.0%**	**-72**	**-1%**	**-1,846**	**-24%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

France, Germany, Spain and the United Kingdom account for 75 % of emissions and for 75 % of activity data (Figure 3.63). The IEF for the EU-15 is 73.6 t/TJ Liquid fuels in 2005.

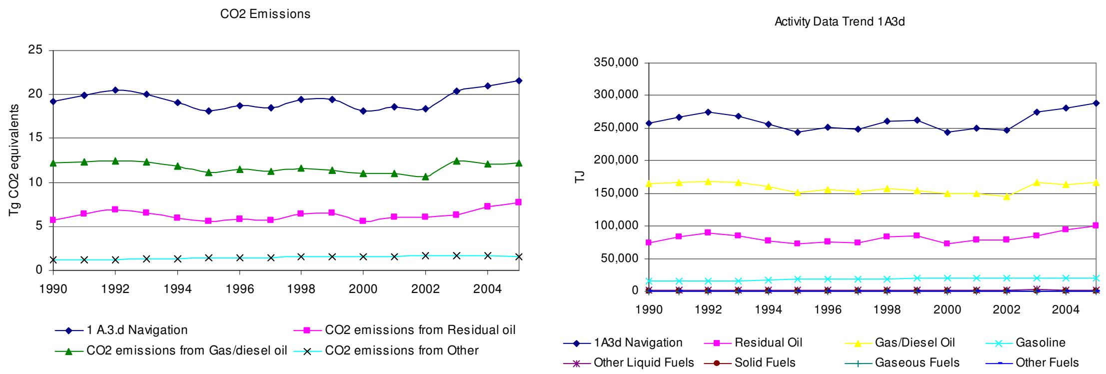
Figure 3.63 1A3c Railways, liquid fuels: Activity data and implied emission factors for CO_2



3.2.3.4. Navigation (1A3d)

CO_2 emissions from 1A3d Navigation account for 0.5 % of total EU-15 GHG emissions in 2005. Between 1990 and 2005, CO_2 emissions from navigation increased by 12 % in the EU-15 (Table 3.58). The emissions from this key source are due to fossil fuel consumption in navigation, which increased by more than 30 % between 1990 and 2005. The total CO_2 emission trend is dominated by emissions from gas/diesel oil and residual oil (Figure 3.64).

Figure 3.64 1A3d Navigation: CO_2 Emission Trend



Four Member States (Italy, France, Spain and the United Kingdom) contributed most to the emissions from this source (72 %). Most Member States increased emissions from navigation between 1990 and 2005, except for Germany, Ireland and Denmark. The Member States with the highest increases in absolute terms were Spain, France and Italy (Table 3.58).

Table 3.58 1A3d Navigation: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005	
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	52	77	81	0.4%	5	6%	29	56%
Belgium	267	343	334	1.5%	-9	-3%	67	25%
Denmark	554	493	543	2.5%	50	10%	-11	-2%
Finland	441	523	533	2.5%	9	2%	91	21%
France	1,691	2,501	2,602	12.1%	101	4%	911	54%
Germany	2,050	868	998	4.6%	130	15%	-1,052	-51%
Greece	1,825	2,153	2,091	9.7%	-62	-3%	266	15%
Ireland	84	60	57	0.3%	-3	-4%	-27	-32%
Italy	5,401	6,229	6,143	28.5%	-86	-1%	742	14%
Luxembourg	6	6	6	0.0%	0	0%	0	0%
Netherlands	405	832	637	3.0%	-195	-23%	233	57%
Portugal	240	211	263	1.2%	51	24%	22	9%
Spain	1,500	2,419	2,560	11.9%	141	6%	1,060	71%
Sweden	538	568	536	2.5%	-32	-6%	-2	0%
United Kingdom	4,122	3,674	4,179	19.4%	505	14%	57	1%
EU-15	**19,175**	**20,957**	**21,563**	**100.0%**	**606**	**3%**	**2,388**	**12%**

1A3d Navigation – Residual Oil (CO_2)

CO_2 emissions from Residual oil account for 36 % of CO_2 emissions from 1A3d Navigation in 2005. Between 1990 and 2005, CO_2 emissions from Residual oil increased by 35 % in the EU-15. The countries with the highest increase were Greece, Spain and the United Kingdom. The Member State with the highest decrease is France. Austria, Belgium, Germany, Luxembourg and the Netherlands report emissions as 'Not occuring', 'Not estimated' or '0' (Table 3.59).

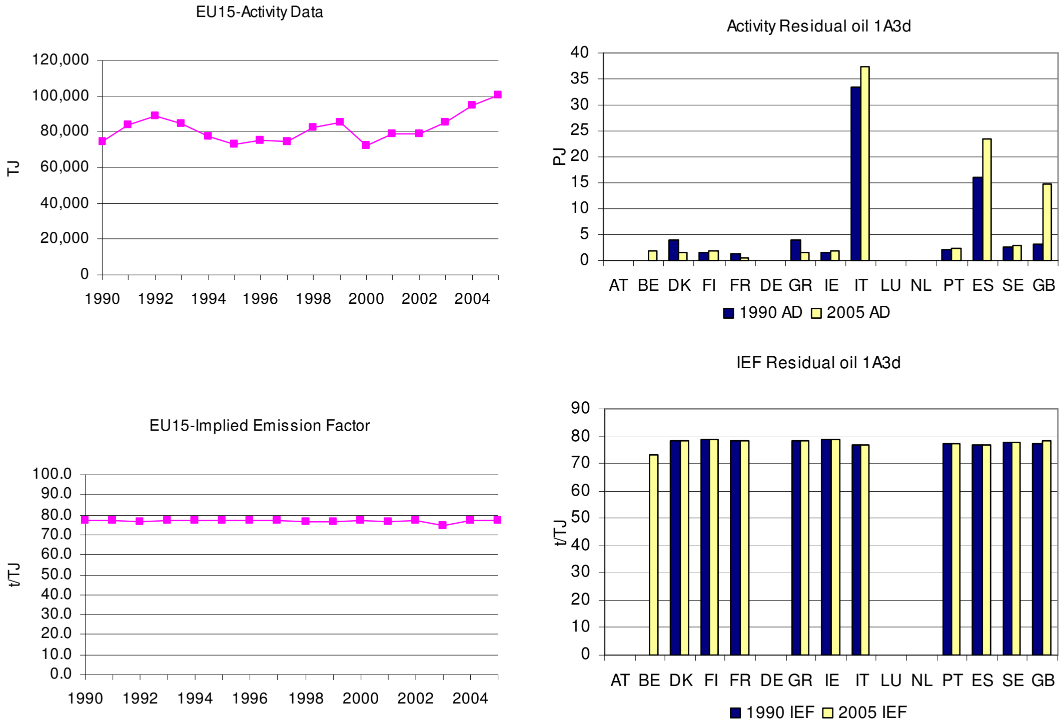
Table 3.59 1A3d Navigation, residual oil: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	NO	NO	NO	-	-	-	-	-	-	-	-
Belgium	IE	IE	126	1.6%	126	-	126	-	C, M	RS	C
Denmark	300	133	117	1.5%	-16	-12%	-182	-61%	C	NS	C
Finland	123	158	151	1.9%	-7	-5%	27	22%	T3, M	-	CS
France	102	50	39	0.5%	-11	-22%	-63	-62%	C	NS	CS
Germany	NO	NO	NO	-	-	-	-	-	-	-	-
Greece	730	1,154	1,033	13.3%	-121	-10%	304	42%	C	NS	C
Ireland	63	56	53	0.7%	-3	-6%	-9	-15%	T1	NS	CS
Italy	2,553	2,769	2,861	36.9%	93	3%	308	12%	T1, T2	NS	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	-	-	-
Netherlands	NO	NO	NO	-	-	-	-	-	-	-	-
Portugal	173	152	189	2.4%	37	24%	16	9%	C	NS,AS	C
Spain	1,234	1,693	1,801	23.3%	108	6%	567	46%	C	AS, IS	C
Sweden	194	231	231	3.0%	-1	0%	36	19%	T1	NS	CS
United Kingdom	251	858	1,144	14.8%	285	33%	893	355%	T2	NS, AS	CS
EU-15	**5,723**	**7,255**	**7,746**	**100.0%**	**490**	**7%**	**2,023**	**35%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Greece, Italy, the United Kingdom and Spain account for 88 % of emissions and for 77 % of activity data (Figure 3.65). The IEF for the EU-15 is 77.2 t/TJ Residual oil in 2005.

Figure 3.65 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 57 % of CO_2 emissions from 1A3d "Navigation" in 2005 (Table 3.60). The CO_2 emissions from Gas/Diesel oil increased slightly between 1990 and 2005 (+0,2 %). Member States with the highest increase in percent were Spain, Austria and the France. The countries with the highest decrease were Germany and Ireland.

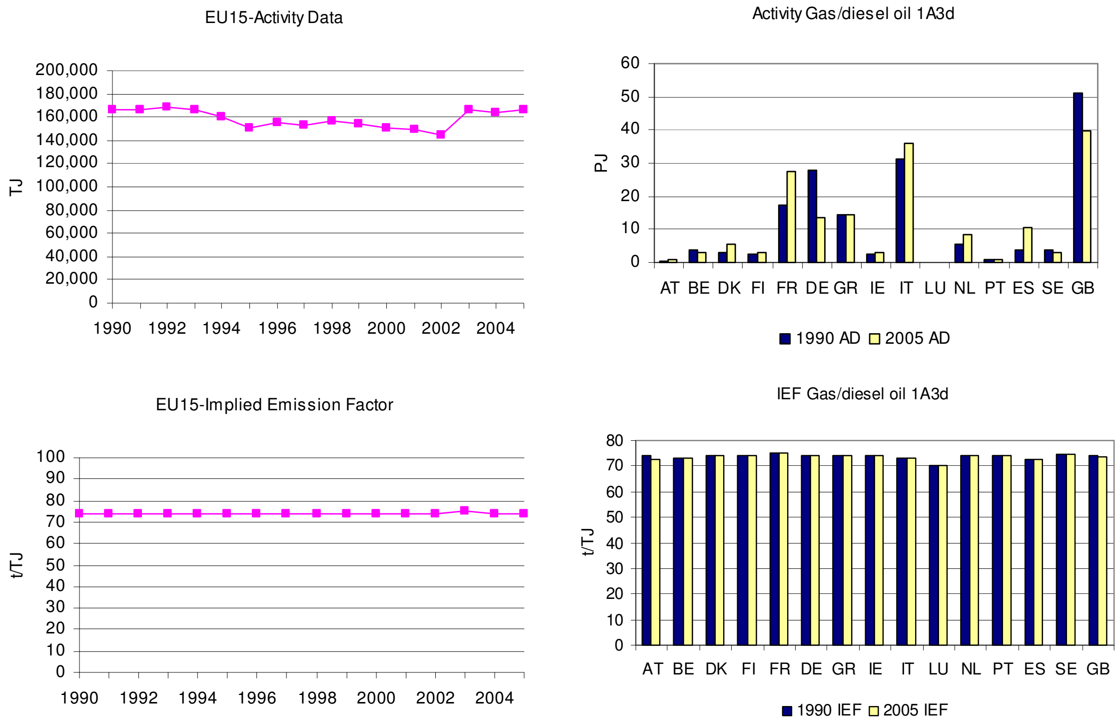
Table 3.60 1A3d Navigation, gas/diesel oil: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	43	68	72	0.6%	5	7%	30	69%	CS	NS	CS
Belgium	267	343	208	1.7%	-135	-39%	-58	-22%	C,M	RS	C
Denmark	231	331	397	3.2%	66	20%	165	72%	C	NS	C
Finland	186	207	222	1.8%	15	7%	35	19%	T2	NS	CS
France	1,291	1,911	2,050	16.7%	139	7%	759	59%	C	NS	CS
Germany	2,050	868	998	8.1%	130	15%	-1,052	-51%	T1	NS/AS	CS
Greece	1,068	979	1,040	8.5%	61	6%	-28	-3%	C	NS	D
Ireland	21	3	4	0.0%	1	16%	-18	-83%	T1	NS	CS
Italy	2,299	2,807	2,629	21.4%	-179	-6%	329	14%	T1, T2	NS	CS
Luxembourg	6	6	6	0.0%	0	0%	0	0%	C	-	C
Netherlands	405	832	637	5.2%	-195	-23%	233	57%	T2	NS/Q	CS
Portugal	67	59	74	0.6%	14	24%	6	9%	C	NS,AS	C
Spain	266	726	759	6.2%	33	5%	493	185%	T2	NS, AS	C
Sweden	269	262	231	1.9%	-31	-12%	-38	-14%	T1	NS	CS
United Kingdom	3,763	2,692	2,934	23.9%	242	9%	-830	-22%	T2	NS, AS	CS
EU-15	**12,233**	**12,094**	**12,259**	**100.0%**	**166**	**1%**	**27**	**0%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

France, Germany, Greece, Italy and the United Kingdom account for 79 % of activity data and for 79 % of the CO_2 emissions (Figure 3.66). The IEF for the EU-15 is 73.78 t/TJ residual oil in 2005.

Figure 3.66 1A3d Navigation, gas/diesel oil: Activity data and implied emission factors for CO_2



3.2.3.5. Other (1A3e)

CO_2 emissions from 1A3e Other account for 0.2 % of total EU-15 GHG emissions in 2005. 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 28 % between 1990 and 2005. (Table 3.61). A fuel shift occurred from oil to gas.

Two Member States (Germany and France) contributed most to the emissions from this source (64 %). Between 1990 and 2005 all Member States except Spain (-100%) and Belgium (-33 %) reported increasing emissions. Denmark, Luxembourg, the Netherlands, Portugal and Spain report emissions as 'Not occuring' or '0' (Table 3.61).

Table 3.61 1A3e Other: Member States' contributions to CO_2 emissions

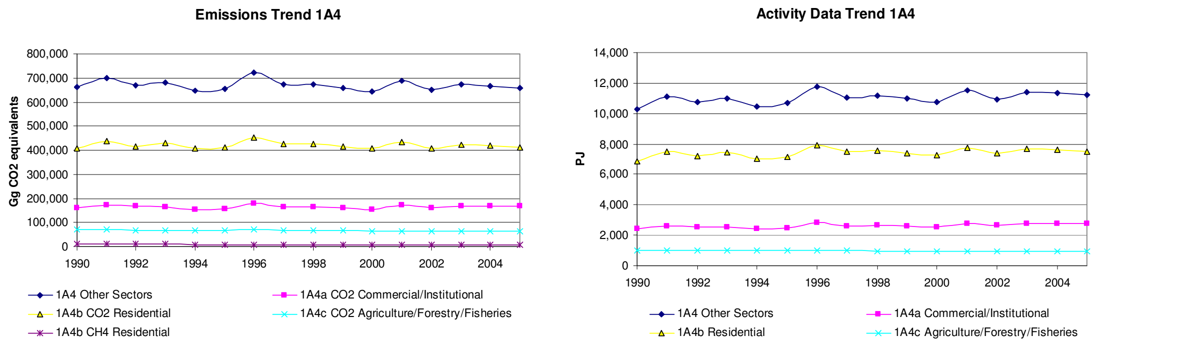
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005	
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	224	441	544	6.5%	103	23%	320	143%
Belgium	196	154	131	1.6%	-22	-15%	-65	-33%
Denmark	NO	NO	NO	-	-	-	-	-
Finland	661	708	708	8.4%	0	0%	47	7%
France	213	845	963	11.5%	118	14%	750	352%
Germany	4,302	4,511	4,422	52.6%	-89	-2%	120	3%
Greece	NO	2	4	0.1%	2	94%	4	-
Ireland	62	136	165	2.0%	29	22%	103	166%
Italy	406	707	751	8.9%	43	6%	344	85%
Luxembourg	NO	NO	NO	-	-	-	-	-
Netherlands	NO	NO	NO	-	-	-	-	-
Portugal	NO	NO	NO	-	-	-	-	-
Spain	20	243	NA,NE	-	-243	-100%	-20	-100%
Sweden	231	269	275	3.3%	5	2%	43	19%
United Kingdom	268	419	443	5.3%	24	6%	175	65%
EU-15	**6,584**	**8,436**	**8,407**	**100.0%**	**-29**	**0%**	**1,822**	**28%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

3.2.4. Other Sectors (CRF Source Category 1A4)

Figure 3.67 shows the trend of total GHG emissions within source category 1A4 and the dominating sources: CO_2 emissions from 1A4b Residential and from 1A4c Commercial/Residential. The emission of the key sources only changed slightly, CO_2 emissions from 1A4c and CH_4 emissions from 1A4b decreased.

Figure 3.67 1A4 Other Sectors: Total, CO_2 and CH_4 emission trends



GHG emissions from source category 1A4 account for 15 % 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: Biomass (CH_4)
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 3.62 shows total GHG, $CO_2$and CH_4 emissions from 1A4 Other sectors. Between 1990 and 2005 CO_2 emissions from 1A4 Other Sectors increased by 1 % , CH_4 decreased by 41% and N_2O emissions decreased by 5%.

Table 3.62 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 2005 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO_2 emissions in 2005 (Gg)	CH_4 emissions in 1990 (Gg CO_2 equivalents)	CH_4 emissions in 2005 (Gg CO_2 equivalents)
Austria	14,947	15,602	14,266	15,046	388	262
Belgium	28,133	31,402	27,215	30,519	129	90
Denmark	9,339	7,481	9,139	7,176	91	203
Finland	7,308	5,286	7,040	5,022	181	192
France	98,975	105,258	93,680	101,565	3,983	2,272
Germany	207,893	165,820	204,313	164,515	2,593	736
Greece	8,984	15,241	8,126	14,161	213	217
Ireland	10,469	10,938	10,065	10,550	95	50
Italy	80,253	96,923	76,508	92,969	309	536
Luxembourg	1,257	1,282	1,246	1,274	11	8
Netherlands	38,305	38,079	37,868	37,671	393	370
Portugal	4,610	7,067	4,025	6,587	348	318
Spain	26,399	40,132	25,280	39,133	819	657
Sweden	11,287	5,643	10,721	5,100	248	241
United Kingdom	111,957	112,537	109,451	111,405	1,549	487
EU-15	**660,114**	**658,692**	**638,942**	**642,691**	**11,351**	**6,641**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.63 provides information on the contribution of Member States to EU-15 recalculations in CO_2 from 1A4 Other sectors for 1990 and 2004 and main explanations for the largest recalculations in absolute terms.

Table 3.63 1A4 Other Sectors: Contribution of MS to EU-15 recalculations in CO_2 for 1990 and 2004 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2004		Main explanations
	Gg	Percent	Gg	Percent	
Austria	-125	-0.9	-145	-1.0	Revised energy data for railways (coal, diesel, electricity) up to 2000 according to the updated national energy balance.
Belgium	0	0.0	-249	-0.8	In the Flemish region most recalculations in the energy sector of the emission inventory 1990-2005 are performed in the last years (2003 and 2004) because more accurate information became available for these years. The year 2004 has undergone a complete revision because the emissions of 2004 reported last year were reported on a temporary basis.
Denmark	-20	-0.2	88	1.2	Military: A revision of the 1985-2004 time-series of emission factors has been made based on new aggregated emission factors from road transport. National sea transport and fisheries:A new research project carried out by Winther (2007b) has given new knowledge, and the following changes have therefore been made to the national inventory: 1) Updated emission factors has given some changes in the total emissions from 1985-2004, 2) The residual fuel use amount from the fishery sector in the national energy statistics, has been moved to the national sea transport category, resulting in fuel use and emission changes 1985-2004. Less diesel fuel is subtracted from fisheries, due to an error correction for inland waterways. This results in fuel use and emission changes 1985-2003. Agriculture: Updated stock information for tractors and harvesters 2001-2004, has given a fuel use and emissions increase for these years.
Finland	-25	-0.4	-648	-10.9	The most important changes were the updates of the heating energy calculation system and TYKO submodel
France	0	0.0	-4,016	-3.8	update of enery consumption, rervision of method for wood (1A4b)
Germany	0	0.0	2,580	1.5	updated activity data
Greece	0	0.0	0	0.0	
Ireland	67	0.7	-334	-3.2	Reallocation of all heavy fuel oil consumption from the commercial sector under 1.A.4 Other Sectors to 1.A.2 Manufacturing Industries and Construction;
Italy	-41	-0.1	3,095	3.7	Coal and natural gas emission factors have been updated; Activity data reported in the National energy balance have been updated
Luxembourg	0	0.0	0	0.0	
Netherlands	0	0.0	0	0.0	
Portugal	0	0.0	-6	-0.1	data updates
Spain	0	0.0	-22	-0.1	updated activity data according to revised energy balance (2004), error correction (1991, 2003)
Sweden	0	0.0	0	0.0	
UK	210	0.2	325	0.3	Revisions to DTI fuel use statistic in 1A4 a b and c, including a large decrease in coal consumption, and an increase in natural gas consumption. Reallocation of gas oil to 1A4a and 1A4b, as a result of the reduction in gas oil allocated to the rail sector. Revisions to emission factors for coke in 1A4b
EU-15	**66**	**0.0**	**668**	**0.1**	

Table 3.64 provides information on the contribution of Member States to EU-15 recalculations in CH_4 from 1A4 Other sectors for 1990 and 2004.

Table 3.64 1A4 Other Sectors: Contribution of MS to EU-15 recalculations in CH_4 for 1990 and 2004 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

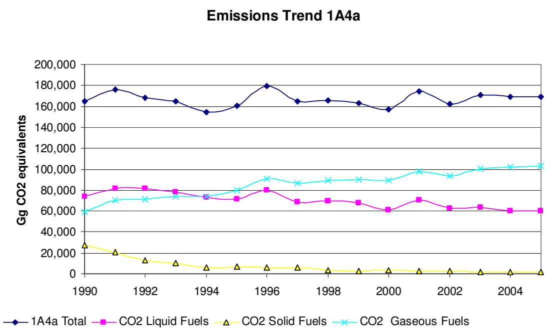
	1990		2004		Main explanations
	Gg	Percent	Gg	Percent	
Austria	0	0.0	-6	-2.5	Revised energy data for railways (coal, diesel, electricity) up to 2000 according to the updated national energy balance.
Belgium	0	0.0	-1	-1.3	In the Flemish region most recalculations in the energy sector of the emission inventory 1990-2005 are performed in the last years (2003 and 2004) because more accurate information became available for these years. The year 2004 has undergone a complete revision because the emissions of 2004 reported last year were reported on a temporary basis.
Denmark	0	0.0	21	11.8	Military: A revision of the 1985-2004 time-series of emission factors has been made based on new aggregated emission factors from road transport. National sea transport and fisheries:A new research project carried out by Winther (2007b) has given new knowledge, and the following changes have therefore been made to the national inventory: 1) Updated emission factors has given some changes in the total emissions from 1985-2004, 2) The residual fuel use amount from the fishery sector in the national energy statistics, has been moved to the national sea transport category, resulting in fuel use and emission changes 1985-2004. Less diesel fuel is subtracted from fisheries, due to an error correction for inland waterways. This results in fuel use and emission changes 1985-2003. Agriculture: Updated stock information for tractors and harvesters 2001-2004, has given a fuel use and emissions increase for these years.
Finland	-19	-9.5	-16	-7.4	The most important changes were the updates of the heating energy calculation system and TYKO submodel
France	-14	-0.4	-854	-25.9	update of enery consumption, rervision of method for wood (1A4b)
Germany	0	0.0	105	16.4	updated activity data
Greece	0	0.0	0	0.0	
Ireland	1	0.7	0	0.0	Reallocation of all heavy fuel oil consumption from the commercial sector under 1.A.4 Other Sectors to 1.A.2 Manufacturing Industries and Construction;
Italy	0	0.0	-2	-0.3	Activity data reported in the National energy balance have been updated
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	-1	-0.1	-139	-20.5	Revisions to DTI fuel use statistic in 1A4 a and b, including a large decrease in coal consumption, and an increase in natural gas consumption. Reallocation of gas oil to 1A4a and 1A4b, as a result of the reduction in gas oil allocated to the rail sector. Revision to the emission factor for petrol use in 1A4 b and c.
EU-15	**-33**	**-0.3**	**-892**	**-11.5**	

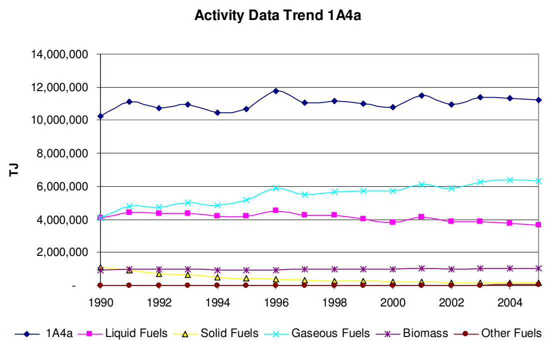
3.2.4.1. Commercial/Institutional (1A4a)

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 are the fifth largest key source of GHG emissions in the EU-15 and account for 4 % of total GHG emissions in 2005.

Figure 3.68 shows the emission trend within the category 1A4a, which is mainly dominated by CO_2 emissions from liquid and gaseous fuels. Total emissions increased by 3 %, mainly due to increases in emissions from gaseous fuels (+72 %). Decreasing emissions are reported for solid (-94 %) and liquid (-19 %) fuels.

Figure 3.68 1A4a Commercial/Institutional: Total and CO_2 emission and activity trends





Between 1990 and 2005, CO_2 emissions from 1A4a increased by 3 % in the EU-15 (Table 3.65). Main factors influencing CO_2 emissions from this source category are (1) outdoor temperature, (2) number and size of offices, (3) building codes, (4) age distribution of the existing building stock, and (5) fuel split for heating and warm water. Fossil fuel consumption in Commercial/Institutional increased by 9 % between 1990 and 2005, 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 (76 %). The Member States with the highest increases in absolute terms were Spain, Italy, France and the Netherlands. The Member State with the highest reduction in absolute values was Germany.

Table 3.65 1A4a Commercial/Institutional: Member States' contributions to CO_2 emissions in 1990, 2004 and 2005

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005	
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	2,518	3,542	4,056	2.4%	514	15%	1,539	61%
Belgium	4,272	5,978	5,958	3.6%	-20	0%	1,686	39%
Denmark	1,403	971	911	0.5%	-59	-6%	-492	-35%
Finland	1,951	1,127	1,043	0.6%	-84	-7%	-908	-47%
France	27,895	30,865	30,858	18.4%	-7	0%	2,963	11%
Germany	63,950	46,486	45,094	27.0%	-1,392	-3%	-18,856	-29%
Greece	527	1,221	1,549	0.9%	328	27%	1,022	194%
Ireland	2,338	2,608	2,862	1.7%	254	10%	524	22%
Italy	16,171	25,544	27,431	16.4%	1,887	7%	11,260	70%
Luxembourg	583	618	598	0.4%	-20	-3%	15	3%
Netherlands	7,501	11,465	9,899	5.9%	-1,566	-14%	2,398	32%
Portugal	744	3,494	3,421	2.0%	-73	-2%	2,678	360%
Spain	3,745	8,974	9,590	5.7%	616	7%	5,845	156%
Sweden	2,541	792	657	0.4%	-135	-17%	-1,885	-74%
United Kingdom	25,595	23,769	23,376	14.0%	-394	-2%	-2,219	-9%
EU-15	**161,732**	**167,454**	**167,304**	**100.0%**	**-150**	**0%**	**5,572**	**3%**

1A4 a Commercial/Institutional – Liquid Fuels (CO_2)

In 2005 CO_2 from liquid fuels had a share of 35 % within source category 1A4a (compared to 45 % in 1990). Between 1990 and 2005 the emissions decreased by 19 % (Table 3.66). Five Member States had increases in this time, with the highest in Portugal (+316 %) and Greece (+167%). The highest absolute reduction was achieved in Germany. Between 2004 and 2005 EU-15 total emission decreased by 1 %.

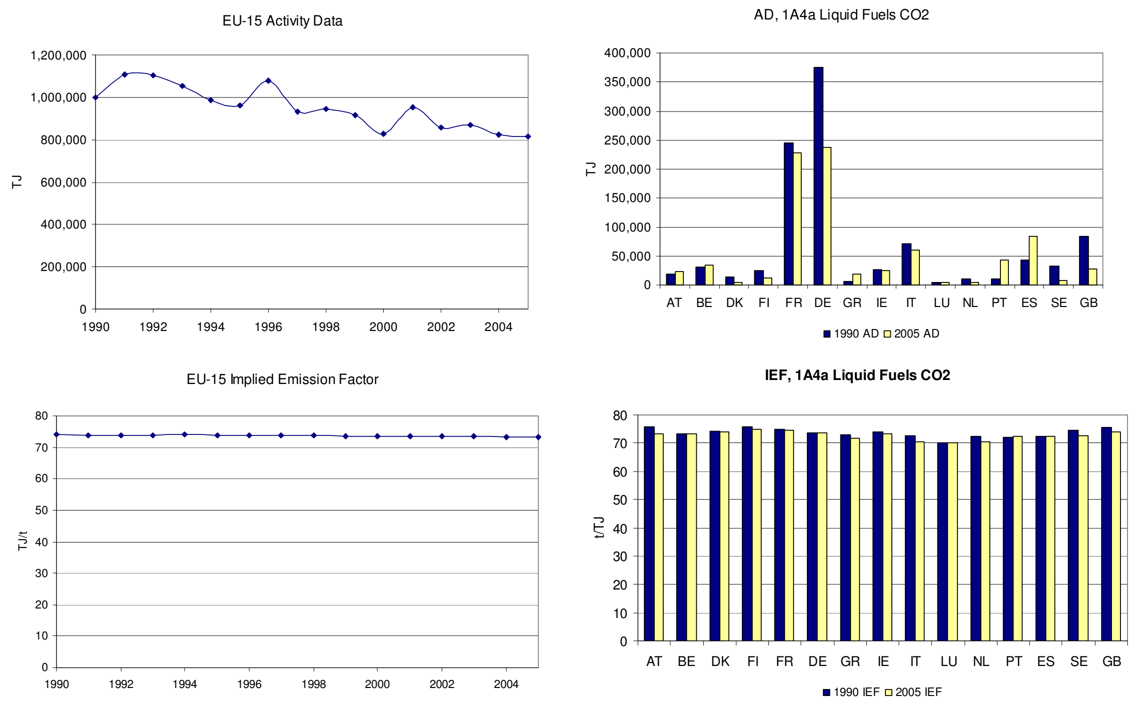
Table 3.66 **1A4a Commercial/Institutional, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor**

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	1,448	1,591	1,662	2.8%	71	4%	213	15%	T2	NS	CS
Belgium	2,312	2,467	2,464	4.1%	-4	0%	152	7%	C	RS	C
Denmark	1,008	356	318	0.5%	-38	-11%	-690	-68%	C	NS	CS/C
Finland	1,885	997	919	1.5%	-78	-8%	-967	-51%	T1	NS	CS
France	18,284	17,180	17,046	28.6%	-135	-1%	-1,238	-7%	C	NS	CS
Germany	27,633	18,460	17,444	29.2%	-1,015	-6%	-10,188	-37%	T2	NS/AS	CS
Greece	505	1,120	1,348	2.3%	229	20%	843	167%	C	NS	D
Ireland	1,977	1,755	1,798	3.0%	43	2%	-179	-9%	T1	NS	CS
Italy	5,142	4,325	4,307	7.2%	-18	0%	-835	-16%	T2	NS	CS
Luxembourg	331	342	322	0.5%	-20	-6%	-9	-3%	C	-	C
Netherlands	739	348	282	0.5%	-66	-19%	-457	-62%	T2	NS	CS
Portugal	744	3,162	3,094	5.2%	-68	-2%	2,350	316%	T2	NS	D,C
Spain	3,196	6,109	6,103	10.2%	-6	0%	2,908	91%	T2	NS	C
Sweden	2,455	726	548	0.9%	-177	-24%	-1,907	-78%	T1,T2,T3	NS	CS
United Kingdom	6,363	1,523	2,042	3.4%	519	34%	-4,321	-68%	T2	NS, AS	CS
EU-15	**74,021**	**60,460**	**59,698**	**100.0%**	**-762**	**-1%**	**-14,323**	**-19%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.69 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 more than 68% of the CO_2 emissions from liquid fuels in 1A4a. Fuel consumption in the EU-15 decreased by 19 % between 1990 and 2005. The implied emission factor of EU-15 was 73.4 t/TJ in 2005.

Figure 3.69 **1A4a Commercial/Institutional, liquid fuels: Activity Data and Implied Emission Factors for CO_2**



1A4a Commercial/Institutional – Solid Fuels (CO_2)

In 2005, CO_2 from solid fuels had a share of 1 % within source category 1A4a (compared to 17 % in 1990). Between 1990 and 2005 the emissions decreased by 94 % (Table 3.67). Denmark, Sweden, France, Finland and Portugal report emissions as 'Not occuring' in 2005. All Member States decreased emissions. Between 2004 and 2005 EU-15 emissions declined by 3 %.

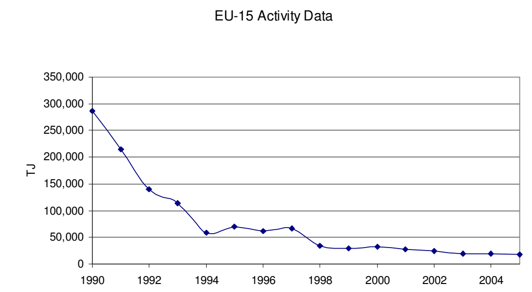
Table 3.67 **1A4a Commercial/Institutional, solid fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor**

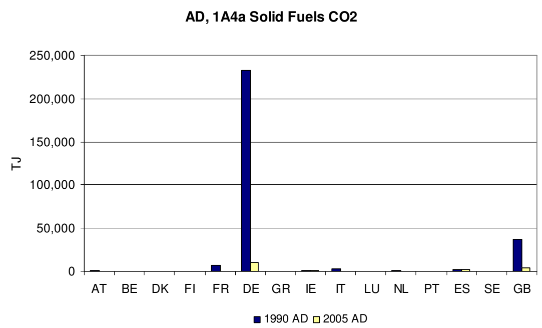
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	90	64	43	2.5%	-21	-32%	-47	-52%	T2	NS	CS
Belgium	9	2	2	0.1%	0	0%	-7	-78%	C	RS	C
Denmark	8	0	NO	-	-	-	-	-	-	-	-
Finland	NO	NO	NO	-	-	-	-	-	-	-	-
France	698	NO	NO	-	-	-	-698	-100%	C	NS	CS
Germany	22,712	982	1,000	58.0%	17	2%	-21,712	-96%	T2	NS/AS	CS
Greece	10	NO	8	-	-	-	-2	-23%	C	NS	D
Ireland	138	104	105	6.1%	1	1%	-33	-24%	T1	NS	CS
Italy	218	2	2	0.1%	0	-9%	-216	-99%	T2	NS	CS
Luxembourg	48	4	4	0.2%	0	-10%	-44	-93%	C	-	C
Netherlands	128	114	29	1.7%	-86	-75%	-99	-78%	T2	NS	CS
Portugal	NO	NO	NO	-	-	-	-	-	-	-	-
Spain	154	123	125	7.2%	2	1%	-30	-19%	T2	NS	C
Sweden	NO	NO	NO	-	-	-	-	-	-	-	-
United Kingdom	3,454	391	407	23.6%	17	4%	-3,047	-88%	T2	NS, AS	CS
EU-15	**27,668**	**1,787**	**1,725**	**100.0%**	**-63**	**-3%**	**-25,943**	**-94%**			

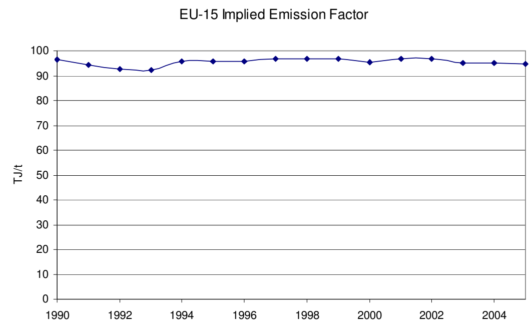
Abbreviations explained in the Chapter 'Units and abbreviations'.

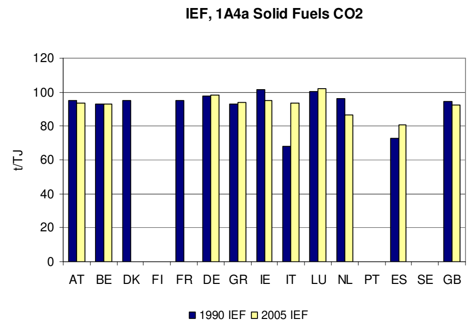
Figure 3.70 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by Germany and the Unitded Kingdom; together in 2005 they cause up to 82 % of the CO_2 emissions from solid fuels in 1A4a. Fuel consumption in the EU-15 decreased by 94 % between 1990 and 2005. The implied emission factor of EU-15 was 94.8 t/TJ in 2005.

Figure 3.70 **1A4a Commercial/Institutional, solid fuels: Activity Data and Implied Emission Factors for CO_2**









1A4a Commercial/Institutional – Gaseous Fuels (CO_2)

In 2005 CO_2 from gaseous fuels had a share of 61 % within source category 1A4a (compared to 36 % in 1990). Between 1990 and 2005 the emissions increased by 74 % (Table 3.68). All Member States reported increasing emissions. The highest absolute increase occurred in Germany and Italy. Between 2004 and 2005 EU-15 emissions changed marginally (1 %), five Member States reported a decrease.

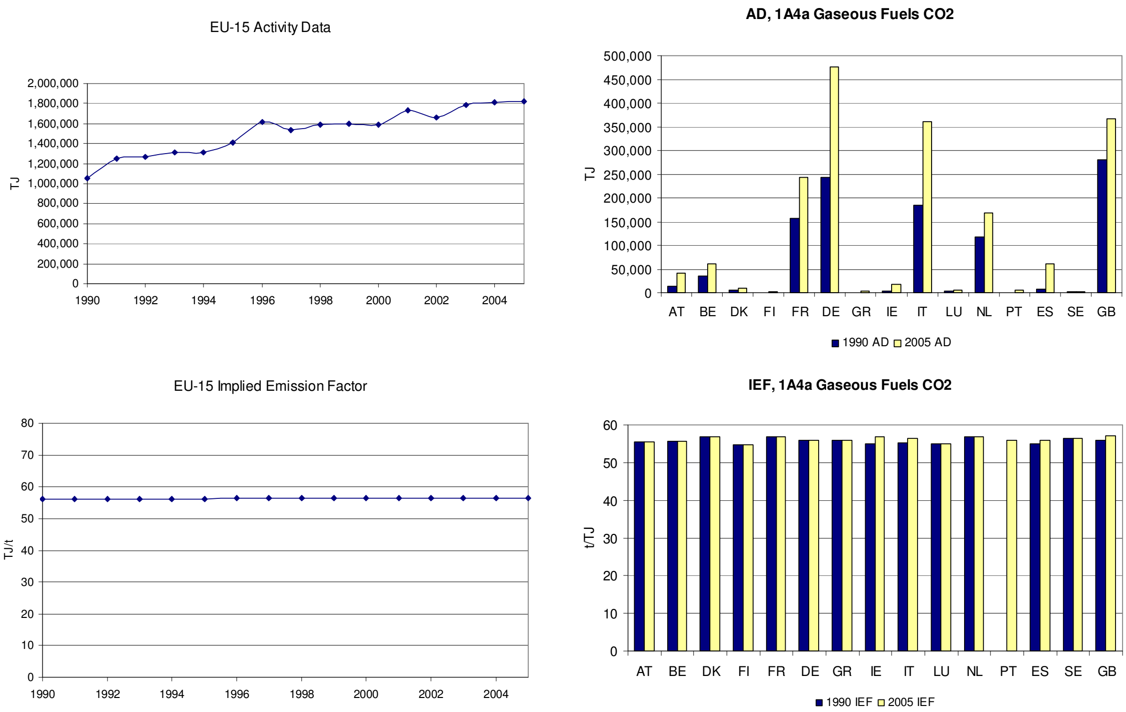
Table 3.68 **1A4a Commercial/Institutional, gaseous fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor**

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	740	1,795	2,280	2.2%	484	27%	1,540	208%	T2	NS	CS
Belgium	1,921	3,433	3,417	3.3%	-17	0%	1,496	78%	C	RS	C
Denmark	365	589	590	0.6%	1	0%	224	61%	C	NS	CS/C
Finland	50	122	116	0.1%	-6	-5%	66	131%	T1	NS	CS
France	8,910	13,684	13,812	13.4%	128	1%	4,902	55%	C	NS	CS
Germany	13,605	27,044	26,650	25.9%	-394	-1%	13,044	96%	T2	NS/AS	CS
Greece	12	102	193	0.2%	92	90%	181	1504%	C	NS	D
Ireland	223	749	959	0.9%	210	28%	735	329%	T1	NS	CS
Italy	10,243	18,584	20,333	19.8%	1,750	9%	10,091	99%	T2	NS	CS
Luxembourg	204	271	273	0.3%	1	0%	69	34%	C	-	C
Netherlands	6,634	11,003	9,588	9.3%	-1,414	-13%	2,954	45%	T2	NS	CS
Portugal	NO	332	327	0.3%	-5	-2%	327	-	T2	NS	D,C
Spain	395	2,741	3,362	3.3%	621	23%	2,967	752%	T2	NS	CS
Sweden	86	66	108	0.1%	42	63%	22	26%	T1,T2,T3	NS	CS
United Kingdom	15,717	21,815	20,885	20.3%	-930	-4%	5,168	33%	T2	NS, AS	CS
EU-15	**59,106**	**102,331**	**102,893**	**100.0%**	**562**	**1%**	**43,787**	**74%**			

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, Italy and the United Kingdom; together they cause 79 % of the CO_2 emissions from gaseous fuels in 1A4a. Fuel combustion in the EU-15 rose by 73 % between 1990 and 2005. The implied emission factor of EU-15 was 56.5 t/TJ in 2005.

Figure 3.71 **1A4a Commercial/Institutional, gaseous fuels: Activity Data and Implied Emission Factors for CO_2**

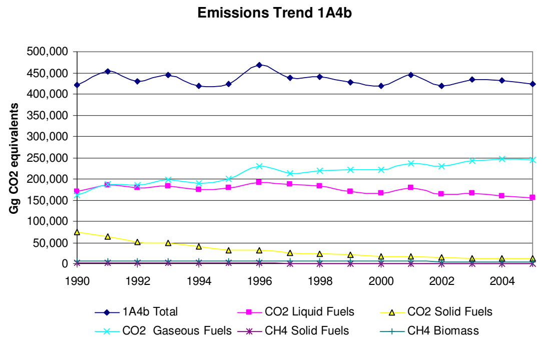


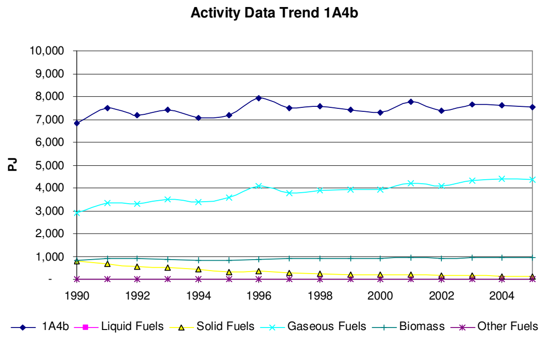
3.2.4.2. Residential (1A4b)

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 source of GHG emissions in the EU-15 and account for 10 % of total GHG emissions in 2005.

Figure 3.72 shows the emission trend within the category 1A4b, which is mainly dominated by CO_2 emissions from liquid and gaseous fuels. Total GHG emissions are at the same level as in 1990, altough CO_2 emissions from gaseous fuels (+52 %), but this was counterbalanced by decreasing emissions from all other fuels.

Figure 3.72 1A4 Residential: Total, CO_2 and CH_4 emission and activity trends





CO_2 emissions from 1A4b Residential

Between 1990 and 2005, CO_2 emissions from households increased by 2 % in the EU-15 (Table 3.69). Main factors influencing CO_2 emissions from this source category are (1) outdoor temperature, (2) number and size of dwellings, (3) building codes, (4) age distribution of the existing building stock, and (5) fuel split for heating and warm water. Fossil fuel consumption in households increased by 10 % between 1990 and 2005, with a fuel shift from coal and oil to gas.

Between 1990 and 2005, the largest reduction in absolute terms was reported by Germany reducing emissions by 16 million tonnes. Netherlands, Denmark, and Finland show emission reductions of more than 1 million tonne each, and Sweden more than 4 million tonnes. Spain and France had the largest emission increases in absolute terms. One reason for the performance of the Nordic countries 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 3.69 1A4b Residential: Member States' contributions to CO_2 emissions in 1990, 2004 and 2005

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005	
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	9,906	8,770	9,338	2.3%	568	6%	-568	-6%
Belgium	20,213	22,659	22,166	5.4%	-492	-2%	1,953	10%
Denmark	5,084	4,112	4,009	1.0%	-102	-2%	-1,074	-21%
Finland	3,072	2,175	2,050	0.5%	-125	-6%	-1,022	-33%
France	55,173	61,573	61,354	14.9%	-219	0%	6,181	11%
Germany	129,446	118,334	113,032	27.4%	-5,302	-4%	-16,414	-13%
Greece	4,671	9,602	9,882	2.4%	280	3%	5,211	112%
Ireland	7,066	6,849	6,859	1.7%	10	0%	-207	-3%
Italy	51,990	53,362	57,161	13.9%	3,799	7%	5,171	10%
Luxembourg	585	620	600	0.1%	-20	-3%	15	3%
Netherlands	19,495	19,087	18,179	4.4%	-908	-5%	-1,315	-7%
Portugal	1,621	2,276	2,261	0.5%	-15	-1%	640	39%
Spain	12,979	19,513	19,675	4.8%	162	1%	6,696	52%
Sweden	6,421	3,034	2,409	0.6%	-625	-21%	-4,012	-62%
United Kingdom	78,712	87,626	83,572	20.3%	-4,054	-5%	4,860	6%
EU-15	**406,435**	**419,592**	**412,549**	**100.0%**	**-7,044**	**-2%**	**6,114**	**2%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A4b Residential – Liquid Fuels (CO_2)

In 2005 CO_2 from liquid fuels had a share of 37 % within source category 1A4b (compared to 40 % in 1990). Between 1990 and 2005 the emissions decreased by 9 % (Table 3.70). The highest absolute increases show Greece and Ireland. The highest absolute decrease was reported by Italy. Between 2004 and 2005 EU-15 emissions decreased by 3 %.

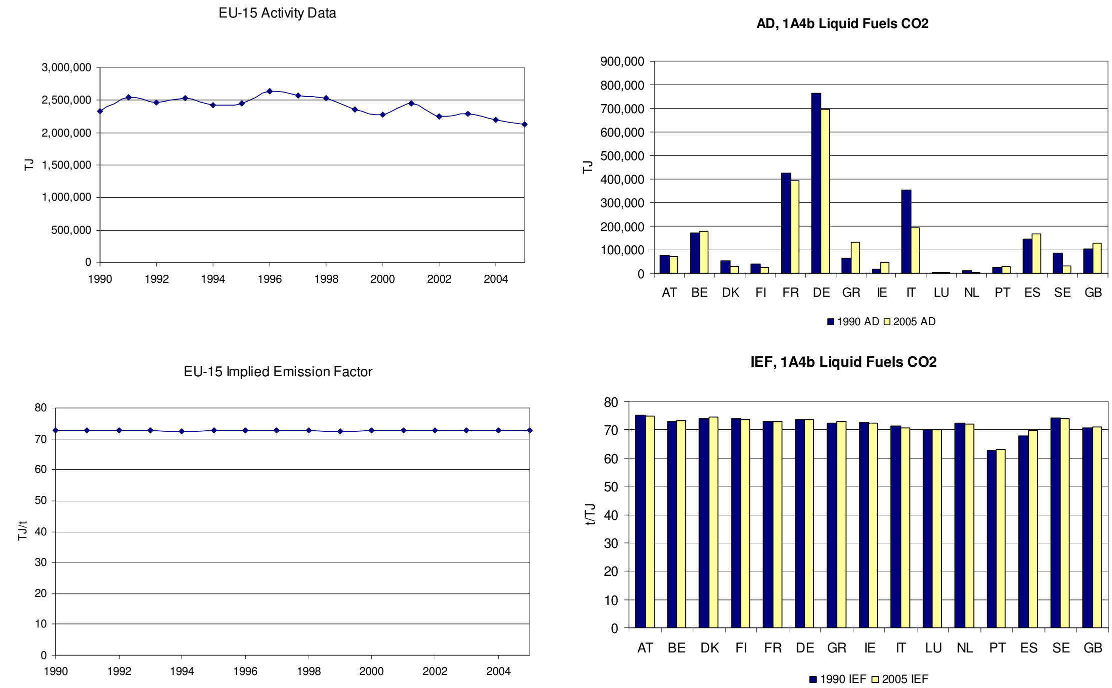
Table 3.70 1A4b Residential, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	5,603	5,174	5,454	3.5%	280	5%	-149	-3%	T2	NS	CS
Belgium	12,609	13,340	13,170	8.5%	-170	-1%	560	4%	C	RS	C
Denmark	4,023	2,315	2,242	1.4%	-73	-3%	-1,781	-44%	C	NS	CS/C/D
Finland	2,951	2,063	1,935	1.2%	-128	-6%	-1,016	-34%	T1	NS	CS
France	30,992	29,086	28,552	18.4%	-534	-2%	-2,440	-8%	C	NS	CS
Germany	56,344	53,556	51,110	33.0%	-2,446	-5%	-5,235	-9%	T2	NS/AS	CS
Greece	4,585	9,498	9,681	6.2%	183	2%	5,096	111%	C	NS	D
Ireland	1,190	3,371	3,459	2.2%	88	3%	2,270	191%	T1	NS	CS
Italy	25,165	13,807	13,726	8.9%	-81	-1%	-11,439	-45%	T2	NS	CS
Luxembourg	334	345	324	0.2%	-20	-6%	-9	-3%	C	-	C
Netherlands	737	281	273	0.2%	-8	-3%	-464	-63%	T2	NS	CS
Portugal	1,621	1,892	1,838	1.2%	-54	-3%	217	13%	T2	NS	D,C
Spain	9,971	12,017	11,821	7.6%	-197	-2%	1,850	19%	T2	NS	C
Sweden	6,335	2,985	2,323	1.5%	-662	-22%	-4,011	-63%	T1,T2,T3	NS	CS
United Kingdom	7,253	9,531	9,052	5.8%	-479	-5%	1,798	25%	T2	NS, AS	CS
EU-15	**169,713**	**159,261**	**154,960**	**100.0%**	**-4,301**	**-3%**	**-14,754**	**-9%**			

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 Belgium, France, Germany and Italy; together they cause 69 % of the CO_2 emissions from liquid fuels in 1A4b. Fuel consumption in the EU-15 decreased by 9 % between 1990 and 2005. The implied emission factor of EU-15 was 72.6 t/TJ in 2005.

Figure 3.73 1A4b Residential, liquid fuels: Activity Data and Implied Emission Factors for CO_2



1A4b Residential –Solid Fuels (CO_2)

In 2005 CO_2 from solid fuels had a share of 3 % within source category 1A4b (compared to 18 % in 1990). Between 1990 and 2005 the emissions decreased by 84 % (Table 3.71). All Member States reported decreasing emissions with the highest reductions in absolute terms in Germany, the UK, Ireland and France. Between 2004 and 2005 EU-15 emissions declined by 10 %, although three Member States reported rising emissions. France, Sweden and Portugal report emissions for 2005 as 'Not occuring'.

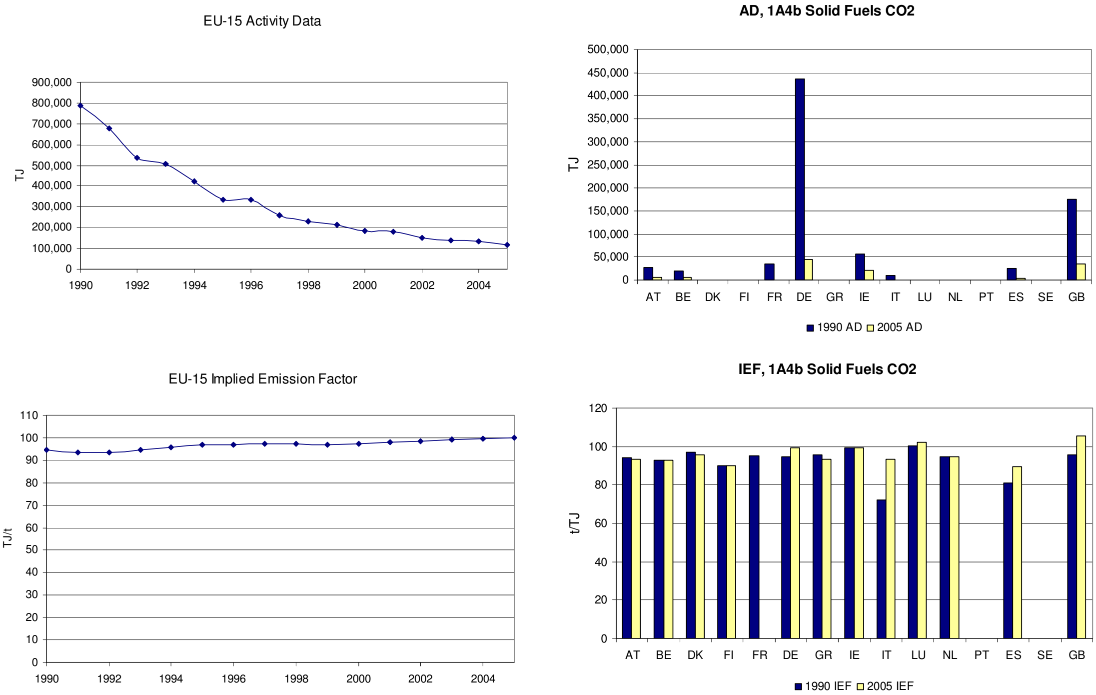
Table 3.71 1A4b Residential, solid fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	2,512	487	509	4.3%	21	4%	-2,004	-80%	T2	NS	CS
Belgium	1,759	552	527	4.5%	-26	-5%	-1,232	-70%	C	RS	C
Denmark	72	3	1	0.0%	-2	-74%	-71	-99%	C	NS	CS/C/D
Finland	33	1	1	0.0%	0	0%	-32	-96%	T1	NS	CS
France	3,350	NO	NO	-	-	-	-3,350	-100%	-	-	-
Germany	41,387	4,858	4,466	37.8%	-392	-8%	-36,921	-89%	T2	NS/AS	CS
Greece	82	23	11	0.1%	-12	-51%	-70	-86%	C	NS	D
Ireland	5,607	2,068	2,159	18.3%	91	4%	-3,448	-61%	T1	NS	CS
Italy	702	33	30	0.3%	-3	-9%	-673	-96%	T2	NS	CS
Luxembourg	48	4	4	0.0%	0	-10%	-44	-93%	C	-	C
Netherlands	61	20	19	0.2%	-1	-3%	-42	-69%	T2	NS	CS
Portugal	NO	NO	NO	-	-	-	-	-	-	-	-
Spain	2,091	421	427	3.6%	6	1%	-1,664	-80%	T2	NS	C
Sweden	NO	NO	NO	-	-	-	-	-	-	-	-
United Kingdom	16,821	4,680	3,653	30.9%	-1,027	-22%	-13,168	-78%	T2	NS, AS	CS
EU-15	**74,525**	**13,151**	**11,806**	**100.0%**	**-1,345**	**-10%**	**-62,719**	**-84%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.74 shows activity data and implied emission factors for CO_2 for EU-15and the Member States. The largest emissions – Germany, Ireland and the United Kingdom; together cause 87 % of the CO_2 emissions from gaseous fuels in 1A4b. Fuel consumption in the EU-15 decreased by 85 % between 1990 and 2005. The implied emission factor of EU-15 was 100 t/TJ in 2005.

Figure 3.74 1A4b Residential, solid fuels: Activity Data and Implied Emission Factors for CO_2



1A4b Residential – Gaseous Fuels (CO_2)

In 2005, CO_2 from gaseous fuels had a share of 58 % within source category 1A4b (compared to 38 % in 1990). Between 1990 and 2005 the emissions increased by 52 % (Table 3.72). All Member States reported increasing emissions except the Netherlands. The highest absolute increase occurred in Germany, Italy, France and the United Kingdom. Between 2004 and 2005, EU-15 emissions changed marginally (-1 %), six Member States reported a decrease.

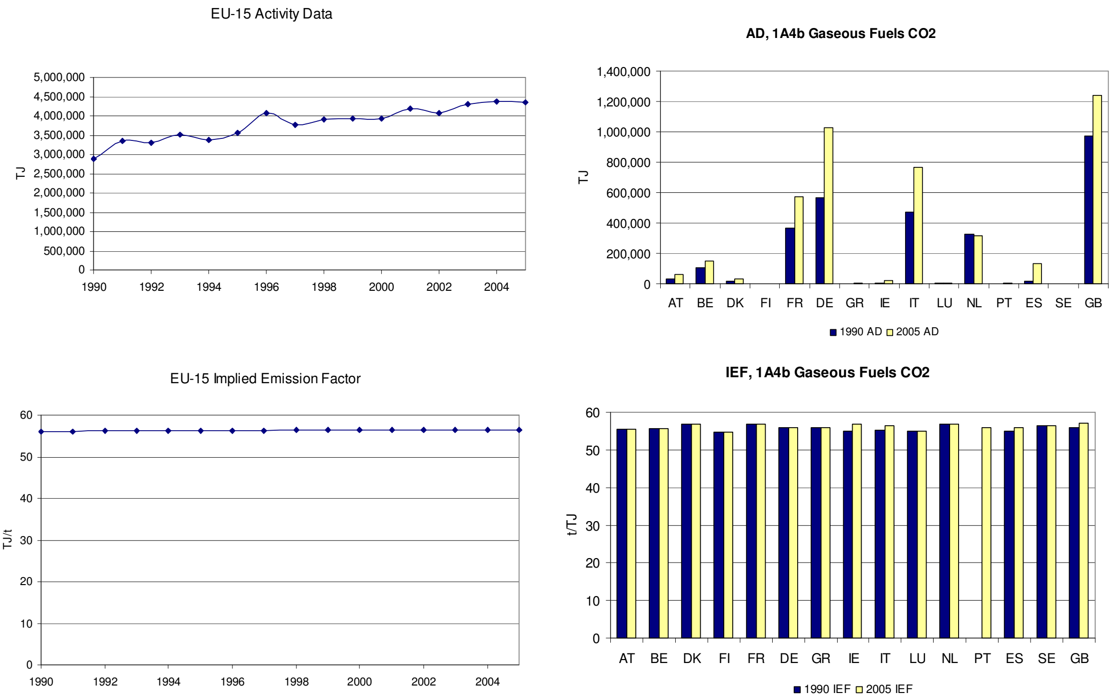
Table 3.72 1A4b Residential, gaseous fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	1,791	3,109	3,375	1.4%	267	9%	1,584	88%	T2	NS	CS
Belgium	5,824	8,747	8,455	3.4%	-291	-3%	2,631	45%	C	RS	C
Denmark	988	1,793	1,766	0.7%	-27	-2%	778	79%	C	NS	CS/C/D
Finland	22	63	67	0.0%	4	6%	45	205%	T1	NS	CS
France	20,764	32,404	32,707	13.3%	303	1%	11,943	58%	C	NS	CS
Germany	31,714	59,920	57,456	23.4%	-2,464	-4%	25,742	81%	T2	NS/AS	CS
Greece	5	81	190	0.1%	109	135%	185	3762%	C	NS	D
Ireland	270	1,409	1,241	0.5%	-169	-12%	971	360%	T1	NS	CS
Italy	26,123	39,523	43,405	17.7%	3,883	10%	17,283	66%	T2	NS	CS
Luxembourg	204	271	273	0.1%	1	0%	69	34%	C	-	C
Netherlands	18,696	18,786	17,887	7.3%	-899	-5%	-809	-4%	T2	NS	CS
Portugal	NO	384	423	0.2%	39	10%	423	-	T2	NS	D,C
Spain	918	7,075	7,427	3.0%	353	5%	6,510	709%	T2	NS	CS
Sweden	86	49	86	0.0%	37	76%	0	0%	T1,T2,T3	NA	CS
United Kingdom	54,473	73,186	70,637	28.8%	-2,549	-3%	16,165	30%	T2	NS	CS
EU-15	**161,877**	**246,800**	**245,397**	**100.0%**	**-1,403**	**-1%**	**83,519**	**52%**			

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 France, Germany, Italy and the United Kingdom; together they cause 83 % of the CO_2 emissions from gaseous fuels in 1A4b. Fuel consumption in the EU-15 rose 50 % between 1990 and 2005. The implied emission factor of EU-15 was 56.5 t/TJ in 2005.

Figure 3.75 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 account for 0.1 % of total GHG emissions in 2005. Between 1990 and 2005, CH_4 emissions from households decreased by 37 % in the EU-15 (Table 3.73). France is reponsible for 36 % of total CH_4 emissions and achieved between 1990 and 2005 a reduction of 44 %. All Member States except Denmark, Finland and Italy reported a decrease in emissions. Between 2004 and 2005 EU-15 emissions decrased by 3%.

Table 3.73 1A4b Residential: Member States' contributions to CH_4 emissions in 1990, 2004 and 2005

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005	
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	377	219	229	3.8%	11	5%	-148	-39%
Belgium	121	82	81	1.3%	0	-1%	-40	-33%
Denmark	68	133	145	2.4%	12	9%	77	114%
Finland	164	179	177	2.9%	-2	-1%	13	8%
France	3,891	2,363	2,194	36.3%	-169	-7%	-1,697	-44%
Germany	1,200	674	666	11.0%	-8	-1%	-534	-45%
Greece	205	205	204	3.4%	-1	0%	-1	0%
Ireland	90	41	42	0.7%	1	3%	-48	-53%
Italy	260	429	409	6.8%	-20	-5%	149	57%
Luxembourg	5	3	4	0.1%	1	36%	-1	-27%
Netherlands	355	342	329	5.4%	-14	-4%	-26	-7%
Portugal	344	311	312	5.2%	1	0%	-32	-9%
Spain	775	614	614	10.2%	0	0%	-161	-21%
Sweden	239	213	232	3.8%	19	9%	-8	-3%
United Kingdom	1,459	456	405	6.7%	-51	-11%	-1,054	-72%
EU-15	**9,554**	**6,262**	**6,043**	**100.0%**	**-219**	**-3%**	**-3,511**	**-37%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A4b Residential – Biomass (CH_4)

In 2005 CH_4 from biomass had a share of 1.1 % within source category 1A4b (compared to 1.5 % in

1990). Between 1990 and 2005 the emissions decreased by 22 % (Table 3.74). France reported the highest absolute decrease, while Germany's (105 %) and Denmarks's (100 %) CH_4 emissions increased significantly. Between 2004 and 2005, EU-15 emissions changed marginally (-3 %).

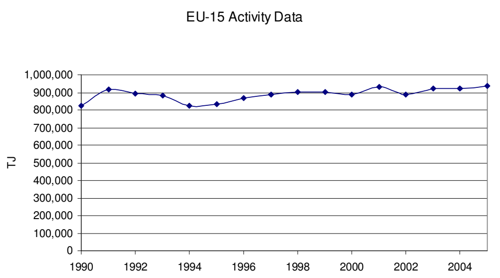
Table 3.74 1A4b Residential, biomass: Member States' contributions to CH_4 emissions and information on method applied, activity data and emission factor

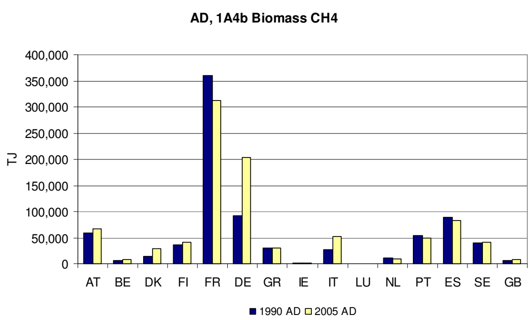
Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	312	206	216	4.4%	10	5%	-96	-31%	T2	-	CS
Belgium	30	38	39	0.8%	1	3%	8	28%	C	-	D
Denmark	59	106	118	2.4%	12	11%	59	100%	C	NS	CS/C/D
Finland	152	172	171	3.5%	-2	-1%	18	12%	T1	-	D
France	3,737	2,255	2,086	42.8%	-169	-7%	-1,652	-44%	C	NS	CS
Germany	235	466	484	9.9%	17	4%	248	105%	T2	-	CS
Greece	198	198	198	4.1%	0	0%	0	0%	C	-	C
Ireland	1	1	1	0.0%	0	1%	0	-2%	T1	-	C, CS, D
Italy	183	369	347	7.1%	-22	-6%	164	89%	T2	NS	C
Luxembourg	2	1	2	0.0%	1	83%	0	10%	C	-	C
Netherlands	73	59	59	1.2%	0	0%	-14	-19%	T2	NS/Q	CS
Portugal	343	309	311	6.4%	2	0%	-33	-10%	T2	NS	D,C
Spain	621	562	562	11.5%	0	0%	-59	-9%	T2	-	C
Sweden	229	202	222	4.6%	19	10%	-7	-3%	T1, T2, T3	-	CS
United Kingdom	46	54	54	1.1%	0	0%	8	17%	T1	-	C
EU-15	**6,222**	**4,998**	**4,868**	**100.0%**	**-130**	**-3%**	**-1,354**	**-22%**			

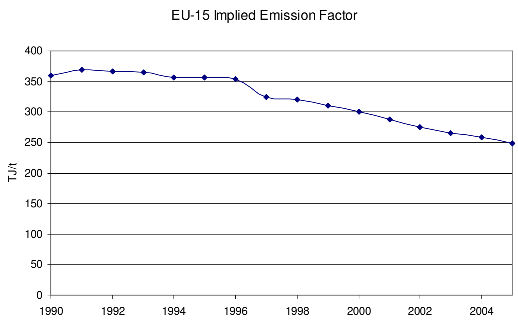
Abbreviations explained in the Chapter 'Units and abbreviations'.

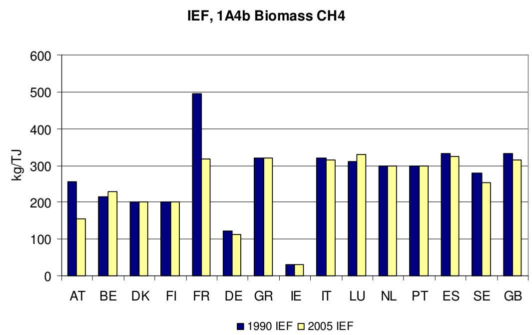
Figure 3.76 shows activity data and implied emission factors for CH_4 for EU-15 and the Member States. The largest emissions are reported by France, Germany and Spain; together they cause more than 64 % of the CO_2 emissions from biomass fuels in 1A4b. Fuel consumption in the EU-15 rose by 13 % between 1990 and 2005. The implied emission factor of EU-15 was 248 kg/TJ in 2005.

Figure 3.76 1A4b Residential, biomass: Activity Data and Implied Emission Factors for CH_4









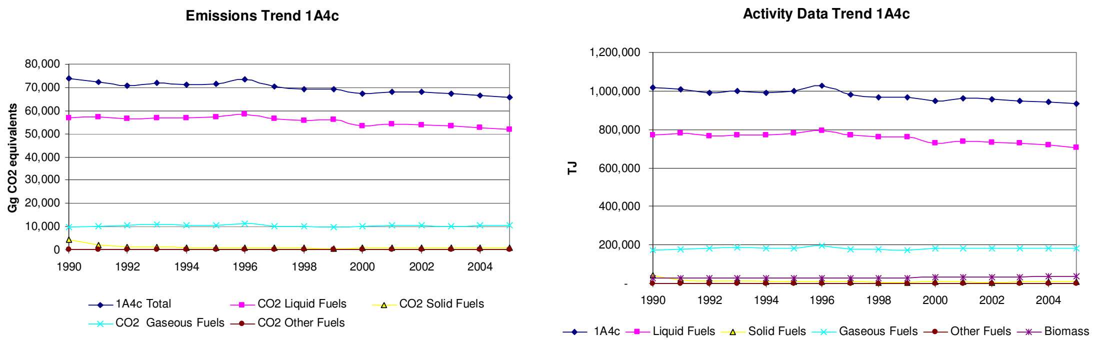
3.2.4.3. Agriculture/Forestry/Fisheries (1A4c)

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 account for 1.5 % of total EU-15 GHG emissions in 2005. Between

1990 and 2005, CO_2 emissions from 1A4c Agriculture/Forestry/Fisheries decreased by 11 % in the EU-15 (Table 3.75).

Figure 3.77 shows the emission trend within source category 1A4c, which is mainly dominated by CO_2 emissions from liquid fuels. Total GHG emissions decreased by 11 %, mainly due to decreases in CO_2 emissions from liquid fuels (-9 %).

Figure 3.77 1A4c Agriculture/Forestry/Fisheries: Total and CO_2 emission trends



Three Member States France, Germany, Italy, the Netherlands and Spain contributed the most to the emissions from this source (69 %). The Member State with the highest increase in absolute terms between 1990 and 2005 was Spain, the highest decreases were in Germany, France and the Netherlands. In the Netherlands, this decrease was due to significant energy conservation measures in the greenhouse horticulture which account for approximately 85 % of the primary energy use of the Dutch agricultural sector.

Table 3.75 1A4c Agriculture/Forestry/Fisheries: Member States' contributions to CO_2 emissions in 1990, 2004 and 2005

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005	
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	1,842	1,724	1,652	2.6%	-72	-4%	-190	-10%
Belgium	2,730	2,357	2,394	3.8%	37	2%	-336	-12%
Denmark	2,653	2,165	2,256	3.6%	91	4%	-397	-15%
Finland	2,017	1,981	1,928	3.1%	-53	-3%	-89	-4%
France	10,612	9,677	9,353	14.9%	-324	-3%	-1,259	-12%
Germany	10,917	6,769	6,389	10.2%	-380	-6%	-4,528	-41%
Greece	2,927	2,666	2,729	4.3%	63	2%	-198	-7%
Ireland	660	803	829	1.3%	25	3%	168	25%
Italy	8,347	8,298	8,377	13.3%	79	1%	30	0%
Luxembourg	78	75	75	0.1%	0	0%	-3	-4%
Netherlands	10,872	9,623	9,592	15.3%	-30	0%	-1,280	-12%
Portugal	1,660	1,055	904	1.4%	-151	-14%	-756	-46%
Spain	8,556	9,850	9,868	15.7%	18	0%	1,312	15%
Sweden	1,759	1,975	2,034	3.2%	59	3%	275	16%
United Kingdom	5,144	4,616	4,457	7.1%	-159	-3%	-687	-13%
EU-15	**70,775**	**63,635**	**62,838**	**100.0%**	**-797**	**-1%**	**-7,938**	**-11%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A4c Agriculture/Forestry/Fisheries –Liquid Fuels (CO_2)

In 2005 CO_2 from liquid fuels had a share of 79 % within source category 1A4c (compared to 77 % in 1990). Between 1990 and 2005 the emissions decreased by 9 % (Table 3.76). Three Member States (Ireland, Spain and Sweden) reported increasing emissions with the highest increases in absolute terms in Spain. Between 2004 and 2005 EU-15 emissions declined by 2 %, the highest change reported Portugal (-14 %).

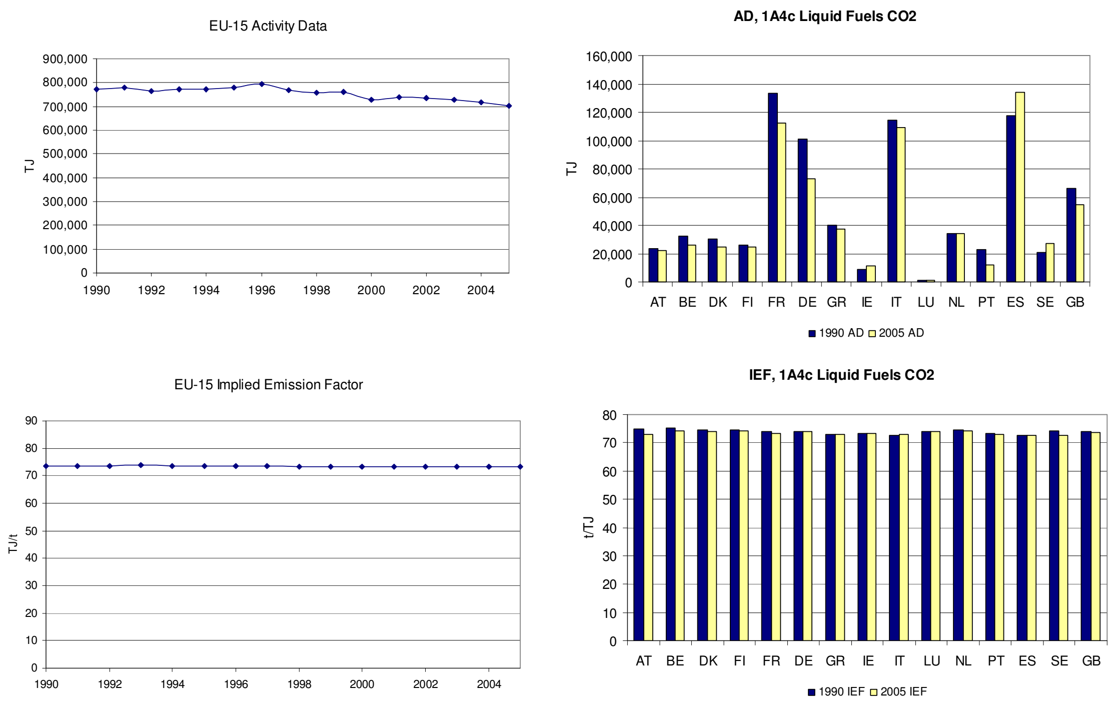
Table 3.76 1A4c Agriculture/Forestry/Fisheries, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	1,771	1,680	1,604	3.1%	-76	-5%	-167	-9%	T2	NS	CS
Belgium	2,455	1,964	1,952	3.8%	-11	-1%	-503	-20%	C	RS	C
Denmark	2,281	1,771	1,812	3.5%	42	2%	-469	-21%	C	NS	CS/C
Finland	1,932	1,878	1,834	3.6%	-44	-2%	-97	-5%	T1, T2	NS	CS
France	9,875	8,600	8,252	16.0%	-348	-4%	-1,624	-16%	C	NS	CS
Germany	7,484	5,762	5,392	10.4%	-371	-6%	-2,092	-28%	T2	NS/AS	CS
Greece	2,917	2,666	2,720	5.3%	54	2%	-197	-7%	C	NS	D
Ireland	660	803	829	1.6%	25	3%	168	25%	T1	NS	CS
Italy	8,295	7,971	7,974	15.5%	3	0%	-322	-4%	T2	NS	CS
Luxembourg	75	75	75	0.1%	0	0%	0	0%	C	-	C
Netherlands	2,544	2,581	2,551	4.9%	-30	-1%	7	0%	T2	NS/Q	CS,D
Portugal	1,660	1,048	898	1.7%	-150	-14%	-762	-46%	T2	NS	D,C
Spain	8,513	9,700	9,703	18.8%	3	0%	1,190	14%	T2, T3	NS, Q	C
Sweden	1,569	1,919	1,978	3.8%	59	3%	408	26%	T1,T2,T3	NS	CS
United Kingdom	4,914	4,165	4,029	7.8%	-136	-3%	-885	-18%	T2	NS, AS	CS
EU-15	**56,946**	**52,584**	**51,602**	**100.0%**	**-981**	**-2%**	**-5,344**	**-9%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.78 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 61 % of the CO_2 emissions from liquid fuels in 1A4c. Fuel consumption in the EU-15 decreased by 9 % between 1990 and 2005. The implied emission factor of EU-15 was 73.3 t/TJ in 2005.

Figure 3.78 1A4c Agriculture/Forestry/Fisheries, liquid fuels: Activity Data and Implied Emission Factors for CO_2



1A4c Agriculture/Forestry/Fisheries – Solid Fuels (CO_2)

In 2005 CO_2 from solid fuels had a share of 1 % within source category 1A4c (compared to 6 % in 1990). Between 1990 and 2005 the emissions decreased by 82 % (Table 3.77). All Member States reported decreasing emissions. Ireland, Italy, the Netherlands, Luxembourg, Portugal, Spain and Sweden report CO_2 emissions from this source category in 2005 as 'Not ocurring', 'Not applicable' or '0'. Between 2004 and 2005 EU-15 emissions increased by 13 %.

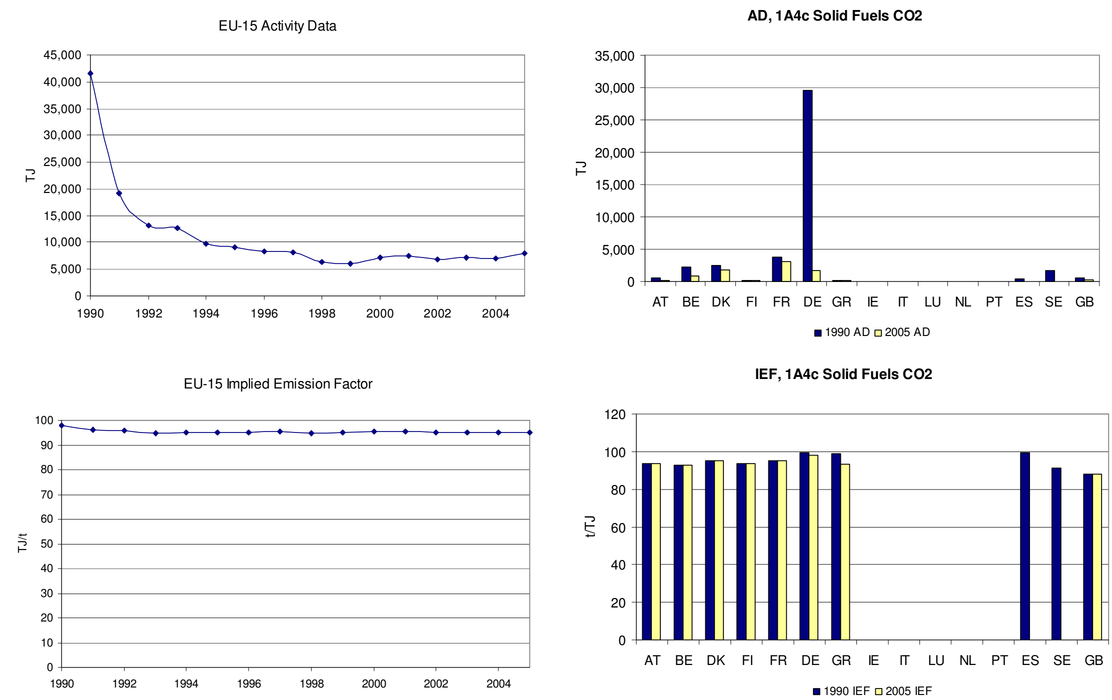
Table 3.77 1A4c Agriculture/Forestry/Fisheries, solid fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	51	9	10	1.4%	1	11%	-41	-80%	T2	NS	CS
Belgium	208	76	76	10.1%	0	0%	-132	-64%	C	RS	C
Denmark	239	99	170	22.6%	71	72%	-69	-29%	C	NS	CS/C
Finland	13	16	11	1.4%	-6	-34%	-2	-19%	T1	NS	CS
France	353	287	287	38.2%	0	0%	-66	-19%	C	NS	CS
Germany	2,948	164	167	22.2%	3	2%	-2,781	-94%	T2	NS/AS	CS
Greece	11	NO	10	-	-	-	-1	-12%	C	NS	D
Ireland	NO	NO	NO	-	-	-	-	-	-	-	-
Italy	NO	NO	NO	-	-	-	-	-	-	-	-
Luxembourg	NE	NE	NE	-	-	-	-	-	-	-	-
Netherlands	NO	NO	NO	-	-	-	-	-	-	-	-
Portugal	NO	NO	NO	-	-	-	-	-	-	-	-
Spain	37	NA	NA	-	-	-	-37	-100%	-	-	-
Sweden	157	NO	NO	-	-	-	-157	-100%	-	-	-
United Kingdom	48	16	21	2.8%	5	29%	-27	-56%	T2	NS, AS	CS
EU-15	**4,066**	**668**	**752**	**100.0%**	**84**	**13%**	**-3,315**	**-82%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.79 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by Denmark, France and Germany; together they cause 83 % of the CO_2 emissions from solid fuels in 1A4b. Fuel consumption in the EU-15 decreased by 81 % between 1990 and 2005. The implied emission factor of EU-15 was 95.1 t/TJ in 2005.

Figure 3.79 1A4c Agriculture/Forestry/Fisheries, solid fuels: Activity Data and Implied Emission Factors for CO_2



1A4c Agriculture/Forestry/Fisheries –Gaseous Fuels (CO_2)

In 2005, CO_2 from gaseous fuels had a share of 16 % within source category 1A4c (compared to 13 % in 1990). Between 1990 and 2005 the emissions increased by 7 % (Table 3.78). All Member States reported increasing emissions except Finland, Luxembourg and the Netherlands.The highest relative increase ocurred in Spain (+2577 %). Between 2004 and 2005 EU-15 emissions hardly changed.

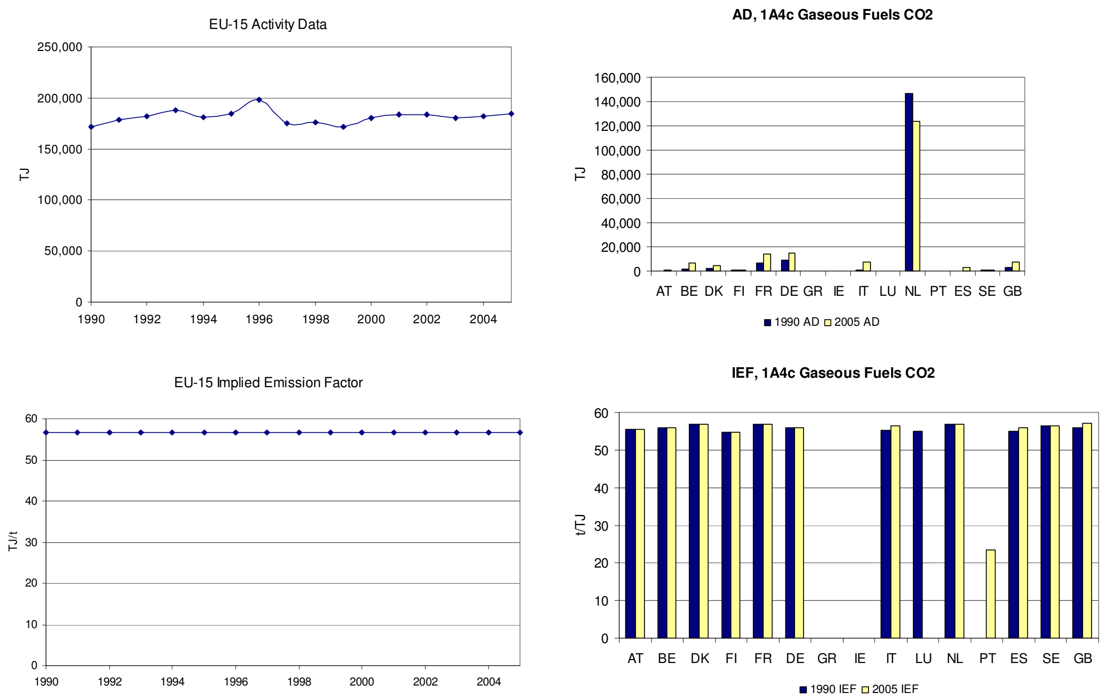
Table 3.78 1A4c Agriculture/Forestry/Fisheries, gaseous fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	20	35	38	0.4%	3	9%	18	88%	T2	NS	CS
Belgium	67	318	367	3.5%	49	15%	300	447%	C	RS	C
Denmark	132	296	273	2.6%	-22	-8%	141	107%	C	NS	CS/C
Finland	32	28	30	0.3%	2	7%	-2	-7%	T1	NS	CS
France	383	790	814	7.8%	24	3%	431	113%	C	NS	CS
Germany	485	842	830	8.0%	-12	-1%	345	71%	T2	NS/AS	CS
Greece	NO	NO	NO	-	-	-	-	-	-	-	-
Ireland	NO	NO	NO	-	-	-	-	-	-	-	-
Italy	52	327	403	3.9%	76	23%	352	681%	T2	NS	CS
Luxembourg	3	NE	NE	-	-	-	-3	-100%	-	-	-
Netherlands	8,328	7,041	7,041	67.5%	0	0%	-1,287	-15%	T2	NS/Q	CS,D
Portugal	NO	7	6	0.1%	-1	-14%	6	-	T2	NS	D,C
Spain	6	150	165	1.6%	15	10%	159	2577%	T2	NS	CS
Sweden	33	56	56	0.5%	0	0%	23	70%	T1,T2,T3	NS	CS
United Kingdom	182	435	407	3.9%	-28	-6%	225	124%	T2	NS	CS
EU-15	**9,723**	**10,324**	**10,430**	**100.0%**	**106**	**1%**	**707**	**7%**			

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 the Netherlands, accounting for 68 % of the CO_2 emissions from gaseous fuels in 1A4c. Fuel consumption in the EU-15 increased by 7 % between 1990 and 2005. The implied emission factor of EU-15 was 56.7 t/TJ in 2005.

Figure 3.80 1A4c Agriculture/Forestry/Fisheries, gaseous fuels: Activity Data and Implied Emission Factors for CO_2



3.2.5. Other (CRF Source Category 1A5)

Table 3.79 provides an overview of Member States' source allocation to Source Category 1A5 Other.

Table 3.79 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 aviation	NIR 2006
Denmark	Mobile: Military use	CRF Table 1.s.2

Member State	Source allocation to 1A5 Other	Source
Finland	Stationary: Other non-specified & Non-energy use of fuel & Indirect N_2O 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	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	CRF Table 1.s.2
Spain	Emissions are ‘Not occuring’	CRF Table 1.s.2
Sweden	Mobile: Military use and Other non-specified	CRF Table 1.s.2
United Kingdom	Mobile: military use	CRF Table 1.s.2

Figure 3.81 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 60 % between 1990 and 2005.

Figure 3.81 1A5 Other: Total and CO_2 emission and activity trends

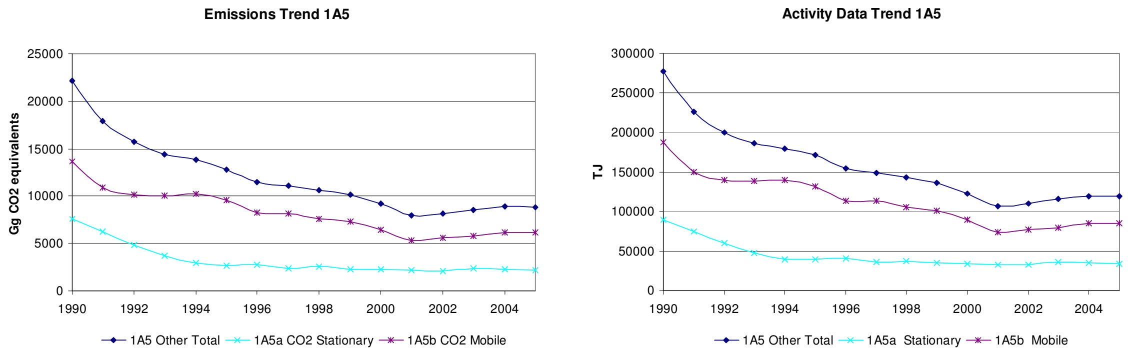


Table 3.80 shows total GHG and CO_2 emissions by Member State from 1A5. CO_2 emissions from 1A5 Other account for 0.2 % of total GHG emissions in 2005. Between 1990 and 2005, CO_2 emissions from this source decreased by 60 % in the EU-15. Between 1990 and 2005, the largest reduction in absolute terms was reported by Germany, which was partly due to reduced military operations after German reunification.

Table 3.80 1A5 Other: Member States' contributions to CO_2 emissions

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2005 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO_2 emissions in 2005 (Gg)
Austria	36	123	35	120
Belgium	168	96	166	95
Denmark	120	275	119	271
Finland	1,777	1,823	1,325	1,546
France	NO	NO	NO	NO
Germany	12,127	1,774	11,826	1,757
Greece	NO	NO	NO	NO
Ireland	NO	NO	NO	NO
Italy	1,114	1,291	1,041	1,198
Luxembourg	NE	NE	NE	NE
Netherlands	577	383	566	375
Portugal	8	NO	8	NO
Spain	NO	NO	NO	NO
Sweden	872	227	845	223
United Kingdom	5,337	2,816	5,285	2,788
EU-15	**22,136**	**8,809**	**21,216**	**8,373**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.81 provides information on the contribution of Member States to EU-15 recalculations in CO_2 from 1A5 Other for 1990 and 2004 and main explanations for the largest recalculations in absolute terms.

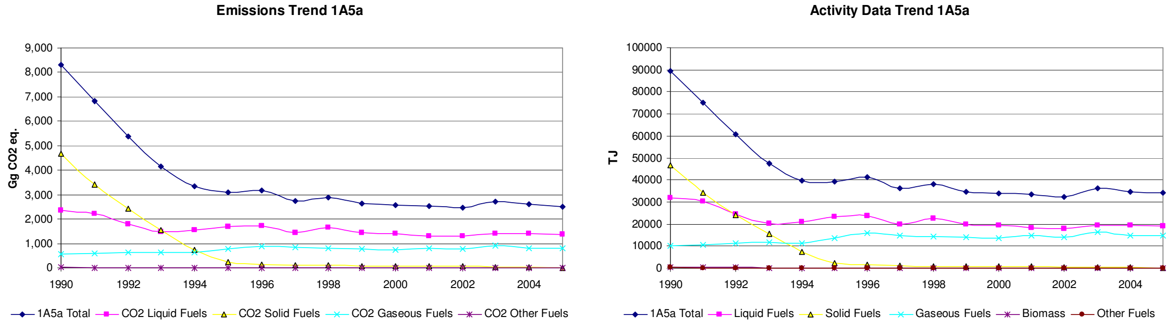
Table 3.81 1A5 Other: Contribution of MS to EU-15 recalculations in CO_2 for 1990 and 2004 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2004		Main explanations
	Gg	Percent	Gg	Percent	
Austria	0	0.0	0	0.0	
Belgium	0	0.0	0	0.0	
Denmark	0	0.0	0	0.0	
Finland	131	10.9	55	3.5	The most important changes were the updates of the heating energy calculation system and TYKO submodel
France	NE	0.0	NE	0.0	
Germany	0	0.0	-5	-0.3	updated activity data
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	
Netherlands	0	0.0	0	0.0	
Portugal	0	0.0	NE	0.0	
Spain	0	0.0	NE	0.0	
Sweden	0	0.0	0	0.0	
UK	0	0.0	0	0.0	
EU-15	**131**	**0.6**	**49**	**0.6**	

3.2.5.1. Stationary (1A5a)

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 account for 0.1 % of total EU-15 GHG emissions in 2005. Figure 3.82 shows the emission trend within the categories 1A5a, which is mainly dominated by CO_2 emissions from liquid fuels. The reduction in the early 1990s was driven by CO_2 from solid fuels. Total emissions decreased by 70 %, mainly due to decreases in emissions from solid fuels (-99.7 %) and liquid fuels (-41 %).

Figure 3.82 1A5a Stationary: Total and CO_2 emission and activity trends



In only two Member States (Finland and Germany) emissions from this key source are reported. Between 1990 and 2005 Finland had an increase of 9 % and Germany a decrease of 87 %. This led to an EU-15 decrease of 71 %. Between 2004 and 2005 Finland had an decrease of 8 % and Germany a increase of 9 %. (Table 3.82). This led to an EU-15 decrease of 2 %

Table 3.82 1A5a Stationary: Member States' contributions to CO_2 emissions in 1990, 2004 and 2005

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005	
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	NA	NA	NA	-	-	-	-	-
Belgium	NA	NA	NA	-	-	-	-	-
Denmark	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Finland	1,267	1,502	1,380	62.1%	-122	-8%	114	9%
France	NO	NO	NO	-	-	-	-	-
Germany	6,329	769	841	37.9%	72	9%	-5,489	-87%
Greece	NO	NO	NO	-	-	-	-	-
Ireland	NO	NO	NO	-	-	-	-	-
Italy	NO	NO	NO	-	-	-	-	-
Luxembourg	IE,NO	IE,NO	IE,NO	-	-	-	-	-
Netherlands	NA	NA	NA	-	-	-	-	-
Portugal	8	NO	NO	-	-	-	-8	-100%
Spain	NO	NO	NO	-	-	-	-	-
Sweden	NO	NO	NO	-	-	-	-	-
United Kingdom	NA	NA	NA	-	-	-	-	-
EU-15	**7,604**	**2,271**	**2,221**	**100.0%**	**-50**	**-2%**	**-5,383**	**-71%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A5a Stationary – Solid Fuels (CO_2)

In 2005 CO_2 from solid fuels had a share of 1 % within source category 1A5a (compared to 56 % in 1990). Between 1990 and 2005 the emissions decreased by 99.7 % (Table 3.83). In 2005 only Germany reported emissions for this key source.

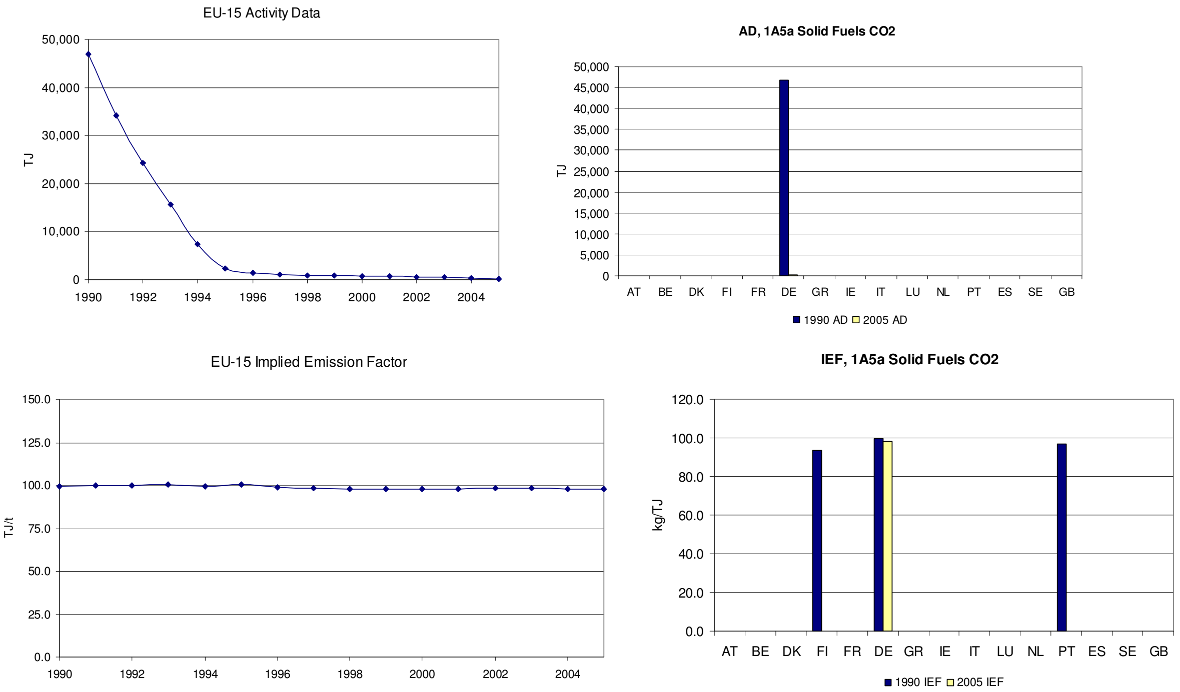
Table 3.83 1A5a Stationary, solid fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	NA	NA	NA	-	-	-	-	-	-	-	-
Belgium	NA	NA	NA	-	-	-	-	-	-	-	-
Denmark	NO	NO	NO	-	-	-	-	-	-	-	-
Finland	1	NO	NO	-	-	-	-1	-100%	-	-	-
France	NO	NO	NO	-	-	-	-	-	-	-	-
Germany	4,657	36	15	100.0%	-21	-58%	-4,642	-100%	CS	NS	CS
Greece	NO	NO	NO	-	-	-	-	-	-	-	-
Ireland	NO	NO	NO	-	-	-	-	-	-	-	-
Italy	NA	NA	NA	-	-	-	-	-	-	-	-
Luxembourg	NO	NO	NO	-	-	-	-	-	-	-	-
Netherlands	NA	NA	NA	-	-	-	-	-	-	-	-
Portugal	8	NO	NO	-	-	-	-8	-100%	-	-	-
Spain	NO	NO	NO	-	-	-	-	-	-	-	-
Sweden	NO	NO	NO	-	-	-	-	-	-	-	-
United Kingdom	NA	NA	NA	-	-	-	-	-	-	-	-
EU-15	**4,667**	**36**	**15**	**100.0%**	**-21**	**-58%**	**-4,651**	**-100%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.83 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. Germany accounting for 100 % of EU-15 CO_2 emissions from this source category in 2005. Fuel combustion in the EU-15 decreased by 99,7 % between 1990 and 2005. The implied emission factor is 98 t/TJ in 2005.

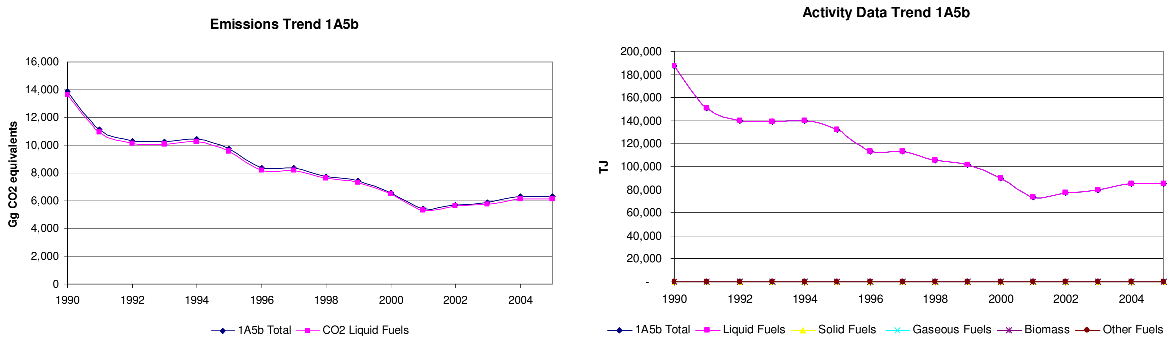
Figure 3.83 1A5a Stationary, solid fuels: Activity Data and Implied Emission Factors for CO_2



3.2.5.2. Mobile (1A5b)

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 account for 0.1 % of total EU-15 GHG emissions in 2005. Figure 3.84 shows the emission trend within the category 1A5b, which is dominated by CO_2 emissions from liquid fuels. Total CO_2 emissions decreased by 54 %.

Figure 3.84 1A5b-Mobile: Total and CO_2 emission trends



Six Member States report emissions as ‘Not occuring’. The United Kingdom has the highest emissions in 2005 and – together with Germany - decreased most between 1990 and 2005. Austria, Denmark and Finland reported a rise of more than 100 %. Between 2004 and 2005 the UK had the largest absolute reduction. The EU-15 emissions did hardly change between 2004 and 2005 (Table 3.84).

Table 3.84 1A5b Mobile: Member States’ contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005	
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	35	107	120	2.0%	14	13%	85	243%
Belgium	166	94	95	1.5%	1	1%	-71	-43%
Denmark	119	239	271	4.4%	32	13%	152	128%
Finland	58	122	166	2.7%	44	36%	108	186%
France	NO	NO	NO	-	-	-	-	-
Germany	5,497	882	916	14.9%	34	4%	-4,581	-83%
Greece	NO	NO	NO	-	-	-	-	-
Ireland	NO	NO	NO	-	-	-	-	-
Italy	1,041	1,091	1,198	19.5%	107	10%	157	15%
Luxembourg	IE,NO	IE,NO	IE,NO	-	-	-	-	-
Netherlands	566	437	375	6.1%	-61	-14%	-190	-34%
Portugal	NO	NO	NO	-	-	-	-	-
Spain	NO	NO	NO	-	-	-	-	-
Sweden	845	278	223	3.6%	-55	-20%	-622	-74%
United Kingdom	5,285	2,903	2,788	45.3%	-115	-4%	-2,496	-47%
EU-15	**13,612**	**6,153**	**6,152**	**100.0%**	**-1**	**0%**	**-7,459**	**-55%**

Abbreviations explained in the Chapter ‘Units and abbreviations’.

1A5b Mobile – Liquid Fuels (CO_2)

In 2005, CO_2 from liquid fuels had a share of 97 % within source category 1A5b (compared to 98 % in 1990). Between 1990 and 2005 the emissions decreased by 55 % (Table 3.85). France, Greece, Ireland, Luxembourg, Portugal and Spain report emissions as ‘Not occuring’, or ‘Included Elsewhere’. The highest decrease was achieved in Germany (-83 %), while Austria, Denmark and Finland had increases of more than 100 %.

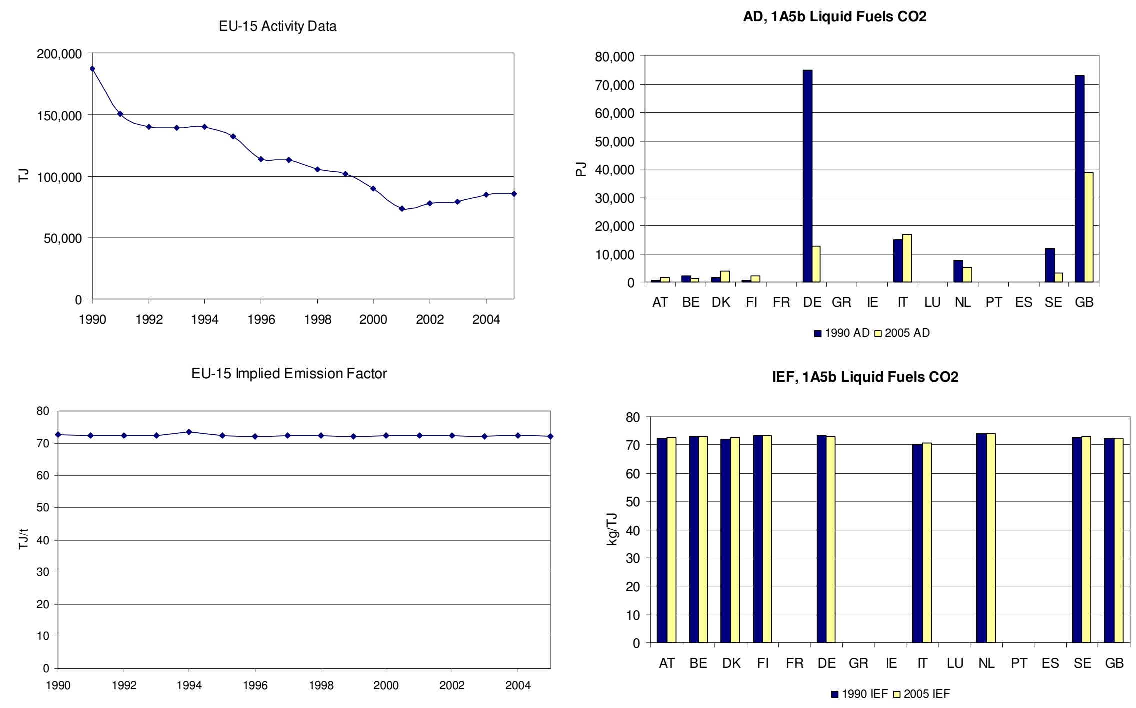
Table 3.85 1A5b Mobile, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	35	107	120	2.0%	14	13%	85	243%	M	AS	CS
Belgium	166	94	95	1.5%	1	1%	-71	-43%	C	RS	C
Denmark	119	239	271	4.4%	32	13%	152	128%	C	NS	CS/C
Finland	58	122	166	2.7%	44	36%	108	186%	T1, T2	NS	D, CS
France	NO	NO	NO	-	-	-	-	-	-	-	-
Germany	5,497	882	916	14.9%	34	4%	-4,581	-83%	CS	NS	CS
Greece	NO	NO	NO	-	-	-	-	-	-	-	-
Ireland	NO	NO	NO	-	-	-	-	-	-	-	-
Italy	1,041	1,091	1,198	19.5%	107	10%	157	15%	T2	NS	CS
Luxembourg	IE	IE	IE	-	-	-	-	-	-	-	-
Netherlands	566	437	375	6.1%	-61	-14%	-190	-34%	T2	NS/Q	D
Portugal	NO	NO	NO	-	-	-	-	-	-	-	-
Spain	NO	NO	NO	-	-	-	-	-	-	-	-
Sweden	845	278	223	3.6%	-55	-20%	-622	-74%	T1	NS	CS
United Kingdom	5,285	2,903	2,788	45.3%	-115	-4%	-2,496	-47%	T2	NS, AS	CS
EU-15	**13,612**	**6,153**	**6,152**	**100.0%**	**-1**	**0%**	**-7,459**	**-55%**			

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. The largest emissions are reported by Italy and the United Kingdom; together they cause 65 % of the CO_2 emissions from liquid fuels in 1A5b. Fuel consumption in the EU-15 decreased by 55 % between 1990 and 2005. The implied emission factor of EU-15 was 72.2 t/TJ in 2005.

Figure 3.85 1A5b Mobile, liquid fuels Activity Data and Implied Emission Factors for CO_2



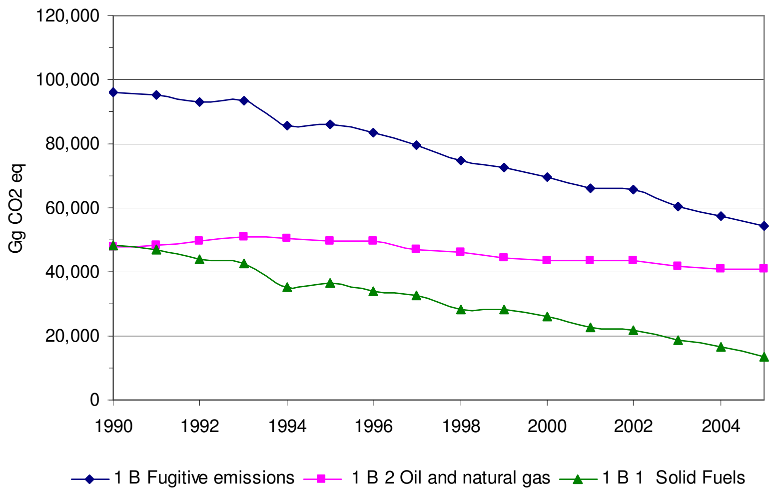
3.2.6. Fugitive emissions from fuels (CRF Source Category 1.B)

This chapter describes gaseous or volatile emissions which occur during extraction, handling and consumption of fossil fuels. In 2005, in terms of CO_2 equivalents, two thirds of these emissions were fugitive CH_4 emissions while the other third correspond to fugitive CO_2 emissions. Together, they represent 1.3% of total GHG emissions in the EU-15.

Definition (from Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories):
Fugitive emissions are intentional or unintentional releases of gases from anthropogenic activities. In particular, they may arise from the production, processing, transmission, storage and use of fuels, and include emissions from combustion only 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 1A3bv.

Fugitive greenhouse gas emissions are steadily declining as Figure 3.86 shows. Between 1990 and 2005, the total fugitive GHG emissions decreased by 43 %, mainly due to the source category 1B1a.i Underground mines (responsible for more than three fourths of the absolute decrease). In 1990 emissions from the two sources (1B1 Solid Fuels and 1B2 Oil and Natural Gas) represented each 50% of total fugitive emissions. However between 1990 and 2005, emissions from 1B1 Solid Fuels decreased strongly (-72 %), whereas emissions from 1B2 Oil and Natural Gas decreased by 14 % only. As a result, in 2005, fugitive emissions from 1B1 Solid Fuels represent now only 25% of total fugitive emissions.

Figure 3.86 1B Fugitive Emission from Fuel: GHG Emissions trend

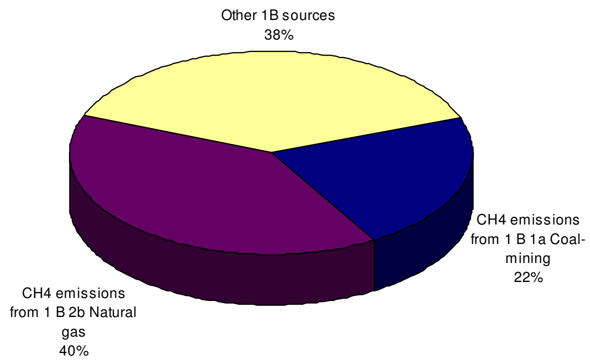


Fugitive emissions include four key sources:

- 1B1a Coal Mining (CH_4),
- 1B2a Oil (CO_2),
- 1B2a Natural Gas (CH_4),
- 1B2c Venting and Flaring (CO_2).

Figure 3.87 shows that the two largest key sources, i.e. CH_4 emissions from 1B1a Coal Mining and CH_4 from 1B2b Natural Gas, account together for 62 % of total fugitive GHG emissions.

Figure 3.87 1B-Fugitive Emissions of Fuels: Proportion of fugitive emissions within source category



3.2.6.1. Fugitive emissions from Solid Fuels (1B1)

Definition: Fugitive emissions from solid fuels correspond to 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.

Fugitive emissions from solid fuels account for 0.3 % of the total GHG emissions in the EU-15 and 25 % of total fugitive emissions in the EU-15:

- 88 % of these emissions are 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 result from underground mines; surface mines are a smaller source.
- 10% of these emissions are CO_2 emissions from solid fuel transformation (5 %) and other activities (5 %).

CH_4 fugitive emissions from 1B1 Solid fuels are a key source. Since 1990, they have been steadily decreasing, caused by the reduction of coal mining (3.89).

Figure 3.88 1B1 Fugitive Emissions from Solid Fuels: Trend

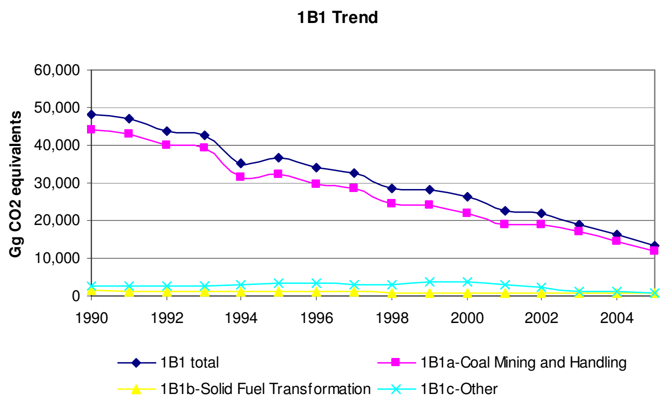


Table 3.86 shows that in 2005, nine Member States report positive fugitive emissions from solid fuels:

- eight Member States report positive fugitive CH_4 emissions and seven Member States report zero emissions,
- five Member States report positive fugitive CO_2 emissions and ten Member States report that CO_2 emissions from this source are not occurring, not occurring anymore or not estimated.

In 2005, three countries represent more than 83 % of total fugitive emissions from solid fuels: Germany (43 %), United Kingdom (29 %) and Greece (12%).

Table 3.86 1B1 Fugitive Emissions from Solid Fuels: Member States Contribution

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2005 (Gg CO_2 equivalents)	CH_4 emissions in 1990 (Gg CO_2 equivalents)	CH_4 emissions in 2005 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO_2 emissions in 2005 (Gg)
Austria	11	IE,NA,NO	11	0	IE,NA,NO	IE,NA,NO
Belgium	36	12	36	12	NA,NE	NA,NO
Denmark	NA,NO	NA,NO	0	0	NA,NO	NA,NO
Finland	NO	NO	0	0	NO	NO
France	4,331	61	4,331	61	IE,NA,NO	IE,NA,NO
Germany	20,240	5,755	20,240	5,755	NE,NO	NE,NO
Greece	1,095	1,572	1,095	1,465	NE,NO	107
Ireland	NE, NO	NO	0	0	NE,NO	NO
Italy	122	69	122	69	NA	NA
Luxembourg	NO	NO	0	0	NO	NO
Netherlands	433	480	30	23	403	457
Portugal	75	IE, NO	66	0	9	IE,NO
Spain	1,837	1,031	1,820	941	18	90
Sweden	791	583	0	0	789	581
United Kingdom	19,148	3,918	18,290	3,807	856	110
EU-15	**48,119**	**13,480**	**46,041**	**12,132**	**2,074**	**1,345**

Emissions of Greece for 1990 not estimated because of a lack of background data and methodological approach.
Emissions of Ireland for 1990 are not estimated because they were negligeable.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.86 shows that fugitive CH_4 emissions from solid fuels decreased by 74 % between 1990 and 2005. The largest reductions (in absolute terms) were observed in Germany and in the United Kingdom, while emissions actually increased by a third in Greece.

Table 3.87 1B1 Fugitive Emissions from Solid Fuels: Methodological Issues according to NIRs (submitted in 2007) of EU-15 Member States

Member State	**Methodology**
Austria	**General:** consideration of brown coal **Completeness:** Emissions form solid fuel transformation are included in the energy sector (sub category 'Iron and Steel'), because the only solid fuel transformation occurring in Austria is one coking plat as part of an integrated iron and steel site. **Activity data**: taken form the national energy balance. **Emission factor:** CORINAIR default emission factor 214g CH_4/Mg coal
Belgium	**General:** Emissions result from coke production **Activity data:** delivered by corresponding industry **Emission factor:** from EMEP/CORINAR Handbook 400g CH_4/ton coke
Denmark	**General:** Coal mining not occurring
Finland	**General**: Emissions from the peat production are reported in LULUCF sector (category Wetlands, CRF 5.D 2) as suggested in GPG LULUCF (IPCC 2003) (see chapter 7.5). There are no coal mines in Finland.
France	**General:** closure of surface mines 2002, closure of underground mines 2004 **Activity data:** bottom up approach according to site specific data, Tier 2/3 depending on site **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 **Activity data:** Statistik der Kohlenwirtschaft, national statistics **Emission factor:** country specific EF for all sub source categories, German lignite-industry association
Greece	**General:** only brown coal surface mines **Activity data:** national statistics **Emission factor:** Default
Ireland	**General:** coal mining not existing
Italy	**General**: fugitive emissions from solid fuels are negiligible **Activity Data:** National Energy Balance, National Statistical Yearbook **Emission Factor**: IPCC Guidelines (1997), Corinair Guidebook
Luxembourg	**General:** no extraction or consumption of solid fuels
Netherlands	**General:** Fugitive emissions from this category refer mainly to CO_2 from the key source 1B1b 'Coke Manufacture'. The Netherlands currently has only one on-site coke production facility at the iron and steel plant of Corus. A second independent coke producer in Sluiskil discontinued ist activities in 1999. The fugitive emissions of CO_2 and CH_4 from both coke production sites are included here. We note that fugitive emissions from all coke production sites are included. There are no fugitive emissions from coal mining and handling

Member State	Methodology
	activities (1B1a) in The Netherlands; these activities ceased with the closing of the last coal mine in the early 1970s. Fugitive emissions from 'Charcoal Production' are presently not accounted for. **Activity data:** national energy statistics **Emission factor:** country specific, carbon balance
Portugal	**General:** coal mining activity stopped in 1994 **Activity data**: national energy reports **Emission factor**: Default
Spain	**General:** Activities identified and for which methane and/or carbon dioxide emissions have been estimated are: a) coal mining; b) pre-treatment of coal; c) coal storage; and d) coke ovens (door leakage and extinction). According to Tier 2 for CH_4, country specifiv for CO_2; **Activity Data**: Subdirectorate-General for Mines at the Ministry of Industry, Tourism and Commerce, international coal questionnaires sent to the International Energy Agency **Emission Factor**: country specific
Sweden	**General:** no coal mines, only flaring of coke oven gas. Flaring of coke oven gas, blast furnace gas and steel converter gas are reported in CRF 1B1c since Submission 2004 (Tier 2). **Activity data:** country specific and plant specific **Emission factor:** plant specific
United Kingdom	**General:** Carbon emissions from coke ovens are based on a carbon balance approach. For process emissions from coke ovens for other pollutants, emissions are estimated either on the basis of total production of coke or the coal consumed. Emissions of carbon from Solid Smokeless Fuel (SSF) production are also based on a carbon balance approach. Methane emissions from closed coal mines are accounted for within Sector 1B1a of the UK inventory. **Activity data:** revised DTI coal mining statistics **Emission factor:** national studies, UK Coal Mining Ltd

CH_4 from Coal Mining (1B1a)

Definition: 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).

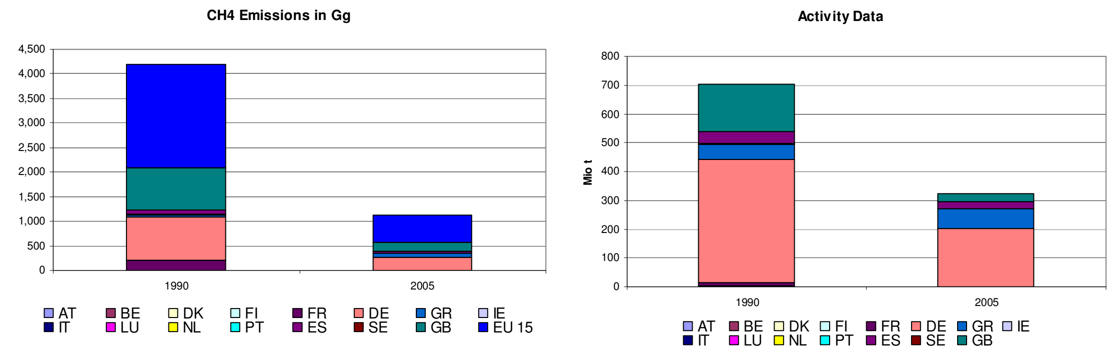
CH_4 emissions from 1B1a Coal-Mining account for 0.3 % of total GHG emissions in 2005 and for 22 % of all fugitive emissions in the EU-15. Between 1990 and 2005, CH_4 emissions from this source decreased by 73 % in the EU-15. Just between 2004 and 2005, these emissions decreased by 17 %. Six Member States report emissions occuring from this source. In 2005, the largest share on total emissions from this source had Germany and the United Kingdom, both together accounting for 80 % of EU-15 emissions (Table 3.88). Both Member States have substantially reduced their emissions between 1990 and 2005 due to the decline of coal mining.

Table 3.88 1B1a Coal Mining: Member States contribution for CH_4

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	11	1	0	0.0%	-1	-100%	-11	-100%	T1	NS	C
Belgium	0	NO	NO	-	-	-	-	-	-	-	-
Denmark	NO	NO	NO	-	-	-	-	-	-	-	-
Finland	NO	NO	NO	-	-	-	-	-	-	-	-
France	4,279	581	29	0.2%	-552	-95%	-4,250	-99%	C	AS	CS
Germany	18,415	6,461	5,686	47.7%	-775	-12%	-12,729	-69%	T2	AS/PS	CS
Greece	1,095	1,478	1,465	12.3%	-14	-1%	369	34%	T1	NS	D
Ireland	NO	NO	NO	-	-	-	-	-	-	-	-
Italy	55	21	21	0.2%	-1	-3%	-34	-62%	T1	NS	D,CS
Luxembourg	NO	NO	NO	-	-	-	-	-	-	-	-
Netherlands	NA	NA	NA	-	-	-	-	-	-	-	-
Portugal	66	NO	NO	-	-	-	-66	-100%	-	-	-
Spain	1,796	971	919	7.7%	-52	-5%	-877	-49%	CS, T2	0	CS
Sweden	NO	NO	NO	-	-	-	-	-	-	-	-
United Kingdom	18,271	4,922	3,797	31.9%	-1,124	-23%	-14,474	-79%	T2	AS	CS
EU-15	**43,989**	**14,435**	**11,917**	**100.0%**	**-2,518**	**-17%**	**-32,072**	**-73%**			

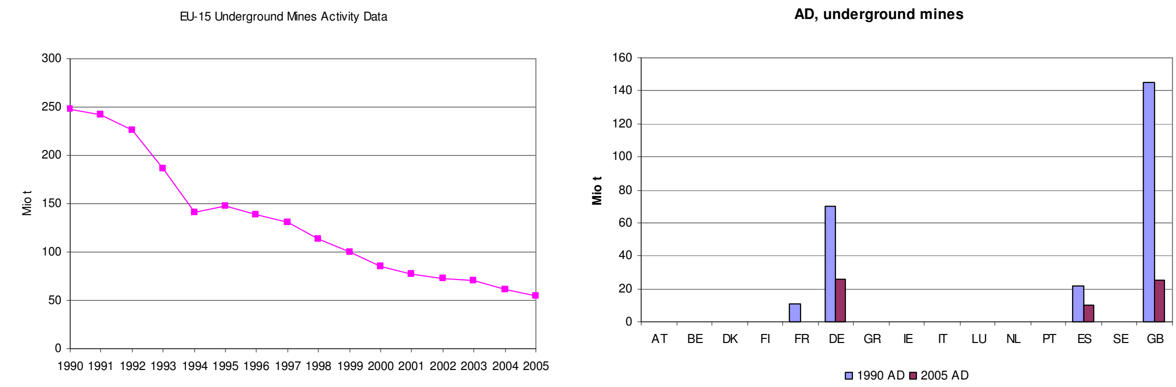
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.89 1B1a Coal Mining and Handling: Contribuition of MS to CH_4 Emission and Activity Data



Most of fugitive emissions from coal mines are due to underground mines. Figure 3.90 shows how activity data and emission factors for CH_4 emissions from underground mines changed between 1990 and 2005. Within the EU-15 coal mining in underground mines decreased substantially (more than 78%), whereas the implied emissions factor increased from 8 to 9 kg/t coal produced. The sharp increase of the French implied emission factor is mainly the result coal production having almost stopped in 2004, while some minor emissions were still occuring.

Figure 3.90 1B1ai Underground Mines: Activity Data and Implied Emission Factors for EU-15 and the emitting countries of CH_4



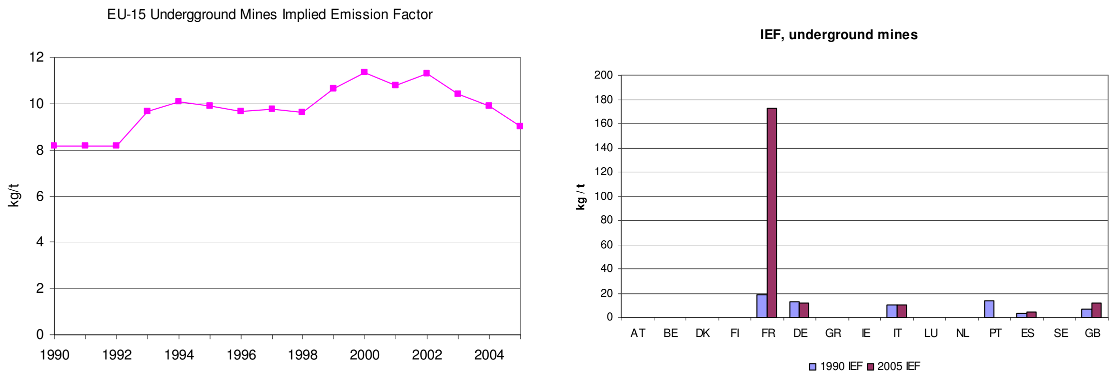


Figure 3.91 shows how activity data and emission factors for CH_4 emissions from surface coal mines changed between 1990 and 2005. Overall, in the EU-15 coal production from surface mines decreased by 40 % between 1990 and 2005. Coal mining in surface mines decreased in most Member States except in Greece, which is also the only country using a default emission factor (all other countries apply country specific emission factors).

Figure 3.91 1B1aii Surface Mines: Activity Data and Implied Emission Factors for EU-15 and the emitting countries of CH_4

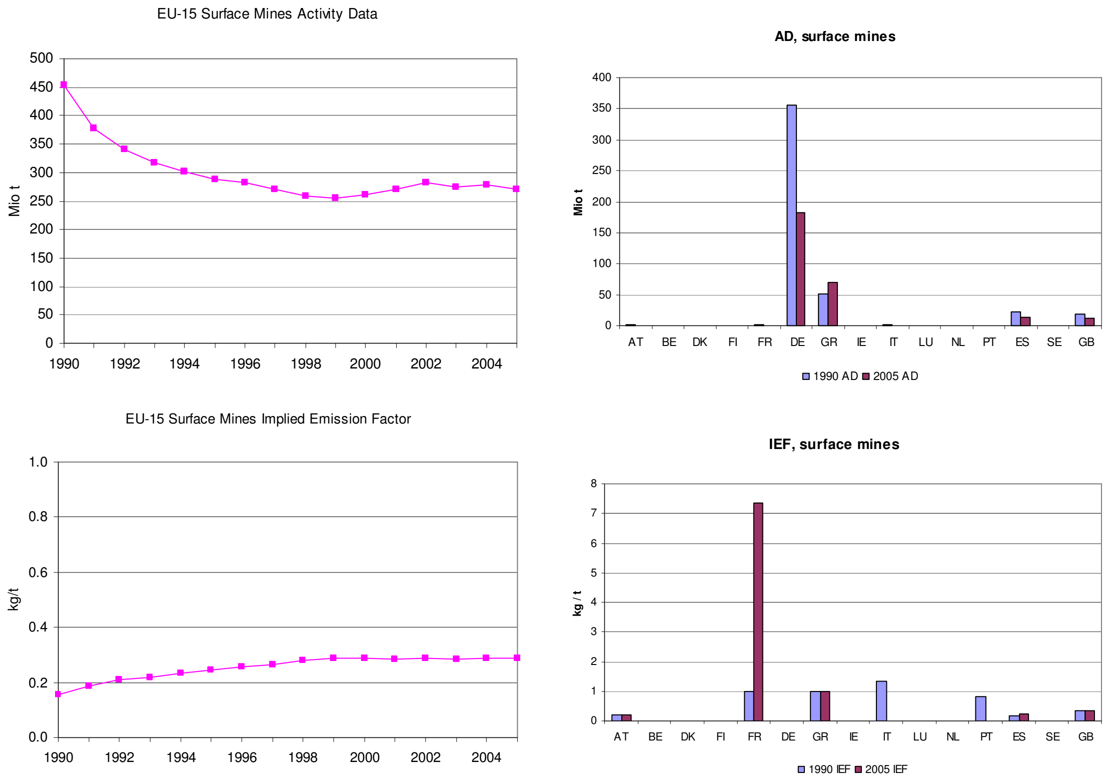


Table 3.89 provides information on the contribution of Member States to EU-15 recalculations in CH_4 from 1B1 Solid fuels for 1990 and 2004 and main explanations for the largest recalculations in absolute terms.

Table 3.89 1B1 Fugitive Emissions from Solid Fuels: Contribution of MS to EU-15 recalculations in CH_4 for 1990 and 2004 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2004		Main explanations
	Gg	Percent	Gg	Percent	
Austria	0.0	0.0	0.0	0.0	
Belgium	0.0	0.0	0.0	0.0	
Denmark	0.0	0.0	0.0	0.0	
Finland	0.0	0.0	0.0	0.0	
France	0.0	0.0	-0.7	-0.1	update of coke production
Germany	0.0	0.0	-1,436.3	-18.0	1B1c: Recaculcations due to updated Dataf from "Gesamtverband des deutschen Steinkohlenbergbaus (GVSt)". Since 1998, methane is partly recoveredwhich led to a significant reductione in methane emissions till 2005.
Greece	0.0	0.0	0.0	0.0	
Ireland	-	-	0.0	0.0	
Italy	0.0	0.0	0.0	0.0	
Luxembourg	0.0	0.0	0.0	0.0	
Netherlands	0.0	0.0	0.0	0.0	
Portugal	0.0	0.0	0.0	0.0	
Spain	0.0	0.0	-17.3	-1.7	
Sweden	0.0	0.0	0.0	0.0	
UK	0.0	0.0	-0.3	0.0	Revision to DTI coal mining statistics
EU-15	**0.0**	**0.0**	**-1,454.7**	**-9.0**	

3.2.6.2. Fugitive emissions from oil and natural gas (1B2)

Definition: 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 included (the combustion is considered a nonproductive activity).

Fugitive emissions from 1B2 Oil and natural gas include all emissions from exploration, production, processing, transport, and use of oil and natural gas. They account for 1.0 % of the total GHG emissions in 2005 and for 75 % of all fugitive emissions in the EU-15.

Of all fugitive emissions from oil and natural gas, in 2005:

- Around 53 % of these emissions are CH_4 emissions from natural gas (production, processing, transport and distribution).
- 24% of these emissions are CO_2 emissions from oil refining and storage.
- 16% of these emissions are due to flaring of CO_2 and CH_4.

This source category includes three key source categories:

- CO_2 from 1B2a Oil,
- CH_4 from 1B2b Natural Gas,
- CO_2 from 1B2c Venting and flaring.

Figure 3.92 1B2-Fugitive Emissions Oil and Natural Gas: Trend

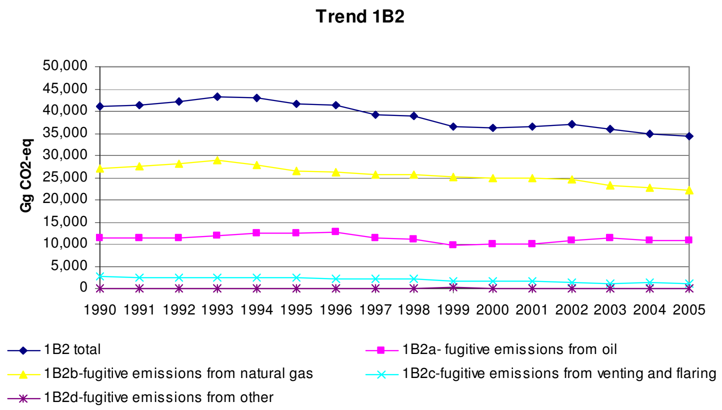


Table 3.90 shows fugitive emissions from oil and natural gas arise in all Member States. Total GHG emissions from 1B2 decreased by 14 % between 1990 and 2005 (Table 3.91). This trend is mainly due to reduced fugitive CH_4 emissions (-21 % during the same period). By contrast, fugitive CO_2 emissions declined only by 2 %.

In 2005, 78% of all fugitive GHG emissions from oil and natural gas were emitted by four countries: the United Kingdom, Italy, Germany and France. The largest reductions (in absolute terms) between 1990 and 2005 were observed in the United Kingdom (decrease in CH_4 emissions) and in Italy (both CH_4 and CO_2 emissions), while emissions increased most in Portugal, where they were multiplied by more than 10 between 1990 and 2005.

Table 3.90 1B2 Fugitive emissions from oil and natural gas: Member States' contributions

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2005 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO_2 emissions in 2005 (Gg)	CH_4 emissions in 1990 (Gg CO_2 equivalents)	CH_4 emissions in 2005 (Gg CO_2 equivalents)
Austria	476	872	102	205	374	667
Belgium	610	543	85	147	525	396
Denmark	304	538	263	435	40	101
Finland	238	194	226	130	11	64
France	7,105	5,892	4,508	3,948	2,560	1,894
Germany	7,008	6,977	0	0	7,008	6,977
Greece	162	148	70	10	92	138
Ireland	270	117	139	60	131	57
Italy	10,614	7,756	3,341	2,112	7,273	5,644
Luxembourg	28	59	IE,NE,NO	IE,NE,NO	28	59
Netherlands	2,414	1,828	775	1,074	1,639	754
Portugal	150	1,557	115	705	35	852
Spain	2,375	3,060	1,744	2,151	631	909
Sweden	98	98	93	92	5	5
United Kingdom	16,107	11,411	5,760	5,748	10,304	5,618
EU-15	**47,959**	**41,050**	**17,222**	**16,815**	**30,655**	**24,135**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.91 1B2 –Fugitive Emissions from Oil and Gas: Methodological Issues according to NIRs (submitted in 2007) of EU-15 Member States

	Methodology
Austria	**General:** Emissions from oil refining (CH_4) and CO_2 and CH_4 emissions from combined oil and gas production are considered. CO_2 emissions from the refinery resulting from combustion processes (including flaring) are included in 1 A 1 b Petroleum Refining. For transport, distribution and storage only NMVOC emissions are estimated, the CH_4 content of the NMVOC emissions is assumed to be negligible. **Activity data:** national statistics, Association of the Austrian Petroleum Industry, Austrian Natural Gas and District Heat Association. **Emission factor**: according to IPCC GPG
Belgium	**General:** consideration of petroleum refining and gas distribution **Activity data:** country specific. Energy balance recently revised. **Emission factor:** plant specific, country specific
Denmark	**General:** Emissions from offshore activities include emissions from extraction of oil and gas, on-shore oil tanks. On-shore and off-shore loading of ships. **Activity data**: country specific (Danish Energy Agency) **Emission factor:** EMEP/CORINAIR, country specific (Danish Gas Transmission Company)
Finland	**General** The fugitive methane emissions from the refining and storage of oil have been calculated on the basis of the Revised 1996 IPCC Guidelines using the default emission factors for oil refining and data from Energy Statistics on oil refining activities. **Activity data:** Energy statistics (quantity of oil refined) **Emission factor**: default factor according to IPCC GPG
France	**General:** includes exploration, production, transport, refining **Activity data:** national and plant statistics **Emission factor:** exploration Tier 1, refining Tier 2/3
Germany	**General:** The CH_4 emissions for natural gas were determined from the relevant specific emission factors and activity rates. **Activity data:** National Energy Balance, Federal Association of the German Gas and Water Industry, Reports of. German oil and gas industry association, German Society for Petroleum and Coal Science and Technology **Emission factor:** derived by the Federal Environmental Agency, on the basis of research in the literature (SCHÖN, WALZ et al., 1993) and among relevant companies and they have been continually used, Statistik der Kohlenwirtschaft
Greece	**General:** includes extraction, processing, storage, transmission/distribution, venting and flaring only from 1996 to 2005 **Activity data:** National Energy Balance, Public Gas Corporation **Emission factor:** Tier 1
Ireland	**General:** only fugitive emissions of natural gas considered **Activity data:** country specific, **Emission factor:** country specific
Italy	**General**: CO_2 emissions in refineries during petroleum production process, CH_4 production of oil and natural gas, transmission and distribution of natural gas **Activity Data:** National Energy Balance, specific industry data **Emission Factor**: IPCC GPG (2000), Corinair Guidebook
Luxembourg	**General:** no information provided
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. CO_2 from gas flaring (including the venting of gas with high carbon dioxide content) and methane from gas venting/flaring are identified as key sources. Emissions for CH_4 from gas venting and flaring are plant-specific. Fugitive emissions of methane from refineries in category 1B2 are based on a 4% share in total VOC emissions reported in the annual environmental reports of the Dutch companies **Activity data:** country specific **Emission factor:** country specific (decreases according to replacement of cast iron), 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.
Portugal	**General:** no extraction of crude oil in Portugal, includes refining, storage, transport **Activity data**: plant and country specific (Directorate General of Geology and Energy) **Emission factor**: IPCC, CONCAWE, US-EPA
Spain	**General:** main sources of CO_2 are processes in the oil refining industry, including fluid catalytic cracking and other processes to refine oil-derived products. Emissions from category 1B2 have been calculated by grouping the estimations for each potential emission source. **Activity Data:** national natural gas transmission company, Spanish Gas Association, SEDIGAS **Emission Factors:** CO_2 - country specific (questionnaires), CH_4 – Corinair Guidebook
Sweden	**General:** includes catalytic cracking, desulphurisation, storage and handling of oil, gasoline distribution and storage. Data includes flaring of refinery gases at two refineries and one chemical industry, and flaring of LPG at three iron and steel plants and one pulp industrial plant. Data has been collected directly from the plant operators. **Activity data:** statistics on fuel consumption (Statistics Sweden), plant specific (non-CO_2 emissions). **Emission factor:** Tier 2, plant specific, CONCAWE
United Kingdom	**General**: Emissions estimates for the offshore oil & gas industry are based on data provided by the trade

	Methodology
	organisation, UKOOA, through their annual emissions reporting mechanism to UK regulators, the Environmental Emissions Monitoring System (EEMS). This system provides a detailed inventory of point source emissions estimates, based on operator returns for the years 1995-2005. **Activity data**: UKOOA (trade organisation), UK Petroleum Industry Association, UK Energy Statistics **Emission factor**: plant specific and aggregated, calculated by UK Institute of Petroleum, small change to methane emission factor for oil production, based on data reported in the pollution inventory

CO_2 from Oil (1B2a)

Definition: 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.

CO_2 emissions from 1B2a 'Fugitive CO_2 emissions from oil' account for 0.2 % of total EU-15 GHG emissions in 2005 and for 18 % of all fugitive emissions in the EU-15. Between 1990 and 2005, CO_2 emissions from this source increased by 0.7 % in the EU-15 (Table 3.92), but showed a 0.7 % decrease between 2004 and 2005. By contrast, during the same period 1990-2005, CH_4 emissions of this source category were reduced by 45 %.

France is the largest emitter in the EU-15, followed by Spain and Italy (Table 3.103). During the period 1990-2005, the largest decreases in CO_2 emissions (in absolute values) were observed in Italy and the United Kingdom, while emissions increased most in Portugal (by more than 7 times), in Spain and in the Netherlands.

Table 3.92 1B2a Fugitive CO_2 emissions from oil: Member States' contributions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	43	122	122	1.3%	0	0%	79	184%	CS	AS	CS
Belgium	NA,NO	NA,NO	NA,NO	-	-	-	-	-	-	-	-
Denmark	NA	NA	NA	-	-	-	-	-	-	-	-
Finland	1	1	1	0.0%	0	-6%	0	25%	CS	NS	CS
France	3,428	3,284	3,125	32.4%	-159	-5%	-302	-9%	CR	-	CS
Germany	NE	NE	NE	-	-	-	-	-	CS	AS/PS	CS
Greece	0.3	0.04	0.04	0.0%	-0.008	-18%	-0.2	-87%	T1	NS	D
Ireland	NE,NO	NE,NO	NE,NO	-	-	-	-	-	-	-	-
Italy	2,627	1,918	1,875	19.4%	-43	-2%	-753	-29%	T2	NS	CS
Luxembourg	NO,NE	NO,NE	NO,NE	-	-	-	-	-	-	-	-
Netherlands	IE,NA,NE	873	945	-	72	8%	945	-	CS	-	CS
Portugal	65	502	503	5.2%	1	0%	438	678%	M	AS,NS,PS	D,PS
Spain	1,564	1,970	1,934	20.0%	-36	-2%	370	24%	T2	-	PS
Sweden	22	2	2	0.0%	0	13%	-20	-90%	T1	-	CS
United Kingdom	1,840	1,054	1,147	11.9%	93	9%	-693	-38%	T2	NS	CS
EU-15	**9,590**	**9,726**	**9,655**	**100.0%**	**-71**	**-1%**	**65**	**1%**			

Emissions of Irland are not estimated, because no activity data are available.
Emissions of the Netherlands are not estimated resp. included elswhere, as no data are available (negligible amounts).

Abbreviations explained in the Chapter 'Units and abbreviations'.

CH_4 from Natural gas (1B2b)

Definition: 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.

CH_4 emissions from 1B2b 'Fugitive CH_4 emissions from natural gas' account for 0.5 % of total EU-15 GHG emissions in 2005 and for 40 % of all fugitive emissions in the EU-15. Between 1990 and 2005, CH_4 emissions from this source decreased by 17 % in the EU-15 (Table 3.93), although a 0.6 % increase was observed between 2004 and 2005.

In 2005, CH_4 fugitive emissions from Germany, the United Kingdom and Italy and France represented

87 % of CH_4 emissions from this source (Table 3.93). The emission decreases in the United Kingdom (–41 %) and in Italy (-24 %) contributed most significantly to the overall reduction observed in the EU-15 between 1990 and 2005.

Table 3.93 1B2b Fugitive CH_4 emissions from natural gas: Member States' contributions

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	273	539	552	2.5%	13	2%	279	102%	T1	AS	D
Belgium	519	386	389	1.8%	3	1%	-130	-25%	CS	AS	CS
Denmark	6	7	5	0.0%	-1	-17%	0	-3%	CS	-	CS
Finland	4	45	55	0.3%	10	22%	51	1431%	M/T1	PS	M/D/CS
France	2,457	1,868	1,858	8.6%	-10	-1%	-599	-24%	C	PS	CS
Germany	6,782	7,008	6,846	31.6%	-162	-2%	65	1%	CS	AS/PS	CS
Greece	10	87	88	0.4%	0	0%	78	814%	T1	NS	D
Ireland	131	66	57	0.3%	-9	-14%	-74	-57%	CS	NS	CS
Italy	7,042	5,376	5,365	24.8%	-11	0%	-1,677	-24%	T2	NS	CS
Luxembourg	28	61	59	0.3%	-2	-3%	32	116%	C	-	PS
Netherlands	373	388	405	1.9%	18	5%	32	9%	T2,T3	AS	CS
Portugal	NO	373	808	3.7%	435	117%	808	-	T1	AS,NS	C,OTH
Spain	466	486	474	2.2%	-11	-2%	8	2%	CR, CS	-	CR, CS
Sweden	NO	NO	NO	-	-	-	-	-	NA	-	NA
United Kingdom	7,955	4,849	4,695	21.7%	-153	-3%	-3,259	-41%	T2	NS, AS	CS
EU-15	**26,044**	**21,538**	**21,657**	**100.0%**	**119**	**1%**	**-4,387**	**-17%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

CO_2 from Venting and Flaring (1B2c)

Definition: 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.

Fugitive CO_2 emissions from 1B2c Venting and Flaring account for 0.2 % of total GHG emissions in 2005 and for 12 % of all fugitive emissions in the EU-15. The United Kingdom is responsible for more than 71 % of the emissions from this source.

Between 1990 and 2005, CO_2 emissions from this source decreased by 1 % in the EU-15 (Table 3.94). This was largely due to reductions occuring in the Netherlands (- 83%) and in Italy (- 68%), offsetting the increase observed in the United Kingdom (+17%). Fugitive CO_2 emissions from flaring and venting increased by 10% between 2004 and 2005, due to significant increases in the United Kingdom and in France.

It should be noted that Austria, Germany and Ireland do not report such emissions in this source category: Austria's emissions are included in 1B2a Oil Refining/Storage, as the emission declaration of the refinery includes all emissions from this plant. Germany's emissions from venting and flaring of oil during direct further processing (refinery flaring) are reported in source category 1B2a.ii. Oil Production, and emissions from venting and flaring of natural gas are included in source categories 1B2a and 1B2b. Ireland reports emissions from venting of gas in source category 1B2b. Natural gas production/Processing.

Table 3.94 1B2c Fugitive CO_2 emissions from venting and flaring: Member States' contributions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	IE	IE	IE	-	-	-	-	-	-	-	-
Belgium	84	145	145	2.2%	0	0%	61	73%	CS	PS,AS	CS
Denmark	263	608	435	6.7%	-174	-29%	171	65%	C	NO	CS
Finland	123	62	77	1.2%	15	24%	-46	-37%	CS	NS	CS
France	297	338	495	7.7%	156	46%	198	67%	NA	-	NA
Germany	NE	NE	NE	-	-	-	-	-	-	-	-
Greece	70	11	9	0.1%	-2	-18%	-61	-87%	T1	NS	D
Ireland	IE,NO	IE,NO	IE,NO	-	-	-	-	-	-	-	-
Italy	681	210	215	3.3%	5	2%	-466	-68%	T2	NS	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	-	-	-
Netherlands	774	125	129	2.0%	3	3%	-646	-83%	T2	AS	PS
Portugal	49	42	42	0.7%	0	0%	-6	-13%	D	AS,NS	D
Spain	179	209	217	3.4%	8	4%	37	21%	CR, CS T1	-	CR, CS
Sweden	71	77	90	1.4%	12	16%	19	27%	T2	-	CS
United Kingdom	3,920	4,046	4,601	71.3%	555	14%	681	17%	T2	NS	CS
EU-15	**6,511**	**5,874**	**6,453**	**100.0%**	**579**	**10%**	**-58**	**-1%**			

Table 3.95 1B2b Fugitive CH_4 emissions from natural gas: Information on activity data, emission factors by Member State

		1990					2005				
		Activity data			Implied emission factor (kg/unit)	CH4 emissions (Gg)	Activity data			Implied emission factor (kg/unit)	CH4 emissions (Gg)
Member State	GHG source category	Description	Unit	Value			Description	Unit	Value		
Austria	**Natural Gas**					**12.98**					**26.28**
	i. Exploration			1288	IE	IE			1637	IE	IE
	ii. Production (4) / Processing	Gas throughput (a)	10^6 m^3	1288	IE	IE	Gas throughput (a)	10^6 m^3	1637	IE	IE
	iii. Transmission	Pipelines length (km)	km	1032	2900.00	2.99	Pipelines length (km)	km	1430	2900.00	4.15
	iv. Distribution	Distribution network length	km	15200	657.43	9.99	Distribution network length	km	34450	642.55	22.14
	v. Other Leakage	(e.g. PJ gas consumed)	PJ	1500	NO	NO	(e.g. PJ gas consumed)	PJ	NE	NO	NO
	at industrial plants and power stations			NE	NO	NO			NE	NO	NO
	in residential and commercial sectors			NE	NO	NO			NE	NO	NO
Belgium	**Natural Gas**					**24.71**					**18.52**
	i. Exploration			NO	NO	NO		0	NO	NO	NO
	ii. Production (4) / Processing	(speci		NO	NE	NE	(speci	0	NO	NE	NE
	iii. Transmission	(e.g. PJ gas consumed)		401	5079.35	2.04	(e.g. PJ gas consumed)	PJ	613	4269.92	2.62
	iv. Distribution	PJ gas consumed		401	56470.77	22.67	PJ gas consumed	PJ	613	25925.10	15.90
	v. Other Leakage	(speci)		NO	NO	NO	(speci)	0	NO	NO	NO
	at industrial plants and power stations			NO	NO	NO		0	NO	NO	NO
	in residential and commercial sectors			NO	NO	NO		0	NO	NO	NO
Denmark	**Natural Gas**					**0.27**					**0.26**
	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	11523	IE	IE
	iii. Transmission	Gas transmission	10^6 m^3	2739	88.62	0.24	Gas transmission	10^6 m^3	7600	25.66	0.20
	iv. Distribution	Gas distributed	10^6 m^3	1574	14.56	0.02	Gas distributed	10^6 m^3	2983	20.64	0.06
	v. Other Leakage	Incl. in transmission		IE	NO	NO	Incl. in transmission		IE	NO	NO
	at industrial plants and power stations			IE	NO	NO			IE	NO	NO
	in residential and commercial sectors			IE	NO	NO			IE	NO	NO
Finland	**Natural Gas**					**0.17**					**2.60**
	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	151	6660.56	1.00
	iv. Distribution	PJ gas distributed via local networks	PJ	5	NO	NO	PJ gas distributed via local networks	PJ	7	224403.93	1.60
	v. Other Leakage	t of natural gas released from pipelines		NE	NO	NO	t of natural gas released from pipelines		NE	NO	NO
	at industrial plants and power stations			NE	NO	NO			NE	NO	NO
	in residential and commercial sectors			NE	NO	NO			NE	NO	NO
France	**Natural Gas**					**117.01**					**88.47**
	i. Exploration		0	309	1614.89	0.50		0	128	803.04	0.10
	ii. Production (4) / Processing	PJ Production	PJ	1055	110392.09	116.51	PJ Production	PJ	1713	51593.09	88.37
	iii. Transmission	PJ Consumed	PJ	NA	NA	NA	PJ Consumed	PJ	NA	NA	NA
	iv. Distribution	(specify)	0	NO	NO	NO	(specify)	0	NO	NO	NO
	v. Other Leakage	(specify)	0	NO	NO	NO	(specify)	0	NO	NO	NO
	at industrial plants and power stations		0	NO	NO	NO		0	NO	NO	NO
	in residential and commercial sectors		0	NO	NO	NO		0	NO	NO	NO

Germany	**Natural Gas**					**322.93**					**326.02**
	i. Exploration	(natural gas)	TJ	556007	NE	NE	(natural gas)	TJ	597125	NE	NE
	ii. Production (4) / Processing	(natural gas from crude oil extraction)	TJ	563382	101.94	57.43	(natural gas from crude oil extraction)	TJ	597125	89.00	53.14
	iii. Transmission	(total amount of gas consumed)	TJ	2292780	12.89	29.56	(total amount of gas consumed)	TJ	3224000	12.42	40.05
	iv. Distribution	(distribution net)	km	NE	NE	199.57	(distribution net)	km	NE	NE	165.87
	v. Other Leakage	(gas consumed)	TJ	825669	44.05	36.37	(gas consumed)	TJ	NE,NO	NE,NO	66.96
	at industrial plants and power stations			NO	NO	NO			NO	NO	NO
	in residential and commercial sectors	(gas consumed)	TJ	825669	44.05	36.37	(gas consumed)	TJ	NE	NE	66.96
Greece	**Natural Gas**					**0.46**					**4.17**
	i. Exploration			NE	NE	NE			NE	NE	NE
	ii. Production (4) / Processing	Natural gas production	10^6 m^3	123	3708.46	0.46	Natural gas production	10^6 m^3	22	317.00	0.01
	iii. Transmission	Length of transmission pipeline	km	NO	NO	NO	Length of transmission pipeline	km	962	2569.48	2.47
	iv. Distribution	Length of distribution mains	km	NO	NO	NO	Length of distribution mains	km	2751	615.00	1.69
	v. Other Leakage	(e.g. PJ gas consumed)		NE	NE	NE	(e.g. PJ gas consumed)		0	NE	NE
	at industrial plants and power stations			NE	NE	NE			0	NE	NE
	in residential and commercial sectors			NE	NE	NE			0	NE	NE
Ireland	**Natural Gas**					**6.24**					**2.71**
	i. Exploration			IE	IE	IE			IE	IE	IE
	ii. Production (4) / Processing	PJ of Gas produced	PJ	79	14330.72	1.13	PJ of Gas produced	PJ	19	14897.53	0.29
	iii. Transmission	(e.g. PJ gas consumed)	0	IE	IE	IE	(e.g. PJ gas consumed)	0	IE	IE	IE
	iv. Distribution	PJ of gas consumed	PJ	24	214516.33	5.12	PJ of gas consumed	PJ	56	43129.08	2.42
	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**					**335.32**					**255.48**
	i. Exploration			NA	IE	IE			NA	IE	IE
	ii. Production (4) / Processing	(Mm3 gas produced)	10^6 m^3	17296	2910.93	50.35	(Mm3 gas produced)	10^6 m^3	11963	2710.77	32.43
	iii. Transmission	(Mm3 gas transported)	10^6 m^3	45684	827.60	37.81	(Mm3 gas transported)	10^6 m^3	85100	328.59	27.96
	iv. Distribution	(Mm3 gas transported)	10^6 m^3	20632	11979.84	247.17	(Mm3 gas transported)	10^6 m^3	33000	5911.90	195.09
	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**					**1.31**					**2.83**
	i. Exploration			NO	NO	NO			NO	NO	NO
	ii. Production (4) / Processing			NO	NO	NO			NO	NO	NO
	iii. Transmission	gas consumed	PJ	18	71041.21	1.31	gas consumed	PJ	52	54110.90	2.83
	iv. Distribution			IE	IE	IE			IE	IE	IE
	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

Netherlands	**Natural Gas**					**17.79**					**19.30**
	i. Exploration	number of wells drilled/tested	number	79	IE	IE	number of wells drilled/tested	number	19	IE	IE
	ii. Production (4) / Processing	gas produced	PJ	2292	IE	IE	gas produced	PJ	2308	IE	IE
	iii. Transmission	gas transported	PJ	2292	2468.91	5.66	gas transported	PJ	2437	2560.47	6.24
	iv. Distribution	natural gas distribution network	10^3 km	100	121283.21	12.13	natural gas distribution network	10^3 km	122	107505.58	13.06
	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**					**38.45**
	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	4934	7793.81	38.45
	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**					**22.20**					**22.58**
	i. Exploration			NE	NE	NE			NE	NE	NE
	ii. Production (4) / Processing	PJ gas produced (NCV)	PJ	51	70889.00	3.63	PJ gas produced (NCV)	PJ	7	70889.00	0.47
	iii. Transmission	PJ gas (NCV)	PJ	207	802.99	0.17	PJ gas (NCV)	PJ	1295	876.46	1.13
	iv. Distribution	PJ gas consumed (NCV)	PJ	214	86027.02	18.40	PJ gas consumed (NCV)	PJ	1307	16051.12	20.98
	v. Other Leakage	(e.g. PJ gas consumed)	0	NE	NE	NE	(e.g. PJ gas consumed)	0	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**					**NO**					**NO**
	i. Exploration			NO	NO	NO			NO	NO	NO
	ii. Production (4) / Processing			NO	NO	NO			NO	NO	NO
	iii. Transmission	Pressure levelling losses	TJ	NO	NO	NO	Pressure levelling losses	TJ	NO	NO	NO
	iv. Distribution	(e.g. PJ gas consumed)		NO	NO	NO	(e.g. PJ gas consumed)		NO	NO	NO
	v. Other Leakage			NO	NO	NO			NO	NO	NO
	at industrial plants and power stations			NE	NE	NE			NO	NO	NO
	in residential and commercial sectors			NE	NE	NE			NO	NO	NO
United Kingdom	**Natural Gas**					**378.80**					**223.59**
	i. Exploration			IE	IE	IE			IE	IE	IE
	ii. Production (4) / Processing	(e.g. PJ gas produced)		IE	IE	IE	(e.g. PJ gas produced)		IE	IE	IE
	iii. Transmission	(e.g. PJ gas consumed)		IE	IE	IE	(e.g. PJ gas consumed)		IE	IE	IE
	iv. Distribution	Gas consumed	PJ	1573	240742.27	378.80	Gas consumed	PJ	3316	67426.61	223.59
	v. Other Leakage	(e.g. PJ gas consumed)		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

Tables 3.96 and 3.97 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 2004 and main explanations for the largest recalculations in absolute terms.

Table 3.96 1B2 Fugitive CO_2 emissions from Oil and natural gas: Contribution of MS to EC recalculations in CO_2 for 1990 and 2004 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2004		Main explanations
	Gg	Percent	Gg	Percent	
Austria	0.0	0.0	0.0	0.0	
Belgium	0.0	0.0	0.0	0.0	
Denmark	0.0	0.0	0.0	0.0	
Finland	0.0	0.0	0.0	0.0	
France	0.0	0.0	2.2	0.0	
Germany	0.0	0.0	0.0	0.0	
Greece	0.0	-	0.0	-	
Ireland	0.0	0.0	0.0	0.0	
Italy	0.0	0.0	2.4	0.1	Basic data regarding the losses of crude oil used to balance CO2 emission reported on the National Energy Balance have been updated
Luxembourg	-	0.0	-	0.0	
Netherlands	0.0	0.0	873.0	695.6	part of the emissions formerly allocated in category 1Ab1, are now allocated in category 1B2. This change is based on detailed information from annual environmental reports of refineries in category 1B2, distribution of oil and gas, the whole time series (except 1990) was corrected (shifted one year);
Portugal	0.0	0.0	-179.0	-21.5	The activity data time series was revised for the period 1994-2004 using statistical information from DGGE.
Spain	0.0	0.0	2.0	0.1	
Sweden	0.0	0.0	32.0	67.6	CRF 1B2a iv: Reported emissions of NMVOC from refineries were updated for 2002 – 2004 due to new measurements of the emissions at two of the refineries. CRF 1B2a v:Fugitive NMVOC emissions from handling of gasoline at depots were updated for 2004. Activity data, volume of gasoline, used for calculating fugitive emissions from distribution of gasoline were corrected for 2003 and 2004. CRF 1B2c:Data on flaring of gas for one plant was recalculated due to errors in previous calculations of emissions during 1995-2004 which resulted in an increase in CO2 emissions with on average about 29 Gg every year.
UK	0.0	0.0	0.0	0.0	
EU-15	**0.0**	**0.0**	**732.5**	**4.6**	

Table 3.97 1B2 Fugitive CH_4 emissions from Oil and natural gas: Contribution of MS to EU-15 recalculations in CH_4 for 1990 and 2004 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2004		Main explanations
	Gg	Percent	Gg	Percent	
Austria	0.0	0.0	0.0	0.0	
Belgium	0.0	0.0	-18.1	-4.4	Revision of Energy Balance: Transport through pipelines for 1999 to 2003 (approx. 0.2 PJ/year)
Denmark	0.0	0.0	0.0	0.0	
Finland	0.0	0.0	0.0	0.0	
France	0.0	0.0	0.0	0.0	
Germany	0.0	0.0	9.2	0.1	
Greece	0.0	0.0	0.0	0.0	
Ireland	-19.6	-13.0	-12.3	-15.7	
Italy	0.0	0.0	7.4	0.1	Emission factors for gas production have been updated
Luxembourg	0.0	0.0	0.0	0.0	
Netherlands	0.0	0.0	0.0	0.0	
Portugal	0.0	0.0	0.0	0.0	
Spain	0.0	0.0	-2.5	-0.3	
Sweden	0.0	0.0	0.0	0.2	CRF 1B2a iv: Reported emissions of NMVOC from refineries were updated for 2002 – 2004 due to new measurements of the emissions at two of the refineries. CRF 1B2a v:Fugitive NMVOC emissions from handling of gasoline at depots were updated for 2004. Activity data, volume of gasoline, used for calculating fugitive emissions from distribution of gasoline were corrected for 2003 and 2004. CRF 1B2c:Data on flaring of gas for one plant was recalculated due to errors in previous calculations of emissions during 1995-2004 which resulted in an increase in CO2 emissions with on average about 29 Gg every year.
UK	-0.7	0.0	0.1	0.0	Small change to methane emission factor for oil production, based on data reported in the pollution inventory
EU-15	**-20.3**	**-0.1**	**-16.2**	**-0.1**	

3.3 Methodological issues and uncertainties

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 3.98 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 1A4 (liquid fuels) and the lowest for CO_2 from 1A1a (liquid fuels). With regard to trend CH_4 from 1A5 (gaseous fuels) shows the highest uncertainty estimates, CO_2 from 1A1a (solid fuels) the lowest. For a description of the Tier 1 uncertainty analysis carried out for the EU-15 see Chapter 1.7.

Table 3.98 Sector 1 Energy (excl. 1A3b and 1B): Uncertainty estimates for EU-15

Source category	Fuel	Emissions 1990	Emissions 1990	Emissions 2005 [1)]	Emission trends 1990-2005	Emissions for which MS uncertainty estimates are available [2)]	Share of emissions for which MS uncertainty estimates are available	Level uncertainty estimates based on MS uncertainty estimates
1.A.1.a Public electricity and heat production	Gaseous	CO_2	60,435	225,811	274%	84,868	38%	2%
1.A.1.a Public electricity and heat production	Liquid	CO_2	124,477	74,870	-40%	50,290	67%	1%
1.A.1.a Public electricity and heat production	Other	CO_2	13,834	27,724	100%	12,681	46%	5%
1.A.1.a Public electricity and heat production	Solid	CO_2	751,475	675,494	-10%	724,585	107%	2%
1.A.1.b Petroleum refining	Gaseous	CO_2	3,678	9,026	145%	8,796	97%	2%
1.A.1.b Petroleum refining	Liquid	CO_2	98,606	113,805	15%	52,104	46%	4%
1.A.1.b Petroleum refining	Solid	CO_2	3,461	651	-81%	488	75%	8%
1.A.1.c Manufacture of solid fuels	Gaseous	CO_2	16,506	22,177	34%	1,487	7%	9%
1.A.1.c Manufacture of solid fuels	Liquid	CO_2	3,401	1,787	-	216	-	7%
1.A.1.c Manufacture of solid fuels	Other	CO_3	3,390	3,511	4%	5	0%	9%
1.A.1.c Manufacture of solid fuels	Solid	CO_4	72,520	30,375	-58%	21,683	71%	6%
1.A.2 Manufacturing industries and construction	Gaseous	CO_4	174,928	249,455	43%	162,353	65%	3%
1.A.2 Manufacturing industries and construction	Liquid	CO_4	193,843	155,991	-20%	132,022	85%	5%
1.A.2 Manufacturing industries and construction	Other	CO_4	8,215	17,945	118%	8,695	48%	13%
1.A.2 Manufacturing industries and construction	Solid	CO_4	232,697	123,547	-47%	109,245	88%	8%
1.A.4.a Commercial/institutional	Gaseous	CO_4	59,106	102,893	74%	41,564	40%	9%
1.A.4.a Commercial/institutional	Liquid	CO_4	74,021	59,698	-19%	30,059	50%	8%
1.A.4.a Commercial/institutional	Other	CO_4	937	2,989	219%	125	4%	13%
1.A.4.a Commercial/institutional	Solid	CO_4	27,668	1,725	-94%	1,361	79%	12%
1.A.4.b Residential	Gaseous	CO_4	161,877	245,397	52%	136,117	55%	5%
1.A.4.b Residential	Liquid	CO_4	169,713	154,960	-9%	142,073	92%	5%
1.A.4.b Residential	Other	CO_4	319	386	21%	20	5%	10%
1.A.4.b Residential	Solid	CO_4	74,525	11,806	-84%	6,630	56%	11%
1.A.4.c Agriculture/Forestry/Fisheries	Gaseous	CO_4	9,723	10,430	7%	8,184	78%	9%
1.A.4.c Agriculture/Forestry/Fisheries	Liquid	CO_4	56,946	51,602	-9%	13,992	27%	10%
1.A.4.c Agriculture/Forestry/Fisheries	Solid	CO_4	4,066	752	-82%	152	20%	10%
1.A.5 Other	Gaseous	CO_4	560	818	46%	653	80%	11%
1.A.5 Other	Liquid	CO_4	15,965	7,540	-53%	2,096	28%	14%
1.A.5 Other	Solid	CO_4	4,667	15	-100%	44	286%	8%
1.A stationary combustion unspecified	Gaseous	CO_4	-	-	-	393,496	-	2%
1.A stationary combustion unspecified	Liquid	CO_4	-	-	-	95,374	-	10%
1.A stationary combustion unspecified	Other	CO_4	-	-	-	2,645	-	16%
1.A stationary combustion unspecified	Solid	CO_4	-	-	-	120,471	-	4%
1.A.1 Energy Industries	Biomass	CH_4	200	457	128%	80	18%	30%
1.A.1 Energy Industries	Gaseous	CH_4	127	613	382%	585	95%	2%
1.A.1 Energy Industries	Liquid	CH_4	149	114	-24%	18	16%	48%
1.A.1 Energy Industries	Other	CH_4	32	51	62%	7	13%	42%
1.A.1 Energy Industries	Solid	CH_4	402	248	-38%	101	41%	44%
1.A.2 Manufacturing industries and construction	Biomass	CH_4	137	157	14%	84	53%	48%
1.A.2 Manufacturing industries and construction	Gaseous	CH_4	194	375	93%	53	14%	43%
1.A.2 Manufacturing industries and construction	Liquid	CH_4	180	156	-13%	35	22%	33%
1.A.2 Manufacturing industries and construction	Other	CH_4	13	13	-1%	2	13%	38%
1.A.2 Manufacturing industries and construction	Solid	CH_4	632	388	-39%	112	29%	38%
1.A.4 Other Sectors	Biomass	CH_4	6,380	5,131	-20%	3,631	71%	33%
1.A.4 Other Sectors	Gaseous	CH_4	574	740	29%	39	5%	68%
1.A.4 Other Sectors	Liquid	CH_4	365	304	-17%	69	23%	54%
1.A.4 Other Sectors	Other	CH_4	27	25	-7%	1	5%	56%
1.A.4 Other Sectors	Solid	CH_4	4,005	441	-89%	117	27%	104%
1.A.5 Other	Gaseous	CH_4	0	0	370%	0	100%	60%
1.A.5 Other	Liquid	CH_4	38	15	-61%	8	56%	40%
1.A.5 Other	Solid	CH_4	210	0	-100%	0	4482%	50%
1.A stationary combustion unspecified	Biomass	CH_4	-	-	-	1,316	-	45%
1.A stationary combustion unspecified	Gaseous	CH_4	-	-	-	1,369	-	39%

Note: Emissions are in Gg CO_2 equivalents; trend uncertainty is presented as percentage points.

1) The sum of the source category emissions may not be the total sector emissions because uncertainty estimates are not available for all source categories.

2) Includes for Greece and Spain 2004 data and for Belgium and Germany 2003 data

Table 3.99 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 uncertainty was estimated for N_2O from 1B2 and the lowest for CO_2 from 1B2. With regard to trend N_2O from 1B1 shows the highest uncertainty estimates, CH_4 from 1B2 the lowest.

Table 3.99 1B Fugitive Emissions: Uncertainty estimates for EU-15

Source category	Gas	Emissions 1990	Emissions 2005 1)	Emission trends 1990-2005	Emissions for which MS uncertainty estimates are available 2)	Share of emissions for which MS uncertainty estimates are available	Level uncertainty estimates based on MS uncertainty estimates	Trend uncertainty estimates based on MS uncertainty estimates
1.B.1 Solid fuels	CO_2	2,074	1,345	-35%	1,148	85%	28%	15
1.B.2 Oil and natural gas	CO_2	17,222	16,815	-2%	15,757	94%	8%	6
1.B.1 Solid fuels	CH_4	46,041	12,132	-74%	12,258	101%	34%	17
1.B.2 Oil and natural gas	CH_4	30,655	24,135	-21%	22,653	94%	15%	4
1.B.1 Solid fuels	N_2O	4	3	-41%	3	100%	51%	44
1.B.2 Oil and natural gas	N_2O	83	100	21%	48	48%	104%	7
Total	**all**	**96,079**	**54,530**	**-43%**	**51,867**	**95%**	**11%**	**8**

Note: Emissions are in Gg CO_2 equivalents; trend uncertainty is presented as percentage points.

1) The sum of the source category emissions may not be the total sector emissions because uncertainty estimates are not available for all source categories.

2) Includes for Greece and Spain 2004 data and for Belgium and Germany 2003 data

Table 3.100 shows the total EU-15 uncertainty estimates for the sector 1A3 ‘Transport’ and the uncertainty estimates for the relevant gases for each source category. The highest uncertainty was estimated for N_2O from 1A3d and the lowest for CO_2 from 1A3b. With regard to trend N_2O from 1A3a shows the highest uncertainty estimates, CO_2 from 1A3b the lowest.

Table 3.100 1A3 Transport: Uncertainty estimates for EU-15

Source category	Gas	Emissions 1990	Emissions 2005 1)	Emission trends 1990-2005	Emissions for which MS uncertainty estimates are available 2)	Share of emissions for which MS uncertainty estimates are available	Level uncertainty estimates based on MS uncertainty estimates	Trend uncertainty estimates based on MS uncertainty estimates
1.A.3.a Civil aviation	CO_2	17,450	25,063	44%	17,353	69%	22%	11
1.A.3.b Road transport	CO_2	636,776	793,884	25%	795,424	100%	3%	1
1.A.3.c Railways	CO_2	7,888	6,003	-24%	4,568	76%	7%	5
1.A.3.d Navigation	CO_2	19,175	21,563	12%	17,358	80%	9%	3
1.A.3.e Other	CO_2	6,584	8,407	28%	6,136	73%	11%	3
1.A.3.a Civil aviation	CH_4	11	13	20%	7	57%	52%	14
1.A.3.b Road transport	CH_4	4,428	2,038	-54%	1,430	70%	13%	23
1.A.3.c Railways	CH_4	10	7	-29%	6	79%	30%	14
1.A.3.d Navigation	CH_4	48	52	9%	45	86%	52%	4
1.A.3.e Other	CH_4	17	19	11%	19	102%	31%	9
1.A.3.a Civil aviation	N_2O	169	274	62%	573	209%	51%	98
1.A.3.b Road transport	N_2O	7,069	21,627	206%	24,127	112%	42%	76
1.A.3.c Railways	N_2O	403	396	-2%	474	120%	119%	29
1.A.3.d Navigation	N_2O	181	205	13%	169	83%	257%	22
1.A.3.e Other	N_2O	105	172	63%	54	31%	61%	22
Total	**all**	**700,313**	**879,721**	**25.6%**	**867,743**	**99%**	**3%**	**1**

Note: Emissions are in Gg CO_2 equivalents; trend uncertainty is presented as percentage points.

1) The sum of the source category emissions may not be the total sector emissions because uncertainty estimates are not available for all source categories.

2) Includes for Greece and Spain 2004 data and for Belgium and Germany 2003 data

3.4 Sector-specific quality assurance and quality control

There are several activities for improving the quality of GHG emissions from energy: Before and during the compilation of the EC 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 EC 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 EC 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'.

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. In 2005 the emissions under the EU ETS covered ca 47% of the total CO_2 emissions and ca. 39% of total greenhouse gas emissions in EU-15.

A further sector-specific QA/QC activity is the project lead by Eurostat on the harmonisation of the energy data used for energy balances and CO_2 inventories. The work programme for this project foresees that Member States perform the following tasks:

- examine the energy data used by the two submissions (CRF to UNFCCC and the European Commission's DG Environment, and joint questionnaires to Eurostat and the IEA) for 1990, 1995 and 2000 and identify and explain the differences;
- establish a procedure at national level that will eliminate discrepancies in the two reporting mechanisms in future; this procedure will be agreed with Eurostat;
- provide the updated energy data in the form of annual questionnaires for the period 1990–2000 ensuring comparable data under the two reporting mechanisms.

By end of 2004, final reports of ten EU-15 Member States were available (Austria, Denmark, France, Germany, Ireland, Italy, Netherlands, Portugal, Sweden and the United Kingdom). The projects results were analysed thoroughly and an additional comparison between the available environmental data and Eurostat data for the period 1990-2002 for each Member State was carried out. The main conclusion of these actions and the use of the more detailed revised annual joint questionnaires led Eurostat to introduce to its work programme for next year to disaggregate of the information stored in its database.

In 2003, a workshop on 'Energy balances and energy-related greenhouse gas emission inventories' was organised under Working Group I of the EC Climate Change Committee, and linked to the Eurostat Energy Statistics Committee. The objectives of the workshop were to: (1) share best practice between countries, both statistical institutes and national GHG inventory compilers; (2) strengthen the links between the reporting mechanisms of energy data (Eurostat/IEA) and GHG inventories (UNFCCC/Commission); (3) make recommendations to improve coherency in the data reported under the two reporting mechanisms. More than 60 experts attended the workshop from almost all EU-15 Member States and accession and candidate countries, the European Commission (DG Environment, Eurostat), the EEA and ETC/ACC. Representatives from the IEA, the UNFCCC Secretariat and the European non-energy use research network, attended as observers. The workshop report with the recommendations can be downloaded from the ETC/ACC website: http://air-climate.eionet.eu.int/.

A number of these recommendations were addressed by Eurostat this year, namely timelines of energy data (all the annual joint energy questionnaires were available to Eurostat by the middle of March 2006). Another very important recommendation aiming to strength the EU's energy statistics system is the creation of a draft of an EU legal basis on energy statistics. The first draft Regulation was prepared by Eurostat in 2005. EU Member States have already commented this draft that was then circulated for consultation to other European Commission Directorates. Eurostat's Statistical Programming Committee is expected to give also a final opinion on this draft before it is submitted to the European Council and Parliament. The annexes of this Regulation cover all energy quantities statistics (annual and monthly questionnaires) currently collected by Eurostat.

Another workshop recommendation aiming to improve the quality of the basic energy data was the preparation of the Energy Statistics manual. The English version of the book prepared by the IEA, Eurostat and UNECE was translated by Eurostat into the French and German language.

Issues related to the workshop's recommendations on the methodology of energy statistics were also addressed in the Energy Statistics Working Group of November 16-17 in Paris co-organised by Eurostat and the IEA. It was agreed that the 2005 joint Eurostat/IEA/UNECE energy statistics questionnaires will have a more detailed fuel breakdown (inclusion of Anthracite, Tars, etc.) which is more in line with the emissions reporting requirements, calorific values for oil products will be included and definitions of bunker fuels will be improved. More information on the outcome of this Working Group can be found at: http://www.iea.org/Textbase/stats/questionnaire/background.asp. The new questionnaires were used for collecting 2004 energy statistics and with no disruption with respect to the quality of the collected statistics. Some Member States had however difficulties in reporting more detailed energy consumption data.

3.5 Sector-specific recalculations

Table 3.102 shows that in the energy sector the largest recalculations in absolute terms were made in 1990 for N_2O and in 2004 for CO_2. In relative terms the recalculations of N_2Oemissions in 1990 were -0.3 % and of CO_2 emissions in 2004, they were at 0.2 %.

Table 3.102 Sector 1 Energy: Recalculations of total GHG emissions and recalculations of GHG emissions for the years 1990 and 2004 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	-12,662	-0.4%	-284	-0.1%	-4,944	-1.2%	-1	0.0%	0	0.0%	1	0.0%
Energy	20	0.0%	-49	-0.1%	-116	-0.3%	NO	NO	NO	NO	NO	NO
2004												
Total emissions and removals	-8,944	-0.3%	-2,528	-0.8%	-558	-0.2%	-2,281	-4.4%	-59	-1.1%	31	0.3%
Energy	5,405	0.2%	-2,409	-4.6%	-15	0.0%	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 had the most influence on CO_2 recalculations in the EU-15 in 2004, due to updated activity data. 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 2004 by gas (difference between latest submission and previous submission Gg of CO_2 equivalents)

	1990						2004					
	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
Austria	-2	0	2	NO	NO	NO	-23	-5	9	NO	NO	NO
Belgium	0	0	0	NO	NO	NO	-11	-17	-151	NO	NO	NO
Denmark	-12	6	-3	NO	NO	NO	45	17	10	NO	NO	NO
Finland	163	-21	-84	NO	NO	NO	-281	-14	7	NO	NO	NO
France	18	-19	71	NO	NO	NO	-397	-852	97	NO	NO	NO
Germany	-107	8	63	NO	NO	NO	11,136	-1,307	183	NO	NO	NO
Greece	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
Ireland	-7	-17	-38	NO	NO	NO	474	7	-68	NO	NO	NO
Italy	-41	0	-1	NO	NO	NO	1,036	-61	18	NO	NO	NO
Luxembourg	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
Netherlands	0	0	0	NO	NO	NO	346	-5	-20	NO	NO	NO
Portugal	0	1	-12	NO	NO	NO	279	-7	40	NO	NO	NO
Spain	0	0	0	NO	NO	NO	-2,742	-10	-4	NO	NO	NO
Sweden	0	0	0	NO	NO	NO	-33	0	0	NO	NO	NO
UK	8	-6	-114	NO	NO	NO	-4,425	-154	-136	NO	NO	NO
EU-15	**20**	**-49**	**-116**	**NO**	**NO**	**NO**	**5,405**	**-2,409**	**-15**	**NO**	**NO**	**NO**

Abbreviations explained in the Chapter 'Units and abbreviations'.

3.6 Comparison between the sectoral approach and the reference approach

The IPCC reference approach for CO_2 from fossil fuels for the EU-15 is based on Eurostat energy data (NewCronos database, March 2007 version). This submission includes the reference approach tables for 1990–2005.

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, net calorific values and carbon emission factors as available in the Eurostat NewCronos database. In the CRF Table 1.A(b) some fuel categories are grouped and average net calorific values are used: 'Orimulsion' is included in 'Residual fuel oil'. 'Natural gas liquids' is included in 'Crude oil'. 'Other kerosene' is included in 'Total kerosene'. 'Anthracite', 'Coking coal' and 'Other bituminous coal' are referred to in the Eurostat NewCronos database as 'Hard coal' and are included in CRF Table 1.A(b) under 'Other bituminous coal'. 'Sub-bitumenous coal' and 'Peat' are included in 'Lignite'. 'Solid biomass', 'Liquid biomass' and 'Gas biomass' is included in 'Total biomass'. For international bunkers, only fuel consumption for international navigation is available in the NewCronos database; data on international aviation is taken from the EU-15 sectoral approach. For the calculation of CO_2 emissions, the IPCC default carbon emission factors are used in the Eurostat database.

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 (except international aviation) 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. These net calorific values are updated annually for solid fuels together with the energy data in the NewCronos database; for petroleum products the net calorific values are kept constant. For groups of fuels average weighted net calorific values are used, which is the case for 'Other bituminous coal' and 'Lignite'.

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: Fuel consumption from international aviation is included in Tables 1.A(b) from the Table 1.C from the EU-15 sectoral approach.

Step 4: 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 2005 as provided in Tables 1.A(b). Total fossil fuel energy consumption increased by 10 % between 1990 and 2005. Large increases had gas consumption (+72 %), whereas solid fuel combustion declined by 30 %.

Table 3.115 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, increased by 3.4 % and 4.1 % respectively between 1990 and 2005; the percentage differences between the two data sets are 0.1 % in 1990 and 0.6 % in 2005.

Table 3.104 Reference Approach: Apparent EU-15 energy consumption (in PJ) (Eurostat data)

Fuel types	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Liquid Fuels	21,866	22,734	22,835	22,576	22,675	22,939	23,371	23,274	23,733	23,458	23,007	23,588	23,246	23,365	23,246	23,067
Solid Fuels	12,580	11,896	11,100	10,264	10,124	9,855	9,766	9,308	9,299	8,625	9,014	9,086	9,072	9,330	9,370	9,035
Gaseous Fuels	9,355	10,066	9,989	10,556	10,633	11,519	12,791	12,675	13,215	13,787	14,204	14,543	14,636	15,335	15,746	16,100
Total	**43,802**	**44,696**	**43,924**	**43,397**	**43,432**	**44,313**	**45,928**	**45,256**	**46,248**	**45,871**	**46,226**	**47,217**	**46,953**	**48,031**	**48,362**	**48,202**

Table 3.105 IPCC Reference approach (Eurostat data) and sectoral approach (Member State data) for EU-15 (in Tg)

CO2 emissions	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Sectoral approach	3,110	3,143	3,076	3,030	3,014	3,042	3,128	3,067	3,113	3,092	3,112	3,186	3,176	3,253	3,262	3,238
Reference approach	3,113	3,141	3,061	3,009	2,997	3,037	3,134	3,065	3,122	3,073	3,093	3,167	3,164	3,233	3,253	3,218
Percentage difference	-0.12%	0.05%	0.52%	0.69%	0.58%	0.16%	-0.19%	0.08%	-0.31%	0.61%	0.63%	0.60%	0.37%	0.61%	0.30%	0.64%

Table 3.106 provides an overview by Member State on differences between the Eurostat and national reference approach for 1990 and 2004/2005, as far as available. The differences can occur due to differences in the basic energy data or due to differences when calculating CO_2 emissions from the basic energy data. 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;
- small 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).

The main reasons for diverging CO_2 emissions are:

- differences in the treatment of non-energy use of fossil fuels and carbon stored;
- the use of country-specific emission factors. The Eurostat reference approach uses the IPCC default emission factors.

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 (see Section 3.4).

Table 3.116 shows the comparison between Eurostat and national reference approach for apparent consumption and CO_2 from fuel combustion. The most complete year is 2004. So, if 2004 is taken, apparent consumption of the two approaches is within 2 % for several Member States (Austria, Denmark, Finland, Germany, Hungary, Ireland, Latvia, Lithuania, Luxembourg, Netherlands, Slovenia, Spain and the UK). Differences of more than 5 % can be observed only for Belgium and Estonia.

For Belgium the differences in apparent consumption in liquid fuels is due to different CV used for Crude oil and oil products. Belgium is not providing information on CVs in the Joint questionnaire. Eurostat is using default values of the CV of petroleum products and a weighted average value for crude oil (weighting refinery inputs and outputs). The Eurostat CV for crude is therefore variable along time (38-40 GJ/kT), while in the CRF the value of (41.87GJ/kT) is used leading to approx. 10% higher apparent consumption from liquid fuels in 2004. Further analysis is needed in order to explain the large difference for Estonia.

The differences of CO_2 emissions for 2004 range from 0.0 % (Austria) to 11.5 % (Greece). For the EU-15 as a whole the differences for both apparent consumption and CO_2 emissions are 2 % in 2004.

A comparison of these tables with the tables provided in the 2006 submission does not show a clear trend; about half of the Member States have now a better fit with than in 2006.

Table 3.106 Comparison between Eurostat and national reference approach for CO_2 from fuel combustion (CRF 1.A) ([19])

Austria

1990	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	429,666	28,908	432,368	28,416	0.6%	-1.7%
Solid fossil fuels	169,451	16,145	168,733	15,914	-0.4%	-1.4%
Gaseous fossil fuels	217,047	11,843	219,239	12,238	1.0%	3.3%
Total	**816,164**	**56,896**	**820,341**	**56,568**	**0.5%**	**-0.6%**

2004	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	557,718	37,756	579,354	38,276	3.9%	1.4%
Solid fossil fuels	170,506	16,303	164,905	15,523	-3.3%	-4.8%
Gaseous fossil fuels	312,539	17,259	313,362	17,492	0.3%	1.3%
Total	**1,040,762**	**71,318**	**1,057,621**	**71,290**	**1.6%**	**0.0%**

2005	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	567,839	38,669	583,136	38,899	2.7%	0.6%
Solid fossil fuels	170,152	16,390	165,638	15,643	-2.7%	-4.6%
Gaseous fossil fuels	345,975	19,115	349,470	19,507	1.0%	2.1%
Total	**1,083,966**	**74,175**	**1,098,245**	**74,049**	**1.3%**	**-0.2%**

Belgium

1990	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	688,879	44,966	747,727	49,182	8.5%	9.4%
Solid fossil fuels	408,855	37,859	443,046	41,148	8.4%	8.7%
Gaseous fossil fuels	342,022	18,768	342,955	18,819	0.3%	0.3%
Total	**1,439,756**	**101,593**	**1,533,728**	**109,150**	**6.5%**	**7.4%**

2004	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	767,948	48,114	849,806	54,745	10.7%	13.8%
Solid fossil fuels	251,003	23,362	269,250	24,993	7.3%	7.0%
Gaseous fossil fuels	610,016	33,393	611,680	33,484	0.3%	0.3%
Total	**1,628,968**	**104,868**	**1,730,735**	**113,222**	**6.2%**	**8.0%**

Bulgaria

1990	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	392,077	26,922	396,034	28,320	1.0%	5.2%
Solid fossil fuels	364,395	35,134	388,933	40,554	6.7%	15.4%
Gaseous fossil fuels	225,887	12,104	225,622	12,085	-0.1%	-0.2%
Total	**982,359**	**74,161**	**1,010,589**	**80,960**	**2.9%**	**9.2%**

2004	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	171,782	10,923	180,305	11,631	5.0%	6.5%
Solid fossil fuels	303,545	29,409	299,825	31,451	-1.2%	6.9%
Gaseous fossil fuels	104,363	5,443	104,376	5,444	0.0%	0.0%
Total	**579,690**	**45,775**	**584,506**	**48,526**	**0.8%**	**6.0%**

2005	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	200,404	12,927	206,141	13,227	2.9%	2.3%
Solid fossil fuels	288,782	27,950	291,834	30,560	1.1%	9.3%
Gaseous fossil fuels	117,401	6,146	118,011	6,178	0.5%	0.5%
Total	**606,588**	**47,022**	**615,986**	**49,966**	**1.5%**	**6.3%**

([19]) Minus means that Member State-based estimates are lower than the Eurostat-based estimates.

Cyprus

2004	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	87,815	6,405	94,743	6,722	7.9%	4.9%
Solid fossil fuels	1,603	149	1,008	93	-37.1%	-37.4%
Gaseous fossil fuels	0	0	0	0	-	-
Total	**89,418**	**6,555**	**95,751**	**6,815**	**7.1%**	**4.0%**

2005	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	89,294	6,281	94,164	6,836	5.5%	8.8%
Solid fossil fuels	1,517	141	937	87	-38.2%	-38.3%
Gaseous fossil fuels	0	0	0	0	-	-
Total	**90,811**	**6,422**	**95,102**	**6,923**	**4.7%**	**7.8%**

Czech Republic

1990	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	360,714	22,063	347,586	22,941	-3.6%	4.0%
Solid fossil fuels	1,251,487	115,636	1,326,753	127,439	6.0%	10.2%
Gaseous fossil fuels	219,711	12,264	224,667	12,541	2.3%	2.3%
Total	**1,831,911**	**149,963**	**1,899,006**	**162,922**	**3.7%**	**8.6%**

2004	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	370,075	21,611	361,015	24,503	-2.4%	13.4%
Solid fossil fuels	816,115	75,604	856,788	82,943	5.0%	9.7%
Gaseous fossil fuels	326,064	18,201	326,488	18,224	0.1%	0.1%
Total	**1,512,253**	**115,416**	**1,544,291**	**125,671**	**2.1%**	**8.9%**

2005	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	383,109	22,346	378,072	25,523	-1.3%	14.2%
Solid fossil fuels	841,281	77,840	838,467	81,167	-0.3%	4.3%
Gaseous fossil fuels	322,528	18,003	320,502	17,890	-0.6%	-0.6%
Total	**1,546,917**	**118,189**	**1,537,041**	**124,581**	**-0.6%**	**5.4%**

Denmark

1990	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	312,348	21,796	318,561	22,425	2.0%	2.9%
Solid fossil fuels	254,881	23,645	259,311	24,478	1.7%	3.5%
Gaseous fossil fuels	76,099	4,248	76,098	4,269	0.0%	0.5%
Total	**643,328**	**49,689**	**653,970**	**51,172**	**1.7%**	**3.0%**

2004	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	311,784	22,019	316,974	22,596	1.7%	2.6%
Solid fossil fuels	182,486	16,933	190,821	17,939	4.6%	5.9%
Gaseous fossil fuels	194,007	10,829	194,008	10,884	0.0%	0.5%
Total	**688,277**	**49,782**	**701,802**	**51,419**	**2.0%**	**3.3%**

2005	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	301,897	21,352	307,406	21,952	1.8%	2.8%
Solid fossil fuels	155,554	14,434	163,754	15,374	5.3%	6.5%
Gaseous fossil fuels	184,195	10,282	184,194	10,333	0.0%	0.5%
Total	**641,646**	**46,068**	**655,355**	**47,659**	**2.1%**	**3.5%**

Estonia

1990	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	124,407	9,050	126,268	9,303	1.5%	2.8%
Solid fossil fuels	264,628	26,180	256,011	24,920	-3.3%	-4.8%
Gaseous fossil fuels	51,175	2,857	51,175	2,857	0.0%	0.0%
Total	**440,210**	**38,087**	**433,454**	**37,080**	**-1.5%**	**-2.6%**

2004	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	44,268	3,068	28,901	2,040	-34.7%	-33.5%
Solid fossil fuels	142,545	14,127	139,017	13,462	-2.5%	-4.7%
Gaseous fossil fuels	32,429	1,683	32,458	1,812	0.1%	7.7%
Total	**219,242**	**18,878**	**200,376**	**17,313**	**-8.6%**	**-8.3%**

2005	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	43,966	3,061	28,086	1,976	-36.1%	-35.4%
Solid fossil fuels	133,381	13,218	133,438	12,818	0.0%	-3.0%
Gaseous fossil fuels	33,481	1,735	33,481	1,869	0.0%	7.7%
Total	**210,829**	**18,014**	**195,005**	**16,663**	**-7.5%**	**-7.5%**

Finland

1990	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	403,739	26,075	443,738	29,201	9.9%	12.0%
Solid fossil fuels	223,043	21,309	224,363	20,384	0.6%	-4.3%
Gaseous fossil fuels	94,646	5,265	91,944	5,076	-2.9%	-3.6%
Total	**721,428**	**52,649**	**760,045**	**54,661**	**5.4%**	**3.8%**

2004	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	433,563	29,569	433,059	27,209	-0.1%	-8.0%
Solid fossil fuels	314,353	29,909	313,931	28,913	-0.1%	-3.3%
Gaseous fossil fuels	165,401	9,193	165,816	9,135	0.3%	-0.6%
Total	**913,318**	**68,670**	**912,807**	**65,257**	**-0.1%**	**-5.0%**

2005	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	413,163	27,935	410,300	25,637	-0.7%	-8.2%
Solid fossil fuels	206,187	19,758	205,608	18,643	-0.3%	-5.6%
Gaseous fossil fuels	150,643	8,368	151,008	8,307	0.2%	-0.7%
Total	**769,992**	**56,061**	**766,916**	**52,587**	**-0.4%**	**-6.2%**

France

1990	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	3,537,969	228,045	3,534,399	223,844	-0.1%	-1.8%
Solid fossil fuels	824,313	76,822	803,792	74,941	-2.5%	-2.4%
Gaseous fossil fuels	1,089,913	59,368	1,089,913	59,718	0.0%	0.6%
Total	**5,452,195**	**364,234**	**5,428,104**	**358,502**	**-0.4%**	**-1.6%**

2004	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	3,634,882	233,451	3,689,698	232,263	1.5%	-0.5%
Solid fossil fuels	563,305	52,418	366,254	34,084	-35.0%	-35.0%
Gaseous fossil fuels	1,680,931	92,507	1,992,283	111,208	18.5%	20.2%
Total	**5,879,118**	**378,377**	**6,048,235**	**377,556**	**2.9%**	**-0.2%**

Germany

2004	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	4,982,504	297,492	5,118,926	333,644	2.7%	12.2%
Solid fossil fuels	3,594,236	345,652	3,723,059	367,773	3.6%	6.4%
Gaseous fossil fuels	3,296,307	182,340	3,212,448	175,774	-2.5%	-3.6%
Total	**11,873,047**	**825,485**	**12,054,433**	**877,192**	**1.5%**	**6.3%**

2005	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	4,862,269	288,498	4,878,639	338,714	0.3%	17.4%
Solid fossil fuels	3,466,885	333,258	3,427,661	370,511	-1.1%	11.2%
Gaseous fossil fuels	3,385,287	187,307	3,226,396	176,641	-4.7%	-5.7%
Total	**11,714,440**	**809,063**	**11,532,697**	**885,866**	**-1.6%**	**9.5%**

Greece

1990	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	499,289	35,284	512,864	36,388	2.7%	3.1%
Solid fossil fuels	338,766	33,343	337,788	40,142	-0.3%	20.4%
Gaseous fossil fuels	5,783	248	5,783	261	0.0%	5.2%
Total	**843,839**	**68,876**	**856,435**	**76,792**	**1.5%**	**11.5%**

2004	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	679,597	47,690	704,555	49,624	3.7%	4.1%
Solid fossil fuels	380,626	37,630	382,242	46,107	0.4%	22.5%
Gaseous fossil fuels	93,314	5,108	93,314	5,111	0.0%	0.1%
Total	**1,153,537**	**90,428**	**1,180,111**	**100,842**	**2.3%**	**11.5%**

2005	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	709,569	50,391	733,055	52,202	3.3%	3.6%
Solid fossil fuels	374,483	37,054	379,212	45,901	1.3%	23.9%
Gaseous fossil fuels	98,538	5,402	109,156	5,987	10.8%	10.8%
Total	**1,182,589**	**92,847**	**1,221,423**	**104,091**	**3.3%**	**12.1%**

Hungary

1990	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	358,929	23,261	337,089	21,191	-6.1%	-8.9%
Solid fossil fuels	249,534	24,260	267,548	26,496	7.2%	9.2%
Gaseous fossil fuels	373,172	20,405	373,173	20,405	0.0%	0.0%
Total	**981,635**	**67,925**	**977,810**	**68,092**	**-0.4%**	**0.2%**

2004	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	253,412	14,729	248,868	14,776	-1.8%	0.3%
Solid fossil fuels	143,914	14,007	146,313	14,796	1.7%	5.6%
Gaseous fossil fuels	490,368	27,124	487,071	26,940	-0.7%	-0.7%
Total	**887,694**	**55,860**	**882,252**	**56,512**	**-0.6%**	**1.2%**

2005	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	294,761	16,249	287,707	16,659	-2.4%	2.5%
Solid fossil fuels	129,156	12,493	129,723	13,340	0.4%	6.8%
Gaseous fossil fuels	506,349	27,987	506,349	27,987	0.0%	0.0%
Total	**930,266**	**56,729**	**923,779**	**57,986**	**-0.7%**	**2.2%**

Ireland

1990	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	185,990	13,068	179,039	12,524	-3.7%	-4.2%
Solid fossil fuels	143,033	13,617	144,942	14,575	1.3%	7.0%
Gaseous fossil fuels	78,417	4,046	78,575	3,328	0.2%	-17.7%
Total	**407,440**	**30,732**	**402,556**	**30,427**	**-1.2%**	**-1.0%**

2004	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	360,010	25,595	348,758	24,801	-3.1%	-3.1%
Solid fossil fuels	101,305	9,543	98,471	9,683	-2.8%	1.5%
Gaseous fossil fuels	152,609	8,519	152,944	8,683	0.2%	1.9%
Total	**613,924**	**43,657**	**600,172**	**43,167**	**-2.2%**	**-1.1%**

2005	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	317,227	22,355	355,300	25,230	12.0%	12.9%
Solid fossil fuels	112,401	10,632	109,194	10,825	-2.9%	1.8%
Gaseous fossil fuels	145,266	8,109	145,594	8,270	0.2%	2.0%
Total	**574,894**	**41,096**	**610,087**	**44,325**	**6.1%**	**7.9%**

Italy

1990	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	3,717,793	247,998	3,753,119	251,644	1.0%	1.5%
Solid fossil fuels	612,156	56,829	614,758	57,389	0.4%	1.0%
Gaseous fossil fuels	1,632,906	89,854	1,644,135	87,138	0.7%	-3.0%
Total	**5,962,855**	**394,681**	**6,012,012**	**396,171**	**0.8%**	**0.4%**

2004	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	3,421,647	228,564	3,687,077	237,201	7.8%	3.8%
Solid fossil fuels	694,277	64,717	695,842	65,805	0.2%	1.7%
Gaseous fossil fuels	2,764,083	153,529	2,782,448	152,772	0.7%	-0.5%
Total	**6,880,007**	**446,809**	**7,165,367**	**455,778**	**4.1%**	**2.0%**

2005	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	3,334,690	218,708	3,575,532	229,668	7.2%	5.0%
Solid fossil fuels	689,847	64,219	690,592	64,908	0.1%	1.1%
Gaseous fossil fuels	2,958,026	164,350	2,977,681	165,813	0.7%	0.9%
Total	**6,982,563**	**447,277**	**7,243,806**	**460,388**	**3.7%**	**2.9%**

Latvia

1990	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	146,075	10,586	143,923	10,359	-1.5%	-2.1%
Solid fossil fuels	33,049	3,110	30,542	2,851	-7.6%	-8.3%
Gaseous fossil fuels	99,653	5,563	99,653	5,563	0.0%	0.0%
Total	**278,776**	**19,259**	**274,117**	**18,773**	**-1.7%**	**-2.5%**

2004	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	53,713	3,658	54,326	3,718	1.1%	1.6%
Solid fossil fuels	2,950	277	2,848	261	-3.5%	-5.9%
Gaseous fossil fuels	55,785	3,114	55,857	3,118	0.1%	0.1%
Total	**112,447**	**7,050**	**113,030**	**7,096**	**0.5%**	**0.7%**

2005	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	54,250	3,618	55,165	3,712	1.7%	2.6%
Solid fossil fuels	3,426	321	3,414	312	-0.3%	-2.8%
Gaseous fossil fuels	56,852	3,173	56,931	3,178	0.1%	0.1%
Total	**114,528**	**7,112**	**115,510**	**7,202**	**0.9%**	**1.3%**

Lithuania

1990	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	282,525	20,113	285,387	20,316	1.0%	1.0%
Solid fossil fuels	34,054	3,166	33,633	3,125	-1.2%	-1.3%
Gaseous fossil fuels	195,855	10,436	195,855	9,429	0.0%	-9.7%
Total	**512,434**	**33,716**	**514,875**	**32,870**	**0.5%**	**-2.5%**
2004	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	102,053	7,146	104,359	7,358	2.3%	3.0%
Solid fossil fuels	8,202	773	7,951	738	-3.1%	-4.5%
Gaseous fossil fuels	98,293	5,070	99,283	4,251	1.0%	-16.1%
Total	**208,547**	**12,989**	**211,593**	**12,347**	**1.5%**	**-4.9%**
2005	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	108,007	7,532	110,165	7,756	2.0%	3.0%
Solid fossil fuels	8,437	793	8,672	806	2.8%	1.7%
Gaseous fossil fuels	103,685	5,340	103,692	4,432	0.0%	-17.0%
Total	**220,128**	**13,666**	**222,529**	**12,994**	**1.1%**	**-4.9%**

Luxembourg

1990	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	62,551	4,481	63,497	4,548	1.5%	1.5%
Solid fossil fuels	47,493	4,952	47,493	4,952	0.0%	0.0%
Gaseous fossil fuels	17,983	1,004	17,983	1,004	0.0%	0.0%
Total	**128,026**	**10,436**	**128,972**	**10,504**	**0.7%**	**0.6%**
2004	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	105,610	7,598	107,562	7,738	1.8%	1.8%
Solid fossil fuels	3,940	365	3,940	365	0.0%	0.0%
Gaseous fossil fuels	50,215	2,803	50,215	2,803	0.0%	0.0%
Total	**159,765**	**10,766**	**161,717**	**10,907**	**1.2%**	**1.3%**
2005	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	110,254	7,929	109,529	7,877	-0.7%	-0.7%
Solid fossil fuels	3,412	316	3,412	316	0.0%	0.0%
Gaseous fossil fuels	49,346	2,754	49,346	2,768	0.0%	0.5%
Total	**163,013**	**11,000**	**162,288**	**10,962**	**-0.4%**	**-0.3%**

Netherlands

1990	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	929,915	51,135	964,000	49,701	3.7%	-2.8%
Solid fossil fuels	384,249	35,481	368,000	34,034	-4.2%	-4.1%
Gaseous fossil fuels	1,289,950	70,249	1,305,000	71,906	1.2%	2.4%
Total	**2,604,114**	**156,865**	**2,637,000**	**155,641**	**1.3%**	**-0.8%**
2004	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	1,145,757	64,948	1,204,290	54,940	5.1%	-15.4%
Solid fossil fuels	384,243	35,607	359,650	33,437	-6.4%	-6.1%
Gaseous fossil fuels	1,538,432	84,212	1,539,560	85,302	0.1%	1.3%
Total	**3,068,432**	**184,767**	**3,103,500**	**173,679**	**1.1%**	**-6.0%**
2005	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	1,159,871	63,750	1,251,000	58,034	7.9%	-9.0%
Solid fossil fuels	339,599	31,426	346,490	32,150	2.0%	2.3%
Gaseous fossil fuels	1,478,939	80,659	1,480,000	81,919	0.1%	1.6%
Total	**2,978,409**	**175,835**	**3,077,490**	**172,103**	**3.3%**	**-2.1%**

Poland

1990	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	547,412	33,931	600,881	43,057	9.8%	26.9%
Solid fossil fuels	3,149,097	294,201	3,213,814	312,299	2.1%	6.2%
Gaseous fossil fuels	374,206	19,406	381,508	18,979	2.0%	-2.2%
Total	**4,070,715**	**347,538**	**4,196,202**	**374,335**	**3.1%**	**7.7%**

2005	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	904,825	58,592	888,070	63,483	-1.9%	8.3%
Solid fossil fuels	2,283,568	213,255	2,263,729	220,378	-0.9%	3.3%
Gaseous fossil fuels	512,234	27,037	512,105	26,164	0.0%	-3.2%
Total	**3,700,627**	**298,884**	**3,663,904**	**310,024**	**-1.0%**	**3.7%**

Portugal

1990	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	466,742	29,140	491,139	30,430	5.2%	4.4%
Solid fossil fuels	108,009	10,017	115,571	10,463	7.0%	4.5%
Gaseous fossil fuels	0	0	NO	NE,NO		
Total	**574,750**	**39,157**	**606,709**	**40,892**	**5.6%**	**4.4%**

2004	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	594,800	41,327	615,434	38,321	3.5%	-7.3%
Solid fossil fuels	141,182	13,092	141,306	12,746	0.1%	-2.6%
Gaseous fossil fuels	138,308	7,720	138,854	7,751	0.4%	0.4%
Total	**874,291**	**62,139**	**895,594**	**58,818**	**2.4%**	**-5.3%**

2005	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	609,492	39,124	628,850	39,124	3.2%	0.0%
Solid fossil fuels	140,125	12,993	140,209	12,647	0.1%	-2.7%
Gaseous fossil fuels	157,034	8,766	157,469	8,790	0.3%	0.3%
Total	**906,652**	**60,882**	**926,528**	**60,561**	**2.2%**	**-0.5%**

Romania

1990	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	800,059	56,275	789,057	57,221	-1.4%	1.7%
Solid fossil fuels	426,099	41,720	489,771	46,875	14.9%	12.4%
Gaseous fossil fuels	1,207,409	67,397	1,200,116	64,261	-0.6%	-4.7%
Total	**2,433,567**	**165,391**	**2,478,944**	**168,358**	**1.9%**	**1.8%**

2004	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	423,208	27,563	422,565	30,520	-0.2%	10.7%
Solid fossil fuels	390,667	38,318	382,205	36,980	-2.2%	-3.5%
Gaseous fossil fuels	583,528	32,077	576,374	31,673	-1.2%	-1.3%
Total	**1,397,403**	**97,958**	**1,381,144**	**99,173**	**-1.2%**	**1.2%**

2005	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	397,777	25,986	383,664	27,840	-3.5%	7.1%
Solid fossil fuels	368,375	36,002	364,028	35,037	-1.2%	-2.7%
Gaseous fossil fuels	583,727	31,756	578,637	31,368	-0.9%	-1.2%
Total	**1,349,879**	**93,745**	**1,326,328**	**94,245**	**-1.7%**	**0.5%**

Slovakia

1990	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	174,905	9,639	196,758	10,596	12.5%	9.9%
Solid fossil fuels	325,896	31,390	343,341	32,576	5.4%	3.8%
Gaseous fossil fuels	213,023	11,891	223,810	12,171	5.1%	2.4%
Total	**713,824**	**52,920**	**763,909**	**55,342**	**7.0%**	**4.6%**
2004	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	136,188	8,221	133,872	7,378	-1.7%	-10.2%
Solid fossil fuels	189,502	17,916	189,484	17,844	0.0%	-0.4%
Gaseous fossil fuels	255,823	14,005	230,207	12,628	-10.0%	-9.8%
Total	**581,513**	**40,141**	**553,563**	**37,850**	**-4.8%**	**-5.7%**
2005	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	153,733	8,865	139,445	7,420	-9.3%	-16.3%
Solid fossil fuels	179,547	16,936	178,393	16,831	-0.6%	-0.6%
Gaseous fossil fuels	248,056	13,549	247,163	13,288	-0.4%	-1.9%
Total	**581,336**	**39,350**	**565,002**	**37,538**	**-2.8%**	**-4.6%**

Slovenia

1990	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	72,549	5,200	72,559	5,342	0.0%	2.7%
Solid fossil fuels	68,837	6,710	66,716	6,882	-3.1%	2.6%
Gaseous fossil fuels	31,934	1,783	31,955	1,627	0.1%	-8.7%
Total	**173,320**	**13,693**	**171,231**	**13,851**	**-1.2%**	**1.2%**
2004	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	104,278	7,153	96,945	7,053	-7.0%	-1.4%
Solid fossil fuels	64,262	6,305	63,336	6,448	-1.4%	2.3%
Gaseous fossil fuels	37,628	2,021	37,626	1,813	0.0%	-10.3%
Total	**206,168**	**15,479**	**197,907**	**15,314**	**-4.0%**	**-1.1%**
2005	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	106,468	7,361	101,836	7,481	-4.4%	1.6%
Solid fossil fuels	64,456	6,322	61,982	6,304	-3.8%	-0.3%
Gaseous fossil fuels	38,888	2,073	38,900	1,848	0.0%	-10.9%
Total	**209,812**	**15,756**	**202,718**	**15,634**	**-3.4%**	**-0.8%**

Spain

1990	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	1,837,978	119,006	1,867,157	117,880	1.6%	-0.9%
Solid fossil fuels	790,770	74,100	790,581	77,094	0.0%	4.0%
Gaseous fossil fuels	208,100	11,327	213,880	11,523	2.8%	1.7%
Total	**2,836,848**	**204,433**	**2,871,619**	**206,498**	**1.2%**	**1.0%**
2004	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	2,741,629	184,287	2,782,739	176,584	1.5%	-4.2%
Solid fossil fuels	883,240	81,933	887,786	84,664	0.5%	3.3%
Gaseous fossil fuels	1,053,889	58,488	1,056,231	58,633	0.2%	0.2%
Total	**4,678,759**	**324,707**	**4,726,756**	**319,881**	**1.0%**	**-1.5%**
2005	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	2,767,245	185,853	2,797,159	178,479	1.1%	-4.0%
Solid fossil fuels	866,593	80,418	912,768	86,990	5.3%	8.2%
Gaseous fossil fuels	1,249,511	69,377	1,252,287	69,708	0.2%	0.5%
Total	**4,883,349**	**335,648**	**4,962,214**	**335,178**	**1.6%**	**-0.1%**

Sweden

1990	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	583,716	35,953	628,532	38,905	7.7%	8.2%
Solid fossil fuels	112,065	10,575	121,965	11,204	8.8%	6.0%
Gaseous fossil fuels	24,156	1,348	24,002	1,356	-0.6%	0.6%
Total	**719,937**	**47,876**	**774,499**	**51,466**	**7.6%**	**7.5%**

2004	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	609,814	37,910	647,599	39,305	6.2%	3.7%
Solid fossil fuels	123,101	11,669	114,110	10,842	-7.3%	-7.1%
Gaseous fossil fuels	37,028	2,067	36,839	2,082	-0.5%	0.7%
Total	**769,942**	**51,647**	**798,548**	**52,228**	**3.7%**	**1.1%**

2005	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	574,024	35,795	577,565	35,757	0.6%	-0.1%
Solid fossil fuels	109,935	10,384	104,567	9,911	-4.9%	-4.6%
Gaseous fossil fuels	35,279	1,969	31,741	1,793	-10.0%	-8.9%
Total	**719,238**	**48,147**	**713,873**	**47,462**	**-0.7%**	**-1.4%**

United Kingdom

1990	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	3,166,273	207,736	3,268,191	214,410	3.2%	3.2%
Solid fossil fuels	2,656,489	246,279	2,630,882	241,988	-1.0%	-1.7%
Gaseous fossil fuels	1,976,312	109,118	1,980,560	109,002	0.2%	-0.1%
Total	**7,799,074**	**563,133**	**7,879,633**	**565,400**	**1.0%**	**0.4%**

2004	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	2,898,750	188,530	3,077,649	198,797	6.2%	5.4%
Solid fossil fuels	1,582,265	146,974	1,567,414	144,126	-0.9%	-1.9%
Gaseous fossil fuels	3,658,744	203,631	3,663,996	207,032	0.1%	1.7%
Total	**8,139,758**	**539,135**	**8,309,059**	**549,954**	**2.1%**	**2.0%**

2005	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	2,938,621	190,798	3,085,654	198,290	5.0%	3.9%
Solid fossil fuels	1,586,628	147,339	1,681,908	154,723	6.0%	5.0%
Gaseous fossil fuels	3,554,528	197,832	3,550,748	197,089	-0.1%	-0.4%
Total	**8,079,778**	**535,968**	**8,318,311**	**550,102**	**3.0%**	**2.6%**

EU-15

2004	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO2 emissions (Gg)	Apparent consumption (TJ)	CO2 emissions (Gg)	Apparent consumption (TJ)	CO2 emissions (Gg)
Liquid fossil fuels	23,246,014	1,494,851	24,163,479	1,536,045	3.9%	2.8%
Solid fossil fuels	9,370,069	886,107	9,278,980	896,998	-1.0%	1.2%
Gaseous fossil fuels	15,745,821	871,597	16,003,998	888,146	1.6%	1.9%
Total	**48,361,904**	**3,252,555**	**49,446,457**	**3,321,190**	**2.2%**	**2.1%**

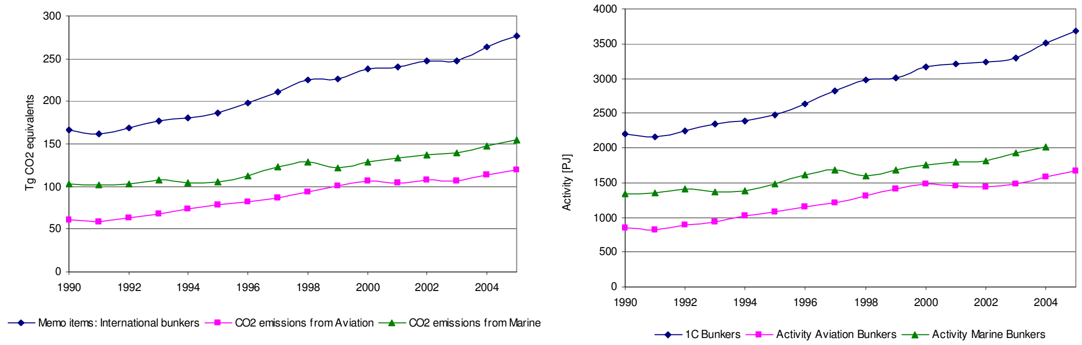
3.7 International bunker fuels

International bunker emissions include emissions from Aviation bunkers and Marine bunkers. The emissions of the EC inventory are the sum of the international bunker emissions of the Member States ([20]). Between 1990 and 2005, greenhouse gas emissions from international bunker fuels increased by

([20]) 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

68 % in the EU-15. CO_2 emissions from “Marine bunkers” account for 55 % of total greenhouse gas emissions from international bunkers in 2005, CO_2 from “Aviation bunkers” accounts for 45 % (Figure 3.93).

Figure 3.93 International bunker fuels: GHG emission trend and activity data



3.7.1. Aviation bunkers

CO_2 emissions from Aviation Bunkers account for 2.9 % of total GHG emissions in 2005 but are not included in the national total GHG emissions. Between 1990 and 2005, CO_2 emissions from Aviation bunkers increased by 96 % in the EU-15 (Table 3.107).

The Member States France, the Netherlands, Germany and the United Kingdom contributed the most to the emissions from this source (69 %). Nearly all Member States increased emissions from Aviation bunkers between 1990 and 2005, excepting Greece. The Member States with the highest increases in absolute terms were United Kingdom, Germany, France and the Netherlands. The countries with the lowest increase were Finland and Belgium.

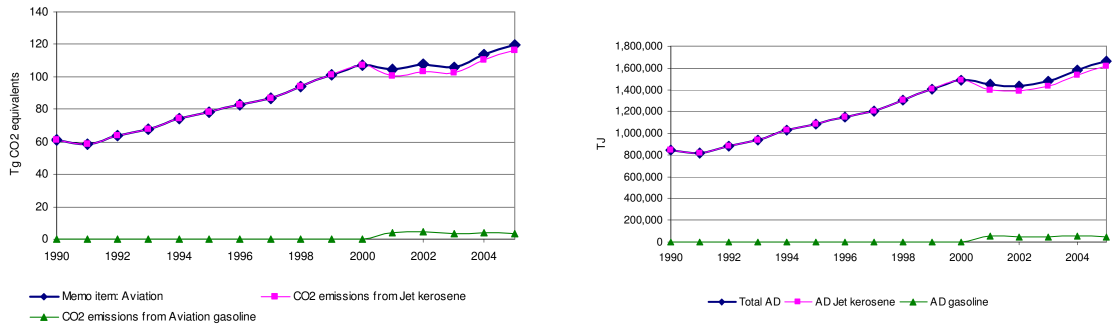
Table 3.107 Aviation bunkers: Member States’ contributions to CO_2

Member State	CO2 emissions in Gg			Share in EU15 emissions in 2005	Change 1990-2005		Change 2004-2005	
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	886	1,532	1,731	1.4%	845	95%	199	11%
Belgium	3,096	3,719	3,565	3.0%	470	15%	-153	-4%
Denmark	1,736	2,449	2,575	2.2%	839	48%	127	5%
Finland	1,008	1,282	1,290	1.1%	282	28%	8	1%
France	8,404	15,412	15,636	13.1%	7,232	86%	224	1%
Germany	11,589	17,632	20,286	17.0%	8,697	75%	2,654	13%
Greece	2,448	3,106	2,387	2.0%	-60	-2%	-719	-30%
Ireland	1,058	2,114	2,454	2.1%	1,396	132%	340	14%
Italy	4,116	8,068	8,543	7.1%	4,427	108%	475	6%
Luxembourg	399	1,290	1,311	1.1%	912	228%	20	-
Netherlands	4,540	10,503	10,876	9.1%	6,335	140%	372	3%
Portugal	1,391	2,374	2,508	2.1%	1,117	80%	134	5%
Spain	3,432	9,484	9,519	8.0%	6,088	177%	35	0%
Sweden	1,335	1,772	1,936	1.6%	601	45%	164	8%
United Kingdom	15,674	33,124	35,008	29.3%	19,334	123%	1,884	5%
EU-15	**61,111**	**113,861**	**119,626**	**100.0%**	**58,514**	**96%**	**5,765**	**5%**

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.

CO_2 emissions from Jet kerosene account for 97 % of total emissions from “Aviation bunkers” in 2005 (Figure 3.94). All Member States increased emissions from Jet kerosene between 1990 and 2005. Member States with the highest increase in percent were Luxembourg, Spain, the Netherlands and the United Kingdom. The country with the lowest increase was Belgium.

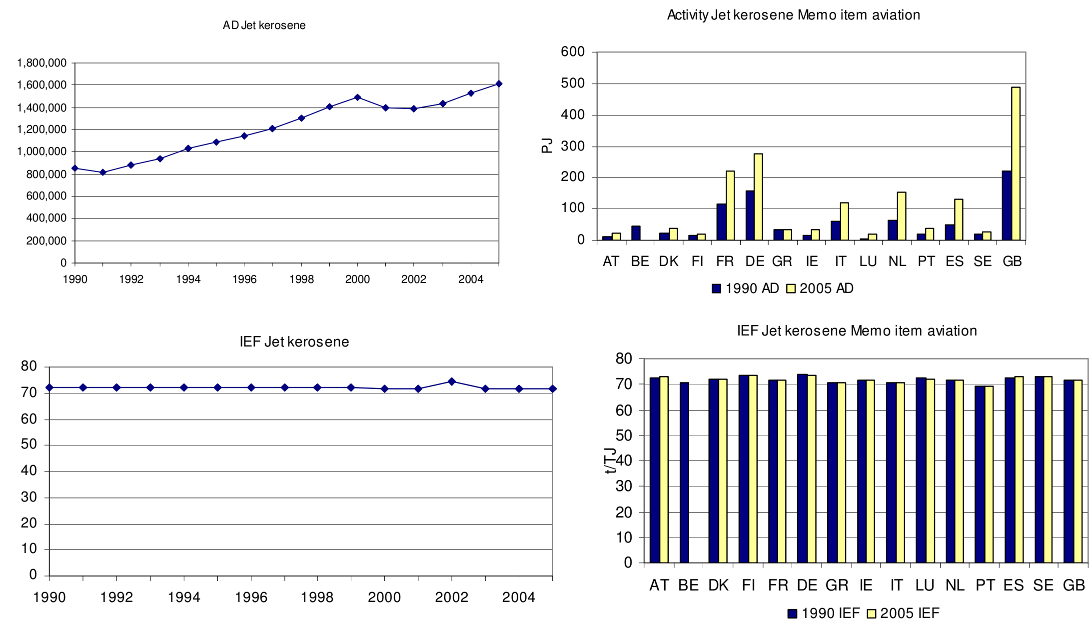
Figure 3.94 Aviation bunkers: Trend of CO_2 Emissions and Activity Data



Aviation Bunkers – Jet Kerosene (CO_2)

Figure 3.95 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 90 % between 1990 and 2005. The EU-15 implied emission factor was at 71.9 t/TJ in 2005.

Figure 3.95 Aviation bunkers, Jet kersoene: Activity Data and Implied Emission Factors for CO_2



3.7.2. Marine bunkers

CO_2 emissions from “Marine bunkers” account for 3.7 % of total GHG emissions in 2005 and are also not included in the national total GHG emissions. Between 1990 and 2005, CO_2 emissions from Marine bunkers increased by 50 % in the EU-15 (Table 3.108).

The Member States Spain, the Netherlands and Belgium contributed most to the emissions from this source (66 %). Most Member States increased emissions from Marine bunkers between 1990 and 2005. Denmark, Finland and the UK decreased the emissions from Marine bunkers. The Member States with the highest increase in absolute terms were also Spain, the Netherlands and Belgium.

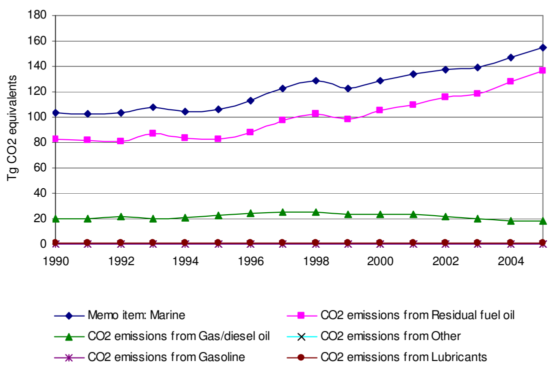
Table 3.108 Marine bunkers: Member States' contributions to CO_2 emissions

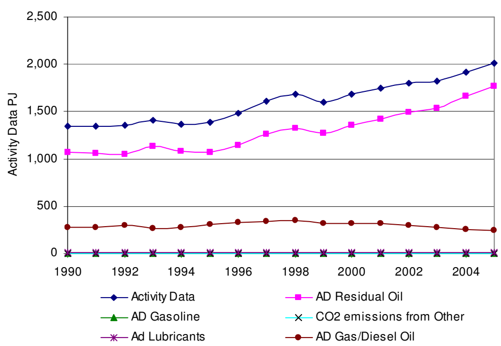
Member State	CO2 emissions in Gg			Share in EU15 emissions in 2005	Change 1990-2005		Change 2004-2005	
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Belgium	13,303	24,247	23,736	15.3%	10,433	78%	-511	-2%
Denmark	3,087	2,545	2,636	1.7%	-451	-15%	91	3%
Finland	1,842	1,679	1,651	1.1%	-191	-10%	-28	-2%
France	7,954	9,586	8,755	5.7%	801	10%	-830	-9%
Germany	7,980	8,582	8,582	5.5%	602	8%	0	0%
Greece	8,028	10,221	9,079	5.9%	1,051	13%	-1,142	-13%
Ireland	57	474	329	0.2%	272	480%	-145	-44%
Italy	4,389	6,000	6,210	4.0%	1,820	41%	210	3%
Luxembourg	NE	NE	NE	-	-	-	-	-
Netherlands	34,357	46,846	54,080	34.9%	19,723	57%	7,234	13%
Portugal	1,780	1,839	2,131	1.4%	351	20%	292	14%
Spain	11,528	22,896	25,139	16.2%	13,611	118%	2,243	9%
Sweden	2,228	6,503	6,640	4.3%	4,412	198%	137	2%
United Kingdom	6,680	5,875	5,860	3.8%	-821	-12%	-16	0%
EU-15	**103,213**	**147,293**	**154,828**	**100.0%**	**51,615**	**50%**	**7,535**	**5%**

CO_2 emissions from Residual fuel oil account for 88 % of total emissions from "Marine bunkers" in 2005 (Figure 3.96). Between 1990 and 2005, CO_2 emissions from Residual fuel oil increased by 65 % in the EU-15. Most Member States increased emissions from Residual oil between 1990 and 2005. Member States with the highest increase in percent were Ireland and Sweden. The countries with the lowest increase were Germany and France.

CO_2 emissions from Gas/Diesel oil account for 12 % of total emissions from "Marine bunkers" in 2005. Between 1990 and 2005, CO_2 emissions from Gas/Diesel oil decreased by 10 % in the EU-15.

Figure 3.96 Marine bunkers: Trend of CO_2 Emissions and Activity Data

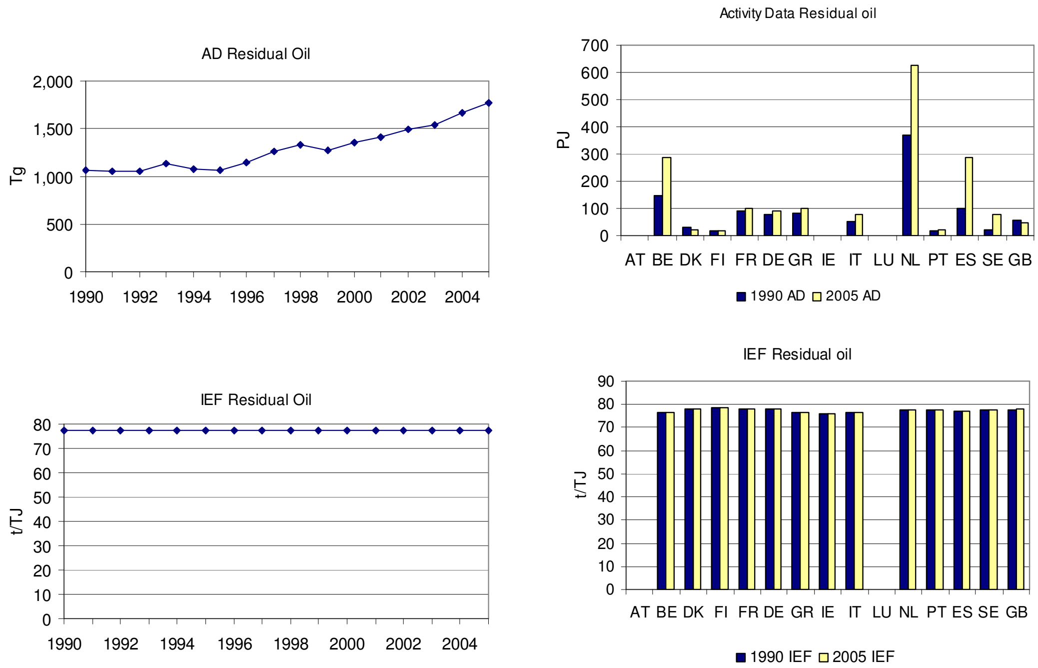




Marine Bunkers – Residual Oil (CO_2)

Figure 3.97 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 66 % between 1990 and 2005. The EU-15 implied emission factor was at 77.2 t/TJ in 2005.

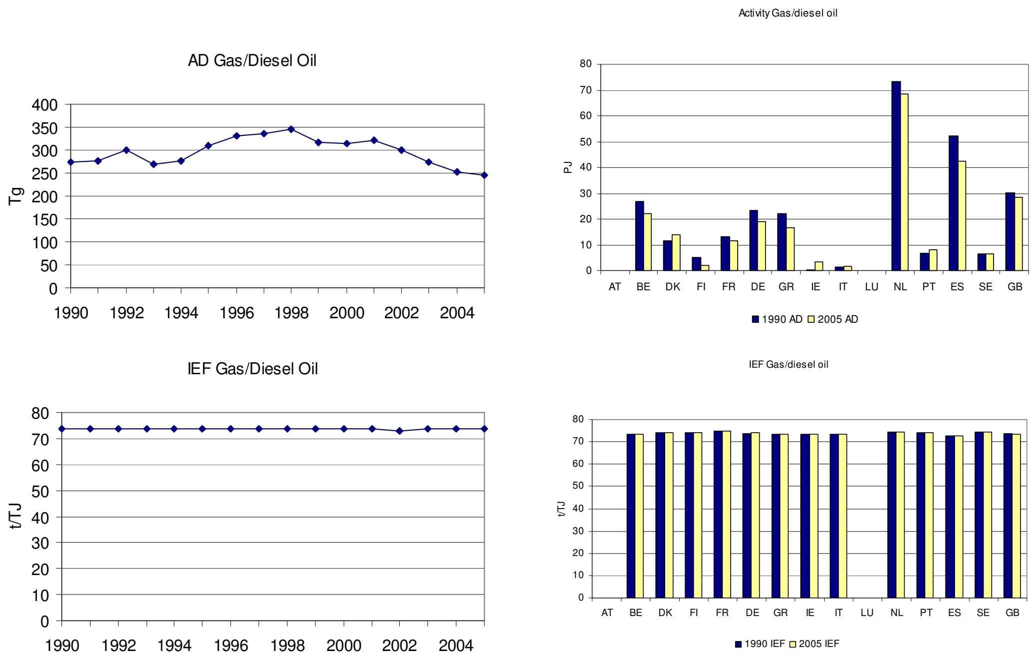
Figure 3.97 Marine bunkers' – Residual Oil: Activity Data and Implied Emission Factors for CO_2



Marine Bunkers – Gas/Diesel Oil (CO_2)

3.98 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 decreased by 10 % between 1990 and 2005. The EU-15 implied emission factor was at 73.73 t/TJ in 2005.

Figure 3.98 Marine bunkers, Gas/Diesel Oil: Activity Data and Implied Emission Factors for CO_2



QA/QC activities

A project shared between the Commission (Eurostat and DG Environment), Eurocontrol and EEA has been initiated to improve the quality of the estimates of CO_2 emissions from international aviation. In a first phase of the project, Eurocontrol, the European Organisation for the Safety of Air Navigation and responsible for the coordination of the European air traffic management system, provided Eurostat with aggregated air traffic data. Several comparisons have been made between energy and emission estimates based on Eurocontrol data on the one hand and data from the energy statistics and GHG inventories on the other hand. The main results of these comparison exercises are:

(1) There are large discrepancies when comparing fuel consumption calculated on the basis of air movement data, with energy statistics. These discrepancies are due to several reasons (a) aircraft carrying fuel reserves - they do not refuel at every landing and take-off (b) the inclusion or exclusion of overseas territories (c) inaccurate coefficients for some older aircraft types (d) ground operations. Discrepancies of up to 20 % were seen as acceptable, but larger differences should be investigated.

(2) A comparison between emissions data provided by Eurostat (calculated on basis of Eurocontrol data) for the years 1996-2001 with data from Member States' GHG inventories revealed that total CO_2 emissions for aviation reported in the 2000 CRF-tables by most Member States are within 10 % of the estimates provided by Eurostat. The share of domestic emissions is usually higher in Member States' estimates, especially as new Member States tend to overestimate the domestic sector.

In May 2004, a 'Workshop on emissions of greenhouse gases from aviation and navigation' was held in Copenhagen. The aim of this workshop was to improve the inventories of GHG emissions from aviation and navigation with special attention to the disaggregation between domestic and international bunker fuels. The workshop brought together the national experts from statistical institutes or other organisations that are responsible for energy balances and/or aviation and navigation transport statistics, the national experts responsible for annual GHG inventories and the experts from international organisations that are performing relevant projects. The workshop report with the recommendations can be downloaded from the ETC/ACC website: http://air-climate.eionet.eu.int/.

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' 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

CRF Sector 2 Industrial Processes is the third largest sector contributing 8 % to total EU-15 GHG emissions in 2005. The most important GHGs from this sector are CO_2 (5 % of total GHG emissions), HFCs and N_2O (1 % each). The emissions from this sector decreased by 12 % from 375 Tg in 1990 to 332 Tg in 2005 (Figure 4.1). In 2005, the emissions increased by 0.3 % compared to 2004. 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 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 B 5 Other: (N_2O)
2 C 1 Iron and Steel Production: (CO_2)
2 C 3 Aluminium production: (PFC)
2 E 1 By-product Emissions: (HFC)
2 F 1 Refrigeration and Air Conditioning Equipment : (HFC)
2 F 4 Aerosols/ Metered Dose Inhalers: (HFC)
2 F 9 Other: (SF_6)

Figure 4.1 CRF Sector 2 Industrial Processes: EU-15 GHG emissions for 1990–2005 in CO_2 equivalents (Tg)

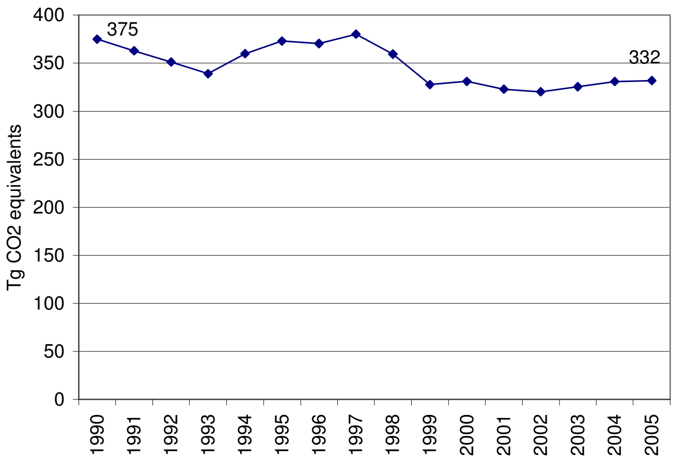
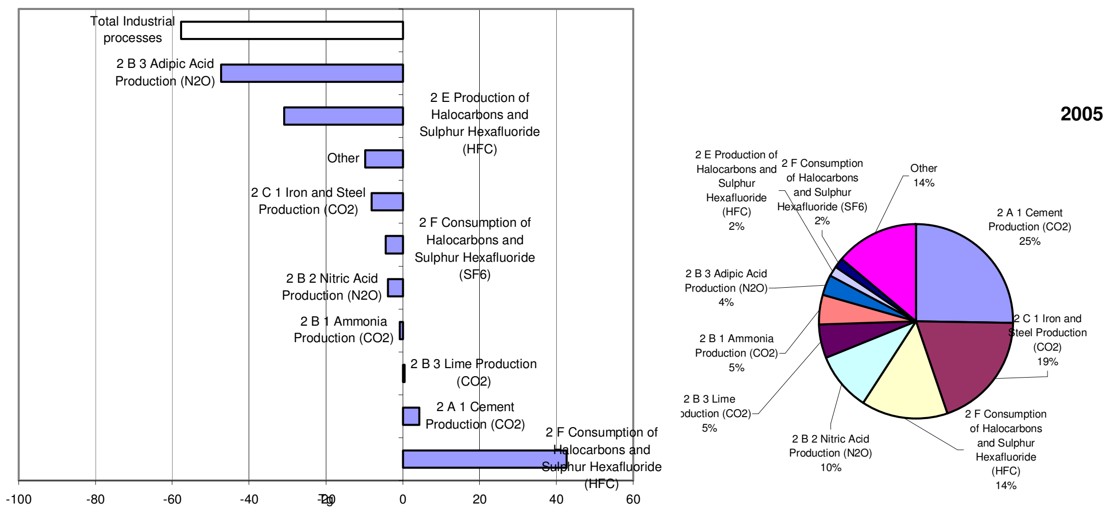


Figure 4.2 shows that large emission reductions occurred in adipic acid production (N_2O) mainly due to reduction measures in Germany, France and the UK and in production of halocarbons and SF_6 (HFCs). Large HFCemission increases can be observed from consumption of halocarbons and SF_6. According to Figure 4.2, the three largest key sources account for about 58 % 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 1990–2005 in CO_2 equivalents (Tg) and share of largest key source categories in 2005



4.2 Source categories

4.2.1 Mineral products (CRF Source Category 2A)

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.

Table 4.1 summarises Member States' emissions from Mineral Products in 1990 and 2005. CO_2 emission from Mineral Products increased by 6 %. The relative decrease was largest in the United Kingdom, the relative growth was largest in Ireland. Spain had largest emission increases in absolute terms and Germany largest absolute emission reductions in the period 1990-2005.

Table 4.1 2A Mineral Products: Member States'total GHG and CO_2 emissions in 1990 and 2005

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2005 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO_2 emissions in 2005 (Gg)
Austria	3,269	3,120	3,269	3,120
Belgium	5,335	5,451	5,335	5,451
Denmark	1,072	1,641	1,072	1,641
Finland	1,309	1,153	1,309	1,153
France	14,919	13,077	14,919	13,077
Germany	22,567	19,329	22,567	19,329
Greece	6,454	7,430	6,454	7,430
Ireland	1,106	2,554	1,106	2,554
Italy	21,100	23,908	21,100	23,908
Luxembourg	591	500	591	500
Netherlands	1,000	1,143	1,000	1,143
Portugal	3,385	4,392	3,384	4,390
Spain	15,669	22,239	15,669	22,239
Sweden	1,919	2,119	1,919	2,119
United Kingdom	9,507	7,765	9,483	7,754
EU-15	**109,202**	**115,821**	**109,178**	**115,809**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.2 provides information on emission trends of the key source CO_2 from 2A1 Cement Production by Member State. CO_2 emissions from Cement Production account for 2 % of total EU-15 GHG emissions in 2005. In 2005, CO_2 emissions from Cement Production were 5 % above 1990 levels in the EU-15.

Spain and Italy are the largest emitters accounting for 42 % of EU-15 emissions, followed by Germany (15 %). Germany, France and the United Kingdom had large reductions in absolute terms between 1990 and 2005, whereas especially Spain had large increases. Relative emisssion growth compared to 1990 was highest in Ireland (167 %) and Denmark (65 %). The emission trend in Cement Production is influenced by economic and population growth, e.g. in Ireland the construction sector was growing strongly with general economic growth and increased population.

Table 4.2 2A1 Cement production: Member States' contributions to CO_2 emissions in 1990, 2004 and 2005

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005	
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	2,033	1,790	1,797	2.1%	7	0%	-236	-12%
Belgium	2,824	2,837	2,934	3.5%	97	3%	110	4%
Denmark	882	1,539	1,456	1.7%	-83	-5%	574	65%
Finland	786	520	542	0.6%	22	4%	-244	-31%
France	10,948	8,926	9,239	11.0%	313	4%	-1,709	-16%
Germany	15,146	13,929	12,921	15.4%	-1,008	-7%	-2,225	-15%
Greece	5,778	6,382	6,615	7.9%	233	4%	837	14%
Ireland	884	2,295	2,357	2.8%	62	3%	1,473	167%
Italy	16,084	17,846	17,886	21.3%	40	0%	1,802	11%
Luxembourg	551	445	438	0.5%	-7	-2%	-112	-20%
Netherlands	416	446	421	0.5%	-25	-6%	5	1%
Portugal	3,107	3,656	3,656	4.3%	0	0%	550	18%
Spain	12,534	16,631	17,141	20.4%	510	3%	4,607	37%
Sweden	1,272	1,284	1,341	1.6%	56	4%	69	5%
United Kingdom	6,659	5,456	5,423	6.4%	-32	-1%	-1,236	-19%
EU-15	**79,905**	**83,984**	**84,168**	**100.0%**	**184**	**0%**	**4,263**	**5%**

Table 4.3 shows information on methods applied, activity data, emission factors for CO_2 emissions from 2A1 Cement Production for 1990 and 2005. The table shows that all MS except Denmark report clinker production as activity data. The implied emission factors per tonne of clinker produced vary slightly from 0.50 for the UK to 0.56 for Austria; most MS use country-specific and plant-specific emission factors. The EU-15 IEF (excluding Denmark) is 0.53 t/t of clinker produced. The table also suggests that more than 98 % of EU-15 emissions are estimated with higher Tier methods.

Table 4.3 2A1 Cement Production: Information on methods applied, activity data, emission factors for CO_2 emissions for 1990 and 2005

				1990				2005			
Member State	Method applied	Activity data	Emission factor	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	CS	PS	CS	Clinker production	3694	0.55	2033	Clinker production	3221	0.56	1797
Belgium	CS	PS	CS	Clinker production	5292	0.53	2824	Clinker production	5555	0.53	2934
Denmark	CS/T2	PS	PS	Cement production	1620	0.54	882	Total cement equivalents	2706	0.54	1456
Finland	T2	PS	CS	Clinker production	1470	0.53	786	Clinker production	1110	0.49	542
France	C	AS	PS	Clinker production	20854	0.53	10948	Clinker production	17332	0.53	9239
Germany	CS	AS	CS	Clinker production	28577	0.53	15146	Clinker production	24378	0.53	12921
Greece	T2	PS	CS	Clinker production	10645	0.54	5778	Clinker production	12185	0.54	6615
Ireland	T2	PS	PS	Clinker production	1610	0.55	884	Clinker production	4400	0.54	2357
Italy	T2	NS	CS, PS	Clinker production	29786	0.54	16084	Clinker production	33122	0.54	17886
Luxembourg	CS	PS	CS	Clinker production	1048	0.53	551	Clinker production	834	0.53	438
Netherlands	CS	Q	PS	Clinker production	770	0.54	416	Clinker production	814	0.52	421
Portugal	T2	PS	D	Clinker production	6128	0.51	3107	Clinker production	7212	0.51	3656
Spain	T2	AS	CS	Clinker production	23212	0.54	12534	Clinker production	31742	0.54	17141
Sweden	T2	PS	PS	Clinker production	2348	0.54	1272	Clinker production	2457	0.55	1341
UK	T2	NS	CS	Clinker production	13199	0.50	6659	Clinker production	10749	0.50	5423
EU15				**EU15 w/o DK (99%)**	**148,632**	**0.53**	**79,022**	**EU15 w/o DK (98%)**	**155,113**	**0.53**	**82,712**

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 (Austria, France, Germany, Italy, Sweden) use or verify with data collected from plants under the EU Emission trading Scheme, where 2005 was the first year with verified emissions.

Table 4.4 2A1 Cement Production: Summary of methodological information provided by Member States

Member State	Methodology comment
Austria	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. AD and emissions for 2004 and 2005 were reported directly by the Association of the Austrian Cement Industry. For 2005 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 2007].
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 on the all time-series 1990-2001. Since 2002, the EF varies each year and was calculated directly by the 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 2007]
Denmark	The CO2 emission from the production of cement has been estimated from the annual production of cement expressed as TCE (total cement equivalents) and an EF estimated by the company (Aalborg Portland, 2006). The EF 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. [NIR 2007]
Finland	The amount of clinker produced annually is used as AD. The data for years 1990–2005 for clinker production is collected from the industry. EFs used in the calculation of emissions from cement production are plant-specific provided by the industry for the whole time series. Previously the EFs had not been directly collected from the industry on as detailed level as in the present inventory. Annual EFs vary slightly, since the parameters affecting them vary slightly from year to year. The EF for year 2005 is the same as reported under the EU´s Emission Trading Scheme. EF of cement production is based on the CaO and MgO contents of clinker. Cement kiln dust (CKD) and by pass dust as well as the amounts of CaO and MgO that are calcined already before the process (and therefore do not cause emissions) are taken into account at plants. CKD correction factors vary from year to year. [NIR 2007]
France	Methodology based on national statistics (clinker statistics) from cement association and national EFs from industry. Since 2004 detailed plant-specific emissions reported under the EU-ETS are used. In France 3 plants produce a special type of cement with a specific higher EF. As the production from these plants increased, the average IEF has increased from 2004 to 2005. [NIR2007 and responses to initial checks]
Germany	Methodology based on AD from associations of industries (clinker production) and a CS EF (which is also obtained from associations of industries based on PS data). Small content of MgO taken into account. EF consistent with the EF used under EU ETS. [NIR 2007]
Greece	Methodology based on AD and parameters for emission calcualtions collected from industry, data for 2003 kept constant for 2004 due to lack of updated data [NIR2006]
Ireland	Estimation was re-examined during the preparation of the Irish National Allocation Plan under the EU ETS and IEFs from 2001 onwards are now based on plant-specific information. The new information was obtained from a number of additional cement producers who had entered the Irish market in 2000, in addition to the single larger original manufacturer. Four cement plants in operation were verified in 2005. The process CO2 emissions from these plants were calculated using the Tier 2 method, based on reliable data on clinker production, corrected as appropriate for CKD, and CaO content of the clinker. The EFs in 2004 ranged from 0.533 t CO2/ t clinker to 0.540 t CO2/ t clinker with a weighted average of 0.536 t CO2/t for all clinker production. The procedure was repeated for 2005, giving an implied emission factor of 0.536 t CO2/ t clinker. [NIR 2007]
Italy	Methodology based on AD from national statistics (clinker production). EFs are estimated on the basis of information provided by the plants and by the Italian Cement Association, EPER and the EU ETS [NIR2006].
Luxembourg	The AD of the clinker production were received from the operator of the plant. The EF for CO2 was calculated based on information from the operator about the raw material composition and the process. The value of that factor is 525.4 kg CO2/t clinker produced. The CO2 -EFs are plant specific. The CORINAIR (simple) methodology is applied [NIR 2007].
Netherlands	For cement clinker production the environmental reports (MJVs) of the single Dutch company are used. Emission data obtained from the environmental report related to clinker production figures give an IEF of 0.55 t/t clinker (IPCC Default = 0.51 t/t clinker) [NIR 2007]
Portugal	Clinker production, for all the years from 1990 to 2003, was received directly from each industrial plant, and the correspondent time series may be observed in next figure. For 2004 only total production of clinker in Portugal is available.2004 which was extrapolated to 2005. The EF was estimated according to the GPG equation 3.3. The default IPCC CaO fraction in clinker was considered in the inventory (64.6%). The final EF is 0.507 ton CO2/ ton clinker.[NIR 2007]
Spain	Clinker production data and the applied EF are obtained from associations of industries. The EF was derived in 2004 based on the average of 12 cement plants and takes into account the small MgO content. [NIR2007]
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. For 2005, data on clinker production has been acquired through the ETS. Emissions have been calculated using ETS activity data together with EFs from the GHG protocol by WRI. The company producing cement has not been able to provide data on by-pass dust and CKD for 2005, whereby data from 2004 have been applied to estimate the equivalent for 2005. [NIR2007]
UK	The methodology used for estimating CO2 emissions from calcination is the IPCC Tier 2 approach (IPCC, 2000). The emission was estimated from the annual UK production of clinker (British Cement Association, 2006). The British Cement Association has also provided an estimate of the average CaO content of cement clinker (63%) and that the use of non-carbonate CaO can be assumed to be zero. The clinker production data are revised up to take account of losses in the form of kiln dust, by assuming that these losses are 2% of clinker production. This is also based on an estimate provided by the British Cement Association. Based on these data, an EF of 137.6 t C/kt clinker was calculated according to the IPCC Tier 2 method and applied to all years. [NIR 2007]

Table 4.5 summarizes the recommendations from 2005 UNFCCC inventory review in relation to the category 2A1 Cement Production. The overview shows that there are few findings that are not resolved and that the remaining unresolved findings are mostly not very significant methodological problems.

Table 4.5 2A1 Cement Production: Findings of the 2005 UNFCCC inventory review in relation to CO_2 emissions and responses in 2006 inventory submissions

Member State	Review findings and responses related to 2A1 Cement Production	
	Comment UNFCCC inventory review report 2005	Status in 2007 submission
Austria	Austria has reported the 2002 values for 2003. The ERT recommends that the Party ensure the timely annual reporting of emissions, as well as the corresponding AD.	resolved, data from EU ETS is used for most recent year.
Belgium	Elements of the IPCC good practice guidance can be seen in the method used, but information is lacking on how the country-specific EFs have been developed and updated and how data for clinker production have been obtained. Belgium should provide this information in its future submissions and indicate how the IPCC good practice guidance is followed.	More detailed descriptions provided that include individual elements of IPCC GPG.
Denmark	ERT found method based on cement production not in line with IPCC GPG and encouraged Denmark to use approach based on clinker in future submissions.	Not resolved, emissions still based on cement production. Improvement planned with data from EU ETS.
Finland	To improve transparency the ERT encourages Finland to document the plant-specific cement kiln dust (CKD) correction factor applied in calculating the CO2 emissions using the tier 2 method. In its response to the review, Finland explained that plant specific CKD correction factors cannot be reported due to confidentiality reasons, but that a country-specific factor has been calculated which will be included in the 2006 submission.	CDK correction factors are presented in new table.
France	ERT recommended that France explain the method used, the reasons for the EF being higher than the default EF. The ERT also invites France to explain why clinker production decreased by 22 per cent between 1990 and 2003. In its response to the draft review report France provided this information. The ERT recommends including this information in the next submission.	France explained the method, the decrease in clinker production and that the decomposition of MgO in clinker to CO2 is taken into account which results in a higher EF.
Germany	According to the information provided in the NIR, a source-specific review of the CO2 emissions from Cement Production for the period 1990–1999 will be carried out by the Party. The ERT welcomes the planned review and encourages the Party to check the consistency of the whole time series and to recalculate if necessary.	The review was completed and an improved source for AD identified and used.
Greece	No recommendation for improvement for this source category in 2005 review report.	No follow-up necessary
Ireland	The ERT encouraged Ireland to apply the same methodology derived from EU ETS data for the entire time-series.	Time-series was completely recalculated based on plant-specific data.
Italy	No recommendation for improvement for this source category in 2005 review report.	No follow-up necessary
Luxembourg	not reviewed	No follow-up necessary
Netherlands	No recommendation for improvement for this source category in 2005 review report.	No follow-up necessary
Portugal	The ERT encouraged Portugal to use a country-specific CaO content as indicated under planned improvements. During the review, Portugal informed the ERT that the revision of the data on clinker production for 2002 was done because in the previous submission the data were a forecast made from incomplete information. The ERT encourages Portugal to report on data improvement in its next NIR, including information on how the revised data may have affected the time series consistency.	Portugal reports that not sufficient information is available to establish a CS CaO contents: CaO fractions are not available for all industrial plants; some raw materials, such as carbonate shales, have a very large range of possible carbonate content; and some carbon content materials are only used as fillers and will not result in emissions.
Spain	The ERT requested further information on the data collection, whether data from the industrial association is complete, how QA/QC issues are taken into consideration, and how the IPCC good practice guidance has been applied for this key category.	References of publications used for AD provided.
Sweden	To improve the transparency of the submission, the Party is encouraged to conduct plant surveys on non-carbonate feeds to kilns, calcium oxide (CaO) content of the clinker, the amount of dust released and the fraction of dust recycled, and apply the results in the CO2 emissions calculations.	More detailed information on the methods and parameters used at plant level are provided.
UK	Source category not addressed by review report 2005	No follow-up necessary

CO_2 emissions from 2A2 Lime Production account for 0.4 % of total GHG emissions in 2005. Between 1990 and 2005, CO_2 emissions from this source increased by 3 % in the EU-15 (Table 4.6). Germany was responsible for 30 % of the emissions from this source. The decreases in Germany (–12%) but also in the UK (-38%) were offset by emissison increases in other EU-15 Member States

(Italy, Spain, Portugal, Greece, Finland, Austria, Sweden) between 1990 and 2005.

Table 4.6 2A2 Lime Production: Member States' contributions to CO_2 emissions in 1990, 2004 and 2005

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005	
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	396	601	579	3.3%	-22	-4%	183	46%
Belgium	2,097	2,228	2,018	11.3%	-210	-9%	-79	-4%
Denmark	152	109	110	0.6%	0	0%	-43	-28%
Finland	383	528	455	2.6%	-73	-14%	72	19%
France	2,559	2,638	2,475	13.9%	-162	-6%	-83	-3%
Germany	6,135	5,412	5,415	30.4%	3	0%	-720	-12%
Greece	367	490	490	2.8%	0	0%	122	33%
Ireland	214	202	184	1.0%	-18	-9%	-31	-14%
Italy	2,042	2,686	2,674	15.0%	-12	0%	632	31%
Luxembourg	NO	NO	NO	-	-	-	-	-
Netherlands	NE	NE	NE	-	-	-	-	-
Portugal	178	437	458	2.6%	21	5%	280	158%
Spain	1,123	1,633	1,594	9.0%	-39	-2%	471	42%
Sweden	498	537	607	3.4%	69	13%	109	22%
United Kingdom	1,192	815	738	4.1%	-77	-9%	-453	-38%
EU-15	**17,336**	**18,316**	**17,795**	**100.0%**	**-521**	**-3%**	**459**	**3%**

Emissions of the Netherlands are not estimated as there is only a small amount of lime production and data are not available.
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 2005. The table shows that most MS use lime production as activity data for calculating CO_2 emissions. The EU-15 IEF (excluding Denmark and the UK) is 0.77 t/t of lime produced. The implied emission factors per tonne of lime produced vary between 0.74 for Finland and 0.83 for Sweden. The table also suggests that more than 92 % MS use methodologies that consider different types of lime and corresponding EFs, that could be considered as higher tier methods.

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 (Comission 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 Tier2 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 for 1990 and 2005

				1990				2005			
Member State	Method applied	Activity data	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	PS	CS	Lime Production	513	0.77	396	Lime Production	760	0.76	579
Belgium	CS	PS	CS	Lime and dolomite production	2661	0.79	2097	Lime Production	2601	0.78	2018
Denmark	D	NS	D	Production of Lime and Bricks	778	0.20	152	Production of Lime and Bricks	804	0.14	110
Finland	T2	PS	CS	Lime Production	519	0.74	383	Lime Production	611	0.74	455
France	C	AS	PS	Lime Production	3319	0.77	2559	Lime Production	3092	0.80	2475
Germany	D	AS	D	Lime Production	7719	0.79	6135	Lime Production	6823	0.79	5415
Greece	T1	Q, NS	D	Lime Production	492	0.75	367	Lime Production	656	0.75	490
Ireland	T3	PS	PS	Lime Production	255	0.84	214	Lime Production	226	0.81	184
Italy	D	NS	CS,PS	Lime Production	2583	0.79	2042	Lime Production	3349	0.80	2674
Portugal	D	NS,PS	D	Lime Production	268	0.66	178	Lime Production	613	0.75	458
Spain	D	AS	D, PS	Lime Production	1475	0.76	1123	Lime Production	2070	0.77	1594
Sweden	D	PS	D, CS	Lime Production	923	0.83	498	Lime Production	1128	0.83	607
UK	T2	NS	D	Limestone consumption	2708	0.44	1192	Limestone consumption	1677	0.44	738
EU15				**EU15 w/o DK and UK (92%)**	**20,728**	**0.77**	**15,992**	**EU15 w/o DK and UK (95%)**	**21,929**	**0.77**	**16,947**

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, Finland and Italy included an explicit reference to the use of plant-specific data under the EU ETS. Some Member States include lime production and use in some industries such as sugar or pulp and paper resulting in different EFs.

Table 4.8 2A2 Lime Production: Summary of methodological information provided by Member States

Member State	Methodology comment
Austria	Emissions were estimated using a CS method based on detailed production data. AD and emission values were reported by the Association of the Stone & Ceramic Industry. For 2005 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 2007]
Belgium	The AD is the lime and dolomite lime production and is collected directly from individual plants. The EFs are also collected directly from individual plants. The emissions are estimated by using a plant-specific EF (741-839 kg CO2/t lime or dolomite). 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 2007]
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)).[NIR 2007]
Finland	The amount of (quick)lime (CaO) produced annually is used as AD. 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. For 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. The received data was compared to data from industrial statistics and the VAHTI database. EF for lime production is based on the actual CaO and MgO contents of lime derived by measurements. EF for lime production is calculated from emission and product data of the years 1998−2002. For the remaining part the EF is based on an estimate of the CaO content of lime that is less accurate than the measurement based values of 1998−2002. For the years 1990−1997 the mean value of the EF of 1998−2002 is used for all lime production. [NIR 2007]
France	Higher tier methodology considering types of lime. AD from associations are used. Stochiometric EF for lime, and CS EF for hydraulic lime used based on national data. The production of "hydraulic lime" with a higher EF has increased from 2004 to 2005, therefore the IEF has increased.[NIR2007 and response to initial checks]
Germany	Higher tier methodology considering types of lime. EF based on tochiometric relationships. AD from association based on plant-specific data CS EF based on plant-secific EFs from association. Emissions fro production of hydraulic lime are considered as negligable and are not estimated. [NIR2007]
Greece	Higher tier methodology considering types of lime based on plant-specific data. Data for 2004 kept constant from 2003 due to lack of updated data [NIR2006]
Ireland	The estimation was revised based on estimates provided by lime producers calculated in accordance with the methods under the EU ETS described in Decision 2004/156/EC, thus enabling the inventory agency to review and revise the previously submitted estimates. The CO2 estimates have been obtained for all years up to 2005. They indicate implied EFs in the range 0.75 to 0.88 t CO2/t lime produced. [NIR 2007]
Italy	AD obtained from national statistics and information from associations of industry. PS EF from EU ETS used [NIR2006]
Netherlands	Only small amounts of lime production, not estimated due to lack of AD (NIR 2007]
Portugal	Higher tier methodology considereing different types of lime and using default EF. Production data from national statistics until 2000, linear trend extrapolation for 2001-2005. AD for lime production in iron and steel industry only available for period 1991-1994, extrapolation based on energy consumption in steel industry for remaining years. [NIR 2007]
Spain	Higher tier methodology considereing different types of lime and using EF obtained from national association [NIR2007]
Sweden	AD for conventional lime, quicklime and hydraulic lime production is collected from their trade association and covers all, in total eight plants. For the conventional producers, the emissions of CO2 are calculated by multiplying the amount of quicklime and dolomite lime with the IPPC´s default emission factors. AD also covers lime produced within the sugar industry to purify sugar, collected directly from the only sugar producing company in Sweden. The gases produced within the lime production are reused and the carbon is bound, causing lower emissions. The calculations of CO2 emissions are based on the consumed amount of limestone. The source category also includes AD based on the amount of make-up lime within the pulp and paper industry in the recycling of cooking chemicals and this AD is collected from the pulp and paper trade association. Most of the lime can be reused and only 5% of the lime needed is new make-up lime. The emissions are calculated by using EFs from the pulp and paper industry. The same EF has been used since 2002 by recommendation from the trade association. [NIR2007]
UK	Estimation of lime production is based on limestone and dolomite consumption data from British Geological Survey (2006). 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 EF of 120 t carbon/kt limestone was used, based on the stoichiometry of the chemical reaction and assuming pure limestone. For dolomite, an EF of 130 t 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 use 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 2007]

Table 4.9 summarizes the recommendations from 2005 UNFCCC inventory review in relation to the

category 2A2 Lime Production. The overview shows that there are few findings that are not resolved and that the remaining unresolved findings are mostly no very significant problems.

Table 4.9 2A2 Lime Production: Findings of the 2005 UNFCCC inventory review in relation to CO_2 emissions and responses in 2007 inventory submissions

Member State	Review findings and responses related to 2A2 Lime Production	
	Comment UNFCCC inventory review report 2005	**Status in 2007 submission**
Austria	Austria reported the 2002 values for 2003 when no updated data were available. The ERT recommends that the Party ensure the timely annual reporting of emissions, as well as the corresponding AD.	resolved, updated values reported for subsequent years
Belgium	Plant-specific EFs are given, although without relevant details on type of lime and the source of the lime production data. In its future NIRs the Party is encouraged to provide more information on how the IPCC good practice guidance is followed for this key category. To avoid confusion arising from the terminology, it is suggested that the Party use “dolomite lime” instead of “dolomite”, since the latter gives the impression that emissions were from dolomite production within the Lime Production emission source.	More details on the data sources , the EFs and the methodology is provided. Terminology was corrected.
Denmark	Source category not addressed by review report 2005	No follow-up necessary
Finland	EF data were unavailable for the years 1990–1997 and 2003. For these years the mean EF for the years 1998–2002 has been used. The ERT encourages Finland to obtain and use an actual EF for the latest year of the inventory in future submissions.	Emission factor for lime production is based on the actual CaO and MgO contents of lime derived by measurements.
France	ERT recommended that France explain the fluctuations in IEFs and include the production of lime by autoproducers in this category (sugar mills, steel, soda ash, calcium carbide etc.)	France explains that emissions from sugar mills and paper industries are of biomass origin and that lime used in steel industry continues to be reported under 2C because emissions are recycled in the process. The issue of allocation of lime production in other sectors is not constently addressed in the review reports and was not raised for other EU countries. There is no clear good practice recommendation from IPCC regarding this allocation. Fluctuations of the IEF due to different lime products are explained.
Germany	Emissions from the decomposition of limestone to produce lime are reported, but emissions from the decomposition of dolomite to produce dolomitic “quick” lime are not estimated. Germany considers these emissions as less significant than emissions from the decomposition of limestone. The ERT encourages Germany to include an estimate of emissions from dolomite decomposition in this category in its next submission in order to improve the completeness of the inventory.	Time-series was completely recalculated and dolomite was included
Greece	Limestone and Dolomite Use – CO2 is identified as a key category according to the trend assessment performed by Greece. Emissions are estimated using the IPCC default method and the default EF. The estimates include limestone use in metal production and ceramics production. Dolomite use is not accounted for, and this is not explained in the NIR.	No clear recommendation provided by the ERT
Ireland	The ERT encouraged to assess time-series consistency when data from national statistics and from EU ETS are used.	Time-series was completely recalculated based on plant-specific data.
Italy	The ERT ecouraged Italy to report limestone and dolomite use as AD in the CRF instead of limestone production data with appropriate explanations in the NIR	Category 2A3 is reported separately.
Netherlands	No recommendation for improvement for this source category in 2005 review report.	No follow-up necessary
Portugal	No recommendation for improvement for this source category in 2005 review report.	No follow-up necessary
Spain	No recommendation for improvement for this source category in 2005 review report.	No follow-up necessary
Sweden	When applying the tier 2 method as prescribed in the IPCC good practice guidance, the NIR is not transparent in how the EFs from each identified industry source was derived. For example, according to the NIR, the amount of CO2 emissions from sugar production is based on the amount of limestone consumed, while the amount of CO2 emissions from pulp and paper production is based on the amount of pulp produced. The Party is encouraged to report the calculation of CaO production and EFs in terms of CaO so as to improve transparency and comparability among Parties.	Very detailed and transparent description is provided in the NIR
UK	The ERT encouraged UK to provide information justifying the assumption of small dolomite calcination.	UK explains that dolomite calcination is believed to be a small proportion of the total.

CO_2 emissions from 2A3 Limestone and Dolomite Use account for 0.2 % of total GHG emissions in 2005. Between 1990 and 2005, CO_2 emissions from this source increased by 25 % in the EU-15 (Table 4.10). Italy was responsible for 34 % and Spain for 31% of the emissions from this source.

Emissions from this source category increased in all MS between 1990 and 2005, except UK, with the largest absolute growth in Spain.

Table 4.10 2A3 Limestone and Dolomite Use: Member States' contributions to CO_2 emissions in 1990, 2004 and 2005

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005	
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	222	297	291	3.9%	-7	-2%	68	31%
Belgium	IE	IE	IE	-	-	-	-	-
Denmark	18	64	61	0.8%	-4	-5%	43	234%
Finland	99	153	134	1.8%	-19	-12%	36	36%
France	IE	IE	IE	-	-	-	-	-
Germany	IE	IE	IE	-	-	-	-	-
Greece	286	302	303	4.1%	1	0%	17	6%
Ireland	8	13	13	0.2%	1	5%	6	73%
Italy	2,375	2,514	2,548	34.3%	34	1%	174	7%
Luxembourg	NE	NE	NE	-	-	-	-	-
Netherlands	276	297	293	23.2%	-4	-1%	16	6%
Portugal	33	89	91	1.2%	3	3%	58	174%
Spain	1,220	2,204	2,292	30.9%	88	4%	1,071	88%
Sweden	109	141	137	1.8%	-4	-3%	28	25%
United Kingdom	1,285	1,378	1,261	17.0%	-117	-8%	-24	-2%
EU-15	**5,932**	**7,453**	**7,424**	**100.0%**	**-28**	**0%**	**1,492**	**25%**

Belgium reports emissions in the source categories 2.A.7 (ceramic sector and glass production) and 2C (Iron and Steel production: sinter production).
France reports emissions in the source categories 2A1 (cement production), 2A2 (lime production) and 2.A.7.a (glass production).
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'.

Table 4.11 shows information on methods applied, activity data, emission factors for CO_2 emissions from 2A3 Limestone and Dolomite Use for 1990 to 2005. The table shows that most MS use limestone and dolomite consumption as activity data for calculating CO_2 emissions. The EU-15 IEF (excluding Denmark, Ireland and Portugal) is 0.45 t/t of lime produced. The implied emission factors per tonne of lime produced vary between 0.34 for the Netherlands and 0.53 for UK. The table also shows the specific sources estimated in this category. 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 Tier2 or Tier 3 method.

Table 4.11 2A3 Limestone and Dolomite Use: Information on methods applied, activity data, emission factors for CO_2 emissions for 1990 and 2005

				1990				2005			
Member State	Method applied	Activity data	Emission factor	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	D	PS	CS, D	Limestone and Dolomite Use	503	0.44	222	Limestone and Dolomite Use	666	0.44	291
Belgium	D	PS	D	Limestone and Dolomite Use	NO	IE	IE	Limestone and Dolomite Use	NO	IE	IE
Denmark	T1/T2	NS	D	Generation of gypsum	506	0.04	18	Generation of gypsum	506	0.12	61
Finland	T1	-	D	Limestone and Dolomite Use	223	0.44	99	Limestone and Dolomite Use	321	0.42	134
France	NA	-	NA	Limestone and Dolomite Use	IE	IE	IE	Limestone and Dolomite Use	IE	IE	IE
Germany	IE	-	-	Limestone and Dolomite Use	IE	IE	IE	Limestone and Dolomite Use	IE	IE	IE
Greece	T2	PS	PS	Limestone Consumption	649	0.44	286	Limestone Consumption	688	0.44	303
Ireland	CS	PS	CS, D	Clay, shale & limestone use	110	0.07	8	Clay, shale & limestone use	148	0.09	13
Italy	D	NS	D, CS,PS	Carbonates input to brick, tiles, ceramic production	5397	0.44	2375	Carbonates input to brick, tiles, ceramic production	5792	0.44	2548
Netherlands	CS	-	D	Limestone and Dolomite Use	733	0.38	276	Limestone and Dolomite Use	857	0.34	293
Portugal	D	NS	D	Limestone consumption	74	0.45	33	Limestone consumption	199	0.46	91
Spain	D	AS, PS	D, PS	Limestone and Dolomite Use	2758	0.44	1220	Limestone and Dolomite Use	5213	0.44	2292
Sweden	D	PS	D	Limestone and Dolomite Use	234	0.47	109	Limestone and Dolomite Use	297	0.46	137
UK	D	NS	D, PS	Limestone and Dolomite Use	3044	0.42	1285	Limestone and Dolomite Use	2379	0.53	1261
EU15				**EU15 w/o DK and IE (99%)**	**13,616**	**0.43**	**5,906**	**EU15 w/o DK and IE (99%)**	**16,413**	**0.45**	**7,350**

Table 4.12 provides a more detailed overview on methods used in EU-15 Member States and the coverage of this source category. Austria, Finland, Ireland, Italy, Portugal and Spain report using plant-specific data reported and verified under the EU ETS.

Table 4.12 2A3 Limestone and Dolomite Use: Summary of methodological information provided by Member States

Member State	Methodology comment
Austria	Emissions were estimated using the methodology and the IPCC default EF for the years 1990-2004. AD for limestone and dolomite used in glass industry were reported by the Association of Glass Industry for the years 2002-2004, for the years before AD was estimated using a constant ratio of limestone and dolomite used per ton of glass produced (glass production was reported by the Association of Glass Industry for all years). 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 verified CO2 emissions and AD, reported under the ETS, were used for the inventory. These data cover limestone and dolomite use in the glass and iron and steel industry. AD for limestone used for desulphurization were taken from a national report on desulphurization technologies in Austria. For 2005 additional information due to emissions reported under the ETS was included. [NIR 2007]
Belgium	The CO2 emissions in the "limestone and dolomite use" category are mainly reported in others source categories : table 2(I).A-G, under A. Mineral products, 7 "other" (ceramic sector and glass production) and table 2(I).A-G, under C. Iron and Steel production (sinter production). In these sectors, the CO2-emissions are mostly due to the use of limestone in the production processes. In Wallonia, the CO2-emissions due to the use of limestone in pollution control are negligible and non-estimated. [NIR 2007]
Denmark	The CO2 emission from the production of bricks and tiles has been estimated from information on annual production registered by Statistics Denmark, corrected for amount of yellow bricks and tiles. The EF (0.44 kg CO2/kg CaCO3) is based on stoichiometric determination. The CO2 emission from the production of container glass/glass wool has been estimated from production statistics published in environmental reports from the producers and EFs based on release of CO2 from specific raw materials (stoichiometric determination). Consumption of limestone for fluegas cleaning estimated from statistics of gypsum and stoichiometric relations between gypsum and CO2 release, EF 0.2325 ton CO2/t gypsum. The CO2 emission from the production of expanded clay products has been stimated from production statistics compiled by Statistics Denmark and an emission factor of 0.045 tonne CO2/tonne product. The CO2 emission from the refining of sugar is estimated from production statistics for sugar and a number of assumptions: consumption of 0.02 tonne CaCO3/tonne sugar and precipitation 90% CaO resulting in an EF at 0.0088 tonne CO2/tonne sugar. [NIR 2007]
Finland	The consumption of limestone and dolomite has been used as AD when calculating emissions from lime stone and dolomite use. AD for 2005 is collected directly from individual companies and the Energy Market Authority. Data for earlier years has been partly taken from industrial statistics and from individual companies. EFs for calculating emissions from limestone and dolomite and soda ash use are based on IPCC default factors. [NIR 2007]
France	Limestone consumption reported under iron and steel and under 2A7 Other. [NIR 2007]
Germany	Limestone consumption is reported in the sectors that use limestone and in 2A7 Other. [NIR 2007]
Greece	Estimate inludes limestone use in steel, aluminium and ceramics production. AD and EF from operators under EU ETS.
Ireland	The reported emissions for 2.A.3 Limestone and Dolomite Use refer to the manufacture of bricks and ceramics up to the year 2000 and thereafter also include the emissions from limestone use in the new peat-fired power plant, that started operation in 2001. The inclusion of this new source leads to a higher IEF after 2001. Information on the raw materials used in brick manufacture (clay, carbonates and shale) has been supplied for the years 1990-2005 by three companies who are participants in the EU emissions trading scheme. CO2 emissions estimates from the three individual companies are used in inventory calculations. Limestone has been used to capture sulphur emitted from peat burning in one new electricity generating station since 2001. The CO2 emissions from this use of limestone are estimated on the basis of limestone quantity reported by the company and an emission factor of 0.44 t CO2/t limestone, which is the stoichiometric ratio of CO2 to CaCO3. [NIR 2007]
Italy	CaCO3 and limestone/dolomite use from plants under EU ETS, EF from bricks and ceramics industry and EU ETS
Netherlands	Limestone and dolomite use: environmental reports are used for emission data. AD on plaster production for use in desulphurising installation for power plants are based on the environmental reports of the coal-fired power plants. Data on the consumption of limestone and dolomite are based on statistical information obtained from Statistics Netherlands. EF= 0.440 t/t (IPCC default) [NIR 2007]
Portugal	Includes consumption in paper and pulp production, emissions from production of calcium and magnesium nitrates. Consumption in blast furnaces included in energy emissions. EF based on stoichiometric relation of materials. AD from national statistics and EU ETS. Some recent years extrapolated. [NIR 2007]
Spain	Includes emissions from glass, bricks and tiles and magnesites and flue gas desulphurization. AD and EF for magnesite and desulphurization from plants, AD and EF for glass, bricks and tiles from industrial associations. Lime and dolomite use in iron and steel industry is included in source category 2C1. Detailed plant-specific data was used for the limeuse in desulphurization plants. [NIR 2007]
Sweden	The calculations are made by applying the IPCC Guidelines default emission factors for limestone and dolomite for the different production sectors. Emissions arise mainly from production of glass (mainly two big companies), mineral wool (two companies) and ore-based iron pellets (one company). It also includes the use within production of steel (two plants), chemical products-detergents (one plant), tile (one plant) and from scrubbers in energy production plants (five plants). Data on the use of limestone and dolomite have been acquired from the ETS and through direct contacts with the companies. [NIR 2007]
UK	Includes use in sinter production, glass production and steel industry. Emissions are calculated using EFs of 120 t carbon/kt limestone and 130 t carbon/kt dolomite, in the case of glass processes involving calcinations, and 69 t carbon/kt gypsum produced in the case of FGD processes. These factors are based on the assumption that all of the CO2 is released to atmosphere. Data on the usage of limestone and dolomite for glass and steel production are available from the British Geological Survey (2006) and the Iron & Steel Statistics Bureau (2006), respectively and gypsum produced in FGD plant is available from the British Geological Survey (2006). Corus UK Ltd has provided analytical data for the carbon content of limestones and dolomites used at their steelworks and these have been used to generate EFs of 111 t carbon/kt limestone and 123 t carbon/kt dolomite for sintering and basic oxygen furnaces.

Table 4.13 summarizes the recommendations from 2005 UNFCCC inventory review in relation to the category 2A3 Limestone and Dolimite Use. The overview shows that all findings were addressed and resolved.

Table 4.13 2A3 Lime Production and Dolomite Use: Findings of the 2005 UNFCCC inventory review in relation to CO_2 emissions and responses in 2007 inventory submissions

Member State	Review findings and responses related to 2A3 Limestone and Dolomite Use	
	Comment UNFCCC inventory review report 2005	Status in 2007 submission
Austria	Source category estimated for the first time in 2004	Source category estimated for the first time in 2004
Belgium	No recommendation for improvement for this source category in 2005 review report.	No follow-up necessary
Denmark	The Party aims to include estimates for this source in its next inventory submission.	Estimates are included in 2007 submission.
Finland	not addressed	No follow-up necessary
France	IE	No follow-up necessary
Germany	IE	No follow-up necessary
Greece	Dolomite use is not accounted for, and this is not explained in the NIR.	No updated NIR provided before the finalization of this report
Ireland	Source category estimated for the first time in 2004	Source category estimated for the first time in 2004
Italy	The IPCC default EFs, equal to 0.44 and 0.447 (t CO2/t calcium carbonate (CaCO3)) for limestone and dolomite, respectively, are used for Limestone and Dolomite Use. However, the IEF presented in the NIR is 0.10 t/t. During the review the Party indicated that the IEF is different because it refers to total ceramics, tiles and iron production and not to the amount of limestone and dolomite used in the process. The ERT encourages the Party to report limestone and dolomite use as AD in the CRF instead of production data and recommends providing explanation in the NIR as to how the calculations have been done and what AD and EF have been used.	Carbonates input to brick,tiles,ceramic production is used as activity data in the CRF. No updated NIR provided until the finalization of this report.
Netherlands	not addressed	No follow-up necessary
Portugal	not addressed	No follow-up necessary
Spain	Although the NIR is unclear, Spain has explained to the ERT that CO2 emissions from limestone and dolomite consumption use are from glass manufacturing, frits of glass, brick and tiles and magnesium production. For subsequent submissions the Party is considering including emissions from the use of limestone for environmental pollution control purposes. The ERT encourages transparency in the NIR to give assurance that omission or double counting have been avoided.	Limestone use for desulphurization plants was included based on plant-specific information.
Sweden	not addressed	No follow-up necessary
UK	In the CRF, the United Kingdom reports a very large increase in the AD (more than 300-fold) between 1990 and 2003. However, estimated CO2 emissions have not increased. This has resulted in an unusual change in the IEF (0.45 t/t in 1990–1993, while it is 0.00 t/t from 1994 onwards). The ERT recommends the United Kingdom to provide clarifications on this issue in its next NIR. In its response to the review, the United Kingdom explained that this was due to an erroneous data entry for AD in the CRF which will be corrected in the 2006 inventory submission.	No follow-up necessary

Table 4.14 provides an overview about the emission sources reported in the category 2A7 Other Mineral Products in 2005 as well as total emissions in this category. The most frequent source reported under Other Mineral Products is glass production (11 Member States), followed by bricks and tiles production. Some Member States include emissions from brick and tile production under 2A3 Limestone and Dolimite Use. Germany is the largest contributor to this category with 22 %, followed by France (21 %) and Italy (12 %)

Table 4.14 2A7 Other Mineral Products: Emission sources reported in the year 2005

Member State	2.A.7 Other Mineral Products	CO_2 emissions [Gg]	Share in EU-15 total
Austria	Sinter, glass production, bricks and tiles (decarbonizing)	438	10%
Belgium	Glass production, ceramics	500	11%
Denmark	Glass Production (Glass and glass wool)	13	0%
France	Glass Production, Brick and Tile Production	978	21%
Germany	Glass Production, Ceramics, Brick and Tile Production	994	22%
Greece	Glass Production	22	0%
Italy	Glass production	525	12%
Luxembourg	Glass production	62	1%
Netherlands	Glass production, Production of other building material	253	6%
Portugal	Glass Production	173	4%
Spain	Magnesia production, Porous tiles production, Potassium Carbonate, Ferrum Carbonate, Coal as reducing agent in glass industry, Non-porous tiles production, Barium Carbonate	469	10%
Sweden	Light expanded clay aggregate	7	0%
UK	Fletton Brick Production	129	3%
EU-15 Total		**4,561**	**100%**

Table 4.15 provides information on the contribution of Member States to EC recalculations in CO_2 from 2A Mineral products for 1990 and 2004 and main explanations for the largest recalculations in absolute terms.

Table 4.15 2A Mineral products: Contribution of MS to EC recalculations in CO_2 for 1990 and 2004 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2004		Main explanations
	Gg	Percent	Gg	Percent	
Austria	0.0	0.0	37.1	1.2	2A1 Cement Production: Activity and emission data for CO2 emissions from Cement Production 2004 has been updated using plant-specific data provided by the Association of the Austrian Cement Industry.
Belgium	0.0	0.0	26.2	0.5	In the Flemish region the process emissions of CO2 in the glass industry (category 2A7) are revised in 2 companies from 1990 on because more reliable information became available.
Denmark	0.0	0.0	0.1	0.0	
Finland	0.0	0.0	-2.1	-0.2	
France	-39.8	-0.3	8.5	0.1	adjustment of emissions of different poduction sites, new method for calculation of emission factor for 2A4
Germany	-405.6	-1.8	-221.7	-1.1	updated activity data and emissions factors, new calculation for CO2 from glass production
Greece	0.0	0.0	0.0	0.0	
Ireland	0.0	0.0	5.1	0.2	Plant-specific data is used to calculate process CO2 emissions from 2.A.1 Cement Production for the years 1990-2005. As a result of a review as part of Irelands QA/QC procedures under the National Inventory System, data for 2003 and 2004 has been revised.
Italy	0.0	0.0	0.0	0.0	
Luxembourg	0.0	0.0	0.0	0.0	
Netherlands	0.0	0.0	0.0	0.0	
Portugal	0.0	0.0	119.7	2.8	No changes occurred for this sector apart from update of the clinker production value for 2004. No modifications were done in what concerns methodology and emission factors.
Spain	0.0	0.0	-3.7	0.0	revised activity data
Sweden	0.0	0.0	0.0	0.0	
UK	13.2	0.1	9.1	0.1	A revision to the data for dolomite use by the glass industry in recent years has lead to a very small change in the estimated emissions for IPCC Sector 2A3. Revisions to the estimate of fletton brick production in Construction Statistics
EU-15	**-432.2**	**-0.4**	**-21.8**	**0.0**	

4.2.2 Chemical industry (CRF Source Category 2B)

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 4.16 summarises information on Member States' emissions from chemical industry in 1990 and 2005 for total GHG, CO_2 and N_2O. Between 1990 and 2005, CO_2 emission from 2B Chemical Industry increased by 9 %. The absolute increase was largest in Germany, Portugal and Belgium, the absolute reductions were largest in France and Italy. Between 1990 and 2005, N_2O emission from 2B Chemical Industry decreased by 54 %. The absolute decreases were largest in UK and France, emissions increased in Italy and Portugal.

Table 4.16 2B Chemical Industry: Member States' contributions tototal GHG and CO_2 and N_2O emissions

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2005 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO_2 emissions in 2005 (Gg)	N_2O emissions in 1990 (Gg CO2 equivalents)	N_2O emissions in 2005 (Gg CO2 equivalents)
Austria	1,512	847	585	557	912	274
Belgium	4,852	5,653	918	2,241	3,934	3,410
Denmark	1,044	3	1	3	1,043	-
Finland	1,790	1,700	130	125	1,656	1,569
France	27,683	8,629	3,537	2,385	24,143	6,244
Germany	35,599	29,600	11,823	14,897	23,776	14,702
Greece	713	634	IE,NA,NE,NO	IE,NA,NE,NO	713	634
Ireland	2,025	NO	989	NO	1,035	-
Italy	8,914	9,084	2,186	1,317	6,676	7,760
Luxembourg	NO	NO	NO	NO	NO	NO
Netherlands	11,526	10,385	3,702	3,746	7,570	6,364
Portugal	1,209	2,559	634	1,936	567	612
Spain	3,757	2,341	832	727	2,884	1,563
Sweden	901	502	69	53	832	449
United Kingdom	27,943	6,091	3,165	3,253	24,641	2,796
EU-15	**129,468**	**78,031**	**28,572**	**31,240**	**100,382**	**46,376**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.17 provides information on the contribution of Member States to EC recalculations in CO_2 from 2B Chemical industry for 1990 and 2004 and main explanations for the largest recalculaltions in absolute terms.

Table 4.17 2B Chemical Industry: Contribution of MS to EC recalculations in CO_2 for 1990 and 2004 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2004		Main explanations
	Gg	Percent	Gg	Percent	
Austria	-0.7	-0.1	-0.8	-0.1	correction of double counting
Belgium	0.0	0.0	130.7	5.6	Since 2005, CO2 process emissions in the Walloon region have been mainly obtaining directly by the reporting of the plants under the emission trading scheme.
Denmark	0.0	0.0	0.0	0.0	
Finland	-3.3	-2.4	0.0	0.0	Review of Vahti database (indirect CO2 from NMVOC emissions)
France	0.5	0.0	222.8	11.3	update of emissions declared in 2004, correction of production figures for 2B4 (1990)
Germany	0.0	0.0	0.0	0.0	
Greece	0.0	0.0	0.0	0.0	
Ireland	0.0	0.0	0.0	0.0	
Italy	0.0	0.0	0.0	0.0	
Luxembourg	NE	0.0	NE	0.0	
Netherlands	0.0	0.0	0.0	0.0	
Portugal	0.0	0.0	0.0	0.0	
Spain	0.0	0.0	0.0	0.0	
Sweden	0.0	0.0	0.0	0.0	
UK	0.0	0.0	-65.5	-1.9	Revision to the activity data and emission factor for the feedstock use of natural gas to produce ammonia
EU-15	**-3.5**	**0.0**	**287.2**	**0.9**	

Table 4.18 provides information on the contribution of Member States to EC recalculations in N_2O from 2B Chemical Industry for 1990 and 2004 and main explanations for the largest recalculations in absolute terms.

Table 4.18 2B-Chemical Industry: Contribution of MS to EC recalculations in N_2O for 1990 and 2004 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2004		Main explanations
	Gg	Percent	Gg	Percent	
Austria	0.0	0.0	0.0	0.0	
Belgium	0.0	0.0	0.0	0.0	
Denmark	0.0	0.0	0.0	0.0	
Finland	0.0	0.0	0.0	0.0	
France	0.0	0.0	-0.4	0.0	update of emissions declared in 2004
Germany	0.0	0.0	0.0	0.0	
Greece	0.0	0.0	0.0	0.0	
Ireland	0.0	0.0	0.0	0.0	
Italy	0.0	0.0	0.0	0.0	
Luxembourg	0.0	0.0	0.0	0.0	
Netherlands	0.0	0.0	0.0	0.0	
Portugal	0.0	0.0	0.0	0.0	
Spain	0.0	0.0	0.0	0.0	
Sweden	0.0	0.0	0.0	0.0	
UK	-4,628.8	-15.8	-459.0	-11.4	Major revision to the emissions from nitric and adipic acid production, across the time series. Based on reported emission factors and production data from industry.
EU-15	**-4,628.8**	**-4.4**	**-459.4**	**-1.0**	

CO_2 emissions from 2B1 Ammonia Production account for 0.4 % of total EU-15 GHG emissions in 2005. Between 1990 and 2005, CO_2 emissions from this source decreased by 5 % (Table 4.19). The Netherlands, France, Germany, and Portugal are responsible for 75% of these emissions in the EU-15. France and Italy had large reductions in absolute terms between 1990 and 2005. The largest growth had Portugal, followed by Belgium.

Table 4.19 2B1 Ammonia Production: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005	
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	517	468	503	3.0%	35	8%	-14	-3%
Belgium	694	1,265	1,330	7.9%	65	5%	637	92%
Denmark	NO	NO	NO	-	-	-	-	-
Finland	44	NO	NO	-	-	-	-44	-100%
France	3,357	2,176	2,362	14.1%	187	9%	-995	-30%
Germany	4,596	5,169	5,253	31.3%	84	2%	657	14%
Greece	IE	IE	IE	-	-	-	-	-
Ireland	989	NO	NO	-	-	-	-989	-100%
Italy	1,710	748	705	4.2%	-42	-6%	-1,004	-59%
Luxembourg	NO	NO	NO	-	-	-	-	-
Netherlands	3,096	3,086	3,105	18.5%	20	1%	9	0%
Portugal	569	1,715	1,809	10.8%	94	5%	1,240	218%
Spain	709	592	612	3.6%	20	3%	-96	-14%
Sweden	NO	NO	NO	-	-	-	-	-
United Kingdom	1,322	1,262	1,120	6.7%	-142	-11%	-202	-15%
EU-15	**17,603**	**16,481**	**16,801**	**100.0%**	**320**	**2%**	**-802**	**-5%**

Emissions of Greece are reported in Energy - Chemicals.
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 2005. The table shows that most MS report Ammonia Production as activity data. The implied emission factors per tonne of ammonia produced vary for 2005 between 1.05 for Austria and 1.82 for Germany. The EU-15 IEF (excluding Belgium, Greece, Netherlands, Portugal and the UK) is 1.58 t/t of ammonia produced. The decrease of the IEF from 1990 to 2005 is partly due to changing ratios of production of the different countries and partly due to emission reduction measures (France). The table also suggests that 55 % of EU-15 emissions are estimated with higher Tier methods.

Table 4.20 2B1 Ammonia Production: Information on methods applied, activity data, emission factors for CO_2 emissions for 1990 and 2005

Member State	Method applied	Activity data	Emission factor	1990				2005			
				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	CS	NS,PS	CS	Ammonia Production	461	1.12	517	Ammonia Production	478.43	1.05	503.06
Belgium	T2	PS	CS	Ammonia Production	C	C	694	Ammonia Production	C	C	1330
Finland	T1	PS	D	Ammonia Production	28	1.55	44	Ammonia Production	NO	NO	NO
France	C	AS	PS	Ammonia Production	1928	1.74	3357	Ammonia Production	1444	1.64	2362
Germany	D	NS	D	Ammonia Production	2532	1.82	4596	Ammonia Production	2894	1.82	5253
Greece	IE	IE	IE	Ammonia Production	313	IE	IE	Ammonia Production	160	IE	IE
Ireland	T2	NS, PS	CS, PS	Ammonia Production	430	2.30	989	NO	NO	NO	NO
Italy	D	NS,PS	C, PS	Ammonia Production	1455	1.18	1710	Ammonia Production	607	1.16	705
Netherlands	T1b	PS/Q	CS	Ammonia Production	C	C	3096	Ammonia Production	C	C	3105
Portugal	T2	NS,PS	PS	Ammonia Production	C	C	569	Ammonia Production	C	C	1809
Spain	D	PS	PS	Ammonia Production	573	1.24	709	Ammonia Production	542	1.13	612
UK	T2, T3	PS	CS	Natural gas consumption PJ net	45	29.59	1322	Natural gas consumption PJ net	31	35.71	1120
EU15				**EU15 w/o BE, GR, NL, PT and UK (68%)**	**7408**	**1.61**	**11922**	**EU15 w/o BE, GR, NL, PT and UK (56%)**	**5966**	**1.58**	**9436**

Abbreviations explained in the Chapter 'Units and abbreviations'.

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 2007.

Table 4.21 2B1 Ammonia Production: Summary of methodological information provided by Member States

Ammonia Production	
Member State	Methodology comment
Austria	AD since 1990 and CH4 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. CO2 emissions are calculated from the natural gas input with a standard emission factor (55.4 t/TJ). In this methodology it is assumed that all natural gas is transformed to CO2 and emitted at once. But, according to information from the producer, there are also CH4 emissions during start-ups of the ammonia production. Therefore this CH4 has to be subtracted from total CO2 to avoid double counting. Furthermore, CO2 and CH4 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 CO2 emissions from ammonia production to avoid double counting of emissions. Account was taken for the carbon bound in the melamine production. [NIR2007]
Belgium	In Flanders the emissions of CO2 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). In the past the same methodology as in Wallonia was used, nowadays the methodology is adapted because a part of the emissions of CO2 is recuperated in the plant and no longer emitted. In the Walloon region, until 2004, the CO2 emissions were calculated based on the natural gas used as feedstock. 100% per cent of the carbon content of the natural gas was presumed to be emitted; the default IPCC emission factor for CO2 for natural gas (55,8 kton CO2/PJ) was used to calculate the total CO2 emissions. The amount of natural gas used in the process was given directly by the plant. Since 2005, CO2 emissions have been given directly by the reporting of the plant under the emission trading scheme.[NIR2007]
Finland	The annual ammonia production figures have been obtained from the production plants. The CO2 emissions have been calculated with the mean value of two IPCC default emission factors (1.55 tonne CO2/tonne ammonia produced). [NIR 2007]
France	Emission data obtained directly from plants, CS EF calculated onthis basis. [NIR2007]
Germany	Emissions are estimated from ammonia production data from national statistics and the IPCC default EF. [NIR2007]
Greece	Emissions are included in the energy sector to avoid double-counting [NIR 2006]
Ireland	Emissions are calculated using natural gas consumption data and a CS EF for natural gas. [NIR2004] Ammonia production was closed in 2002 [NIR 2005]
Italy	AD from international industrial statistical yearbooks (UN) and from national EPER registry were used. For the years 1990-2001 CO2 EF have been calculated based on information reported from EPER for 2002 and 2003. Assumption that no modifications to the production plants have occurred over the period. For the years 2002-2004 the average emission factors result from PS data from EPER were used [NIR 2006]
Netherlands	Emissions are calculated from the amount of natural gas used as feedstock (equivalent to IPCC Tier 1b) obtained from national statistics. CS EF based on a 17% fraction of carbon in the gas-feedstock oxidised during the ammonia manufacture, which was calculated from the carbon not contained in the urea produced. [NIR 2007]
Portugal	Emissions are estimated using feedstock (Vaccum Residual Fuel Oil) consumption data from national statistics and default EFs. [NIR2007]
Spain	Production data and country-specific EF from plants. The IEF for CO2 decreased in 2005 due to a corresponding decrease of the EF in one ammonia producing plant in 2005. [NIR 2007].
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. [NIR 2007]
UK	Emissions of CO2 from feedstock use of natural gas were calculated by combining reported data on CO2 produced, emitted and sold by the various ammonia processes. Where data were not available, they have been calculated from other data such as plant capacity or natural gas consumption. A correction has to be made for CO2 produced at one site where some of this CO2 is subsequently 'recovered' through sequestration in methanol. the default carbon emission factor for natural gas was used to convert between carbon and natural gas. [NIR2007]

Table 4.22 summarizes the recommendations from 2005 UNFCCC inventory review in relation to the category 2B1 Ammonia Production. The overview shows that most recommendations were implemented and that the remaining unresolved findings are mostly not very significant.

Table 4.22 2B1 Ammonia Production: Findings of the 2005 UNFCCC inventory review in relation to CO_2 emissions and responses in 2006 inventory submissions

Member State	Review findings and responses in relation to 2B1 Ammonia Production	
	Comment UNFCCC inventory review report 2005	**Status in 2007 submission**
Austria	The CO2 IEF values are among the lowest of reporting Parties and lower than the IPCC default range. The ERT recommends that Austria provide information in the NIR regarding the QA/QC procedures carried out for the emissions reported by the only producer of ammonia in the country.	Method for CO2 emissions at production plant was examined and subsequently changed, emissions for time series were recalculated. The CO2 IEF was revised and is considerably higher in 1990, but slightly lower than before in 2004. During the in-country review of the submission 2006 it was found that there was a double counting concerning CO2 emissions from ammonia. The double counting was corrected in this submission and CO2 emissions have been recalculated for the whole time-series.
Belgium	The NIR mentions use of the IPCC good practice guidance on emissions from ammonia production, but there is currently no IPCC good practice guidance on ammonia production emissions. The Party did report emissions of CO2 from two other plants in the Walloon region; these two plants also use ammonia production process CO2 emission, which is reported by the Party. Belgium has stated that it will improve documentation in its next NIR to improve the transparency of this activity, and to address the double counting issue.	Methodological description was revised.
Finland	Source category only estimated for 1990-1993, afterwards production phased out.	No follow-up necessary
France	ERT encouraged France to include methodological descriptions.	Methodological description was added.
Germany	The ERT encourages the Party to identify and report the reasons for the increase in ammonia production. As indicated in previous 2005 review stages, the IEF value for CO2 from Ammonia Production is not well documented. Germany plans to begin using the IPCC default value range. The ERT recommends that Germany follow this approach.	Reasons for increase provided and IPCC default EF used, therefore time-series was recalculated for 2006 inventory submission.
Greece	For its next submission, the Party should check whether emissions and destruction data are available at the plant level. Emissions estimated using AD need to be calculated using AD from the same year.	No plant-specific data are used yet.
Ireland	Source category not addressed by review report 2005	No follow-up necessary
Italy	Source category not addressed by review report 2005	No follow-up necessary
Netherlands	The ERT recommended Netherlands include explanations for the decreasing trend of emissions.	Trend not explained in NIR 2007.
Portugal	No recommendation for improvement for this source category in 2005 review report.	No follow-up necessary
Spain	In 2003, as in 2002, the ratio of CO2 emissions to production (0.92 t CO2/t ammonia) is lower than the IPCC default (1.5–1.6 t CO2/t ammonia). The NIR does not provide supporting information on the AD, EFs or methods used. The Party should investigate the possible causes of the difference and report on it in its next NIR.	Spain explained that there is one plant with direct ammonia synthesis in a closed circle which does not emit CO2.
UK	Source category not addressed by review report 2005	No follow-up necessary

Abbreviations explained in the Chapter 'Units and abbreviations'.

CO_2 emissions from 2B5 Other account for 0.3 % of total EU-15 GHG emissions in 2005. Between 1990 and 2005, CO_2 emissions from this source increased by 40 % (Table 4.23). Germany is responsible for 68 % of these emissions in the EU-15. Emissions mainly increased in Germany, but also in Belgium and the UK. For an overview of sources included in the source 2B5 see Table 4.33.

Table 4.23 2B5 Other: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005	
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	31	25	18	0.1%	-6	-25%	-12	-40%
Belgium	224	1,200	911	6.4%	-289	-24%	687	306%
Denmark	1	3	3	0.0%	0	0%	2	276%
Finland	86	172	125	0.9%	-47	-27%	39	45%
France	21	24	23	0.2%	-2	-6%	2	7%
Germany	6,783	9,691	9,628	67.7%	-64	-1%	2,844	42%
Greece	NA,NE,NO	NA,NE,NO	NA,NE,NO	-	-	-	-	-
Ireland	NO	NO	NO	-	-	-	0	-100%
Italy	475	579	610	4.3%	32	5%	135	29%
Luxembourg	NO	NO	NO	-	-	-	-	-
Netherlands	606	571	640	3.8%	69	12%	35	6%
Portugal	65	122	127	0.8%	5	4%	61	94%
Spain	NE	NE	NE	-	-	-	-	-
Sweden	NA	NA	NA	-	-	-	-	-
United Kingdom	1,844	2,094	2,133	15.0%	39	2%	290	16%
EU-15	**10,136**	**14,482**	**14,218**	**100.0%**	**-263**	**-2%**	**4,082**	**40%**

Sweden did not estimate emissions from 2B5. Ethylene because presently no data is available.
Abbreviations explained in the Chapter 'Units and abbreviations'.

N_2O emissions from 2B2 Nitric acid production account for 0.8 % of total EU-15 GHG emissions in 2005. Between 1990 and 2005, N_2O emissions from this source decreased by 10% (Table 4.24). Germany accounts for 34% of EU-15 emissions from this source, followed by the Netherlands (17%) and France (13%). Nearly all Member States had reductions from this source between 1990 and 2005. France had the greatest reductions in absolute terms. The largest growth was in Germany.

Table 4.24 2B2 Nitric acid production: Member States' contributions to N_2O emissions in 1990, 2004 and 2005

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005	
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	912	281	274	0.8%	-7	-2%	-638	-70%
Belgium	3,562	3,118	3,066	9.3%	-52	-2%	-496	-14%
Denmark	1,043	531	0	0.0%	-531	-100%	-1,043	-100%
Finland	1,656	1,460	1,569	4.8%	109	7%	-87	-5%
France	6,570	4,654	4,337	13.2%	-317	-7%	-2,233	-34%
Germany	4,673	7,518	11,061	33.6%	3,543	47%	6,388	137%
Greece	713	352	634	1.9%	282	80%	-79	-11%
Ireland	1,035	NO	NO	-	-	-	-1,035	-100%
Italy	2,086	1,805	1,688	5.1%	-118	-7%	-398	-19%
Luxembourg	NO	NO	NO	-	-	-	-	-
Netherlands	6,330	5,617	5,659	17.2%	42	1%	-671	-11%
Portugal	567	605	612	1.9%	7	1%	45	8%
Spain	2,884	1,788	1,563	4.7%	-225	-13%	-1,322	-46%
Sweden	814	427	440	1.3%	13	3%	-374	-46%
United Kingdom	3,904	2,642	2,020	6.1%	-622	-24%	-1,884	-48%
EU-15	**36,749**	**30,798**	**32,922**	**100.0%**	**2,124**	**7%**	**-3,827**	**-10%**

Table 4.25 shows information on methods applied, activity data, emission factors for N_2O emissions from 2B2 Nitric Acid Production for 1990 to 2005. The table shows that almost all MS report Nitric Acid Production as activity data; for some MS this information is confidential. The implied emission factors per tonne of nitric acid produced vary for 2005 between 0.0016 for Austria and 0.0135 for Belgium. The EU-15 IEF (excluding Netherlands and Portugal) is 0.0058 t/t of nitric acid produced. The decrease of the IEF is mainly due to changing production ratios in the different MS having different technological standards and close down of older plants in some MS. The table also suggests that more than 80 % of EU-15 emissions are estimated with higher Tier methods.

Table 4.25 2B2 Nitric Acid Production: Information on methods applied, activity data, emission factors for N_2O emissions for 1990 and 2005

Member State	Method applied	Activity data	Emission factor	1990				2005			
				Activity data		Implied emission factor	N_2O emissions	Activity data		Implied emission factor	N_2O emissions
				Description	(kt)	(t/t)	(Gg)	Description	(kt)	(t/t)	(Gg)
Austria	CS	PS	PS	Nitric Acid Production	530	0.0056	2.9	Nitric Acid Production	558	0.0016	0.9
Belgium	CS	PS	CS	Nitric Acid Production	1436	0.0080	11.5	Nitric Acid Production	733	0.0135	9.9
Denmark	NO	NO	NO	Nitric Acid Production	450	0.0075	3.4	Nitric Acid Production	NO	NO	NO
Finland	T2	PS	CS	Nitric acid production medium pressure plants	549	0.0097	5.3	Nitric acid production medium pressure plants	582	0.0087	5.1
France	C	AS	PS	Nitric Acid Production	3200	0.0066	21.2	Nitric Acid Production	2816	0.0050	14.0
Germany	CS	NS	CS	Nitric Acid Production	2741	0.0055	15.1	Nitric Acid Production	6488	0.0055	35.7
Greece	D	NS	D	Nitric Acid Production	511	0.0045	2.3	Nitric Acid Production	454	0.0045	2.0
Ireland	D	NS, PS	CS, PS	Nitric Acid Production	339	0.0099	3.3	NO	NO	NO	NO
Italy	D	PS	D, PS	Nitric Acid Production	1037	0.0065	6.7	Nitric Acid Production	572	0.0095	5.4
Netherlands	T2	QNS	PS	Nitric Acid Production	C	C	20.4	Nitric Acid Production	C	C	18.3
Portugal	D	NS,PS	C,OTH	Nitric Acid Production	C		1.8	Nitric Acid Production	C		2.0
Spain	D	AS	CS	Nitric Acid Production	1329	0.0070	9.3	Nitric Acid Production	720	0.0070	5.0
Sweden	T2	PS	PS	Nitric Acid Production	374	0.0070	2.6	Nitric Acid Production	264	0.0054	1.4
UK	T2, T3	PS	CS	Nitric Acid Production	2408	0.0052	12.6	Nitric Acid Production	1713	0.0038	6.5
EU15				**EU15 w/o NL and PT (81%)**	**14,904**	**0.0065**	**96**	**EU15 w/o NL and PT (81%)**	**14,899**	**0.0058**	**86**

Abbreviations explained in the Chapter 'Units and abbreviations'.

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 2007]
Belgium	Emissions are estimated in Flanders using an emission factor of 8 kg N2O/ton HNO3 from CITEPA [2]. The three plants involved in Flanders since 1990 agreed with this factor of 8 kg N2O/ton HNO3 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 N2O/ton HNO3). The use of catalysts reduces these emissions. The producer of nitric acid in the Walloon region provides the N2O emissions based on their production and on monitoring. There are three installations on the plant. The global emission factor used in this region is 4,5 kg/t in 2005. 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 given the strong increase of the production since 1996. [NIR2007]
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 (Kemira Growhow, 2004). The production of nitric acid ceased in the middle of 2004. [NIR 2007]
Finland	The annual nitric acid production figures have been obtained from the production plants. Emission factors are plant specific and are based on measurements started in 1999 and was done by an outside consultant. At one site emission factors has been defined to be 7.6 kg/t and 9.5 kg/t for the whole time series. At other sites emission factors are about 9.2 kg/t. The new plant has a continuous measurement unit. A portable measurement device to measure emissions of the other plants of the company has been purchased and the emissions are now measured periodically. This has improved the emissions factors for 2005 and will improve the accuracy of the emission factors in future.[NIR 2007]
France	Emission data obtained from association based on plant-specific data until 2001. Since 2002 plant-specific information directly reported to authorities available for all sites. Common good practice Guidance for the N2O estimation was adopted in all plants in 2002. [NIR2007]
Germany	Activity data taken from national statistics, since 2002 the share of nitirc acid is estimated from a more aggregated production figure. Country-specific emission factor is assumed to be constant and is within the range provided by German industry. [NIR 2007]
Greece	Estimates are based on activity data from industry and average IPCC default EF. No abatement technologies are used [NIR 2006]
Ireland	Nitric acid production was closed in 2002
Italy	Emissions are calculated based on date from EPER and national statistics and plant-specific EF. IPCC default EF for low and medium pressure plants that are now closed [NIR2006].
Netherlands	Activity data are confidential. Emissions are reported by the companies. Plant-specific N2O emission factors are used (which 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 national Pollutant Emission Register (PER). [NIR 2007]
Portugal	Estimates are calculated from nitric acid production data (national statistics and some extrapolations for recent years) and PS EF. Plant-specific Efs are monitored at one from three plants. [NIR2007]
Spain	Production data and EF obtained from national business association. AD disaggregated per plant and type of manufacturing process [NIR 2007] CS EF form industrial association is used compiled from plant-specific data. [NIR2007]
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. The assumed emission factor of 7 kg/Mg for 1991 - 1993 is based on the calculated emission factors for 1990 and 1994 and is in line with the default factors for nitric acid production in IPCC Good Practice Guidance. [NIR 2007]
UK	Estimates are based on PS data as well as calculated using nitric acid production data and production capacities. Emissions partly provided directly by operators, site specific EF and default EFs [NIR 2007]

Table 4.27 summarizes the recommendations from 2005 UNFCCC inventory review in relation to the category 2B2 Nitric Acid Production. The overview shows that recommendations were mostly implemented.

Table 4.27 **2B2 Nitric Acid Production: Findings of the 2005 UNFCCC inventory review in relation to CO_2 emissions and responses in 2007 inventory submissions**

Member State	Review findings and responses related to 2B2 Nitric Acid Production	
	Comment UNFCCC inventory review report 2005	**Status in 2007 submission**
Austria	The ERT encourages the Party to explain the particular operating conditions that caused the sudden increase in the IEFs between 1994 and 1995.	Explanation of operating conditions provided
Belgium	An EF of 5.189 kg/t has been used, but no justification provided on the use of this factor with reference to plant age, technology type and so on, and whether this factor is considered as country industry average throughout the time series. The N2O emissions show a general decreasing trend, but there is no mention of introduction of abatement technology. Belgium is encouraged to provide clear details of the methodological approach used, in line with the IPCC good practice guidance, and understands that plant specific data are available.	More detailed information on abatement technologies provided that explain decreasing trend. It is explained why the EF are considered as appropriate.
Denmark	ERT recommended to include EF of 7.5 kg N2O/ton nitirc acid communicated during the review in the NIR.	EF quoted is available from CRF background data table and was already available in 2004 CRF submission. Review finding unclear.
Finland	ERT recommended to obtain and use measurement data in next submission. ERT recommened to explain that no abatement technologies are used for nitric acid production.	Additional measurement devices were installed and measurement data obtained.More detailed description of plant types added.
France	The ERT encouraged France to reference estimation methods used by facilities. The ERT also invited France to assess the consistency of time series as data source changed.	Reference of estimation method provided. France changed from plant-specific data reported to association to plant-specific data reported to national authorities. This should not impact time-series consistency.
Germany	The reasons for changes in volumes of production are not explained, except for the sharp rise value from 2002 to 2003 (the number of production plants rose from four to six). The ERT encourages the Party to verify the changes in production volumes and include this information in the NIR. The six different plants that produce nitric acid in Germany have different emissions abatement techniques. Because N2O from Nitric Acid Production is a key category, the ERT encourages Germany to collect plant-specific data which take into account different production and emissions abatement technologies.	Changes in production volumes are explained with additionaol manufacturers that started production. Plant-specific Efs were not used, but additional checks with data provided from industry were used to check the correctness of the EF aplied.
Greece	Due to lack of AD, the Party reports the same N2O emissions for 2003 as for 2002. No reference is made in the NIR to the availability of NOx abatement technologies and their effect on N2O emissions. For its next submission, the Party should check whether emissions and destruction data are available at the plant level. Emissions estimated using AD need to be calculated using AD from the same year.	No updated NIR provided in time for this report
Ireland	Source category not addressed by review report 2005	No follow-up necessary
Italy	The ERT welcomes the Party’s effort to improve its EFs and AD in future by collecting more information from the operators about N2O emission trends for Nitric Acid Production, especially for the years 1990–2000.	No clear recommendation provided. Additional trend information provided.
Netherlands	The ERT recommended Netherlands include explanations for the decreasing trend of emissions.	The reduction in 2001 was explained by technical control measures implemented. Emissions decrease in 2002 was due to lower production. In 2004 production increased.
Portugal	The ERT recommended that Portugal develop CS EF from each plant.	Plant-specific EFs are used
Spain	The ERT recommended that Spain verify the EF used. Spain is encouraged to use the IPCC good practice guidance for this key category.	EF from association was confirmed by main manufacturer.
Sweden	In order to improve transparency, the Party is encouraged to provide in its NIR a summary of available plant-specific information.	Summary is provided
UK	Review report welcomed improvements reported in previous inventory submission.	No follow-up necessary

N_2O emissions from 2B3 Adipic Acid Production account for 0.3 % of total EU-15 GHG emissions in 2005. Between 1990 and 2005, N_2O emissions from this source decreased by 80 % (Table 4.28). Italy is responsible for 52 % of these emissions in the EU-15 and it had increases in emissions from this source between 1990 and 2005, but emissions declined compared to the previous year. All other Member States that reported emissions from this source had large emissions reductions between 1990 and 2005 due to abatement measures in adipic acid production.

Table 4.28 2B3 Adipic Acid Production: Member States' contributions to N_2O emissions in 1990, 2004 and 2005

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005	
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	NO	NO	NO	-	-	-	-	-
Belgium	NO	NO	NO	-	-	-	-	-
Denmark	NO	NO	NO	-	-	-	-	-
Finland	NO	NO	NO	-	-	-	-	-
France	14,806	1,176	1,520	13.1%	344	29%	-13,286	-90%
Germany	18,805	4,781	3,276	28.1%	-1,505	-31%	-15,529	-83%
Greece	NO	NO	NO	-	-	-	-	-
Ireland	NO	NO	NO	-	-	-	-	-
Italy	4,579	6,638	6,073	52.1%	-565	-9%	1,493	33%
Luxembourg	NO	NO	NO	-	-	-	-	-
Netherlands	NO	NO	NO	-	-	-	-	-
Portugal	NO	NO	NO	-	-	-	-	-
Spain	NO	NO	NO	-	-	-	-	-
Sweden	NO	NO	NO	-	-	-	-	-
United Kingdom	20,737	925	776	6.7%	-149	-16%	-19,961	-96%
EU-15	**58,927**	**13,519**	**11,645**	**100.0%**	**-1,874**	**-14%**	**-47,282**	**-80%**

Table 4.29 shows information on methods applied, activity data, emission factors for N_2O emissions from 2B3 Adipic Acid Production for 1990 to 2005. The table shows that in 2005 adipic acid was produced in four MS only. Only Italy reports adipic acid production as activity data; for France, Germany and the UK this information is confidential. The implied emission factors per tonne of adipic acid produced is only provided by Italy with 0.3 t/t for 1990 and 0.26 t/t for 2005. With the exception of Italy the implied emission factors have been reduced substantially due to emission reduction measures. The table suggests that 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 from for 1990 and 2005

				1990				2005			
Member State	Method applied	Activity data	Emission factor	Activity data		Implied emission factor (t/t)	N_2O emissions (Gg)	Activity data		Implied emission factor (t/t)	N_2O emissions (Gg)
				Description	(kt)			Description	(kt)		
France	C	PS	PS	Adipic acid production	C	C	47.8	Adipic acid production	C	C	4.9
Germany	CS	PS	CS	Adipic acid production	C	C	60.7	Adipic acid production	C	C	10.6
Italy	D	PS	PS	Adipic acid production	49	0.30	14.8	Adipic acid production	75	0.26	19.6
UK	T2, T3	PS	CS	Adipic acid production	C	C	66.9	Adipic acid production	C	C	2.5
EU15				**EU15**			**190**	**EU15**			**38**

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	Emission data obtained from industry on plant level and verified with other declarations reported by the plant to other national authorities. Estimation method used by plant is provided. [NIR 2007]
Germany	Estimates are based on detailed plant-specific data since mid90ies, before emissions are calculated using nitric acid production and the IPCC default value [NIR 2007]
Italy	Production and emission data obtained from industry on plant level. IPCC default EF used until 2003 because no abatement technology was installed. The decrease of N2O emissions in 2004 and 2005 is the result of the application of the BAT to reduce emission in the only existing in Italy adipic acid production plant. The technology has been applied in trial for few months both in 2004 and in 2005. The technology of catalitic decomposition of N2O was fully operative from December 2005 and will reduce 100% of N2O emissions. [NIR 2006 and explanations in 2007]
UK	Production data and emission estimates have been estimated based on data provided by the process operator (Invista, 2006). 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. 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. A small nitric acid plant is associated with the adipic acid plant that also emits nitrous oxide. From 1994 onwards this emission is reported as nitric acid production but prior to 1994 it is included under adipic acid production. This will cause a variation in reported effective emission factor for these years. This allocation reflects the availability of data. [NIR 2007]

Table 4.31 summarizes the recommendations from 2005 UNFCCC inventory review in relation to the category 2B3 Adipic Acid Production. For France it has to be argued whether the review finding is correct and should be implemented as it would reduce transparency. UK did not include results from research programmes in the NIR. However, it is not the essential function of the NIR to communicate research results. Scientific publications maybe better suited for this purpose and countries should also strive to concentrate on the essential information in the NIR. The recommendations that are not implemented are not essential for the quality of the estimation.

Table 4.31 2B3 Adipic Acid Production: Findings of the 2005 UNFCCC inventory review in relation to CO_2 emissions and responses in 2007 inventory submissions

Member State	Review findings and responses related to 2B3 Adipic Acid Production	
	Comment UNFCCC inventory review report 2005	**Status in 2007 submission**
France	The ERT critizised France for having reported confidential AD expressed as an index instead of using the notation key C without any further information in order to increase transparency.	In the view of the compilers of this report France had chosen a transparent way to show changes in data when the absolute values are confidential. Fortunately France has kept the more transparent way of reporting in the NIR while the CRF uses correct notation keys. Portugal used a similar way of reporting confidential data for ammonia production and was commended for this in the review report.
Germany	Source category not addressed by review report 2005	No follow-up necessary
Italy	The ERT welcomed efforts to improve EFs and AD in the future by collecting more data from operators for the years 1990-2000.	No follow-up necessary.
UK	The ERT encouraged UK to reports results of a research programme on adipic acid production.	Additional methodological information, e.g. on abatement system provided, but no specific reference to research programme.

N_2O emissions from 2B5 Other account for 0.04 % of total EU-15 GHG emissions in 2005. Between 1990 and 2005, N_2O emissions from this source decreased by 62 % (Table 4.32). The Netherlands, France and Germany are responsible for 81 % of these emissions in the EU-15. Emission decreases in the Netherlands and France had the most influence on the reductions in the EU-15.

Table 4.32 2B5 Other: Member States' contributions to N_2O emissions in 1990, 2004 and 2005

Member State	N2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005	
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	NA,NE,NO	NA,NE,NO	NA,NE,NO	-	-	-	-	-
Belgium	372	278	344	19.0%	66	24%	-28	-8%
Denmark	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Finland	NE,NO	NE,NO	NE,NO	-	-	-	-	-
France	2,767	396	387	21.4%	-9	-2%	-2,380	-86%
Germany	298	365	365	20.2%	0	0%	66	22%
Greece	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Ireland	NO	NO	NO	-	-	-	-	-
Italy	11	0	0	0.0%	0	-	-11	-
Luxembourg	NO	NO	NO	-	-	-	-	-
Netherlands	1,240	759	705	39.0%	-53	-7%	-535	-43%
Portugal	0.0	0.1	0.1	0.0%	0	4%	0	118%
Spain	NE	NE	NE	-	-	-	-	-
Sweden	18	17	9	0.5%	-8	-47%	-9	-49%
United Kingdom	IE, NO	IE, NO	IE, NO	-	-	-	-	-
EU-15	**4,707**	**1,815**	**1,810**	**100.0%**	**-5**	**0%**	**-2,896**	**-62%**

Emissions of Finland are not estimated because of lack of emission factor.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.33 provides an overview of all sources reported under 2B5 Other Chemical Production by EU-15 Member States for the year 2005. The largest contributor to emissions is Germany with 61 %.

Table 4.33 2B5 Other: Overview of sources reported under this source category in 2005

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 Production, Other chemical industry, CO2 from nitric acid production	18.5	0.7	NA,NO	32.2	0.2%
Belgium	Caprolactam Production, Other chemical production	910.8	0.1	1.1	1,256.9	7.7%
Denmark	Catalysts/Fertilizers, Pesticides and Sulphuric acid	3.0	NA,NO	NA,NO	3.0	0.0%
Finland	Ethylene, Hydrogen, chemicals production	125.0	0.3	NO	131.9	0.8%
France	Glyoxylic acid production, Anhydrid Phtalic Production, Other chemical production	22.9	0.0	1.2	410.2	2.5%
Germany	Carbon black, Methanol, Caprolactam, N2O for Medical Using, Catalytic Burning, Conversion loss, N-Dodecandiacid	9,627.6	0.0	1.2	9,992.6	60.8%
Greece	Organic chemicals production	NA,NE,NO	0.0	NA,NO	0.7	0.0%
Italy	Carbon black, Ethylene, Titanium Dioxide Production, Propylene	610.2	0.3	NA,NO	617.3	3.8%
Netherlands	Carbon black, Ethylene, Styrene, Methanol, Graphite, Caprolactam, Other chemical industry, Carbon electrodes, Ethene oxide production	640.5	12.4	2.3	1,606.8	9.8%
Portugal	Carbon black, Ethylene, Ammonium sulphate, Monomere production, Production of explosives	126.5	0.5	0.0	138.1	0.8%
Spain	Carbon black, Ethylene, Styrene	NE	2.3	NE	48.0	0.3%
Sweden	Pharmaceutical industry, Other inorganic chemical production, Other organic chemical production, Base chemicals for plastic industry	NA	0.0	0.0	9.8	0.1%
UK	Ethylene, Chemical Industry (All), Carbon from NEU products	2,133.2	2.0	NO	2,175.5	13.2%
EU-15 Total		**14,218**	**19**	**6**	**16,423**	100.0%

Abbreviations explained in the Chapter 'Units and abbreviations'.

4.2.3 Metal production (CRF Source Category 2C)

Table 4.34 summarises information by Member State on total GHG emissions, CO_2, SF_6 and PFC emissions from Metal Production. Between 1990 and 2005, CO_2 emission from 2C Metal Production decreased by 11 %. The relative decrease was largest in Luxembourg, the relative growth was largest in Greece. This source category includes the following key sources: CO_2 from 2C1 Iron and Steel Production, PFC from 2C3 Aluminium Production

Table4.34 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 2005 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO_2 emissions in 2005 (Gg)	PFC emissions in 1990 (Gg CO2 equivalents)	PFC emissions in 2005 (Gg CO2 equivalents)	SF_6 emissions in 1990 (Gg CO2 equivalents)	SF_6 emissions in 2005 (Gg CO2 equivalents)
Austria	5,029	5,011	3,725	5,011	1,050	NO	253	NO
Belgium	1,946	1,576	1,946	1,535	NO	NO	NA,NO	NA,NO
Denmark	60	16	28	16	NA,NO	NA,NO	31	NO
Finland	1,864	2,403	1,859	2,394	NO	NO	NO	NO
France	8,550	5,011	4,638	3,871	3,032	699	880	439
Germany	52,449	45,868	49,767	43,506	2,489	338	189	2,023
Greece	740	918	482	846	258	72	NE, NO	NE, NO
Ireland	NO	NO	NO	NO	NO	NO	NO	NO
Italy	5,713	1,977	3,983	1,654	1,673	181	-	85
Luxembourg	962	246	962	246	NO	NO	NO	NO
Netherlands	5,155	1,779	2,909	1,692	2,246	87	NO	NO
Portugal	16	15	16	15	NE	NO	NE	NO
Spain	3,750	3,953	2,846	3,794	883	143	NE	NE
Sweden	2,877	2,910	2,413	2,516	440	293	24	100
United Kingdom	4,096	2,916	2,309	2,446	1,333	155	426	288
EU-15	**93,205**	**74,598**	**77,882**	**69,542**	**13,404**	**1,967**	**1,803**	**2,934**

SF_6 Emissions of Greece are not estimated because of lack of activity data.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.35 provides information on the contribution of Member States to EC recalculations in CO_2 from 2C Metal production for 1990 and 2004 and main explanations for the largest recalculations in absolute terms.

Table 4.35 2C Metal Production: Contribution of MS to EC recalculations in CO_2 for 1990 and 2004 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2004		Main explanations
	Gg	Percent	Gg	Percent	
Austria	0	0	32	1	Update fo Activity data (2004)
Belgium	0	0	3	0	
Denmark	0	0	0	0	
Finland	1	-	0	-	
France	152	3	402	10	correction of anode consumption (1990-2004)
Germany	55	0	6	0	updated activity data for ferroalloys
Greece	0	0	0	0	
Ireland	0	0	0	0	
Italy	0	0	0	0	
Luxembourg	0	0	0	0	
Netherlands	0	0	0	0	
Portugal	-14	-47	-20	-53	In order to avoid double counting emissions of ultimate CO2 in EAF do not consider the conversion of carbon bearing pollutants (NMVOC and CH4). It was latter realized that the carbon that is emitted in these compounds was already accounted in the procedures used to derive the emission factors (mass balance). This caused a reduction in emission estimates for all years in the time series. Also, in previous submission an error in the spreadsheets caused that emissions of CO2 were wrongly estimated for all years in the time series.
Spain	0	0	0	0	
Sweden	0	0	0	0	
UK	-1	0	-37	-2	Revisions to emissions associated with the iron and steel sector (2C1). Part of the iron and steel carbon balance.
EU-15	**193**	**0**	**386**	**1**	

Table 4.36 provides information on the contribution of Member States to EC recalculations in PFC from 2C3 Aluminium production for 1990 and 2004 and main explanations for the largest recalculations in absolute terms.

Table 4.36 2C3 Aluminium Production: Contribution of MS to EC recalculations in PFC for 1990 and 2004 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2004		Main explanations
	Gg	Percent	Gg	Percent	
Austria	0.0	0.0	0.0	0.0	
Belgium	NO	0.0	NO	0.0	
Denmark	0.0	0.0	0.0	0.0	
Finland	0.0	0.0	0.0	0.0	
France	0.0	0.0	0.0	0.0	
Germany	0.0	0.0	0.0	0.0	
Greece	0.0	0.0	0.0	0.0	
Ireland	0.0	0.0	0.0	0.0	
Italy	0.0	0.0	0.0	0.0	
Luxembourg	-	0.0	-	0.0	
Netherlands	0.0	0.0	0.0	0.0	
Portugal	NE	NE	NE	0.0	
Spain	0.0	0.0	0.0	0.0	
Sweden	0.0	0.0	23.0	8.7	CRF 2C3: Emissions of C2F6 and CF4 for 2004 were updated due to new information from the com-pany.
UK	0.0	0.0	0.0	0.0	
EU-15	**0.0**	**0.0**	**23.0**	**0.9**	

CO_2 emissions from 2C1 Iron and Steel Production account for 2% of total EU-15 GHG emissions in 2005. Between 1990 and 2005, CO_2 emissions from this source decreased by 11 % (Table 4.37). Germany is responsible for 67% of these emissions in the EU-15. Germany had the largest decreases in absolute terms between 1990 and 2005 while the largest increases were in Austria.

Table 4.37 2C1 Iron and Steel Production: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	3,546	4,446	4,995	7.8%	549	12%	1,449	41%	T2	NS,PS	CS,D
Belgium	1,946	1,655	1,535	2.4%	-120	-7%	-411	-21%	CS	PS	CS
Denmark	28	NA,NO	16	-	16	-	-13	-45%	T1	NS	D
Finland	1,859	2,551	2,394	3.7%	-158	-6%	535	29%	CS	PS	PS
France	4,104	3,728	3,227	5.0%	-500	-13%	-877	-21%	C	AS/ NS	CS
Germany	48,326	44,296	42,621	66.6%	-1,676	-4%	-5,705	-12%	T2	NS/AS	CS
Greece	203	476	511	0.8%	35	7%	308	152%	T2	NS	CS
Ireland	NO	NO	NO	-	-	-	-	-	-	-	-
Italy	3,124	1,179	1,221	1.9%	43	4%	-1,903	-61%	D	NS	C, CS, PS
Luxembourg	962	240	246	0.4%	5	2%	-716	-74%	C	-	PS
Netherlands	2,514	1,313	1,208	1.9%	-105	-8%	-1,306	-52%	T2	PS	CS
Portugal	13	15	12	0.0%	-3	-19%	-1	-6%	T2	PS	PS
Spain	1,825	1,879	2,176	3.4%	297	16%	351	19%	T2	PS; AS	CS, PS
Sweden	1,813	1,831	1,974	3.1%	143	8%	161	9%	T1, CS	PS	CS, PS
United Kingdom	1,859	1,498	1,879	2.9%	381	25%	20	1%	T2, T3	NS, AS	CS
EU-15	**72,122**	**65,108**	**64,015**	**100.0%**	**-1,093**	**-2%**	**-8,108**	**-11%**			

Table 4.38 shows information on activity data, emission factors for CO_2 emissions from 2C1 Iron and Steel Production for 1990 and 2005. 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 very different in different MS.

Table 4.38 2C1 Iron and Steel Production: Information on activity data, emission factors for CO_2 emissions for 1990 and 2005

Member State	1990 Activity data Description	1990 Activity data (kt)	1990 Implied emission factor (t/t)	1990 CO2 emissions (Gg)	2005 Activity data Description	2005 Activity data (kt)	2005 Implied emission factor (t/t)	2005 CO2 emissions (Gg)
Austria	**Iron and steel production**	**0**	**0.26**	**3546**	**Iron and steel production**	**0**	**0.31**	**4995**
	Steel Production [kt]	4291	0.11	484	Steel Production [kt]	7032	0.11	763
	Iron Production [kt]	3444	0.88	3043	Iron Production [kt]	5458	0.77	4186
	Sinter Production [kt]	4384	IE	IE	Sinter Production [kt]	3528	IE	IE
	Coke Production [kt]	1725	IE	IE	Coke Production [kt]	1	IE	IE
	Other	0	0.00	20	Other	0	0.00	45
Belgium	**Iron and steel production**	**0**	**0.06**	**1946**	**Iron and steel production**	**0**	**0.06**	**1535**
	Steel	7621	0.13	1019	Steel	6032	0.10	625
	Pig Iron	9415	0.06	546	Pig Iron	7186	0.09	641
	Sinter	13735	0.03	381	Sinter	11681	0.02	260
	Coke	IE	IE	IE	Coke	IE	NA	NA
	Other	0	0.00	NA	Other	0	0.00	9
Denmark	**Iron and steel production**	**0**	**0.05**	**28**	**Iron and steel production**	**0**	**0.06**	**16**
	Steel	614	0.05	28	Steel	250	0.06	16
	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	0	0.00	NA	Other	0	0.00	NA
Finland	**Iron and steel production**	**0**	**0.56**	**1859**	**Iron and steel production**	**0**	**0.43**	**2394**
	Steel	2861	0.65	1855	Steel	4738	0.50	2389
	Pig Iron	IE	IE	IE	Pig Iron	IE	IE	IE
	Sinter	IE	IE	IE	Sinter	IE	IE	IE
	Coke	487	0.00	1	Coke	894	0.00	1
	Other	0	0.00	3	Other	0	0.00	3
France	**Iron and steel production**	**0**	**0.12**	**4104**	**Iron and steel production**	**0**	**0.10**	**3227**
	kt Production	19073	0.09	1639	kt Production	19657	0.07	1440
	kt Production	14088	0.14	1972	kt Production	12705	0.11	1430
	kt Production	IE	IE	IE	kt Production	IE	IE	IE
	Coke	IE	IE	IE	Coke	IE	IE	IE
	Other	0	0.00	493	Other	0	0.00	357
	2.C.1.5.1 Rolling mills, blast furnace charging	16848	0.03	493	2.C.1.5.1 Rolling mills, blast furnace charging	18232	0.02	357
Germany	**Iron and steel production**	**0**	**0.32**	**48326**	**Iron and steel production**	**0**	**0.42**	**42621**
	Steel	87878	0.55	48326	Steel	44524	0.96	42621
	Pig Iron	32263	IE	IE	Pig Iron	28854	IE	IE
	Sinter	29869	IE	IE	Sinter	28480	IE	IE
	Coke	NE	NE	NE	Coke	NE	NE	NE
	Other	0	0.00	NO	Other	0	0.00	NO
Greece	**Iron and steel production**	**0**	**0.20**	**203**	**Iron and steel production**	**0**	**0.24**	**511**
	steel production in EAF	999	0.20	203	steel production in EAF	2113	0.24	511
	NO	NO	NO	NO	NO	NO	NO	NO
	NO	NO	NO	NO	NO	NO	NO	NO
	NO	NO	NO	NO	NO	NO	NO	NO
	Other	0	0.00	NO	Other	0	0.00	NO

	1990				2005			
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)		
Ireland	**Iron and steel production**	**0**	**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	0	0.00	NO	Other	0	0.00	NO
Italy	**Iron and steel production**	**0**	**0.05**	**3124**	**Iron and steel production**	**0**	**0.02**	**1221**
	Steel	25467	0.05	1346	Steel	29319	0.02	618
	Pig Iron	11852	0.15	1778	Pig Iron	11392	0.05	604
	Sinter	13577	NA	NA	Sinter	10427	NA	NA
	Coke	6356	NA	NA	Coke	4574	NA	NA
	Other	0	0.00	NA	Other	0	0.00	NA
Luxembourg	**Iron and steel production**	**0**	**0.09**	**962**	**Iron and steel production**	**0**	**0.11**	**246**
	Steel	3560	0.16	577	Steel	2194	0.11	246
	Pig Iron	2645	0.15	385	Pig Iron	NO	NA	NA
	Sinter	4804	IE	IE	Sinter	NO	NA	NA
	Coke	NO	NO	NO	Coke	NO	NO	NO
	Other	0	0.00	NE	Other	0	0.00	NE
Netherlands	**Iron and steel production**	**0**	**0.49**	**2514**	**Iron and steel production**	**0**	**0.17**	**1208**
	Crude steel production	5162	0.01	43	Crude steel production	6930	0.01	58
	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	0	0.00	2471	Other	0	0.00	1150
	Carbon input	2298	0.97	2223	Carbon input	2666	0.31	820
	Limestone equiv. use	595	0.42	249	Limestone equiv. use	718	0.46	331
Portugal	**Iron and steel production**	**0**	**0.02**	**13**	**Iron and steel production**	**0**	**11.87**	**12**
	Steel	316	0.04	11	Steel	1	11.87	12
	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	0	0.00	NO	Other	0	0.00	NO
Spain	**Iron and steel production**	**0**	**0.06**	**1825**	**Iron and steel production**	**0**	**0.07**	**2176**
	Steel production	13163	0.08	1041	Steel	17842	0.08	1389
	Pig iron production	5588	0.04	246	Pig Iron	4187	0.11	453
	Sinter production	7126	0.08	538	Sinter	5507	0.06	334
	Coke production	3211	IE	IE	Coke	3010	IE	IE
	Other	0	0.00	NA	Other	0	0.00	NA
Sweden	**Iron and steel production**	**0**	**0.40**	**1813**	**Iron and steel production**	**0**	**0.35**	**1974**
	Production of secondary steel	1743	0.08	147	Production of secondary steel	1802	0.10	178
	Production of primary iron	2845	0.59	1667	Production of primary iron	3849	0.47	1796
	Sinter	IE	IE	IE	Sinter	IE	IE	IE
	Coke	IE	IE	IE	Coke	IE	IE	IE
	Other	0	0.00	NA	Other	0	0.00	NA
UK	**Iron and steel production**	**0**	**0.08**	**1859**	**Iron and steel production**	**0**	**0.11**	**1879**
	Steel production (EAF) (kt)	4546	0.01	37	Steel production (EAF) (kt)	2685	0.01	20
	Pig iron production (BF) (kt)	12463	IE	IE	Pig iron production (BF) (kt)	10189	IE	IE
	Sinter	NA	IE	IE	Sinter	NA	IE	IE
	Coke consumed in blast furnaces (kt)	5180	IE	IE	Coke consumed in blast furnaces (kt)	4067	IE	IE
	Other	0	0.00	1822	Other	0	0.00	1859
	Blast furnace gas flared (PJ)	7	256.91	1805	Blast furnace gas flared (PJ)	8	237.48	1848
	Pig Iron Production (ISW)	12218	NA	NA	Steel Production (OC)	10550	0.00	12
	Steel Production (OC)	13169	0.00	17		NO	NO	NO

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 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 form 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 4.39.

Table 4.39 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 2005	Share 2C1
	1A2a	2C1	Combined		
	2005	2005	2005		
Austria	6 393	4 995	11 388	6.9%	44%
Belgium	9 470	1 535	11 005	6.6%	14%
Denmark	524	16	540	0.3%	3%
Finland	3 627	2 394	6 020	3.6%	40%
France	17 694	3 227	20 921	12.6%	15%
Germany	16 544	42 621	59 165	35.6%	72%
Greece	207	511	719	0.4%	71%
Ireland	2	NO	2	0.0%	NA
Italy	15 607	1 221	16 828	10.1%	7%
Luxembourg	252	246	498	0.3%	49%
Netherlands	4 538	1 208	5 746	3.5%	21%
Portugal	180	12	193	0.1%	6%
Spain	8 107	2 176	10 283	6.2%	21%
Sweden	1 186	1 974	3 160	1.9%	62%
United Kingdom	17 866	1 879	19 745	11.9%	10%
EU-15	**102 196**	**64 015**	**166 211**	**100.0%**	**39%**

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:

<u>Germany</u>: About three quarters 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.

<u>France</u>:Major share of emissions is reported under 2A1a. In the CRF tables emissions from sinter and coke are reported as IE, but in the CRF tables it is not specified where.

<u>United Kingdom:</u>Major share of emissions is reported under 2A1a. Emissions from pig iron, sinter and coke production are allocated in 2A1a instead of 2C1.

Italy: Major share of emissions is reported under 2A1a. 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 is 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 is reported under 2A1a. 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 is reported under 1A2a. Emissions from coke are included in the energy sector.

Table 4.40 summarises information by Member State on methods used for estimating CO_2 emissions from 2C1 Iron and Steel Production.

Table 4.40 2C1 Iron and Steel Production : Information on activity data and methods used for CO_2 emissions for 1990 and 2005

Member states	Description of methods
Austria	Total CO_2 emissions from the two main integrated iron and steel production sites in Austria are 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. 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 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	In Flanders, the calculation of the process CO_2 emissions from iron and steel production is based on the production figures of fluid steel and pig iron and on the consumption of electrodes of the only two industrial plants in this sector in Flanders and with an emission factor approved by these plants (% carbon blown off and an emission factor of 158 kg CO_2/ton pig iron). 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. The method used is the Tier 2 method. Since 2005, CO_2 emissions have been obtained directly by the reporting of the plants under the emission trading scheme.
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 (1996), 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

Member states	Description of methods
	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 iron and steel plants in Finland report to the ETS. From this submission, also GHG inventory will be using the total CO_2 emissions from ETS data, although the split between process and fuel based emissions will be done in the same way as in the previous calculation.
France	IPCC Tier 2 Data sources: Annual pollutant emission reports; French Iron Association.
Germany	Energy-related emissions are reported under 1A2. The method for determining energy related and process-related emissions is described in the Annex, Chapter 14.2.3.1. The emission factor for blown steel, for process-related CO_2 from reducing agents, takes account of process-related emissions from blast furnaces. Process-related CO_2 emissions from limestone use in pig-iron production are determined separately and reported together with emissions from oxygen-steel works (blown steel). CO_2 emissions from reducing agents are determined in keeping with Tier 2 of the IPPC Guidelines. In oxygen-steel works, the carbon dissolved in pig iron is driven out through the blowing process. Consequently, the emissions released during the blowing process do not have to be reported separately – all of the carbon in the reducing agents used in steel production is released into the atmosphere. The CO_2 emissions from electric steel production are added to process-related emissions; they are obtained by multiplying the standard emission factor for electrode combustion with the relevant amount of electrode burn-off.
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. CO_2 emissions from iron and steel production are calculated using a tier 2 methodology that is based on tracking carbon through the production process according to the equation (IPCC 2000). [NIR2006]
Ireland	NO
Italy	CO_2 emissions from the sector have been estimated on the basis of activity data published in the national statistical yearbooks (ISTAT, several years), reported in the framework of the European emission registry (EPER) and the European emission trading scheme, and supplied by industry (FEDERACCIAI, 2004) and emission factors reported in the EMEP/CORINAIR Guidebook (EMEP/CORINAIR, 2005), in sectoral studies (APAT, 2003; CTN/ACE, 2000) or supplied directly by industry (FEDERACCIAI, 2004). CO_2 emissions from iron and steel production refer to the carbonates used in the sinter plant and in basic oxygen furnaces to remove impurities and to the steel and pig iron scraps and graphite electrodes consumed in electric arc furnaces. The average emission factor in 1990 was equal to 0.15 t CO_2/t pig iron production, while in 2004 it reduced to 0.053 t CO_2/t pig iron production. Implied emission factors for steel reduced from 0.053 to 0.022 t CO_2/t steel production, from 1990 to 2004. The reductions are driven by the increase in the use of lime instead of carbonates in sinter, blast and basic oxygen furnaces in the Italian plants. CO_2 average emission factor in electric arc furnaces, equal to 0.035 t CO_2/t steel production, has been supplied by industry (FEDERACCIAI, 2004; APAT, 2003) and it has been calculated on the basis of equation 3.6B of the IPCC Good Practice Guidance (IPCC, 2000) taking into account the pig iron and steel scraps and graphite electrodes used in the furnace. 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. [NIR2006]
Luxembourg	The CORINAIR (simple) methodology is applied. Emissions were calculated from *Decarbonizing of iron ore during sintering, Basic oxygen furnace steel production, Electric arc furnace steel production and Blast furnace charging* using country or plant specific emission factors.
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). The same emission factors for blast furnace (BF) gas and oxygen furnace (OF) gas are used (see *Annex 2.*). 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. 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 (EUETS), 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	Emissions were calculated using IPCC Tier 2 method. The estimation of the CO_2 emissions for each of the processes mentioned above (steel, sinter and pig iron) has been inferred from the respective carbon mass balances in the corresponding input-output materials. The information on material flow was obtained form producers.
Sweden	Steel: The emissions include secondary steel plants using reducing agents such as coke, coal and electrodes in

Member states	Description of methods
	electric arc furnaces. 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. For the 2005 inventory, ETS data has been applied for five plants, but for the remaining plants direct contact was taken with the plants to collect data that was comparable with earlier years. 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: Another way to make the correct calculations of process emissions from blast furnaces, as Sweden has done, is to base the calculations on the consumed amount of blast furnace gas, as all emissions from the blast furnace are collected in this gas and emitted when combusting it. The amount of blast furnace gas is used in the cowpers as activity data when calculating all emissions. Emissions are calculated as the product of fuel consumption, thermal value and emission factors (EF) in the same way as in the Energy sector.
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 Briggs (2005).

Source: NIR 2007 unless stated otherwise

Table 4.41 summarizes the recommendations from 2005 UNFCCC inventory review in relation to the category 2C1 Iron and Steel Production. The overview shows that most recommendations were implemented.

Table 4.41 2C1 Iron and Steel Production : Findings of the 2005 UNFCCC inventory review in relation to CO_2 emissions and responses 2007 inventory submissions

Member State	Review findings and responses related to 2.C.1 Iron and Steel Production	
	Comment UNFCCC inventory review report 2005	**Status in 2007 submission**
Austria	The trend in IEF values for CO2 from Iron and Steel Production - Pig Iron is unstable and fluctuates. The ERT noted a change in the activity data source. The ERT encourages Austria to provide further information on this issue in its next NIR.	Austria reports that the consistency between the data sources was checked and that fluctuations in IEF might derive from the imperfect separation of total coke input in energy and non-energy use in the national energy balance and the use of other reducing agents that are not directly allocated.
Belgium	The ERT encourages Belgium to use industryrepresentative data for this key category. The distribution of CO2 emissions across different reporting categories is confusing. Belgium is also encouraged to use the IPCC good practice guidance for this key category.	Belgium has reevaluated this source and reports that Tier 2 methodology is used.
Denmark	No recommendation for improvement for this source category in 2005 review report.	No follow-up necessary
Finland	The ERT encourages Finland to split emissions arising from this category between Energy and Industrial Processes in its 2006 submission, as planned.	Resolved; Process specific emissions are reported in this category.
France	The ERT encourages France to review and document the methodology and the EF used in order to improve the transparency of the inventory in this category.	Not resolved; No further information is provided.
Germany	The ERT encourages Germany to split emissions arising from this category between Energy and Industrial Processes in its 2006 submission.	Resolved; Process specific emissions are reported in this category.
Greece	The ERT encourages to provide more detailed information on the AD used for the estimation and to allocate consumption of solid fuels to the specific activities in order to allow a check of the estimates reported under Industrial Processes and to ensure there is no double counting.	Not resolved; No further information is provided.
Ireland	The ERT encourages Ireland to include a description of the time-series consistency in the NIR and recommends estimating the emissions prior to 2001. If this is not possible Ireland should revise the use of the notation keys in the CRF.	Resolved; Iron and Steel Production is reported as NO in NIR2006.
Italy	The ERT welcomes the further investigation which is in progress on collecting sufficient information to apply the IPCC good practice guidance in reporting these emissions. It encourages the Party to provide more detailed explanations of the methodology used, the underlying assumptions, and the conversion factors, AD and EFs used in the NIR. It is also desirable to report the flowchart of the carbon cycle from the iron and steel industry in the NIR.	Resolved; a better description of the methodology is provided. Energy and carbon balance has been carried out as recommended by the ERT.
Luxembourg	not reviewed	
Netherlands	The ERT recommends that the Party give an explanation of AD and emission fluctuations and report in more detail on the impact of any increase in AD and decrease of CO2 emissions in its next NIR.	Not resolved; No further information is provided.
Portugal	No recommendation for improvement for this source category in 2005 review report.	No follow-up necessary
Spain	The ERT encourages Spain to be clearer in the NIR on allocation to give assurance that omission or double counting have been avoided between the Industrial Processes, Energy and Waste sectors.	Resolved; Spain provides a detailed explanation of the methodology used to calculate emissions from Iron and Steel Production in the NIR 2006.
Sweden	The ERT encourages Sweden to adopt the recommended tier 2 approach. In case the Party is unable to apply the tier 2 approach, it should at least provide, in its NIR, information on the source of AD and how the country-specific EF has been derived, as already recommended in previous review reports.	Sweden provides a detailed methodological description for steel and pig iron production.
UK	No recommendation for improvement for this source category in 2005 review report.	No follow-up necessary

Table 4.42 summarise information by Member State on emission trends, methodologies, activity data and emission factors for the key source PFCs from 2C3 Aluminium Production. PFC emissions from 2C3 Aluminium production account for 0.05 % of total EU-15 GHG emissions in 2004. Between 1990 and 2005, PFC emissions from this source decreased by 85 %. France, Germany and Sweden are responsible for 68 % of these emissions in the EU-15. All Member States reduced their emissions from this source between 1990 and 2005. France, the Netherlands and Germany had the largest decreases in absolute terms.

Table 4.42 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 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	1,050	NO	NO	-	-	-	-1,050	-100%	-	-	-
Belgium	NO	NO	NO	-	-	-	-	-	-	-	-
Denmark	NO	NO	NO	-	-	-	-	-	-	-	-
Finland	NO	NO	NO	-	-	-	-	-	-	-	-
France	3,032	1,239	699	35.5%	-540	-44%	-2,333	-77%	C	NS	PS
Germany	2,489	446	338	17.2%	-108	-24%	-2,152	-86%	T3	AS	CS
Greece	258	72	72	3.6%	0	0%	-186	-72%	T3b	PS	PS
Ireland	NO	NO	NO	-	-	-	-	-	-	-	-
Italy	1,673	157	181	9.2%	24	15%	-1,493	-89%	T1, T2	PS	PS
Luxembourg	NO	NO	NO	-	-	-	-	-	-	-	-
Netherlands	2,246	106	87	4.4%	-18	-17%	-2,159	-96%	T2	NS	PS
Portugal	NO	NO	NO	-	-	-	-	-	-	-	-
Spain	883	183	143	7.3%	-40	-22%	-740	-84%	T2	-	PS
Sweden	440	286	293	14.9%	7	2%	-147	-33%	T2	-	CS
United Kingdom	1,333	152	155	7.9%	2	1%	-1,178	-88%	T2, T3	NS	PS
EU-15	**13,404**	**2,641**	**1,967**	**100.0%**	**-674**	**-26%**	**-11,437**	**-85%**			

Table 4.43 shows information on activity data and emission factors for PFC emissions from 2C Metal Production for 1990 to 2005. The table shows that in 2005 aluminium production was reported by all MS as activity data; for some MS this information is confidential. The implied emission factors for CF_4 per tonne of aluminium produced vary for 2005 between 0.03 kg/t for the Netherlands and 0.38 kg/t for Sweden. The EU-15 IEF (excluding Greece and the UK) is 0.10 kg/t. The decrease of the IEF from 1990 to 2005 is mainly due to emission reduction measures that have been implemented. The implied emission factors for C_2F_6 per tonne of aluminium produced vary for 2005 between 0.00 kg/t for the Netherlands and Spain and 0.05 kg/t for France. The EU-15 IEF (excluding Greece and the UK) is 0.02 kg/t. The table suggests that for 2005 all reported emissions are estimated using higher tier methods (based on plant specific data). For 1990 Italy used a T1 approach to estimate emissions.

Table 4.43 2C Metal Production: Information on methods applied, activity data, emission factors for PFC emissions for 1990 and 2005

Member State	Method applied	Activity data	Emission factor	Gas	1990 Activity data Description	1990 Activity data (t)	1990 Implied emission factor (kg/t)	1990 Emissions (t)	2005 Activity data Description	2005 Activity data (t)	2005 Implied emission factor (kg/t)	2005 Emissions (t)
Austria	T3b	NS	PS	CF_4	Aluminium production	88021	1.56	137	Aluminium production	NO	NO	NO
				C_2F_6	Aluminium production	88021	0.19	17	Aluminium production	NO	NO	NO
France	C	NS	PS	CF_4	Aluminium production	325900	1.13	369	Aluminium production	442588	0.18	79
				C_2F_6	Aluminium production	325900	0.21	69	Aluminium production	442588	0.05	20
Germany	T3	AS	CS	CF_4	Aluminium production	740251	0.45	336	Aluminium production	645815	0.07	45
				C_2F_6	Aluminium production	740251	0.05	34	Aluminium production	645815	0.01	5
Greece	T3b	PS	PS	CF_4	Aluminium production	C	C	35	Aluminium production	C	C	10
				C_2F_6	Aluminium production	C	C	3	Aluminium production	C	C	1
Italy	T1, T2	PS	PS	CF_4	Aluminium production	231800	0.86	198	Aluminium production	195791	0.12	24
				C_2F_6	Aluminium production	231800	0.18	42	Aluminium production	195791	0.02	3
Netherlands	T2	NS	PS	CF_4	Aluminium production	272122	1.02	277	Aluminium production	333800	0.03	11
				C_2F_6	Aluminium production	272122	0.18	48	Aluminium production	333800	0.00	2
Spain	T2	Q	PS	CF_4	Aluminium production	355301	0.34	122	Aluminium production	397203	0.05	20
				C_2F_6	Aluminium production	355301	0.03	10	Aluminium production	397203	0.00	1
Sweden	T2	PS	CS	CF_4	Aluminium production	96300	0.61	59	Aluminium production	102520	0.38	39
				C_2F_6	Aluminium production	96300	0.07	7	Aluminium production	102520	0.04	4
UK	T2, T3	NS	PS	$CF_4 + C_2F_6$	Aluminium production	289796	IE	IE	Aluminium production	368477	IE	IE
					Aluminium production	289796	NE	NE	Aluminium production	368477	IE	IE
EU-15				**CF_4**	**EU-15 w/o GR,UK (98%)**	**2109695**	**0.71**	**1498**	**EU-15 w/o GR,UK (97%)**	**2117717**	**0.10**	**219**
				C_2F_6	**EU-15 w/o GR,UK (98%)**	**2109695**	**0.11**	**226**	**EU-15 w/o GR,UK (96%)**	**2117717**	**0.02**	**35**

Abbreviations explained in the Chapter ‘Units and abbreviations’.

Table 4.44 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	IPCC Tier 2
Germany	The production figures for the year 2005 were taken from the monitoring report by the aluminium industry for the year 2005. 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 foundries in the years 1996 and 2001 form the basis for calculation of CF_4 emissions. In this context, specific CF_4 emission factors per anode effect were calculated, in keeping with the technology used. The number of anode effects is recorded and documented in the foundries. The total CF_4 emissions in 2005 were calculated by multiplying the total anode effects by the specific CF_4 emissions per anode effect determined in 2005. The total emission factor for CF_4 is obtained by adding the CF_4 emissions of the five foundries and then dividing the sum by the total aluminium production of the foundries. C_2F_6 and CF_4 occur in a constant ratio of about 1:10. The above-described method was applied to the entire time series, and emissions for the years 1990 to 1996 were filled in via recalculations.

Member States	Description of methods
Greece	PFC emissions estimates are based on measurements data made by the aluminium industry according to the PESHINEY methodology (Tier 3b methodology, IPCC 2000). [NIR2006]
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 CF_4 and C_2F_6, have been calculated on the basis of the information provided by the national primary aluminium producer, with reference to the document drawn up by International Aluminium Institute (IAI, 2003) and the IPCC Good Practice Guidance (IPCC, 2000). The Tier 1 has been used to calculate PFC emissions relating to the entire period 1990-1999. As from the year 2000, the more accurate Tier 2 method has been followed, based on default technology specific slope and overvoltage coefficients. As concerns the Tier 1 methodology, the emission factors for CF_4 and C_2F_6 were provided, whereas for the Tier 2 site specific values and, where they were not available, default coefficients were provided. [NIR2006]
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 1990-2005. Emission factors are plant specific and are based on measured data.
Portugal	NO
Spain	From the information received a distinction is drawn by plants and the series of manufacturing method used (prebaked anodes with side or central worked and the vertical studs Söderberg process). Within each series, information was obtained on the number of anode effects per cell and day and the duration of the anode effect in minutes. Using this information, the emissions are estimated by application of the Tier 2 method referred to in the IPCC Good Practice Guidance.
Sweden	Calculations of emissions of PFCs (CF_4+C_2F_6) are made by the company, according to a formula from EAA (European Aluminium Association). Emissions of PFC in kg/Mg Al=K*Anode effects in min/oven day, where K=0.12 for Pre-baked and K=0.08 for Söderberg. The PFC emissions are assumed to consist of 90% CF4 and 10% C2F6.
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. However, in the near future they are looking to move to Tier 3b methodology, once on-site equipment is in place to make the relevant field measurements. 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. The methodology used for estimating emissions, based on IPCC Good Practice Guidance (2000), was 'Tier 2 Method – smelter-specific relationship between emissions and operating parameters based on default technology-based slope and over-voltage coefficients'. 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.

Source: NIR 2007 unless stated otherwise

Table 4.45 summarizes the recommendations from 2005 UNFCCC inventory review in relation to the category 2C3 Aluminium Production. The overview shows that some recommendations could be implemented.

Table 4.45 2C3 Aluminium Production: Findings of the 2005 UNFCCC inventory review in relation to PFC emissions and responses in 2007 inventory submissions

Member State	Review findings and responses related to 2.C.3 Aluminium Production	
	Comment UNFCCC inventory review report 2005	Status in 2007 submission
Austria	No recommendation for improvement for this source category in 2005 review report.	No follow-up necessary
Belgium	No recommendation for improvement for this source category in 2005 review report.	No follow-up necessary
Denmark	No recommendation for improvement for this source category in 2005 review report.	No follow-up necessary
Finland	No recommendation for improvement for this source category in 2005 review report.	No follow-up necessary
France	The ERT recommends that France provide more detailed information on the methodology and EFs used in the NIR.	France reports the information given during the 2005 review.
Germany	The ERT invites the Party to explain why the AD reported in the tables 2.(I).A-G (Aluminium Production) and 2.(II).C,E PFCs from Aluminium Production) are different.	Resolved; same AD are reported in the two tables.
Greece	Greece is encouraged to verify the emissions estimates. The fluctuation in the time series is clearly explained in the NIR.	No follow-up necessary
Ireland	No recommendation for improvement for this source category in 2005 review report.	No follow-up necessary
Italy	No recommendation for improvement for this source category in 2005 review report.	No follow-up necessary
Luxembourg	not reviewed	
Netherlands	The Party plans to carry out a recalculation for the sake of time-series consistency and will report it in its 2006 NIR. The ERT welcomes the efforts by the Netherlands to recalculate PFC emissions from aluminium production.	Resolved; PFC emissions have been recalculated.
Portugal	No recommendation for improvement for this source category in 2005 review report.	No follow-up necessary
Spain	The ERT encourages Spain to add the explanation for significant emission reduction of PFCs from aluminium production from 1990 to 2003 to the NIR.	Only the emission reduction 2000-2001 is described in the NIR, but there is no information included about the decrease 1990-2000.
Sweden	The ERT encourages Sweden to split production data, emissions and IEFs by type of technology (pre-baked and Soderberg) in order to improve transparency and comparability of the estimates.	Not resolved; No further information is provided.
UK	lThe ERT recommends that, for transparency, the United Kingdom report CF4 and C2F6 emissions separately in its next NIR. In its response to the review, the United Kingdom indicated that reasons of commercial confidentiality may prevent such detailed reporting.	Not resolved; No further information is provided.

Table 4.46 summarise information by Member State on emission trends and methodologies for the source category SF_6 from 2C Metal Production.

Table 4.46 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. Information about the amount of SF_6 used was obtained directly from the aluminium producers in Austria and thus represent 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.
Belgium	NO
Denmark	no activity on Magnesium Foundry exists any longer
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 2002, annual surveys have been conducted of sales figures relative to the application "aluminium casting". Magnesium production: The quantity of SF_6 used for magnesium-cast production (consumption = AR) is equated with emissions, in accordance with the revised IPCC Guidelines (IPPC, 1996a: 2.34). SF_6 consumption is determined via direct surveys of foundries aimed at determining annual consumption levels. This is a feasible approach, since there are not a great many foundries. The usage data obtained is cross-checked against gas sellers' sales figures for this sector (these figures are also obtained via surveys). The method outlined was applied for the report years 1995, 1997, 1998, 2000, 2001, 2002, 2003 and 2004. The

Member states	Description of methods
	missing annual data has been obtained by means of interpolation.
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 which operates the only magnesium foundry located in Italy (Magnesium products of Italy, 2005). The plant started its activity in September 1995. [NIR2006]
Luxembourg	NO
Netherlands	NO
Portugal	NO
Spain	NE
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.
United Kingdom	For magnesium alloy production, emissions from 1998-2004 were estimated based on the emission data reported by the company to the UK's Pollution Inventory. This data is 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). As this is obviously a key assumption that affects the level of reported emissions, this factor for HFC destruction will be kept under review and the possibility of obtaining a UK-specific factor will be investigated in the future. For the casting operations, emission estimates made in previous years (as documented in AEAT (2004)) used a previous model from the March (1999) study for the casting sector. In order to improve the quality of this data this estimate has been revised based on consultation with all of the casting operators. Each operator was asked to supply annual SF_6 usage data for 1990 – 2004 – all responded to this request. The data supplied has been aggregated with the magnesium alloy production sector, to produce a single estimate for the whole sector, thus avoiding disclosure of company specific data. Actual emissions of SF_6 and HFC134a for this sector are reported under 2C5 for practical reasons under 2C5 'Other metal production' as the CRF Reporter does not allow reporting of HFC emissions under the 2C4 sector category.

4.2.4 Production of halocarbons and SF_6 (CRF Source Category 2E)

Table 4.47 summarise information by Member State on emission trends for the key source HFCs from 2E Production of Halocarbons and SF_6.

Table 4.47 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 2005 (Gg CO_2 equivalents)	HFC emissions in 1990 (Gg CO_2 equivalents)	HFC emissions in 2005 (Gg CO_2 equivalents)
Austria	NA, NO	NA,NO	NA,NO	NA
Belgium	3,313	141	NO	NO
Denmark	0	0	NA,NO	NA,NO
Finland	0	0	NA,NO	NA,NO
France	4,691	1,264	3,635	639
Germany	4,409	516	4,329	516
Greece	935	2,551	935	2,551
Ireland	NA, NO	NA, NO	NA,NO	NA,NO
Italy	605	20	351	20
Luxembourg	0	0	NO	NO
Netherlands	4,432	235	4,432	235
Portugal	NE, NO	NE, NO	NE,NO	NA,NO
Spain	2,403	681	2,403	681
Sweden	0	0	NO	NA,NO
United Kingdom	11,385	451	11,374	341
EU-15	**32,172**	**5,859**	**27,459**	**4,983**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.48 provides information on the contribution of Member States to EC recalculations in HFC from 2E Production of Halocarbons for 1990 and 2004 and main explanations for the largest recalculaltions in absolute terms.

Table 4.48 2E Production of Halocarbons and SF_6: Contribution of MS to EC recalculations in HFC for 1990 and 2004 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2004		Main explanations
	Gg	Percent	Gg	Percent	
Austria	0.0	0.0	0.0	0.0	
Belgium	0.0	0.0	0.0	0.0	
Denmark	0.0	0.0	0.0	0.0	
Finland	0.0	0.0	0.0	0.0	
France	0.0	0.0	-17.0	-3.0	update of emissions declared in 2004
Germany	0.0	0.0	0.0	0.0	
Greece	0.0	0.0	0.0	0.0	
Ireland	0.0	0.0	0.0	0.0	
Italy	0.0	0.0	0.0	0.0	
Luxembourg	-	0.0	-	0.0	
Netherlands	0.0	0.0	0.0	0.0	
Portugal	NE	0.0	NE	0.0	
Spain	0.0	0.0	0.0	0.0	
Sweden	0.0	0.0	0.0	0.0	
UK	0.0	0.0	0.0	0.0	
EU-15	**0.0**	**0.0**	**-17.0**	**-0.3**	

HFC emissions from 2E Production of Halocarbons and SF_6 account for 0.1 % of total EU-15 GHG emissions in 2005. Between 1990 and 2005, HFC emissions from this source decreased by 82 %. Greece is responsible for 65 % of these emissions in the EU-15. Greece was the only Member State with emission increases from this source between 1990 and 2005 (Table 4.49).

Table 4.49 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 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	NA,NO	NA	NA	-	-	-	-	-	-	-	-
Belgium	NO	NO	NO	-	-	-	-	-	-	-	-
Denmark	NO	NO	NO	-	-	-	-	-	-	-	-
Finland	NO	NO	NO	-	-	-	-	-	-	-	-
France	1,663	427	474	12.2%	47	11%	-1,189	-72%	C	PS	PS
Germany	C,NA,NO	C,NA,NO	C,NA,NO	-	-	-	-	-	-	-	-
Greece	935	2,551	2,551	65.4%	0	0%	1,616	173%	T1	PS	D
Ireland	NO	NO	NO	-	-	-	-	-	-	-	-
Italy	351	4	4	0.1%	0	10%	-347	-99%	CS	PS	PS
Luxembourg	NO	NO	NO	-	-	-	-	-	-	-	-
Netherlands	4,432	354	196	5.0%	-158	-45%	-4,236	-96%	T2	-	PS
Portugal	NO	NO	NO	-	-	-	-	-	-	-	-
Spain	2,403	454	334	8.6%	-120	-26%	-2,069	-86%	T2	-	PS
Sweden	NO	NO	NA,NO	-	-	-	-	-	-	-	-
United Kingdom	11,374	283	341	8.7%	57	20%	-11,033	-97%	T2	NS	CS
EU-15	**21,158**	**4,073**	**3,899**	**100.0%**	**-174**	**-4%**	**-17,259**	**-82%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.50 shows information on methods used for HFC emissions from 2E Production of Halocarbons and SF_6 for 1990 tand 2005. For Production of Halocarbons 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.

Table 4.50 2E Production of Halocarbons and SF_6: Description of national methods used for estimating HFC emissions

Member States	Description of methods
Austria	NO
Belgium	NO
Denmark	NO
Finland	NO
France	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 (arrêté du 24 décembre

Member States	Description of methods
	2002 modifié).
Germany	By-product emissions: For the 1995 to 2003 report years, emissions of the latter producer 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. Da die HFCKW-Produktionsmenge nicht mitgeteilt wird, kann kein Emissionsfaktor bestimmt und mit dem IPCC Standard-Emissionsfaktor verglichen werden. Vom Hersteller werden nur die Emissionen des HFKW-23 mitgeteilt. Diese werden aggregiert berichtet mit den Emissionen aus der CRF-Unterquellgruppe 2.E.2, da sie vertraulich sind. Production related emissions: In Deutschland gibt es ein einziges Unternehmen, das an zwei Standorten HFKW (134a und 227ea) und SF_6 produziert. Die Emissionsentwicklung geht mit der Entwicklung der Produktionsmengen einher. Aus den gemeldeten Emissions- und Produktionsmengen kann ein Emissionsfaktor errechnet werden. Dieser wird aber auch aufgrund der Vertraulichkeit der Daten nicht veröffentlicht. Als einziger Hersteller von HFKW in Deutschland genießt das Unternehmen Vertrauensschutz. Die Emissions- und Produktionsmengen werden dem Umweltbundesamt gemeldet, aber nur aggregiert mit den Emissionen aus der CRF-Unterquellgruppe 2.E.1 berichtet.
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. [NIR2006]
Ireland	NO
Italy	For source category ”HFC-23 emissions from HCFC-22 manufacture”, the IPCC Tier 2 method is used, based on plant-level data communicated by the national producer (Solvay-Solexis, 2006); since 1996, data are adjusted for HCFC-22 destruction. Also for source category “Fugitive emissions”, emission estimates are based on plant-level data communicated by the national producer (Solvay-Solexis, 2006). [NIR2006]
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, based on (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 afterburner; *Handling activities (HFCs)* (2E3): Tier 1 country-specific methodologies are used to estimate the *handling* emissions of HFCs, 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.
Sweden	NO
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.

Source: NIR 2007 unless stated otherwise

Table 4.51 summarizes the recommendations from 2005 UNFCCC inventory review in relation to the category 2E Production of Halocarbons. The overview shows that some recommendations could be implemented.

Table 4.51 2E Production of Halocarbons and SF_6: Findings of the 2005 UNFCCC inventory review and responses in 2007 inventory submissions

Member State	Review findings and responses related to 2.E. Production of halocarbons and SF6	
	Comment UNFCCC inventory review report 2005	**Status in 2007 submission**
Austria	No recommendation for improvement for this source category in 2005 review report.	No follow-up necessary
Belgium	No recommendation for improvement for this source category in 2005 review report.	No follow-up necessary
Denmark	No recommendation for improvement for this source category in 2005 review report.	No follow-up necessary
Finland	No recommendation for improvement for this source category in 2005 review report.	No follow-up necessary
France	To improve the transparency of its reporting, the ERT recommends that France explains fluctuations of emissions and provide more information about the methodologies applied.	Not resolved; No further information is provided.
Germany	The ERT recommends that Germany validate the AD provided in 1997 and clarify the methods used to estimate emissions for the whole time series.	Not resolved; No further information is provided.
Greece	For confidentiality reasons, Greece reports only total emissions of HFC-23 and no AD are available in the NIR or the CRF. In the 2005 NIR Greece indicates that the emissions reported are based on production statistics and a reference EF rather than on the collection and elaboration of on-site measurement data, as recommended by the IPCC good practice guidance.	Not resolved; No further information is provided.
Ireland	No recommendation for improvement for this source category in 2005 review report.	No follow-up necessary
Italy	No recommendation for improvement for this source category in 2005 review report.	No follow-up necessary
Luxembourg	not reviewed	
Netherlands	No recommendation for improvement for this source category in 2005 review report.	No follow-up necessary
Portugal	No recommendation for improvement for this source category in 2005 review report.	No follow-up necessary
Spain	The ERT encourages Spain to add the explanation for the significant decline in HFC-23 emissions after 2001 to the NIR.	Resolved; An explanation is provided in the NIR 2006
Sweden	No recommendation for improvement for this source category in 2005 review report.	No follow-up necessary
UK	The ERT encourages the United Kingdom to include the explanation for the significant decrease in HFC after 1999 in the NIR of its next submission. The ERT encourages the United Kingdom to explain the significant increase in PFC emissions from the production of halocarbons from 1990 to 1996 (with the trend stabilizing after 1996) in its next NIR.	Resolved; The explanations are included.

4.2.5 Consumption of halocarbons and SF_6 (CRF Source Category 2F)

Table 4.52 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 4.52 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 2005 (Gg CO_2 equivalents)	HFC emissions in 1990 (Gg CO_2 equivalents)	HFC emissions in 2005 (Gg CO_2 equivalents)	SF_6 emissions in 1990 (Gg CO_2 equivalents)	SF_6 emissions in 2005 (Gg CO_2 equivalents)
Austria	301	1,316	23	912	249	287
Belgium	537	1,497	434	1,454	103	43
Denmark	13	841	NA,NE,NO	805	13	22
Finland	94	893	0	864	94	20
France	1,419	11,711	23	10,319	1,054	798
Germany	4,655	11,705	40	8,846	4,477	2,478
Greece	3	3,364	NA,NE,NO	3,360	3	4
Ireland	36	701	1	431	35	96
Italy	213	5,803	NO	5,247	213	375
Luxembourg	17	86	14	83	3	4
Netherlands	236	1,633	NO	1,118	217	337
Portugal	3	401	NE,NO	391	3	10
Spain	67	4,703	NA,NO	4,330	67	272
Sweden	87	822	4	777	84	43
United Kingdom	664	9,820	2	8,879	604	855
EU-15	**8,345**	**55,297**	**539**	**47,815**	**7,221**	**5,644**

Abbreviations explained in the Chapter 'Units and abbreviations'.

HFC emissions from 2F Consumption of Halocarbons and SF_6 account for 1.1 % of total EU-15 GHG emissions in 2005. HFC emissions in 2005 were 89 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, UK, Germany and Italy had the most significant absolute increases from this source between 1990 and 2005.

SF_6 emissions from 2F Consumption of Halocarbons and SF_6 account for 0.1 % of total EU-15 GHG emissions in 2005. Between 1990 and 2005, SF_6 emissions from this source decreased by 22 %. Germany, UK and France are responsible for 73 % of total EU-15 emissions from this source. In absolute terms, Germany had also the most significant decreases from this source between 1990 and 2005.

Table 4.53 provides information on the contribution of Member States to EC recalculations in HFC from 2F Consumption of Halocarbons for 1990 and 2004 and main explanations for the largest recalculations in absolute terms.

Table 4.53 2F Consumption of halocarbons: Contribution of MS to EC recalculations in HFC for 1990 and 2004 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2004		Main explanations
	Gg	Percent	Gg	Percent	
Austria	0.0	0.0	-4.8	-0.5	Update of activity Data (2004)
Belgium	0.0	0.0	-6.2	-0.4	The following changes have been made in the fluorinated gas inventory for the period 1995-2004: - The bulk potential emissions have been recalculated, using a revised approach (note that there is no impact for the years 1995-97). - Emissions from domestic refrigerators have been re-estimated for all years. - Disposal emissions of refrigeration 'installations' have been revised. - A certain number of minor mistakes or inconsistencies have been removed. All of them only have a marginal impact on the total emissions. - Rounding errors have been removed for all years.
Denmark	0.0	0.0	0.0	0.0	
Finland	0.0	-21.7	0.0	0.0	
France	-1.5	-6.2	-1,085.3	-9.9	update of inventory by EMP
Germany	0.0	-	-122.6	-1.5	correction of error, change of calculation method, updated activity data
Greece	0.0	0.0	0.0	0.0	
Ireland	0.0	-	-15.2	-3.8	Most of the changes relate to the methods and data used for the individual source categories of HFC, PFC and SF6. Specifically there was a inconsistency between the UK population data which is used in some cases to derive emission estimates for Ireland on the basis that Ireland and the UK have for example similar purchasing trends as is the case in recalculations in 2.F.4 Aerosols and 2.F.9 Other-sporting goods.
Italy	-	0.0	-1,184.2	-20.8	Update of data supplied by the national industry that elaborate consumption data of HFCs
Luxembourg	0.0	0.0	0.0	0.0	
Netherlands	0.0	0.0	38.0	3.7	2F9, some minor errors in the use of HFCs (activity data) were corrected for a number of years
Portugal	NE	0.0	-22.3	-6.2	Improvements in importation time series; Correction of time series of households with refrigeration equipments in Domestic Refrigeration subsector; Correction of disagregation by dimension of installations using HFC as Refrigeration Gas in Commercial Refrigeration; Correction of disagregation on the number of Transport Refrigeration registered vehicles, done by the Portuguese Authority on Vehicles (DGV); Correction on Foam Blowing calculations; Correction on Electric Equipment emission factors.
Spain	0.0	0.0	67.4	1.8	new information on the use of gases
Sweden	0.0	0.0	-3.8	-0.5	CRF 2.F.8: Adjustments of installed amounts for 2004 due to improved back-ground information
UK	0.0	0.3	74.4	0.9	Inclusion of emissions from UK Crown Dependencies (previously excluded).
EU-15	**-1.5**	**-0.3**	**-2,264.6**	**-4.8**	

Table 4.54 provides information on the contribution of Member States to EC recalculations in SF_6 from 2F Consumption of Halocarbons for 1990 and 2004 and main explanations for the largest recalculations in absolute terms.

Table 4.54 2F Consumption of halocarbons and SF_6: Contribution of MS to EC recalculations in SF_6 for 1990 and 2004 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2004		Main explanations
	Gg	Percent	Gg	Percent	
Austria	0.0	0.0	0.0	0.0	
Belgium	0.0	0.0	-14.7	-22.3	The following changes have been made in the fluorinated gas inventory for the period 1995-2004: - The bulk potential emissions have been recalculated, using a revised approach (note that there is no impact for the years 1995-97). - Emissions from domestic refrigerators have been re-estimated for all years. - Disposal emissions of refrigeration 'installations' have been revised. - A certain number of minor mistakes or inconsistencies have been removed. All of them only have a marginal impact on the total emissions. - Rounding errors have been removed for all years.
Denmark	0.0	0.0	0.0	0.0	
Finland	0.0	0.0	0.0	0.0	
France	0.1	0.0	88.6	12.0	update of emissions from 2F7
Germany	231.8	5.5	291.2	12.5	correction of error, change of calculation method, updated activity data
Greece	0.0	0.0	0.0	0.0	
Ireland	0.0	0.0	-2.9	-4.2	Most of the changes relate to the methods and data used for the individual source categories of HFC, PFC and SF6. Specifically there was a inconsistency between the UK population data which is used in some cases to derive emission estimates for Ireland on the basis that Ireland and the UK have for example similar purchasing trends as is the case in recalculations in 2.F.4 Aerosols and 2.F.9 Other-sporting goods.
Italy	0.0	0.0	-110.8	-21.8	SF6 imported by electrical industry have been added
Luxembourg	0.0	-0.1	0.0	-0.3	
Netherlands	0.0	0.0	0.0	0.0	
Portugal	1.1	-	4.9	141.4	Improvements in importation time series; Correction of time series of households with refrigeration equipments in Domestic Refrigeration subsector; Correction of disagregation by dimension of installations using HFC as Refrigeration Gas in Commercial Refrigeration; Correction of disagregation on the number of Transport Refrigeration registered vehicles, done by the Portuguese Authority on Vehicles (DGV); Correction on Foam Blowing calculations; Correction on Electric Equipment emission factors.
Spain	0.0	0.0	-1.1	-0.4	new information on the use of gases
Sweden	0.0	0.0	-1.4	-3.3	CRF 2.F.8: Adjustments of installed amounts for 2004 due to improved back-ground information
UK	0.0	0.0	0.8	0.1	
EU-15	**233.0**	**3.3**	**254.4**	**4.5**	

Table 4.55 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 73 % of HFC emissions in source category 2F4 Aerosols/Metered Dose Inhalers and 2F2 Foam Blowing account for 15 % and 6 % respectively.

Table 4.55 2F Consumption of Halocarbons and SF_6: Member States' sub-categories of HFC emissions for 2005 (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	**912**	591	243	28	44	2	NO	4	NO	NA,NO
Belgium	**1.454**	1.190	101	11	151	0	0	0	NO	0
Denmark	**805**	651	146	NO	9	NO	NO	NO	NA	NA,NO
Finland	**864**	777	9	C,NO	77	NO	NO	NE,NO	NO	0
France	**10.319**	6.208	520	111	3.203	265	NO	12	NO	NA,NO
Germany	**8.846**	7.492	716	7	613	C,NE,NO	NO	16	NO	2
Greece	**3.360**	3.360	NE	NE	NE	NE	NO	NE	NA	NO
Ireland	**431**	297	18	14	101	NO	NO	2	NO	NA,NO
Italy	**5.247**	4.686	234	80	240	NO	NO	7	NO	NA,NO
Luxembourg	**43**	34	6	NE	3	NE	NE	NE	NA	NO
Netherlands	**1.118**	958	NO	NO	NO	NO	NO	NO	NO	160
Portugal	**391**	313	59	19	0	NO	NO	NO	NO	NA,NO
Spain	**4.330**	2.595	125	1.452	158	NO	NO	NO	NO	NA
Sweden	**777**	655	87	6	29	NE	NO	NO	NA	NA,NO
UK	**8.879**	5.068	563	298	2.746	46	NA	IE	IE	158
EU-15	**47.775**	**34.874**	**2.828**	**2.025**	**7.374**	**313**	**0**	**41**	**0**	**319**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.56 and 4.57 show MS contribution to EU-15 HFC emissions from the two most important sub-sources 2F1 and 2F4 and summarise information by Member State on emission trends, methodologies, activity data and emission factors.

Table 4.56 2F1 Refrigeration and Air conditioning: Member States' contributions to HFC emissions and information on method applied, activity data and emission factor

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	2	525	591	1.7%	65	12%	589	33463%	CS	Q	CS
Belgium	74	1,107	1,190	3.4%	83	8%	1,117	1512%	T2, CS	AS, PS	CS
Denmark	NA,NE	596	651	1.9%	55	9%	651	-	M/CS	CS	M/CS
Finland	0	589	777	2.2%	189	32%	777	6169190%	T1a, T1b, T2	Q	D
France	NO	5,797	6,208	17.8%	411	7%	6,208	-	M	Q	CS/ D
Germany	NA,NE,NO	6,615	7,492	21.5%	877	13%	7,492	-	T2	Q/AS	CS/D
Greece	NO	3,159	3,360	9.6%	201	6%	3,360	-	T2a	Q, IS	D
Ireland	IE,NO	259	297	0.9%	37	14%	297	-	T2	PS, NS	D, CS
Italy	NO	4,001	4,686	13.4%	684	17%	4,686	-	T2	AS	CS
Luxembourg	6	34	34	0.1%	0	0%	28	445%	CS	-	CS
Netherlands	NO	851	958	2.7%	107	13%	958	-	T2	Q	CS
Portugal	NE,NO	260	313	0.9%	53	20%	313	-	T2	NS,PS	D,CS
Spain	NO	2,277	2,595	7.4%	317	14%	2,595	-	T1, T2	AS, Q	D
Sweden	3	597	655	1.9%	58	10%	652	25634%	T2, CS	CS, PS, NS	D, CS
UK	IE,NO	5,089	5,068	14.5%	-20	0%	5,068	-	T3	NS	CS
EU-15	**84**	**31,758**	**34,874**	**100.0%**	**3,117**	**10%**	**34,790**	**41207%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

In 2005, HFC emissions from 2F1 were more than 400 times higher than in 1990. Germany, France, UK and Italy are responsible for 67 % of total EU-15 emissions from this source. Between 2004 and 2005 EU-15 emissions increased by 10 %. The only country in which emissions decreased between these years was UK (Table 4.56).

Table 4.57 2F4 Foam Blowing: Member States' contributions to HFC emissions and information on method applied, activity data and emission factor

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	19	47	44	0.6%	-4	-8%	25	131%	CS	Q	D
Belgium	35	137	151	2.1%	14	11%	116	329%	T2, CS	AS, PS	CS
Denmark	NA,NE	9	9	0.1%	-	-	9	-	M/CS	CS	M/CS
Finland	NA,NO	61	77	1.0%	16	27%	77	-	T1, T2	-	D
France	NE,NO	3,178	3,203	43.4%	25	1%	3,203	-	C/ T2	AS	CS
Germany	NO	603	613	8.3%	10	2%	613	-	CS	Q/AS	CS/D
Greece	NE	NE	NE	-	-	-	-	-	-	-	-
Ireland	0	96	101	1.4%	5	6%	101	1568449%	T1, T2, T3	-	CS
Italy	NO	215	240	3.3%	25	12%	240	-	T2	AS	CS
Luxembourg	0	3	3	0.0%	0	0%	3	68325%	CS	-	CS
Netherlands	NO	NO	NO	-	-	-	-	-	-	-	-
Portugal	NE	0.2	0.2	0.0%	0	0%	0	-	RA	NS	CS
Spain	NO	180	158	2.1%	-22	-12%	158	-	T1, T2, D	-	D
Sweden	1	30	29	0.4%	-1	-2%	28	2136%	CS,T1,T2	-	CS,D,PS
UK	2	2,586	2,746	37.2%	160	6%	2,745	165038%	T2, T3	NS	CS
EU-15	**57**	**7,143**	**7,374**	**100.0%**	**231**	**3%**	**7,317**	**12818%**			

In 2005, HFC emissions from 2F4 were more than 100 times higher than in 1990. France and UK are responsible for 81 % of total EU-15 emissions from this source. Between 2004 and 2005 EU-15 emissions increased by 3 %. In Spain, Austria and Sweden emissions decreased between these years (Table 4.57).

Table 4.58 provide descriptions on methods used for estimating HFC, PFC and SF_6 emissions from 2F Consumption of Halocarbons and SF_6.

Table 4.58 2F Consumption of halocarbons and SF_6: General description of national methods used for estimating emissions

Member States	**Description of methods**
Austria	A study has been contracted out to determine the consumption data and emissions from 1990-2000 for all uses

Member States	Description of methods
	of FCs (BICHLER ET AL. 2001). 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 study also included projections until 2010, these were used to estimate emissions from 2001-2005 for the subcategories *2 F 1 Refrigeration and Air conditioning equipment*, *2 F 3 Fire Extinguishers* and *2 F 9 Other sources of* SF_6. For the sub-categories *2 F 7 Semiconductor Manufacture* and *2 F 8 Electrical Equipment* data for these years were available due to the Austrian reporting obligation (see below). 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. 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.
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.
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 (1996), vol. 3, p. 2.43ff) as well as the relevant decision trees from the IPCC Good Practice Guidance (GPG, IPCC (1999) 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. 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.
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
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 cover only a part of the materials/equipments mentioned above. Specifically: (a) only HFC emissions from refrigerating and air conditioning (including mobile air conditioning) equipment are included, which, however, are considered to represent the basic source of the respective emissions (b) emissions from the use of SF_6 in electrical equipment. [NIR2006]
Ireland	In 2000, the EPA commissioned special studies on HFC, PFC and SF_6 emissions, led by the Clean Technology Centre (CTC) at Cork Institute of Technology that were designed to identify the important sources in Ireland and to quantify the emissions in 1998 on the basis of separate bottom-up and top-down methodologies. The reports on these studies (O'Doherty and McCulloch, 2002 and O'Leary et al, 2002) describe a very comprehensive investigation into the emissions of fluorinated gases in Ireland and the bottom-up method provided a readily applicable approach that could be used for developing inventories of these gases for other years. The bottom-up approach took full account of the available IPCC methodologies and IPCC good practice guidance in developing the 1998 emissions estimates for HFC, PFC and SF_6. Tier 2 methods were used for estimating the emissions from the majority of sources that have non-zero emissions. The actual and potential emissions in 1998 were compiled in the CRF tables, with table modifications where necessary to facilitate transparent reporting of the country-specific data. The methodological approach adopted in the special study for 1998 was subsequently used in early 2002, again under contract with CTC (O'Leary, 2002), to compile emissions estimates for HFC, PFC and SF_6 for the timeseries 1995 through 2000, which were incorporated in the recalculated inventories submitted in 2002. Estimates were also compiled to the extent possible at that time for 1990, but data were difficult to obtain and it was clear that the use of many of the substances had not become established in the country by then. The focus in this particular follow-up study was on the years from 1995 to 2000, in the knowledge that 1995 could be selected as the base year for emissions of fluorinated gases. The inventory agency subsequently continued reporting for the years up to 2003, based broadly on the CTC approach used for the 1995-2000 time-series.The inventory agency subsequently continued reporting for the years up to 2003, based broadly on the CTC approach

Member States	Description of methods
	used for the 1995-2000 time-series.
Italy	Methodology used is IPCC Tier 2a, except for SF_6 emissions from electrical equipment (2F7), where it is IPCC Tier 3c. [NIR2006]
Luxembourg	A first estimation of the emissions of fluorinated GHG types (HFCs, PFCs and SF_6) was done end of 1999 by the Environment Agency of Luxembourg and Luxembourg's *Centre de Ressources des Technologies pour l'Environnement* (*CRTE*). The data in Table 99 should be seen as first estimates since they have not been done using activity data and emission factors, but using other methods, like for example deriving data for Luxembourg on the basis of statistical data of other European countries and comparing the population sizes of Luxembourg and of those countries. Neither PFCs applications nor PFCs emission sources have been found in Luxembourg so far. For the inventories, it has been assumed that the estimates of 1995 in Table 99 can be included in the emission inventories of the years 1990 through 1999, and the estimates of 2000 can be used for the inventories from 2000 through 2004.
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 air-conditioning, aerosols* and *Semiconductor manufacturing*. The country-specific methods for the sources *Electrical equipment, Sound-proof windows and Electron microscopes* are equivalent to IPCC Tier 2 methods.
Portugal	For those sources for which sufficient data was available, actual emissions where estimated with a Tier 2 (advanced or actual method) approach which is considered Good Practice in accordance with GPG. As a general rule bottom-up methodologies were used, and in fact overall methodology should be classified as Tier 2a. This approach departs from the knowledge of the number of equipments using HFC 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.
Spain	IPCC Tier 2; following closely the IPCC Guidelines and GPG.
Sweden	In estimating the actual emissions, as far as possible, a Tier 2 approach has been used. 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.
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. [NIR2006]

Source: NIR 2007 unless stated otherwise

Table 4.59 provide descriptions on methods used for estimating HFC emissions from 2F1 Refrigeration and Air-Conditioning Equipment.

Table 4.59 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 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.
Belgium	See also General description of national methods used for estimating emissions from Consumption of halocarbons and SF_6. For the refrigeration sector, 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. The refrigerant consumption and emissions of the transportation sector are estimated by modelling the number of vehicles and the penetration of air conditioning or refrigerated transport, by category of vehicles.
Denmark	See General description of national methods used for estimating emissions from Consumption of halocarbons and SF_6.
Finland	Refrigeration and air conditioning (CRF 2.F.1) Top-down Tier 2, Tier 1a, Tier 1b Tier 2 top-down method is used for all sources in this category, both stationary and mobile. Data is not collected for separate sub-categories because such statistics are either not available or the preparation of such statistics would entail a very high reporting burden on companies, given that such a task would be taken seriously. 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. The total emissions for each sub- source category, and for each refrigerant, consist of the sub-emissions in the areas of production, usage and disposal. Emissions in these areas are determined separately. Disposal emissions occurred for the first time in 2003. For calculation of HFC emissions from the sub-categories of refrigeration and stationary airconditioning systems, individual data is collected/estimated, or refrigerant models used, for each group in question. The total emissions for vehicle air-conditioning systems, for each vehicle model and each refrigerant, comprise

Member States	Description of methods
	sub-emissions in the areas of production, usage and disposal. Emissions in these areas are determined separately. Since the 2002 report year, less relevant sources (such as agricultural machinery) have been included for the first time. In another change, carried out for the first time in this report year, only ships sailing under German flags – rather than all German ships – have been taken into account. The resulting changes are marginal, however.
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. Data sources: • Market survey • EUROSTAT data • Official data on new vehicles [NIR2006]
Ireland	See General description of national methods used for estimating emissions from Consumption of halocarbons and SF_6.
Italy	Refrigeration and air-conditioning: IPCC Tier 2a Basic data have been supplied by industry: specifically, for the air conditioning equipment the national motor company and the agent's union of foreign motor-cars vehicles has provided the yearly consumptions (FIAT, 2006; IVECO, 2006; UNRAE, 2006; CNH, 2006) [NIR2006]
Luxembourg	See General description of national methods used for estimating emissions from Consumption of halocarbons and SF_6.
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 air-conditioning, aerosols* and *Semiconductor manufacturing*.
Portugal	CFC, HCFC and HFC emissions from operation and disposal of Domestic Refrigeration Equipments, 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 2 or actual method) as proposed in chapter 3.7.4 of the GPG.
Spain	With respect to refrigeration and air conditioning, information has been supplied for certain years by the business associations for this sector. These data have been extrapolated for recent years by the inventory working party with the help of information on evolution proxies taken from the automobile industry. For the national production of motor vehicles, the emission factors are those derived from the data obtained in questionnaires from the manufacturing plants, and are taken from the IPCC Guidelines for the other sub-sectors.
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).
United Kingdom	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 refrigeration sub-sectors, emissions for these sectors were based on the activity data supplied by industry and used in previous emission estimates by March (1999) and WS Atkins (2000). Consultation with a range of stakeholders was used to determine appropriate country-specific emission factors; these generally fell within the ranges given in IPCC guidance (IPCC 2000).

Source: NIR 2007 unless stated otherwise

Table 4.60 summarises 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.

Table 4. 60 2F9 Other: Member States' contributions to SF_6 emissions and information on method applied, activity data and emission factor

Member State	SF_6 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	127	100	82	2.7%	-18	-18%	-45	-35%	CS	Q	CS
Belgium	84	41	32	1.1%	-8	-20%	-51	-61%	T2, CS	AS, PS	CS
Denmark	12	23	9	0.3%	-14	-60%	-3	-23%	M/CS	CS	M/CS
Finland	8	14	16	0.5%	2	15%	8	100%	T1, T2	Q	D
France	114	NO	NO	-	-	-	-114	-	-	-	-
Germany	3,354	1,614	1,636	54.7%	21	1%	-1,719	-51%	CS	-	CS
Greece	NO	NO	NO	-	-	-	-	-	-	-	-
Ireland	13	13	7	0.2%	-6	-47%	-7	-49%	T2	PS, NS	D, CS
Italy	NO	NO	NO	-	-	-	-	-	-	-	-
Luxembourg	2	3	3	0.1%	0	10%	0	21%	CS	-	CS
Netherlands	217	328	337	11.3%	9	3%	120	55%	CS, T2	AS	D, PS
Portugal	NE	NO	NO	-	-	-	-	-	-	-	-
Spain	NA	NA	NA	-	-	-	-	-	-	-	-
Sweden	2	12	14	0.5%	3	24%	12	483%	CS	CS	CS, D, PS
United Kingdom	604	740	855	28.6%	115	16%	251	42%	T3	AS, Q	CS
EU-15	**4,538**	**2,888**	**2,991**	**100.0%**	**104**	**4%**	**-1,546**	**-34%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.61 provide descriptions on methods used for estimating SF_6 emissions from 2F Consumption of Halocarbons and SF_6.

Table 4.61 2F 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. Consumption data is not reported in the CRF as it is treated confidential. 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. Electrical Equipment: Information on SF_6 stocks in electrical equipment in 2003-2005 were obtained from energy suppliers and industrial facilities SF_6 emissions were calculated based on the assumption that there are no emissions during first filling on site (furthermore, smaller equipment is already filled during manufacture); based on information from experts from industry, it was thus estimated that emissions during service and leakage are 1% of annual stocks. Noise insulating windows: Activity data were estimated based upon information from experts from industry. The actual emissions are the sum of emissions during production and leakage, which is estimated to be 1% of the original SF_6 filling. Tyres: Information on the amount of SF_6 used for filling tyres was obtained from SF_6 retailers. Emissions were calculated as one third per year for the three years following consumption. Shoes: Emissions from the imported amount of shoes with SF_6 filling was obtained from the producer. It was assumed that all SF_6 is emitted at the end of the lifetime of these shoes, which was estimated to be 3 years. Research: SF_6 is used in research in electron microscope and other equipment, the annual consumption was estimated to be 100 kg per year until the total estimated stock of 500 kg was reached (1996), emissions are estimated to be 20 kg per year (after 1996 consumption = emissions).
Belgium	See also General description of national methods used for estimating emissions from Consumption of halocarbons and SF_6. The SF_6 emissions originate from the production and the stock of soundproof double-glazing and to a minor extent from the electricity sector.
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.
France	IPCC Tier 2. Fabrication de semi-conducteurs (2F6) : 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 (2F7) : 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.

Member States	Description of methods
Germany	Semiconductor manufacture: In keeping with a standardised calculation formula (Tier 2c approach), the emissions data is calculated for each production site, from annual consumption, aggregated and then reported by the German Electrical and Electronic Manufacturers Association (Zentralverband Elektrotechnik- und Elektroindustrie e.V. - ZVEI, electronic components and systems) to the Federal Environmental Agency. The basic data for calculation, the emissions data, is not publicly accessible, but it may be inspected for review purposes. Since only emissions – and not the underlying consumption – are reported, no IEF can be provided/calculated. Electrical equipment: Die Emissionsangaben basieren im Wesentlichen auf einer Massenbilanz und nicht auf der Berechnung aus EF und AR. Die Emissionsrate wird seit 1998 mit konstanten 0,1 % angesetzt, da seit Mitte der 90er Jahre praktisch nur noch Anlagen zum inländischen Bestand gelangen, die nicht nur als "closed for life", sondern als "sealed for life" gelten. Ältere Anlagen mit Emissionsraten höher als 0,1 % verlieren dadurch an Gewicht. Noise insulating windows: Die Emissionen werden analog den Gleichungen 3.24 – 3.26 der IPCC-GPG (2000) mittels des Inlandsneuverbrauchs, des mittleren Jahresbestands und des Restbestands vor 25 Jahren berechnet. Tyres and Shoes: Zur Berechnung der Emissionen wird die Gleichung 3.23 des IPCC-GPG (2000) angewendet.
Greece	Electrical equipment The available information is not sufficient in order to apply the methodologies suggested by the IPCC Good Practice Guidance. CS: emissions are estimated on the basis of information provided by PPC regarding losses in the transmission and in the distribution system. [NIR2006]
Ireland	See also General description of national methods used for estimating emissions from Consumption of halocarbons and SF_6.
Italy	SF_6 emissions from electrical equipment have been estimated according to the IPCC Tier 2a approach from 1990 to 1994, and IPCC Tier 3b 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, 2006). Additional data on SF_6 used in high voltage gas-insulated transmission lines have been supplied by the main energy distribution companies. 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 Solexis, 2006). [NIR2006]
Luxembourg	See also General description of national methods used for estimating emissions from Consumption of halocarbons and SF_6.
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* and *Semiconductor manufacturing*. The country-specific methods for the sources *Electrical equipment, Sound-proof windows and Electron microscopes* are equivalent to IPCC Tier 2 methods.
Portugal	Actual emissions of SF_6 from electrical equipment were estimated with a tier T3b, based on data from utilities, but without the details in life-cycle and using a country-specific emission factor.
Spain	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). 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 + ER donde: 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	In 2001-2002, a questionnaire was sent out to power companies from the trade association Swedenergy (Svensk Energi) asking for the installed amounts of SF_6 in operating equipment, and the replaced amounts of SF_6 during service. The results of the questionnaire 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	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

Member States	Description of methods
	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 2007 unless stated otherwise

Table 4.62 summarizes the recommendations from 2005 UNFCCC inventory review in relation to the category 2F Consumption of Halocarbons. The overview shows that several recommendations have been implemented.

Table 4.62 2F Consumption of halocarbons and SF_6: Findings of the 2005 UNFCCC inventory review in relation and responses in 2007 inventory submissions

Member State	Review findings and responses related to 2.F. Consumption of halocarbons and SF6	
	Comment UNFCCC inventory review report 2005	Status in 2007 submission
Austria	The ERT recommends that the Party include in its future inventories explanations regarding the introduction of the use of HFC-134a for the production of hard foam in 2000. The ERT encourages the Party to include information in its future inventories regarding the quadrupling of the air purification capacity in semiconductor manufacture, and to provide the necessary supporting information regarding the control of emissions in order to explain the trends.	These explanations are included.
Belgium	The ERT encourages Belgium to provide methodological information in its future submissions, in accordance with the Revised 1996 IPCC Guidelines and the IPCC good practice guidanceand to apply the IPCC good practice guidance for this source.	Some methodological issues have been included for this source; nevertheless a more detailed description of the assumptions made for modelling consumptions and emissions would be desirable.
Denmark	The ERT encourages Denmark to provide more information on the choice of EFs and the specific modelling approaches applied.	Denmark states that: Emission factors are primarily defaults from GPG, which are assessed to be applicable in a national context. In case of commercial refrigerants and Mobile Air Condition (MAC), national emission factors are defined and used. These are still not further described.
Finland	The ERT recommends that Finland further investigate the reasons for inter-annual fluctuations of HFC and PFC emissions from Refrigeration and air conditioning equipment and explain them in its next NIR. To increase the transparency of the reporting and to ensure time-series consistency, the ERT encourages Finland to provide the results of the comparison of the different methods used in its next NIR.	No further explanation for the inter-annual fluctuations is provided. Finland describes the results from this comparison.
France	The ERT encourages France to estimate the total potential emissions of halocarbons (by chemical) and SF6 for all years.	Resolved; Potential emissions are reported.
Germany	The ERT encourages Germany to ensure time-series consistency for the source Other – Soundproof Glazing.	Resolved; Germany reports plausibility control in NIR
Greece	Emissions are estimated according to the tier 2a methodology described in the IPCC good practice guidance. However, the NIR states that Greece is unable to estimate potential emissions (tier 1 methodology) for consumption of halocarbons and SF6. Potential emissions are reported as not estimated “NE”. For all other sources, emissions are reported as “NE”.	Not resolved; Potential emissions are not reported.
Ireland	The ERT encourages Ireland to detail the methodology used to estimate emissions for Semiconductor Manufacture and to take the abatement technology into account in its calculations of emissions. The ERT recommends the Party to review its use of the notation keys for the whole time series and to investigate the possibility of estimating emissions between 1990 and 1994. The ERT encourages Ireland to present in its NIR the actual-to-potential ratios of subsector Refrigeration and Air Conditioning Equipment along with a description of the factors that influence variations in these ratios.	Ireland has again examined, on a contract basis, the known sources of HFC, PFC and SF6 emissions over an extended time period (1990-2004). No further description is given in the NIR on methodologies or time series descriptions; instead Ireland refers to a supplementary document (Adams et al, 2005)
Italy	No recommendation for improvement for this source category in 2005 review report.	No follow-up necessary
Luxembourg	not reviewed	
Netherlands	No recommendation for improvement for this source category in 2005 review report.	No follow-up necessary
Portugal	Several emission sources are not yet included in this category – Aerosols, Solvents, Fire Protection, and Potential Emissions of HFCs, PFCs and SF6. The ERT encourages Portugal to estimate these emissions.	Portugal reports that emissions from Aerosols and Solvents are still not included in the inventory.
Spain	Information on the consumption of halocarbons and SF6 in semiconductor manufacturing is currently lacking. The methodology used for Refrigeration and Air Conditioning seems to be mainly based on a complex extrapolation from previous years and should be described more clearly.	Emissions from semiconductor manufacturing are reported as not occurring in the CRF. The methodology used for Refrigeration and Air Conditioning is described more clearly in the NIR 2006.
Sweden	Actual emissions are estimated for all categories except solvents, as shown in table 2(II)s1; in the line corresponding to solvents, the Party should use the notation key “NE” rather than “NO” (not occurring). Complete data for potential emissions has been submitted only for 1995–2003.	Emissions from solvents are now reported as NE.
UK	No recommendation for improvement for this source category in 2005 review report.	No follow-up necessary

4.2 Methodological issues and uncertainties

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 4.63 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 2B and the lowest for CO_2 from 2A1. With regard to trend SF_6 from 2C shows the highest uncertainty estimates, CO_2 from 2A2 the lowest. For a description of the Tier 1 uncertainty analysis carried out for the EU-15 see Chapter 1.7.

Table 4.63 Sector 2 Industrial processes: Uncertainty estimates for the EU-15

Source category	Gas	Emissions 1990	Emissions 2005 1)	Emission trends 1990-2005	Emissions for which MS uncertainty estimates are available 2)	Share of emissions for which MS uncertainty estimates are available	Level uncertainty estimates based on MS uncertainty estimates	Trend uncertainty estimates based on MS uncertainty estimates
2.A.1 Cement production	CO_2	79,905	84,168	5%	88,000	105%	4%	1
2.A.2 Lime production	CO_2	17,336	17,795	3%	13,141	74%	18%	3
2.A.3 Limestone and dolomite use	CO_2	5,932	7,424	25%	6,874	93%	11%	2
2.A.4 Soda ash production and use	CO_2	1,551	1,844	19%	768	42%	15%	3
2.A.7 Other	CO_2	4,427	4,561	3%	2,951	65%	13%	5
2.B Chemical industry	CO_2	28,572	31,240	9%	18,950	61%	8%	3
2.C Metal production	CO_2	77,882	69,542	-11%	27,501	40%	8%	2
2.G Other	CO_2	648	665	3%	554	83%	11%	2
2.B Chemical industry	CH_4	514	415	-19%	448	108%	137%	24
2.C Metal production	CH_4	105	145	38%	93	64%	36%	14
2.G Other	CH_4	47	44	-8%	319	731%	50%	5
2.B Chemical industry	N_2O	100,382	46,376	-54%	39,384	85%	21%	7
2.E Production of halocarbons and SF_6	HFC	27,459	4,983	-82%	4,657	93%	45%	13
2.F Consumption of halocarbons and SF_6	HFC	539	47,815	8768%	45,731	96%	35%	99
2.C Metal production	PFC	13,404	1,967	-85%	2,114	107%	9%	8
2.F Consumption of halocarbons and SF_6	PFC	585	1,839	214%	1,550	84%	28%	48
2.C Metal production	SF_6	1,803	2,934	63%	1,402	48%	92%	221
2.F Consumption of halocarbons and SF_6	SF_6	7,221	5,644	-22%	5,981	106%	49%	15
Total	**all**	**374,971**	**331,868**	**-11.5%**	**260,420**	**78%**	**7%**	**5**

Note: Emissions are in Gg CO_2 equivalents; trend uncertainty is presented as percentage points.

1) The sum of the source category emissions may not be the total sector emissions because uncertainty estimates are not available for all source categories.

2) Includes for Greece and Spain 2004 data and for Belgium and Germany 2003 data

4.3 Sector-specific quality assurance and quality control

There are two main activities for improving the quality of GHG emissions from industrial processes: (1) Before and during the compilation of the EC 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 EC 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.

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. In 2005 the emissions under the EU ETS covered ca 47% of the total CO_2 emissions and ca. 39% of total greenhouse gas emissions in EU-15.

In addition, Eurostat has started a project for evaluating the quality of Eurostat activity data (industrial production data) for the use in the EC GHG inventory.

4.4 Sector-specific recalculations

Table 4.64 shows that in the industrial processes sector the largest recalculations in absolute terms were made for N_2O in 1990, while in 2004 the recalculations for CO_2 emissions were the highest.

Table 4.64 Sector 2 Industrial processes: Recalculations of total GHG emissions and recalculations of GHG emissions for 1990 and 2004 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	-12,662	-0.4%	-284	-0.1%	-4,944	-1.2%	-1	0.0%	0	0.0%	1	0.0%
Industrial Processes	-253	-0.1%	3	0.4%	-4,629	-4.4%	-1	0.0%	0	0.0%	1	0.0%
2004												
Total emissions and removals	-8,944	-0.3%	-2,528	-0.8%	-558	-0.2%	-2,281	-4.4%	-59	-1.1%	31	0.3%
Industrial Processes	642	0.3%	32	6.0%	-459	-1.0%	-1,522	-3.0%	-59	-1.1%	31	0.3%

Table 4.65 provides an overview of Member States' contributions to EU-15 recalculations. The United Kingdom had the most influence on the N_2O recalculations in 1990. France and Italy had the largest recalculation for HFCs in 2004.

Table 4.65 Sector 2 Industrial processes: Contribution of Member States to EU-15 recalculations for 1990 and 2004 by gas (difference between latest submission and previous submission Gg of CO_2 equivalents)

	1990						2004					
	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
Austria	-1	0	0	0	0	0	68	0	0	-5	0	0
Belgium	0	0	0	0	0	0	164	3	0	-6	0	-15
Denmark	0	0	0	0	0	0	0	0	0	0	0	0
Finland	-5	0	0	0	0	0	-6	0	0	0	0	0
France	105	1	0	-1	0	0	625	2	0	-1,102	0	89
Germany	-351	0	0	0	0	0	-216	0	0	-122	0	68
Greece	0	0	0	0	0	0	0	0	0	0	0	0
Ireland	0	0	0	0	0	0	5	0	0	-15	-10	-3
Italy	0	0	0	0	0	0	0	0	0	-1,184	-57	-111
Luxembourg	0	0	0	0	-	0	0	0	0	0	-	0
Netherlands	0	0	0	0	0	0	0	0	0	38	0	0
Portugal	-14	0	0	0	0	1	99	0	0	-22	0	5
Spain	0	0	0	0	0	0	-4	27	0	67	0	-1
Sweden	0	0	0	0	0	0	0	0	0	-4	23	-1
UK	13	1	-4,629	0	0	0	-94	0	-459	74	-16	1
EU-15	**-253**	**3**	**-4,629**	**-1**	**0**	**1**	**642**	**32**	**-459**	**-2,281**	**-59**	**31**

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 first time includes more detailed descriptions of methods used by Member States.

5.1 Overview of sector

CRF Sector 3 Solvent and Other Product Use contributes 0.2 % to the total EU-15 GHG emissions (Table. 5.4). The EU-15 Member states jointly achieved a emissions reduction of about 21 % from 10.2 Tg in 1990 to 8.0 Tg in 2005 (Figure 5.1 and Table 5.1).

As it is shown in Table 5.1 and Figure 5.2, in the period 1990 to 2005 an emission reduction in this sector could be archieved by

- Germany (915 Gg CO_2eq; -44 %), France (520 Gg CO_2eq; -28 %), the Netherlands (319 Gg CO_2eq; -59 %), and Italy (297 Gg CO_2eq; -12 %)
- Austria, Finland, Denmark, Sweden, Greece and Ireland (together 301 Gg CO_2eq; -14 %)

The Member States with the highest increase in emission in this sector are Portugal with 112 Gg CO_2eq (51 %) and Spain with (89 Gg CO_2eq; 6 %). The emissions in this sector in the Member States United Kingdom and Luxembourg are nearly zero.

Figure 5.1 Sector 3 Solvent and Other Product Use: EU-15 GHG emissions for 1990–2005 in CO_2 equivalents (Tg)

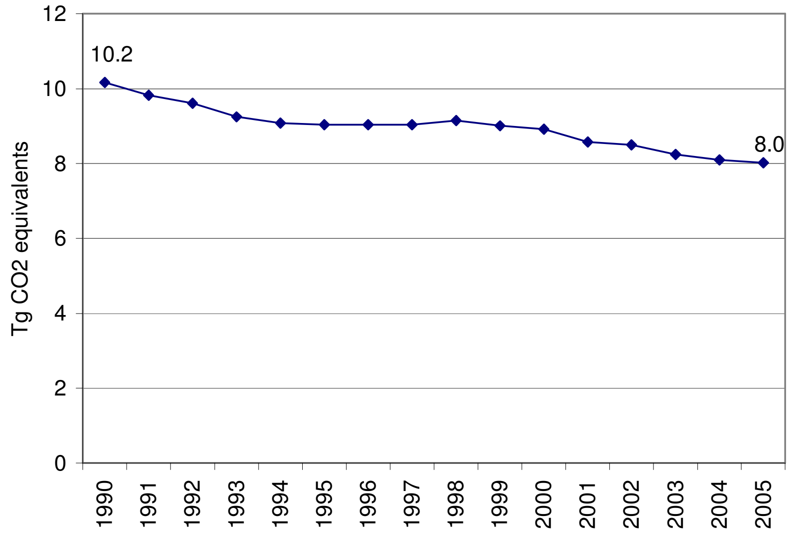
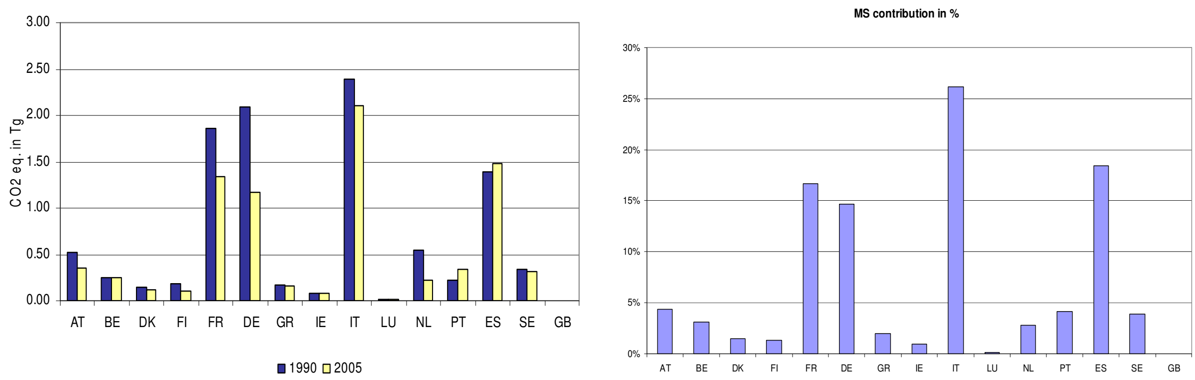


Figure 5.2 **Sector 3 Solvent and Other Product Use: GHG emissions of EU-15 MS for 1990 and 2005 as well as Member States' contributions to GHG emissions for 2005 in percentage**



In 2005, the emissions decreased by 1 % compared to 2004 (Table 5.1). In this period the highest emission reduction in absolute terms was achieved by Spain (-38 Gg CO_2eq; -3 %).

The Member State with the highest emission increases in this sector is Portugal (7 Gg CO_2eq; 2 %). In the Member States Finland, Greece and Denmark a slight increase could be noted.

As it is shown in Table 5.1 the Member States Italy and Spain are jointly responsible for 45 % of the total GHG emissions in this sector and Germany and France are jointly responsible for 31 % of the total emissions in this sector. The remaining 24 % of GHG emissions of this sector emanate from all other EU-15 Member States each with shares of 5 % or even less.

Table 5.1 **Sector 3 Solvent and Other Product Use: Member States' contributions to GHG emissions**

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005	
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	515	367	351	4.4%	-16	-4%	-164	-32%
Belgium	246	250	249	3.1%	0	0%	3	1%
Denmark	142	114	116	1.4%	2	2%	-26	-18%
Finland	178	105	106	1.3%	1	1%	-72	-40%
France	1,857	1,348	1,337	16.7%	-12	-1%	-520	-28%
Germany	2,089	1,174	1,174	14.6%	0	0%	-915	-44%
Greece	170	156	158	2.0%	2	1%	-12	-7%
Ireland	81	76	75	0.9%	0	0%	-5	-7%
Italy	2,394	2,114	2,098	26.2%	-16	-1%	-297	-12%
Luxembourg	9	9	9	0.1%	0	1%	0	3%
Netherlands	541	231	222	2.8%	-9	-4%	-319	-59%
Portugal	220	325	332	4.1%	7	2%	112	51%
Spain	1,391	1,518	1,480	18.5%	-38	-3%	89	6%
Sweden	332	311	311	3.9%	0	0%	-22	-7%
United Kingdom	0	0	0	0.0%	0	-	0	-
EU-15	**10,166**	**8,098**	**8,019**	**100.0%**	**-80**	**-1.0%**	**-2,147**	**-21%**

This sector does not contain a key source.

In the sector 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 2005 the CO_2 emissions have a share of 0.14 % of the 'Total CO_2 Emissions and Removals' and a share of 0.12 % of the 'Total GHG emissions' (Table 5.2). In 2005 the N_2O emissions have a share of 0.89 % of the 'Total N_2O emissions' and a share of 0.07 % of the 'Total 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 for 1990 and 2005

	Unit	1990	2005
CO_2 emission in Solvent and Other Product Use	[Gg]	5 983	5 048
Total GHG emission in 'Solvent and Other Product Use'	[Gg CO_2 eq]	10 166	8 019
Share of CO_2 emission in Total GHG in 'Solvent and Other Product Use'		*59%*	*63%*
Total National CO_2 Emissions and Removals	[Gg]	3 357 427	3 482 238
Share of CO_2 emission from 'Solvent and Other Product Use' in Total CO_2 Emissions and Removals		*0.18%*	*0.14%*
Total National GHG Emissions and Removals	[Gg CO_2 eq]	4 257 165	4 192 000
Share of CO_2 emission from 'Solvent and Other Product Use' in Total GHG Emissions and Removals		*0.14%*	*0.12%*

Table. 5.3 Sector 3 Solvent and Other Product Use: EU-15 N_2O emissions as well as their share for 1990 and 2005

	Unit	1990	2005
N_2O emission in Solvent and Other Product Use	[Gg]	13.5	9.6
Total GHG emission in Solvent and Other Product Use	[Gg CO_2 eq]	10 166	8 019
Share of N_2O emission in Total GHG in 'Solvent and Other Product Use'		*41%*	*37%*
Total National N_2O Emissions and Removals	[Gg]	1 318	1 080
Share of N_2O emission from 'Solvent and Other Product Use' in Total N_2O Emissions and Removals		*1.02%*	*0.89%*
Total National GHG Emissions and Removals	[Gg CO_2 eq]	4 257 165	4 192 000
Share of N_2O emission from 'Solvent and Other Product Use' in Total GHG Emissions and Removals		*0.10%*	*0.07%*

Table. 5.4 Sector 3 Solvent and Other Product Use: EU-15 GHG emissions as well as their share for 1990 and 2005

	Unit	1990	2005
GHG emission in 'Solvent and Other Product Use'	[Gg CO_2 eq]	10 166	8 019
Total National GHG Emissions and Removals	[Gg CO_2 eq]	4 257 165	4 192 000
Share of GHG emission from 'Solvent and Other Product Use' in Total GHG Emissions and Removals		*0.24%*	*0.19%*

5.2 Methodological issues and uncertainties

This sector does not contain any key source. An overview information on methodologies used by the Member States is given in Table. 5.5. For estimation the emission in this sector the methodologies used by the Member States can be devided roughly in three groups:

- Methodology provided by IPPC Guidelines and CORINAIR;
- Bottom up and top down approach / consumption-based emissions estimating;
- mass balance for single substances or groups of substances
- plant specific surveys / expert judgment.

Furthermore a couple of Member States changed their methodology in the last three years.

No additional overview information on qualitative uncertainty estimates is provided. Alltogether it can be noted that very high uncertainties are reported because of lack of information and rough assumptions.

Table. 5.5 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 2007)

CO_2 emissions from solvent use were calculated from NMVOC emissions of this sector. So 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 overestimated emissions because a large amount of solvent substances is used for "non-solvent-applications" (applications where substances usually are used as feed stock in chemical, pharmaceutical or petrochemical industry). However, there might be emissions from the use of the produced products, such as MTBE 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, de-icing agents of aeroplanes, tourism, cement- respectively pulp industry, which were not considered in the top-down approach.

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, (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. 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'. 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.

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 meanst that activity data = emission (1.00 Mg N_2O / Mg product use)

Belgium (NIR BE 2007)

In Belgium the emissions of NMVOC in this source category include paint application, production of medicines, paints, inks and glues, domestic use of other products, coating processes, printing industry, wood conservation, treatment of rubber, storage and handling of products, recuperation of solvents and extraction of oil, cleaning and degreasing and dry cleaning. No estimation of the CO_2 equi. emissions of the solvent consumption is carried out in Belgium; except in the Flemish region (from non-energy use of lubricants and solvents wich are reported under category 2.G).

The regions in Belgium are using comparable methodologies to estimate the emissions in their region. The emissions of NMVOC in Flanders are estimated by using the results of a study (University of Gent (1998) / 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. Emissions of NMVOC are estimated in Belgium as follows :

- All emissions of category 3.A (emissions for Paint Application…), and some of category 3.C (production of paints, inks and glues) as well as some of category 3.D (other domestic use, wood and textile coating, printing industry, 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 category 3.D (storage/handling of products, assembly of automobiles, extraction of oil seeds) are estimated based on information gathered in the industrial databases (originating from reporting obligations of 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. 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).
- 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.

Denmark (NIR DK 2007)

Use of solvents and other organic compounds in industrial processes and households are important sources of evaporation of non-methane volatile hydrocarbons (NMVOC), and are related to the source categories Paint application, Degreasing and dry clean-ing, Chemical products, manufacture and processing and Other. Until 2002 the NMVOC inventory in Denmark was based on questionnaires and interviews with different industries, regarding emissions from specific activities, such as lacquering, painting impregnation etc. In 2003 a new approach has been introduced, focusing on single chemicals instead of activities. The method is based on a chemical approach, and this implies that the SNAP category system is not applicable. Instead emissions will be related to specific chemicals, products, industrial sectors and house-holds and to the CRF sectors mentioned before. This will lead to a clearer picture of the influence from each specific chemical, which will enable a more detailed differentiation on products and the influence of product use on emissions. The procedure is to quantify the use of the chemicals and estimate the fraction of the chemicals that is emitted as a consequence of use. Mass balances are simple and functional methods for calculating the use and emissions of chemicals by the equations

(A) Use = production + import – export – destruction/disposal – hold up and (B) emission = use * emission factor

where "hold up" is the difference in the amount in stock in the beginning and at the end of the year of inventory.

A mass balance can be made for single substances or groups of substances, and the total amount of emitted chemical is obtained by summing up the individual contributions. It is important to perform an in-depth investigation in order to include all relevant emissions from the large amount of chemicals. The tasks in a chemical focused approach are (1) Definition of chemicals to be included (2) Quantification of use amounts from Eq.(A) (3) Quantification of emission factors for each chemical.

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions

Finland (NIR FI 2007)

The solvent and other product use contribute a small amount to GHG emissions in Finland. The only direct GHG source in the solvent and other product use is use of N_2O in industrial, medical and other applications reported under CRF category 3.D (Other). In Finland, N_2O is used in hospitals and by dentists to relieve pain and for detoxification.

Under CRF categories 3.A (Paint application), 3.B (Degreasing and dry cleaning), 3.C (Chemical products, manufacture and processing) and 3.D (Other) Finland reports indirect GHG emissions (NMVOCs) and also indirect CO_2 emissions from NMVOC emissions. CRF category 3.A includes NMVOC emissions arising from the use of paints in industry and households. CRF category 3.B includes emissions from degreasing in metal and electronics industries and dry-cleaners. Under CRF category 3.C Finland reports NMVOC emissions from pharmaceutical, leather, plastic, textile industries, rubber conversion and manufacture of paints. The activities reported under CRF category 3.D (Other) causing NMVOC emissions are printing industry, preservation of wood, use of pesticides, glass and mineral wool enduction, domestic solvent use and fat and oil extraction in the Finnish inventory.

Indirect CO_2 emissions from solvents and other product use have been calculated from NMVOC emissions for time series 1990–2005. Indirect CO_2 emissions were calculated using the equation below. It was assumed that the average carbon content is 60 percent by mass for all categories under sector of solvents and other products use.

$$\text{emission}_{CO2} = \text{Emissions}_{NMVOC}\text{*Percent in NMVOCs by mass*44/12}$$

Paint application 3.A: NMVOC emissions are based on the emissions calculated by the Association for Finnish Paint Industry, a questionnaire sent to non-members of this association and emission data from the Regional Environment Centres´ VAHTI database. Questionnaires are sent to those companies which are not obligated to report NMVOC emissions from their production processes to the Regional Environment Centres. The emissions are calculated at the Finnish Environment Institute based on the emission and/or activity data information from the survey. These questionnaires have been sent for five inventories, starting from summer 2002 when the emissions of year 2001 were collected. Before that time the amount of emissions of non-members was estimated as 15 percent of emissions of members.

Degreasing and dry cleaning 3.B: NMVOC emissions are based on import statistics of pure chlorinated solvents, amount of products containing chlorinated organic solvents & amounts of solvent waste processed in hazardous waste treatment plant.

Chemical products, manufacture and processing 3.C: The emissions are foremost from emission data of the Regional Environment Centres' VAHTI database. There are also sent questionnaires to companies in textile, plastic and paint industry in which they inform either amount of used solvent or emissions of their production processes.

Other 3.D: The N_2O emissions are calculated by Statistics Finland. Tier 2 calculation method is consistent with the IPCC Guidelines. For estimation of N_2O emissions sales data is obtained from a few companies for the years 1990 and 1998. The emission estimation is base on assumption that all used N_2O is emitted to atmosphere the same year it is used. Very small part of emissions is estimated due to non response. The NMVOC emissions are based on the emission data of the Regional Environment Centres' VAHTI database, a questionnaire to presses and oil mills that do not report their emissions to VAHTI database, activity data from the Finnish Environment Institute's Chemical Divisions database and emission calculation of the Finnish Cosmetics, Toiletry and Detergents Association. Indirect CO_2 emissions from this category have been calculated using same equation as mentioned above.

France (NIR FR 2007)

The activities (*Paint application, Degreasing and dry cleaning, Chemical products, manufacture and processing, Other)* of this category are important sources of NMVOC emissions. There are also N_2O emissions from the use of N_2O as anaesthesia estimated. The procedure to calculate the emisions from solvent use is based on statistics of paint and varnish consumption, adhesive consumption, tabac consumption, number of fireworks, capita data, national emission factors. The content of solvents is given by the industries, national studies and associations. Also a bottom up approach is used.

Germany (NIR DE 2007)

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 are calculated via specific emission factors. 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:

• Quantities of VOC-containing (pre-) products and agents used in the report year,

• The VOC concentrations in these products (substances and preparations),

• The relevant application and emission conditions (or the resulting specific emission factor).

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 areas (in a manner similar to that used for CORINAIR SNAP Level 3), and the calculated NMVOC emissions are then aggregated. The product / substance quantities used are determined at the productgroup level with the help of production and foreign-trade statistics. Where possible, the sodetermined 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 emission factors 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 in 2003 and 2004 is available; as a result, the data obtained for 2002 will continue to be used in current reporting. For this reason, it is expected that this data will be revised later on.

Greece (NIR GR 2006)

Most solvents are part of a final product, e.g. paint, and will sooner or later evaporate to the atmosphere. This evaporation of solvent and other products containing volatile organic compounds represents a major source of NMVOC emissions that, once released into the atmosphere, will react with reactive molecules (mainly HO-radicals) or high energetic light to finally form CO_2. This sector also includes evaporative emissions of greenhouse gases arising from other types of product use (e.g. N_2O emissions from medical use).

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.
- Consumption-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%.

Ireland (NIR IE 2007)

The Irish inventories include an estimate of CO_2 emissions but emissions associated with the direct use of N_2O are not estimated. The activity data used for computing estimates of CO_2 emissions in Solvent and Other Product Use are the mass emissions of NMVOC computed for the relevant source categories (3.A, 3.B, 3.C and 3.D). The Irish data used for this purpose are the VOC emissions compiled according to the CORINAIR methodology for reporting to UNECE under the Convention on LRTAP. As part of the work on recalculations for the 2002 submission, Ireland produced a revised and consistent time-series of such NMVOC emissions estimates based on the results of detailed analysis and investigations for 1998 (Finn et al, 2001). The CO_2 emissions were derived by assuming that 85 percent of the mass emissions of NMVOC in the four categories is converted to CO_2.

Emission control strategies are being implemented in Ireland to comply with a limit of 65 kt for total emissions of NMVOC in 2010 under the NEC Directive. The levels of solvent use and the emissions from solvents are changing substantially in response to product replacement and reformulation and emission controls being implemented under Integrated Pollution Control (IPC) and the Solvents Directive. In these circumstances, the inventories of VOC emissions from solvent use over recent years were reassessed as part of the general improvements conducted for Irish emission inventories during 2005. The inventory agency commissioned a project to carry out in-depth analysis of the specified NMVOC source categories (CTC, 2005) in order to compile the best possible estimates of emissions in 2004 as a follow-up to the earlier commissioned work and to revise the inventories for the years 1998-2003 as necessary in the light of new information. The revised estimates for these target years indicated lower NMVOC emissions than had been previously reported and used as the basis for CO_2 in the sector Solvent and Other Product Use.

A bottom-up approach was possible for activities subject to IPC licensing in the four source categories. 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 not covered by the IPC licensing system. These included the use of paints and the use of domestic solvents, the two principal source categories. Input, usage and emissions data for each individual activity was collated into IPC and non-IPC spreadsheets and emissions were estimated by applying EMEP/CORINAIR methods, default emission factors and general guidance as appropriate. Scaling up to national level was applied where necessary. The estimates of CO_2 emissions from Solvent and Other Product Use for 1990-2005 are presented in Table 5.1. The largest contributor to overall emissions is domestic solvent use. It is also to be noted that emissions from this sector have increased while those from the majority of sectors are decreasing. The main drivers are considered to be the increased number of vehicles, growth in the number of individual households, and higher per-capita consumption of non-aerosol automotive products, cosmetics, toiletries, and household products. It should be noted that UK emission factors together with Irish statistics for number of vehicles, persons and households were used in the absence of any other data. One of the only two other significant sectors for which emissions are increasing is industrial application of paint in the wood products sector. This is as a result of an expansion in activity in the sector as well as the continued use of conventional high solvent content coatings. The vast majority of these companies are small operations outside the remit of IPC. Emissions from architectural paint use are decreasing (even while paint sales are increasing) as a result of an increased market share for water-based paints and a reduction in the VOC content of water based paints (VOC content of solvent based paints remains more or less static). From discussions with industry, one of the key drivers for the decrease in solvent use in architectural paint has been as a result of pressure from some of the larger retailers. The decrease in VOC emissions from architectural painting should be set to continue with the advent of the deco-paints Directive (2004/42/EC) and can only benefit from continued and expanded retailer/consumer pressure. There have been significant drops in both printing and wood impregnation. The decrease in printing is principally due to the installation of abatement equipment in the plant, which is the largest user of solvents. The decrease in the use of wood preservatives can be attributed to several site closures and to the switch from solvent-borne to water-borne wood preservatives. Other industrial paint application and other manufacturing taken together show a decrease in emissions between 1998 and 2005. The diversity within these sectors is very large in terms of the type of process, the products made, and the scale involved. There have been closures, particularly of a few of the large emitters, which have decreased emissions, but there has also been some new processes licensed. In addition there is a large degree of uncertainty associated with the non-IPC element of the emissions estimates for these sources. However, the study found that there are specific instances of IPC licensed sites reducing VOC emissions through prevention at source or through abatement.

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions

Italy (NIR IT 2006)

Emissions of NMVOC from solvent use have been estimated according to the CORINAIR methodology with a bottom-up approach, applying both national and international emission factors. All the activities in the SNAP97 have been estimated.
Country specific emission factors provided by several accredited sources have been used extensively, together with data provided by the national EPER Registry, in particular for paint application, solvent use in dry cleaning, solvent use in textile finishing and in the tanning industries. 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 revised. Instead of the simpler method, that uses a single emission factor expressed on a per person basis, a detailed methodology, based on VOC content per type of consumer product, has been applied. 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 and by the Italian Association of Aerosol Producers. As regards cosmetics and toiletries, basic data have been supplied by the Italian Association of Aerosol Producers too and by national statistics; emission factors time series have been reconstructed on the basis of the information provided by the EC, 2002. The conversion of NMVOC emissions into CO_2 emissions has been carried out considering specific factors calculated on the basis of molecular weights and suggested by the EEA for the CORINAIR project, except for emissions from the 3C sub-sector to avoid double-counting.
Emissions of N_2O have been estimated taking into account information made 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 2004. For previous years, data have been estimated by the number of surgical beds published by national statistics.
Moreover, the Italian Association of Aerosol Producers 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 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. N_2O emissions have been calculated multiplying activity data, total quantity of N_2O used for anaesthesia and total aerosol cans, by the related emission factors.

Luxembourg (NIR LU 2006)

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 2007)

Emissions of the greenhouse gases of this sector include indirect emissions of CO_2 related to the release of non-methane volatile organic compounds (NMVOCs) with the use of solvents and a wide range of other fossil carbon-containing products (e.g. paints, cosmetics, cleaning agents etc). In addition, this sector includes N_2O emissions originating from the use of N_2O as anaesthesia and as a propelling agent in aerosol cans (for example, in cream).

The Netherlands has three source categories in this CRF sector (a) 3A, 3B, 3D Solvents and other product use: indirect CO_2 emissions (related to NMVOC)), (b) 3D Anaesthesia: N_2O emissions, (c) 3D Aerosol cans: N_2O emissions.

This sector comprises all non-combustion emissions from sectors other than those of the manufacturing and energy industries, with the exception of (a) Indirect CO_2 emissions from 3C Chemical products, manufacture and processing; (b) Use of F-gases (HFCs, PFCs and SF_6); (c) Direct non-energy use of mineral oil products (e.g. lubricants, waxes, etc.).

Country-specific carbon contents of the NMVOC emissions from 3A Paint application, 3B Degreasing and dry cleaning and 3D Other product use 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 organisations (e.g paints, detergents and cosmetics).

Methodological issues: Indirect CO_2 emissions from NMVOCs

The indirect CO_2 emissions from NMVOCs are calculated from the average carbon contents of the NMVOC emissions reported in categories 3A, 3B and 3D. The carbon contents are based on the composition of compounds responsible for 85–95% of the total NMVOC emission within the category. The fractions are calculated on the basis of the 1990 and 2000 emissions. This simplification is justified due to the small contribution of these emissions to the total inventory of national NMVOC emissions. The following fixed carbon fractions are used for the total time series 3A: 0.72; 3B: 0.16; 3D: 0.69 The emissions are then calculated as follows:

CO_2 (in Gg) = S{NMVOC emission in subcategory i (in Gg) * C-fraction subcategory i} * 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). More details can be found in Spakman et al. (2003). 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 (see Section 2.4). Due to the increased sales of hairspray and deodorant sprays NMVOC emissions have increased slightly during recent years. The NMVOC contents of these products have remained more or less stable.

Emission factors: it is assumed that all of NMVOC in the product is emitted (with the exception of some cleaning products and methylated spirit, which partly are broken down in sewerage treatment plants or used as fuel in BBQ's).

Methodological issues: Miscellaneous N_2O emissions from solvents and product use (use of N_2O for anaesthesia [3D1] and N_2O from aerosol cans [3D3])

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 and implied emission factors: Detailed information on the activity data and emission factors of N_2O estimates are found in the monitoring protocol 7114 on the website. Activity data: The major hospital supplier of N_2O for anaesthetic use reports the consumption data of anaesthetic 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 these data. More details can be found in Spakman et al. (2003). Domestic sales of cream in aerosol cans have shown a small increase since 2000. In 2005 sales increased 7%, which is reflected in the increased emission in that year. Emission factors: The emission factor used for N_2O in anaesthesia is 1 kg/kg. Sales and consumption of N_2O for anaesthesia are assumed to be equal each year. The emission factor for N_2O from aerosol cans is estimated to be 7.6 g/can, and – based on data provided by the producer – it is assumed to be constant over time.

Portugal (NIR PT 2007)

The dominant sources of NMVOC from this sector in Portugal during the period 1990-2005 were Paint Application, Chemical Products Manufacture and Processing and other solvent use, while Degreasing and Dry Cleaning also contribute to emissions at a smaller scale.

Methodology Paint Application (CRF 3A): NMVOC emissions from use of coating materials are estimated in a simple manner using the following formulation: $Emi_{NMVOC(a,p,y)} = \Sigma a \Sigma p[EF(p) * CoatingCONS(a,p,y)] * 10\text{-}3$

Where: $Emi_{NMVOC(y)}$ – NMVOC emissions resulting from use/application of coating substances during year y (ton/yr); $Coating_{CONS(a,p,y)}$ – Use of coating substance p in economic activity a during year y (ton coater/yr); $EF_{(p)}$ – NMVOV emission factor (solvent content) resulting from application of substance p (kg/ton).

Ultimate CO_2 emissions were calculated assuming that 85 percent of the mass emissions of NMVOC is carbon and it is converted to CO_2 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: $U_{CO2} = 44/12 * NMVOC * 0.85$ where: U_{CO2} - Ultimate CO_2 (ton/yr); NMVOC - Global emissions of NMVOC (ton/yr).

Emission factors for NMVOC were made equal to solvent content of paints, which were established as expert guess from information collected from two of the biggest paint sellers in Portugal. These specific emission factors were applied to the total consumption of paint, irrespective of the application where it is used, and average emission factors were hence determined for water based paint, solvent based paint and other paints.

Activity data: For most activities in Portugal there is no available and reliable statistical information concerning the use of paints. From IAIT and IAPI industrial surveys, from INE, 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: $TotalCons_{(y,p)} = Production_{(y,p)} + Imports_{(y,p)} - Exports_{(y,p)}$

where: $TotalCons_{(y)}$ - Consumed paint and varnish of type p in year y (ton/yr); $Production_{(y,p)}$ - National Produced paint and varnish of type p in year y (ton/yr); $Imports_{(y,p)}$ - Imported paint and varnish of type p in year y (ton/yr); $Exports_{(y,p)}$ - Exported paint and varnish of type p in year y (ton/yr).

The most detailed level desegregation per paint type that was possible to achieve was dependent, however on the fact that the statistical classes available for production data were dissimilar from the classes that are used for external trade. Annual production of paints by paint type are collected in IAIT and IAPI surveys, and from INE. Total consumption of paints was calculated from 1990 and 2000; Values for 2001 to 2005 were forecasted by IA from the available time series of paint consumption. Total consumption of paint was also disaggregated by the economic activity where the paint is used. In first place, from IAIT and IAIP industrial surveys, it was possible to determine consumption of coating materials per economic activity but only for the industry sector (IAIT and IAPI). The remaining use of water based paints and solvent based paints was attributed to the use domestic, services and construction, as well as all use of oil and powder paints.

Methodology 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, them 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:

$U_{CO2} = 44/12 * NMVOC * 0.85$ where: U_{CO2} - Ultimate CO_2 (ton/yr); NMVOC - Global emissions of NMVOC (ton/yr).

Activity data: Statistical information concerning total solvent use, from the 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 imported to Portugal is used in dry-cleaning activity and that all PER that is used is imported (no national production). Annual importation, which is available from INE's statistical databases on external trade from 1990 to 2002, was therefore assumed as equal to solvent use, data for the years after 2002 are forecasted.

Methodology 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: $Emi_{NMVOC} = EF * Activity_{Rate} * 10\text{-}3$

where Emi_{NMVOC} - annual emission of NMVOC (ton/yr); $Activity_{Rate}$ - 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 and that they have 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:

$Emi_{CO2} = 44 / 12 * 0.85 * Emi_{NMVOC}$

- 3C1 - polymer processing- *Activity data:* Information about activity data for this sector is scarce and limited to year 1990, from National Statistics Institute (INE); *Emission factors* applied to polymer processing and fibber production were set from AP42 (USEPA), and from CORINAIR/EMEP
- 3C2 - rubber processing - NMVOC emissions had to be estimated from quantity of rubber processed according to:
  $Emi_{NMVOC(y)} = Solvent = \Sigma p[S_{Fac(p)} * Proc_{RUBBER(p,y)}] * 10\text{-}3$ Where: $Emi_{NMVOC(y)}$ – NMVOC total emissions from rubber processing (ton/yr); Solvent (y) – Total solvent use in rubber processing (ton/yr); $S_{Fac(p)}$ – Quantity of solvent used to produce product p, either in kg/unit or kg/ton; $Prod_{RUBBER(p,y)}$ – Production of rubber product p in year y.
  Units vary according to product either number/yr to ton/yr. *Emission factor*, or solvent use factor, that was used to estimate solvent consumption after 1992 was derived from the statistical information available from IAIT for this sector for years 1989 to 1991. *Activity data:* Production data of rubber artefacts, including tires and tire reconstruction, was available from the IAIT and IAPI industrial surveys from INE.
- 3C3 - paints manufacturing: *Activity data* - Production of paints and varnish (see CRF 3A); Emission factor: The USEPA (1983) emission factor was used - 15 kg for each tone of paint or varnish manufactured, that includes emissions during cleaning of installations and applies to production of all coating materials. This emission factor was applied to the total value of paint and varnish produced in Portugal irrespective of type.
- 3C4 – Ink manufacturing: Activity data - Statistical data of annual production of inks in Portugal is available from IAIT and IAPI industrial surveys (INE), for years 1990 though 2000. Linear forecast values were considered for subsequent years. Use of pigments in ink production was also available from INE's database. The NMVOC emission factor that was used, 60 kg for each tone of ink manufactured, refers to vehicle coking and applies to general ink type, is from USEPA (1983). Particulate emissions during ink manufacturing were also estimated using an emission factor of 1 kg/ton pigment used (USEPA,1983).
- 3C5 - glues manufacturing: *Activity data:* Production of glues and adhesives in Portugal is available in Portugal for years 1990 and 1991 from INE. Average values were considered for subsequent years. Production of glues and adhesives see in CRF 3D. *Emission factor:* The CORINAIR emission factor was adopted - 20 kg for each tone of glues and adhesives manufactured, which is applied to all kind of glues and adhesives, with or without solvents in their composition, and includes the cleaning of industrial installations.

Methodology: Other use of solvents and related activities (CRF 3D)

- 3D1- NMVOC emissions from printing result from the evaporation of solvents that are components of the ink or that are added (dilution) just prior to printing activities. Emissions may also result from the use of cleaning products and dampeners. Emissions may occur during drying at air or at ovens (heat set).
  $Emi_{NMVOC(a,p,y)} = \Sigma_p\Sigma_t\Sigma_i[EF(i) * INK_{CONS(p,i,t,y)}] * 10\text{-}3$
  Where $Emi_{NMVOC(y)}$ – NMVOC emissions resulting from printing activities during year y (ton/yr); InkCONS(p,i,t,y) – Use of ink i for printing product p using technology t during year y (ton coater/yr); EF(p) – Emission Factor (solvent content) of ink i (kg/ton).
  Ultimate CO_2 emissions are calculated assuming that 85 percent of the mass emissions of NMVOC is carbon and it is converted to CO_2 in the atmosphere. All solvents are assumed to have fossil origin and hence all ultimate CO_2 emissions are included in the inventory (see above). *Emission factors*: NMVOC emission factors reflect solvent content of ink, assuming that all solvents contribute to volatile organic compounds, and that control equipment for emissions are not widespread and representative. Solvent content of ink are from USEPA (1981).
- 3D2 - 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: $Emi_{NMVOC(y)} = MakeUp_{Solvents(y)}$
  where: $Emi_{NMVOC(y)}$ - Emissions of NMVOC (ton/yr); $MakeUp_{Solvents(y)}$ - annual consumption of solvent in edible and non-edible oil industry, to replenish looses (ton/yr). Emission factor: 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.
- 3D3 - Emissions from glues and adhesives: $NMVOC = Cons_{Nat} \times FE_{Nat} + Imp \times FE_{imp}$
  where: NMVOC = Global emissions of NMVOC (ton), ConsNat = Consumption of Glues and Adhesives produced in Portugal (ton), FE_{Nat} = Emission factor for Glues and Adhesives produced in Portugal (kg NMVOC/ton Ink), Imp = Importation of Glues and Adhesives (ton), FE_{imp} = Emission factor associated to the use of imported Glues and Adhesives and $Cons_{Nat} = Prod_{Nat} – Exp$ where: ConsNat = Consumed Glues and Adhesives produced in Portugal (ton), ProdNat = National Produced Glues and Adhesives (ton), Exp = Exported Glues and Adhesives (ton)
  Emission factors: 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.
- 3D4 - Preservation of wood, against weathering, fungi and insect attack, is applied to wood furniture, artifacts an building and

construction materials. It is usually done by impregnation or immersion of timber in organic solvent based preservatives, creosote or water based preservatives. NMVOCs result from the evaporation of organic solvents and the volatile components of creosote.

$Emi_{NMVOC\ (y)} = Consumption_{(y)} * FE_{Consumption}$ 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.

Emission factors: CORINAIR90 Emission Factor Handbook proposes three emission factors for VOC emission from wood preservation, depending on the type of product used.

- 3D5, 3D6, 3D7 - Perfumes, personal hygiene and cosmetic products; waxes and polishing products; SOAPS AND DETERGENTS: Emissions are estimated from:

  $NMVOC = Use * FE_{Prod+use}$ where: NMVOC - Emissions of NMVOC associated to the production and use of product (ton), Use - Use of product (ton); $FE_{Prod+use}$ - Emission factor associated to the production and use of product (ton)

  Emission factors: Since there are no available VOC emission factor for this activity an emission factor for VOC emission during the production and the use of these products was calculated. It was estimated by the ratio of the amount of solvents consumed during the manufacture process with the amount of product manufactured.

  $FE_{Prod+use} = Solvents / National\ Production$ where: $FE_{Prod+use}$ = Emissions of NMVOC associated to consumption of product use (ton), Solvents = Solvent content of product (ton), National Production = National production values of product (ton)
- 3D8 - Uses of solvents from biomass: There are two organic substances used as solvents: ethanol and rosin derivatives that may be emitted to atmosphere when used. Emissions may be estimated from consumption of these substances. However, in some activities, such as beverage and food industry, use of alcohol does not contribute to air emissions because it is ingested, and it is not included in emissions. Emissions are therefore estimated from: $NMVOC = TotalConsumption – Cons_{NONEMI}$ Where NMVOC – Emission (ton/yr); TotalConsumption – Total consumption of biological solvent in all activities (ton/yr); $Cons_{NONEMI}$ – Consumption of biological solvents in activities where solvents are not emitted to atmosphere (ton/yr).
- 3D9 - Other uses of synthetic solvents from fossil fuels: Emission calculation: NMVOC = Produced Solvents where: NMVOC = Emissions of NMVOC (ton), Consumed Solvents = quantity of produced solvents(ton)

Spain (NIR ES 2007)

For NMVOCs, the methodology applied for the estimation of emissions is essentially that of EMEP/CORINAIR, supplemented by contributions and inquiries made to the IIASA and EGTEI1. With respect to specific issues, it should be noted that for some particularly relevant emission sources, the information has been obtained and processed at individual plant level (as in the case of vehicle manufacturing plants). For the remaining emission sources, a vast proportion of the data on activity variables comes from the corresponding business associations: ASEFAPI, FEIQUE, ANAIP, ATEPA, COFACO, AFOEX. Likewise, in the case of some activities, general statistical information such as population was obtained from the Spanish National Statistics Institute (INE), the Industrial Survey (INE) or the publication entitled “The Chemical Industry in Spain” from the Ministry of Industry, Tourism and Trade (MITYC).

As for emission factors, the methodology used attempts to quantify the NMVOC content in solvents and other products containing these substances. Where appropriate, the corresponding reduction factors are incorporated for the different applications and emissions abatement techniques used. More specifically, in the case of paint application, the differentiation between the different types of paint (waterbased, solvent-based, etc.) is particularly relevant. As and when information on the

development of these techniques over time is available, the factors are shown on an annualized basis. The case of vehicle manufacturing plants deserves special mention, as each manufacturing plant received individualized treatment through the gathering of information on the amounts of concentrate and solvent used, their VOC content during the different phases of the paint lines and production process, as well as during the recovery and disposal processes installed at each centre, so that the emissions are estimated by mass balance.

Once the immediate NMVOC emissions are determined, their final conversion to CO_2 is performed using the following algorithm: CO_2 Emission = NMVOC Emission · 0.85 · 44/12 where 0.85 is the coefficient to transform the NMVOC to carbon mass, and 44/12 to express the carbon mass as CO_2 mass. As far as N_2O is concerned, the emissio

As far as N_2O is concerned, the emissions considered in the inventory are limited to the use of this gas for anaesthetic purposes, as mentioned above. Nitrous oxide, with its characteristically greater solubility in fats than in water, is transported in gaseous form by the blood to the central nervous system through the fluids contained in the latter, where it produces a state of complete unconsciousness or narcosis. Like many other volatile anaesthetic products, N_2O leaves the organism unchanged, that is to say, it is resistant to catabolism through biological processes. As a result of this peculiar quality, N_2O emissions are considered to be equal to its consumption for such uses. This consumption has been estimated on the basis of the information

furnished by one of the sector's firms.

Sweden (NIR SE 2007)

A new method was developed during 2005 in order to obtain all activity data concerning solvent and other product use from the Products register hosted by the Swedish Chemicals Inspectorate. Reliably activity data, for this purpose, can only be obtained from 1995. The Products register is a register over chemical products imported to or manufactured in Sweden. A list of substances defined as NMVOCs, and found in the Products register in quantities over 100 tonnes, has been compiled. The following definition of NMVOC has been used:

Volatile organic compound (VOC) mean any organic compound having a vapour pressure of 0.01 kPa or more at 293.15 K, or having a corresponding volatility under the particular conditions of use. The fraction of creosote which exceeds this value of vapour pressure at 293.15 K shall be considered a VOC. The list includes 365 substances (Cas-nr, name, carbon contents for each substance) and was used for extracting quantities of NMVOC and C in substances found in the Products register. Data extractions have been made for each year from 1995 to 2004. The extractions show for each year “The intended use of the product, the type of product (product code)”, “Industry to which the product is sold (industry category)”, “Quantity NMVOC”, “Quantity C”

Using the information concerning "product code" and "industry category" in combination, the quantities of NMVOC and C for each year and CRF code were compiled. The quantities of NMVOC used as raw material in processes were identified for each CRF code. Country specific emission factors for solvents used as raw material and for remaining solvents were developed for each CRF code. The emission factors for raw material are set very low, since most of the solvents will not be emitted during production, but will end up in the product. The sold amount of solvent is not always identical to the amount of solvent used. Therefore the time series has been recalculated using a running average over three years. This leads to need for updating of reported emissions for the latest three years in the time series in every new submission.

Since accurate data for compiling time series for NMVOC and CO_2 from "Solvents and other product use" only can be found in the Products register from 1995, reported emissions for CRF codes 3A-D for 1990 until 1994 were taken from the old time series and in some cases emission data for 1990 - 1994 has been interpolated. Activity data for the latest year, 2005, is not yet official and hence Sweden has chosen to report data from 2004 also for 2005. Data for 2005 will be updated in the next submission.

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions
Emission of CO_2 has been calculated with the following equation: $\text{emission}_{CO2} = C_{quantity}$*emission factor*44/12 C quantity is the carbon quantity of the solvents. 44 and 12 are the molecular weights of CO_2 and C, respectively. Since the method for calculating CO_2 emissions have been changed compared to the method used in previous submissions, the reported emissions of NMVOC for 1990-94 have been related to the NMVOC emissions for 1995. The ratio has been used to calculate the emissions of CO_2 for each CFR code (3A-D).
United Kingdom (NIR GB 2007) *3A – Paint Application:* Emission estimates for most types of coatings are based on annual consumption data and emission factors provided by the British Coatings Federation (BCF, 2005; BCF, 2006). 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. *3B – Degreasing and Dry Cleaning:* 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), 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. *3C – Chemical Products, Manufacture and Processing:* 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), 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. *3D – OTHER:* 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

There are no sector-specific QA/QC procedures for this sector.

5.4 Sector-specific recalculations

Table 5.6 shows that in the solvent sector only minor recalculations were made (in particular in absolute terms). In 1990 only for CO_2 emissions recalculations were undertaken, in 2004 for CO_2 and CH_4.

Table 5.6 Sector 3 Solvent and Other Product Use: Recalculations of total GHG emissions and recalculations of GHG emission for 1990 and 2004 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	-12,662	-0.4%	-284	-0.1%	-4,944	-1.2%	-1	0.0%	0	0.0%	1	0.0%
Solvent and other product use	-54	-0.9%	0	0.0%	0	0.0%	NO	NO	NO	NO	NO	NO
2004												
Total emissions and removals	-8,944	-0.3%	-2,528	-0.8%	-558	-0.2%	-2,281	-4.4%	-59	-1.1%	31	0.3%
Solvent and other product use	-49	-1.0%	0	0.0%	-47	-1.5%	NO	NO	NO	NO	NO	NO

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 5.7 provides an overview of Member States' contributions to EU-15 recalculations. There were only minor recalculation. France contributed most to recalculations for CO_2 emissions in 1990; in 2004 it was Ireland and France with the the most influence on recalculations in the sector Solvents.

Table 5.7 Sector 3 Solvent and Other Product Use: Contribution of Member States to EU-15 recalculations for 1990 and 2004 by gas (difference between latest submission and previous submission Gg of CO_2 equivalents)

	1990						2004					
	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	0	-47	NO	NO	NO
Belgium	NE	0	0	NO	NO	NO	NE	0	0	NO	NO	NO
Denmark	5	0	0	NO	NO	NO	0	0	0	NO	NO	NO
Finland	1	0	0	NO	NO	NO	0	0	0	NO	NO	NO
France	-59	0	0	NO	NO	NO	-65	0	0	NO	NO	NO
Germany	NE	0	0	NO	NO	NO	NE	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	76	0	0	NO	NO	NO
Italy	0	0	0	NO	NO	NO	-10	0	0	NO	NO	NO
Luxembourg	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
Netherlands	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
Portugal	0	0	0	NO	NO	NO	5	0	0	NO	NO	NO
Spain	0	0	0	NO	NO	NO	2	0	0	NO	NO	NO
Sweden	0	0	0	NO	NO	NO	27	0	0	NO	NO	NO
UK	NE	0	0	NO	NO	NO	NE	0	0	NO	NO	NO
EU-15	**-54**	**0**	**0**	**NO**	**NO**	**NO**	**-49**	**0**	**-47**	**NO**	**NO**	**NO**

Abbreviations explained in the Chapter 'Units and abbreviations'.

6 Agriculture (CRF Sector 4)

Half of 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[21].

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.

6.1 Overview of the sector

CRF Sector 4 Agriculture contributes 9 % to total EU-15 GHG emissions, making it the second largest sector after the Sector Energy. The most important GHGs from Sector 4 Agriculture are N_2O and CH_4 accounting for 5 % and 4 % of the total GHG emissions respectively. The emissions from this sector decreased by 11 % from 434 Tg in 1990 to 386 Tg in 2005 (Figure 6.1). In 2005, the emissions decreased by 1.4 % compared to 2004. The key sources in this sector are:

4 A 1 Cattle: (CH_4)
4 A 3 Sheep: (CH_4)
4 B 1 Cattle: (CH_4)
4 B 13 Solid Storage and Dry Lot: (N_2O)
4 B 8 Swine: (CH_4)
4 D 1 Direct Soil Emissions: (N_2O)
4 D 2 Pasture, Range and Paddock Manure: (N_2O)
4 D 3 Indirect Emissions: (N_2O)

Figure 6.1 Sector 4-Agriculture: EU-15 GHG emissions for 1990–2005 in CO_2 equivalents (Tg)

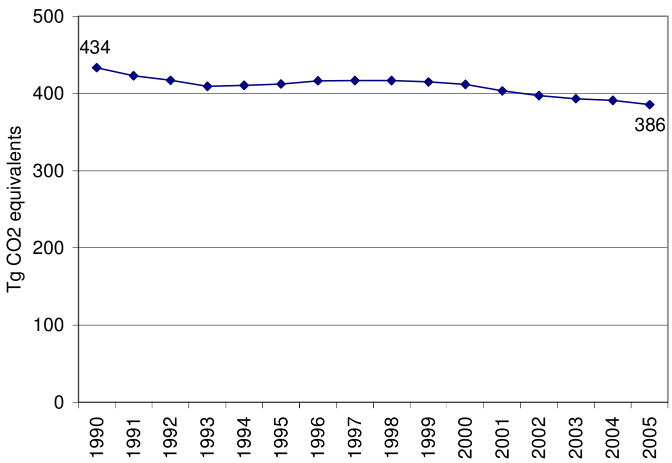
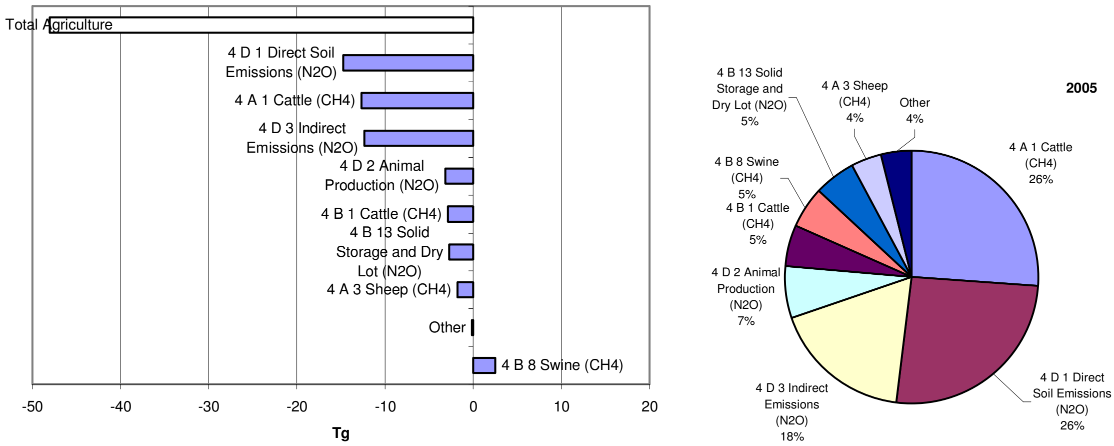


Figure 6.2 shows that large reductions occurred in the largest key sources CH_4 from 4A1 Cattle and N_2O from 4D1 Direct Soil Emissions. The main reasons for this are declining cattle numbers and

[21] http://europa.eu.int/comm/agriculture/envir/index_en.htm

decreasing use of fertiliser and manure in most Member States. The three largest key sources account for about 70% of agricultural GHG emissions of the EU-15.

Figure 6.2 **Sector 4-Agriculture: Absolute change of GHG emissions by large key source categories 1990–2005 in CO_2 equivalents (Tg) and share of largest key source categories in 2005**



6.2 Source Categories

6.2.1 Enteric fermentation (CRF Source Category 4A)

Table 6.1 shows total GHG and CH_4 emissions by Member State from 4A Enteric Fermentation. Between 1990 and 2005, CH_4 emission from 4A Enteric fermentation decreased by 8 %. The relative decrease was largest in Germany, the relative increase was largest in Portugal.

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 2005 (Gg CO_2 equivalents)	CH_4 emissions in 1990 (Gg CO_2 equivalents)	CH_4 emissions in 2005 (Gg CO_2 equivalents)
Austria	3,762	3,233	3,762	3,233
Belgium	4,556	3,850	4,556	3,850
Denmark	3,259	2,630	3,259	2,630
Finland	1,918	1,577	1,918	1,577
France	30,653	27,632	30,653	27,632
Germany	24,083	18,342	24,083	18,342
Greece	2,866	2,889	2,866	2,889
Ireland	9,338	9,049	9,338	9,049
Italy	12,178	10,852	12,178	10,852
Luxembourg	197	158	197	158
Netherlands	7,525	6,345	7,525	6,345
Portugal	2,622	3,038	2,622	3,038
Spain	11,780	13,498	11,780	13,498
Sweden	3,020	2,804	3,020	2,804
United Kingdom	18,421	15,934	18,421	15,934
EU-15	**136,177**	**121,830**	**136,177**	**121,830**

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 2.4 % of total GHG emissions in 2005. Between 1990 and 2005, CH_4 emissions from enteric fermentation from cattle declined by 11 % in the EU-15 (Table 6.2). In 2005, the emissions were 1 % lower compared to 2004. The main driving force of CH_4 emissions from enteric fermentation is the number of cattle, which was 15 % below 1990 levels in 2005. The Member States with most emissions from this source were France and Germany (42 %). All Member States except Greece, Spain and Portugal reduced CH_4 emissions from enteric fermentation of cattle between 1990 and 2005.

Table 6.2 4A1 Cattle: Member States' contributions to CH_4 emissions and information on method applied, activity data and emission factor

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	3,561	3,072	3,029	3.0%	-43	-1%	-532	-15%	T2	NS	CS
Belgium	4,301	3,665	3,606	3.6%	-59	-2%	-695	-16%	M	NS	CS
Denmark	2,950	2,297	2,227	2.2%	-69	-3%	-723	-25%	T2	NS	CS
Finland	999	805	795	0.8%	-10	-1%	-205	-20%	T2	NS	CS
France	28,162	25,472	25,487	25.3%	15	0%	-2,674	-9%	C	NS	D/ CS
Germany	22,639	17,010	16,951	16.9%	-59	0%	-5,688	-25%	CS/D/T2	RS	CS
Greece	866	807	931	0.9%	124	15%	65	8%	T1	NS	D
Ireland	8,269	8,327	8,194	8.1%	-132	-2%	-75	-1%	T2	NS	CS
Italy	10,039	8,641	8,664	8.6%	23	0%	-1,375	-14%	T2	NS	CS
Luxembourg	192	152	151	0.2%	-1	-1%	-41	-21%	T2	-	CS
Netherlands	6,767	5,712	5,677	5.6%	-35	-1%	-1,090	-16%	T2	NS	CS
Portugal	1,814	2,111	2,148	2.1%	37	2%	334	18%	T2	NS	CS
Spain	6,473	8,388	8,201	8.2%	-186	-2%	1,728	27%	CS, T2	NS	CS, D
Sweden	2,729	2,554	2,520	2.5%	-34	-1%	-210	-8%	CS	NS	CS
United Kingdom	13,484	12,179	11,975	11.9%	-205	-2%	-1,510	-11%	T2	NS	CS, D
EU-15	**113,248**	**101,191**	**100,559**	**100.0%**	**-632**	**-1%**	**-12,689**	**-11%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Enteric fermentation from sheep is the seventh largest single source of CH_4 emissions in the EU-15 and accounts for 0.3 % of total GHG emissions in 2005. Between 1990 and 2005, CH_4 emissions from enteric fermentation of sheep declined by 11 % in the EU-15 (Table 6.3). In 2005, the emissions were 2 % lower compared to 2004. The main driving force of CH_4 emissions from enteric fermentation is the number of sheep, which was 13 % below 1990 levels in 2005. The Member States with most emissions from this source were Spain and the United Kingdom (53 %). Nine Member States reduced CH_4 emissions from enteric fermentation of sheep, six Member States did not.

Table 6.3 4A3 Sheep: Member States' contributions to CH_4 emissions and information on method applied, activity data and emission factor

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	52	55	55	0.4%	0	0%	3	5%	T1	NS	CS
Belgium	33	26	26	0.2%	0	1%	-7	-21%	M	NS	CS
Denmark	33	29	32	0.2%	3	11%	-1	-4%	T2	NS	CS
Finland	15	17	15	0.1%	-1	-9%	1	5%	T2	NS	CS
France	1,922	1,547	1,534	10.8%	-13	-1%	-388	-20%	C	NS	D/ CS
Germany	556	456	444	3.1%	-12	-3%	-112	-20%	T1	RS	CS
Greece	1,350	1,416	1,408	9.9%	-8	-1%	58	4%	T2	NS	D
Ireland	1,032	861	809	5.7%	-51	-6%	-223	-22%	T2	NS	CS
Italy	1,468	1,362	1,336	9.4%	-26	-2%	-132	-9%	T1	NS	CS
Luxembourg	1	2	2	0.0%	0	5%	0	41%	T1	-	CS
Netherlands	286	208	229	1.6%	21	10%	-57	-20%	T1	NS	CS
Portugal	560	696	686	4.8%	-10	-1%	126	23%	T2	NS	CS
Spain	4,258	4,119	4,089	28.8%	-30	-1%	-168	-4%	T2, CS	NS	CS, D
Sweden	68	78	79	0.6%	1	1%	11	16%	T1	NS	CS
United Kingdom	4,354	3,627	3,469	24.4%	-158	-4%	-884	-20%	T2	NS	CS, D
EU-15	**15,988**	**14,497**	**14,214**	**100.0%**	**-283**	**-2%**	**-1,774**	**-11%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 6.4 provides information on the contribution of Member States to EC recalculations in CH_4 from 4A Enteric Fermentation for 1990 and 2004 and main explanations for the largest recalculations in absolute terms.

Table 6.4 4A Enteric Fermentation: Contribution of MS to EC recalculations in CH_4 for 1990 and 2004 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2004		Main explanations
	Gg	Percent	Gg	Percent	
Austria	0.0	0.0	0.0	0.0	
Belgium	0.0	0.0	0.1	0.0	
Denmark	0.0	0.0	-5.4	-0.2	Refer to the ERT recommendation an interpolation on feed intake from 1990 to 1994 has been performed for dairy cattle to avoid jumps in the time-series. The relatively large difference in the IEF for enteric fermenta-tion in 1993 and 1994 was a result of unavailable one-year data and re-flects a development in milk yield from a four year period (1990 – 1994).
Finland	-0.4	0.0	-2.7	-0.2	Some updating and corrections in weight data and animal nurmbers
France	0.0	0.0	15.4	0.1	update of live stock for 2004
Germany	-341.0	-1.4	-146.7	-0.8	updated activity data for 2004
Greece	0.0	0.0	0.0	0.0	
Ireland	0.0	0.0	0.0	0.0	
Italy	0.0	0.0	4.5	0.0	Updated milk production data from buffalo
Luxembourg	-0.2	-0.1	0.7	0.5	
Netherlands	0.0	0.0	0.0	0.0	
Portugal	-0.1	0.0	-0.1	0.0	
Spain	0.0	0.0	0.0	0.0	
Sweden	0.0	0.0	0.0	0.0	
UK	0.0	0.0	-5.7	0.0	The digestibility of the dairy breeding herd diet has been increased from 65 to 74%, leading to a small revision to the methane emissions for this sector.
EU-15	**-341.7**	**-0.3**	**-139.9**	**-0.1**	

6.2.2 Manure management (CRF Source Category 4B)

Table 6.5 shows total GHG, CH_4 and N_2O emissions by Member State from 4B Manure Management. Between 1990 and 2005, CH_4 emission from 4B Manure Management decreased by 1 %. The relative decrease was largest in the Netherlands and Austria, the relative increase was largest in Sweden, Spain and Denmark.

Between 1990 and 2005, N_2O emission from 4B Manure Management decreased by 10 %. The relative decrease was largest in Germany, Sweden and Finland, the relative increase was largest in Spain.

Table 6.5 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 2005 (Gg CO_2 equivalents)	CH_4 emissions in 1990 (Gg CO_2 equivalents)	CH_4 emissions in 2005 (Gg CO_2 equivalents)	N_2O emissions in 1990 (Gg CO2 equivalents)	N_2O emissions in 2005 (Gg CO2 equivalents)
Austria	2,065	1,757	1,060	881	1,005	876
Belgium	3,650	3,247	2,686	2,389	964	857
Denmark	1,436	1,574	751	1,016	684	557
Finland	895	777	230	278	665	500
France	20,537	18,973	13,699	12,972	6,839	6,001
Germany	9,974	7,990	5,881	4,954	4,093	3,036
Greece	798	826	497	519	301	307
Ireland	2,720	2,634	2,314	2,224	406	409
Italy	7,383	6,838	3,462	3,150	3,921	3,688
Luxembourg	77	79	77	79	NE, NO	NE, NO
Netherlands	3,663	3,213	2,969	2,459	694	753
Portugal	1,739	1,737	1,176	1,159	563	578
Spain	8,695	11,798	6,231	8,871	2,465	2,928
Sweden	1,098	993	354	479	743	514
United Kingdom	4,437	3,781	2,923	2,509	1,514	1,271
EU-15	**69,167**	**66,215**	**44,309**	**43,936**	**24,858**	**22,276**

Abbreviations explained in the Chapter 'Units and abbreviations'.

CH_4 emissions from 4B1 Cattle account for 0.5 % of total EU-15 GHG emissions in 2005. Between 1990 and 2005, CH_4 emissions from this source decreased by 13 % (Table 6.6). Germany and France are responsible for 55 % of the total EU-15 emissions from this source. All Member States except Finland, Greece, Portugal and Sweden had reductions between 1990 and 2005. In absolute terms, France and Germany had the most significant decreases from this source.

Table 6.6 4B1 Cattle: Member States' contributions to CH_4 emissions and information on method applied, activity data and emission factor

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	587	469	459	2.3%	-10	-2%	-128	-22%	T2	NS	CS
Belgium	1,131	932	913	4.5%	-19	-2%	-219	-19%	M	NS	CS
Denmark	282	272	257	1.3%	-15	-5%	-25	-9%	T2	NS	CS
Finland	66	86	89	0.4%	3	3%	23	36%	T2	NS	CS
France	8,734	7,909	7,980	39.7%	71	1%	-754	-9%	C/ T1	NS	D/ CS
Germany	4,035	3,194	3,160	15.7%	-34	-1%	-875	-22%	D/T2	RS	CS
Greece	202	188	217	1.1%	29	15%	15	7%	T1	NS	D
Ireland	1,850	1,667	1,644	8.2%	-23	-1%	-206	-11%	T2	NS	CS
Italy	1,636	1,262	1,243	6.2%	-20	-2%	-394	-24%	T2	NS	CS
Luxembourg	32	25	25	0.1%	0	-1%	-7	-23%	T2	-	CS
Netherlands	1,574	1,475	1,448	7.2%	-26	-2%	-125	-8%	T2	NS	CS
Portugal	47	68	70	0.3%	2	3%	23	50%	T2	NS	CS
Spain	473	462	447	2.2%	-16	-3%	-26	-6%	CS, T2	NS	CS, D
Sweden	218	300	312	1.6%	12	4%	94	43%	T2	NS	CS
United Kingdom	2,114	1,869	1,841	9.2%	-27	-1%	-272	-13%	T2	NS	CS, D
EU-15	**22,981**	**20,177**	**20,104**	**100.0%**	**-74**	**0%**	**-2,877**	**-13%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

CH_4 emissions from 4B8 Swine account for 0.5 % of total EU-15 GHG emissions in 2004. Between 1990 and 2005, CH_4 emissions from this source increased by 14% (Table 6.7). France and Spain are responsible for 59 % of the total EU-15 emissions from this source. In absolute terms, Spain had the most significant increases from this source while the Netherlands and the UK had the largest reductions.

Table 6.7 4B8 Swine: Member States' contributions to CH_4 emissions and information on method applied, activity data and emission factor

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	448	385	397	1.9%	12	3%	-51	-11%	T2	NS	CS
Belgium	1,432	1,354	1,347	6.5%	-7	-1%	-85	-6%	M	NS	CS
Denmark	448	727	719	3.5%	-8	-1%	271	60%	T2	NS	CS
Finland	81	101	104	0.5%	3	3%	23	29%	T2	NS	CS
France	4,209	4,364	4,278	20.6%	-86	-2%	69	2%	C/ T1	NS	D/ CS
Germany	1,621	1,480	1,546	7.4%	65	4%	-75	-5%	T1	RS	CS/D
Greece	146	141	150	0.7%	8	6%	3	2%	T1	NS	D
Ireland	328	444	439	2.1%	-5	-1%	111	34%	T1	NS	D
Italy	1,432	1,431	1,454	7.0%	23	2%	22	2%	T2	NS	CS
Luxembourg	43	48	51	0.2%	3	7%	8	19%	T2	-	CS
Netherlands	1,141	919	932	4.5%	13	1%	-209	-18%	T2	NS	CS
Portugal	1,087	1,035	1,035	5.0%	0	0%	-52	-5%	T2	NS	CS
Spain	5,329	7,937	7,946	38.2%	9	0%	2,618	49%	T2, CS	NS	D, CS
Sweden	99	117	128	0.6%	11	9%	28	28%	T2	NS	CS
United Kingdom	476	325	296	1.4%	-29	-9%	-180	-38%	T2	NS	CS, D
EU-15	**18,319**	**20,810**	**20,817**	**100.0%**	**7**	**0%**	**2,498**	**14%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 6.8 provides information on the contribution of Member States to EC recalculations in CH_4 from 4B Manure Management for 1990 and 2004 and main explanations for the largest recalculations in absolute terms.

Table 6.8 4B Manure Management: Contribution of MS to EC recalculations in CH_4 for 1990 and 2004 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2004		Main explanations
	Gg	Percent	Gg	Percent	
Austria	0.0	0.0	0.0	0.0	
Belgium	0.0	0.0	0.3	0.0	
Denmark	-0.3	0.0	-9.4	-0.9	The emission from poultry now includes exported living animals – chickens for slaughtering, ducks, geese and turkeys. Data on living ex-ported poultry is available from 1994 and based on information from the Danish Poultry Council. The Danish normative feeding norms for 2003 are updated. A higher ni-trogen excretion for dairy cattle and a lower nitrogen excretion from slaughtering pigs than previous estimated. This has a slight effect on the total GHG emission by 0.03 Gg CO2 equivalents or less than a half per-cent.
Finland	-0.7	-0.3	17.1	6.7	Correction of N excretion for swine in 2004. Changes in the distribution of manure management systems as well as some minor changes in activity data
France	0.0	0.0	0.0	0.0	
Germany	-190.4	-3.1	-295.1	-5.5	updated activity data, change the Tier 2 for 4B9
Greece	0.0	0.0	0.0	0.0	
Ireland	87.7	3.9	88.0	4.1	The emission estimates for CH4 from manure management for laying hens in the 2006 submission used the emission factor for broilers.
Italy	0.0	0.0	0.0	0.0	
Luxembourg	0.3	0.3	-0.2	-0.2	
Netherlands	0.0	0.0	0.0	0.0	
Portugal	0.0	0.0	-0.2	0.0	
Spain	0.0	0.0	267.4	3.2	correction of N content in compost applied to soils
Sweden	0.0	0.0	0.0	0.0	
UK	0.0	0.0	0.0	0.0	
EU-15	**-103**	**0**	**68**	**0**	

N_2O emissions from 4B13 Solid Storage and Dry Lot account for 0.5 % of total EU-15 GHG emissions in 2005. Between 1990 and 2005, N_2O emissions from this source decreased by 12 % (Table 6.9). Italy and France are responsible for 44 % of the total EU-15 emissions from this source. In absolute terms, Germany had the most significant decrease from this source while Spain had the largest increases. In relative terms, Sweden had the largest decrease from 1990-2005.

Table 6.9 4B13 Solid Storage and Dry Lot: Member States' contributions to N_2O emissions and information on method applied, activity data and emission factor

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	965	849	840	4.1%	-9	-1%	-125	-13%	T1	NS	D, CS
Belgium	897	807	792	3.9%	-15	-2%	-105	-12%	D	NS	D
Denmark	590	497	482	2.4%	-15	-3%	-108	-18%	T1	NS	D
Finland	652	488	481	2.4%	-7	-1%	-171	-26%	D	NS	D
France	6,605	5,834	5,774	28.4%	-60	-1%	-831	-13%	C/ T1	NS	D/ CS
Germany	3,642	2,676	2,649	13.0%	-27	-1%	-993	-27%	T1	RS	D
Greece	282	261	285	1.4%	24	9%	3	1%	D	NS	D
Ireland	351	355	354	1.7%	-1	0%	3	1%	T1	NS	D
Italy	3,728	3,298	3,259	16.0%	-39	-1%	-469	-13%	T2	NS	D, CS
Luxembourg	NE	NE	NE	-	-	-	-	-	-	-	-
Netherlands	515	577	623	3.1%	46	8%	109	21%	T2	NS	D
Portugal	548	563	563	2.8%	0	0%	15	3%	D	NS	D
Spain	2,387	2,855	2,819	13.8%	-36	-1%	432	18%	D, CS	NS	D
Sweden	663	420	381	1.9%	-39	-9%	-282	-43%	T2	NS	D
United Kingdom	1,280	1,094	1,061	5.2%	-33	-3%	-219	-17%	T2	NS	CS, D
EU-15	**23,104**	**20,572**	**20,362**	**100.0%**	**-210**	**-1%**	**-2,742**	**-12%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

N_2O emissions from 4B14 Other account for 0.01 % of total EU-15 GHG emissions in 2005. Between 1990 and 2005, N_2O emissions from this source increased by 114 % (Table 6.10). Italy is responsible for 46 % of the total EU-15 emissions from this source and had the most significant increases from this source in absolute terms.

Table 6.10 4B14 Other: Member States' contributions to N_2O emissions

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005	
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	17	16	16	2.8%	0	0%	-1	-4%
Belgium	3	10	9	1.6%	0	-4%	6	193%
Denmark	NO	NO	NO	-	-	-	-	-
Finland	NE	NE	NE	-	-	-	-	-
France	NA	NA	NA	-	-	-	-	-
Germany	0	0	0	0.0%	0	-	0	-
Greece	13	14	15	2.5%	1	4%	2	15%
Ireland	NO	NO	NO	-	-	-	-	-
Italy	0	275	271	46.2%	-4	-1%	271	-
Luxembourg	NE	NE	NE	-	-	-	-	-
Netherlands	NO	NO	NO	-	-	-	-	-
Portugal	NO	NO	NO	-	-	-	-	-
Spain	NO	NO	NO	-	-	-	-	-
Sweden	65	102	110	18.8%	8	8%	45	69%
United Kingdom	175	165	165	28.1%	0	0%	-11	-6%
EU-15	**273**	**582**	**586**	**100.0%**	**4**	**1%**	**313**	**114%**

Abbreviations explained in the Chapter 'Units and abbreviations'.
Emissions of Finland were not estimated due to lack of data.

Table 6.11 provides information on the contribution of Member States to EC recalculations in N_2O from 4B Manure Management for 1990 and 2004 and main explanations for the largest recalculations in absolute terms.

Table 6.11 4B Manure Management: Contribution of MS to EC recalculations in N_2O for 1990 and 2004 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2004		Main explanations
	Gg	Percent	Gg	Percent	
Austria	0.0	0.0	0.0	0.0	
Belgium	0.0	0.0	0.0	0.0	
Denmark	-0.7	-0.1	8.4	1.5	The emission from poultry now includes exported living animals – chickens for slaughtering, ducks, geese and turkeys. Data on living ex-ported poultry is available from 1994 and based on information from the Danish Poultry Council. The Danish normative feeding norms for 2003 are updated. A higher ni-trogen excretion for dairy cattle and a lower nitrogen excretion from slaughtering pigs than previous estimated. This has a slight effect on the total GHG emission by 0.03 Gg CO2 equivalents or less than a half per-cent.
Finland	-1.2	-0.2	-34.5	-6.2	Correction of N excretion for swine in 2004. Changes in the distribution of manure management systems as well as some minor changes in activity data
France	0.0	0.0	0.0	0.0	
Germany	-34.9	-0.8	186.9	6.4	updated activity data, change the Tier 2 for 4B9
Greece	0.0	0.0	0.0	0.0	
Ireland	0.4	0.1	-0.6	-0.1	
Italy	0.0	0.0	0.0	0.0	
Luxembourg	0.0	0.0	0.0	0.0	
Netherlands	0.0	0.0	0.0	0.0	
Portugal	0.0	0.0	-1.4	-0.2	
Spain	0.0	0.0	3.3	0.1	correction of N content in compost applied to soils
Sweden	0.0	0.0	0.0	0.0	
UK	0.0	0.0	0.0	0.0	
EU-15	**-36.3**	**-0.1**	**162.2**	**0.7**	

6.2.3 Agricultural soils (CRF Source Category 4D)

N_2O emissions from this source category account for 5 % of total GHG emissions. Table 6.12 show total GHG and N_2O emissions by Member State for N_2O from 4D Agricultural Soils. N_2O emissions from this source decreased by 13 % between 1990 and 2005. All EU-15 Member States decreased emissions except Portugal and Spain.

Table 6.12 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 2005 (Gg CO_2 equivalents)	N_2O emissions in 1990 (Gg CO_2 equivalents)	N_2O emissions in 1990 (Gg CO_2 equivalents)
Austria	3,295	2,831	3,288	2,824
Belgium	4,600	3,938	4,597	3,935
Denmark	8,352	5,677	8,352	5,677
Finland	4,301	3,226	4,301	3,226
France	55,881	48,634	55,881	48,634
Germany	43,628	37,211	44,300	37,845
Greece	9,749	7,665	9,749	7,665
Ireland	7,005	6,771	7,005	6,771
Italy	19,437	18,042	19,437	18,042
Luxembourg	146	146	146	146
Netherlands	10,791	8,615	10,791	8,615
Portugal	3,216	3,271	3,216	3,271
Spain	19,064	19,157	19,064	19,157
Sweden	5,251	4,769	5,251	4,769
United Kingdom	30,407	25,110	30,407	25,110
EU-15	**225,123**	**195,062**	**225,785**	**195,684**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 6.13 provides information on emission trends and information on methods applied activity data 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 2.4 % of total EU-15 GHG emissions in 2005. Direct N_2O emissions from agricultural soils occur from the application of mineral nitrogen fertilisers and organic nitrogen from animal manure. Between 1990 and 2005, emissions declined by 13 % in the EU-15. The Member States with most emissions from this source were France and Germany. All Member States except the Netherlands 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 both 18 % below 1990 levels in 2005. 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 6.13 4D1 Direct soil emissions: Member States' contributions to N_2O emissions and information on method applied, activity data and emission factor

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)		
Austria	1,760	1,502	1,518	1.5%	16	1%	-242	-14%	T1a,b	NS
Belgium	2,471	2,222	2,198	2.2%	-24	-1%	-273	-11%	D	NS
Denmark	4,224	2,964	2,976	3.0%	12	0%	-1,249	-30%	D/CS	NS
Finland	3,370	2,506	2,489	2.5%	-17	-1%	-881	-26%	D	NS
France	26,595	23,369	22,963	22.9%	-406	-2%	-3,633	-14%	C/ T1	NS
Germany	27,711	24,031	23,816	23.8%	-215	-1%	-3,896	-14%	C/D/T1/T2	RS
Greece	2,760	1,704	1,743	1.7%	40	2%	-1,017	-37%	T1a, T1b	NS, IS
Ireland	2,861	2,787	2,688	2.7%	-100	-4%	-173	-6%	T1a, T1b	NS
Italy	9,590	9,302	8,997	9.0%	-305	-3%	-593	-6%	D	NS
Luxembourg	146	146	146	0.1%	0	-	0	-	C	-
Netherlands	4,597	4,839	4,802	4.8%	-37	-1%	205	4%	T1b,T2	NS
Portugal	1,380	1,226	1,327	1.3%	101	8%	-53	-4%	T1a	NS
Spain	10,080	10,553	9,736	9.7%	-817	-8%	-344	-3%	CS, T1a, T1b	NS
Sweden	3,191	2,975	2,918	2.9%	-57	-2%	-273	-9%	CS, T1a, T1b	NS
United Kingdom	14,262	12,083	11,950	11.9%	-133	-1%	-2,312	-16%	T1a, T1b	NS
EU-15	**115,000**	**102,208**	**100,265**	**100.0%**	**-1,943**	**-1.9%**	**-14,735**	**-13%**		

Abbreviations explained in the Chapter 'Units and abbreviations'.

N_2O emissions from 4D2 Pasture, Range and Paddock Manure account for 0.6 % of total EU-15 GHG emissions in 2005. Between 1990 and 2005, N_2O emissions from this source decreased by 11 % (Table 6.14). France, the United Kingdom and Greece are responsible for 59 % of the total EU-15 emissions from this source. France had the greatest reduction in absolute terms while Spain had the largest increases.

Table 6.14 4D2 Pasture, Range and Paddock Manure: Member States' contributions to N_2O emissions and information on method applied, activity data and emission factor

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	218	220	219	0.9%	-1	0%	1	0%	T1a,b	NS	D
Belgium	941	823	807	3.2%	-16	-2%	-134	-14%	D	NS, AS	CS
Denmark	312	281	271	1.1%	-10	-4%	-42	-13%	D/CS	NS	D
Finland	165	145	146	0.6%	1	0%	-19	-12%	D	NS	D
France	8,539	7,446	7,384	29.1%	-62	-1%	-1,155	-14%	C/ T1	NS	D/ CS
Germany	1,682	1,398	1,397	5.5%	-1	0%	-286	-17%	C	RS	C/D
Greece	3,383	3,562	3,187	12.6%	-376	-11%	-197	-6%	D	NS	D
Ireland	2,799	2,815	2,773	10.9%	-42	-1%	-26	-1%	T1a	NS	D
Italy	1,736	1,545	1,532	6.0%	-13	-1%	-204	-12%	D	NS	D, CS
Luxembourg	NE	NE	NE	-	-	-	-	-	-	-	-
Netherlands	1,308	651	651	2.6%	0	0%	-657	-50%	T1b	NS	CS
Portugal	614	681	695	2.7%	14	2%	80	13%	T1a	NS	D
Spain	1,366	1,604	1,576	6.2%	-28	-2%	210	15%	T1a, T1b, CS	NS	D
Sweden	286	317	319	1.3%	1	0%	32	11%	T2	NS	CS
United Kingdom	5,223	4,568	4,431	17.5%	-138	-3%	-792	-15%	NO	NO	NO
EU-15	**28,574**	**26,055**	**25,387**	**100.0%**	**-669**	**-3%**	**-3,188**	**-11%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

N_2O emissions from 4D3 Indirect Emissions account for 1.6 % of total EU-15 GHG emissions in 2004. Between 1990 and 2005, N_2O emissions from this source decreased by 15 % (Table 6.15). France, Germany and the UK are responsible for 57 % of the total EU-15 emissions from this source, but the same Member States had large absolute reductions between 1990 and 2005.

Table 6.15 4D3 Indirect Emissions: Member States' contributions to N_2O emissions and information on method applied, activity data and emission factor

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	1,310	1,083	1,086	1.6%	4	0%	-223	-17%	T1a,b	NS	D
Belgium	1,184	938	929	1.4%	-9	-1%	-255	-22%	D	NS	CS
Denmark	3,787	2,399	2,351	3.4%	-48	-2%	-1,436	-38%	D/CS	NS	D
Finland	758	597	589	0.9%	-7	-1%	-168	-22%	D	NS	D
France	20,401	18,124	18,036	26.3%	-89	0%	-2,365	-12%	C/ T1	NS	D/ CS
Germany	14,906	12,606	12,463	18.2%	-143	-1%	-2,443	-16%	C/D/T1	RS	C/D
Greece	3,606	2,880	2,735	4.0%	-145	-5%	-871	-24%	T1a	NS, IS	D
Ireland	1,345	1,331	1,310	1.9%	-21	-2%	-35	-3%	T1b	NS	CS
Italy	8,111	7,797	7,513	11.0%	-283	-4%	-598	-7%	D	NS	D, CS
Luxembourg	NE	NE	NE	-	-	-	-	-	-	-	-
Netherlands	4,861	3,209	3,156	4.6%	-53	-2%	-1,705	-35%	T1,T3	NS/M	D
Portugal	1,221	1,174	1,249	1.8%	75	6%	28	2%	T1a	NS	D
Spain	7,515	8,225	7,612	11.1%	-613	-7%	97	1%	CS, T1a, T1b	NS	D
Sweden	1,142	932	935	1.4%	3	0%	-206	-18%	CS, T1	NS	D
United Kingdom	10,754	8,640	8,561	12.5%	-79	-1%	-2,192	-20%	NO	NO	NO
EU-15	**80,900**	**69,935**	**68,527**	**100.0%**	**-1,408**	**-2%**	**-12,373**	**-15%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 6.16 provides information on the contribution of Member States to EC recalculations in N_2O from 4D Agricultural Soils for 1990 and 2004 and main explanations for the largest recalculations in absolute terms.

Table 6.16 4D Agricultural soils: Contribution of MS to EC recalculations in N_2O for 1990 and 2004 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2004		Main explanations
	Gg	Percent	Gg	Percent	
Austria	1.4	0.0	-4.3	-0.1	4 D 1 Direct Soil Emissions – urea consumption data: Revised urea application data from 2002 to 2004 have been used. In accordance with the other N mineral fertilizer application data, figures now relate to the economic year of the farmers and not to the calendar year. 4 D 1 Direct Soil Emissions – sewage sludge application: Emissions from sewage sludge application on agricultural soils have been shifted from source category 4 D 4 Other to 4 D 1 Direct Soil Emissions – 6. Other. 2004 data has been updated, which resulted in lower emissions.
Belgium	0.0	0.0	23.7	0.6	change of emission factor in the Flemish Region
Denmark	-0.7	0.0	62.5	1.1	For the first time we have received data from the Danish Plant Directorate concerning the contribution of stable type 2005. Previous this has been estimated by expert judgement from the Danish Agricultural Advisory Centre. The new data are in very good accordance with previous estimations and shows only a few differences.
Finland	7.7	0.2	13.4	0.4	Updating of crop yield of sugar beet for 2004. Area of organic soils was corrected for the whole time series because area of grassland was previously accidentally excluded from the total area. Changes in the distribution of manure management systems.
France	3.1	0.0	2.5	0.0	update of quantities of manure applied (2004)
Germany	-51.2	-0.1	-83.9	-0.2	updated and new activity data
Greece	0.0	0.0	0.0	0.0	
Ireland	-265.2	-3.6	-241.0	-3.3	Change in method: Move to Tier 1 A(Atm Dep) and Tier 1B(Animal Manure applied to soils); change in activity data: New Populations stats., New AWMS Proportioning
Italy	0.0	0.0	258.6	1.4	Updated livestock data, other nitrogenous fertilizers, surface/production data
Luxembourg	0.0	0.0	0.0	-	
Netherlands	0.0	0.0	0.0	0.0	
Portugal	-9.6	-0.3	-64.7	-2.2	No modifications were made for this source category except the update of statistical information for more recent years, and the revision of time series for grape production were an error was detected. The revision of animal numbers, explained elsewhere, had indirect effects in the quantity of nitrogen in animal manure added to soil as fertilizer or during grazing. Total changes in nitrogen added to soil were nonetheless small.
Spain	0.0	0.0	-385.6	-1.7	correction of nitrogen content in compost applied to agricultural soils; new figures for swine
Sweden	0.0	0.0	0.0	0.0	
UK	0.0	0.0	0.0	0.0	
EU-15	**-314.5**	**-0.1**	**-418.8**	**-0.2**	

6.3 Methodological issues

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 4A, 4B (both methane and nitrous oxide) and 4D (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.

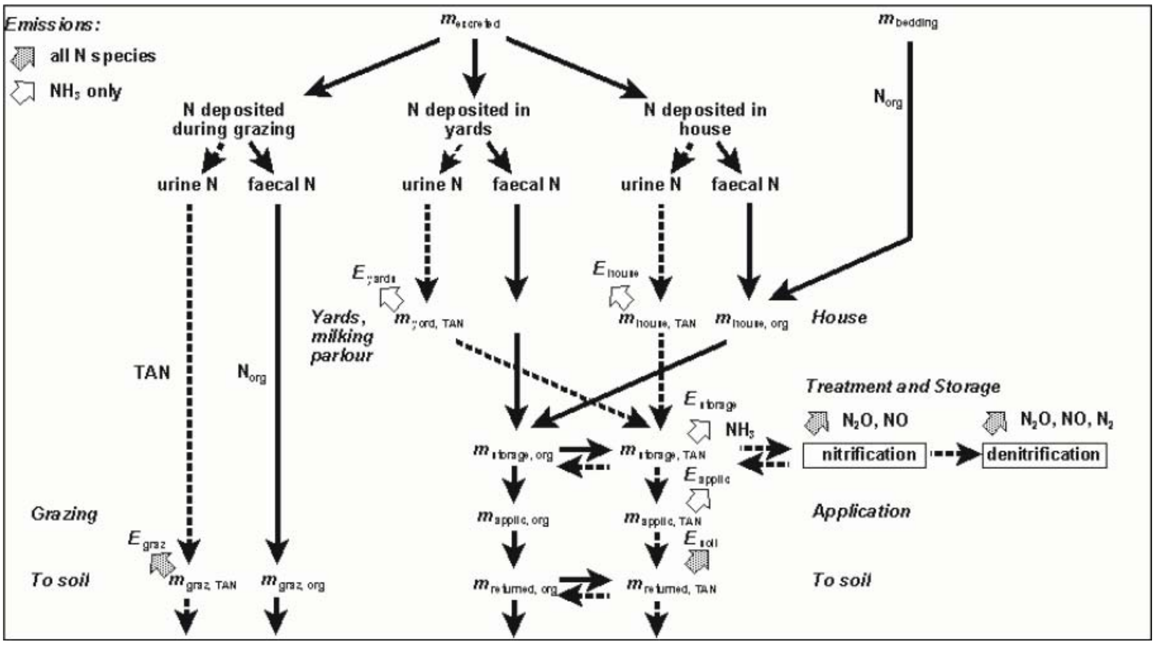
Many countries recognise that in the agriculture sector the emissions from the different categories are inherently linked and are best estimated in a comprehensive model that covers not only greenhouse gases (CH_4 and N_2O) in a consistent manner, but also ammonia. Estimations of ammonia emissions are 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., 2002). 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 is developing the calculation method towards a mass-flow approach 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 4A)

6.3.1.1. Source category description

CH_4 emissions in the source category Enteric Fermentation stem for 9 Member States to over 85% from the sub-category Cattle. Substantial emissions from the sub-category Sheep (up to 49% of emissions in category 4A.) 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 Greece for the sub-category Goats (18%min) and for the sub-category Swine (Denmark: 11%).

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 6.17. Data are given for 2005 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 6.17 Total CH_4 emissions in category 4A and implied Emission Factor at EU-15 level for the years 1990 and 2005

1990[1)]	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine
CH_4 emissions [Gg CH_4]	2532	2860	761	65	154
Animal population [1000 heads]	26356	63840	114501	12682	112532
Implied EF (kg CH_4/head/yr)	96	45	6.6	5.1	1.4

2005	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine
CH_4 emissions [Gg CH_4]	2072	2716	677	58	161
Animal population [1000 heads]	18775	57897	99274	11222	115989
Implied EF (kg CH_4/head/yr)	110	47	6.8	5.1	1.4

2005 value in percent of 1990	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine
CH4 emissions [Gg CH4]	82%	95%	89%	88%	104%
Animal population [1000 heads]	71%	91%	87%	88%	103%
Implied EF (kg CH4/head/yr)	115%	105%	103%	100%	101%

Information source: CRF for 1990 and 2005, submitted in 2007

6.3.1.2. 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 Table 6.18. Beside 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. 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. Greece uses the default values of Eastern European countries of 81 and 56 kg CH_4 head^{-1} year-1 for dairy and non-dairy cattle, respectively. We can observe that for cattle, almost all emissions are calculated with the help of country-specific data, while sheep still of the emissions are Tier 1.

On EU-15 level, 95% of the CH_4 emissions in category 4A have been estimated with a Tier 2 approach. As Table 6.18 shows, this percentage was especially high for dairy cattle, where 99% have been estimated using the Tier 2 methodology. The situation can be considered satisfying for sheep with 76% of the emissions being calculated with a Tier 2 approach.

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 are reported by 3 countries only. 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.

Table 6.18 4A Enteric Fermentation: 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	a	b	a	b	c	a	b	c
Austria	3,233	40%	Tier 2	54%	Tier 2	n	2%	Tier 1	n
Belgium	3,850	42%	Tier 2	52%	Tier 1	nr	1%	Tier 2	nr
Denmark	2,630	57%	Tier 2	27%	Tier 2	n	1%	Tier 2	n
Finland	1,577	50%	Tier 2	39%	Tier 2	n	1%	Tier 2	n
France	27,632	31%	Tier 2	61%	Tier 2	n	6%	Tier 1	n
Germany	18,342	55%	Tier 2	37%	Tier 2	nr	2%	Tier 1	nr
Greece	2,889	10%	Tier 1	22%	Tier 1	n	49%	Tier 2	n
Ireland	9,049	28%	Tier 2	63%	Tier 2	nr	9%	Tier 2	nr
Italy	10,852	40%	Tier 2	40%	Tier 2	n	12%	Tier 1	n
Luxembourg	158	64%	Tier 2	32%	Tier 2	nr	1%	Tier 2	nr
Netherlands	6,345	61%	Tier 2	29%	Tier 2	nr	4%	Tier 2	nr
Portugal	3,038	27%	Tier 2	44%	Tier 2	n	23%	Tier 2	n
Spain	13,498	15%	Tier 2	46%	Tier 2	nr	30%	Tier 2	nr
Sweden	2,804	38%	Tier 2	52%	Tier 2	nr	3%	Tier 1	nr
United Kingdom	15,934	28%	Tier 2	47%	Tier 2	n	22%	Tier 2	n
EU-15: Tier 1	5%	1%		4%			24%		
EU-15: Tier 2	95%	99%		96%			76%		

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 6.19.

Table 6.19 4A Eenteric Fermentation: Methodology used by Member States for calculating CH_4 emissions in category 4A

Member State	Methodology
Austria	The IPCC Tier 1 Method was applied for Swine, Sheep, Goats, Horses and Other Animals. For Cattle the more detailed Tier 2 method was applied.
Belgium	CH_4 emissions from enteric fermentation from animal husbandry are estimated using the Tier 1 methodology. Belgium does not use a Tier 2 methodology because data such as gross energy intake are not available and the use of Tier 2 without reliable activity data does not appear likely to reduce the overall uncertainty of the estimate.
Denmark	The emissions from the agricultural sector are calculated in a comprehensive agricultural model complex called DIEMA (Danish Integrated Emission Model for Agriculture) (Mikkelsen, 2005). 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.
Finland	Tier 1 for Horses, Swine and Goats. Tier 2 method for Cattle, since emissions from cattle (key source in Finnish inventory0. 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.
France	Emissions from Dairy Cattle are calculated using an equation developed at INRA (Tier 2+). Tier 1 other animal types. Heifers are included in Other Cattle.
Greece	*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. The daily energy requirement of cows in each region was calculated by month based on maintenance requirements, milk yield and composition, requirements for foetal growth, and gain or loss of bodyweight. 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.
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.
Spain	Cattle and Sheep: Tier 2. Other animal categories: Tier 1. If Tier 1 was used, the default emission factor for developed countries was reduced by 20% for young animals. If Tier 2 was used, some of the activity data required are not available in Spain.
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. The national methodology for Dairy Cows, Beef Cows and Other Cattle.

Activity Data

Animal population of dairy and non-dairy cattle, sheep, goat, swine, and poultry in 2005 are given in Table 6.20. The characterization of the livestock population across the background tables 4A, 4B(a), and 4B(b) is done in a consistent way by all Member States and will therefore be discussed only here. Only the number of poultry differs in the Belgian inventory between Table 4B(b) and Table 4A/Table4B(a) as the N_2O emission inventory for does not include emissions from goats, horses and mules/asses. 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 29% for dairy cattle and 9% for non-dairy cattle, and by 13% for sheep. An increase in the number of cattle has only been observed in the category of non-dairy cattle in Sweden (6%), Ireland (10%), Portugal (12%) and Spain (56%). Largest decrease of the number of dairy cattle occurred in Austria (2005 at 59% of the 1990 level). For non-dairy cattle, largest decrease occurred in Denmark (2005 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 2005 increased by 201% respective to the population in 1990; in the Netherlands this figure amounts to 381%. However, due to a decrease of the goat number in other countries with a high population (mainly Spain with a 2,905,1000 heads in 2005), the goat population at EU-15 level was rather stable (2005 at 88% of 1990-level).

The swine population was increasing especially in Denmark (42%), Spain (54%), and Ireland (38%), but this was balance from reductions in other countries. Poultry numbers saw a slight increase of 10% in EU-15; only Austria reported CH_4 emissions from enteric fermentation of poultry.

Other animal types reported in Table 4A are deer (Austria and United Kingdom), reindeer (Finland and Sweden), fur farming (Denmark, Finland) and rabbits (Portugal), other poultry (Spain), and other non-specified animals (Greece, Ireland, and Italy).

Some information on the source of the animal numbers for the different Member States is given in Table 6.21.

Table 6.20 4A Enteric Fermentation: Animal population [1000 heads] in 2005

Member State 2005	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Sw ine	Poultry
Austria	534	1,476	326	55	3,170	13,027
Belgium	744	1,954	153	26	6,318	34,715
Denmark	558	986	88	14	13,466	17,514
Finland	319	640	90	7	1,401	10,538
France	3,964	15,487	9,131	1,301	9,790	257,218
Germany	4,236	8,799	2,643	170	24,481	120,562
Greece	168	549	9,066	4,822	1,017	32,382
Ireland	1,122	5,090	6,600	8	1,680	16,057
Italy	1,842	4,410	7,954	1,046	9,201	188,595
Luxembourg	39	147	10	2	90	83
Netherlands[1)]	1,433	2,366	1,363	292	11,312	94,354
Portugal	330	1,093	3,390	473	2,313	39,242
Spain	1,028	5,398	22,749	2,905	25,244	161,342
Sw eden	393	1,212	471	6	1,811	17,154
United Kingdom	534	1,476	326	55	3,170	13,027
EU-15	18,775	57,897	99,274	11,222	115,989	1,173,018

Information source: CRF for 1990 and 2005, submitted in 2007

[1)] For non-dairy cattle, the number represents the sum of mature non-dairy and young cattle

Table 6.21 4A Enteric Fermentation: Information on the source of animal population data ta

Member State	Activity Data
Austria	The Austrian official statistics (Statistic Austria, 2004) provides national data of annual livestock numbers on a very detailed level. In 1998-2002 increasing/ decreasing swine numbers, 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).
Belgium	The main activity data are the land-use and the livestock figures. The National Institute of Statistics (NIS) publishes these numbers yearly. 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. 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	Activity data and emission factors are collected and discussed in cooperation with specialists and researchers in various institutes, such as the Danish Institute of Agricultural Sciences, Statistics Denmark, the Danish Agricultural Advisory Centre (DAAC), the Danish Plant Directorate and the Danish Environmental Protection Agency. 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 DAAC, as Statistics Denmark does not include farms less than 5 hectares. The Danish Institute of Agricultural Sciences (FAS) delivers Danish standards related to feed consumption, manure type in different stable types, nitrogen content in manure, etc.
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. Cattle is not used for work in Finland.
France	Agricultural statistics are issued by the ministry of agriculture (SCEES/AGRESTE). Calculation of methane emissions according the population numbers. Activity data is a one year average.
Germany	A complete animal census at the "Kreise" level is available for every second year in the official agricultural statistics. 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.
Greece	Data on animal population, agricultural production and cultivated areas used for the emissions calculation were provided by the NSSG. As far as animal population for years 2002 – 2004 is concerned, data are calculated by extrapolation based on the existed data of the previous 10 years, as no provisional estimations exist. 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, 2005). 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. For the rice cultivation and enteric fermentation (buffalo) categories have been contacted the C.R.A.3 – Experimental Institute of Cereal Research – Rice Research Section of Vercelli and the University of Napoli "Federico II".
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 (e.g. Smink et al., 2005; Van der Hoek and Van Schijndel, 2006). 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).
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) from 1987 to 2004 for Cattle, Swine, Sheep, Goats, Horses, Mules and Donkeys, dissagregated per region 96, 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.
United Kingdom	The animal population data are collected in an annual census (Defra). Dairy Cattle - changed animal weights with data from Steve Walton, Defra stats. Pre-1995 is corrected home killed slaughter weights

Member State	Activity Data
	(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).

Emission Factors and other parameters

Considerable variation is found in the IEF for dairy and non-dairy cattle with values between 81 kg CH_4 head^{-1} yr^{-1} (Greece) and 129 kg CH_4 head^{-1} yr^{-1} (Sweden) for dairy cattle, and 31 kg CH_4 head^{-1} yr^{-1} (Luxembourg2) and 58 CH_4 head^{-1} yr^{-1} (Portugal) for non-dairy cattle. The difference can mainly be explained by the different levels of intensity for dairy production and will be discussed below. The IEF for the EU-15 Member States and the CH_4 conversion factors used are given in Table 6.22.

At the aggregated level for EU-15, the implied emission factor for dairy cattle increase from 96 kg CH_4 head^{-1} yr^{-1} to 110 kg CH_4 head^{-1} yr^{-1} while at the same time the animal number of dairy cattle decreased by 29%, resulting in a decrease of European CH_4 emissions from enteric fermentation in the category of dairy cattle by Dairy Cattle.

Note however, that the increase of the implied emission factor of 15% for dairy cattle is due to changes reported in 13 countries, whereas only 13 countries have used a fixed implied emissions factor. For non-dairy cattle, also 13 countries have used a time-varying implied emission factor. This, however, is 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 3% between 1990 and 2005 from 46.9 kg CH_4 head^{-1} yr^{-1} to 48.5 kg CH_4 head^{-1} yr^{-1}. It decreased in 5 countries (Denmark, Germany, Italy, Netherlands, United Kingdom). The maximum decrease was observed in Denmark by 28%.

For sheep, the implied emission factors changed since 1990 in 7 countries, but stayed close to the 1990-value for EU-15. Only Finland and Portugal saw a substantial increase of the IEF for sheep by 21% and 16%, respectively. Note that the IEF for sheep and goats used in Denmark (Tier 2 methodology) is with 17.2 kg CH_4 head^{-1} yr^{-1} and 13.2 kg CH_4 head^{-1} yr^{-1} considerably higher than the IPCC default values and the numbers used in other Member States. The CH_4 conversion factor is IPCC default for most Member States. This is explained by the fact that a Tier 2 approach has been followed including lambs and kids in the numbers for sheep and goats, respectively.

More detailed information on the development of the emission factors for category 4A is given in Table 6.23.

Table 6.22 4A-Enteric Fermentation: 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)]						CH_4 conversion (%) [1)]				
2005	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine		Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine
Austria	115	56	8.0	5.0	1.5		6.0	6.0	6.0	5.0	0.6
Belgium	103	48	8.2	8.6	1.5		NE	NE	NE	NE	NE
Denmark	128	35	17.2	13.2	1.1		5.9	5.9	6.0	5.0	0.6
Finland[1)]	119	45	8.2	5.0	1.5		6.0	6.0	NA	NA	NA
France	104	52	8.0	5.0	1.5		NA	NA	NA	NA	NA
Germany	113	37	8.0	5.0	1.3		6.0	5.5	6.0	5.0	0.6
Greece	81	56	7.4	5.0	1.5		NE	NE	5.1	NE	NE
Ireland	107	53	5.8	5.0	0.4		6.0	6.0	7.0	NE	NE
Italy	113	46	8.0	5.0	1.5		6.0	4.4	NA	NA	NA
Luxembourg[2)]	122	31	7.9	4.6	1.5		6.0	6.0	6.0	5.0	0.6
Netherlands[2)]	128	37	8.0	5.1	1.5		NE	NE	NE	NE	NE
Portugal	118	58	9.6	7.6	1.4		6.0	5.9	6.0	5.0	0.6
Spain[3)]	94	54	8.6	5.0	1.5		5.5	5.3	0.1	NA	NA
Sweden	129	57	8.0	5.0	1.5		6.7	7.0	6.0	5.0	0.6
United Kingdom	104	43	4.7	5	2		6.0	6.0	NE	5	1
EU-15	110	46.9	7	5	1		5.5	4.9	3.0	5.0	0.6

Information source: CRF for 1990 and 2005, submitted in 2007. 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). [3)] The values for the CH4 conversion were given as a fraction for Spain and have been multiplied by 100.

Table 6.23 4A Enteric Fermentation: Member State's background information for CH_4 emissions in category 4A Emission Factor and other parameters

Member State	Emission Factor and other parameters
Austria	Country specific emission factors for cattle were used. They were calculated from the specific gross energy intake and the methane conversion rate. The methane conversion rate (Ym) was taken from the IPCC recommended value for "all other cattle" (0.06 +/- 8.3%) because there are few if any feedlot cattle with a high-energy diet. Austrian specific values for dairy cows were derived from feed intake data and energy content of feed (forage and concentrate) in dependency of annual milk yields (Gruber and Steinwidder, 1996; Poetsch et al. 2005). For suckler cows, a constant average milk yield of 3 000 kg was applied. This results in a Gross Energy Intake of 235.3 MJ per suckling cow and day. Emissions from deer were estimated applying the default emission factor of sheep. For the calculation of emissions from poultry the IPCC Tier 2 method with Swiss emission factors (Gross Energy Intake, Methane Conversion Rate) was used. For the calculation of emissions from category Poultry the IPCC Tier 2 method with Swiss emission factors (Gross Energy Intake, Methane Conversion Rate) was used (Minonzio, 1998). The animal category Other livestock corresponds to Deer with default EF used for sheep.
Belgium	The IPCC emission factors are used for most animal categories. In Wallonia, the emission factor for dairy cattle, which is the most important subcategory in this sector, is adjusted regarding the increasing milk production. The resulting EF is very close to the IPCC default, from 100 kg CH_4/yr in 1990, with an average milk production of 4 021 litres, to 110 kg CH_4/yr in 2004, with a milk production of 5 222 litres.
Denmark	The implied emission factors for all animal categories are based on the Tier 2 approach. Feed consumption for all animal categories is based on the Danish normative figures (Poulsen et al. 2001). Default values for the methane conversion rate (Ym) given by the IPCC are used for all livestock categories, except for dairy cattle and heifers, where a national Ym is used for all years. New investigations from FAS have shown a change in fodder practice from use of sugarbeets to use of maize. Research showed that sugar beets as feeding stuff is resulting in a higher methane conversion rate than the default values. The Danish 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.
Finland	IPCC default emission factors were used for calculating CH_4 emissions from enteric fermentation of swine, goats and horses (Tier 1 method). National emission factors were calculated with the Tier 2 method for cattle by using IPCC equations. 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, respectively. 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.
France	Emission Factors: values IPCC for each type of the Cattle. The EF for Dairy Cattle, is depending to the milk production.
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. The latter (grass/grass silage or maize/maize silage) is derived from the regional approach. 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	In certain cases the emission factor was not calculated for a full year period, but rather for the period that actually corresponds to the given activity. Default factors of Eastern Europe were chosen, based on data from NSSG regarding the rate of milk production per animal, which fluctuates from 2500 kg to 3530 kg for the period 1990 – 2000.
Ireland	The Tier 2 emission factors for the 11 animal categories was initially carried out for the 2003 herd and then repeated for 1990 and 1994. 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 MidetAIRaneo 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.
Netherlands	The emission factors for three cattle types are calculated annually (e.g. adult dairy, adult non-dairy and young cattle, respectively. For both adult dairy and adult non-dairy cattle during the period 1990–2005 IEF increased as a result of an increase in total feed intake and of changes in the share of feed components. For dairy cattle also a change in the feeds nutrient composition influenced the IEF. The slightly lower Dutch IEF compared to the default IPCC IEF for adult dairy cattle at a comparable milk production rate (e.g. 7400 kg per cow per year in 2000) can be explained by the higher feed digestibility in the Netherlands. 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. For all other animal types the existence of an enhanced livestock population and animal characteristics allowed the use of a higher methodology level, Tier

Member State	Emission Factor and other parameters
	2. Following the recommendations from previous review processes, a tier 2 analysis was seek for the most significant animal types.
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 steps 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	The emission factors for Beef and Other Cattle were calculated using the IPCC Tier 2 procedure but do not vary from year to year. The enteric emission factors for Beef cattle were almost identical to the IPCC Tier 1 default so the default was used in the estimates. The emission factor for Lambs is assumed to be 40% of that for adult Sheep (Sneath, 1997).

Milk productivity is one of the most important factors determining the level of CH_4 emissions by dairy cattle. Several countries have reported milk productivity, which are reproduced in Table 6.24 and Table 6.25 beside information on feed intake, animal weight, and feed digestibility. The data show clearly a strong intensification of the milk yield, ranging from 16% (Ireland) to 116% (Germany). This is thus more than the increase in the CH_4 emission factor. This can be explained that the increased production was only partly achieved by increased energy intake (up to a maximum of 31%, 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 2 do, compared to 11 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 EU-15 the numbers are 18% and 42%, 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 -47% than the default value for Western Europe (11.5 kg/day) in 1990, and increased to a level which was -25% above IPCC default in 2005. Even though feed digestibility for dairy cattle was not separately estimated for each year by all countries, the level is 11% to 14% above IPCC default (60%) digestibility.

Table 6.24 4A Enteric Fermentation: Additional background information for calculating CH_4 emissions from enteric fermentation from dairy cattle

Member State	Dairy Cattle			
2005	Feed Intake[1)]	Animal Weight (kg)	Milk prod.[1)]	Feed Digest. (%)
Austria	292	700	16	70
Belgium	NE	NE	NE	
Denmark	329	575	23	71
Finland	302	572	21	70
France	NA	NA	0	NA
Germany	288	590	0	66
Greece	NE	NE	14	
Ireland	227	535	13	NE
Italy	287	603	17	65
Luxembourg	310	650	18	66
Netherlands	NE	NE	NE	NE
Portugal	300	NE	17	60
Spain	262	648	18	71
Sweden	339	NE	NE	NE
United Kingdom	263	577	19	74
EU-15	280	593	9	68

Member State	Dairy Cattle			
1990	Feed Intake[1)]	Animal Weight (kg)	Milk prod.[1)]	Feed Digest. (%)
Austria	248	700	10	66
Belgium	NE	NE	NE	
Denmark	278	575	17	71
Finland	247	503	16	70
France	NA	NA	0	NA
Germany	241	539	0	63
Greece	NE	NE	9	
Ireland	227	535	11	NE
Italy	236	603	12	65
Luxembourg	310	650	18	66
Netherlands	NE	NE	NE	NE
Portugal	241	NE	12	60
Spain	200	642	10	71
Sweden	339	NE	NE	NE
United Kingdom	224	550	14	74
EU-15	238	570	6	67

Information source: CRF for 1990 and 2005, submitted in 2007. Abbreviations explained in the Chapter 'Units and abbreviations'.

1) Unit for feed intake: MJ/head/yr; unit for Milk productivity: kg/day/head.

Table 6.25 4A Enteric Fermentation: Additional background information for calculating CH_4 emissions from enteric fermentation from non-dairy cattle

Member State	Non-dairy Cattle			
2005	Feed Intake[1)]	Animal Weight (kg)	Milk prod.[1)]	Feed Digest. (%)
Austria	142	428	NO	72
Belgium	NE	NE	NE	
Denmark	106	325	NO	78
Finland	116	354	4	
France	NA	NA	NA	NA
Germany	96	270	NE	72
Greece	NE	NE	NE	NE
Ireland	139	500	13	NE
Italy	140	384	NA	NA
Luxembourg	42	430	NA	NE
Netherlands	NE	IE	NE	NE
Portugal	150	440	3	62
Spain	154	468	1	70
Sweden	181	NE	NE	NE
United Kingdom	189	NE	NE	
EU-15	143	388	7	71

Member State	Non-dairy Cattle			
1990	Feed Intake[1)]	Animal Weight (kg)	Milk prod.[1)]	Feed Digest. (%)
Austria	123	364	NO	74
Belgium	NE	NE	NE	
Denmark	107	325	NO	78
Finland	103	283	4	
France	NA	NA	NA	NA
Germany	93	249	NE	73
Greece	NE	NE	NE	NE
Ireland	139	500	11	NE
Italy	141	376	NA	NA
Luxembourg	32		NA	NE
Netherlands	NE	IE	NE	NE
Portugal	130	355	2	62
Spain	155	460	1	69
Sweden	181	NE	NE	NE
United Kingdom	189	NE	NE	
EU-15	136	346	7	72

Information source: CRF for 1990 and 2005, submitted in 2007. Abbreviations explained in the Chapter 'Units and abbreviations'.

1) Unit for feed intake: MJ/head/yr; unit for Milk productivity: kg/day/head.

Trends

Figure 6.4 through Figure 6.9 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 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.

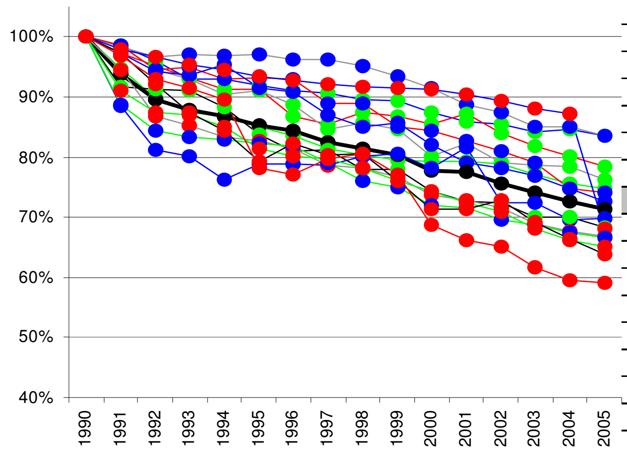
For example, in the Netherlands, cattle and swine number decreased between 1990 and 2005 by 23 and 19% respectively, while poultry numbers hardly changed. Sheep numbers decreased by 20%. Goat numbers increased by 479% and horse numbers increased by 91%. For cattle the decrease in numbers is mainly explained by an increase in milk production per dairy cow combined with an unchanged total milk production. Milk production per cow increased between 1990 and 2005, 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. Between 1990 and 2005 the numbers of young (dairy) cattle follow the same trends as those of adult female cattle – namely, a decrease (Van der Hoek and Van Schijndel, 2006).

One reason for the sharp decrease of emissions from agriculture in Finland is its membership in the EU that 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). Those changes caused also a decrease in the livestock numbers except in the number of horses and swine that has increased in the recent years. The number of dairy cattle, for example, declined from 490 000 in 1990 to 319 000 in 2005. Emissions from other livestock decreased during 1990-2001 but have been increasing slightly since 2002 due to increasing number of swine and horses. Coefficient 1.03 has been used to express the amount of milk produced as kg/animal/yr for the whole time series. The milk production of suckler cow has been estimated to remain constant in 1990-2005 being 1620 kg/yr. Average daily weight again for cattle was estimated to remain constant in 1990-2005 being 0 for dairy cow and suckler cow, 1.1 for bull, 0.7 for heifer and 0.85 kg for calf.

In 2005, the number of agricultural and horticultural businesses in Belgium amounted to 51.540. This number had dropped by 17 % in 5 years, the disappearing of small businesses being a general trend in the sector, also reinforced by the successive crises that have hit the agricultural sector (BSE [Bovine Spongiform Encephalitis], dioxin). 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 18 ha per farm in the Flemish region and 44 ha per farm in the Walloon region.

Figure 6.4 4A Enteric Fermentation: Activity data for dairy cattle

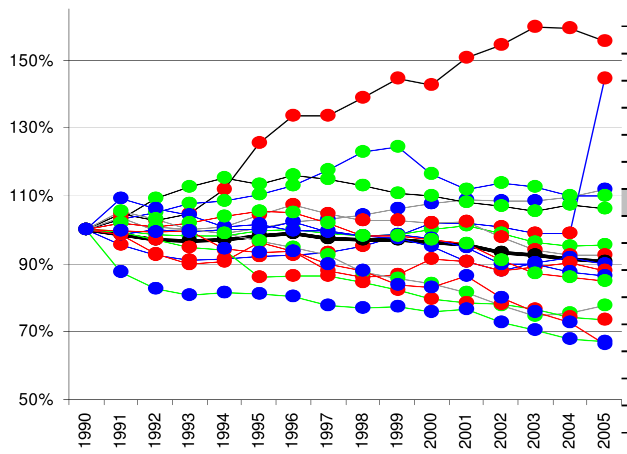
Dairy Cattle: Population size (1000 head)



	1990	Trend (%) 1990-2005	2005
Ireland	1,342	84%	1,122
Portugal	394	84%	330
Belgium	950	78%	744
Netherlands	1,878	76%	1,433
France	5,310	75%	3,964
Denmark	753	74%	558
United Kingdom	2,847	73%	2,065
EU-15	26,356	71%	18,775
Italy	2,642	70%	1,842
Sweden	576	68%	393
Greece	246	68%	168
Luxembourg	59	67%	39
Germany	6,355	67%	4,236
Finland	490	65%	319
Spain	1,611	64%	1,028
Austria	905	59%	534

Figure 6.5 4A Enteric Fermentation: Activity data for non-dairy cattle

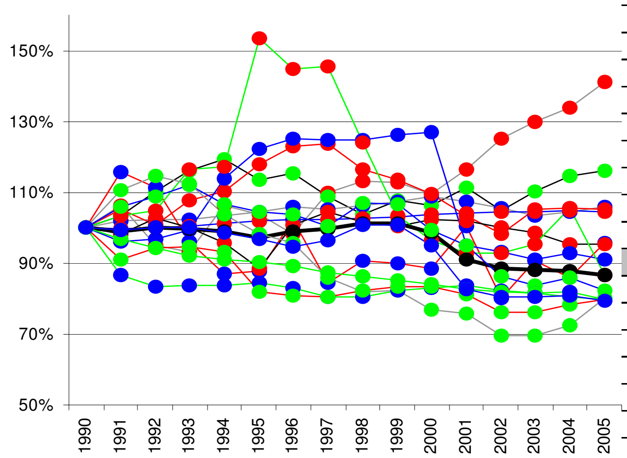
Non-dairy cattle: Population size (1000 head)



	1990	Trend (%) 1990-2005	2005
Spain	3,469	156%	5,398
Greece	380	145%	549
Portugal	978	112%	1,093
Ireland	4,628	110%	5,090
Sweden	1,142	106%	1,212
France	16,227	95%	15,487
Luxembourg	159	92%	147
EU-15	63,840	91%	57,897
United Kingdom	9,232	90%	8,289
Austria	1,679	88%	1,476
Italy	5,110	86%	4,410
Belgium	2,298	85%	1,954
Netherlands	3,048	78%	2,366
Finland	870	74%	640
Germany	13,133	67%	8,799
Denmark	1,486	66%	986

Figure 6.6 4A Enteric Fermentation: Activity data for sheep

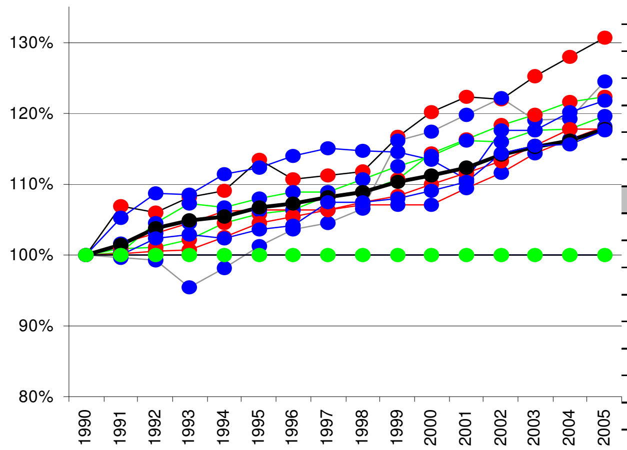
Sheep: Population size (1000 head)



	1990	Trend (%) 1990-2005	2005
Luxembourg	7	141%	10
Sweden	406	116%	471
Portugal	3,197	106%	3,390
Austria	310	105%	326
Greece	8,692	104%	9,066
Denmark	92	96%	88
Spain	23,822	95%	22,749
Italy	8,739	91%	7,954
Finland	103	87%	90
EU-15	114,501	87%	99,274
Ireland	8,021	82%	6,600
Netherlands	1,702	80%	1,363
Germany	3,310	80%	2,643
Belgium	192	80%	153
France	11,439	80%	9,131
United Kingdom	44,469	79%	35,241

Figure 6.7 4A Enteric Fermentation: Activity data for dairy cattle

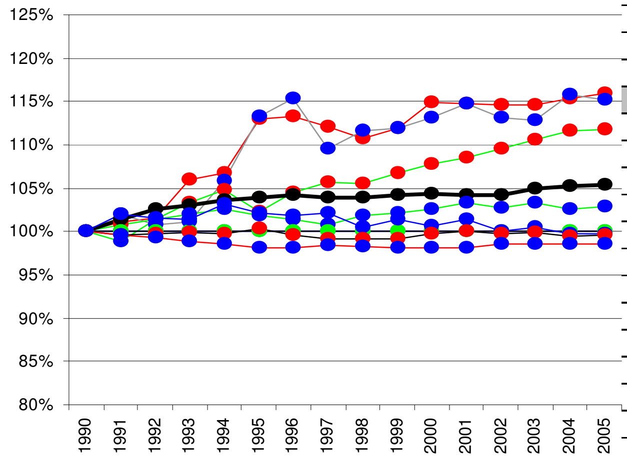
Dairy Cattle: Average gross energy intake (GE) (MJ/head/day)



	1990	Trend (%) 1990-2005	2005
Spain	200	131%	262
Portugal	241	124%	300
Finland	247	122%	302
Italy	236	122%	287
Germany	241	120%	288
Denmark	278	118%	329
Austria	248	118%	292
EU-15	238	118%	280
United Kingdom	224	118%	263
Ireland	227	100%	227
Sweden	339	100%	339
Luxembourg			
Greece			
France			
Belgium			
Netherlands			

Figure 6.8 4A Enteric Fermentation: Activity data for non-dairy cattle

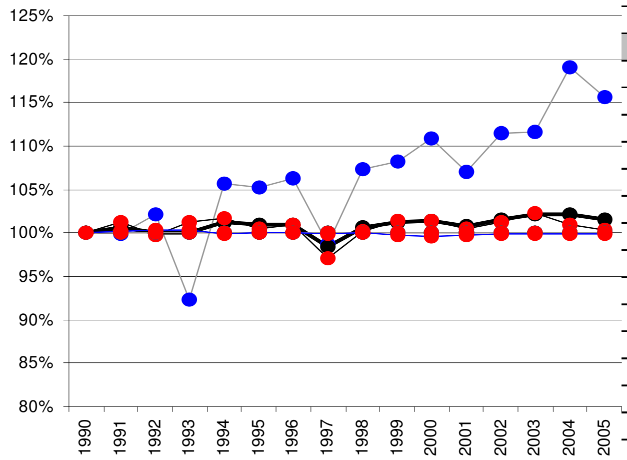
Non-Dairy Cattle: Average gross energy intake (GE) (MJ/head/day)



	1990	Trend (%) 1990-2005	2005
Austria	123	116%	142
Portugal	130	115%	150
Finland	103	112%	116
EU-15	136	105%	143
Germany	93	103%	96
United Kingdom	189	100%	189
Ireland	139	100%	139
Sweden	181	100%	181
Italy	141	100%	140
Spain	155	100%	154
Denmark	107	99%	106
Luxembourg			
Greece			
France			
Belgium			
Netherlands			

Figure 6.9 4A Enteric Fermentation: Activity data for sheep

Sheep: Average gross energy intake (GE) (MJ/head/day)



	1990	Trend (%) 1990-2005	2005
Portugal	21	116%	24
EU-15	20	102%	20
Spain	19	100%	19
Austria	20	100%	20
Germany	20	100%	20
Ireland	20	100%	20
Sweden	20	100%	20
Denmark	44	100%	44
Luxembourg	20	100%	20
Greece	22	100%	22
Finland			
United Kingdom			
Italy			
France			
Belgium			
Netherlands			

6.3.1.3. Uncertainty and time series consistency

CH_4 emissions from enteric fermentation belong to the source category in agriculture, which are less uncertain. Animal numbers are assumed to be correct with a maximum uncertainty of 10%, 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).

The contribution of enteric fermentation to the overall inventory uncertainty is generally less than 1%, only Ireland and France report a contribution of 2.7% and 2.3% to the total inventory uncertainty, respectively.

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). 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 %. In the United Kingdom, the time-series consistency of these activity data is very good due to the continuity in data provided.

6.3.2 Manure Management (CH_4) (CRF source category 4B(a))

6.3.2.1. Source category description

Table 6.26 shows that at the European level, swine and cattle contribute more or less equally to CH_4 emissions from manure management (46% and 47% 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 28% and 18%, respectively. The highest contribution of cattle to CH_4 emissions from manure management are observed in Ireland (74%) and the United Kingdom (73%); the lowest in Portugal and Spain, where cattle contribute with only 5%. This is compensated with the emissions from swine manure with 90% of the total CH_4 from manure management. As also for enteric fermentation, significant emissions from sheep and goat occur in Greece with 10% and 3.5% of total CH_4 from manure management, respectively. Greece has also the highest contribution of poultry to CH_4 emissions from manure management with 15%.

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 4B(a) Manure Management: Total CH_4 emissions in category 4B(a) and implied Emission Factor at EU-15 level for the years 1990 and 2005

	Dairy Cattle	Non-dairy cattle	Swine
	1990		
Total Emissions of CH_4 [Gg CH_4]	452	642	872
Total Population [1000 heads]	26356	63840	112532
Implied Emission Factor [kg CH_4 / head / year]	17.1	10.1	7.8

	Dairy Cattle	Non-dairy cattle	Swine
	2005		
Total Emissions of CH_4 [Gg CH_4]	379	579	991
Total Population [1000 heads]	18776	57897	115984
Implied Emission Factor [kg CH_4 / head / year]	20.2	10.0	8.5

	Dairy Cattle	Non-dairy cattle	Swine
	2005 value in percent of 1990		
Total Emissions of CH_4 [Gg CH_4]	84%	90%	114%
Total Population [1000 heads]	71%	91%	103%
Implied Emission Factor [kg CH_4 / head / year]	118%	99%	110%

Source of information: CRF Table4s1 and 4.B(a) for 1990 and 2005, submitted in 2007

Dairy cattle includes Mature Dairy cattle, Non-dairy cattle includes Mature Non-Dairy Cattle and Young Cattle

6.3.2.2. 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 4B(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 AWMS-climate region combination. 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. If the estimation procedure contains significant country-specific elements, then we assign Tier 2. The following approach was applied to assign to each country/animal type the Tier 1 or Tier 2 methodology. Tier 2 approach was assigned if at least one of the parameters used (VS, B_0, or MCF) is different than the IPCC default value. 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. According to this definition, 95% of the emissions in category 4B(a) are calculated with country-specific data. 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.

Table 6.27 **4B(a) Manure Management: Total emissions and contribution of the main sub-categories to CH_4 emissions, 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	a	b	a	b	c	a	b	c
Austria	881	26%	Tier 2	26%	Tier 2	n	45%	Tier 2	n
Belgium	2,389	15%	Tier 1	23%	Tier 1	nr	56%	Tier 1	nr
Denmark	1,016	22%	Tier 2	3%	Tier 2	n	71%	Tier 2	n
Finland	278	32%	Tier 2	12%	Tier 2	n	37%	Tier 2	n
France	12,972	12%	Tier 2	50%	Tier 2	n	33%	Tier 2	n
Germany	4,954	34%	Tier 2	30%	Tier 2	nr	31%	Tier 2	nr
Greece	519	13%	Tier 2	29%	Tier 2	n	29%	Tier 2	n
Ireland	2,224	22%	Tier 2	52%	Tier 2	nr	20%	Tier 2	nr
Italy	3,150	18%	Tier 2	22%	Tier 2	n	46%	Tier 2	n
Luxembourg	79	22%	Tier 2	9%	Tier 2	nr	65%	Tier 2	nr
Netherlands	2,459	46%	Tier 2	13%	Tier 2	nr	38%	Tier 2	nr
Portugal	1,159	3%	Tier 2	3%	Tier 2	n	89%	Tier 2	n
Spain	8,871	4%	Tier 2	1%	Tier 2	nr	90%	Tier 2	nr
Sweden	479	32%	Tier 2	33%	Tier 2	nr	27%	Tier 2	nr
United Kingdom	2,509	44%	Tier 2	29%	Tier 2	n	12%	Tier 2	n
EU-15: Tier 1	5%	4%		4%			6%		
EU-15: Tier 2	95%	96%		96%			94%		

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)

Some additional information on the methodological approaches for some Member States is given in Table 6.28.

Table 6.28 4B(a) Manure Management: Member State's background information for the calculation of CH_4 emissions

Member State	Methods
Austria	The IPPC-Tier 2 methodology is applied to estimate CH_4 emissions from manure management of cattle and swine as these are key sources. Sheep, Goats, Horses and Other Soliped, Chicken, Other Poultry and Other animals are of minor importance in Austria, therefore the CH_4 emissions of these livestock categories are estimated with the Tier 1 approach.
Belgium	CH_4 emissions from manure management in Flanders are estimated using the Tier 2 method. 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. Since 1996 Flanders has got a Manure Action Plan (MAP), which foresees in processing of the surplus of manure (based on the Nitrate Directive). 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, 2005). 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. Biogas plants using animal slurry reduce the emissions of CH_4 and N_2O (Sommer, 2001). In 2005, approximately 7% were treated in biogas plants (DEA 2005). The reduction in the CH_4 emission is based on model calculations for an average size biogas plant with a capacity of 550 m3 per day. For methane, a reduction of 30% for cattle slurry and 50% for pig slurry is obtained (Nielsen et al. 2002, Sommer et al. 2001).
Finland	The Tier 2 is used for all animal categories. Cattle category includes emissions from Dairy. Emissions from Non-dairy are reported under other livestock (Suckler Cows, Bulls, Heifers, Calves).
France	Tier 1+. AWMS distribution national on the basis of a survey carried out in 1994. Milk heifers are counted with Non-dairy cattle. But heifers more than 2 years old (40% of the total heifer livestock) are considered as Dairy cattle. Other parameters are from IPCC.
Germany	As detailed data for the application of the Tier 2 methodology are missing, emissions are estimated using the "improved" CORINAIR/EMEP methodology (Daemmgen et al., 2007). The emission factors represent the general situation in Germany. Calculations are done at the district level.
Greece	IPCC Tier 1 methodology.
Ireland	The analysis of the feeding regime for cattle included a full evaluation of the organic matter content of the feeds applicable to the 11 categories that characterise the national herd, which facilitated the estimation of their respective levels of organic matter excretion.
Italy	Methane emission factors for manure management have been calculated for cattle, buffalo and swine with the IPCC Tier 2 approach. For estimating slurry and solid manure management emission factors and specific conversion factors, detailed methodologies (Method 1) for cattle and buffalo categories have been applied at a regional basis.a simplified methodology, for estimating emission factors time series, has been applied (Method 2). For both, Method 1 and Method 2, the average production of slurry and solid manure per livestock category per day (m3 $head^{-1}$ day^{-1}) has been updated according to results from the Inter-regional project on nitrogen balance. For the estimation of swine methane emissions a country-specific methane emission rate has been experimentally determined at the Research Centre on Animal Production (CRPA, 1996).
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, whereas in the IPCC method the emission factor is expressed as the amount of methane (in kg) emitted per animal per year. A Tier 2 approach is followed for CH_4 emissions. The amounts of manure (in kilogrammes) produced are calculated annually for every manure management system per animal category. Country-specific CH_4 emission factors are calculated 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).
Portugal	All animal types: Tier 2. Emission factors by animal type and climatic conditions.
Spain	Tier 2 for beef and pork herds, Tier 1 for other animal categories using smooth temperature functions for the MCF and EF (modification accepted by IPCC). Management systems: own expert calculation.
Sweden	Tier 2 for Cattle and Swine, Tier 1 methodology is used for other animal groups.
United Kingdom	Cattle, Lambs and Deer: Tier 2; other: Tier 1. For Dairy cattle, the calculations are based on the population of the 'dairy breeding herd' rather than 'Dairy cattle in milk' used in earlier inventories. The former definition includes 'cows in calf but not in milk'. 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.

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 2005 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 and Ireland 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 Austria 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 52% in 2005). The trend for non-dairy cattle goes into the other direction in Sweden with a decreasing portion of manure managed in liquid systems (18% in 1990 and 16% in 2005) and increasing use of solid storage systems.

Table 6.29 **4B(a) Manure Management: Member State's Allocation of Animal Waste Management Systems over liquid systems, solid storage and dry lot, and pasture range and paddock in 2005**

Member State	Dairy Cattle - Allocation of AWMS (%)			Non-Dairy Cattle - Allocation of AWMS (%)			Swine - Allocation of AWMS (%)		
2005	Liquid system[1)]	Solid storage and dry lot	Pasture range paddock	Liquid system[1)]	Solid storage and dry lot	Pasture range paddock	Liquid system[1)]	Solid storage and dry lot	Pasture range paddock
Austria	19%	70%	11%	24%	66%	10%	72%	28%	NO
Belgium	32%	68%		16%	84%		77%	22%	
Denmark	NO	NO	NO	NO	NO	NO	NO	NO	NO
Finland	45%	27%	28%	NO	NO	NO	60%	40%	NA
France	11%	42%	47%	37%	23%	40%	83%	17%	0%
Germany	65%	20%	15%	54%	33%	14%	86%	14%	
Greece		90%	8%		62%	33%	90%	10%	
Ireland	41%	3%	56%	23%	12%	65%	100%	NO	NO
Italy	38%	57%	5%	56%	41%	3%	100%	NA	NA
Luxembourg	19%	36%	45%	23%	28%	50%	95%	5%	
Netherlands	NO	NO	NO	NO	NO	NO	NO	NO	NO
Portugal	46%	24%	30%	NO	20%	80%	94%	2%	4%
Spain	15%	60%			37%	63%	46%	50%	4%
Sweden	52%	24%	24%	16%	24%	44%	72%	21%	NO
United Kingdom	31%	10%	46%	6%	21%	50%	31%	55%	7%
EU15	37%	33%	29%	32%	29%	35%	82%	17%	1%

Source of information: CRF 4.B(a) for 2005, submitted in 2007. Abbreviations explained in the Chapter 'Units and abbreviations'.
[1)] Anaerobic lagoon + Liquid system. Anaerobic lagoon contributes significantly only in Spain with 25% and in Ireland with 2% of the manure managed.

Table 6.30 4B(a) Manure Management: : 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]	Solid storage and dry lot	Pasture range paddock	Liquid system[1]	Solid storage and dry lot	Pasture range paddock	Liquid system[1]	Solid storage and dry lot	Pasture range paddock
Austria	19%	70%	11%	25%	66%	9%	71%	29%	NO
Belgium	30%	70%		16%	85%		75%	24%	
Denmark	NO	NO	NO	NO	NO	NO	NO	NO	NO
Finland	22%	50%	28%	NO	NO	NO	45%	55%	NA
France	11%	42%	47%	36%	23%	40%	83%	17%	0%
Germany	51%	29%	20%	57%	32%	10%	84%	16%	
Greece		90%	8%		62%	33%	90%	10%	
Ireland	41%	3%	56%	23%	12%	65%	100%	NO	NO
Italy	38%	57%	5%	58%	40%	2%	100%	NA	NA
Luxembourg	19%	36%	45%	23%	28%	50%	95%	5%	
Netherlands	NO	NO	NO	NO	NO	NO	NO	NO	NO
Portugal	35%	35%	30%	NO	28%	72%	95%	3%	2%
Spain	15%	60%			32%	68%	49%	50%	1%
Sweden	23%	54%	22%	18%	34%	39%	44%	52%	NO
United Kingdom	31%	10%	46%	6%	21%	50%	31%	55%	7%
EU15	32%	37%	29%	35%	30%	31%	78%	21%	1%

Source of information: CRF 4.B(a) for 1990, submitted in 2007

Abbreviations explained in the Chapter 'Units and abbreviations'.

[1] Anaerobic lagoon + Liquid system. Anaerobic lagoon contributes significantly only in Spain with 25% and in Ireland with 2% of the manure managed.

For some countries, background information on in addition to what is reported in Table 6.21 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 4B(a) Manure Management: Member State's background information on the allocation to animal waste management systems used for the calculation of CH_4 and N_2O emissions

Member State	Activity data
Austria	In Austria national statistics on manure management systems are not available. Up to now, only one comprehensive survey has been carried out. This manure management system distribution was used for the whole period from 1990-2005. Manure management systems are distinguished for Dairy Cattle, Suckling Cows and Cattle 1–2 years in "summer situation" and "winter situation". During the summer months, a part of the manure from these livestock categories is managed in "pasture/range/paddock". The value for "pasture/range/paddock" is estimated as follows: During summer, 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	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	The distribution to AWMS is for the first time received from the Danish Plant Directorate and are reflecting the situation of 2005. Previous they were based on expert judgement from the Danish Agricultural Advisory Centre (DAAC). As 90-95% of farmers in Denmark are members of DAAC, which collects regularly statistics, the data were considered to be reliable and are in good accordance with the new data.
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.
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.
Netherlands	Specified data on manure management are based on statistical information on management systems; these data are documented in Van der Hoek and Van Schijndel, 2006.
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. (see below).

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. The ratio of the highest and the smallest IEF used by the Member States is 8 for dairy cattle, and 17 for non-dairy cattle and 13, 12, and 8 for sheep, goats and swine, respectively. The highest IEF for dairy cattle is used by Netherlands with 37.5 kg CH_4/head/year and the smallest by Portugal with 4.6 kg CH_4/head/year.

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. It therefore astonishing that Portugal reports the smallest IEF for dairy cattle in view that 46% of the manure are managed in liquid systems and country has one of the largest share of temperate climate regions. Indeed, when calculating a "default" factor on the basis of the allocations to climate regions and AWMS as reported by the Member States and using default values for MFCs for the 14 countries for which the required information is available, Portugal ranks eleventh after Sweden and Germany, which have the largest share of liquid systems.

Table 6.32 4B(a) Manure Management: : Implied Emission factors for CH_4 emissions from manure management used in Member State's inventory 2005

Member State	Implied EF (kg CH_4/head/yr)				
2005	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Sw ine
Austria	20.4	7.4	0.19	0.12	6.0
Belgium	22.5	13.7	1.41	1.47	10.1
Denmark	18.9	1.7	0.32	0.26	2.5
Finland[1)]	13.3	2.5	0.19	0.12	3.5
France	18.3	19.9	0.28	0.18	20.8
Germany	18.9	8.0	0.19	0.12	3.0
Greece	19.0	13.0	0.28	0.18	7.0
Ireland	20.3	10.9	0.17	0.12	12.4
Italy	14.4	7.4	0.22	0.15	7.5
Luxembourg	21.2	2.3	0.16	0.10	26.9
Netherlands	37.5	6.4	0.18	0.34	3.9
Portugal	4.6	1.6	0.31	0.24	21.3
Spain	14.6	1.2	0.22	0.16	15.0
Sw eden	18.6	6.2	0.19	0.12	3.4
United Kingdom	25.4	4.2	0.11	0.12	3.0
EU-15	20.2	10.0	0.19	0.18	8.5

Source of information: CRF 4.B(a) for 2005, submitted in 2007 Abbreviations explained in the Chapter 'Units and abbreviations'.
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. 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).

Shifts in emission factors are partly explained by the increasing milk 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 from 1990-2005 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 replace for poultry by solid manure systems which explain the decreasing emissions for poultry.

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 7% and 56%, respectively) and only Greece allocating 100% of the animals to the temperate climate region. France assumes 0.2% 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 4%, 17%, and 2% 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 1.8 (dairy cattle) and 23 (swine).

Table 6.33 **4B(a) Manure Management Member State's allocation of dairy cattle, non-dairy cattle and swine to the climate regions "cool", "temperate" and "warm" in 2005**

Member State	Dairy Cattle - Allocation by climate region[1)]			Non-Dairy Cattle - Allocation by climate region[1)]			Swine - Allocation by climate region[1)]		
2005	Cool (%)	Temperate (%)	Warm (%)	Cool (%)	Temperate (%)	Warm (%)	Cool (%)	Temperate (%)	Warm (%)
Austria	100%	NO	NO	100%	NO	NO	100%	NO	NO
Belgium	100%			100%			100%		
Denmark	NO	NO	NO	NO	NO	NO	NO	NO	NO
Finland	100%	NA	NA	NO	NO	NO	100%	NA	NA
France	NO	100%	0.2%	NO	99%	0.9%	NO	99%	1.2%
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	93%	7%	NO	89%	11%	NO	97%	3%	NO
Luxembourg	100%	NA	NA	100%	NA	NA	100%	NA	NA
Netherlands	NO	NO	NO	NO	NO	NO	NO	NO	NO
Portugal	44%	56%	NO	26%	74%	NO	20%	80%	NO
Spain	87%	13%	NO	66%	34%	NO	NO	NO	NO
Sweden	100%	NO	NO	100%	NO	NO	100%	NO	NO
United Kingdom[1)]	100%			100%			100%		
EU-15	72%	28%	0%	64%	36%	0%	80%	19%	0%

Source of information: CRF 4.B(a) for 2005, submitted in 2007. 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 4B(a) Manure Management Member State's Methane Conversion Factor used for dairy cattle, non-dairy cattle and swine for the different animal waste management systems in 2005

Member State	Dairy Cattle - Methane Conversion Factor (%) [1)]				Non-dairy Cattle - Methane Conversion Factor (%) [1)]				Swine - Methane Conversion Factor (%) [1)]			
2005	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		39%	1.00%	1.00%	90%	39%	1.00%	1.00%	NO	39%	1.00%	NO
Belgium	NO	NE	NE	NE	NO	NE	NE	NE	NO	NE	NE	NE
Denmark		10%	1.00%	1.00%		10%	1.00%	1.00%		10%	1.00%	1.00%
Finland	NA	10%	1.00%	1.00%	NO	10%	1.00%	1.00%	NO	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	10%	1.00%	1.00%	NO	10%	1.00%	1.00%	NO	10%	0.01%	1.00%
Greece												
Ireland	NO	39%	1.00%	1.00%	NO	39%	1.00%	1.00%	NA	39%	NA	NA
Italy	NO	16%	3.00%	1.25%	NO	16%	3.00%	1.25%	NO	25%	NA	NA
Luxembourg	90%	10%	1.00%	1.00%	90%	10%	1.00%	1.00%	90%	10%	1.00%	1.00%
Netherlands	IE	IE	IE	IE	IE	IE	IE	IE	NA	NA	NA	NA
Portugal	42%		1.25%	1.25%	NA	NA	1.25%	1.25%	42%		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		39%	1.00%	1.00%								
EU15	58%	43%	1.79%	1.49%	90%	43%	1.72%	1.48%	43%	41%	1.31%	1.50%

Source of information: CRF 4.B(a) for 2005, submitted in 2007. Abbreviations explained in the Chapter 'Units and abbreviations'.
[1)] Anaerobic lagoon + Liquid system. Anaerobic lagoon contributes only in Ireland with 2% of the manure managed. [2)] Values reported by Sweden have been multiplied with a factor of 100.

Table 6.35 4B(a) Manure Management: Member State's methane producing potential for emissions from manure management for the main animal types in 2005

Member State	CH4 producing potential (Bo) (CH4 m³/kg VS)				
2005	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine
Austria	0.24	0.17	0.19	0.17	0.45
Belgium	NE	NE	NE	NE	NE
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	0.20	0.20	0.20	0.17	0.50
Greece	NE	NE	NE	NE	NE
Ireland	0.24	0.24	0.19	0.17	0.45
Italy	0.15	0.13	0.19	0.17	0.42
Luxembourg	0.20	0.20	0.20	0.20	0.50
Netherlands	NE	NE	NE	NE	NE
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	0.24	NE	NE	NE
EU-15	0.22	0.18			0.46

Source of information: CRF 4B(a) for 2005, submitted in 2007. Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 6.36 **4B(a) Manure Management: Member State's volatile solid excretion from managed manure for the main animal types in 2005**

Member State	VS excretion (kg dm/head/day)				
2005	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine
Austria	4.2	2.0	0.4	0.3	0.4
Belgium	NE	NE	NE	NE	NE
Denmark	4.4	0.8	0.2	0.2	0.1
Finland	4.5	1.7	0.4	0.3	0.5
France	5.1	2.7	0.4	0.3	0.5
Germany*	4.4	1.3	0.4	0.4	0.3
Greece	NE	NE	NE	NE	NE
Ireland	4.5	2.7	0.4	0.3	0.5
Italy	6.4	2.9	0.4	0.3	0.3
Luxembourg	5.2	0.1	0.3	0.2	0.7
Netherlands	NE	NE	NE	NE	NE
Portugal	6.0	2.9	0.5	0.4	0.5
Spain	3.7	2.4	NA	NA	1.4
Sweden	5.3	1.5	0.4	0.3	0.3
United Kingdom$	3.5	2.7	NE	NE	NE
EU-15	4.9	2.3	0.0	0.0	0.6

Source of information: CRF 4B(a) for 2005, submitted in 2007. Abbreviations explained in the Chapter 'Units and abbreviations'.
* Values have been divided by 389 to convert from year to day. $ Values have been multiplied by 365

Some additional background information on the factors and parameters used by the Member States is given in Table 6.37.

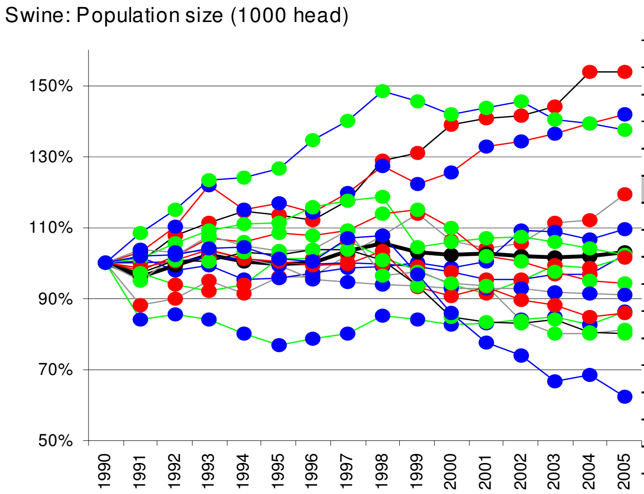
Table 6.37 4B(a) Manure Management: Member State's background information on the emission factors and other parameters used for the calculation of CH_4 emissions

Member State	Emission Factors and other parameters
Austria	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). Within the revision of Austrian N excretion values (following a recommondation of the Centralized Review 2005) energy intake data and VS excretion data of dairy and suckling cows were recalculated (Potsch 2005). For the calculation of VS excretion of suckling cows for the years 1990-2005 an average milk yield of 3 000 kg was applied. As no major changes in diets of Non-Dairy Cattle occurred in the period from 1990-2005, 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.From Manure Management for Sheep, Goats, Horses, Poultry and Other Livestock / Deer - default emission factors were taken from the IPCC guidelines.
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. For Non-dairy cattle and Swine, the implied EF in the CRF tables for Wallonia is a weighted average of specific EF for further disagregated animal categories.
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 slaugther pigs.
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.
Greece	The choice of emission factors follows the same criteria as for the case of enteric fermentation.
Italy	Cattle. For estimating slurry and solid manure management emissions factors and specific conversion factors, detailed methodologies for cattle and buffalo categories have been applied at a regional basis. Then, a simplified methodology for estimating national time series for emission factors have been used. 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 (CRPA, 1996).
Netherlands	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, determining the methane conversion factor. 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	The significant difference between the Portuguese country-specific emission factors (CS) and the IPCC default emission factors for CH_4 emissions from Manure Management arises mostly, from the use of a different share of Management Systems for Manure.
Sweden	The B_0i and MCF factors used are the default values in the Good Practice Guidance, except for the revised MCF for liquid manure, where the value of 10 % given by IPCC Guidelines, is adopted as a national value. This value is considered to be a more appropriate for Swedish conditions, firstly because of Sweden's cold climate, and secondly because of the fact that the slurry containers usu-ally have a surface cover.
United Kingdom	The emission factors for Lambs are assumed to be 40% of that for adult Sheep (Sneath, 1997).

Trends

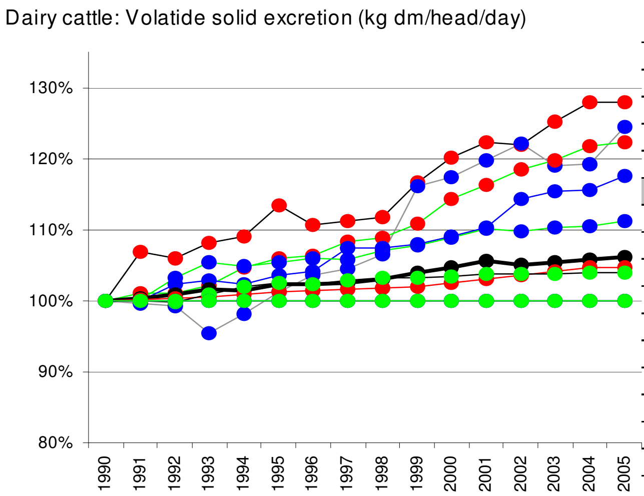
Figure 6.10 through Figure 6.13 show the trend of the swine population in the Member States and the development of animal productivity in terms of volatile solid excretion for dairy and non-dairy cattle and swine. These figures show how the different development of the animal sectors in the various countries 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. A reduction of the CH_4 emissions during the time period observed in Germany can be explained by the reduction of animal numbers after the German reunification. There is some inconsistency in the time series of animal numbers 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.

Figure 6.10 4B(a) Manure Management: Trend of the population size for swine



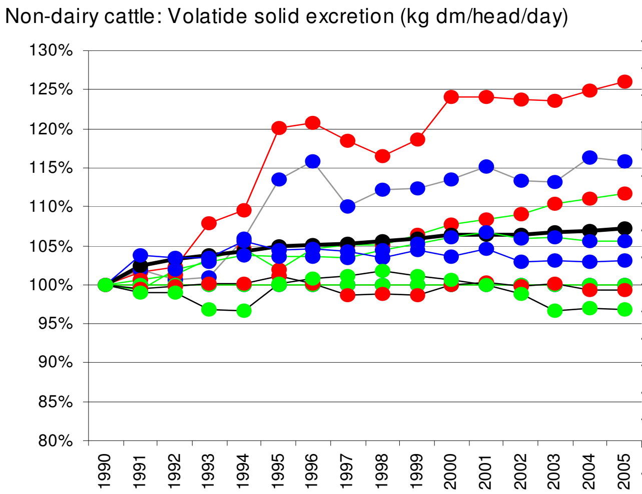
	1990	Trend (%) 1990-2005	2005
Spain	16,393	154%	25,244
Denmark	9,497	142%	13,466
Ireland	1,221	138%	1,680
Luxembourg	75	119%	90
Italy	8,407	109%	9,201
EU-15	112,532	103%	115,989
Greece	994	102%	1,017
France	9,587	102%	9,790
Finland	1,381	101%	1,401
Belgium	6,700	94%	6,318
Portugal	2,536	91%	2,313
Germany	28,326	86%	24,481
Austria	3,688	86%	3,170
Netherlands	13,915	81%	11,312
Sweden	2,264	80%	1,811
United Kingdom	7,548	62%	4,696

Figure 6.11 4B(a) Manure Management: Trend of volatile solid excretion for dairy cattle



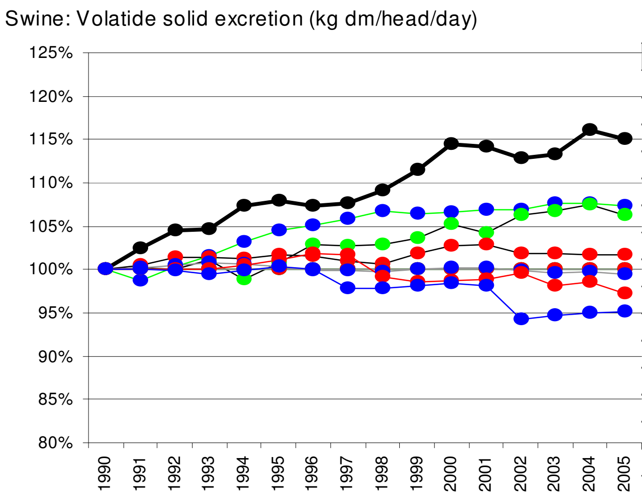
	1990	Trend (%) 1990-2005	2005
Spain	2.879	128%	3.684
Portugal	0.013	124%	0.016
Finland	3.690	122%	4.510
United Kingdom	1,076.813	118%	1,266.391
Germany	0.011	111%	0.012
EU-15	4.585	106%	4.866
Austria	0.011	105%	0.012
Sweden	5.116	104%	5.316
Ireland	4.533	100%	4.533
Denmark	0.012	100%	0.012
Italy	6.374	100%	6.374
France	5.100	100%	5.100
Luxembourg			
Greece			
Belgium			
Netherlands			

Figure 6.12 4B(a) Manure Management: Trend of volatile solid excretion for non-dairy cattle



	1990	Trend (%) 1990-2005	2005
Austria	0.004	126%	0.005
Portugal	0.007	116%	0.008
Finland	1.550	112%	1.730
EU-15	2.138	107%	2.291
Germany	0.003	106%	0.004
Italy	2.768	103%	2.853
United Kingdom	2.650	100%	2.650
Ireland	2.709	100%	2.709
Denmark	0.002	100%	0.002
France	2.700	100%	2.700
Spain	2.419	99%	2.401
Sweden	1.499	97%	1.451
Luxembourg			
Greece			
Belgium			
Netherlands			

Figure 6.13 4B(a) Manure Management: Trend of activity data for swine:



	1990	Trend (%) 1990-2005	2005
EU-15	0.521	115%	0.599
Germany	0.001	107%	0.001
Sweden	0.285	106%	0.303
Spain	1.339	102%	1.363
Finland	0.500	100%	0.500
Ireland	0.500	100%	0.500
Denmark	0.000	100%	0.000
France	0.500	100%	0.500
Luxembourg	0.700	100%	0.700
Portugal	0.001	99%	0.001
Austria	0.001	97%	0.001
Italy	0.365	95%	0.348
United Kingdom			
Greece			
Belgium			
Netherlands			

6.3.2.3. 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 and Sweden (20%). Portugal assigns a high uncertainty to the population data of mules and asses (272%).

The uncertainty estimate for the emission factors is higher and ranges between 15% (Finland) and 100% (Denmark, Italy, Netherlands).

6.3.3 Manure Management (N_2O) (CRF source category 4.B(b))

6.3.3.1. Source category description

Generally, GHG emissions (in $CO_{2\text{-eq}}$uivalents) 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 , ranging from 0.8 (Finland) to

8.2 (Ireland). Values close or smaller to unity are found for example for Italy (1.3).

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 also given in Table 6.38.

Table 6.38 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 2005 with decrease by 1% increase of the IEF for solid systems.

Table 6.38 4B(b) Manure Management: Total N_2O emissions in category 4B(b) and implied Emission Factor at EU-15 level for the years 1990 and 2005

	Anaerobic lagoon	Liquid systems	Solid storage and dry lots
	1990		
Total Emissions of N_2O [Gg N_2O-N]	0	5	75
Total Nitrogen excreted [Gg N]	16	3073	2421
Implied Emission Factor [kg N_2O-N / kg N]	0.10%	0.10%	1.96%

	Anaerobic lagoon	Liquid systems	Solid storage and dry lots
	2005		
Total Emissions of N_2O [Gg N_2O-N]	0	4	66
Total Nitrogen excreted [Gg N]	16	2764	2160
Implied Emission Factor [kg N_2O-N / kg N]	0.10%	0.10%	1.94%

	Anaerobic lagoon	Liquid systems	Solid storage and dry lots
	2005 value in percent of 1990		
Total Emissions of N2O [Gg N2O-N]	98%	90%	88%
Total Nitrogen excreted [Gg N]	98%	90%	89%
Implied Emission Factor [kg N2O-N / kg N]	100%	100%	99%

6.3.3.2. 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 74% in Sweden and 97% in Portugal.

Table 6.39 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. Also, it is given whether the source category is key for the Member States, whereby one has to note that most countries do not disaggregate by manure management system. 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.

Therefore, on the basis of this information only, for only a low percentage of the N_2O emissions from manure management (8%) the estimate stems from a Tier 2 calculation. This value is much lower for solid systems (5%) than for liquid systems (45%) for solid systems with country-specific IEFs for Belgium, Germany, Netherlands, and Sweden. However, also the nitrogen excretion rates are, for some countries, based on country-specific methodologies or data. For the Member States where such an approach has been described, we have indicated the Tier 2 (= higher than Tier 1) approach in Table 6.39. The table shows, that most countries use country-specific calculations to estimate nitrogen excretion rates and that thus the method can be regarded as "Tier 2". A justification can be found in Table 6.45. This is important if we assess the uncertainty of the EU-15 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. 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. In the table we have indicatively estimated the approach as "Tier 1.6" and Tier 1.9 for solid and liquid systems, respectively. This is done to account the for the fact that IPCC default value of 100 kg N head^{-1} is used for dairy cattle and a country-specific nitrogen excretion values of 57.4 and 17.5 kg N head^{-1} is used for non-dairy cattle and swine, respectively, and using population data and allocation of animals over AWMSs from the category 4B(a).

Summarizing, we find that 87% of the N_2O emissions from manure management is calculated using country-specific information, with a higher share of liquid systems (98%) than solid systems (86%).

Additional background information, if available, is summarised in Table 6.40.

Table 6.39 **4B(b) Manure Management: Total emissions and contribution of the main sub-categories to N_2O emissions, 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	a	b	c	a	b	c
Austria	876	96%	Tier 2	y	2%	Tier 2	n
Belgium	857	92%	Tier 2	nr	7%	Tier 2	nr
Denmark	557	86%	Tier 2	y	14%	Tier 2	n
Finland	500	96%	Tier 2	y	4%	Tier 2	n
France	6,001	96%	Tier 1.6	y	4%	Tier 1.9	n
Germany	3,036	87%	Tier 2	nr	13%	Tier 2	nr
Greece	307	93%	Tier 1	y	2%	Tier 1	n
Ireland	409	86%	Tier 2	nr	14%	Tier 2	nr
Italy	3,688	88%	Tier 2	y	4%	Tier 2	n
Luxembourg	NE,NO						
Netherlands	753	83%	Tier 2	nr	17%	Tier 2	nr
Portugal	578	97%	Tier 2	y	1%	Tier 2	n
Spain	2,928	96%	Tier 2	nr	4%	Tier 2	nr
Sweden	514	74%	Tier 2	nr	4%	Tier 2	nr
United Kingdom	1,271	83%	Tier 2	y	4%	Tier 2	n
EU-15: Tier 1	13%	14%			2%		
EU-15: Tier 2	87%	86%			98%		

a Contribution to N_2O 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

Table 6.40 **4B(b) Manure Management: Member State's background information on the methodology for estimating N_2O emissions**

Member State and reference	Methods
Austria	For the estimation of N_2O emissions from manure management systems only a Tier 1 approach is available. Manure management from Solid storage and dry lot is the key source, EFs are default.
Denmark	Emissions from manure management are calculated in with the model DIEMA ((Danish Integrated Emission Model for Agriculture, Mikkelsen et al., 2005). The N_2O emission from manure management is based on the amount of nitrogen in the manure in stables. The emission from manure deposits on grass is included in "Animal Production".
Germany	Emissions of nitrogen compounds from manure management are calculated with the mass-flow approach (EMEP, 2003; Daemmgen et al., 2007). 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. The distribution over manure management systems (solid storage and liquid systems) is from (Luettich et al., 2007). Main drivers of the emissions are manure storage system and temperature. Emissions of nitrogen compounds from grazed areas are occurring simultaneously, using IPCC methodologies (Tier 1) for N_2O and NO emission estimates. All calculations are done on the district level using the agricultural model RAUMIS.
Italy	Liquid system, solid storage and other management systems (chicken-dung drying process system) have been considered according to their significance and major application in Italy. Tier 1 methodology and IPCC default emission factors were used for the management systems. For the 2006 submission, different parameters have been updated: nitrogen excretion rates, slurry and solid manure production and the average weight for the different livestock categories. For the specific case of sheep and goat, a detailed analysis has been carried out with information from ASSONAPA9, 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	N_2O emissions are calculated by multiplying the amount of nitrogen in manure per manure management system with the emission factor of that manure management system. The amount of nitrogen in manure refers to the net amount, i.e. excluding ammonia emissions from cowshed/pigsty and storage. This approach has been selected because the Emissions Registration procedure does not differentiate between ammonia emissions from slurry or solid manure.
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.

Activity Data

In EU-15, a total of Gg N was managed in manure management systems or excreted on pasture range and paddock in 2005. 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 . The largest decrease of nitrogen managed occurred for the solid storage and dry lot systems, which in 2005 was less than in 1990. The decrease of nitrogen was particularly pronounced in the Netherlands, where total nitrogen decreased by 6%. At the same time, the manure managed on solid storage systems increased by 3% 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 2005 is given in Table 6.41. 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 6.41 4B(b) Manure Management: 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 2005

Member State 2005	Anaerobic lagoon	Liquid systems	Daily Spread	Solid storage and dry lot	Other	Pasture range paddock	Total
Austria		42		86	7	23	157
Belgium		112	2	84	4	41	244
Denmark		189		50		30	269
Finland		39		49		22	110
France		465		594		764	1,823
Germany		827		366		148	1,342
Greece		15	1	29	6	327	378
Ireland		114		36		285	435
Italy		325		335	28	157	844
Luxembourg							
Netherlands		305		74		88	467
Portugal	16	15		58		71	160
Spain		224	19	289		331	863
Sweden		0		0	0	0	0
United Kingdom		93	103	109	70	455	830
EU-15	16	2,764	125	2,160	115	2,743	7,923

Information source: CRF Table 4.B(b) for 2005, submitted in 2007. 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 for solid storage used by the Netherlands and Germany), these numbers apply also for the EC-N_2O inventory for manure management. An overview of the implied emission factors is given in Table 6.42. The decreases in N_2O emissions of 10% (total; 10% in liquid systems and 12% for solid systems) are mainly due to decreases in nitrogen excretion. For liquid systems, both nitrogen excretion and the implied emission factor decreases (decreases are estimated for Denmark 17% and Germany 2%); so that the decrease in N_2O emissions is even more pronounced. For solid systems, a dynamic IEF has been reported for Denmark and the Netherlands, which report an increase of the IEF by 1% and 2%,respectively, and for Belgium, Germany and Sweden, which reports a decreasing IEF by 2% and 5% in the case of Germany. In all other countries, the IEF is not time-dependent.

Table 6.42 4B(b) Manure Management: Implied Emission factors for N_2O emissions used in Member State's inventory 2005

Member State	Implied EF (kg N_2O-N / kg N)			
2005	Anaerobic lagoon	Liquid system	Solid storage and dry lot	Other
Austria	NO	0.10%	2.0%	0.5%
Belgium	NO	0.10%	1.9%	0.5%
Denmark	NO	0.08%	2.0%	NO
Finland	NO	0.10%	2.0%	NE
France	NA	0.10%	2.0%	NA
Germany	NO	0.10%	1.5%	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	NE	NE	NE	NO
Netherlands	NO	0.09%	1.7%	NO
Portugal	0.10%	0.10%	2.0%	NO
Spain	NO	0.10%	2.0%	NO
Sweden	NO	0.10%	1.9%	2.0%
United Kingdom	NO	0.10%	2.0%	0.5%
EU-15	0.10%	0.10%	1.9%	1.0%

Information source: CRF Table 4.B(b) for 2005, submitted in 2007
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 6.43 for EU-15-countries and the main animal types. The table shows a range by a factor of ca. 2 between the highest and the lowest value used is found. For example, for dairy cattle, we have a range around 70 kg N head^{-1} y^{-1} for Spain and Greece and 132 kg N head^{-1} y^{-1} for Denmark. Vary large ranges are found for non-dairy cattle with values between 38 (Belgium) and 185 kg N head^{-1} y^{-1} (Sweden) and sheep with values between 5.1 kg N head^{-1} y^{-1} (Spain) and 18.3 kg N head^{-1} y^{-1} (France).

Additional information on the development of the emission factor is available for some Member States and is summarized in Table 6.44. Additional background information on the calculation of nitrogen excretion rates are summarised in Table 6.45.

Table 6.43 4B(b) Manure Management: Total Nitrogen excretion by AWMS [Gg N] for dairy and non-dairy cattle, sheep, swine, and poultry in 2005

Member State 2005	Dairy	Non-Dairy	Sheep	Swine	Poultry
Austria	94.5	46.1	13.1	14.2	0.5
Belgium	94.6	37.8	6.2	11.9	0.6
Denmark	132.2	39.4	17.0	9.0	0.7
Finland	109.9	45.7	9.3	18.1	0.8
France	100.0	57.4	18.3	17.5	0.6
Germany	117.6	42.9	7.5	14.4	0.6
Greece	70.0	50.0	12.0	16.0	0.6
Ireland	85.0	65.0	6.1	8.4	0.3
Italy	116.0	49.8	16.2	11.7	0.5
Luxembourg	NE	NE	NE	NE	NE
Netherlands	NA	NA	NA	NA	NA
Portugal	87.6	47.5	6.1	8.0	0.7
Spain	67.5	52.3	5.1	9.2	0.7
Sweden	123.5	185.0	13.0	46.8	1.2
United Kingdom	105.4	48.9	6.6	10.2	0.7
EU-15	93.4	45.1	7.9	11.1	0.6

Information source: CRF Table 4.B(b) for 2005, submitted in 2007

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 6.44 4B(b) Manure Management: Member State's background information on the emission factor for calculation of N_2O emissions

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.
Netherlands	Emission factors for N_2O from Manure management represent the IPCC default values for liquid and solid systems. Netherlands set the MCF value for stored solid cattle manure equal to the MCF for stored solid poultry manure.
Sweden	The emission factors are calculated as a function of national activity data for manure production, stable periods and animal manure management systems (AWMS), etc. Parameters that are used to estimate methane and N_2O emissions depend on the specific AWMS. The only national value chosen is the MCF for liquid manure, which is set to 10%, as was stated in the IPCC Guidelines. All other parameters, due to the lack of information needed to determine national values, are 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 has been split between SSD and DS to account for this.

Table 6.45 4B(b) Manure Management: Member State's background information for the development of nitrogen excretion rates used in the calculation of N_2O emissions

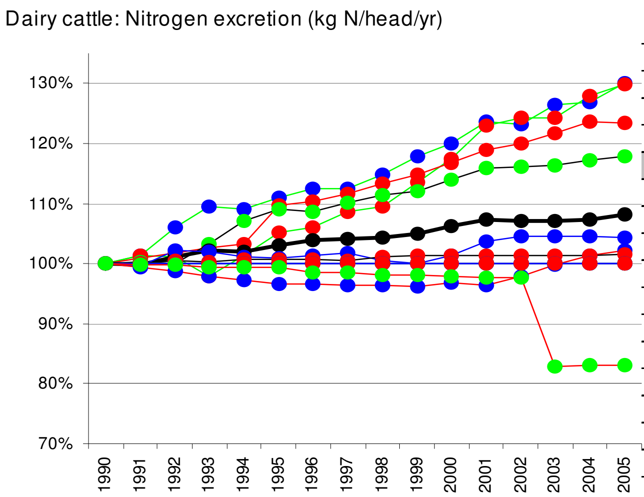
Member State	Nitrogen excretion rates
Austria	N-excretion data are calculated following the guidelines of the European Commissions according to the requirements of the European Nitrate Directive based on feed rations which are estimated on the basis of field studies on representative grassland and dairy 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).
Belgium	N_2O emissions from manure storage is based on N excretion data estimated through local production factors. In <u>Wallonia,</u> 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 <u>Flanders,</u> nitrogen excretion factors are from the Manure Bank of the Flamish Land Agency (www.vlm.be) and is based on the regional situation.
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 effi-ciency and allocation of subcategories.
Finland	Annual N excretion per animal was calculated by experts of MTT Agrifood Research Finland (Nousiainen, 2005, 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/animal and in the case of animals kept less than 1 year in farms (Swine, *Poultry),* replacement of animals with new 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.
Germany	*Dairy cattle:* N-excretion factors are calculated on the basis of milk productivity, protein content of teh milk, the weight, number of births and the composition of the rations. *Swineand 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	IPCC default N excretion values referring to Mediterranean countries were chosen.

Member State	Nitrogen excretion rates
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 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 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 Sheep, Swine and Poultry, respectively in all years.
Italy	Country-specific N-excretion data (Inter-regional nitrogen balance project results, CRPA, 2006)
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$_2$O_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	IPCC methodology using Nex fraction of 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	Nitrogen excretion factors for dairy cattle take into account the animal weight.

Trends

Figure 6.14 through Figure 6.19 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 discussed above. The effect of the AWMS is contrary to that observed for the methane emissions.

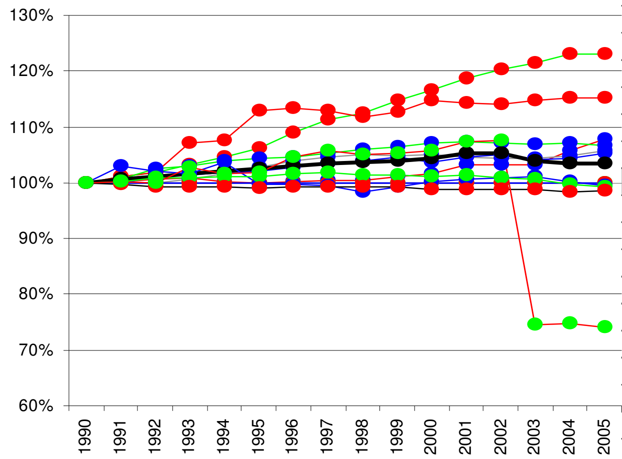
Figure 6.14 4B(b) Manure Management: Trend of nitrogen excretion rates for dairy cattle



	1990	Trend (%) 1990-2005	2005
Germany	90	130%	118
Finland	85	130%	110
Austria	77	123%	95
Sweden	0	118%	0
EU-15	86	108%	93
United Kingdom	101	104%	105
Denmark	129	102%	132
Spain	67	101%	68
Ireland	85	100%	85
France	100	100%	100
Portugal	88	100%	88
Italy	116	100%	116
Greece	70	100%	70
Belgium	114	83%	95
Luxembourg			
Netherlands			

Figure 6.15 4B(b) Manure Management: Trend of nitrogen excretion rates for non-dairy cattle:

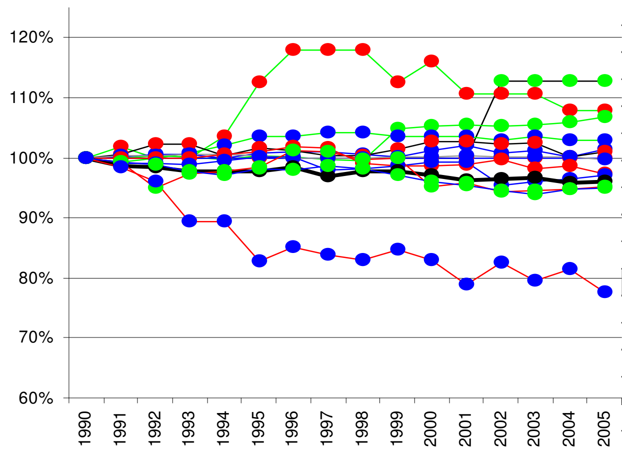
Non-dairy cattle: Nitrogen excretion (kg N/head/yr)



	1990	Trend (%) 1990-2005	2005
Finland	37.1	123%	45.7
Austria	40.0	115%	46.1
Denmark	36.6	108%	39.4
Germany	40.3	107%	42.9
Portugal	45.0	106%	47.5
United Kingdom	46.4	105%	48.9
EU-15	43.7	103%	45.1
Sweden	0.2	100%	0.2
Ireland	65.0	100%	65.0
Greece	50.0	100%	50.0
Italy	50.0	100%	49.8
France	57.9	99%	57.4
Spain	53.1	98%	52.3
Belgium	51.0	74%	37.8
Luxembourg			
Netherlands			

Figure 6.16 4B(b) Manure Management: Trend of nitrogen excretion rates for swine

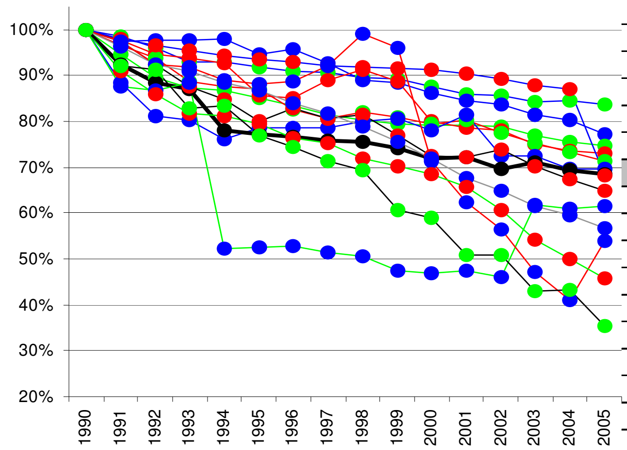
Swine: Nitrogen excretion (kg N/head/yr)



	1990	Trend (%) 1990-2005	2005
Sweden	41.5	113%	46.8
Finland	16.8	108%	18.1
France	16.4	107%	17.5
Germany	14.0	103%	14.4
United Kingdom	10.0	101%	10.2
Spain	9.1	101%	9.2
Greece	16.0	100%	16.0
Portugal	8.0	100%	8.0
Austria	14.6	97%	14.2
Italy	12.0	97%	11.7
EU-15	11.6	96%	11.1
Belgium	12.5	95%	11.9
Ireland	8.8	95%	8.4
Denmark	11.6	78%	9.0
Luxembourg			
Netherlands			

Figure 6.17 4B(b) Manure Management: Trend of N managed in solid storage and dry lot, dairy cattle

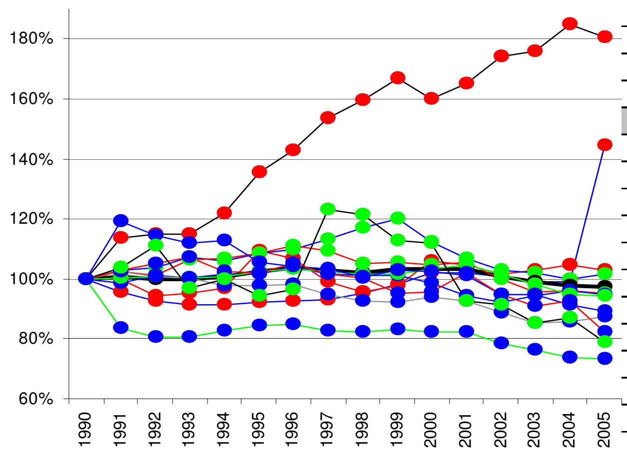
Dairy cattle: N managed in solid storage and dry lot (Gg N/yr)



	1990	Trend (%) 1990-2005	2005
Ireland	3	84%	3
United Kingdom	27	77%	21
France	225	75%	168
Austria	49	73%	36
Belgium	29	71%	21
Italy	175	70%	122
EU-15	800	68%	548
Greece	16	68%	11
Spain	64	65%	42
Germany	164	62%	101
Portugal	12	57%	7
Denmark	15	54%	8
Finland	21	46%	10
Sweden	0	35%	0
Luxembourg			
Netherlands			

Figure 6.18 4B(b) Manure Management: Trend of N managed in solid storage and dry lot, non-dairy cattle

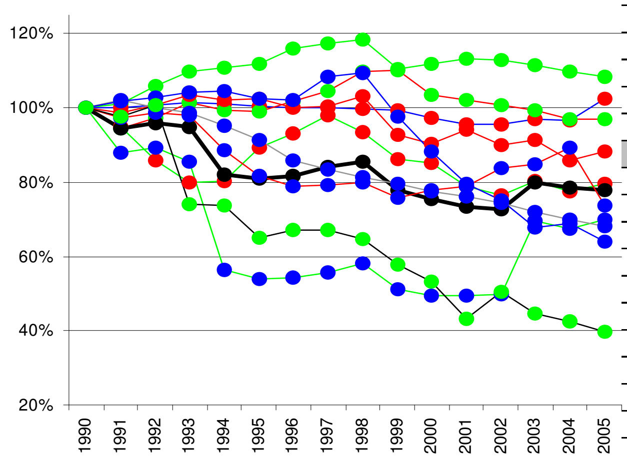
Non-dairy cattle: N managed in solid storage and dry lot (kg N/yr)



	1990	Trend (%) 1990-2005	2005
Spain	58	181%	104
Greece	12	145%	17
Austria	43	103%	44
Ireland	24	101%	24
EU-15	801	97%	779
Belgium	46	95%	44
United Kingdom	67	95%	63
France	275	94%	259
Italy	102	89%	91
Portugal	13	88%	11
Denmark	20	82%	16
Sweden	0	79%	0
Germany	142	73%	104
Finland			
Luxembourg			
Netherlands			

Figure 6.19 4B(b) Manure Management: Trend of N managed in solid storage and dry lot, swine

Swine: N managed in solid storage and dry lot (kg N/yr)



	1990	Trend (%) 1990-2005	2005
France	27	108%	29
Greece	2	102%	2
Belgium	6	97%	6
Austria	7	88%	6
Finland	13	79%	10
EU-15	174	78%	135
Denmark	12	74%	9
Germany	73	70%	51
Portugal	1	68%	0
United Kingdom	33	64%	21
Sweden	0	40%	0
Spain			
Ireland			
Italy			
Luxembourg			
Netherlands			

6.3.3.3. Uncertainty and time series consistency

Activity data used for the estimation of N_2O emissions from manure management are generally analogue to those used for the estimation of CH_4 emissions, and consequently also the uncertainty estimates are similar. Only United Kingdom estimates an uncertainty of up to 100% for the activity data for category 4B(b). The uncertainty of the emission factor is much higher, and only Finland (10%) have 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 Finland report a higher contribution of N_2O emissions from manure management to the overall uncertainty with 1.2% and 1.1% of total emissions, respectively.

6.3.4 Rice Cultivation (CH_4) (CRF source category 4.C)

6.3.4.1. Source category description

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 17 g m^{-2} in 2003 for continuous flooded rice fields, which represents a decrease in the implied emission factor by 11% since 1990 (see Table 6.46), which can be explained by the higher contribution of Spain. 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 (see below). 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 6.46 4C Rice Cultivation: Total CH_4 emissions, area harvested and implied Emission Factor at EU-15 level for 2005

	Continuously Flooded	Intermittently flooded: single aeration	Intermittently flooded: multiple aeration
	1990		
Total Emissions of CH4 [Gg CH4]	31.1	0.6	73.8
Total Area harvested [10^9 m^2 y^{-1}]	1.64	0.02	2.13
Implied Emission Factor [g CH4 / m^2]	19	27	35

	Continuously Flooded	Intermittently flooded: single aeration	Intermittently flooded: multiple aeration
	2005		
Total Emissions of CH4 [Gg CH4]	31.2	9.4	60.4
Total Area harvested [10^9 m^2 y^{-1}]	1.86	0.39	1.85
Implied Emission Factor [g CH4 / m^2]	17	24	33

	Continuously Flooded	Intermittently flooded: single aeration	Intermittently flooded: multiple aeration
	2005 value in percent of 1990		
Total Emissions of CH4 [Gg CH4]	100%	1539%	82%
Total Area harvested [10^9 m^2 y^{-1}]	113%	1730%	87%
Implied Emission Factor [g CH4 / m^2]	89%	89%	94%

6.3.4.2. Methodological Issues

Methods

A summary of the methodologies used for the calculation of CH_4 emissions from rice cultivation is given in Table 6.47. More detailed data are given in the section on the emission factors.

Table 6.47 4C Rice Cultivation: Additional information in the methodology used for the calculation of CH_4 emissions in 2005

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). 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
Portugal	Methane emissions from rice production were estimated following the GPG, but simplified 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. Rice cultivated area is available from annual statistics from National Statistical Institute,
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 2240 km^2 of rice cultivation, followed by Spain with an area of 1182 km^2 (2005 data). The other three countries have rice producing areas around 200 km^2, as shown in Table 6.48 for the rice cultivation practices continuously flooded, intermittently flooded with single aeration, and intermittently flooded with multiple aerations.

Table 6.48 4C Rice Cultivation: Harvested Area Rice in the Member States in 2005 and 1990

Member State 2005	Harvested area in 2005 [10^9 m^2]		
	Continuously Flooded	Intermittently flooded: single aeration	Intermittently flooded: multiple aeration
France	0.22	NO	NO
Greece	0.23	NO	NO
Italy	NO	0.39	1.85
Portugal	0.22	NO	NO
Spain	1.18	NO	NO
EU-15	1.86	0.39	1.85

Member State 1990	Harvested area in 1990 [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 2005 and 1990, submitted in 2007
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 6.49. 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 (information from the submission of 2005 or the inventory 2003), as reference factor 33 g m^2 CH_4 per year has been selected (Schuetz et al., 1989), which are based on averaged CH_4 flux measurements over 3 years during the growing period only, carried out in continuously flooded rice paddies in the Po valley, without org. matter amendment or mineral fertilisation (Tani, 2000). The value has been adapted to 39.6 g m^2 CH_4 per year to take into account the post-harvest emissions (Tani, 2000). This value has been multiplied with the factor of 1.5 to account for the assumed emissions of rice fields that are amended with organic matter (factor of two) representing about 50% of the area cultivated. A scaling factor of 25% and 50% has then been applied to estimate the emissions from single and multiple aeration management regimes. No changes in implied emission factors occurred since 1990. 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 2005 are the above-mentioned value of 36 g m^{-2} measured by Schuetz et al. (1989).

Table 6.49 4C Rice Cultivation: Implied Emission factors for CH_4 emissions used in Member State's inventory

Member State 2005	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	24.15	32.59
Portugal	36.00	NO	NO
Spain	12.00	NO	NO
EU-15	16.80	24.15	32.59

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	27.14	34.60
Netherlands	NO	NO	NO
Portugal	36.00	NO	NO
Spain	12.00	NO	NO
EU-15	18.90	27.14	34.60

Information source: CRF Table 4.C for 2005 and 1990, submitted in 2007
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 2003 was 4% larger than in 1990. The harvested area in Spain increased from 1990 to 2003 by 31%, but around 1993-1995 rice production was only half of the area in 1990; also Greece increased its rice production since 1990 by 40%. The trend was opposite in France with peaks in rice production during 1993-1995 and in 2005 the level was about 6% lower than in 1990. Finally, Portugal saw a decline in rice production, amounting to 35% since 1990.

6.3.5 Agricultural soils – N_2O (CRF Source Category 4D)

6.3.5.1. Source category description

For EU-15, emissions from all sub-categories in the category 4.D have decreased since 1990 (see Table 6.50). This was most significant for direct emissions from the application of synthetic fertiliser (-19%), followed by indirect emissions from leaching and run-off (-15%) and volatilisation of NH_3+NO_x (-16%). 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 4%.

At the aggregated EU-15 level, the implied emission factor for N_2O emissions from the application of manure increased by 6%, caused by a doubling of the implied emission factor for this source in the Netherlands during 1990 to 2005. 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 19% for synthetic fertilizer application, 9% for application of manure, 4% of the area of histosols cultivated and 10% of nitrogen excreted by grazing animals. This translated to a reduction of volatilized and re-deposited nitrogen by 16% and of the amount of nitrogen leached by 14%.

Table 6.50 **4D Agricultural Soils: Total N_2O emissions, Total Nitrogen input into agricultural soils and implied Emission Factor at EU-15 level in 2005 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	89	27	92	47	214
Total Nitrogen input [Gg N]	10284	4674	22794	3120	3003	7447
Implied Emission Factor [kg N_2O-N / kg N]	1.22%	1.21%	7.5	1.88%	1.00%	1.83%

2005	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]	159	86	26	82	40	181
Total Nitrogen input [Gg N]	8361	4252	21875	2805	2513	6391
Implied Emission Factor [kg N_2O-N / kg N]	1.21%	1.28%	7.5	1.86%	1.00%	1.81%

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	81%	96%	96%	89%	84%	85%
Total Nitrogen input	81%	91%	96%	90%	84%	86%
Implied Emission Factor	100%	106%	100%	99%	100%	99%

Source of information: Tables 4.D for 1990 and 2005, submitted in 2007

[1)] Histosols unit AD: km^2; Unit for IEF: kg N_2O-N/ha

6.3.5.2. 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 6.51 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 using the geometric mean if two parameters were multiplied and using an emission-weighted average if two sources were to be added. For the calculation of indirect N_2O emissions, the estimation procedure is mainly based on the fraction of NH_3 and NO_x volatilised or nitrogen leached. Here, we did not include the quality of nitrogen excretion calculations into the estimate, which influences already the estimated quality for animal production and manure application, so that the numbers presented below can be regarded as a conservative estimate. For emissions from grazing animals, 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. Thus, also this values can be considered as conservative and quality of the emission estimates is probably higher. For direct emissions from crop residues and N-fixing crops, a “Tier 2” level has been assigned only if country-specific data have been used; the use of Tier 1b with default IPCC parameters did count as Tier 1 level only.

As a result, we estimate that a minimum of one third of the emissions reported in category 4D are estimated with country-specific information. Highest Tier-level was obtained for emissions from grazing animals, which reflects the direct impact of the calculation of N-excretion rates.

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.

A summary of the main methodological issues, as presented in the respective national greenhouse gas inventory reports, is given in Table 6.52. Note however, that most information will be summarized in specific tables on the emission factors and parameters used.

Table 6.51 **4D Agricultural Soils: Total emissions and contribution of the main sub-categories to N_2O emissions, methodology and key source assessment by Member States for the sub-categories direct emissions, animal production and indirect emissions for the year 2005.**

	Total	Direct			Animal Production			Indirect		
Member State	Gg CO_2-eq	a	b	c	a	b	c	a	b	c
Austria	2,824	54%	Tier 1.3	y	8%	Tier 1.3	y	38%	Tier 1.1	y
Belgium	3,935	56%	Tier 1.2	nr	21%	Tier 1.4	nr	24%	Tier 2.0	nr
Denmark	5,677	52%	Tier 1.3	y	5%	Tier 1.4	y	41%	Tier 2.0	y
Finland	3,226	77%	Tier 1.5	y	5%	Tier 1.4	y	18%	Tier 2.0	y
France	48,634	47%	Tier 1.1	y	15%	Tier 1.3	y	37%	Tier 1.0	y
Germany	37,845	63%	Tier 1.9	nr	4%	Tier 1.4	nr	33%	Tier 1.2	nr
Greece	7,665	23%	Tier 1.0	y	42%	Tier 1.4	y	36%	Tier 1.0	y
Ireland	6,771	40%	Tier 1.1	nr	41%	Tier 1.4	nr	19%	Tier 1.8	nr
Italy	18,042	50%	Tier 1.1	y	8%	Tier 1.4	y	42%	Tier 1.2	y
Luxembourg	146	100%	Tier 1.0	nr						
Netherlands	8,615	56%	Tier 2.0	nr	8%	Tier 2.0	nr	37%	Tier 2.0	nr
Portugal	3,271	41%	Tier 1.1	y	21%	Tier 1.4	y	38%	Tier 1.2	y
Spain	19,157	51%	Tier 1.8	nr	8%	Tier 2.0	nr	40%	Tier 1.1	nr
Sweden	4,769	61%	Tier 1.6	nr	7%	Tier 2.0	nr	20%	Tier 2.0	nr
United Kingdom	25,110	48%	Tier 1.1	y	18%	Tier 1.4	y	34%	Tier 1.0	y
EU-15: Tier 1	66%	59%			57%			79%		
EU-15: Tier 2	34%	41%			43%			21%		

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)

Table 6.52 4D Agricultural Soils: Member State's background information for the calculation of N_2O emissions

Member State	Methods
Denmark	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	The calculation methodology has been developed towards a mass-flow approach in order to avoid double-counting. The N lost as NH_3 and NO_x ($Frac_{GASF}$, $Frac_{GASM}$) as well as N leached (FracLEACH) are subtracted from the amount on N in synthetic fertilisers, manure and sewage sludge applied to soils, as well from manure deposited on pastures.
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).
Irelands	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.
Netherlands	Direct and animal production N_2O emissions, as well as N_2O emissions from histosols, crop residues and nitrogen fixation are estimated using country-specific tier 2 methods. For the application of fertilisers and animal manures, two soil types are differentiated, and grazing manure depends on the nitrogen in the urine and faeces, each with its own country-specific emission factors.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 extent of the ammonia emissions from fertiliser and animal manure (stables, manure storage, manure usage and grazing) is all part of the annual calculations within the framework of the Emission Registration. The LEI (Dutch agricultural economic institute) performs these calculations based on the
Portugal	Only manure managed in solid systems, from all animal species, are assumed to be applied on soils. Therefore the equation introduces a 'fraction of manure-nitrogen used as fertilizer'. Emissions of N_2O from manure handled in Anaerobic Lagoons and Liquid Storage are already included in Liquid and Solid Waste emission source categories and are not double counted here.
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

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 2005, as shown in Table 6.53. The input of manure decreased by 9%, and the input of mineral fertilizer decreased even more, by 19%. Accordingly, also the amount of nitrogen volatilized or leached decreased by 16% and 14%, respectively.

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 6.53 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 6.54.

Table 6.53 4D Agricultural Soils: Member State's activity data to calculate direct and indirect N_2O emissions

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)
2005	Direct						Indirect	
Austria	97	104	22	26	NO	23	35	75
Belgium[1)]	151	154	2	53	25	83	48	57
Denmark	202	181	35	53	782	28	74	164
Finland	149	59	0.6	27	2,768	15	37	33
France	2,091	839	334	485	NO	758	594	1,248
Germany	1,778	1,019	91	316	12,995	143	495	756
Greece	214	41	1	26	67	327	99	185
Ireland	346	76	1	18	NO	285	91	71
Italy	711	439	177	145	90	157	324	487
Luxembourg	NE	NE	NE	NE	NE	NE	NE	NE
Netherlands	301	314	5	33	2,230	89	100	787
Portugal	134	56	3	26	NO	71	44	85
Spain	907	532	195	117	NO	331	206	1,809
Sweden	162	66	29	54	2,526	41	36	62
United Kingdom	1,119	372	39	407	392	455	329	571
EU-15	8,361	4,252	934	1,839	21,875	2,805	2,513	6,391

Source of information: Tables 4.D for 2005, submitted in 2007. Abbreviations explained in the Chapter 'Units and abbreviations'.

[1)] Belgium uses as unit for N-fixing crops: kg of dry biomass pulses and soybeans produced and as unit for crop residues: kg of dry biomass of other crops produced. It has been excluded from the EU-15 data for these sub-categories

Table 6.54 4D Agricultural Soils: Member State's background information on the activity data used for the calculation of N_2O emissions

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, 2005) and from an agricultural marketing association (Agrarmarkt Austria, AMA). The yearly numbers of the Legume cropping areas were taken from official statistics (BMLFUW). 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 2005 data from the National Austrian Waste Water Database operated by the Umweltbundesamt was used (data query 2006). Values for biological nitrogen fixation were taken from a publication made by the Umweltbundesamt (Goetz, 1998); these values are constant over the time series.
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). The estimates for the amount of fixed nitrogen in crops are estimated by Danish Institute of Agricultural Science (Swedish Board of Agriculture, 2004).
Finland	Activity data is national and received mainly from annual agricultural statistics of the Ministry of Agriculture and Forestry. Other data sources are the Finnish Environment Institute (the amount of N in sewage sludge) and MTT Agrifood Research Finland (area of cultivated organic soils). The amount of synthetic fertilisers sold annually has been received from the annual agricultural statistics of the Ministry of the Agriculture and Forestry and the amount of sewage sludge applied annually has been received from the VAHTI database of Finland's environmental administration. Crop yields of cultivated plants have been received from agricultural statistics. Vegetables grown in the open have also been included into the emission estimate of crop residues. Vegetable yields have been received from literature. The area of cultivated organic soils has been received from MTT Agrifood Research Finland.
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 during the period 1990 – 2002 derive from FAO, while 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 for the period 1990 – 2001 and from the provisional statistical data of the NSSG for the period 2002 – 2004. Data for the areas of organic soils derive from a relevant research conducted by the Soil Science Institute of Athens (SSIA, 2001).
Ireland	The annual statistics on nitrogen fertilizer use (Nfert) are obtained from the Department of Agriculture and Food.

Member State	Activity data
Portugal	The time series of the quantity of nitrogen used as synthetic fertilizers, was obtained from FAO statistical database (http://www.apps.fao.org) which itself results from information gathered in Portugal.
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. 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.
United Kingdom	Annual consumption of synthetic fertilizer is estimated based on crop areas (Defra, 2005a) and fertilizer application rates (BSFP, 2005).

Emission Factors and other parameters

Table 6.55 and Table 6.56 give an overview of the emission factors and other parameters used for the calculation of N_2O emissions from agricultural soil in 2005. 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 6.58 for direct N_2O emissions from fertilizer application, Table 6.59 and Table 6.60 for N_2O emissions from N-fixing crops and crop residues, Table 6.61 for the N_2O emissions from animal production and Table 6.62 for N_2O emissions from cultivated histosols.

Furthermore, background information on the development of national parameters is given in Table 6.63 for $Frac_{GASF}$, Table 6.64 for $Frac_{GASM,}$ and Table 6.65 for $Frac_{LEACH}$.

Table 6.55 4D Agricultural Soils Implied Emission Factors for the category 4D - N_2O emissions from agricultural soils in 2005

Member States	Synthetic Fertilizer	Animal Wastes appl.	N-fixing crops	Crop residue	Cultiv. of Histosols	Animal Production	Atmosph. Deposition	Nitrogen Leaching and run-off
2005	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%	0.99%	2.50%
Denmark	1.25%	1.25%	1.25%	1.25%	2.9	2.0%	1.00%	2.50%
Finland	1.25%	1.25%	1.25%	1.25%	7.9	2.0%	1.00%	2.50%
France	1.25%	1.25%	1.25%	1.25%	NO	2.0%	1.00%	2.49%
Germany	1.19%	1.27%	1.25%	1.00%	8.0	2.0%	1.01%	2.7%
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	NE	NE	NE	NE	NE	NE	NE	NE
Netherlands	0.93%	1.80%	0.93%	0.99%	4.7	1.5%	0.99%	0.70%
Portugal	1.25%	1.25%	1.25%	1.25%	NO	2.0%	1.00%	2.50%
Spain	1.18%	1.02%	1.25%	1.25%	NO	1.0%	1.00%	0.75%
Sweden	0.8%	2.50%	1.25%	1.25%	8.0	1.6%	1.00%	2.50%
United Kingdom	1.25%	1.25%	1.25%	1.25%	8.0	2.0%	1.00%	0.00%
EU-15	1.21%	1.28%	NE	NE	7.5	1.9%	1.00%	1.81%

Source of information: Tables 4.D for 2005, submitted in 2007. Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 6.56 4D Agricultural Soils: Relevant parameters for the calculation of N_2O emissions in 2005

Member States	FracBURN	FracFUEL	FracGASF	FracGASM	FracGRAZ	FracLEACH	FracNCRBF	FracNCRO	FracR
Austria	0.27%	NO	3.1%	20%	14%	30%	0.5%	1.5%	34%
Belgium	NO	3.3%	16.2%	34%	13%	NE	NE	NE	
Denmark	NO	NO	2.2%	21%	11%	34%	NE	NE	23%
Finland	NA	NA	0.6%	33%	20%		4.2%	1.0%	43%
France	NA	NO	10.0%	20%	42%	30%	3.0%	NA	NA
Germany	NO	NE	4.2%	30%	11%	30%	NE	NE	NE
Greece	10%		10.0%	20%	89%	30%	1.4%	0.5%	55%
Ireland		NO	1.6%	20%	65%	10%	NO	NO	NO
Italy			8.8%	29%	19%	30%	3.0%	1.5%	45%
Luxembourg		NE	NE	NE	NE	NE	NE	NE	NE
Netherlands	NO	NO	NE	NE	NE	NE	NE	NE	NE
Portugal	5.1%	NO	6.4%	22%	45%	30%	2.3%	1.3%	71%
Spain		NO	5.8%	34%	38%	30%	2.3%	0.6%	NA
Sweden	NO	NO	1.2%	32%	31%	23%	2.0%	2.0%	20%
United Kingdom			10.0%	20%	52%	30%	3.0%	2.0%	45%
EU-15[1)]	NA	NA	6.2%	26%	35%	28%	2.4%	1.4%	42%

Source of information: Tables 4.D for 2005, submitted in 2007. Abbreviations explained in the Chapter 'Units and abbreviations'.
[1)] Arithmetic average over the MS that reported.

Direct emissions from application of fertiliser.

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, Sweden. The Swedish EF of 0.8% 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 Netherlands distinguish also 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 6.57. Additional background information on the emission factors used is given in Table 6.58.

Table 6.57 4D Agricultural Soils: N_2O emission factors 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)		Reference
	Mineral soil	Organic soil	
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 6.58 4D Agricultural Soils: Member State's background information for the calculation of N_2O emissions from the application

Member State	Direct emissions from fertilizer applicatoin
Finland	The emission factors for organic soils on grass and cereals are based on national data (Monni, in press). The amount of nitrogen applied to soils has been corrected with a fraction of nitrogen volatilised as NH_3 and NO_x ($Frac_{GASF}$ and $Frac_{GASM}$, which is also used for sewage sludge) as well as with the fraction of nitrogen leached from applied synthetic fertilisers, manure and sewage sludge (FracLEACH). Separate EF´s for cultivated organic soils on cereals and grasses has been used. EF for cereals 11.08 kg N_2O-N ha^{-1} y^{-1}, EF for grass 5.7 kg N_2O-N ha^{-1} y^{-1}.
Netherlands	For direct N_2O emission calculations country specific emission factors are used. 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).

Direct emissions from crop residues and nitrogen-fixing crops.

In the German inventory, N_2O emissions from nitrogen fixing crops are reported as an average emission per hectare (2.9) of cultivated crop based on mean nitrogen input factors of 200 kg N ha^{-1} (grass/clover, clover/alfalfa mixtures) and 250 kg N ha^{-1} (alfalfa, leguminous crops) and an emission factor of 1.25% (Daemmgen, 2004). No implied emission factor for N_2O emissions from crop residues are reported in the German inventory.

Table 6.59 4D Agricultural Soils: Member State's background information for the calculation of N_2O emissions from crop residues

Member State	Direct emissions from crop residues
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).
Denmark	Estimates of the amount of N fixed in crops are from (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. 16% of the total agricultural area and represent thus a significant part of N-fixing crops emissions.
Finland	Crop yields of cultivated plants have been received from agricultural statistics (Ministry of Agriculture and Forestry). 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, 2004). 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).
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	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.
Sweden	To estimate nitrogen fixation from the atmosphere, a model according ot (Høgh-Jensen, 2004) has been used. 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	Includes contribution from improved grass (4 kg N/ha/year) (Lord, 1997).

Table 6.60 4D Agricultural Soils: Member State's background information for the calculation of N_2O emissions from N-fixing crops

Member State	Direct emissions from N-fixing crops
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 removes (Loehr 1990).
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 considering also legume forage. Nitrogen fixed per hectare is taken from Erdamn, 1959 in Giardini (1983).
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).
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 Kingdom	Field burning has largely ceased in the UK since 1993. For years prior to 1993, field-burning data were taken from the annual MAFF Straw Disposal Survey (MAFF, 1995).

Direct emissions from animal production.

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, Netherlands and Sweden, which use an EF of 1.0%, 1.5% and 1.6%, respectively.

Table 6.61 4D Agricultural Soils: Member State's background information for the calculation of N_2O emissions from animal production

Member State	Grazing animals
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).
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. Emissions are calculated also for di-nitrogen (0.14 kg N/ kg N) as they influence the quantity of nitrogen input to the soil. The share of grazing varies with subcategory, region, and time.
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 ($Frac_{GASM}$). FracGASG was 0.12 in 1995 and 0.08 in 2003. N_2O emissions from grazing animals are calculated after subtracting the nitrogen that volatilises as ammonia.

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 (33%), Sweden (24%) and a substantial source for N_2O emissions in Germany (13% - 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. Only the Netherlands uses 4.7 kg N_2O-N ha^{-1}; national emission factors are further used in Denmark (2.9 kg N_2O-N ha^{-1}) and Finland (7.9 kg N_2O-N ha^{-1}).

On absolute terms, the estimated emissions of N_2O from the cultivation of histosols are largest for Germany (16.4 Gg N_2O), followed by Finland (3.4 Gg N_2O) and Sweden (3.2 Gg N_2O).

Table 6.62 4D Agricultural Soils: Member State's background information for the calculation of N_2O emissions from the cultivation of histosols

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.
Denmark	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. See the LULUCF section for further description. 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.
Finland	The area of cultivated organic soils has been received from MTT Agrifood Research Finland and has been updated for the 2005 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. Emission factors for organic soils on grass and cereals are country-specific (Monni et al., in press).
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).
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.
Sweden	The area of organic soils is around 252 600 hectares according to a recent mapping of cultivated organic soils in Sweden (Berglund, 2005).
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 but Luxembourg 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 the Netherlands and Spain use a smaller emission factor for N_2O from nitrogen leached or run-off (0.70% and 0.75%). Germany uses a high emission factor of 2.7%.

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. No N_2O emissions from agricultural soils are estimated by Luxembourg.

While volatilisation 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 0.6% to 16% with only Belgium reporting a higher $Frac_{GASF}$ than 10%), 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 20.4% to 34%). 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 0% to 34% with most national values being smaller than the IPCC default 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 6.63 4D Agricultural Soils: Member State's background information on the fraction of NH_3 and NO_x volatilized from applied mineral fertilizer, FracGASF for the calculation of N_2O emissions

Member State	$Frac_{GASF}$
Austria	$Frac_{GASF}$ 23% for mineral fertilizers and 15.3% for urea fertilizers (CORINAIR).
Belgium	$Frac_{GASF}$ 2.3% in Wallonia (recommended by IIASA for different fertiliser types); 4.4% in Flanders (weighted average for NH_3 and NO volatilisation).
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.
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 NOX 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	Losses of nitrogen from volatilisation of NH_3 and NO_x were estimated using a time variable and country-specific fraction $Frac_{GASF}$, which varies between 0.053 and 0.062 kg NH_3-N/kg N, and which are almost half the default value.
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 6.64 4D Agricultural Soils: Member State's background information on the fraction of NH_3 and NO_x volatilized from applied manure, FracGASM for the calculation of N_2O emissions

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.Ammonia emissions from housing and storage were calculated following the CORINAIR EMEP, 1999 - detailed methodology for Cattle and Swine. For the estimation of $Frac_{GASM}$, losses of NH_3-N and NO_x-N occurring during manure application are subtracted (detailed methodology CORINAIR/EMEP 1999). A conservative emission factor for NO_x-N of 1% was used (Freibauer & Kaltschmitt, 2001). Calculated N losses are between 20% and 22% of total N excretion, whic
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 from 1990 to 2005 from 0.26 to 0.21 . 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)
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. The 2004 values of $Frac_{GASM}1$ and $Frac_{GASM}^2$ are 0.491 and 0.038, respectively indicating an overall volatilisation rate of 0.194 for animal manure nitrogen, which is close to the value used previously.
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 lower than the default value for $Frac_{GASM}$. The resultant implied $Frac_{GASM}$ is constant and equals 16%.
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 6.65 4D Agricultural Soils: Member State's background information on the fraction of nitrogen input leached or run-off, FracLEACH for the calculation of N_2O emissions

Member State	FracLEACH
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.
Denmark	The amount of nitrogen lost by leaching and run-off from 1986 to 2002 has been calculated by FAS. The calculation is based on two different model predictions, SKEP/Daisy and N-Les2 (Børgesen and Grant, 2003) and for both models measurements from study fields are taken into account. The result of these two calculations differs only marginally. The average of these two model predictions is used in the emission inventory. The fraction of N input to soils that are lost through leaching and runoff (FracLEACH) used in the Danish emission inventory is higher than the default value given in IPCC (30%). At the beginning of 1990s, manure was often applied in autumn. The high values are partly due to the humid Danish climate, with th precipitatin surplus during winter causing a downward movement of dissolved nitrogen. 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 th
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).
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_2Oemissions from agricultural soil.
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.

Six countries report emissions of N_2O from the application of sewage sludge, according to the IPCC GPG. The emission factors used are in five cases the IPCC default factor for direct N_2O emissions, two 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 6.66.

Table 6.66 4D Agricultural Soils: Member State's emissions from Other sources

Member States 2005	Description	Value kg N/yr	IEF kg N_2O-N/kg N	EMISSIONS N_2O (Gg)	Value kg N/yr	IEF kg N_2O-N/kg N	EMISSIONS N_2O (Gg)
		1990				2005	
Sewage sludge							
Belgium	(specify) & Sludge spreading (kg N/yr)	75,274	0.0125	0.0015	75,555	0.0125	0.0015
Denmark	Use of sewage sludge as fertilizers (kg N/yr)	3,056,917	0.0125	0.0600	3,029,119	0.0125	0.0595
Finland	Municipal sewage sludge applied to fields (kg N/yr)	1,494,440	0.0125	0.0294	292,934	0.0125	0.0058
Germany	Sewage sludge applied in agriculture (kg N/yr)	NO	NO	NO	27,818,612	0.0125	0.5464
Netherlands	Sludge application on land (kg N/yr)	5,000,000	0.0102	0.0800	1,600,000	0.0080	0.0200
Spain	Domestic Wastewater Sludge (kg N/yr)	8,321,005	0.0125	0.1630	29,390,288	0.0125	0.5756
EU-15	Sewage sludge application (kg N/yr)	17,947,636	0.0118	0.3338	62,206,507	0.0124	1.2087
Industrial waste							
Denmark	Industrial waste used as fertilizer (kg N/yr)	1,528,720	0.0125	0.0300	10,000,000	0.0125	0.1964
Compost							
Spain	Municipal Solid Wastes Compost (kg N/yr)	8,506,498	0.0125	0.1666	8,926,294	0.0125	0.1748
Oversea emissions							
France	Other non-specified Nitrogen input applied to soils in overseas territories	NA	NA	1.1185	NA	NA	0.8120
Improved Grassland							
United Kingdom	N fixed by improved grassland (kg N/yr)	27,689,300	0.0125	0.5439	27,618,108	0.0125	0.5425
Cultivation of mineral soils							
Sweden	Cultivation of mineral soils - Area of cultivated mineral soils (ha)	2,592,000	0.5000	2.0366	2,450,000	0.5001	1.9254

Trends

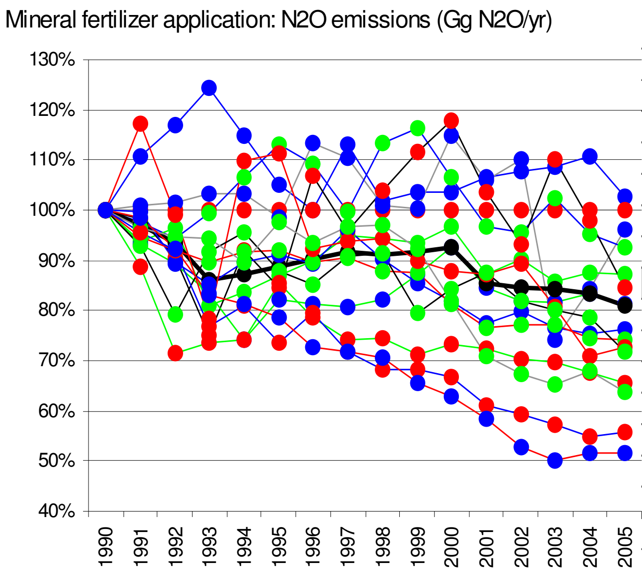
Figure 6.20 through Figure 6.23 show the trend of direct N_2O emissions from the source categories mineral and organic fertilizer application and indirect emissions from atmospheric deposition and nitrogen leaching and run-off.

In Austria, the trend of N_2O emissions is decreasing and the emissions in 2005 emissions were 14.1% below 1990 levels. The S&A report 2004 noticed high inter-annual variations in N_2O emissions of sector 4 D mineral fertilizer use. 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. The decrease in total emissions in Denmark can largely be attributed to the decrease in N_2O emissions from agricultural soils – the total N_2O emission from 1990-2005 has decreased by 31%. This reduction is due to a proactive national environmental policy over the last twenty years. 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. In Finland, emissions from agricultural soils have decreased 25%, from 1990 to 2005. The main reasons causing this reduction are the decrease in animal numbers which affects the amount of nitrogen excreted annually to soils, decrease in the amount of synthetic fertilisers sold annually and decrease in the area of cultivated organic soils. Some parameters, e.g. the annual crop yields affecting the amount of crop residues produced annually, cause the fluctuation in the time series but this fluctuation does not have much effect on the overall N_2O emissions trend.

About 80–85% of the manure collected in the Netherlands in the stable and in storage is applied to Dutch soils. A small portion of the manure (approximately 2–4%) is exported; the remainder is emitted as ammonia during storage. Ultimately, between 1990 and 2005 the part of the N in manure and synthetic fertiliser emitted as NH_3 (during storage, grazing and application to the field) decreased from approximately 18% to 13%. Of the total nitrogen flow to the soil only 30% (default IPCC fracleach) is subject to leaching and run-off. The total N-input to soil in The Netherlands decreased by

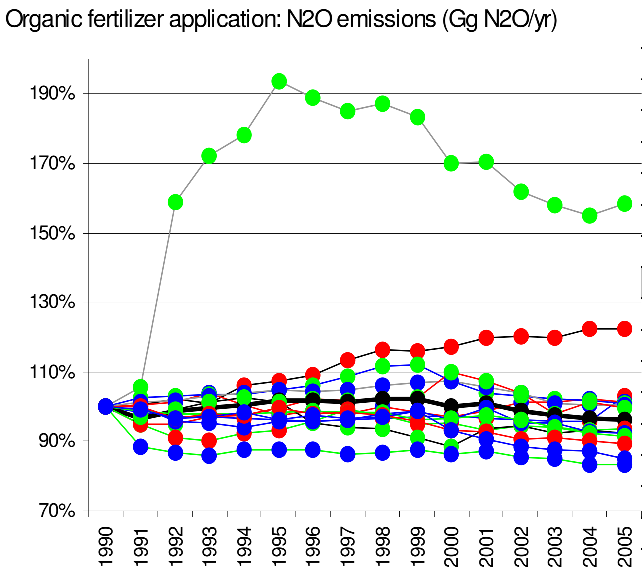
32% from 1990 to 2005, mainly as a result of the Dutch manure policy aimed at reducing N leaching and run-off. This decrease is not fully reflected in the 20% decrease in agricultural soil N_2O emissions during the same period.

Figure 6.20 4D Agricultural Soils: Trend of N_2O emissions for mineral fertilizer



	1990	Trend (%) 1990-2005	2005
Italy	13.6	103%	14.0
Luxembourg	0.5	100%	0.5
Portugal	2.7	96%	2.6
Ireland	7.3	93%	6.8
France	47.0	87%	41.1
Spain	19.8	85%	16.8
Germany	41.0	81%	33.4
EU-15	196.9	81%	159.5
United Kingdom	28.9	76%	22.0
Belgium	4.0	74%	3.0
Austria	2.6	73%	1.9
Sweden	2.8	72%	2.0
Finland	4.5	65%	2.9
Netherlands	6.9	64%	4.4
Greece	7.6	56%	4.2
Denmark	7.7	51%	4.0

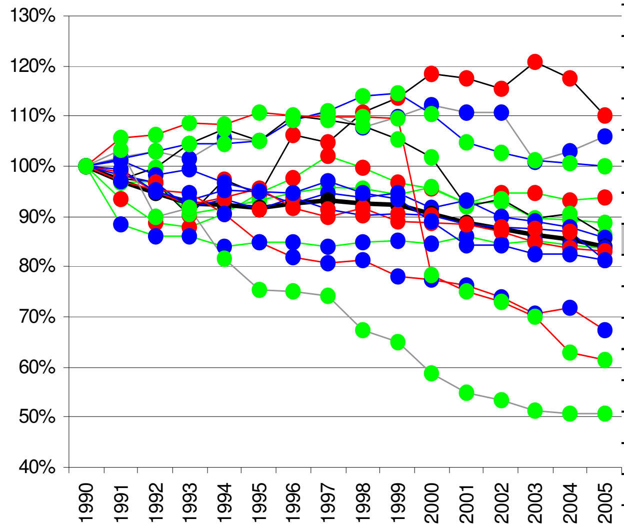
Figure 6.21 4D Agricultural Soils: Trend of N_2O emissions for organic fertilizer



	1990	Trend (%) 1990-2005	2005
Netherlands	5.59	158%	8.86
Spain	6.95	122%	8.49
Greece	0.78	103%	0.80
Denmark	3.51	101%	3.56
Ireland	1.49	101%	1.50
Portugal	1.09	100%	1.09
Belgium	3.05	99%	3.03
EU-15	89.12	96%	85.85
Finland	1.24	94%	1.16
Sweden	2.80	93%	2.59
Italy	9.34	92%	8.62
France	18.03	91%	16.48
Austria	2.28	89%	2.04
United Kingdom	8.61	85%	7.30
Germany	24.38	83%	20.32
Luxembourg			

Figure 6.22 4D Agricultural Soils: Trend of N_2O emissions for atmospheric deposition

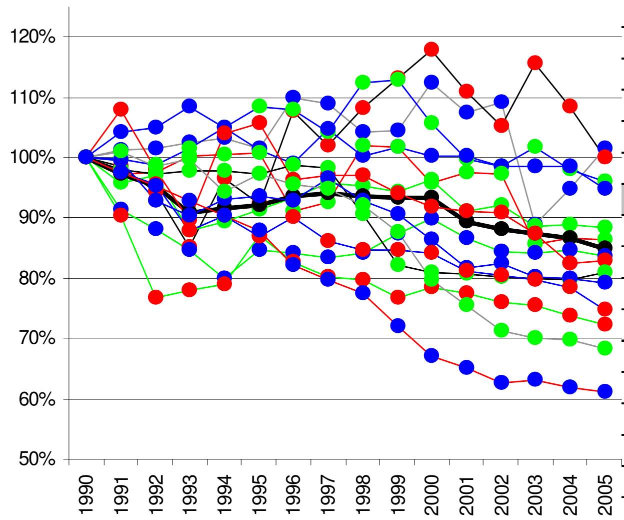
Atmospheric deposition: N2O emissions (Gg N2O/yr)



	1990	Trend (%) 1990-2005	2005
Spain	2.94	110%	3.24
Portugal	0.66	106%	0.69
Ireland	1.42	100%	1.42
Finland	0.63	94%	0.59
France	10.57	89%	9.37
Sweden	0.67	86%	0.57
Italy	5.95	86%	5.10
EU-15	47.23	84%	39.62
Germany	9.44	84%	7.88
Austria	0.67	83%	0.56
Greece	1.92	81%	1.56
United Kingdom	6.38	81%	5.18
Denmark	1.72	67%	1.16
Belgium	1.20	61%	0.74
Netherlands	3.08	51%	1.56
Luxembourg			

Figure 6.23 4D Agricultural Soils: Trend of N_2O emissions for nitrogen leaching and run-off

Nitrogen leaching and run-off: N2O emissions (Gg N2O/yr)



	1990	Trend (%) 1990-2005	2005
Portugal	3.28	102%	3.34
Spain	21.30	100%	21.32
Ireland	2.92	96%	2.80
Italy	20.22	95%	19.14
France	55.24	88%	48.81
Belgium	2.62	86%	2.26
EU-15	213.74	85%	181.43
Germany	38.64	84%	32.32
Austria	3.56	83%	2.95
Sweden	3.02	81%	2.44
United Kingdom	28.31	79%	22.44
Greece	9.71	75%	7.26
Finland	1.82	72%	1.31
Netherlands	12.60	68%	8.62
Denmark	10.50	61%	6.43
Luxembourg			

6.3.5.3. 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).

6.3.6 *Agricultural Soils – CH_4*

Only a few countries report CH_4 fluxes from agricultural soils. Table 6.67 shows that the values spread over a large range and are reported under different sub-categories and thus not comparable.

Explanation on the methodology is given in Table 6.68. While Austria and Belgium relates CH_4 emissions to the sewage sludge and manure that is spread in soils, respectively, Germany calculates a sink strength for methane is calculated in soils as aerobic soils are consuming CH_4 from the atmosphere. Arable soils are known to have smaller sink strength than forest or grassland soils.

Table 6.67 4D Agricultural Soils: CH_4 Emission soils in 2005

Member States	D. Agricultural Soils	1. Direct Soil Emissions	2. Animal Production	3. Indirect Emissions	4. Other
Austria	0.02		NA		
Belgium			NA,NO		
Denmark			NA		
Finland			NO		
France	NO		NO		
Germany			NA,NO		
Greece			NO		
Ireland			NO		
Italy			NA		
Luxembourg			NO		
Netherlands			NO		
Portugal			NO		
Spain			NA		
Sweden			NO		
United Kingdom			NA		
EU-15	0.02	0.00	NO	0.00	0.00

Source of information: Tables 4.D for 2005, submitted in 2007
Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 6.68 4D Agricultural Soils: Methodologies used to calculate CH_4 Emission in 2004

Member States	
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.
Belgium	Following the centralised review report and in harmony with the IPCC 1996 guidelines the methane emissions from wetlands, unmanaged surface waters and removals in forest soils, grassland and agricultural soils are no longer reported in the national inventory. Wallonia calculates the CH_4 emissions on the basis of the manure applied during grazing. In both regions, this source is very small compared to enteric fermentation and manure management.
Germany	The calculation of CH_4 emissions from agricultural soils is based on the approach of Boeckx and Van Cleemput (2001), compiling the available observations in Europe. Emissions are differentiated 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).

6.4 *Sector-specific uncertainty, quality assurance and quality control*

6.4.1 *Uncertainty*

Table 6.69 shows the total EU-15 uncertainty estimates for the Sector 4 Agriculture and the uncertainty estimates for the relevant gases of each source category. The highest level uncertainty was estimated for N_2O from 4D and the lowest for CH_4 from 4A. With regard to trend N_2O from 4F shows the highest uncertainty estimates, CH_4 from 4A the lowest. For a description of the Tier 1 uncertainty analysis carried out for the EU-15 see Chapter 1.7.

Table 6.69 Sector 4 Agriculture: Uncertainty estimates for the EU-15

Source category	Gas	Emissions 1990	Emissions 2005 1)	Emission trends 1990-2005	Emissions for which MS uncertainty estimates are available 2)	Share of emissions for which MS uncertainty estimates are available	Level uncertainty estimates based on MS uncertainty estimates	Trend uncertainty estimates based on MS uncertainty estimates
4.A Enteric fermentation	CH_4	136,177	121,830	-11%	128,832	106%	10%	2
4.B Manure management	CH_4	44,309	43,936	-1%	62,150	141%	15%	3
4.C Rice cultivation	CH_4	2,215	2,119	-4%	1,726	81%	19%	3
4.D Agricultural soils	CH_4	-661	-622	-6%	637	-102%	-105%	6
4.F Field burning	CH_4	475	71	-85%	59	83%	54%	46
4.B Manure management	N_2O	24,858	22,276	-10%	22,205	100%	51%	6
4.D Agricultural soils	N_2O	225,785	195,684	-13%	194,545	99%	79% - 163%	13 - 28
4.F Field burning	N_2O	189	34	-82%	31	91%	69%	164
4.G Other	N_2O	307	286	-7%	225	79%	100%	5
Total Agriculture	**all**	**433,654**	**385,618**	**-11.1%**	**410,410**	**106%**	**38% - 77%**	**6 - 13**

Note: Emissions are in Gg CO_2 equivalents; trend uncertainty is presented as percentage points.

1) The sum of the source category emissions may not be the total sector emissions because uncertainty estimates are not available for all source categories.

2) Includes for Greece and Spain 2004 data and for Belgium and Germany 2003 data

Quantitative estimates of the contribution of agriculture to the overall uncertainty of the national GHG inventories are reported in Table 6.70. For several countries, N_2O emissions from agricultural soils are by far dominating the uncertainty of the national inventory. The uncertainty estimate for this source category ranges from 1.9% (Denmark) to 19.9% (France). Overall, the estimate for the uncertainty range is slightly higher than in the previous years (1.5%, Austria to 17.6%, France for the 2006 submission) and has narrowed down since the 2005 submission (0.6% to 20.9%.

The values are expressed in percentage relative to the total GHG emission estimates and have thus to be interpreted in relation to the overall estimated inventory uncertainty, which ranges from 3.2% (Italy) to 21.3% (France) thus very close to the contribution from agricultural soils. Higher total uncertainty is reported from Finland (58.8%), which is due to very high uncertainties assigned to the estimates of carbon stock changes in soils.

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 5.2% of the national total versus 1.1% uncertainty of the indirect emissions. On the other hands, the Netherlands estimate an uncertainty of 1.4% and 3.0% for direct and indirect N_2O emissions from agricultural soils, respectively. CH_4 emissions from enteric fermentation are less uncertain (0.4% to 2.7% of total national GHG emissions) and manure management contributes with less than 1.6% 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 6.70. The corresponding uncertainties for activity data and emission factors are given in Table 6.71 and Table 6.72.

A table summarizing background information on the uncertainty estimates is given in Table 6.73.

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.

Both factors are important particularly for the source category of N_2O emissions from agricultural soils, as here the uncertainty is considered to be highly skewed in most cases. An overview of the lower and upper 2.5 percentiles and the distribution used in the Monte Carlo assessments is given in Table 6.74.

Table 6.70 Sector 4 Agriculture: Member States' uncertainty estimates

	Total uncertainty of GHG inventory	Share agriculture in total GHG einventory	Total agriculture	Enteric ferment. (4A)	Manure Managem. (4B)		Agricultural soils (4D)			
							total	direct	indirect	animal prod.
				CH_4	CH_4	N_2O	N_2O	N_2O	N_2O	N_2O
Member State	% of total emissions	% of total emissions	uncertainties expressed as % of total GHG emissions							
Austria	3.7	10.3	4.0	0.9	0.6	1.2	3.7	3.0	2.1	
Belgium	7.5	7.7	7.0	1.1	0.7	0.5	6.9			
Denmark	5.4	15.8	2.7	0.5	1.6	0.9	1.9			
Finland	58.8	14.6	9.8	0.7	0.1	1.1	9.7	9.0	3.6	0.5
France	21.3	19.4	20.0	2.3	1.3	0.6	19.9			
Germany	5.6	6.6	4.7	0.6	0.1	0.2	4.7	4.1	2.2	0.1
Greece	12.1	8.6	6.0	0.7	0.2	0.3	6.0	5.2	1.1	2.7
Ireland	6.2	26.6	6.3	2.7	0.3	0.6	5.7	3.9	1.0	4.0
Italy	3.2	7.9	2.8	0.7	0.7	0.8	2.6	1.9	1.6	0.3
Netherlands	4.2	3.0		0.6	0.8	0.4	3.3	1.4	3.0	0.3
Portugal	9.3	8.5	3.5							
Spain	8.4	9.3	9.1	0.4	0.3	0.8	3.9	0.8	3.8	
Sweden	6.0	11.4	4.0	1.1	0.4	0.4	5.3			
United Kingdom	16.50	13.6	5.5	0.5	0.1	0.8	16.7			

Table 6.71 Sector 4 Agriculture: Member States's uncertainty estimates for Activity Date 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			10		5		5
Belgium	5	10	10	30			
Denmark	10	10	10	8			
Finland	0	0	0		0	0	0
France	5	5	5	10			
Germany			7		75	20	75
Greece	5	5	50		20	50	20
Ireland			11		11	11	11
Italy	20	20	20		20	20	20
Luxembourg							
Netherlands			10		10	10	50
Portugal			38			229	
Spain	3	3	16		18		188
Sweden	5	20	20	16			
United Kingdom	10	10	100	100			

Table 6.72 Sector 4 Agriculture: Member States's uncertainty estimates for Emission Factor 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			10		5		5
Belgium	5	10	10	30			
Denmark	10	10	10	8			
Finland	0	0	0		0	0	0
France	5	5	5	10			
Germany			7		75	20	75
Greece	5	5	50		20	50	20
Ireland			11		11	11	11
Italy	20	20	20		20	20	20
Luxembourg							
Netherlands			10		10	10	50
Portugal			38			229	
Spain	3	3	16		18		188
Sw eden	5	20	20	16			
United Kingdom	10	10	100	100			

Table 6.73 Sector 4 Agriculture: Member State's background information on the uncertainty estimates

Member State	Uncertainties
Austria	The uncertainty are mainly based on results from the first comprehensive uncertainty analysis that was performed in 2001 based on data from submission 1999 (Winiwarter and Rypdal, 2001). According to the Tier 1 Uncertainty Analysis, the uncertainty introduced into the trend in total national emissions is 2.97%. 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. The uncertainties for N_2O emissions were calculated by Monte Carlo analysis, using a model implemented with @risk software. The model uses a probability distribution as an input value instead of a single fixed value. Generally, results from the Tier 1 and Tier 2 analysis are very similar, with the exception of non-symmetric distributions, as particularly for N_2O emissions from agricultural soils. The most striking difference is that of the total uncertainty, the tier 1 approach is clearly lower. This difference may be explained by the fact that the tier 1 approach necessarily considers input data for two source categories to be independent, which is assumed to be often not the case. Statistically dependent variables, as can easily be defined in a Monte Carlo analysis, and the reduction of the overall relative uncertainty during error propagation will not be allowed.
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 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.
Finland	Tier 2 estimation of uncertainties using the KASPER model, developed by VTT Technical Research Centre of Finland. The model uses Monte Carlo simulation to estimate uncertainties, and is thus in accordance with the Tier 2 method presented by the IPCC Good Practice Guidance (IPCC, 2000). In agriculture, an uncertainty estimate was given for each calculation parameter of the calculation model at a detailed level. Detailed description in several reports (Monni and Syri, 2003;Monni, 2004; Oinoenen, 2003) and publications (Monni et al., 2004; Monni et al, in press.). The uncertainty for enteric fermentation was assessed in estimating the uncertainty in each calculation parameter. The uncertainty estimate for N_2O emissions from manure management used a negatively 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. 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.
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	The 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.
Netherlands	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.
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).
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 source making the major contribution to the overall uncertainty is 4D – Agricultural Soils.

Table 6.74 4D Agricultural Soils: Selected Information for the Monte Carlo Analysis carried out be a few Member States

MS	Reference	Year	Category	Gas	Parameter	Distrubution	Lower 2.5%il	Upper 97.5 %il	Note
AT	Rypdal and Winiwarter	2001	4D	N_2O	emissions	U	-68	934	
AT	Winiwarter and Rupdal	2001	4D	CH_4	EF	N	-100	100	
AT	Winiwarter and Rupdal	2001	4D	N_2O	EF	T	-32	143	
AT	Winiwarter and Rupdal	2001	4D	CH_4	EF	U	-105	205	systematic variation
AT	Winiwarter and Rupdal	2001	4D	N_2O	EF	U	-32	1034	systematic variation
AT	Winiwarter and Rupdal	2001	4D	N_2O	EF	U	-50	836	nat. soils, systematic variation
FI	Monni et al.	2005	4D	N_2O	AD	N	-10	10	Amount of fertiliser
FI	Monni et al.	2005	4D	N_2O	AD	N	-30	30	N sludge
NL	Rypdal and Winiwarter	2001	4D	N_2O	emissions	N	-75	75	
NL	Olsthoorn and Pielaat	2003	4D	N_2O	AD	N	-10		synthetic fertriliser
NL	Olsthoorn and Pielaat	2003	4D	N_2O	AD	N	-10		area of arable land, grassland mineral and organic soils, forests, other land
NL	Olsthoorn and Pielaat	2003	4D	N_2O	EF	N		10	1990 perc manure injected/incorporated
NL	Olsthoorn and Pielaat	2003	4D	N_2O	EF	N		5	1999 perc manure injected/incorporated
NO	Rypdal and Winiwarter	2001	4D	N_2O	emissions	L	two orders of magnitude		
UK	Rypdal and Winiwarter	2001	4D	N_2O	emissions	L	two orders of magnitude		
USA	Rypdal and Winiwarter	2001	4D	N_2O	emissions	N	-90	100	
FI	Monni et al.	2004	4D1	N_2O	EF	N	-80	80	
FI	Monni et al.	2004	4D1	N_2O	EF	G	-75	87.5	cultivated organic soils
FI	NIR for UNFCCC	2005	4D1	N_2O	emissions		-76	227	
FI	Monni et al.	2005	4D1	N_2O	AD	N	-30	30	Ncrop
FI	Monni et al.	2005	4D1	N_2O	AD	N	-30	30	Nfix
FI	Monni et al.	2005	4D1	N_2O	AD	N	-30	30	Area histosols
NL	Olsthoorn and Pielaat	2003	4D1	N_2O	EF	L		100	manure injected/incorporated, spread on organic and mineral soils
NL	Olsthoorn and Pielaat	2003	4D1	N_2O	EF	L		60	mineral fertiliser
NL	Olsthoorn and Pielaat	2003	4D1	N_2O	EF	L		100	background emission factor for arable land, grassland, organic soil, forest land, and other land
NL	Olsthoorn and Pielaat	2003	4D1	N_2O	EF	N		100	measured gross

MS	Reference	Year	Category	Gas	Parameter	Distrubution	Lower 2.5%il	Upper 97.5 %il	Note
									emissions arable land and grassland (organic and mineral)
NL	Olsthoorn and Pielaat	2003	4D2	N_2O	AD	N		10	N excretion
NL	Olsthoorn and Pielaat	2003	4D2	N_2O	AD	N		10	share of excretion in meadow
NL	Olsthoorn and Pielaat	2003	4D2	N_2O	AD	N		5	share N in urine
NL	Olsthoorn and Pielaat	2003	4D2	N_2O	EF	N		60	EF N in uring
NL	Olsthoorn and Pielaat	2003	4D2	N_2O	EF	N		60	EF N in faeces
FI	Monni et al.	2005	4D3	N_2O	$Frac_{GASM}$	N	-40	40	
FI	Monni et al.	2005	4D3	N_2O	$Frac_{GASF}$	N	-30	30	
FI	Monni et al.	2004	4D3	N_2O	EF	G	-92	380	leaching/runoff
FI	Monni et al.	2004	4D3	N_2O	FracLeach	G	-66	166	
FI	Monni et al.	2005	4D3	N_2O	FracLeach	L	-70	170	
FI	NIR for UNFCCC	2005	4D3	N_2O	emissions		-81	334	
NL	Olsthoorn and Pielaat	2003	4D3	N_2O	EF	N		50	$Frac_{GASM}$ (losses of NH_3 in stable and storage)
NL	Olsthoorn and Pielaat	2003	4D3	N_2O	EF	N		25	$Frac_{GASM}$ (losses of NH_3 application)
NL	Olsthoorn and Pielaat	2003	4D3	N_2O	AD	N		50	1990 Nitrogen input to surface waters
NL	Olsthoorn and Pielaat	2003	4D3	N_2O	AD	N		0	N input to surface waters relative to inut in 1990
NL	Olsthoorn and Pielaat	2003	4D3	N_2O	EF	N		200	Polluted surface waters
FI	Monni et al.	2004	4D3 / 1A	N_2O	EF	G	-80	100	volatilization
FI	Monni et al.	2004	4D4	N_2O	EF	N	-80	80	other

6.4.2 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 are:

1. Overview tables on methodological issues were difficult to read and were not sufficiently integrated to enable a view from European perspective
   Two major changes in the present report respond to this issue

- For each category, an overview table for the main categories (which are key sources for EU-15) is given including quantitative importance and Tier used. This information is used to calculate a percentage of emissions at EU-15 level for each key source which was estimated by Tier 1 or by Tier 2 methodologies. This analysis was presented during the ICR and proposed for inclusion in the present inventory report.
- The textual overview tables on methodological issues have been split into several tables under the different sub-sections for each category to allow more concise comparison between the Member States.

2. Trend recalculations should be better explained
   - New sections on time series and recalculations summarize the relevant information.
   - Graphical representation of the trend for the most important activity data and other parameter enable to understand better the reason of trends in emissions.
3. The level of information presented in the NIR and the CRF tables was not always the same
   - The process of data compilation was streamlined so that is was possible for the first time to present a full set of background CRF tables, in which all relevant cells are filled.
   - Missing information by some MS have been obtained
4. Some relevant information required to assess the differences in the emission estimates across the Member States was not included in the inventory report
   - The inventory report is being continuously developed. This year it was for the first time possible to include overview tables for all relevant parameters in the report.
5. Major milestones in the collaboration with the Member States were mentioned in the inventory report with a link to the relevant websites. The ERT recommended to include also the recommendations of these workshops in the report itself
   - A summary of the workshops is given below.

For the current submission, 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.

6.4.3 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.

Regarding the quality of national greenhouse gas inventories for the agricultural sector, the participants of the workshop expressed concern in the areas of the consistent assessment of the nitrogen balance in agricultural livestock production systems (source category. 4B), the quality of CH_4 emission estimates from enteric fermentation (source category 4A), and the comprehensive treatment of greenhouse gas emissions from agricultural soils (source category 4D). The workshop recommended, amongst other, to continue the exchange of experience between countries, to coordinate the input of MS into the revision of the IPCC *Guidelines*, and to involve European research projects. It was decided to focus on category 4D due to its dominant role in the total uncertainty of European GHG inventories.

Therefore, an expert meeting of the working group on "improving the quality for greenhouse gas emission inventories for category 4D" was held in October 2004 at the Joint Research Center in Ispra, Italy with the participation of experts from 14 countries and six international organizations / projects.

The objectives of the workshop were:

- To assess the current state of reporting of emissions from agricultural soils;
- To highlight gaps in the availability of data;
- To report on national activities for the generation of national emission factors and other parameters;
- To discuss the link between different source categories in agriculture and with the inventory for ammonia emissions;
- To discuss the use of Tier 3 approaches (process-based models);
- To make recommendations to improve comparability, transparency and completeness of reporting of N_2O emissions from agricultural soils.

The workshop's participants formulated general recommendations for the improvement of the quality of greenhouse gas emission inventories for category 4D as well as a series of specific recommendations, directed both at European Member States in order to improve GHG inventories under the current Guidelines and suggestions beyond the current guidelines addressing the IPCC process for revision of the Guidelines. These recommendations have been forwarded to the secretariat of the IPCC and most of the issues addressed are being updated in the 2006 guidelines.

These recommendations were discussed in a wider audience at scientific conferences, such as the Non-CO_2 greenhouse gas conference (NCGG-4) in Utrecht (see Leip, 2005a) and discussed for their scientific relevance in Leip et al. (2005). The proceedings of the workshop have been published as a EUReport (Leip, 2005b).

Recommendations

The participants of the workshop valued the concept and the quality standards as they are currently defined in the Guidelines for reporting to the respective conventions, and felt that some methodologies can indeed be improved.

The workshop's participants formulated general recommendations for improvement of the quality of greenhouse gas emissions for category 4D as well as a series of specific recommendations. Specific recommendations are directed both towards European Member States in order to improve GHG inventories under the current ***Guidelines*** and suggestions beyond the current guidelines addressing the IPCC process for revision of the ***Guidelines***.

General recommendations

Coherent reporting

The participants recognized that, for reporting N-emissions, the existence of the two conventions is complementary rather than competitive and that mutual benefits can be achieved by combining the respective efforts and exchange of information.

Despite the differences in target and scale between the two conventions, the participants urge to a unified concept for reporting. Synergies and coherence with other directives (e.g., nitrate directive) should be considered. Inventory generation requires interdisciplinary expertise.

Comprehensive reporting

Emissions of air pollutants, greenhouse gases and inert gases from agricultural systems are closely interrelated. To avoid that a certain mitigation measure leads to a simple shift in emissions, it is important to have a comprehensive and integrated assessment of all emissions. This assessment could eventually be used for reporting requirements.

The guidance needs to be user-friendly and unequivocally, and stimuli for countries to actually improve reporting quality would help. The IPCC is offering methodologies and invites countries to use improved methodologies. One is the use of the

CORINAIR guidebook for NH_3 calculations.

Stakeholders

The assessment of the environmental impact of agricultural activities in Europe is relevant at different levels, i.e., at the European level, at national and regional (e.g., drainage basins) level and at the farm level.

Each of them requires its own level of detail in the methodological approach (reporting, budgeting, process understanding) and is associated with a different degree and definition of uncertainty. Also, it is helpful to develop a communication tool between the levels.

Mitigation

Mitigation of emissions from agriculture is achieved at the farm and regional level. The processes involved in the formation of emission fluxes in agricultural systems are extremely difficult and complex. There is a need to allow in the reporting methodologies for mitigation measures other than changing N input. Methodologies should also encourage operating in a country-specific way. Process understanding should be incorporated in order to allow for (convincing) mitigation measures at the farm level.

Activity Data

There is (still) a lack (and uncertainty) in activity data. There is need of management data as input data for the guidelines in order to enable to make projection.

Emission Factors

Emission factors and other parameters used in the calculation of emission fluxes are associated with a large degree of uncertainty. The emissions of nitrous oxide from soils are affected by both variability in space and time and by inaccuracy. Deeper process knowledge is required to separate them. This can be achieved by a combination of well conceptualized experiments and (process) modeling.

There is a body of evidence that default Emission Factors can be revised on the basis of recent data. In some cases, there is less uncertainty associated with relative than with absolute emissions (e.g. nitrate ammonium > urea). Such knowledge could be better exploited.

Countries are encouraged to develop and use national data provided these are documented, validated and made available. Regionalization of emission factors is required. Additional information is needed in particular for Southern and Eastern European climate regions. Resources should be allocated with preference into the development of national estimates for indirect N_2O emissions (volatilization, leaching and run-off), which are most uncertain.

In some cases, there might be a need to find a compromise between comparability and accuracy. Existing national data are in some cases not yet used for reporting. Comparability can not be achieved by using the same factor.

Projections

An integrated research approach is required in order to enhance process understanding, to improve biogeochemical models and finally to narrow the uncertainty range in emission projections. Components of an integrated research approach must be field measurements accompanied by laboratory studies and model improvement and validation.

The workshop's participants see need for action at the EU level

There is value in exchanging ideas in the frame of a workshop especially as national data and methodologies are developed[22]. Particularly, the involvement of New Member States and Candidate Countries is needed.

Data requirements for the second commitment period (2006 guidelines) and negotiations/ preparations under COP/SBSTA

Process models are continuously evolving and improving. Their potential use for GHG inventories should be re-assessed in two years time.

There is the need to better assess the uncertainty associated with N_2O emissions from soils and to take action for reducing the uncertainty range.

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22 The participants of the workshop welcomed the project carried out in Italy for comparison of methodologies used in Mediterranean countries.

Specific recommendations

General issues

Recommendations for current reporting

(1) Member States are encouraged to develop national emission factors or parameters required for the calculation of N_2O emissions, which are essential for reducing uncertainty of GHG inventories, provided these are documented, validated and made available. Priority areas are:

  (a) Direct emission factors

  (b) Leaching fraction

  (c) N_2O emissions from groundwater

  (d) Nitrogen fraction in crop residues

  (e) Volatilization fraction for synthetic fertilizer and applied animal wastes.

(2) Member States are required to appropriately disaggregate key source categories according to the *Guidelines*.

(3) Member States are encouraged to collect farm management information, which is still scarce and is required for N_2O emission estimates and projections.

Direct emissions of N_2O

Emission Factors

Recommendations for current reporting

(4) Member States are encouraged to develop regional emission factors/parameters. Eco-systemical stratification of emission factors by main ecological drivers is essential for reducing the uncertainty in national greenhouse gas inventories. Priority areas are:

  - Effect of soil type/climate (wetness/freeze-thaw events/rewetting of dry soils)
  - Effect of type of N applied (mineral / organic)
  - Effect of crop type (classes)

Recommendations for the revision of the Guidelines

(5) There is a basis for differentiating N_2O emission factors between the type of nitrogen input, in relationship to land use and soil conditions. In particular, specific EFs could be adopted, for

  (a) the manure N deposited in situ, taking into account the state of the soil under the grazing regime; and

  (b) the manure from animal housing etc. spread on the fields.

(6) Mitigation measures should be visible in the *Guidelines* for higher Tier methods as emissions of N_2O are a non-linear function of N input. Efficient use of nitrogen given to the crop is a function of both crop type and local conditions. Application rates in relation to crop needs and timing of management activities are key driver for avoiding excess input of nitrogen.

(7) Emissions of N_2O induced by different forms of nitrogen input are non-linearly interacting. The interdependency between forms of N-input should be reflected in the *Guidelines* for higher Tier methodologies, e.g. as an EF-matrix (total input vs. percent animal waste).

N_2O emissions from crop residues and from N-fixing crops

Recommendations for current reporting

(8) Member States should use Table4.F for reporting of parameters relevant for N_2O emissions from crop residues, even in case no burning of crop residues occurs in their country, to enhance transparency.

(9) Member States are required to estimate crop residues from all major crop types occurring in their country.

Recommendations for the revision of the Guidelines

(10) A separate calculation for forage legumes such as alfalfa and clover-grass mixtures should be included in the *Guidelines*. The role of rotational renewal of grass/clover leys by ploughing and reseeding every few years also needs attention.

(11) The methodology for reporting of emissions from crop residues needs revision. In particular:

(c) There are possible risks of double counting when background emissions from the cultivation of mineral soils are included in the inventory. Guidance on background emissions should be given.

(d) Default values for the nitrogen fraction need to be streamlined. Particular attention should be paid to the physiological part of the crop the parameters are referring to (crop product, crop residue, and total aboveground crop).

(e) The C/N ratio of crop residues appears to be a key variable in determining the amount of N_2O produced during winter and could be included in the methodology.

(12) An alternative and simpler method for estimating N_2O emissions could be based on area-based quantities of nitrogen in crop residues by crop type, which are more readily available in some countries.

Background emissions

(13) Reporting of background emissions from cultivation of mineral soils seems appropriate as long as nitrogen in roots is not accounted for and with regard of long-term effects of manure applications. However, reporting of background emissions bears the risk of double accounting. It would be helpful if the *Guidelines* address this issue.

Nitrogen balance in agricultural systems

Recommendations for current reporting

(14) Member States should link NH_3 and N_2O inventories as far as possible in order to enable the assessment of mitigation measures for its impact on both air pollution and climate change related policies.

(15) Member States should apply a mass-flow approach wherever possible, provided that appropriate factors are available (related to Total Ammoniacal Nitrogen for NH_3 and total nitrogen for N_2O). If possible, also emissions of N_2 should be reported wherever relevant.

(16) Member States are encouraged to differentiate between NH_3 volatilization from animal housing systems, manure storage systems and volatilization from soils. Information on NH_3 emission rates from housing and manure could be included in background Table4.B(b) as shown in the following example, indicating emissions of NH_3, NO_x, and N2 in columns $L to $N and differentiation between systems in rows #12ff.

(17) Member States should correct the amount of nitrogen deposited on pasture, range, and paddock (Equation 2 of p. 4.98 of the IPCC *Guidelines*) for the fraction of nitrogen volatilized in analogy to the calculation of direct emissions from applied manure (see equation 4.23 on page 4.56 if the IPCC *Good Practice Guidance*), as volatilization of NH_3 from pasture, range, and paddock occurs before N_2O production takes place. The Fraction of livestock N excreted and deposited onto soil during grazing that volatilizes as NH_3 and NO_x could be reported in cell J16 of the table "Additional information" of background Table4.D. A possible acronym is "$Frac_{GASP}$"

Recommendations for the revision of the Guidelines

(18) The *Guidelines* should apply a nitrogen-balance method allowing the comprehensive assessment of mitigation. This would – in some cases – require the estimation of other nitrogenous losses as NO_x and N_2.

(19) The CRF table should allow reporting separately volatilisation fractions for NH_3 and NO_x and optionally N_2, and differentiating for animal housing and manure storage systems. This could be achieved, for example, with additional columns/rows in the table "Implied Emission Factors" in background Table4.B(b).

(20) The default volatilization fractions for NH_3 and NO_x or fertilizer application should be replaced by a more detailed method, such as the methodology described in the CORINAIR guidebook.

(21) Volatilization fractions for NH_3 and NO_x from soils should be differentiated for manure applied on agricultural soils and manure dropped on Pasture, Range, and Paddock. This could be achieved, for example, by an additional row in the table "Additional information" in Table4.D

(22) The name of category 4D31 "Atmospheric Deposition" easily leads to confusion with atmospheric nitrogen deposited on the agricultural land. The workshop recommends another short name, such as Indirect N_2O emissions from "*Volatilization of NH_3 and NO_x*".

(23) The calculation of "Direct N_2O emissions from Animal Production" should be done under category 4D rather then under category 4B.

(24) The definition of manure as "animal wastes" does not seem appropriate.

Advanced methodologies

Recommendations for the revision of the Guidelines

(25) Biogeochemical models are potentially a powerful tool for deriving emission factors on a regional basis and for the policy-making process (projections, scenario analysis). They could play a useful role for inventory generation in some year's time, provided that they are thoroughly validated. Guidance should be given on the use of biogeochemical models, in particular

(26) how sub-sources, that are integrated in one calculated emission rate should be separated. In biogeochemical models, sub-sources are interacting, non-linear, and non-additive.

(27) if changes in weather conditions and other ephemeral changes should be fully reflected in the emission estimates or if – during a commitment period – climate data should be used rather than weather

(28) how transparency could be ensured (assumption behind models, parameterization, underlying data sets etc.)

Other issues

Recommendations for the revision of the Guidelines

Intercrops

(29) The occurrence of intercrops is common in certain European regions and has an impact on the use and efficiency of nitrogen fertilizer. The use of intercrops should be reflected in the *Guidelines*.

Reporting of emissions from land use and land-use change

(30) Permanent crops are important in Mediterranean countries. Allocation of permanent crops within the land use categories proposed in the *Good Practice Guidance* for LULUCF is not straightforward. Better guidance should be given in the *Guidelines*.

(31) The transformation of volatilized nitrogen from agriculture into N_2O can happen after one or more cycles of deposition/volatilization processes. Indirect N_2O emissions should be reported from all land uses where N_2O emissions are being estimated rather than from cropland only.

Indirect emissions from energy-related activities

(32) Energy-related emissions of NO_x are leading to N_2O emissions further down in the "nitrogen cascade" can significantly contribute to total anthropogenic N_2O emissions. Considering these emissions in the guidelines would ensure methodological consistency across the sectors.

6.5 Sector-specific recalculations

Table 6.75 shows that in the agriculture sector the largest recalculations were made for CH_4 in the years 1990 and 2004. Also N_2O emissions were recalculated in both years.

Table 6.75 Sector 4 Agriculture: Recalculations of total GHG emissions and recalculations of GHG emissions for 1990 and 2004 by gas (Gg CO_2 equivalents and %)

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	-12,662	-0.4%	-284	-0.1%	-4,944	-1.2%	-1	0.0%	0	0.0%	1	0.0%
Agriculture	0	0.0%	-445	-0.2%	-351	-0.1%	NO	NO	NO	NO	NO	NO
2004												
Total emissions and removals	-8,944	-0.3%	-2,528	-0.8%	-558	-0.2%	-2,281	-4.4%	-59	-1.1%	31	0.3%
Agriculture	0	0.0%	-249	-0.1%	-132	-0.1%	NO	NO	NO	NO	NO	NO

NO: not occurring

Table 6.76 provides an overview of Member States' contributions to EU-15 recalculations. Germany and Ireland were mainly responsible for recalculations in 1990 and in 2004 also Portugal, Spain and the UK contributed significantly to recalculations.

Table 6.76 Sector 4 Agriculture: Contribution of Member States to EU-15 recalculations for 1990 and 2004 by gas (difference between latest submission and previous submission Gg of CO_2 equivalents)

	1990						2004					
	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
Austria	0	0	1	NO	NO	NO	0	-1	-7	NO	NO	NO
Belgium	0	0	0	NO	NO	NO	0	2	54	NO	NO	NO
Denmark	0	0	-1	NO	NO	NO	0	1	37	NO	NO	NO
Finland	0	-1	7	NO	NO	NO	0	19	-40	NO	NO	NO
France	0	0	3	NO	NO	NO	0	74	3	NO	NO	NO
Germany	0	-531	-86	NO	NO	NO	0	-425	400	NO	NO	NO
Greece	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
Ireland	0	88	-265	NO	NO	NO	0	88	-239	NO	NO	NO
Italy	0	0	0	NO	NO	NO	0	-8	62	NO	NO	NO
Luxembourg	-	0	0	NO	NO	NO	-	1	0	NO	NO	NO
Netherlands	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
Portugal	0	0	-10	NO	NO	NO	0	-1	-186	NO	NO	NO
Spain	0	0	0	NO	NO	NO	0	0	-444	NO	NO	NO
Sweden	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
UK	0	0	0	NO	NO	NO	0	1	229	NO	NO	NO
EU-15	**0**	**-445**	**-351**	**NO**	**NO**	**NO**	**0**	**-249**	**-132**	**NO**	**NO**	**NO**

NO: not occurring; IE: included elsewhere

6.5.1 Enteric Fermentation (CRF source category 4A)

Information on recalculations of emission estimates in category 4A contained in the NIR of some countries are summarized below:

Table 6.77 4A Enteric Fermentation: Member State's background information for recalculations of CH_4 emissions

Member State	Recalculations
Austria	No recalculations have been required for this version of the inventory.
Belgium	Further harmonisation of the emission factors between the regions is carried out during the submission 2007.
Denmark	Based on the ERT recommendations, improvements to the documentation of number of horses, sheep and goats on small farms, in cooperation with DAAC, is planned. Based on the ERT recommendations, an interpolation on feed intake from 1990 to 1994 has been performed to avoid jumps in the time-series.
Finland	Recalculation of this source category was made because weights of heifers and calves for 2002-2004, weight of bull for 2004 and mature weight of bull in 2003-2004 were corrected according to the latest data. Also, the number of swine in 1990 and sheep EF for the year 2004 was corrected.
Germany	Recalculation of emission factors for 2003 and 2004 lead to small changes. Feed composition of bulls improved by including N-reduced feeding in the region Weser-Ems lead also to very small overall changes. Numbers for horses corrected.
Italy	Recalculations in the dairy cattle category are due to the update of parameters used to estimate emission factors. These parameters are: fat content in milk, portion of cows giving birth, milk production, methane conversion factor, percentage of animal grazing and average weigh. Livestock activity data for the last years (2002-2003) have been updated with new data available from ISTAT.
Luxembourg	In 2006, a re-evaluation of methane emissions of agriculture has been done for Luxembourg for the years 1990 through 2004. Planned revising emission factors for young cattle, which are lower than adult cattle.
Netherlands	There were no source-specific recalculations for this subcategory.
Sweden	Small adjustments have been made in the calculations which affected the implied emission factors and additional information, but not the emissions. According to the Farm Register, there are about 95,660 horses on farms in Sweden. However, the total number of horses, including horses used for leisure activities, is estimated to be about 283,000. This larger number has been used for the calculations for all years in the Submission 2007.
United Kingdom	For calculation of methane from enteric fermentation in the dairy breeding herd, the digestibility of the diet has been increased from 65% to 74%, based on expert opinion of Bruce Cottrill (ADAS).

6.5.2 Manure Management CH_4 (CRF source category 4.B)

Information on recalculations of emission estimates in category 4B contained in the NIR of some countries are summarized below:

Table 6.78 4B Manure Management: Member State's background information for recalculations of CH_4 emissions

Member State	Recalculations
Austria	No recalculations have been done.
Belgium	In the Flemish region a study has been carried out to calculate the NH_3-, N_2O- and the CH_4-emissions from outdoor manure storage. The results of this study will be taken into account from 2005 on.
Denmark	Recalculation has been made because of the correction of N excretion for swine in 2004. Also, changes in the distribution of manure management systems as well as some minor changes in activity data were reasons for recalculating the time series.
Finland	The following improvements and corrections were made for this submission: animal numbers and crop yield data was updated according to the latest statistics, weights of some cattle species were corrected on the basis of new data. Few changes were made on the distribution of manure management system for cattle. Recalculation has been made because of the correction of N excretion for swine in 2004. Also, changes in the distribution of manure management systems as well as some minor changes in activity data were reasons for recalculating the time series.
Germany	Minor changes due to improved feeding characterization of beef cattle and improved calculation of the emission factor for laying hens. Updated N-excretion data .
Ireland	The emission estimates for CH_4 from manure management for laying hens in the 2006 submission used the emission factor for broilers.
Italy	In the 2006 submission, country-specific parameters, which have been collected from a recent Inter-regional nitrogen balance project and other national studies, have been used. Livestock activity data for the last years (2002-2003) have been updated.
Netherlands	Compared to the previous submission, there have been no re-calculations.
Sweden	Nitrogen production per animal in each of the other animal subgroups was published. Due to more intense swine production, the values for sows and pigs for meat production were updated in 2001. 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.
United Kingdom	For calculation of methane emission from manures of the dairy breeding herd (using Tier 2 methodology), the Methane Conversion Factor for cool climate liquid systems was increased from 10% to 39%, in line with IPCC (2000).

6.5.3 Rice Cultivation - CH_4 (Source category 4C)

Table 6.79 4C Rice Cultivation: Member State's background information for recalculations of CH_4 emissions

Member State	Recalculations
Italy	Recalculations have been done for the rice cultivation category, since update activity data and parameters have been incorporated. Methane emissions from the 2005 and 2006 submissions are presented. In the 2005 submission, a seasonal methane emission factor has been used for estimations for the whole time series; in the 2006 submission a daily methane emission factor and cultivation days, depending on cultivars present in Italy, has been used. Scaling factors have changed according to new data available.

6.5.4 Agricultural Soils - N_2O (Source category 4D)

Information on recalculations of emission estimates in category 4D contained in the NIR of some countries are summarized below:

Table 6.80 4D Agricultural Soils: Member State's background information for recalculations of CH_4 emissions

Member State	Uncertainties
Austria	Revised urea application data from 2002 to 2004 have been used. In accordance with the other N mineral fertilizer application data, figures now relate to the economic year of the farmers and not to the calendar year. Emissions from sewage sludge application on agricultural soils have been shifted from source category 4 D 4 Other to 4 D 1 Direct Soil Emissions – 6. Other.
Belgium	The methodology to calculate the emissions of fertilizer is adapted in the Flemish region during this submission, the pressure of manure is taken into account. Based on a recent study 'Coupling and analyses of the NH_3 field emission measurements in Flanders and the Netherlands' the emission factors of NH_3 for different manure application techniques on grassland were measured. The results of this project were taken into account during this submission in the model of N_2O (N_2O direct and N_2O indirect) used in the Flemish region. In the current of 2007 there will be a revision of the model used to calculate the emissions of NH_3. A special attention will go to taken into account the emissions from manure processing, a revision of the emission factors of NH_3 and the N-excretion factors and inventorying fertilizer type and

Member State	Uncertainties
	application. The results of this study will also have an impact on the emissions of N_2O.
Denmark	From 1990 to 2005, there have been changes in the distribution of cultivation of crop types. The total emission from crop residues remains practically unaltered (Table 6.20). The fraction of nitrogen in harvest crop residues has decreased, due to a decrease in areas with sugar beets, which have been replaced by green maize.
Finland	The following improvements and corrections were made for this submission: animal numbers and crop yield data was updated according to the latest statistics, weights of some cattle species were corrected on the basis of new data. Also, area of organic soils was corrected for the whole time series because previous value did not include organic grassland.
Germany	Completed and corrected time series for sewage sludge application. N_2O emissions from crop residues was calculated for the first time as function of yield. Improved characterisation of N-excretion for swine and poultry.
Ireland	A calculation error was found in the estimates of the total NH_3-N lost, which is used in the calculation of FAW (N input from manure after adjustment for volatilization) for the years 1990-2004 inclusive. The quantitative effect of the recalculation of total NH_3-N lost used in the calculation of $Frac_{GASM}$ is an average decrease in N_2O emissions.
Italy	Different parameters for the estimation of nitrous oxide emissions, direct and indirect, have been revised and updated. Recalculations have been done for the following parameters: $FRAC_{GASM}$ and $FRAC_{GASF}$. Additionally, new parameters such as the nitrogen excretion rates for the different livestock categories have been used. Livestock activity data for the last years have been updated.
Netherlands	Compared to the previous submission, there have been no re-calculations.
Portugal	Recalculation for indirect N_2O emissions from soils was made according changes in the quantity of manure and fertilizers. Correction of errors in activity data for some permanent crops (grape production).
Sweden	Regional nitrogen and phosphorus balances for Swedish agriculture have been calculated, according to the soil surface method, since the late 1990s. The difference between “nitrogen-added” and “nitrogen-removed” results in a surplus containing ammonia losses from the fields, leaching, denitrification and the build-up of nutrients in the soil. The leaching is derived from the SOIL-SOILN model.
United Kingdom	The percentage of dry matter in peas green for market has been corrected to 80%, not 8% used previously (S. Landrock-White, PGRO, pers. comm.)

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Leip A, Dämmgen U, Kuikman P & van Amstel AR (2005) The quality of European (EU-15) greenhouse gas inventories from agriculture. *Environmental Sciences* 2, 2-3, 177 – 192.

7 LULUCF (CRF Sector 5)

This chapter starts with an overview on emission and removal trends in CRF Sector 5 LULUCF (Land Use, Land Use Change and Forestry), followed by general methodological information and a discussion of the key categories. Sections on uncertainty, QA/QC and on recalculations are also provided.

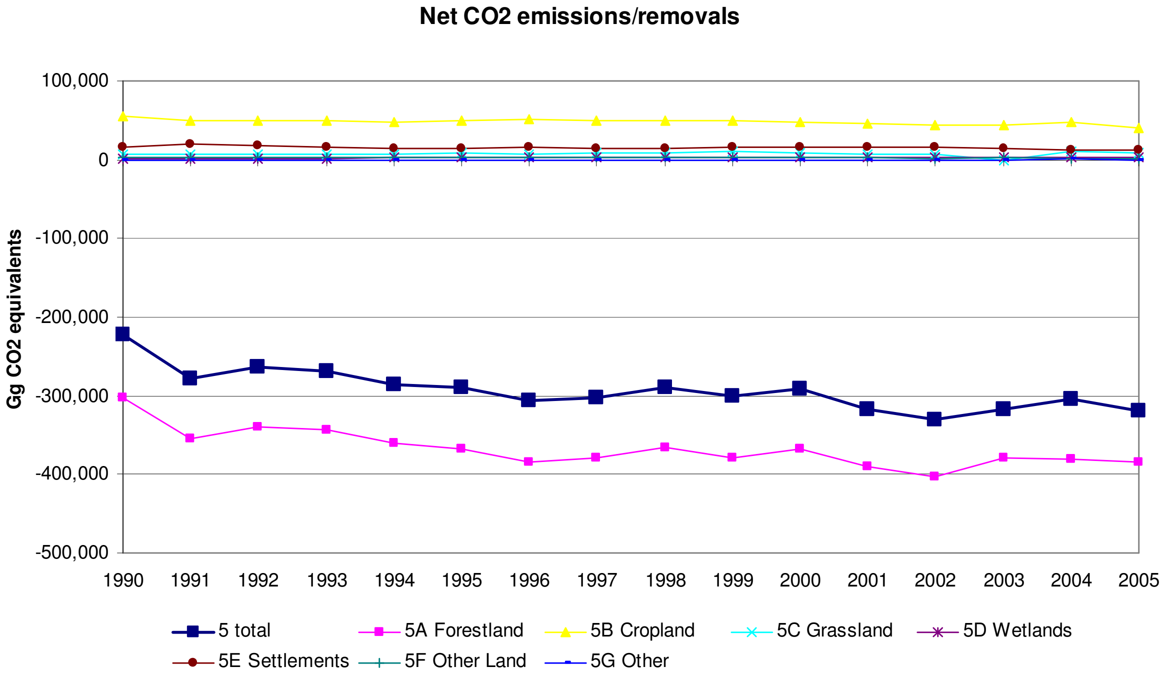
7.1 Overview of sector

Complying with revelant provisions, this section of the NIR is structured to provide information on the LULUCF sector. As the report of the EU-15 is a compilation of the reports of the Member States, we focus on some major issues, mainly related to forests.

With almost all land under more or less intensive management, the LULUCF sector is an important economic sector within the EU-15. In addition to agriculture, forests are the second predominant land use, covering about 39% of EU-15 land.

The CRF 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 big net carbon sink, whereas croplands and grasslands are net sources of greenhouse gases.

Figure 7.1 Sector 5 LULUCF: EU-15 net GHG emissions (emissions minus removals) for 1990–2005 from CRF in CO_2 equivalents (Gg)



In 2005, the net sink of CO_2 in the EU-15 was 319 Tg (315 Tg in CO_2 equivalents when also non-CO_2 greenhouse gases are included), which represents an increase of about 43% from 1990 (Figure 7.1). This increase is mainly due to the increase in CO_2 removals from forests between 1990 and 2005 (+ 27 %) and, in part, to the decrease in net emissions from cropland (-27 %) in the same period. Emissions from grasslands across years fluctuated depending on the sum of emissions and removals reported by the Member States; in 2005, seven Member States reported net CO_2 emissions from grasslands, whereas four reported a net CO_2 sink.

In 2005 Sector 5 is an overall sink of greenhouse gases for all Member States, except the Netherlands and Portugal (Table 7.1). Italy, France, Spain and Germany account for the largest removals in absolute terms. Denmark, Ireland and the UK turned from net emissions in 1990 to net removals in 2005.

Table 7.1 Sector 5 LULUCF: Member States' contributions to net CO_2 emissions

Member State	Net CO_2 emissions (Gg)			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005	
	1990	2004	2005		(Gg CO_2)	(%)	(Gg CO_2)	(%)
Austria	-11,913	-16,974	-17,037	5.3%	-63	0%	-5,124	43%
Belgium	-1,431	-1,173	-370	0.1%	803	-68%	1,061	-74%
Denmark	552	-3,067	-1,453	0.5%	1,614	-53%	-2,004	-363%
Finland	-21,440	-18,513	-30,964	9.7%	-12,451	67%	-9,524	44%
France	-37,635	-63,099	-65,255	20.5%	-2,156	3%	-27,620	73%
Germany	-28,616	-36,252	-36,497	11.5%	-245	1%	-7,882	28%
Greece	-3,248	-5,415	-5,420	1.7%	-6	0%	-2,172	67%
Ireland	121	-195	-657	0.2%	-463	238%	-778	-644%
Italy	-80,652	-105,504	-110,836	34.8%	-5,332	5%	-30,184	37%
Luxembourg	-295	-295	-295	0.1%	0	0%	0	0%
Netherlands	2,392	2,356	2,341	-0.7%	-15	-1%	-51	-2%
Portugal	3,650	2,190	3,664	-1.2%	1,474	67%	14	0%
Spain	-42,763	-51,564	-49,677	15.6%	1,887	-4%	-6,914	16%
Sweden	-3,688	-5,607	-4,057	1.3%	1,550	-28%	-368	10%
United Kingdom	2,882	-1,935	-2,056	0.6%	-122	6%	-4,938	-171%
EU-15	**-222,085**	**-305,047**	**-318,570**	**100.0%**	**-13,522**	**4%**	**-96,484**	**43%**

Overall, for the EU-15, Sector 5 in 2005 offsets 7.5 % of the total emissions (without LULUCF). Accross Member States, the contribution of LULUCF to total emissions ranges from +4.6 % (Portugal) to –44.7 % (Finland) (Table 7.2, column a).

Table 7.2 Sector 5 LULUCF: Contribution of Sector 5 (a) and Category 5A (b) to total emissions (without LULUCF) and Member States contribution to EU-15 Category 5A(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	-18.3%	-18.9%	4.6%
Belgium	-0.3%	-1.5%	0.5%
Denmark	-2.3%	-2.9%	0.5%
Finland	-44.7%	-54.3%	9.8%
France	-11.4%	-14.1%	20.2%
Germany	-3.6%	-7.9%	20.5%
Greece	-3.9%	-3.2%	1.2%
Ireland	-0.9%	-1.2%	0.2%
Italy	-19.0%	-15.9%	24.0%
Luxembourg	-2.1%	NE	NE
Netherlands	1.1%	-1.2%	0.6%
Portugal	4.6%	2.9%	-0.6%
Spain	-11.3%	-11.3%	12.9%
Sweden	-5.8%	-9.4%	1.6%
United Kingdom	-0.3%	-2.4%	4.1%
EU-15	**-7.5%**	**-9.2%**	**100.0%**

Source: 1: Member States' submissions 2007, CRF Table 5, 5A and Summary 2.

In 2005 Category 5A (i.e. Forest Land, the largest contributor to LULUCF) is a net sink of GHG for all Member States except Portugal. The contribution of this Category to total emissions ranges from of +2.9 % to –54.3 % across Member States (Table 7.2, column b). This large variability is partly explainable by the different proportions of total land area covered by forests in the various Member States, ranging from about 10% (Ireland, UK, Denmark and the Netherlands) up to around 60-70% (Finland and Sweden) (see also Fig. 7.2). Note also that, due to disurbances like wind and fire, in individual years net sinks can turn into source (e.g., Denmark, year 2000; Portugal, year 2003).

Sector 5 LULUCF includes the following key categories:

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
Most of the key categories will be discussed in detail the following chapters.

7.2 General methodological information

Pursuant to relevant regulations, emissions and removals from LULUCF of the EC are the sum of Member States' emissions and removals as reported in their CRF tables. Because of the predominance of category Forest Land (5A) in both emission levels and reporting frequency, methodological information provided below mainly focuses on this category However, some details - e.g. information on improvements since previous submissions - are discussed also for the other categories. Furthermore, the discussion mostly relates to CO_2 emissions and removals, as the contribution of the other GHG gases is generally small (see par. 7.4.2).

Table 7.3 illustrates the current coverage of emissions and removals for the various subcategories in 2005. While forest land (FL), cropland (CL) and grassland (GL) are generally well represented, less information is available for wetland (WL), settlements (SL) and other land (OL) subcategories, as they are usually regarded as less important. No MS reported a new subcategory in comparison to the previous submission (2006). However, some subcategories were more complete than previous submissions. For example, the UK also reports CO_2 emissions due to lowland drainage (5B1), changes in stocks of carbon in non-forest biomass due to yield improvements (5B1), and CO_2 emissions due to peat extraction.

Table 7.3 Sector 5 LULUCF: Coverage of CO_2 emissions and removals in the various subcategories in 2005, as derived from Table 5 of MS's CRF.

Member State	Reporting category											
	Forest land		Cropland		Grassland		Wetland		Settlements		Other land	
	5.A.1. FL-FL	5.A.2. L-FL	5.B.1. CL-CL	5.B.2. L-CL	5.C.1. GL-GL	5.C.2. L-GL	5.D.1. WL-WL	5.D.2. L-WL	5.E.1. SL-SL	5.E.2. L-SL	5.F.1. OL-OL	5.F.2. L-OL
Austria	R	R	R	R	E	E		E		E		E
Belgium	R		E		E							
Denmark	R	R	E		E		E	R				
Finland	R		E		E			E				
France	R	R		E	E	R		E		E		E
Germany	R	R	E	E	E	R						E
Greece	R	R	R									
Ireland	R	E	E	E	E	R	E			E		R
Italy	R	R	R	E						E		
Luxembourg												
Netherlands	R	R		R	E	R				R		E
Portugal	E	R	R	E		R		E	E	E		E
Spain	R	R										
Sweden	R	R	E	R	R	R			R	E		
United Kingdom		R	E	E	E	R				E		

Legend: R = net Removal; E = net Emission; Empty cells = the subcategory was not reported

Equally important is the distribution of carbon stock changes by pool for the most important subcategories in 2005, and the changes in comparison to the previous submission (Table 7.4).

Table 7.4 Sector 5 LULUCF: Coverage of carbon stock changes by pool for the most important categories in 2005, and changes in comparison to the previous submission.. This information was compiled from Table 5A, 5B and 5C of MS's CRF.

Member State	Reporting category																	
	Forest land						Cropland						Grassland					
	5.A.1.			5.A.2.			5.B.1.			5.B.2.			5.C.1.			5.C.2.		
	B	DOM	Soil	B	DOM	Soil	B	DOM	Soil	B	DOM	Soil	B	DOM	Soil	B	DOM	Soil
Austria	I	I		I		I	D		I	I		D			D	D		I
Belgium	I		I						D						D			
Denmark	I			I			I		D						D			
Finland	I	I	D						D						D			
France	I	D		I	I	I	0			D	D	D	0	D		D	D	I
Germany	I			I			D		D	I		D			D	D		I
Greece	I	D		I			I		D									
Ireland	I	I		I	I	D			I			D			D	I		I
Italy	I	I	I	I	I	I	I		**I**	I		D						
Luxembourg																		
Netherlands	I	I		I								I			D	D		I
Portugal	D	D	I	I	D	I	I	D	D	D	D	D				D	D	I
Spain	I			I														
Sweden	I	I	D	I			I		D	I			I	D	I	I		
United Kingdom				I	I	I	I		D	D		D			D	I		I

Legend: I = net Increase; D = net Decrease; 0 = no change; Empty cells = the pool was not reported
Dark cells indicate a change in comparison to last year's submission: a pool previously reported but not reported anymore (empty cell) or a pool reported this year for the first time (bold character).

Although the coverage of subcategories and pools did not change significantly as compared to the previous submission (only one MS reported a new pool, whereas two MS reported less pools), several MS improved their reports through:

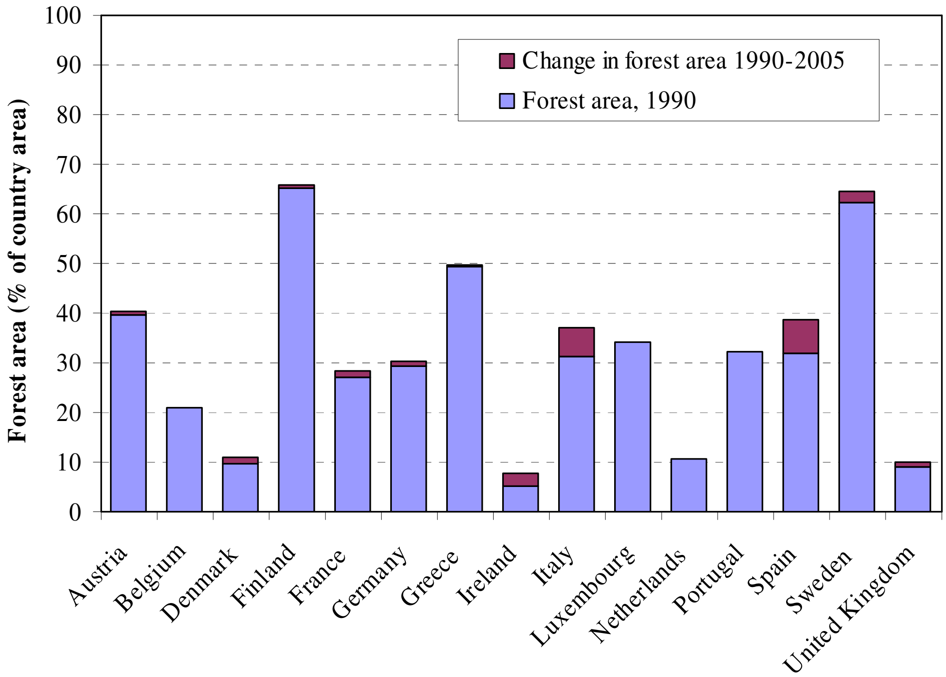
- extended use of the new Good Practice Guidance for LULUCF (IPCC 2003)
- more complete land transition matrix
- key category analysis including LULUCF sector
- use of improved activity data and emission factors
- developments in uncertainty estimation
- improved documentation on methodology.

Due to the improvements, data were recalculated and better estimated in several Member States.

7.3 Forest land (5A1)

Forests land is the dominant category in the LULUCF sector. According to the latest CRFs of MS, forests covered 36.4% of the total EU-15 area in 1990 and the 38.7% in 2005, with large variation between Member States (Fig. 7.5). Although forest area could decrease in a few cases in a few years, the overall trend is an increase of forest area in most Member States. Whereas Forest Land Remaining Forest Land is by far the most important subcategory either by area, or by emissions and removals, also "land converted to forest land" is an important cause of the net removals in this category.

Figure 7.2 The percentage of forest land to total land area in the various countries in 1990 and 2005 (from the latest CRF)



7.3.1 Forest Land remaining Forest Land (5A1)

The area of the subcategory 5A1 Forest land remaining Forest land in EU-15 has increased by about 2 % from 1990 to 2005. However, its net removals have increased by about 24 % in the same period (Table 7.5), representing about 80 % of the net removals of the whole Forest land category in 2005.

Table 7.5 5A1 Forest Land remaining Forest Land: Member States' contributions to net CO_2 emissions

Member State	Net CO_2 emissions (Gg)			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005	
	1990	2004	2005		(Gg CO_2)	(%)	(Gg CO_2)	(%)
Austria	-12,226	-17,536	-17,536	5.7%	0	0%	-5,310	43%
Belgium	-3,205	-2,901	-2,095	0.7%	806	-28%	1,111	-35%
Denmark	-2,831	-3,326	-1,672	0.5%	1,654	-50%	1,159	-41%
Finland	-27,793	-26,174	-37,637	12.1%	-11,463	44%	-9,843	35%
France	-46,014	-65,013	-66,941	21.6%	-1,927	3%	-20,926	45%
Germany	-74,064	-74,064	-74,064	23.9%	0	0%	0	0%
Greece	-2,043	-3,820	-3,955	1.3%	-135	4%	-1,913	94%
Ireland	-1,079	-724	-845	0.3%	-121	17%	234	-22%
Italy	-45,782	-77,803	-77,498	25.0%	305	0%	-31,715	69%
Luxembourg	NE	NE	NE	-	-	-	-	-
Netherlands	-2,505	-2,289	-2,289	0.7%	0	0%	216	-9%
Portugal	2,809	1,349	2,823	-0.9%	1,474	109%	14	0%
Spain	-26,768	-26,768	-26,768	8.6%	0	0%	0	0%
Sweden	-7,733	-6,212	-1,573	0.5%	4,639	-75%	6,160	-80%
United Kingdom	NE,NO	NE,NO	NE,NO	-	-	-	-	-
EU-15	**-249,234**	**-305,280**	**-310,048**	**100.0%**	**-4,768**	**2%**	**-60,813**	**24%**

The largest removals in this subcategory across the time series were reported by Italy, Germany, France, Finland and Spain, while only Portugal reported a source for several years. For this subcategory, UK assumed no significant long term changes in biomass stock[23]

The forests in this subcategory are rather diverse, from Mediterranean evergreen dry forests to boreal coniferous forests, with many intermediate temperate forest types. Diversity can be high even within a country, which may make it very difficult, among others, to develop forest inventories. Largely because of this diversity, the definition of "forest" differs among Member States. A detailed description of forest definitions in the Member States was presented in the EC NIR of 2005. Furthermore, from this submission, some MS (Finland and Sweden) changed the threshold for minimum land area to define a forest. Because of the different conditions in the various countries, it is not possible to develop an harmonized definition from these different definitions. However, this does not really change the emission and removal estimates, as they are mostly based on estimation of timber volume in forests.

As a basis for the greenhouse gas inventory, all countries use forest inventories or forestry census of some kind to obtain activity data. As with the forest definitions, the method of the collection of data itself differs among Member States in terms of their design, spatial intensity, frequency of field survey, and latest information available. However, as it is obvious from Table 7.6, and also from the sources of activity data as reported in the EC NIR in 2005, many countries have made considerable efforts to obtain as recent and accurate information as possible. Also, forest inventories have developed a lot, and further developments are under way (e.g. Denmark is developing a new forest inventory to replace her forestry census).

Table 7.6 5A1 Forest Land remaining Forest Land:. Some relevant information on the National Forest Inventories (NFI) of various Member States

Country	Type of forest inventory	Frequency of field surveys	Latest survey	Other information
Austria	Sample-based	5-10 years	2000-2002	
Belgium	Sample-based	~ 10 years	2000	
Denmark	Questionnaire-based Forestry Census since 1881; sample based inventory since 2002	10 years	2000	The Forestry Census is being replaced by an ongoing sample-based National Forest Inventory, which will be completed in 2007
Finland	Sample-based	~ 8 years	2000	
France	Sample-based	~ 12 years	Continuous	
Germany	Sample-based	Two NFIs so far	2005	
Greece	Sample-based	Only one NFI so far	1994	
Ireland			1995	New inventory is ongoing
Italy	Sample-based	First one in 1985, second one is on-going	Results are expected in the second half of 2007	
Luxembourg	Sample-based	Only one inventory so far	2000	
Netherlands	Sample-based	~ 10 years	2002	
Portugal	Sample-based ?	~ 15 years	1999	

[23] According to UK's NIR, only forests in existence since before 1921 are considered in Category 5A1 (Forest remaining Forest Land). For these forests, it was conservatively assumed no significant long term changes in biomass stock. All the changes in carbon stocks of the forests established since 1920 were entirely included in the Category 5A2 (Land converted to Forest Land) (see Table 7.7). remaining Forest Land). For these forests, it was conservatively assumed no significant long term changes in biomass stock. All the changes in carbon stocks of the forests established since 1920 were entirely included in the Category 5A2 (Land converted to Forest Land) (see Table 7.7).

Spain (based on the NIR of last year)	Second NFI: between 1986 and 1995; third NFI: 1997-2006			
Sweden	Sample-based since 1983-87	5-10 years	Ongoing	
United Kingdom	Forestry censuses and various land use surveys combined with yield tables	Various	2004	

It is also to be noted that considerable efforts have been made to improve and transform the information on forest inventory area and timber volume into carbon stock change. These efforts include e.g. developing new biomass functions (e.g. Austria, Finland, Ireland) that are used, or will be used, in near future instead of former biomass expansion factors to obtain more accurate biomass estimates. In addition to the advantages of using the functions instead of the factors, this development involves measuring new data which should make the new estimates more representative, thus eliminating or reducing some of the possible bias.

7.3.2 Land Converted to Forest Land (5A2)

According to the CRFs submitted by Member States, the area of the subcategory 5A2 Land Converted to Forest Land in EU-15 has increased by about 120 % from 1990 to 2005. Its net removals have increased by about 42 % in the last 15 years (Table 7.7), accounting for about 20 % of the net removals of the whole Forest land category in 2005. However, as some Member State (e.g. Belgium and Finland) did not separate between Forest Land Remaining Forest Land and Land Converted to Forest Land, the above figures are likely to be somehow underestimated.

Table 7.7 5A2 Land converted to Forest Land: Member States' contributions to CO_2 net emissions

Member State	Net CO_2 emissions (Gg)			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005	
	1990	2004	2005		(Gg CO_2)	(%)	(Gg CO_2)	(%)
Austria	-133	-104	-104	0.1%	0	0%	29	-22%
Belgium	NE,NO	NE,NO	NE,NO	#WERT!	#WERT!	-	#WERT!	-
Denmark	NA,NE,NO	-124	-151	0.2%	-28	22%	-	-
Finland	IE	IE	IE	-	-	-	-	-
France	-9,754	-11,116	-10,976	14.6%	139	-1%	-1,223	13%
Germany	-336	-4,418	-4,663	6.2%	-245	6%	-4,327	1288%
Greece	IE,NE,NO	-450	-475	0.6%	-26	6%	-	-
Ireland	601	58	34	0.0%	-25	-42%	-567	-94%
Italy	-13,443	-14,743	-14,832	19.7%	-89	1%	-1,389	10%
Luxembourg	NE	NE	NE	-	-	-	-	-
Netherlands	-11	-159	-170	0.2%	-11	7%	-159	1500%
Portugal	-577	-577	-577	0.8%	0	0%	0	0%
Spain	-15,995	-24,797	-22,909	30.4%	1,887	-8%	-6,914	43%
Sweden	-1,306	-2,233	-4,740	6.3%	-2,507	112%	-3,434	263%
United Kingdom	-12,203	-16,302	-15,738	20.9%	564	-3%	-3,535	29%
EU-15	**-53,157**	**-74,964**	**-75,303**	**100.0%**	**-339**	**0%**	**-22,145**	**42%**

The largest removals in this subcategory were reported by Spain, UK, Italy and France, while only Ireland reported a small source. Most MS reported an increase in removals from 1990 to 2005. However, given the relatively small area of land converted to forest (not easily estimated with sample-based forest inventories), it should be noted that several Member States underlined the significantly higher uncertainty associated with the emissions/removals of this subcategory as compared to the subcategory 5A1 Forest Land Remaining Forest Land.

7.4 Other land use categories, and non-CO_2 emissions

7.4.1 Cropland (5B) and Grassland (5C)

Most of the cropland and grassland area reported for the year 2005 falls into the category Cropland

Remaining Cropland and Grassland Remaining Grassland, respectively. For both land use categories, this is generally more than 90%. Conversion of land to cropland occurred predominantly from grassland, and also conversion to grassland occurred predominantly from cropland.

The following tables 7.8, 7.9, 7.10 and 7.11 illustrate the main data for the Cropland and Grassland subcategories.

Table 7.8 5B1 Crop Land remaining Crop Land: Member States' contributions to CO_2 net emissions

Member State	Net CO_2 emissions (Gg)			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005	
	1990	2004	2005		(Gg CO_2)	(%)	(Gg CO_2)	(%)
Austria	-394	8	-65	-0.7%	-73	-903%	329	-83%
Belgium	471	550	576	6.3%	27	5%	105	22%
Denmark	3,287	321	308	3.4%	-13	-4%	-2,979	-91%
Finland	7,416	3,861	3,612	39.8%	-249	-6%	-3,804	-51%
France	NO	NO	NO	-	-	-	-	-
Germany	23,389	21,964	21,964	241.8%	0	0%	-1,425	-6%
Greece	-1,205	-1,144	-989	-10.9%	155	-14%	216	-18%
Ireland	47	-2	19	0.2%	22	-964%	-28	-59%
Italy	-22,822	-20,308	-20,667	-227.5%	-359	2%	2,155	-9%
Luxembourg	NE	NE	NE	-	-	-	-	-
Netherlands	NA,NE	NA,NE	NA,NE	-	-	-	-	-
Portugal	-164	-164	-164	-1.8%	0	0%	0	0%
Spain	NA	NA	NA	-	-	-	-	-
Sweden	4,353	3,553	3,956	43.6%	403	11%	-397	-9%
United Kingdom	1,010	555	533	5.9%	-22	-4%	-477	-47%
EU-15	**15,388**	**9,194**	**9,083**	**100.0%**	**-111**	**-1%**	**-6,304**	**-41%**

Table 7.9 5B2 Land converted to Crop Land: Member States' contributions to CO_2 net emissions

Member State	Net CO_2 emissions (Gg)			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005	
	1990	2004	2005		(Gg CO_2)	(%)	(Gg CO_2)	(%)
Austria	-130	-140	-121	-0.4%	19	-14%	10	-7%
Belgium	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Denmark	NO	NO	NO	-	-	-	-	-
Finland	IE,NE	IE,NE	IE,NE	-	-	-	-	-
France	21,916	13,532	12,954	41.8%	-578	-4%	-8,962	-41%
Germany	3,145	3,043	3,043	9.8%	0	0%	-102	-3%
Greece	NO	NO	NO	-	-	-	-	-
Ireland	NE,NO	129	129	0.4%	0	0%	-	-
Italy	115	6,069	880	2.8%	-5,189	-86%	765	665%
Luxembourg	NE	NE	NE	-	-	-	-	-
Netherlands	-36	-36	-36	-0.1%	0	0%	0	0%
Portugal	354	354	354	1.1%	0	0%	0	0%
Spain	0	0	0	0.0%	0	-	0	-
Sweden	-11	-82	-497	-1.6%	-415	506%	-486	4493%
United Kingdom	14,034	14,276	14,294	46.1%	18	0%	260	2%
EU-15	**39,388**	**37,147**	**31,001**	**100.0%**	**-6,145**	**-17%**	**-8,387**	**-21%**

For category 5B1 Cropland Remaining Cropland most MS reported a source, while Italy reported a quite important sink. Category 5B2 Land Converted to Cropland is an even more important source at the EU-15 level, with the largest emissions reported by UK and France.

Table 7.10 5C1 Grass Land remaining Grass Land: Member States' contributions to CO_2 net emissions

Member State	Net CO_2 emissions (Gg)			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005	
	1990	2004	2005		(Gg CO_2)	(%)	(Gg CO_2)	(%)
Austria	6	14	14	0.1%	1	4%	8	136%
Belgium	1,303	1,178	1,148	4.9%	-29	-2%	-155	-12%
Denmark	93	74	76	0.3%	2	2%	-17	-19%
Finland	-1,648	3,190	2,333	10.0%	-858	-27%	3,981	-242%
France	132	114	117	0.5%	2	2%	-15	-11%
Germany	18,282	16,670	16,670	71.3%	0	0%	-1,612	-9%
Greece	NO	NO	NO	-	-	-	-	-
Ireland	620	479	478	2.0%	-2	0%	-142	-23%
Italy	NO	NO	NO	-	-	-	-	-
Luxembourg	NE	NE	NE	-	-	-	-	-
Netherlands	4,246	4,246	4,246	18.2%	0	0%	0	0%
Portugal	NE,NO	NE,NO	NE,NO	-	-	-	-	-
Spain	0	0	0	0.0%	0	-	0	-
Sweden	-2,089	-1,554	-2,122	-9.1%	-568	37%	-32	2%
United Kingdom	390	355	404	1.7%	50	14%	15	4%
EU-15	**21,335**	**24,767**	**23,365**	**100.0%**	**-1,402**	**-6%**	**2,030**	**10%**

Table 7.11 5C2- Land converted to Grass Land: Member States' contributions to CO_2 net emissions

Member State	Net CO_2 emissions (Gg)			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005	
	1990	2004	2005		(Gg CO_2)	(%)	(Gg CO_2)	(%)
Austria	439	327	363	-2.3%	36	11%	-76	-17%
Belgium	NO	NO	NO	-	-	-	-	-
Denmark	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Finland	NE,NO	NE,NO	NE,NO	-	-	-	-	-
France	-9,344	-6,547	-6,249	40.4%	298	-5%	3,095	-33%
Germany	273	-72	-72	0.5%	0	0%	-345	-126%
Greece	IE,NO	IE,NO	IE,NO	-	-	-	-	-
Ireland	-128	-139	-421	2.7%	-282	203%	-293	229%
Italy	NO	NO	NO	-	-	-	-	-
Luxembourg	NE	NE	NE	-	-	-	-	-
Netherlands	-51	-51	-51	0.3%	0	0%	0	0%
Portugal	-25	-25	-25	0.2%	0	0%	0	0%
Spain	0	0	0	0.0%	0	-	0	-
Sweden	512	327	-369	2.4%	-696	-213%	-882	-172%
United Kingdom	-7,228	-8,543	-8,627	55.8%	-84	1%	-1,399	19%
EU-15	**-15,551**	**-14,723**	**-15,451**	**100.0%**	**-729**	**5%**	**99**	**-1%**

All MS, except Sweden, reported emissions under the subcategory 5C1 Grassland Remaining Grassland. By contrast, 5C2 Land Converted to Grassland was a sink in all MS which reported this subcategory, except Austria.

7.4.2 Non-CO_2 emissions

Most non-CO_2 emissions are CH_4 and NO_2 deriving from wildfires - especially in the Mediterranean countries – and N_2O from disturbance associated with land-use conversion to cropland. Some Member States (e.g. Spain) did not provide any information on this issue. However, in most cases these emissions appeared relatively small or negligible in comparison to emissions/removals of CO_2 (about 1% for the whole EU-15 LULUCF sector, and always lower than 3.5% accross MS).

Significant N_2O emissions from disturbance associated with land-use conversion was reported by Germany (1.36 Gg N_2O) and Sweden (0.34 Gg N_2O), which represent about 1 and 3% of the agricultural N_2O emissions, respectively. Small N_2O emissions are reported from Austria, about 0.5% of the agricultural emissions (0.03 Gg N_2O). With 0.7 kg N_2O-N per ha converted area, Austria uses the smallest IEF, whereas the highest one is used by Germany (24.5 kg N_2O-N/ha).

Application of fertilizer to forest soils for most countries does not occur or it is not possible to be reported as a separate category. Only Finland and Sweden report small quantities of nitrogen applied and N_2O emissions (0.04 and 0.08 Gg N_2O, respectively).

Only Denmark and Finland report N_2O emissions from drained wetland, which are insignificant.

Many countries report application of lime to agricultural soils with associated carbon emissions ranging from 75 Gg CO_2 (The Netherlands) to 1650 Gg CO_2 (Germany).

7.5 Uncertainties and time-series consistency

Although EC Member States use different methodologies to estimate emissions and removals, they are always in accordance with the IPCC guidelines and the new (2003) GPG for LULUCF. Due to different and complex methodologies, and due to lack of data for many elements of the entire estimation procedure, it is currently not possible to conduct a full uncertainty estimation at the EC level. However, MS have made continous and considerable effort in this field to reduce uncertainty. This includes many elements, as for example improving activity data and emission factors. Several countries have been able to provide quantitative estimates of uncertainties, while some others (e.g. United Kingdom) have foreseen that a full uncertainty analysis will be provided in the next submission.

Member States reports in this year include much information on possible sources, and magnitudes, of uncertainties. Some of this information is included below as examples to demonstrate the current level of accuracy of the estimates in the EC countries. For full reference, see the MS inventory reports. For previously reported detailed country-level uncertainty information (e.g. for UK, Germany, Belgium and Austria, where uncertainty was previously described and quantified), see our previous report.

In Sweden, which is a country with very large forest area, a lot of methodological improvements have taken place that reduced uncertainty. These improvements include complete and consistent representation of all land, upgrading methodologies to Tier 3, using data from more sample plots, and changes from the "default method" to the stock change method. By this latter one, it is expected that possible bias in estimates of harvest and other statistics is removed. Sweden has also estimated uncertainties in most categories (Table 7.12).

Table 7.12 Relative standard errors of the emission/removal estimates for the LULUCF sector in Sweden.

Category	Relative Standard Error [%]		
	CO_2	N_2O	CH_4
Living biomass	34	-	-
Dead organic matter	70	-	-
Soil organic carbon	35	-	-
Direct N fertilization, 5 (I)	-	50	-
Drainage of soils, 5 (II)	-	NE	-
Conversion Cropland, 5 (III)	-	100	-
Agricultural lime application, 5	50	-	-
Biomass burning, 5 (V)	60	100	100
All	42	92	100

Finland, another country with large forests, estimated uncertainties for the biomass pool by age class, and summed them up. For the total values, the following uncertainties were estimated: 3.8 % for C-uptake, 4.6 % for C-release, and 18.8 % for the net C-uptake. The uncertainty assessments for soils are under development, and are expected to be available later.

The Netherlands and Denmark also reported detailed uncerainty estimates (Table 7.13 and 7.14).

Table 7.13 Estimated uncertainties for activity data, emission factors and the emission/removal estimates for the LULUCF sector in the Netherlands.

Category	Gas	*Activity data, %*	*Emission factor, %*	*emission/removal estimates, %*
5A1. Forest Land remaining Forest Land	CO_2	25	62	67
5A2. Land converted to Forest Land	CO_2	25	58	63
5B2. Land converted to Cropland	CO_2	25	50	56
5C1. Grassland remaining Grassland	CO_2	25	50	56
5C2. Land converted to Grassland	CO_2	25	61	66
5E2. Land converted to Settlements	CO_2	25	50	56
5F2. Land converted to Other Land	CO_2	25	50	56
5G. Other (liming of soils)	CO_2	25	1	25
TOTAL				~100

Table 7.14 Estimated uncertainties for activity data, emission factors and the total emission/removal estimates for the LULUCF sector in Denmark.

Category	Gas	*Activity data, %*	*Emission factor, %*	*Total uncertainty,* %
5.A Forests				NE
Broadleaves, Forest remaining forest	CO_2	NE	NE	NE
Conifers, Forest remaining forest	CO_2	NE	NE	NE
Broadleaves, Land converted to forest	CO_2	NE	NE	NE
Conifers, Land converted to forest	CO_2	NE	NE	NE
5.B Cropland				44,9
Mineral soils	CO_2	10	20	22,4
Organic soils	CO_2	10	50	51,0
Hedgerows	CO_2	5	20	20,6
Perennial horticultural	CO_2	10	10	14,1
5.C.Grassland				51,0
Organic soils	CO_2	10	50	51,0
5.D Wetlands				56,0
Land for peat extraction	CO_2	10	50	51,0
Land for peat extraction	N_2O	10	100	100,5
Land for peat extraction	CH_4	10	100	100,5
Reestablished wetlands	CO_2	10	50	51,0
Liming	CO_2	5	50	50,2

Finally, Portugal also reported detailed uncertainty analyses for all land use and land use change categories. Uncertainty data is demonstrated here only for forest land remaining forest land, which also included emissions due to forest fires. The percent uncertainty for activity data and emission factor of biomass was 0.7% and 40%, respectively, whereas that of changes in carbon stocks of the dead organic matter and soil pools was 30% and 95%, respectively.

Time series consistency has been checked for all MS. This included a check of both activity data, as well as implied emission and removal factors for all LULUCF subcategories. Data for single years that may seem to be outliers (e.g. emission in a single year, while there are removals in forests in all other years, e.g. Denmark) are always due to identified cause (e.g. a large-scale wind throw in Denmark in that particular year), which are in turn explained in the MS reports.

7.6 Category-specific QA/QC and efforts for improving reporting

Several Member States reported increased efforts to conduct QA/QC. In addition to Denmark and others, countries with extended forest cover (Finland, Germany, Sweden) reported extended procedures, which ensures the good quality of estimates in forests. These procedures include checking both the forest inventory data, as well as the preparation of the GHG inventory. In addition, several steps were taken with respect to data quality at the EC level (see below).

Under the intergovernmental framework for European cooperation in the field of scientific and technical research (COST), the EC initiated, in 2000, the action ‘Contribution of forests and forestry to mitigate greenhouse effects’ (COST E21) with the objective to exchange experience and knowledge and to improve the quality of GHG inventory compilation for forests in Europe. This action completed its work in 2004 (see the website of the action at www.efi.fi/coste21/). Another action (COST E43) was started in 2004 under the same framework: ‘Harmonisation of national forest inventories in Europe: Techniques for common reporting’ also aiming at improving and harmonising the existing national forest resource inventories in Europe and at promoting the use of scientifically sound and validated methods in forest inventory designs, data collection and data analysis (http://www.metla.fi/eu/cost/e43/). One specific area of work of COST E43, in which 25 European countries participate, is the harmonised estimation procedures for carbon pools and carbon pool changes. Finally, a third action with a planned duration of four years, COST 639, was lauched in December 2006 with the aim to improve the estimation of carbon stock changes and nitrogen emissions from soils (www.cost639.net).

Some methodological improvements at the Member States level was already mentioned above. At the EU level, an important workshop took place in 2005: “Improving the Quality of Community GHG Inventories and Projections for the LULUCF Sector” - Workshop under mandate of Working Groups I and II of the EU Climate Change Committee. The workshop was jointly organized by DG JRC, DG ENV, EEA, and ETC/ACC, and took place in Ispra (Italy), September 22-23, 2005.

Another important workshop took place in Ispra on 27-29 Novemebr 2006: “Technical meeting on specific forestry issues related to reporting and accounting under the Kyoto Protocol”, organised by the Joint Research Centre in collaboration with sink experts from EU, Japan, New Zealand and Canada. For further information on these two workshops, see http://afoludata.jrc.it/events/lucf/lucfmain.cfm.

7.7 Category-specific recalculations

Because of the many methodological improvements, revision of activity data, and the use of new or improved factors (e.g. biomass expansion factors), there have been a lot of recalculations (Table 7.15, 7.16, 7.17 and 7.18). Table 7.15 shows the extent of recalculations in the LULUCF sector by gas for the EU-15 for 1990 and 2004. Table 7.16 provides an overview of Member States' contributions to EU-15 recalculations for the years 1990 and 2004.

Table 7.15 Sector 5 LULUCF: Recalculations of total GHG emissions and recalculations of net GHG emissions in CRF for 1990 and 2004 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	-12,662	-0.4%	-284	-0.1%	-4,944	-1.2%	-1	0.0%	0	0.0%	1	0.0%
LULUCF (net)	-12,368	5.9%	-107	-8.6%	-16	-0.5%	NO	NO	NO	NO	NO	NO
2004												
Total emissions and removals	-8,944	-0.3%	-2,528	-0.8%	-558	-0.2%	-2,281	-4.4%	-59	-1.1%	31	0.3%
LULUCF (net)	-14,703	5.1%	-73	-8.9%	-71	-2.1%	NO	NO	NO	NO	NO	NO

NO: not occurring

Table 7.16 Sector 5 LULUCF: Contribution of Member States to EU-15 recalculations for 1990 and 2004 by gas (difference between latest submission and previous submission Gg of CO_2 equivalents)

	1990						2004					
	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
Austria	59	0	0	NO	NO	NO	-332	0	0	NO	NO	NO
Belgium	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
Denmark	0	-1	0	NO	NO	NO	-787	0	0	NO	NO	NO
Finland	0	-7	-1	NO	NO	NO	0	0	0	NO	NO	NO
France	-10,533	-81	0	NO	NO	NO	-8,671	-62	-184	NO	NO	NO
Germany	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
Greece	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
Ireland	13	0	0	NO	NO	NO	-123	0	0	NO	NO	NO
Italy	-738	0	-18	NO	NO	NO	416	0	92	NO	NO	NO
Luxembourg	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
Netherlands	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
Portugal	1	-17	25	NO	NO	NO	4,766	-13	25	NO	NO	NO
Spain	-19,736	0	0	NO	NO	NO	-21,022	0	0	NO	NO	NO
Sweden	18,600	0	-21	NO	NO	NO	11,044	-1	-5	NO	NO	NO
UK	-34	-1	0	NO	NO	NO	7	3	0	NO	NO	NO
EU-15	**-12,368**	**-107**	**-16**	**NO**	**NO**	**NO**	**-14,703**	**-73**	**-71**	**NO**	**NO**	**NO**

NO: not occurring

From Table 7.17 and 7.18 it is interesting to note that while the changes in increases and decreases of carbon stocks are equally distributed (12 cases of D+ and 12 cases of D-; 19 cases of I+ and 23 cases of I-), their whole effect is an increase in both emissions and removals (16 cases of R+ and 9 cases of R-; 21 cases of E+ and 9 cases of E-). This analysis suggests that – for the years under observation – the increase of the quality of the estimates may increase the estimated values of both emissions and removals, possibly because – inter alia – more complete estimation of the carbon dynamics.

Table 7.17 Sector 5 LULUCF: Subcategories where individual Member States have recalculated the values submitted last year for the inventory year of 1990

Member State	Reporting category											
	Forest land		Cropland		Grassland		Wetland		Settlements		Other land	
	5.A.1. FL-FL	5.A.2. L-FL	5.B.1. CL-CL	5.B.2. L-CL	5.C.1. GL-GL	5.C.2. L-GL	5.D.1. WL-WL	5.D.2. L-WL	5.E.1. SL-SL	5.E.2. L-SL	5.F.1. OL-OL	5.F.2. L-OL
Austria	R+	R-	R-		E+	E-		E+		E+		
Belgium												
Denmark			E+		E-							
Finland	R+		E+		R-			E+				
France	R+	R+		E-	E+	R-						
Germany	R+		E+	E+	E+	E+						E-
Greece												
Ireland	R+	E+	E+	E nr	E+	R-	E+			E+		R+
Italy	R+	R+	R+	E -						E+		
Luxembourg												
Netherlands												
Portugal	E+											
Spain	R+	R+										
Sweden	R-	R-	E-	R-	R+	E+			R-	R+		
United Kingdom		R+	E+	E-	E+	R+				E-		

Legend: The notations “R” and “E” mean, respectively, that the subcategory was a net sink (Removal) and net source (Emissions) in 1990. The “-“ signs mean that the new (2007) values for 1990 are smaller (in absolute terms) than the ones submitted last year, whereas the “+” signs mean the opposite. “nr” means that in the last inventory (2007) that pool has been not reported for 1990, while in the previous inventory (2006) it has been reported as “R” or “E”.

Table 7.18 Sector 5 LULUCF: Subcategories where individual Member States have recalculated the values submitted last year for the inventory year of 1990, separated by pool.

Member State	Reporting category																	
	Forest land						Cropland						Grassland					
	5.A.1.			5.A.2.			5.B.1.			5.B.2.			5.C.1.			5.C.2.		
	B	DOM	Soil	B	DOM	Soil	B	DOM	Soil	B	DOM	Soil	B	DOM	Soil	B	DOM	Soil
Austria	I-	I+		I-		I-			I-						D+	D-		I+
Belgium	I-		I-															
Denmark									D-						D-			
Finland	I-	I-	D-						D+						I-			
France	I+	D-		I+	I+	I+						D-						I-
Germany							D-			I-				D+	D+	D+	D+	I+
Greece																		
Ireland	I+	I+			D-	D+			D+	D nr		D nr			D+	I-		I+
Italy	I+	I+	I+	I+	I+	I+				I-		D-						
Luxembourg																		
Netherlands																		
Portugal																		
Spain	I+			I+														
Sweden	I-	I+	D-	I-	I nr	D nr	D I		D+	I-		D nr	D I	D+	I-	I D	D nr	I nr
United Kingdom				I+	I-	I+	I-			D-		D-			D+	I+		I+

Legend: The notation “I” means that the carbon stock in the pool in 1990 is increased, whereas the notation “D” means that the carbon stock in the pool in 1990 is decreased. The “-“ signs mean that the new (2007) values for 1990 are smaller than the ones submitted last year, whereas the “+” signs mean the opposite. The notation “nr” means that in the new inventory (2007) that pool has been not reported for 1990, while in the last inventory (2006) it was reported as “I” or “D”. The “D I“ notation means that the new (2007) value is a decrease in the carbon stock while the previuos (2006) was an increase, whereas the “I D” notation means the opposite.

8 Waste (CRF Sector 6)

This chapter starts with an overview on emission trends in CRF Sector 6 Waste. 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 quanitative uncertainty estimates for this sector and the sector specific QA/QC activities are summarised in separate sections. Finally, the chapter includes an overview of recalculations.

8.1 Overview of sector

CRF Sector 6 Waste is the fourth largest sector in the EU-15, contributing 2.6 % to total GHG emissions. Total emissions from Waste have been decreasing by 38 % from 176 Tg in 1990 to 109 Tg in 2005 (Figure 8.1). In 2005, emissions decreased by 3.5 % compared to 2004. 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 1990–2005 from CRF in CO_2 equivalents (Tg)

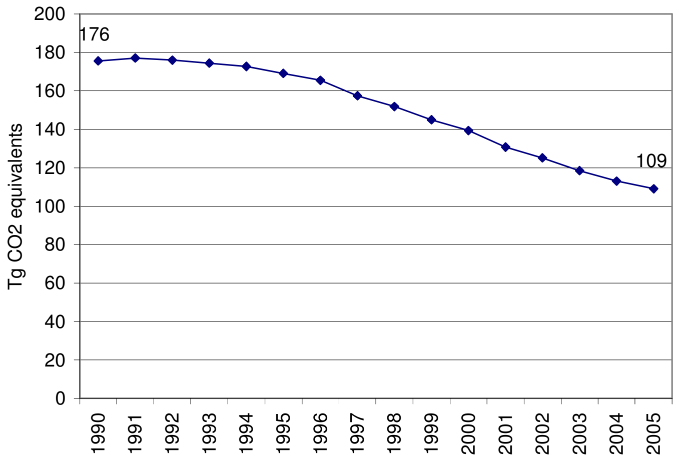
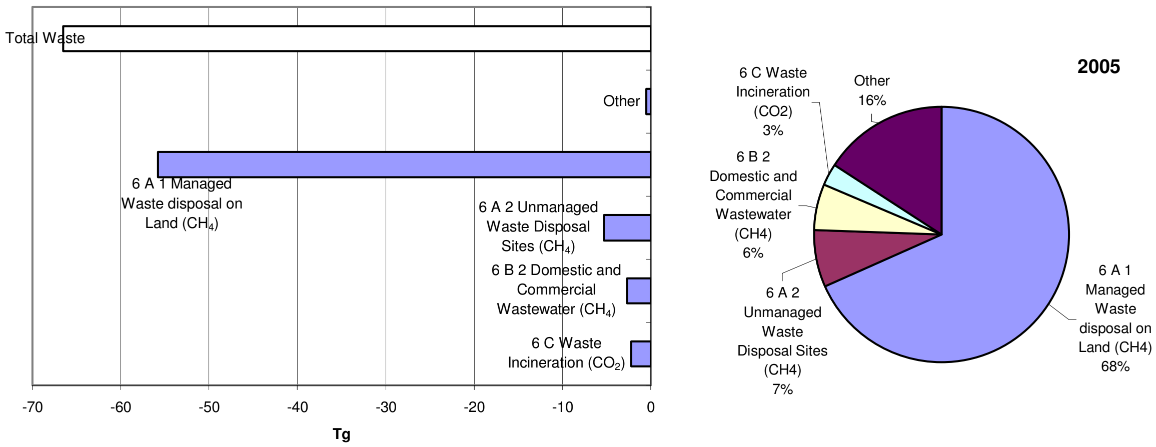


Figure 8.2 shows that CH_4 emissions from 6A1 Managed Waste Disposal on Land had the greatest decrease of all waste-related emissions, but still accounts for 68 % of waste-related GHG emissions in the EU-15 .

Figure 8.2 Sector 6 Waste: Absolute change of GHG emissions by large key source categories 1990–2005 in CO_2 equivalents (Tg) and share of largest key source categories in 2005



8.2 Source categories

8.2.1 Solid waste disposal on land (CRF Source Category 6A)

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 summarises information by Member State on methodologies and emission factors for CH_4 from 6A Solid Waste Disposal on Land. CH_4 emissions from this category decreased by 42 % between 1990 and 2005 in the EU-15. Eleven EU-15 Member States reduced their emissions from this source, Greece, Ireland, Italy, 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 2005 (Gg CO_2 equivalents)	CH_4 emissions in 1990 (Gg CO_2 equivalents)	CH_4 emissions in 2005 (Gg CO_2 equivalents)
Austria	3,377	1,880	3,377	1,880
Belgium	2,630	823	2,630	823
Denmark	1,335	1,059	1,335	1,059
Finland	3,653	2,092	3,653	2,092
France	11,113	9,364	11,113	9,364
Germany	35,910	10,416	35,910	10,416
Greece	1,801	2,437	1,801	2,437
Ireland	1,332	1,618	1,332	1,618
Italy	13,298	14,437	13,298	14,437
Luxembourg	33	24	33	24
Netherlands	12,011	5,931	12,011	5,931
Portugal	3,892	4,815	3,892	4,815
Spain	4,279	8,643	4,045	8,628
Sweden	2,874	1,923	2,874	1,923
United Kingdom	49,772	19,547	49,772	19,547
EU-15	**147,309**	**85,009**	**147,075**	**84,995**

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 1.8 % of total EU-15 GHG emissions. Between 1990 and 2005, CH_4 emissions from managed landfills declined by 43 % in the EU-15. In 2005, CH_4 emissions from landfills decreased by 3 % compared to 2004. 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 32 % between 1990 and 2005. 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 increased in several EU-15 Member States.

The Member States with most emissions from this source were Germany, Spain, Italy and the UK. Nine Member States reduced their emissions between 1990 and 2005. The largest reductions in absolute terms 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 of 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, activity data and emission factor

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	3,377	2,030	1,880	2.5%	-150	-7%	-1,497	-44%	T2	NS	CS
Belgium	2,630	875	823	1.1%	-52	-6%	-1,807	-69%	M	RS	CS
Denmark	1,335	1,084	1,059	1.4%	-25	-2%	-276	-21%	T2	NS/PS	CS
Finland	2,235	1,447	1,306	1.8%	-142	-10%	-930	-42%	T2	PS	CS
France	6,278	7,597	7,386	9.9%	-211	-3%	1,107	18%	CS/ T2	NS	CS
Germany	35,910	11,382	10,416	14.0%	-966	-8%	-25,494	-71%	T2	NS	CS/D
Greece	542	822	866	1.2%	43	5%	323	60%	T1	NS, Q	D
Ireland	980	1,174	1,193	1.6%	19	2%	213	22%	T2	NS	CS
Italy	8,697	12,594	12,641	17.0%	48	0%	3,944	45%	T2	NS	CS
Luxembourg	33	24	24	0.0%	0	0%	-9	-26%	T2	-	D
Netherlands	12,011	6,521	5,931	8.0%	-590	-9%	-6,080	-51%	T2	AS	CS
Portugal	549	1,811	1,959	2.6%	148	8%	1,410	257%	T2	NS	CS,D
Spain	3,299	7,419	7,689	10.3%	270	4%	4,390	133%	T2	NS, Q	D, CR, CS
Sweden	2,874	2,067	1,923	2.6%	-144	-7%	-952	-33%	T3	NS	D, CS
United Kingdom	49,625	19,809	19,471	26.1%	-338	-2%	-30,155	-61%	M	AS	CS
EU-15	**130,375**	**76,656**	**74,564**	**100.0%**	**-2,092**	**-3%**	**-55,811**	**-43%**			

CH_4 emissions from 6A2 Unmanaged Waste Disposal on Land account for 0.2 % of total EU-15 GHG emissions in 2005. Between 1990 and 2005, CH_4 emissions from this source decreased by 41 % due to a decreasing amount of municipal waste going to unmanaged waste disposal sites (Table 8.3). Not all Member States reported emissions from this source. France, Italy and Greece are responsible for 69 % of the total EU-15 emissions. France and Italy had large absolute reductions between 1990 and 2005.

Table 8.3 6A2 Unmanaged Waste Disposal on Land: Member States' contributions to CH_4 emissions and information on method applied, activity data and emission factor

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	NO	NO	NO	-	-	-	-	-	-	-	-
Belgium	NO	NO	NO	-	-	-	-	-	-	-	-
Denmark	NO	NO	NO	-	-	-	-	-	-	-	-
Finland	NO	NO	NO	-	-	-	-	-	-	-	-
France	4,835	2,120	1,979	25.5%	-141	-7%	-2,856	-59%	CS/ T2	NS	CS
Germany	NO	NO	NO	-	-	-	-	-	-	-	-
Greece	1,255	1,507	1,525	19.7%	18	1%	270	22%	T1	NS, Q	D
Ireland	352	462	425	5.5%	-36	-8%	74	21%	T2	NS	CS
Italy	4,601	1,897	1,795	23.1%	-101	-5%	-2,805	-61%	T2	NS	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	-	-	-
Netherlands	NO	NO	NO	-	-	-	-	-	-	-	-
Portugal	1,291	1,185	1,096	14.1%	-89	-7%	-195	-15%	T2	NS	CS,D
Spain	734	968	939	12.1%	-29	-3%	205	28%	T2	NS	D
Sweden	NO	NO	NO	-	-	-	-	-	-	-	-
United Kingdom	NO	NO	NO	-	-	-	-	-	-	-	-
EU-15	**13,067**	**8,138**	**7,760**	**100.0%**	**-378**	**-5%**	**-5,307**	**-41%**			

Table 8.4 provides information on the contribution of Member States to EC recalculations in CH_4 from 6A Solid Waste Disposal on Land for 1990 and 2004 and main explanations for the largest recalculations in absolute terms.

Table 8.4 6A Solid Waste Disposal on Land: Contribution of MS to EC recalculations in CH_4 for 1990 and 2004 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2004		Main explanations
	Gg	Percent	Gg	Percent	
Austria	1.7	0.0	0.2	0.0	Activity data (1998 to 2004) has been updated. According to the Austrian Landfill Ordinance, the operators of landfill sites have to report their activity data annually. Based on reports received after the due date, there are major changes for 2004 values of activity data in this submission compared to the previous submission. During quality control checks a calculation error in non-residual waste categories was detected and corrected, the effects on emission are minor.
Belgium	0.0	0.0	-8.8	-1.0	update of data
Denmark	1.1	0.1	14.4	1.2	For the submissions in 2007, recalculations have been carried out in re-lation to the final submission in 2006 of inventories 2002-2004. The re-calculation represents the slight change in methodology as described above and updates in the energy statistics on the uptake of CH4 by in-stallations at SWDSs for energy production for years 2003-2004.
Finland	0.0	0.0	1.4	0.1	Correction in activity data of municipal solid waste and change in classification of industrial solid waste
France	0.0	0.0	-177.5	-1.7	
Germany	-54.9	-0.2	-605.3	-4.4	update of emission data for waste disposal
Greece	0.0	0.0	0.0	0.0	
Ireland	0.0	0.0	42.4	2.7	Improved estimates of paper, organic matter, textiles and other wastes as a proportion of total MSW sent to landfill sites were obtained for the years 2002-2004 inclusive;The National Waste Report 2004 (Collins et al, 2005) provided revised estimates of MSW arising for 2002 and 2003 and also data in relation to the total amount of industrial sludge produced in 2004; To better reflect the rapid change towards managed landfills the proportions of MSW deposited at managed and unmanaged sites were revised from 2001 onwards with a 0.95 : 0.05 split adopted for 2005; Revised landfill gas utilisation figures for energy production were supplied as part of the national energy balance. These revised estimates apply to the years 1996-2004 inclusive.
Italy	0.0	0.0	2.0	0.0	Waste composition in landfills is still reconstructed including sludge, but un error has been corrected: the percentage of sludge has been lightly changed and consequently the content of DOC
Luxembourg	0.0	0.0	0.0	0.0	
Netherlands	0.0	0.0	0.0	0.0	
Portugal	0.0	0.0	63.0	1.3	update of activity data
Spain	262.1	6.9	675.6	8.7	new information based on questionnaires
Sweden	0.0	0.0	0.0	0.0	
UK	0.0	0.0	62.6	0.3	Correction to emissions from UK Overseas Territories (6A1).
EU-15	**210**	**0**	**70**	**0**	

8.2.2 Wastewater handling (CRF Source Category 6B)

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 8.5 shows total GHG, CH_4 and N_2O emissions by Member State from 6B Wastewater Handling. Between 1990 and 2005, CH_4 emissions from wastewater handling decreased by 34 %.. Between 1990 and 2005, N_2O emissions from wastewater handling increased by 4.1 %.

Table 8.5 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 2005 (Gg CO_2 equivalents)	CH_4 emissions in 1990 (Gg CO_2 equivalents)	CH_4 emissions in 2005 (Gg CO_2 equivalents)	N_2O emissions in 1990 (Gg CO2 equivalents)	N_2O emissions in 2005 (Gg CO2 equivalents)
Austria	210	289	102	41	108	248
Belgium	355	338	85	66	270	272
Denmark	213	314	126	253	88	61
Finland	297	233	154	130	144	102
France	2,120	2,415	768	1,162	1,353	1,253
Germany	4,450	2,366	2,226	91	2,224	2,275
Greece	2,644	889	2,319	519	325	370
Ireland	129	159	15	25	114	134
Italy	3,013	3,392	1,969	2,322	1,045	1,069
Luxembourg	NE,NO	NE,NO	NE,NO	NE,NO	-	-
Netherlands	803	606	290	205	513	401
Portugal	3,159	1,236	2,690	654	470	582
Spain	2,313	3,338	1,240	2,142	1,072	1,197
Sweden	195	138	IE,NO	IE,NO	195	138
United Kingdom	1,743	2,023	710	808	1,034	1,216
EU-15	**21,645**	**17,736**	**12,691**	**8,419**	**8,954**	**9,317**

Swedish emissions are included in 6A1
Abbreviations explained in the Chapter 'Units and abbreviations'.

CH_4 from 6B2 Domestic and Commercial Wastewater accounts for 0.2 % of total EU-15 GHG emissions. Between 1990 and 2005 emissions decreased by 30 %. Large decreases in absolute terms are reported from Germany and Greece, whereas Spain had large emission increases (Table 8.6).

Table 8.6 6B2 Domestic and commercial wastewater: Member States' contributions to CH_4 emissions and information on method applied, acitivity data and emission factor

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	102	41	41	0.6%	0	1%	-61	-60%	D	NS	D,CS
Belgium	85	66	66	1.0%	0	0%	-19	-22%	D	RS	D, CS
Denmark	126	265	253	4.0%	-12	-4%	128	102%	D/CS	NS	D/CS
Finland	131	109	107	1.7%	-2	-2%	-25	-19%	D	PS	CS
France	768	1,141	1,162	18.2%	21	2%	395	51%	CS/ T2	NS	CS
Germany	2,226	91	91	1.4%	0	0%	-2,135	-96%	D	NS	CS/D
Greece	2,211	404	406	6.4%	1	0%	-1,806	-82%	D	NS, Q	D
Ireland	13	20	20	0.3%	0	2%	7	57%	T1	NS	D
Italy	711	1,089	1,106	17.3%	17	2%	395	56%	D	NS	D
Luxembourg	NE	NE	NE	-	-	-	-	-	-	-	-
Netherlands	190	183	172	2.7%	-11	-6%	-18	-10%	T2	NS	CS
Portugal	1,056	693	640	10.0%	-53	-8%	-417	-39%	D	NS	CS,D
Spain	756	1,461	1,522	23.8%	61	4%	766	101%	D	NS	CS, D
Sweden	IE	IE	IE	-	-	-	-	-	-	-	-
United Kingdom	701	794	799	12.5%	5	1%	98	14%	M	NS	CS
EU-15	**9,076**	**6,355**	**6,384**	**100.0%**	**28**	**0%**	**-2,692**	**-30%**			

Swedish emissions are included in 6A1
Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 8.7 provides information on the contribution of Member States to EC recalculations in CH_4 from 6B Wastewater handling for 1990 and 2004 and main explanations for the largest recalculations in absolute terms.

Table 8.7 6B Wastewater Handling: Contribution of MS to EC recalculations in CH_4 for 1990 and 2004 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2004		Main explanations
	Gg	Percent	Gg	Percent	
Austria	0.0	0.0	0.0	0.0	
Belgium	0.0	0.0	0.0	0.0	
Denmark	0.0	0.0	0.0	0.0	
Finland	0.0	0.0	6.2	4.9	Improvements in calculation of total organic product (efficiency in wastewater treatment). Improvements in calculation of population having uncollected wastewater handling system
France	54.3	7.6	9.2	0.8	update of allocation to different treatment
Germany	0.0	0.0	0.0	0.0	
Greece	0.0	0.0	0.0	0.0	
Ireland	0.0	-	0.0	-	
Italy	0.0	0.0	-0.2	0.0	Differences are due to the updating of activity data for some industrial sector
Luxembourg	0.0	0.0	0.0	0.0	
Netherlands	0.0	0.0	0.0	0.0	
Portugal	1.1	0.0	0.0	0.0	
Spain	0.0	0.0	0.0	0.0	
Sweden	-	-	0.0	0.0	
UK	0.0	0.0	-3.7	-0.5	Revision to sewage sludge statistics
EU-15	**55.3**	**0.4**	**11.4**	**0.1**	

N_2O from 6B2 Domestic and Commercial wastewater accounts for 0.2 % of total EU-15 GHG emissions. Between 1990 and 2004 emissions increased by 3 %. Large increases in absolute terms are reported from Spain and the UK (Table 8.8).

Table 8.8 6B2 Domestic and Commercial Wastewater: Member States' contributions to N_2O emissions and information on methd applied, activity data and emission factor

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	104	196	198	2.3%	1	1%	93	89%	CS,D	NS	CS,D
Belgium	270	271	272	3.1%	0	0%	2	1%	-	-	-
Denmark	88	53	61	0.7%	8	15%	-27	-30%	D/CS	NS	D/CS
Finland	105	83	80	0.9%	-4	-5%	-26	-24%	CS	PS	D
France	1,089	975	972	11.2%	-3	0%	-117	-11%	CS/ T2	NS	CS
Germany	2,224	2,277	2,275	26.3%	-2	0%	51	2%	D	NS	D
Greece	325	367	370	4.3%	3	1%	45	14%	NE	NE	NE
Ireland	114	131	134	1.6%	3	2%	20	18%	T1	NS	D
Italy	975	1,000	1,003	11.6%	3	0%	28	3%	D	NS	D
Luxembourg	NE	NE	NE	-	-	-	-	-	-	-	-
Netherlands	513	399	401	4.6%	2	0%	-113	-22%	T2	NS	D
Portugal	286	352	353	4.1%	1	0%	67	23%	D	IS	D
Spain	1,072	1,194	1,197	13.8%	3	0%	124	12%	D	NS	D
Sweden	166	121	121	1.4%	0	0%	-45	-27%	CS	NA	D
United Kingdom	1,027	1,209	1,209	14.0%	1	0%	182	18%	M	NS	D
EU-15	**8,359**	**8,629**	**8,645**	**100.0%**	**16**	**0%**	**286**	**3%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 8.9 provides information on the contribution of Member States to EC recalculations in N_2O from 6B Wastewater Handling for 1990 and 2004.

Table 8.9 6B Wastewater Handling: Contribution of MS to EC recalculations in N_2O for 1990 and 2004 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2004		Main explanations
	Gg	Percent	Gg	Percent	
Austria	91.3	535.9	31.0	15.6	The methodology for calculating N2O emissions was changed according to the recommendation by the ERT during the in-country review 2007. Now also N2O emissions are considered which do not arise in waste water treatment plants. The protein intake per person has been updated according to data published by the FAO. This results in revised N2O emission for industrial and domestic waste water treatment. Population data for 2004 have been updated, which is the reason why CH4 emissions in 2004 vary slightly from last year's submission.
Belgium	0.0	0.0	3.4	1.3	update of data
Denmark	0.0	0.0	0.0	0.0	
Finland	0.0	0.0	0.4	0.4	Improvements in calculation of total organic product (efficiency in wastewater treatment). Improvements in calculation of population having uncollected wastewater handling system
France	78.6	6.2	2.6	0.2	update of allocation to different treatment
Germany	0.0	0.0	0.0	0.0	
Greece	0.0	0.0	0.0	0.0	
Ireland	0.0	0.0	0.0	0.0	
Italy	0.0	0.0	0.3	0.0	Differences are due to the updating of activity data for some industrial sector
Luxembourg	0.0	0.0	0.0	0.0	
Netherlands	0.0	0.0	0.0	0.0	
Portugal	0.3	0.1	0.8	0.1	revision of activity data
Spain	0.0	0.0	0.0	0.0	
Sweden	0.0	0.0	0.0	0.0	
UK	0.0	0.0	-5.7	-0.5	Revision to sewage sludge statistics
EU-15	**170.2**	**1.9**	**32.7**	**0.4**	

8.2.3 Waste incineration (CRF Source Category 6C)

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 8.10 and Table 8.11 summarise information by Member State on emission trends, methodologies and emission factors for CO_2 from 6C Waste Incineration. This key source accounts for 0.1 % of total EU-15 GHG emissions. Between 1990 and 2005, CO_2 emissions from waste incineration decreased by 42 %; France, Spain and the UK had the largest decreases in absolute terms.

Table 8.10 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 2005 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO_2 emissions in 2005 (Gg)
Austria	27	12	27	12
Belgium	360	130	337	115
Denmark	IE	IE	IE	IE
Finland	NE	NE	NE	IE
France	2,635	1,982	2,295	1,647
Germany	NO	NO	NO	NO
Greece	0	1	0	1
Ireland	NE, NO	0	NE	NE
Italy	785	590	537	165
Luxembourg	10	10	10	10
Netherlands	IE	IE	IE	IE
Portugal	10	415	10	383
Spain	917	293	750	126
Sweden	44	91	44	91
United Kingdom	1,389	510	1,207	459
EU-15	**6,178**	**4,034**	**5,217**	**3,009**

Emissions of Denmark are included in 1A1a.
Emissions of Ireland are not reported because data for whole time series are not available.
Emissions of the Netherlands are included in 1A1a.

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 8.11 6C Waste incineration: Member States' contributions to CO_2 emissions and information on methods applied and quality of these emission estimates

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2005	Change 2004-2005		Change 1990-2005		Method applied	Activity data	Emission factor
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	27	12	12	0.4%	0	0%	-15	-54%	D	-	CS,D
Belgium	337	128	115	3.8%	-13	-10%	-223	-66%	-	-	-
Denmark	IE	IE	IE	-	-	-	-	-	-	-	-
Finland	NE	IE	IE	-	-	-	-	-	-	-	-
France	2,295	1,659	1,647	54.7%	-12	-1%	-648	-28%	C	-	CS, PS
Germany	NO	NO	NO	-	-	-	-	-	-	-	-
Greece	0	1	1	0.0%	0	3%	1	567%	D	-	D
Ireland	NE	NE	NE	-	-	-	-	-	-	-	-
Italy	537	199	165	5.5%	-34	-17%	-371	-69%	D	-	CS
Luxembourg	10	10	10	0.3%	0	-	0	0%	CS	-	CS
Netherlands	IE	IE	IE	-	-	-	-	-	-	-	-
Portugal	10	376	383	12.7%	7	2%	373	3701%	D	-	CS,D
Spain	750	76	126	4.2%	50	66%	-625	-83%	CR	-	CR,CS
Sweden	44	89	91	3.0%	2	3%	47	108%	M	-	PS
United Kingdom	1,207	452	459	15.3%	7	2%	-748	-62%	T1,T2	-	CS
EU-15	**5,217**	**3,001**	**3,009**	**100.0%**	**8**	**0%**	**-2,208**	**-42%**			

Emissions of Denmark are included in 1A1a.
Emissions of Finland are included in 1A1a.
Emissions Ireland are not reported because data for whole time serie are not available.
Emissions of the Netherlands are included in 1A1a.

Abbreviations explained in the Chapter 'Units and abbreviations'.

8.3 Methodological issues and uncertainties

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 sources and contribute 1.8 % and 0.2 % of the GHG emissions from the sector Waste, respectively. The reporting category 6B2 CH_4 emissions from domestic and commercial wastewater, key source in the EU-15 as well, 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)

CH_4 emissions from managed solid waste disposal are key sources in all Member States, with the exception of Luxembourg. 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. All EU-15 Member States 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 (see Table 8.2). Three Member States used a country-specific emission model in accordance with the Tier 2 methodology (Denmark, United Kingdom and Belgium) and four Member States (Sweden, France, Ireland and Finland) applied country-specific methods in accordance with the Tier 2 methodology. The remaining Member States applied the tier Tier 2 methodology proposed by the IPCC Good Practice Guidance and the IPCC Guidelines. Table 8.12 summarizes the characteristics of the national methodologies for estimating CH_4 emissions from managed solid waste disposal sites.

Table 8.12 6A1 Managed Waste Disposal: Description of national methods used for estimating CH_4 emissions

Member States	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 defaulte values are taken.
Belgium	The methodology used to calculate the emissions from solid waste disposal on land differs between the 2 regions in Belgium where these sites are located (Flanders and Wallonia). In the Flemish region a combination of 2 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 model that considers separately the emissions of industrial and municipal waste. The model, developed by the Vito, acknowledges the fact that methane is emitted over a long period of time. A first order decay model is used to take into account the various factors that influence the rate and extent of methane generation and release from landfill. The overall methodology follows the Tier 2 IPCC methodology. No waste disposal sites are located in the Brussels region.
Denmark	The CH_4 emission estimates from SWDSs are based on a First Order Decay (FOD) model suited to Danish conditions and according to an IPCC Tier 2 approach.
Finland	Finland used IPCC Tier 2 method as basis. However Equation 5.1 from the GPG (2000) has been slightly modified, so that term MCF (t) has substituted for the term MCF (x) in the calculation of 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 year (and degraded later in year *t*) as well.
France	IPCC Tier 2 Method
Germany	IPCC Tier 2 Method
Greece	IPCC Tier 2 Method (NIR 2006)
Ireland	A modified form of the IPCC Tier 2 method was adopted as the most appropriate basis on which to assess annual CH_4 emissions where reasonable predictions could be made for decreasing waste quantities into the future. The results obtained from this revised methodology were included as an important component of the recalculations reported in the 2002 submission. The approach underlying the quantification of CH_4 from solid waste disposal uses a function to describe the CH_4 production from all contributing solid waste deposited in landfills in a particular year. This relationship is based on a two-stage first-order model (Cossu et al, 1996) for landfill gas production, incorporating a lag period of one year before CH_4 generation commences, followed by active CH_4 production over 20 years. The estimates take account of a variable allocation of wastes between well-managed landfills, where the full CH_4 potential is realised, and shallow unmanaged landfills for which 40 percent of the potential CH_4 is assumed to be emitted. To estimate annual emissions for the years 1990 to 2005, the CH_4 potential of wastes landfilled in each year from 1969 (21 years prior to 1990) is first determined. These annual CH_4 potentials are then assigned as emissions over 20 subsequent years (with an initial lag of 1 year) according to the function described and their cumulative contributions for the 20 year period give the total emissions for the end year in that period.
Italy	In order to calculate CH_4 emissions from all the landfill sites in Italy, the assumption that all the landfills started operation in the same year, and have the same parameters, has been considered, although characteristics of individual sites can vary substantially; the First Order Decay Model has been applied. Thus, the IPCC Tier 2 methodology has been followed for the emission estimation (NIR 2006).
Luxembourg	IPCC Tier 2 Method (NIR 2006)
Netherlands	IPCC Tier 2 Method
Portugal	IPCC Tier 2 Method.
Spain	IPCC Tier 2 Method
Sweden	IPCC Tier 2 methodology with a slightly different time factor and with some estimates on the national gas potentials. Comparison between the suggested IPCC gas potentials and Swedish estimates show that the IPCC values tend to be higher, but considering the large methodological uncertainties, which is the same in both cases, the difference might be within a reasonable interval.
United Kingdom	The UK method uses a first order decay (Tier 2) methodology based on estimates and historical data on waste quantities, composition and disposal practices over several decades. The UK method is based on Equations 4 and 5 in the Revised 1996 IPCC guidelines, which are compatible with Equations 5.1 and 5.2 in the Good Practice Guidance. A slightly modified version of Equation 5.1 is used, which takes into account the fact that the model uses a finite time interval (one year).

Source: NIR 2007, NIR 2006

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 Member States are summarized in Table 8.13.

Table 8.13 6A1 Managed Solid Waste Disposal: Data sources used for generating time series of activity data

Member States	Data sources used for generating time series (6A1)
Austria	The quantities of "residual waste" from 1950 to 1988 were taken from a study [Hackl, Mauschitz; 1999] and from 1989 to 1997 from the current Bundesabfallwirtschaftsplan (Federal Waste Management Plan). However, in both references 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. Thus, to achieve a consistent time series, the two overlapping years (1998 and 1999) were examined and the difference which represents the residual waste from administrative facilities of industries and businesses calculated. The difference was then applied to the years 1950 to 1997 according to the relative known change in data from residual waste from households. The quantities of "non residual waste" from 1998 to 2004 were taken from the database for solid waste disposals "Deponiedatenbank" ("Austrian landfill database"), whereas only the amount of waste with biodegradable lots was 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.
Belgium	In Wallonia, the quantity of waste disposed comes from the statistics of OWD (Walloon Waste Office). It publishes each year the industrial and municipal waste disposed, based on the taxes declaration forms covering 50 solid waste disposal sites of various sizes. 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 (NIR 2007). In the Flemish region the quantity of waste disposed originates from the institute responsible for waste management in Flanders (OVAM). There are no solid waste disposal sites in the Brussels Region.
Denmark	The amount of municipal solid waste deposited at solid waste disposal sites is according to official registration performed by the Danish Environmental Protection Agency in the so-called ISAG database.
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 the report of VTT (Tukhanen 2002).
France	The amount of waste on SWDS derives from the surveys called "ITOMA" made by ADEME.
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. The most recent year for which suitable differentiated data is available is 2004. For the first half of 2005, quantities were extrapolated based on a linear regression analysis over the time period 1996 – 2004. 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.
Greece	Estimates on solid waste quantities generated are contained in various reports, research programs and studies, but refer to specific points in time rather than to complete time series, while different assumptions are applied in each source for the estimation of generated quantities. Therefore, on the one hand there is a lack of data for some years, while on the other hand the evolution of quantities between years for which official data are available cannot always be considered as reliable. For this reason, a re-estimation of generated quantities of municipal solid wastes for the whole period 1960-2004 was carried out, on the basis of population figures and coherent assumptions regarding generation rates per capita and day, in order to derive complete time series for waste quantities generated (NIR 2006).
Ireland	The waste material contributing to DOC includes MSW (household and commercial refuse) and street cleansings, as given in the National Waste Database reports together with sludges from municipal wastewater treatment that are deposited in landfills. The EPA commenced the development of the National Waste Database in the early 1990s. National statistics generated from this database and published on a three-year cycle by EPA are the primary basis for establishing the historical time-series of MSW placed in landfills in Ireland. These publications provide detailed descriptions of the methods employed to compile the waste database. The results of other less comprehensive surveys undertaken in previous years (1987, 1993, and 1994) have also been used to some extent in compiling the MSW time-series.
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 APAT, 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. 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, and regression models based on population. On the basis of the recommendations of the in-country review process, in order to avoid an underestimation of CH_4 emissions, it has been assumed that waste landfilling started in 1950, instead of 1975 as

Member States	Data sources used for generating time series (6A1)
	previously considered. 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 for the period 1975 – 2004; 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%. 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 and 75% as the fraction of sludge that goes to landfill (NIR 2006).
Luxembourg	Activity data for managed waste disposal on land is taken from the Statistical Service of Luxembourg (STATEC) (NIR 2006).
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. Data can be found on www.uitvoeringafvalbeheer.nl, and are documented in SenterNovem (2005). This document contains also yearly the amount of methane recovered from landfill sites.
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 (1995). 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.
Spain	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 arrived at 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. From 1990 on, the information is provided directly by the Ministry of the Environment (MMA) in the publication, “The Environment in Spain”. In managed SWDS with biogas recovery, the monitoring of the waste deposited dates back to the start of activities and the information is provided via a questionnaire completed by the landfills themselves.
Sweden	Household waste: First national survey by EPA in 1980, similar data in 1985 and 1990 and 1994 by Statistics Sweden, since 1994 annual survey on landfilled waste by RVF. Figures on sludge from wastewater treatment and garden waste are available since 1990. Industrial waste: Studies on quantities and treatment of organic waste from industry in 1993 and 1996 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.
United Kingdom	The estimates of historical waste disposal and composition data are based on various data sources. Until 1994 the waste arisings data are based on waste surveys in the UK using actual data combined with landfilled volume estimates, household waste composition surveys and population data to interpolate where necessary. From 1995 to 2000, data are based on a new study, which uses updated waste survey data gathered by the Environmental Agency for 1999/2000. Years between 1995 and 1998 inclusive are calculated by linear interpolation between 1994 and 1999. From 2001 the model uses a scenario of waste disposal from the Local Authority Waste Recycling and Disposal (LAWRRD) model. The LAWRRD model provides arisings for England and so the data has been scaled upwards to UK's total.

Source: NIR 2007, NIR 2006

Some Member States explicitly describe the consistency of their time series (compare Table 8.14).

Table 8.14 6A1 Managed Solid Waste Disposal: Consistency of time series of activity data

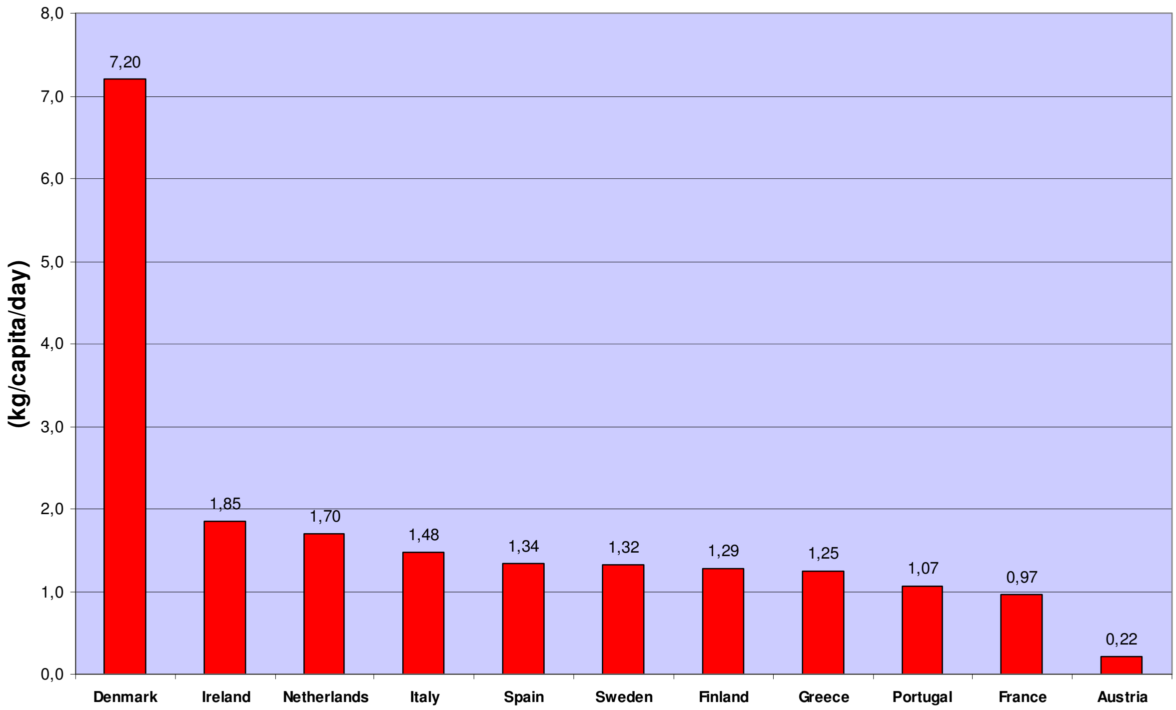
Member States	Consistency of time series
Austria	Concerning residual waste, to achieve a consistent time series between the data sources used before 1998 and from 1998 onwards, the two overlapping years were examined and the difference which represents the residual waste from administrative facilities of industries and businesses calculated. The difference was then applied to the years 1950 to 1997 according to the relative known change in data from residual waste from households. There is no explicit description of time series consistency for non-residual waste.
Belgium	No detailed description of time series consistency.
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.
Finland	No detailed description of time series consistency.
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, for years 1986-1988, 1990 – 1992, 1994 and 2001. For years 1960 – 1984, consistency between 1984 and 1985 was checked to approve the times series (email communication with national waste expert April 2005).
Germany	Over the long activity-data period involved, thirty years, time series inconsistencies are inevitable. In Germany, such

Member States	Consistency of time series
	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.
Greece	No detailed description of time series consistency (NIR 2006).
Ireland	The time-series estimates given in the present submission are updated to account for the inclusion of sewage sludge and are fully consistent over the period 1990-2005.
Italy	No detailed description of time series consistency (NIR 2006).
Luxembourg	No information available.
Netherlands	The time-series consistency of the activity data is very good due to the continuity in data provided (NIR 2007). The amounts of waste deposited are registered by a yearly survey since 1990 with a response of 100% (email communication with national waste expert April 2005).
Portugal	No detailed description of time series consistency.
Spain	No detailed description of time series consistency.
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.
United Kingdom	The estimates for all years have been calculated from the LQM model and thus the methodology is consistent throughout the time series. Estimates of waste composition and quantities have been taken from different sources. This has resulted in relatively stable background trend of an annual increase of around 1 million tonnes per year. Similarly, estimates of industrial and commercial waste arising increase rapidly – from 108 million tonnes in 1995 to 169 million tonnes by 1999 (assuming a linear increase over this period). Arisings are roughly constant in the years before 1995 and after 1999; the values for 2002 are based on Environment Agency data and are assumed constant thereafter.

Source: NIR 2007, NIR 2006.

The amount of waste disposed on SWDS depends on the one hand on the total amount of waste generated respectively on the per capita waste generation rate, Figure 8.3 provides an overview.

Figure 8.3 6A1 Managed Waste Disposal: Waste Generation Rate



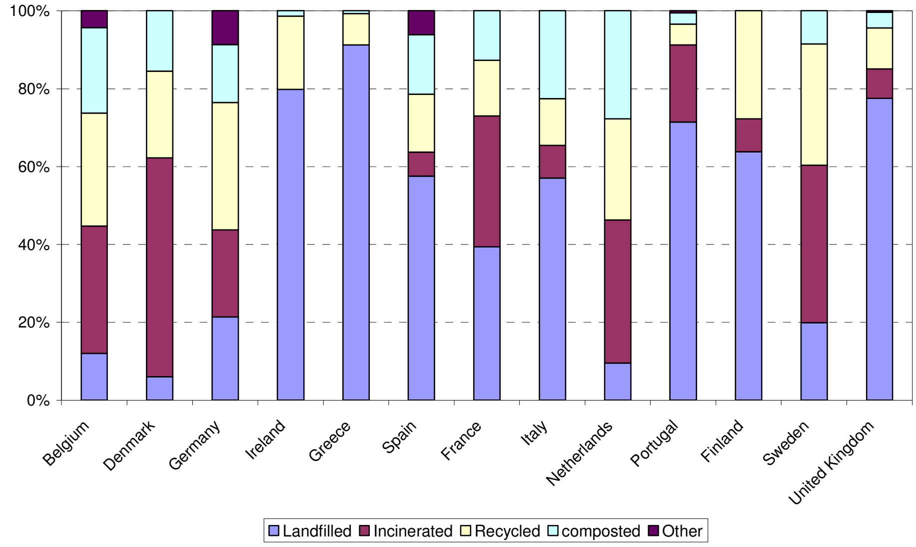
Source: CRF 2007, table 6 A, C Additional information

The waste generation rate per capita varies significantly among the Member States. Austria shows the lowest rate of 0.22 kg/capita/day, while Denmark reports the highest waste generation rate of 7.20 kg/capita/day.

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. 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. For Spain and Greece 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 EU 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.

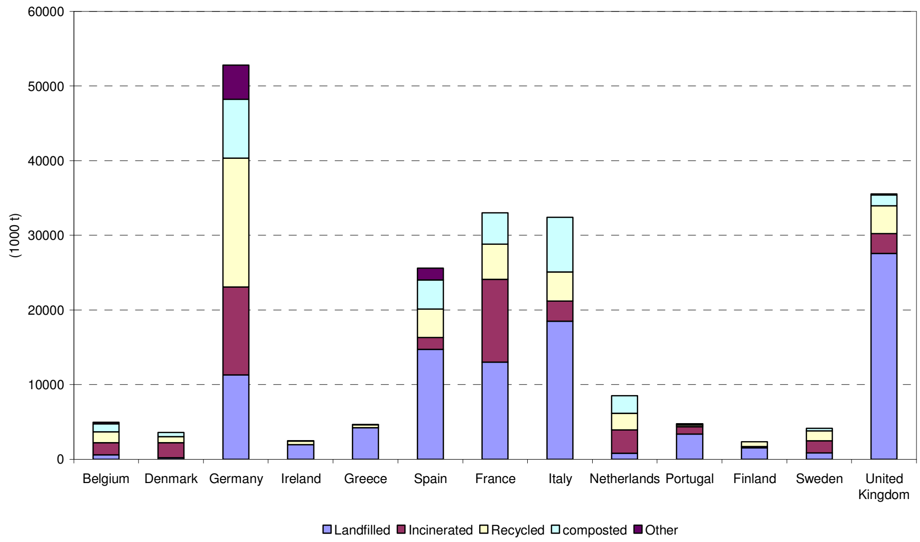
On the other hand the amount of waste generated on SWDS is strongly influenced by the waste management practices of the individual Member States: by the share of waste incinerated, recycled and composted, compare Figure 8.4 and 8.5.

Figure 8.4 6A1 Managed Waste Disposal: Waste management practices in the EU-15 (shares) in 2002



Source: EUROSTAT

Figure 8.5 6A1 Managed Waste Disposal: Waste management practices in the EU-15 (absolute values), 2002



Source: EUROSTAT

The United Kingdom, Italy, Germany, France and Spain are currently representing more than 80% of the generation of MSW and of landfilling within EU-15. Many Member States experienced a reduction of waste landfilled and an increase of amounts of waste recycled, composted and 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 latter 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 store only waste that conforms to strict categorisation criteria. They 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 8.16) as well on waste composition of land filled waste (Table 8.15). The latter parameters are again strongly influenced by waste management practices and policies.

Table 8.15 6A1 Managed Solid Waste Disposal: Waste composition of landfilled waste

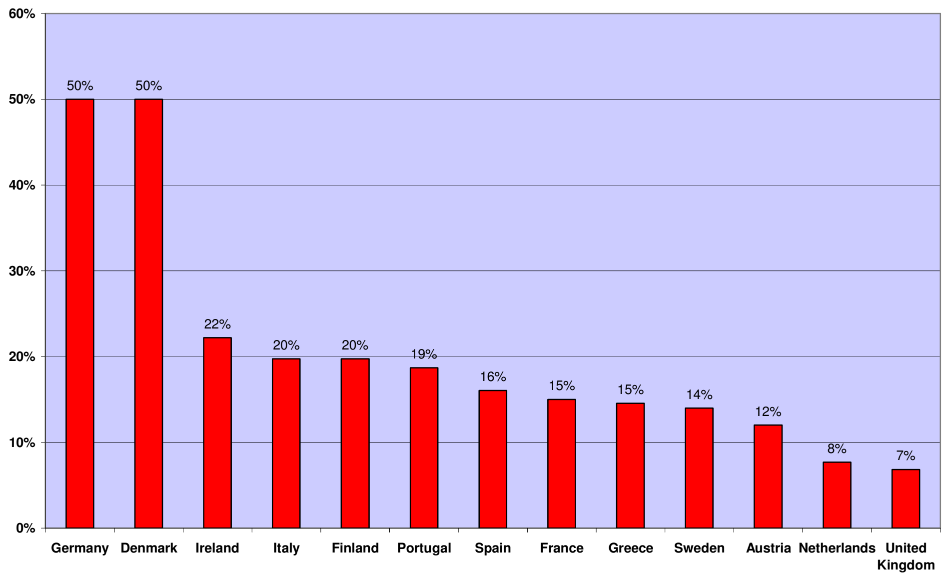
Member States	Composition of landfilled waste
Austria	Landfilled waste is differentiated in "residual waste" and ""non residual waste" (bulk, construction, mixed industrial waste, road sweeping, sewage sludge, rakings, residual matter from waste treatment). Detailed values such as for the half life period, DOC, and DOC_F are available for these waste types. The composition of residual waste is specified according to different waste fractions (such as paper, glass, or plastics).
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.
Denmark	The following waste types are taken into consideration: Domestic waste, bulky waste, garden waste, commercial & office waste, industrial waste, building & construction waste, sludge and ash & slag. As material fraction the following types are differentiated: Waste food, cardboard, paper, wet card board and paper, plastics, other combustibles, glass and other non-combustibles.
Finland	Solid municipal, industrial, construction and demolition wastes and municipal and industrial sludges are considered as waste groups. These groups are further split into several subgroups.
France	Composition of landfilled waste is not mentioned explicitly in the NIR 2006. According to the surveys of ADEME for year 2000, landfilled waste is composed of: "green waste" 0.4%, household waste 42.2% (paper 25%, food and garden waste 29%, plastics,11%, glass 13%, other inert 22%), standard industrial waste 29.1%, waste similar to household waste 4.7%, secondary waste and other (inert) 23% (email communication with national waste expert April 2005).
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 (Lale (2000)). According to that study, household waste in the GDR was composed of vegetable waste, paper/cardboard, wood, rubber, composites as well as textiles.
Greece	The estimated composition of generated MSW is: Putrescible matter, paper, plastics, metals, glass, rest. However, accurate data on the composition of generated municipal solid waste at national level are not available, as a comprehensive analysis at national scale covering a complete time period has not been accomplished yet (NIR 2006).
Ireland	Waste constituents of MSW that contribute to DOC are organics, paper, textiles and in the category other (fine elements, unclassified materials and wood wastes). Furthermore, street cleansings and sludge from municipal wastewater treatment are considered.
Italy	The landfilled waste in Italy has the following composition (2004): paper and paperboard: 26.15%, food and garden waste: 26.72%, plastics: 12.98%, glass: 5.49%, textiles: 4.45%, other (inert): 10.98%, other (organic): 13.23%. Composition of landfilled waste includes sludge (NIR 2006).
Luxembourg	No information available (NIR 2006)
Netherlands	No information available.
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 the fermentable fraction of 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.
Spain	The composition of municipal solid waste comprises the following categories: organic matter, paper and cardboard, plastics, glass, ferrous metals, nonferrous metals, wood, textiles, rubber and latex, disposable and rechargeable

Member States	Composition of landfilled waste
	batteries, other. For waste from origins other than direct household collection, other categories apply: compost plant refuse, waste water sludge and others.
Sweden	Landfilled waste includes household and similar waste, sludge from wastewater handling, garden waste, sludge from the pulp industry and other organic industrial wastes.
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.

Source: NIR 2007, NIR 2006

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 8.16 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 2007 Table 6A,C Additional information.

Table 8.16 6A1 Managed Solid Waste Disposal: Further information on DOC values

Member States	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 2007. A time series of bio-degradable organic carbon content of directly deposited residual waste is indicated for the years 1950 to 2003.
Belgium	For the Walloon region the data are classified according to 12 main categories (119 subcategories), thus allowing an accurate calculation of the amounts of waste and its degradable organic carbon content (IPCC Good Practice Guidance, equation 5.4, page 5.9), which are used as an input in the model. 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 judgment assumptions. The DOC value for municipal waste lies in the default value range from IPCC revised 1996 Guidelines and was chosen according to national expert judgment (NIR 2007). The value for industrial waste was estimated calculated using the detailed waste types from OWD and the IPCC Good Practice Guidance methodology (equation 5.4, page 5.9).
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 combustible, glass, other non-combustible. The values are available in the NIR.
Finland	DOC fractions of different types of waste are based on the IPCC default values 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

Member States	Further information on DOC values
	NIR.
France	The OMINEA report (January 2007) fixes a DOC of 150 kg/t, which corresponds to the value reported in CRF 2007.
Germany	Both national and IPCC default factors were used for DOC. 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%, composites: 10%, sludges from wastewater treatment: 50%
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 (default value), 0.15 for food waste (default value) and 0.4 for sewage sludge (NIR 2006).
Ireland	IPCC DOC default values are used for organics, paper and textiles. Country-specific values for street cleansings and the category other are indicated. The DOC contribution of sludge is determined from information on the BOD content, the BOD removal rate and the proportion of sludge disposed to landfill. DOC of MSW is estimated from the given composition and appropriate DOC contents (40 % for paper and textiles, 15 % for organics, 25 % for street cleansings and 15 % for the category other).
Italy	On the basis of data available on waste composition (Tecneco, 1972; CNR, 1980; Ferrari, 1995), the moisture content, the organic carbon content and the fraction of biodegradable organic carbon for each waste stream (Andreottola and Cossu, 1988; Muntoni and Polettini, 2002), the DOC contents and the methane generation potential values (L_0) have been generated (NIR 2006).
Luxembourg	No information available.
Netherlands	The change in DOC values over time is due to such factors as the prohibition of landfilling combustible wastes.
Portugal	The estimation of DOC for urban waste is based on information on the waste composition from several sources. Figures are presented for IPCC categories A, B, C and D. Furthermore, DOC values are available for the different groups of industrial waste.
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 of the DOC parameter have been used: compost plant refuse (0.09), waste water sludge (0.18) and others (0.05).
Sweden	IPCC values for gas potentials are used for the different fractions of household waste, as well as garden waste. Values for the gas potential are available for different types of organic industrial waste.
United Kingdom	DOC was estimated assuming that the DOC arises solely from the cellulose and hemi-cellulose content of the waste. Cellulose and hemicellulose make up approximately 91% of the degradable fraction, whilst other potential degradable fractions which may have a small contribution (such as proteins and lipids) are ignored. The proportion of cellulose and hemi-cellulose in each waste component and the degradability of these fractions were based on a study. Each waste component (paper, food, etc) was assigned a DOC value based on the cellulose and hemi-cellulose content. The component was then split into four fractions: rapidly degrading, moderately degrading, slowly degrading and inert, each of which was assigned the appropriate degradation rate. For example, paper was taken to be 25% moderately degrading and 75% slowly degrading. The DOC value, applied to both components, was assumed to be equal to the percentage by weight of cellulose and hemi-cellulose multiplied by a factor of 72/162 (to account for the carbon content). This was around 22% for household paper waste.

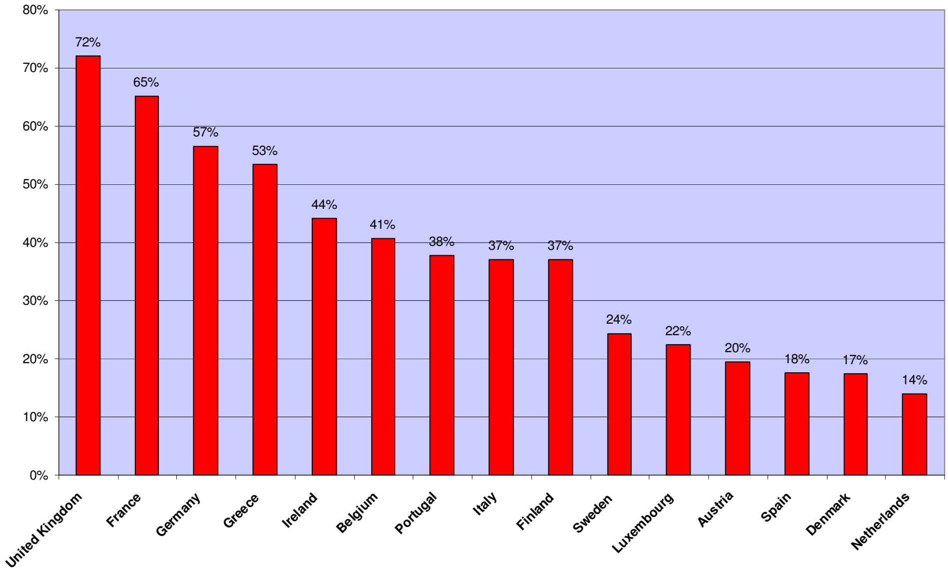
Source: NIR 2007, NIR 2006, CRF 2007, CRF 2006 Table 6A,C Additional information

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 national model is based on a country-specific method, in which the DOC value is based on cellulose and hemi-cellulose content for each waste component and degradability. These values may lack comparability with other countries. 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 the Netherlands and 72% in the United Kingdom and depends on the share of solid waste disposal sites that are able to recover CH_4 (see Table 8.17).

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 2007 Table 6A,C

Table 8.17 6A1 Managed Solid Waste Disposal: Further information on methane recovery

Member States	No of SWDS recovering CH_4 1) 2)	Total No of SWDS 2)	Data source for methane recovery 2)
Austria		Excavated-soil landfills: 340 Construction-waste landfills: 74 Residual waste landfills: 27 Mass waste landfills: 50	In 2004 the Umweltbundesamt made an investigation (ROLLAND & OLIVA 2004) and asked the operators of landfill sites to report their annual collected landfill gas. As this study considers only the amount of collected landfill gas from 1990 to 2002, the data were also used for the years 2003 to 2005. A study to update the amounts of collected landfill gas will be undertaken in 2007.
Belgium	12 (Wallonia)		For Wallonia, each year all the landfills with CH_4 recovery (12 in 2002) 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). Following a 1997 legal decree, a contract with the ISSEP (Scientific Institute for Public Service in Wallonia) also organises a close following of the environmental impacts of the Solid Waste Disposal Sites on Air, Water and Health. Seven main Sites are followed for the time being and the report includes biogas analysis. Details can be found on the DGRNE web site.
Denmark	26	134	Data for landfill gas plants are according to Energy Statistics from the Danish Energy Agency.
Finland	33		Finnish Biogas Plant Register (Kuittinen et al. 2005)
France	88%		88% of the solid waste disposal is landfilled on SWDS with biogas capturing.
Germany	95%	150	For 2004 it was assumed that methane is captured on 95% of all landfills and that the corresponding capturing efficiency is 60%. The Federal Statistical Agency will consider landfill gas recovery in its survey for the next years, which allows to take the value for methane recovery from data of individual plants.
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 3 of these sites (in Patra, Thessalonica and Larissa) the collection of data on the amount of biogas flared has not been possible yet. The estimation of biogas recovered in these sites was based on the assumption that for technical reasons, 60% of biogas released is finally recovered and flared. Detailed measurements data have been collected only for the SWDS of Athens, in which almost 50% of total waste going to managed sites is disposed. The quantities of waste disposed in the 3 sites for which the CH_4 recovery is based on assumptions, the volume of biogas flared in the SWDS of Athens and methane that is totally recovered, are presented. For the estimation of methane recovered in the SWDS of Athens, the fraction of methane in landfill gas (F) was calculated at 0.5 and methane density at 0.7 kg CH_4/m^3, based on the data collected (NIR 2006).
Ireland			Annual reports on renewable energy use; top-down: the amount of CH_4 captured for energy use is estimated from the reported electricity production in the national energy

Member States	No of SWDS recovering CH_4	Total No of SWDS	Data source for methane recovery
	1) 2)	2)	2)
			balance, assuming assigned percentage conversion efficiency factors; bottom-up: estimates on CH_4 utilized and flared from 65 individual landfills that were producing CH_4 in appreciable quantities
Italy	341	401 (1st category landfills)	Landfill gas recovered data have been reconstructed on the basis of information on extraction plants (De Poli and Pasqualini, 1997; Acaia et al., 2004; Asja, 2003) and electricity production (GRTN, several years) (NIR 2006).
Luxembourg	No information available.	No information available.	No information available.
Netherlands	50	27 operating, few thousand old sites which still are 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. Data can be found on www.uitvoeringafvalbeheer.nl, and are documented in SenterNovem, 2005. This document contains also yearly the amount of methane recovered from landfill sites.
Portugal			In the absence of metering landfill gas recovered data, estimates on recovered CH_4 for urban waste were done based on: the information of INR for each waste management system - existence of burners, and the starting year of landfill operation and on an average efficiency for the gas capture (75%) and the gas burners (97%). Industrial waste: Data on quantities of CH_4 recovered and combusted are estimates based on the assumptions presented for urban waste, considering that they share the same disposal places.
Spain	21		25 landfills have been identified as having applied some system of combustion for captured biogas during between 1990-2005, whether for elimination (combustion with flares) or for energy recovery (combustion in boilers, turbines or engines). These landfills are large scale and each of them was provided with an individualized questionnaire for the collection of information.
Sweden	70	165	Information on recovered gas (in energy units) is provided by RVF and converted to use quantities by Statistic Sweden.
United Kingdom			The fraction of methane recovered was derived from a survey of statistics on gas use for power generation, and a survey of installed flare capacity. Flares (other than those used to back up power generation, which are assumed to operate only when needed) are taken to have a load factor of 85% (i.e. 15% downtime), and 7% of the flares are assumed to be replaced every year, so that the flare lifetime is 15 years. This approach was taken because suitable metering data were not available. In 2005 the estimates were that 32% of generated methane was utilised and 38% was flared.

Source: 1) CRF 2007, 2006 Table 6 A,C 2) NIR 2007, 2006

CH_4 recovery in EU-15 amounts to about 56 % of the generated CH_4. Methane recovery will be enhanced by the Landfill Directive, and monitoring programmes 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).

Moreover, Member States use different methods to determine CH_4 recovery. Belgium, Finland, Ireland, the Netherlands and Spain use measured plant-specific data. In Austria, Italy and the United Kingdom surveys are carried out. Denmark, Ireland and Sweden take the corresponding data from their energy statistics. France, Germany and Portugal use general assumptions concerning the methane recovery.

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 8.18 illustrates how industrial waste is considered in the individual Member States. Five Member States do not consider industrial waste in the NIR.

Table 8.18 6A1 Managed Solid Waste Disposal: Methodological issues regarding industrial waste

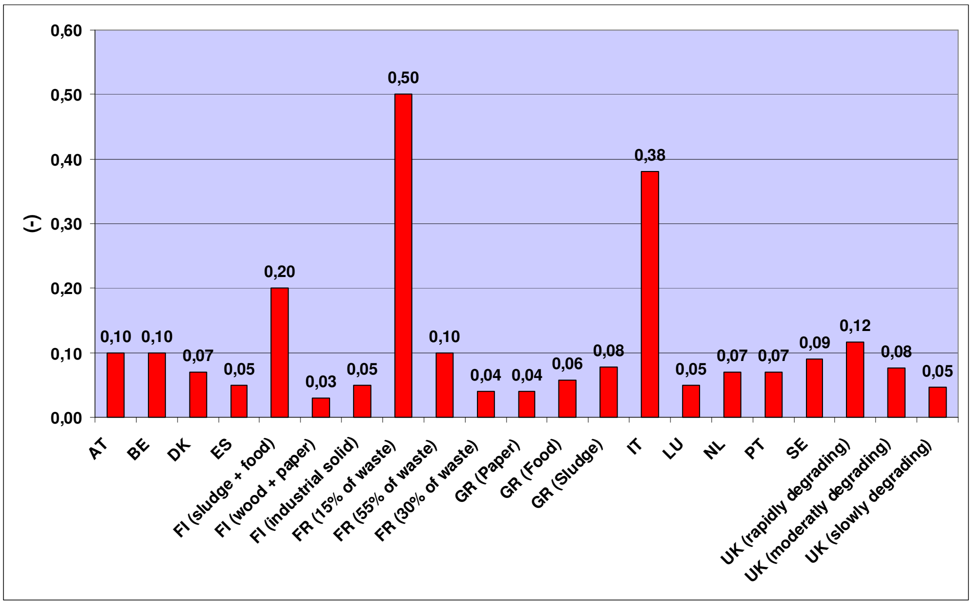
Member States	Industrial waste
Austria	"Mixed industrial waste" is considered under "non residual waste". Several waste types with their respective waste

Member States	Industrial waste
	identification numbers are described. These are not clearly referenced as industrial wastes, though.
Belgium	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 (equation 5.4, page 5.9). This detailed estimation led to a complete recalculation, as the new estimated DOC were much lower than the default value previously used.
Denmark	Industrial waste is considered and data on its composition and amount deposited are used in the emission model.
Finland	Industrial solid waste and industrial sludge are considered as waste types. Activity data and several DOC values are provided in the NIR.
France	Industrial waste is neither mentioned nor considered explicitly.
Germany	The Federal Statistical Office provides detailed data about landfilling of industrial waste since 1996. In the inventory the following waste types 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.
Greece	Industrial waste is neither mentioned nor considered explicitly (NIR 2006).
Ireland	Industrial waste is mentioned, but not considered explicitly.
Italy	Industrial waste which is landfilled in SWDS and sludge from wastewater handling plants has also been considered (NIR 2004).
Luxembourg	Industrial waste is neither mentioned nor considered explicitly (NIR 2006).
Netherlands	Industrial waste is neither mentioned nor considered explicitly.
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 years 2001, 2004 and 2005 are also estimates based on interpolation (2001) and last available data (2004-05 refer to 2003 data). 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.
Spain	Industrial waste is neither mentioned nor considered explicitly.
Sweden	Detailed description available in the NIR of how activity data and emissions of relevant industrial wastes and sludges are generated.
United Kingdom	The estimates of waste disposal quantities include industrial waste. Arisings are based on national estimates from a 1995 survey. Waste quantities have been extrapolated to cover past years based on employment rates in the industries concerned. Commercial and industrial arisings have been scaled up to the UK, based on an England and Wales total from Environment Agency data, for 2002 and assumed constant thereafter; years 1999, 2000 and 2001 are scaled values between 1998 and 2002. In the revised LQM model, all industrial waste except for construction and demolition, blast furnace and steel slag and power station ash is assumed to have some organic content and are therefore included in the figure for MSW.

Source: NIR 2007, NIR 2006; CRF 2006 Table 6,C documentation box

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 and Italy. Figure 8.8 provides some CH_4 generation rate constants reported by the Member States, while Table 8.19 summarizes information on the applied country specific approach.

Figure 8.8 6A1 Managed Solid Waste Disposal: Methane generation rate constant



Source: CRF 2007 Table 6 A,C Additional information, NIR 2007, OMINEA 2007 (France)

Table 8.19 6A1 Managed Solid Waste Disposal: Further information on the methane generation rate constant

Member States	**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.
Belgium	Several values for the biodegradation constant are given.
Denmark	Assumption is that the half-life of the carbon in the waste is 10 years.
Finland	Methane generation rate constants are divided into three categories: k1= 0.2 for wastewater sludges and food waste in MSW, k2=0.03 for wood waste in MSW and in construction and demolition waste, de-inking sludge, paper waste containing lignin in MSW, k3=0.05 for industrial solid waste and other fractions of MSW as well as fibre and coating sludges. Country specific k1 and k2 are according to rapid and slow rate constants in Good Practice Guidance.
France	In the OMINEA report (January 2007) 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.
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.
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 land filled. Considering the fact that climate in Greece is dry temperate (the ratio of mean annual precipitation to potential evapotranspiration (MAP/PET) is around 0.5), "half life" was estimated at 17 years for paper, 12 years for food waste and 9 years for sewage sludge disposed on land. This corresponds to the following values: k1=0.0408 (paper), k2=0.0578 (food) and k3=0.077 (sludge) (NIR 2006).
Ireland	A time-dependent rate of release of CH_4 is provided in the NIR. The emissions in a particular year are simply the cumulative contribution for that year arising from managed landfills and from unmanaged landfills separately over the period of 21 years that ends in the year concerned.
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 by Andreottola and Cossu (Andreottola and Cossu, 1988). Accordingly, waste streams have been categorized in three main types: rapidly biodegradable waste (food, sewage sludge, k1=0.69), moderately biodegradable waste (garden and park waste, k2=0.14) and slowly biodegradable waste (paper and paperboard, textile and leather, wood and straw, k=0.05). Methane emissions have been estimated separately for each mentioned biodegradable class and the results have been consequently added up (NIR 2006). The weighted average CH_4 methane generation constant of the three different values corresponding to each fraction of waste is k=0.38 (CRF 2007).
Luxembourg	No information available.
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.
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

Member States	Information on the half-time respectively the methane generation rate constant
	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).
Spain	The constant rate of methane generation takes the value recommended by the IPCC Good Practice Guidance (0.05) with the exception of one managed landfill whose fraction is 0.07.
Sweden	National value for half-life time of 7.5 years.
United Kingdom	The UK method divides the waste stream into four categories of waste: rapidly degrading, moderately degrading, slowly degrading, and inert. These categories each have a separate decay rate. They range from 0.046 (slowly degrading waste) to 0.076 (moderately degrading waste) to 0.116 (rapidly degrading waste), within the range of 0.030 to 0.200 quoted in the Good Practice Guidance.

Source: NIR 2007, NIR 2006, CRF 2007 Table 6 A,C Additional information, OMINEA 2007 (France)

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)

CH_4 emissions from unmanaged solid waste disposal were reported in only six Member States in 2007 (France, Greece, Ireland, Italy, Portugal and Spain). Four of these six Member States (France, Spain, Greece and Ireland) still dispose MSW to unmanaged SWDS, compare column 'Annual MSW to unmanaged SWDS' in Table 8.20, while in Italy and Portugal waste disposals from the past still emits (see Table 8.3). 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 8.20 gives an overview of the MCF applied the relevant Member States.

Table 8.20 6A2 Unmanaged Solid Waste Disposal: Selected parameters for calculating emissions from source category 6A2

Member States	Emissions reported from unmanaged SWDS	Annual MSW to unmanaged SWDS (Gg)	MCF CH_4		
			Unmanaged SWDS	Deep	Shallow
France	X	6.69	0.50	NO	0.50
Greece	X	1729.82	0.60	0.60	IE
Ireland	X	538.69	NE	NA	0.40
Italy	X	NO	0.60	NO	0.60
Portugal	X	NO	0.60	IE	0.60
Spain	X	530.78	0.60	0.80	0.40

Source: CRF 2007 table 6 and 6A,C

Table 8.21 6A2 Unmanaged Solid Waste Disposal: Further information

Member States	Unmanaged waste disposal on SWDS
France	The difference between managed and unmanaged MSWD is only if MSWD use compacting or not (email communication with national waste expert April 2005). No further information given.
Greece	Out of the existing disposal sites, it is estimated that 37 of them fulfill the criteria set by the IPCC guidelines so as to be considered as 'managed'. The remaining waste is disposed at unmanaged disposal sites. Time series of DOC and MSW quantities disposed on unmanaged SWDS are given for 1960-2004 (NIR 2006).
Ireland	In the period 1990-1995, 40% of DOC is assigned a MCF of 0.4, on the assumption that 40 percent of MSW is placed in unmanaged SWDS of less than 5 m depth. The MSW split between managed and unmanaged sites in 1969 is taken to be the reverse of that adopted for the years 1990-1995 and an appropriate adjustment is made for the intervening years and for the years after 1995 to reflect a gradual increase for managed landfills. The MSW split adopted for 2005 is 0.95 for managed sites and 0.05 for unmanaged sites. This represents a major change from the 0.67:0.33 division used for 2004 and it has been made following discussions with waste experts who believe that almost all landfills in Ireland could be classified in the managed category as used by IPCC.

Member States	Unmanaged waste disposal on SWDS
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 50% deep and 50% shallow (NIR 2006).
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 gas burning starts typically 2-3 years after the beginning of the landfill operation. It was assumed that all estimated industrial waste produced have followed the urban disposal pattern between uncontrolled and controlled SWDS.
Spain	With respect to unmanaged SWDS, there is no statistical information available for the characterization of the parameter of depth, so in the absence of said information it is assumed that 50% are deep and the remaining 50% are shallow. At the same time, within unmanaged SWDS, whether they are deep or shallow, burn coefficients were assumed for the reduction in volume. These coefficients have decreased during the inventory period.

Source: NIR 2007, NIR 2006

8.3.3 Waste water handling (CRF Source Category 6B)

CH_4 Emissions from domestic and commercial waste water handling (6B2) are the most 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 (C, CS, D, M, T1 and T2). Table 8.22 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 8.22 6B2 Domestic and Commercial Waste Water Handling: CH_4 emission sources and methods for determining CH_4 emissions

Member States	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. Mainly due to the structure of area of settlement in Austria there is still a small amount of inhabitants not connected to sewage systems and wastewater treatment plants. This wastewater is discharged in septic tanks and cesspools. 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. Whereas the following parameters were used: Average organic load: 60 g BOD5 per inhabitant and day [IPCC default], Methane producing capacity B_o: 0,6 kg CH_4/ kg BoB_5 [IPCC default], Methane conversion factor MCF: 0,27 (STEINLECHNER ET AL. 1994). The amount of inhabitants not connected to sewage systems and wastewater treatment plants was taken from the recent Austrian reports on water pollution control. Data for the years 1971, 1981, 1991, 1995 and 1998, 2001 and 2003 were available. The missing data were interpolated. The amount of inhabitants connected to septic tanks in the years form 2001 to 2005 has to be extrapolated taking into account the trend of earlier years. In Austria sewage sludge treatment is carried out on the one hand by aerobic stabilisation and on the other hand by anaerobic digestion. As sludge stabilisation is carried out aerobicly, the amount of methane emissions produced is negligible. Methane gas produced in the digestion processes is usually used for energy recovery or is flared. Thus a negligible amount of CH_4 emissions is emitted as well.
Belgium	In this category, two sources of methane emissions are taken into account: the CH_4 emissions from municipal wastewater treatment plants and from sceptic tanks. The methodology for the individual wastewater treatment plant (septic tank) is based on an article (Vasel, 1992), which describes the characteristics and parameters of individual septic tanks. 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, the municipal wastewater treatment plant is conducted aerobically; no CH_4 emissions are then 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.
Denmark	The methodology for estimating emission of methane from wastewater handling follows the IPCC Guidelines (1996) and IPCC Good Practice Guidance (2000). According to IPCC GL the emission should be calculated for domestic and industrial wastewater and the resulting two types of sludge, i.e. domestic and industrial sludge. The information available for the Danish wastewater treatment systems does not fit into the above categorisation as a significant

Member States	CH_4 emission sources and description of methods (municipal wastewater and sludge)
	fraction of the industrial wastewater is treated at centralised municipal wastewater treatment plants (WWTPs) and the data available for the total organic waste (TOW) does not differentiate between industrial and municipal sewage sludge. The IPPC default methodology for household wastewater has been applied by accounting and correcting for the industrial influent load. Of the total influent load of organic wastewater, the separated sludge has different final disposal categories. The fractions that are used for biogas, combustion or reuse including combustion include methane potentials that are either recovered or emitted as CO_2. These fractions have been subtracted from the calculated (theoretical) gross emission of CH_4.An EF value given in IPCC (2003) for the sludge disposal category biogas has been used for calculating the recovered and not emitted methane potential.
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 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.
France	On the basis of the statistics of the wastewater treatment plants in France, the emissions are calculated according to the IPCC tier 2 method, distinguishing natural lagoons and cesspools.
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.
Greece	CH_4 from waste water handling was estimated according to the default methodologies suggested by IPCC (NIR 2006).
Ireland	It is assumed that no CH_4 emissions from wastewater handling occur due to aerobic conditions. National studies (O'Leary and Carty, 1998) indicate that 3 percent of sludge produced in both industrial wastewater and domestic and commercial wastewater handling, including septic tanks, is treated anaerobically. The estimates of CH_4 emissions from wastewater and sludge are derived using the national statistics, country-specific values and default values from the IPCC Guidelines.
Italy	In Italy wastewater handling is managed mainly using aerobic treatment plants, where the complete-mix activated sludge process is more frequently designed. 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 (IPCC, 1997; IPCC 2000). The stabilization of sludge occurs in aerobic or anaerobic reactors; where anaerobic digestion is used, the reactors are covered and provided of gas recovery. Emissions from methane recovered, used for energy purposes, in wastewater treatment plants are estimated and reported under category 1A4a. A percentage of 3% of domestic and commercial wastewater is actually treated in Imhoff tanks, where the digestion of sludge occurs anaerobically without gas recovery. Therefore, very few emissions from sludge disposal do occur (NIR 2006).
Luxembourg	The emission estimation of waste water handling is based on the annual population numbers and corresponding emission factors. A country-specific methodology was applied. Activity data for wastewater handling, i.e. the number of inhabitants, have been taken from national statistics STATEC (NIR 2006).
Netherlands	Country-specific methodology is used for CH_4 from wastewater handling, which is equivalent to the IPCC Tier 2 method. A full description of the methodology is provided in the monitoring protocol 5438 (see www.greenhousegases.nl) and in the background document (Oonk et al., 2004).
Portugal	CH_4 emissions from domestic wastewater handling were estimated using a methodology adapted from IPCC 1996 Revised Guidelines (IPCC,1997) and GPG (IPCC,2000), 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.
Spain	The methodology in Section 5.2 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) through 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 methane production times the weighted methane conversion factor, WMCF. For domestic/commercial waste water, 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.
Sweden	Considerable quantities of heat and bio-energy are recovered from sewage and wastewater. The rest of the methane generated in the wastewater treatment process is considered to be insignificant because of flaring, and is therefore reported as NO (not occurring) in the CRF tables. Methane generated from landfilling of sludge is reported as IE (included elsewhere) because it is included in CRF 6A.
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. Emissions are based on empirical emission factors derived from the literature expressed in kg CH_4/tonne dry solids rather than the BOD default factors used by IPCC. The model however complies with the IPCC Good Practice Guidance as a national model (IPCC, 2000). Emissions from sewage are calculated by disaggregating the throughput of sewage into 14 different routes. The routes consist of different treatment processes each with specific emission factors. The allocation of sludge to the treatment routes is reported for each year.

Source: *NIR 2007, NIR 2006; CRF 2007, CRF 2006 Tables 6 and 6 B*

CH_4 emissions from industrial wastewater and sludge handling are not key sources but the reporting of these emissions by Member States is very inhomogeneous and seems to be difficult.

Emissions from sludge handling are reported by two Member States (Ireland and Spain), other Member States either did not estimate the emissions (eight Member States: Belgium, Denmark, France, Germany, Greece, Luxembourg, the Netherlands and the United Kingdom) or reported the emissions elsewhere (five Member States: Austria, Finland, Italy, Portugal and Sweden).

Emissions from industrial wastewater handling are reported by six Member States (Finland, Greece, Italy, Netherlands, Portugal, Spain), but nine Member States indicate either that emissions are not estimated or not applicable or not occurring (Austria, Belgium, France, Germany, Ireland, Luxembourg, United Kingdom), or that emissions are reported elsewhere (Denmark, Sweden). An overview of methodological issues regarding CH_4 emissions from industrial wastewater and sludge handling is provided in Table 8.23.

Table 8.23 6B1 Industrial Waste Water Handling: CH_4 emissions and methods applied

Member States	CH_4 emissions from industrial wastewater		Methods for determining CH_4 emissions from industrial wastewater and sludge handling
	Waste water	Sludge	
Austria	**NA**	**IE**	Industrial Wastewater treatment and sewage sludge treatment is carried out under aerobic as well as anaerobic conditions. Due to lack of data the overall amount of industrial wastewater can not be estimated. But according to national experts the amount of CH_4 emissions from industrial wastewater treatment and sewage sludge treatment is negligible because CH_4 gas is usually used for energy recovery or is flared.
Belgium	**NE**	**NE**	
Denmark	**IE**	**NE**	The methodology for estimating emission of methane from wastewater handling follows the IPCC Guidelines (1996) and IPCC Good Practice Guidance (2000). According to IPCC GL the emission should be calculated for domestic and industrial wastewater and the resulting two types of sludge, i.e. domestic and industrial sludge. The information available for the Danish wastewater treatment systems does not fit into the above categorisation as a significant fraction of the industrial wastewater is treated at centralised municipal wastewater treatment plants (WWTPs) and the data available for the total organic waste (TOW) does not differentiate between industrial and municipal sewage sludge. The IPPC default methodology for household wastewater has been applied by accounting and correcting for the industrial influent load. Of the total influent load of organic wastewater, the separated sludge has different final disposal categories. The fractions that are used for biogas, combustion or reuse including combustion include methane potentials that are either recovered or emitted as CO_2. These fractions have been subtracted from the calculated (theoretical) gross emission of CH_4.An EF value given in IPCC (2003) for the sludge disposal category biogas has been used for calculating the recovered and not emitted methane potential.
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. A formula is provided.
France	**NO**	**NE**	Due to the major use of aerobic treatment system in industrial wastewater treatment plants CH_4 emissions are very small. Due to the lack of data CH_4 emissions from industrial sludge are not estimated (email communication with national waste expert April 2005).
Germany	**NE**	**NE**	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.
Greece	**X**	**NE**	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 accomplished: Collection of data regarding industrial production of approximately 25 industrial sectors / sub-sectors for the period 1990 – 2003. Data on industrial production for 2004 were not available and for this reason production was estimated through linear extrapolation. Calculation of generated wastewater, by using the default factors per industrial

Member States	CH_4 emissions from industrial wastewater		Methods for determining CH_4 emissions from industrial wastewater and sludge handling
	Waste water	Sludge	
			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 (NIR 2006).
Ireland	**NO**	**X**	It is assumed that no CH_4 emissions from wastewater handling occur due to aerobic conditions. National studies (O'Leary and Carty, 1998) indicate that 3 percent of sludge produced in both industrial wastewater and domestic and commercial wastewater handling, including septic tanks, is treated anaerobically. The estimates of CH_4 emissions from wastewaster and sludge are derived using the national statistics, country-specific values and default values from the IPCC Guidelines.
Italy	**X**	**IE**	In Italy wastewater handling is managed mainly using aerobic treatment plants, where the complete-mix activated sludge process is more frequently designed. 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. 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 (IPCC, 2000), 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. CH_4 emissions from sludge generated from industries are included in the industrial wastewaters (NIR 2006).
Luxembourg	**NE**	**NE**	The emission estimation of waste water handling is based on the annual population numbers and corresponding emission factors. A country-specific methodology was applied. Activity data for wastewater handling, i.e. the number of inhabitants, have been taken from national statistics STATEC (NIR 2006).
Netherlands	**X**	**NE**	CH_4 emissions from industrial wastewater refer to anaerobic industrial waste water treatment plants. The major part of the Dutch industry emit in the sewer system which is connected to municipal waste water treatment plants. These emissions are included in the category Domestic and commercial waste water.
Portugal	**X**	**IE**	Methane emissions from industrial wastewater handling also follow the default methodology proposed in the 1996 IPCC Guidelines (IPCC, 1997) and the Good Practice Guidebook. 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 were developed from field monitoring data at installations in Portugal.
Spain	**X**	**X**	For industrial point sources, with individualized questionnaires sent to each plant, the methane emission factor selected, with regard to the volume of waste water treated, is derived from the EMEP/CORINAIR Guidebook. For the area sources, using information based on studies or sectorial statistics without individualized data for plants, the methodology in Section 5.2 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) through 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 methane production times the weighted methane conversion factor, WMCF. The activity variable taken for the point sources, comprising oil refineries and paper pulp manufacturing plants, has been the volume of treated waste water about which information has been obtained by means of individualized questionnaires. For area sources, covering the sectors of food and beverage and the chemical industry, the activity variable considered has been the organic load in both the water line and the sludge line, expressed in terms of chemical oxygen demand (COD), and the data are derived from discharge regulation studies. From these studies, information was compiled on production or consumption of main raw material, discharge ratio, volume discharged, ratio of organic load per unit discharged, and a parameter indicating the fraction of the organic waste load removed as sludge from the treated discharge.
Sweden	**IE**	**IE**	Considerable quantities of heat and bio-energy are recovered from sewage and wastewater. The rest of the methane generated in the wastewater treatment process is considered to be insignificant because of flaring, and is therefore reported as NO (not occurring) in the CRF tables. Methane generated from

Member States	CH_4 emissions from industrial wastewater: Waste water	Sludge	Methods for determining CH_4 emissions from industrial wastewater and sludge handling
			landfilling of sludge is reported as IE (included elsewhere) because it is included in CRF 6A.
United Kingdom	NE	NE	Industrial waste water is considered together with commercial and domestic wastewater. Emissions from private industrial treatment plants are not estimated, but are believed to be small.

Source: NIR 2007, NIR 2006; CRF 2007, CRF 2006 Tables 6 and 6B

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 8.24 provides an overview of the MCF applied by the Member States.

Table 8.24 6B Waste Water Handling: Methane Conversion Factors

Member States	MCF	Specification of MCF	Further information on MCF
Austria	**0.27**	Cesspools and septic tanks	Value is taken from a study (STEINLECHNER ET AL. 1994).
Belgium	-	-	No information provided.
Denmark	**0.19**	Anaerobic treatment of sludge	Value for the year 2002.
Finland	**0.01** **0.005**	Collected domestic wastewater Industrial wastewater	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 country-specific knowledge.
France	**0.23** **0.35**	"natural" lagoons septic system	Country specific data from experts.
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).
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 2006).
Ireland	**0**	Wastewater	All aerobic treatment.
Italy	**0.5** **0.25**	Domestic and commercial wastewater sludge Industrial wasterwater	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. CH_4 emissions have been calculated on the basis of the IPCC emission factor default value of 0.5 g CH_4 g^{-1} BOD_5. 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 (IPCC, 2000), has been used for the whole time series (NIR 2006).
Luxembourg			No information available.
Netherlands	**0.5**	Septic tank	
Portugal	**0.8** **0.2** **0.17** **0**	Imhoff tank Lagoon with anaerobic pond Percolation beds with anaerobic sludge digestion Oxidation pond	The MCF for wastewater treatment systems were weighted by the percentage of population connected to each type of treatment system, and using the MCF values established by expert judgement for each treatment type. More detailed MCF values are available in the NIR.
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.
Sweden	**-**	-	Not applicable (no CH_4 emissions reported in this category).

United Kingdom	**-**	-	No information available.

Source: NIR 2007, NIR 2006

Most Member States report N_2O Emission from waste water handling. Different methods are applied (C, CS, D, T1 and T2). In Table 8.25 the methods for determining N_2O emissions from wastewater handling applied by the Member States are described in detail.

Table 8.25 6B Waste Water Handling: Methods for determining N_2O emissions

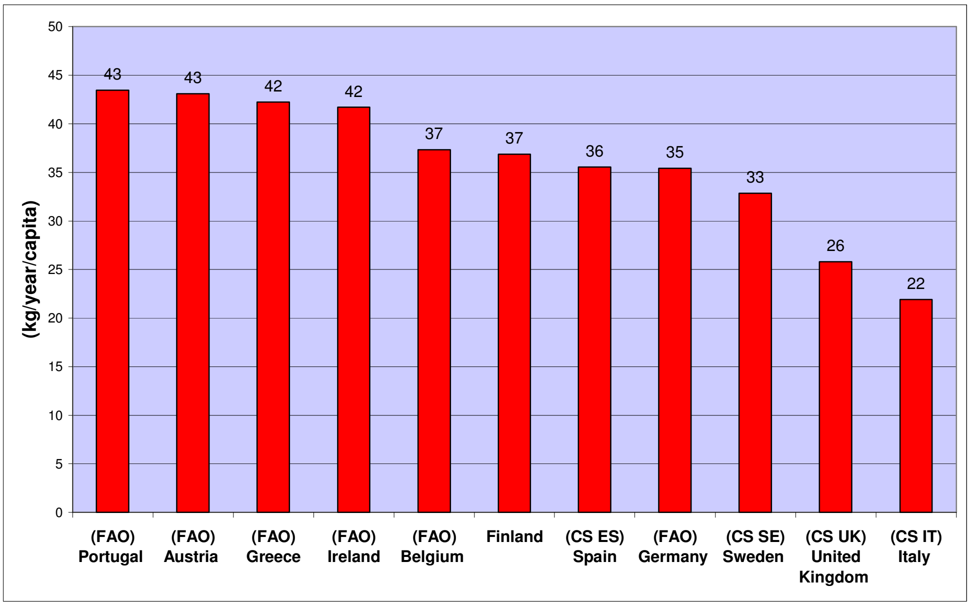
Member States	**N_2O emissions from wastewater [1)]**		**Description of methods used (N_2O)**
	Industrial	**Domestic**	
Austria	**X**	**X**	N_2O emissions from Urban Wastewater Handling are calculated by differing between wastewater arising from households connected and from households not connected to the public 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 plant are calculated by using a country-specific method based on IPCC. According to a national study (ORTHOFER et al. 1995) the amount of wastewater that is treated in sewage plants and the amount of nitrogen that is denitrificated should be considered additionally. 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 urban wastewater treatment plants (ORTHOFER et al. 1995). As there are no better data available this percentage is still used for calculating the emissions. For the next submission efforts will be made to survey the industrial wastewater amounts or to develop an appropriate extrapolation method. 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 (GEWÄSSERSCHUTZBERICHTE 1993, 1996, 1999, 2002); data in between were interpolated or used further for the last years..
Belgium		**X**	The N_2O emissions are estimated by using the methodology described in the IPCC Guidelines. The figures of protein consumption originate from the FAO statistics. The population figures come from the National Institute of Statistics.
Denmark	**IE**	**X**	Emissions of N_2O are divided into direct and indirect emission contributions, i.e. from wastewater handling and effluents, respectively. Indirect emissions are divided into contributions from industrial discharges, rainwater conditioned effluents, effluents from scattered houses, from mariculture and fish farming and from WWTPs.
Finland	**NE**	**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. 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.
France	**X**	**X**	No information available.
Germany	**NE**	**X**	IPCC Default Method
Greece	**NE**	**X**	N_2O from waste water handling were estimated according to the default methodologies suggested by IPCC (NIR 2006).
Ireland	**NA, NE**	**X**	Emissions of N_2O from human sewage discharges reported under source category 6B wastewater handling have been made following the IPCC methodology.
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 value 60 g $capita^{-1}$ d^{-1} of protein intake has been used, as indicate in a survey by the National Research Centre on Nutrition (NIR 2006).
Luxembourg	**NE**	**NE**	The emission estimation of waste water handling is based on the annual population numbers and corresponding emission factors. A country-specific methodology was applied. Activity data for wastewater handling, i.e. the number of inhabitants, have

Member States	N_2O emissions from wastewater [1)]		Description of methods used (N_2O)
	Industrial	Domestic	
			been taken from national statistics STATEC (NIR 2006).
Netherlands	**NE**	**X**	Country-specific methodology is used for N_2O emissions from wastewater handling, which is equivalent to the IPCC Tier 2 method. A full description of the methodology is provided in the monitoring protocol 5438 (see www.greenhousegases.nl) and in the background document (Oonk et al., 2004). The present Tier 2 methodology complies with the IPCC Good Practice Guidance. N_2O from industrial wastewater is considered as minor source and no data is available.
Portugal	**X**	**X**	Emissions of N_2O from domestic wastewater were estimated following the proposal of IPCC 1996 Revised Guidelines (IPCC, 1997). For industrial wastewater, the methodology proposed in the CORINAIR/EMEP Handbook (EEA,2000), 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.
Spain	**NE**	**X**	The methodology followed for the calculation of nitrous oxide emissions is the IPCC Reference Manual. Protein consumption has been obtained from the publication "Nutrition in Spain" by the Ministry of Agriculture, Food and Fisheries" (MAPA). The values of parameters required to calculate the emissions estimation algorithm are those suggested in the Manual. The nitrogen fraction present in protein is 0.16 kg N/kg protein and the emission factor is 0.01 kg N_2O-N/kg N in waste water.
Sweden	**X**	**X**	National activity data on nitrogen in discharged wastewater (industry and domestic waste water) is used, in combination with a model estimating nitrogen in human sewage from people not connected to municipal wastewater treatment plants.
United Kingdom	**NE**	**X**	Nitrous oxide emissions from the treatment of human sewage are based on the IPCC (1997c) default methodology.

1) according to table 6B in CRF 2007, 2006; X= emissions are reported; NE= not estimated; IE= included elsewhere; NO=not occuring
Source: NIR 2007, NIR 2006; CRF 2007, 2006 Tables 6 and 6B

One important parameter for the determination of N_2O emissions from wastewater handling, the daily 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.

Figure 8.9 6B Waste Water Handling: Protein consumption



Source: CRF 2007 Table 6 B; NIR 2007
CS= Country specific value; FAO= FAO data basis
CS ES: Publication "Nutrition in Spain" by the Ministry of Agriculture, Food and Fisheries" (MAPA); CS SE: National value, National Food Administration. 2002. www.slv.se; CS UK: DEFRA, 2004: The National Food Survey, CS IT: INRAN - Istituto Nazionale di Ricerca per gli Alimenti e la Nutrizione, 1997.

8.3.4 Waste Incineration (CRF Source Category 6C)

Emissions from waste incineration are reported by ten Member States in 2005 (Austria, Belgium, France, Greece, Sweden, United Kingdom, Italy, Luxembourg, Spain and Portugal). In Table 8.26 an overview of category descriptions and methodological issues is provided.

Table 8.26 6C Waste Incineration: Emissions reported and methodological issues

Member States	Emissions reported in CRF	Type of waste incinerated and methods applied
Austria	X	In this category CO_2 emissions from incineration of corpses and waste oil are included as well as CO_2, CH_4 and N_2O emissions from municipal waste incineration without energy recovery. 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.
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. CH_4 emissions are not relevant. For CO_2 emissions, each region applies its own methodology according to the available activity data. 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 %. In *Wallonia*, following a legal decree in 2000, the air emissions from 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. There is a distinction between the emission from municipal waste incineration and hospital waste incineration. The 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. The CO_2 emissions from hospital waste incineration are measured by the Walloon incinerators and are fully reported. The emissions of CO_2 from the flaring in the chemical industry in Wallonia are reported in Category 6C according to IPCC Guidelines. In *Brussels*, the emission factors for the incineration of hospital and municipal waste and corpses are estimated by measurements in situ in connection with EMEP/CORINAIR emission factors.
Denmark	IE	For the CRF source category 6C. Waste Incineration the emissions are included in the energy sector since all wastes incinerated in Denmark are used in the energy production.
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 incineration in households is negligibly small.
France	X	Carbon dioxide of biogenic origin was excluded from the emission estimates. Only waste incinerators without energy recovery are considered in this category. The incineration of special industrial waste is partially included according to the information available. Furthermore the incineration of utilised agricultural plastic films is included. Moreover, there is incineration of other non-specified waste.
Germany	NO	Reported in the energy sector (CRF 1).
Greece	X	Carbon dioxide emissions from the incineration of clinical waste produced in the Attica region have been estimated. 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 have not been estimated because there are not any available relevant emission factors. However, according to the IPCC Good Practice Guidance, these emissions are not likely to be significant. Data related to the amount of clinical waste incinerated derive from the ACMAR, which is operating the incinerator. The relevant parameters and emission factor used are the ones suggested in the IPCC Good Practice Guidance (NIR 2006).
Ireland	NE, NO	
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 2004, 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 (EMEP/CORINAIR, 2005). 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. 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. 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.

Member States	Emissions reported in CRF	Type of waste incinerated and methods applied
		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 2006).
Luxembourg	X	The only existing incinerator of municipal waste, SIDOR, is a major CO_2 emission source in that sector. CO_2 emissions were estimated at 125 kt in 1990, however a big part of those emissions result from biomass combustion. It is estimated that 10 kt of CO_2 (non-biomass combustion) should be included into the national total. This value is reported every year though the quantities of refusals incinerated vary from year to year. The reason stems from the fact that the emissions are a first relatively rough estimation of the non-biogenic fraction that is burned in the sole incinerator of the country. A more precise calculation remains to be done. Also, it is worth noticing that waste incineration in Luxembourg is nowadays going with heat/energy recovery. It should then be investigated more deeply where this energy recovered is used and, consequently, whether emissions should be reported in CRF/IPCC sector 6.C or 1.A.1.a (NIR 2006).
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. According to the IPCC Guidelines (IPCC, 1997), these should be reported under category 1A1a. 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 fractions of fossil C in total C is assumed, which will yield the CO_2 emissions. The method is described in detail in Joosen and De Jager (2003) and in the monitoring protocol.
Portugal	X	CO_2 emissions from incineration are calculated according to IPCC Guidelines (IPCC, 1997), 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 as an estimated for the former years. In 1999, two new incineration units, Valorsul and Lipor started to operate in an experimental regime, respectively in April and August 1999. Their industrial exploration started at the end of the same year or early January 2000. These units are exclusively dedicated to the combustion of MSW which is composed of domestic/commercial waste. Most of the organic materials in MSW are of biogenic origin (e.g. food waste, paper), and so they are not accounted for in net emissions calculations, according to the IPCC Guidelines (IPCC, 1997). However, the components of fossil origin – plastics, synthetic fibbers, and synthetic rubber – are to be accounted in the estimates. 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. Nowadays the 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. 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).
Spain	X	Within this category, the emissions produced by the following activities have been estimated: the burning of gas flares at iron and steel plants, and corpse and clinical waste incinerations. Emissions deriving from industrial waste incineration have not been estimated yet. As regards the incineration of municipal waste with energy-related recovery of emissions, according to IPCC nomenclature, they are included in category 1A1a. For the burning of flares in integrated iron and steel plants, information has been gathered by means of a questionnaire. The information on burnt flows has been provided with disaggregation of fuel composition, natural gas, liquefied petroleum gas, coke gas, blast furnace gas and steelworks gas. The estimation of CO_2 emissions has been carried out by applying specific plant factors. For the incineration of human corpses at crematories, the combustion of a supporting fuel and some other material elements incinerated during the process also account for emissions. 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. The main source of emission factors is the EMEP/CORINAIR Guidebook.
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. In the submission 2007, for the first time the CO_2 emissions are reported separately respecting the origin of the incinerated waste. According to information from the facility, occasional measurements concerning CH_4 and N_2O have been

Member States	Emissions reported in CRF	Type of waste incinerated and methods applied
		performed. The CH_4 measurement showed very low or non-detectable amounts. CH_4 is therefore reported as NE in the CRF tables. For N_2O the occasional measurements showed levels giving emissions in the approximate order of 0.2 Mg N_2O/year. N_2O is reported as NE in the CRF tables.
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.

X = Emissions are reported in source category 6C, IE = included elsewhere
Source: NIR 2007, NIR 2006, CRF 2007.

8.3.5 Waste – Other (CRF Source Category 6D)

Under CRF source category 6D eleven Member States report emissions. Emissions from composting have been reported by eight Member States (Austria, Belgium, Finland, France, Germany, Italy, Luxembourg and the Netherlands), Denmark and France determine emissions from biogas production, Portugal indicates emissions from open burning of industrial waste, Luxembourg and Spain from sludge spreading and Germany from mechanical-biological waste treatment plants, compare Table 8.27.

Table 8.27 6D Other: Reported emissions

Member States	Specification of "other waste"	6 D CO_2	6 D CH_4	6 D N_2O	6 D NO_x
Austria	Compost production	NA	1.54	0.22	NA
Belgium	Compost production	NA	1.93	NA	NA
Denmark	Biogas production	1.84	0.00	0.00	0.00
Finland	Compost production	NO	3.02	0.20	NO
France	Compost production	NA	4.66	0.79	NA
France	Biogas production	NA	0.04	NA	NA
Germany	Compost production	NO	25.72	0.66	NO
Germany	Mechanical-biological waste treatment	NO	0.30	0.52	NO
Italy	Compost production	NA	0.20	NA	NA
Luxembourg	Sludge spreading	NO	NO	NO	NO
Luxembourg	Compost production	NO	NO	NO	NO
Netherlands	Compost production	NA	3.23	0.13	
Portugal	Open burning of industrial waste	0.06	0.00	0.00	0.14
Spain	Sludge spreading	NE	32.74	NE	NE

Source: CRF 2007 Table 6

In Table 8.28 the source category is described further in detail

Table 8.28 6D Other: Description and methodological issues

Member States	Waste – Other
Austria	Emissions were estimated using a country specific methodology. To estimate the amount of composted waste it was split up into three fractions of composted waste: 1) mechanical biological treated residual waste, 2) bio waste, loppings, bio composting, 3) sewage sludge. Emissions were calculated by multiplying the quantity of waste with the corresponding emission factor (CH_4 and N_2O) based on national references.
Belgium	CH_4 emissions from compost production are estimated using regional activity data combined with a default emission factor of 2,4 kg CH_4/ton compost.
Denmark	Emission from combustion of biogas in biogas production plants is included in CRF sector 6D. The fuel consumption rate of the biogas production plants refers to the Danish energy statistics. The applied emission factors are the same as for biogas boilers (see NIR chapter 3, Energy).
Finland	Emissions from composting have been calculated using an analogous method with Draft 2006 IPCC Guidelines for National 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 (1992) for municipal solid waste generation and treatment in Finland in 1989. Data on years 1997,2004 and 2005 are from 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 (Ministry of the Environment 1998).

Member States	Waste – Other
France	CH_4 and N_2O emissions from composting as well as CH_4 emissions from biogas production.
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 determined 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.
Italy	Under this source category CH_4 emissions from compost production have been reported. The composting plants are classified in plants that treat a 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. 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 2006).
Luxembourg	Sludge from waste water treatment plants and compost production sites generate CO_2 and CH_4 emissions. The CORINAIR (simple) methodology is applied. For compost production: the mass of dry compost is 33.3% of the mass of humid sludge. CO_2 emissions are accounted for, but composting is biological decomposition of organic material, so it's biogenic. CH_4 emissions for composting are missing. Activity data for sludge spreading and compost production have been taken from the Environment Agency (internal report) (NIR 2006).
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 (data can be found on www.uitvoeringafvalbeheer.nl and in a background document (SenterNovem, 2005a)) and emission factors based on the average emissions (per ton composted organic waste) of some facilities in the late 1990ies (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 this is 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* (IPCC, 2000).
Portugal	This category includes emissions from the open burning of industrial solid waste on land which was previously reported in the category 6C. This change relates to the in-depth review recommendation to report these emissions under category 6A. These emissions have however been reported under 6D in order to report more pollutants (SO_2) in CRF tables than was possible in category 6A. The same methodology as for category 6C Waste incineration was used, which refers to IPCC Guidelines (IPCC, 1997). Ultimate CO_2 emissions from open combustion of industrial waste on land were calculated based on data which refer to uncontrolled combustion of industrial solid waste on land and which were collected from INR. Data for the years 2000. 2002 and 2003 refer to industrial units declarations. The figure for 2001 is interpolated, and 2004-05 refer the last available data (2003). 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%. 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).
Spain	No information provided.

Source: NIR 2007, NIR 2006 and CRF 2007

8.4 EU-15 uncertainty estimates

Table 8.29 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 N_2O from 6B and the lowest for CH_4 from 6A amd CO_2 from 6C. With regard to trend CH_4 from 6D shows the highest uncertainty estimates, CO_2 from 6C the lowest. For a description of the Tier 1 uncertainty analysis carried out for the EU-15 see Chapter 1.7.

Table 8.29 **Sector 6 -Waste: EU-15 uncertainty estimates**

Source category	Gas	Emissions 1990	Emissions 2005 1)	Emission trends 1990-2005	Emissions for which MS uncertainty estimates are available 2)	Share of emissions for which MS uncertainty estimates are available	Level uncertainty estimates based on MS uncertainty estimates	Trend uncertainty estimates based on MS uncertainty estimates
6.C Waste incineration	CO_2	5,217	3,009	-42%	3,190	106%	18%	5
6.A Solid waste disposal on land	CH_4	147,075	84,995	-42%	86,064	101%	18%	13
6.B Waste water handling	CH_4	12,691	8,419	-34%	8,331	99%	91%	26
6.C Waste incineration	CH_4	569	612	7%	301	49%	21%	24
6.D Other	CH_4	375	1,541	311%	118	8%	81%	983
6.B Waste water handling	N_2O	8,954	9,317	4%	7,498	80%	106%	12
6.C Waste incineration	N_2O	391	413	6%	217	52%	92%	32
Total Waste	**all**	**175,641**	**109,104**	**-37.9%**	**105,719**	**97%**	**18%**	**8**

Note: Emissions are in Gg CO_2 equivalents; trend uncertainty is presented as percentage points.

1) The sum of the source category emissions may not be the total sector emissions because uncertainty estimates are not available for all source categories.

2) Includes for Greece and Spain 2004 data and for Belgium and Germany 2003 data

8.5 Sector-specific quality assurance and quality control

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

Table 8.30 shows that in the waste sector the largest recalculations in 1990 were made for CH_4 and in 2004 for CO_2.

Table 8.30 Sector 6 Waste: Recalculations of total GHG and recalculations of GHG emissions for 1990 and 2004 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	-12,662	-0.4%	-284	-0.1%	-4,944	-1.2%	-1	0.0%	0	0.0%	1	0.0%
Waste	-8	-0.1%	315	0.2%	168	1.8%	NO	NO	NO	NO	NO	NO
2004												
Total emissions and removals	-8,944	-0.3%	-2,528	-0.8%	-558	-0.2%	-2,281	-4.4%	-59	-1.1%	31	0.3%
Waste	-239	-7.3%	171	0.2%	167	1.6%	NO	NO	NO	NO	NO	NO

NO: not occurring

Table 8.31 provides an overview of Member States' contributions to EU-15 recalculations. Spain had the largest recalculations for CH_4 in 1990 and 2004. It can be seen that recalculations made in 2004 are generally higher than in 1990.

Table 8.31 Sector 6 Waste: Contribution of Member States to EU-15 recalculations for 1990 and 2004 by gas (difference between latest submission and previous submission Gg of CO_2 equivalents)

	1990						2004					
	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
Austria	0	2	91	NO	NO	NO	0	-186	50	NO	NO	NO
Belgium	0	0	0	NO	NO	NO	-313	60	9	NO	NO	NO
Denmark	IE,NA,NE,NO	1	0	NO	NO	NO	0	10	0	NO	NO	NO
Finland	NE,NO	0	0	NO	NO	NO	NE,NO	15	1	NO	NO	NO
France	-5	54	78	NO	NO	NO	93	-137	28	NO	NO	NO
Germany	NE	-5	0	NO	NO	NO	NE	-100	69	NO	NO	NO
Greece	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
Ireland	NA,NE,NO	0	0	NO	NO	NO	NA,NE,NO	-42	0	NO	NO	NO
Italy	41	0	1	NO	NO	NO	-11	2	0	NO	NO	NO
Luxembourg	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
Netherlands	IE,NA,NO	0	0	NO	NO	NO	IE,NA,NO	0	0	NO	NO	NO
Portugal	0	1	0	NO	NO	NO	46	42	3	NO	NO	NO
Spain	-45	262	-4	NO	NO	NO	-2	441	3	NO	NO	NO
Sweden	0	0	0	NO	NO	NO	-51	0	-1	NO	NO	NO
UK	1	0	0	NO	NO	NO	0	66	6	NO	NO	NO
EU-15	**-8**	**315**	**168**	**NO**	**NO**	**NO**	**-239**	**171**	**167**	**NO**	**NO**	**NO**

NO: not occurring; NE: not estimated; NA: not applicable; IE: included elsewhere

9 Other (CRF Sector 7)

This chapter provides information on recalculations in CRF Sector 7 Other. No further information is provided because no emissions are reported in this sector.

9.1 Overview of sector

No emissions are reported in this sector.

9.2 Methodological issues and uncertainties

No emissions are reported in this sector.

9.3 Sector-specific quality assurance and quality control

There are no sector-specific QA/QC procedures for this sector.

9.4 Sector-specific recalculations

There are no recalculations in CRF Sector 7 Other.

10 Recalculations and improvements

10.1 Explanations and justifications for recalculations

Tables 10.1 and 10.2 provide an overview of the main reasons for recalculating emissions in the year 1990 and 2004 for each Member State, which provided the relevant information. For each Member State, those three sources have been identified which had the largest recalculations in absolute terms. In addition, all recalculations of more that 1 000 Gg are presented. For more details see the information provided by the Member States' submissions in Annex 13.

Table 10.1 Main recalculations in the Member States for 1990 and Member States' explanations for recalculations given in the CRF or in the NIR

	Absolute difference between latest and previous submission used for the EC inventory (Gg CO_2 equivalents)	**Member States' explanation for recalculation**	**Information source of reasons for recalculations**
Austria			
Total emissions excluding LUCF	94		
CO_2 from 1A2	126	Update of activity data is due to updates of the energy balance compiled by the federal statistics authority STATISTIK AUSTRIA. 1990 to 1998: a share of residual fuel oil final consumption is shifted from 1A4c Agriculture to 1A2 Manufacturing Industries subcategories and 1A2a Commercial (1990: 40 kt). A share of the residual fuel previously considered low sulphur fuel oil is now considered high sulphur residual fuel oil (1990: 11 kt).	NIR, Mar 2007, p.326-327
CO_2 from 1A4	-125	Revised energy data for railways (coal, diesel, electricity) up to 2000 according to the updated national energy balance. 1990 to 1997: A share of o*ther solid biomass* is shifted from *1A1* to *1A4* (1990: 0.2 PJ).	NIR, Mar 2007, p. 327
N_2O from 6B	91	The methodology for calculating N_2O emissions was changed according to the recommendation by the ERT during the in-country review 2007. Now also N_2O emissions are considered which do not arise in waste water treatment plants. The protein intake per person has been updated according to data published by the FAO. This results in revised N_2O emission for industrial and domestic waste water treatment.	NIR, Mar 2007, p. 329
Belgium			
Total emissions excluding LUCF	0		
Czech Republic			
Total emissions excluding LUCF	-75		
SF_6 from 2F	-75	Correction of emission factor	NIR, May 2007, p.64
Denmark			
Total emissions excluding LUCF	-5		
CO_2 from 1A4	-20	The biggest changes for CO_2 are for agriculture, where updated stock information for tractors and harvesters 2001-2004, has given a fuel use and emissions increase for these years. A corresponding emission amount is subtracted from stationary sources, due to the overall national energy balance. 1) The residual fuel use amount from the fishery sector in the national energy statistics has been moved to the national sea transport category, resulting also in emission changes 1990-2004. 2) Some diesel oil fuel use has been subtracted from the fishery sector, in order to correct an error in last year's submission for 1990-2004.	NIR, Mar 2007, p. 45-46
CO_2 from 1A3	8	A revision of the 1985-2004 time-series of emissions has been	NIR, Mar 2007, p. 156

	Absolute difference between latest and previous submission used for the EC inventory (Gg CO_2 equivalents)	Member States' explanation for recalculation	Information source of reasons for recalculations
		made, based on revised mileage data from the Danish Road Directorate (derived from the Danish vehicle inspection and maintenance programme) and updated emission factors from the latest version of the European road transport emission model - COPERT IV.	
CO_2 from 3	5	New approach: The improvements in the 2005 reporting include revisions of the following: More detailed information concerning chemical patterns and amounts have been made for four industrial branches, comprising approximately 20% of the total emissions. The branches are plastic industry, graphic industry, auto repairers and colour and laquer industry. Use amounts and emission factors have been refined for pentane and styrene used especially in the plastic industry. The group of glycolethers has been rearranged and comprises more single chemical compounds. The distribution of glycolethers in industrial branches has been revised, and the emission factors have been changed. E.g. for use in dry cleaning an emission factor of 0.0001 is used. Tetrachloroethylene has been removed from use in auto repairers and others, and has been assigned to dry cleaners and metal industry. Emission factor of 0.0001 is assigned for use in dry cleaning as a recovery of 99.99% of solvent used is stated in the literature. Some product categories (as defined in SPIN database) have been transferred from degreasing to paints category. This implies that the used amounts of products in Table 5.3 has increased compared to the latest inventory, because the amount of chemical in a product from the paints category is lower than the amount of chemical in a product from the degreasing category.	NIR, Mar 2007, p. 11-12
Estonia			
Total emissions excluding LUCF	572		
CO_2 from 1A1	988	CO_2 emissions from combustion of other kerosene have been recalculated for whole period 1990-2004. The reason of recalculations is the changed value of carbon emission factor for other kerosene. CEF of other kerosene like CEF for diesel oil is equal to 20.2 tC/TJ (instead of 19.6 tC/TJ in former NIR submissions) because there are similar oil products only the sphere of application is different.	NIR, Apr 2007, p.31
CO_2 from 1A2	-869	Activity data for whole time series (1990-2004) are over checked and updated if necessarily. 2. Changes in emission factors used: CO_2 EF of other kerosene has been changed - 20.2 (instead 19.6) tC/TJ. Manufacturing Industries and Constructions (1.A.2.) has been split into: sub sectors (1.A.2.a: Iron and Steel; 1.A.2.b: Non-Ferrous Metals; 1.A.2.c: Chemicals; 1.A.2.d: Pulp, Paper and Print; 1.A.2.e: Food Processing, Beverages and Tobacco and Other.	Direct Communication, Apr 2007
N_2O from 4D	530	The recalculations were carried out based on updated activity data. As transcription errors were made in the process of the estimations in CRF 4.D sector, thus the recalculations were carried out.	Direct Communication, Apr 2007
Finland			
Total emissions excluding LUCF	59		
CO_2 from 1A1	-193	Update of time series consistency, activity data and emission factors; corrections of errors,	NIR, Mar 2007, p.248-249
CO_2 from 1A2	241	Update of time series consistency, activity data and emission factors; corrections of errors.	NIR, Mar 2007, p.248-249
N_2O from 1A1	-83	Updating of crop yield of sugar beet for 2004. Area of organic soils was corrected for the whole time series because area of grassland was previously accidentally excluded from the total area. Changes in the distribution of manure management systems.	NIR, Mar 2007, p.248-249

	Absolute difference between latest and previous submission used for the EC inventory (Gg CO_2 equivalents)	Member States' explanation for recalculation	Information source of reasons for recalculations
France			
Total emissions excluding LUCF	247		
CO_2 from 2C	152	Correction of anode consumption	NIR, Dec.2006, p.132-134
CO_2 from 3	-59	For the reference year 1990, VOC emission factors defined for the different uses of paints (CRF 3xxx) have been modified following the work carried out in the scope of EGTEI (Expert Group on Techno Economic Issues) and data introduced in the RAINS model.	Direct communication, Mar 2007
N_2O from 6B	79	Update of allocation of different treatment	NIR, Dec.2006, p.132-134
Germany			
Total emissions excluding LUCF	-1 009		
CO_2 from 1A1	-1 852	1990-2004: the former composite emission factor of lignite is replaced by a specific emission factor for mining; new research results in the whole time series, update of municipal waste activity data in 2004; Solid Fuel: SO_2-Scrubbing by using of limestone , Biomass and Other Fuel	CRF Table 8(b)
CO_2 from 1A2	1 745	integration of the activity data of waste fuel into the energy data system for compairison of the data with the energy balance and avoidance of double count; 1995-2004: new data of industrial waste; for Biomass and Other Fuel	CRF Table 8(b)
CO_2 from 2A	-406	Now there is estimated the production of total melt included the use of recycling materials. Expert judgement of product-specific EF. differentiated activity data: now also taking into account the recycling of flat glass and bottle glass for the whole time series. Now there is estimated the total production included bricks and tiles to get more comprehensive data for glass and ceramic production.	CRF Table 8(b)
CH_4 from 4A	-341	change from Tier 1 to Tier 2 (dairy cattle, other cattle, pigs, sheep); description of feeding situation improved; AD: provisional data for 2004 replaced	CRF Table 8(b)
SF_6 from Other	-351	Improvement of data	NIR Mar 2007, p.309
Greece			
Total emissions excluding LUCF	0		
Hungary			
Total emissions excluding LUCF	-5 388		
N_2O from 1A4	-1 085	Changes in Emission Factor: old CS to IPCC, 2006 default max.-value	CRF 1990 Table 8(b)
CH_4 from 1B1	-465	Modified Method, new emission factor and new activity data	CRF 1990 Table 8(b)
N_2O from 4D	-2 225	Changes in Method: New Calculation Method for Direct Soil Emissions (GPG 2000), Changes in activity data: Activity data rounded to the 6th decimal / Mistakes corrected / New activity data	CRF 1990 Table 8(b) 2
CH_4 from 6A	-1 369		
CH_4 from 6B	-541	New activity data	CRF 1990 Table 8(b) 2
Ireland			
Total emissions excluding LUCF	-239		
CO_2 from 1A2	-142	New revised Energy Balance data for all years, 1990-2004.	Direct communication, Mar 2007
CH_4 from 4B	88	Explanation was given at the level of the recalculation. 4.B.9 poultry (new EFs). This category was not ticked in the CRF Reporter tool to be included in CRF Table 8b	Direct communication, Mar 2007
N_2O from 4D	-265	Move to Tier 1 A(Atm Dep) and Tier 1B(Animal Manure applied	CRF 1990, Table 8(b)

	Absolute difference between latest and previous submission used for the EC inventory (Gg CO_2 equivalents)	Member States' explanation for recalculation	Information source of reasons for recalculations
		to soils); New Populations stats., New AWMS Proportioning	
Italy			
Total emissions excluding LUCF	0		
CO_2 from 1A4	-41	CO_2 emission recalculations, both from biogenic and non-biogenic incineration, are only due the new allocation from waste sector to energy sector because of updated information from specific incineration plants (energy vs. non energy recovery).	Direct communication, Mar 2007
CO_2 from 6C	41	CO_2 emission recalculations, both from biogenic and non-biogenic incineration, are only due the new allocation from waste sector to energy sector because of updated information from specific incineration plants (energy vs. non energy recovery).	Direct communication, Mar 2007
Latvia			
Total emissions excluding LUCF	549		
CO_2 from 1A1	-2 259	Updated activity data, due to updated statistical information and mistaken input data correction; improvements regarding methodolody (IPCC Tier 1) and emission factors, exclusion of emissions from biogas	NIR, Mar 2007, p. 32
CO_2 from 1A3	449	The total number of vehicles is the same, but changes have been made in division per vehicle classes and also average mileage has been improved. Changes has been made also in diesel oil consumption, in previous submission 2006, diesel fueled cars was started just for 1994, but in this Submission 2007 diesel fueled cars started from 1990, because CSB present the time series for diesel oil from 1990.	NIR, Mar 2007, p. 42
CO_2 from 1A4	2 278	Overall activity data changes in all sub-sectors of 1.A.4 Other Sectors for all years from time period 1990 – 2004. Changes occurred due to the updated statistical information, mistaken input data correction and fuel consumption data division in IPCC categories. Data of fuel consumption from IEA/AIE – EUROSTAT – UNECE Annual questionnaires were used.	NIR, Mar 2007, p. 47
Lithuania			
Total emissions excluding LUCF	0		
Luxembourg			
Total emissions excluding LUCF	0		
Netherlands			
Total emissions excluding LUCF	0		
Poland			
Total emissions excluding LUCF	26 463		
CO_2 from 1A1	9 003	New formulas for the calculation of EFs for hard coal and lignite; change of EFs for some other fuels according to IPCC 2006	Direct Communication, Apr 2007
CO_2 from 1A2	-5 110	New formulas for the calculation of EFs for hard coal and lignite; change of EFs for some other fuels according to IPCC 2006	Direct Communication, Apr 2007
CO_2 from 1A3	-1 759	Change of EFs for some sub-categories and verification some activity data	Direct Communication, Apr 2007
CO_2 from 1A4	3 801	New formulas for the calculation of EFs for hard coal and lignite; change of EFs for some other fuels according to IPCC 2006 and verification some activity data	Direct Communication, Apr 2007
CH_4 from 1B1	-1 963	Moving the fugitive emission from coking gas system from 1.B.2 to 1.B.1. (recommendation made by ERT 2005); changes of some activities	Direct Communication, Apr 2007
CO_2 from 2B	2 584	Verification of the EFs and adjustment of activity data for ammonia production for entire time period	Direct Communication, Apr 2007

	Absolute difference between latest and previous submission used for the EC inventory (Gg CO_2 equivalents)	Member States' explanation for recalculation	Information source of reasons for recalculations
CO_2 from 2C	5 082	Verification of the activity data for Iron ore sintering for years 2000-2005 and EFs for this process (for entire period) according to data collected for emission trading system purpose; estimation of CO_2 emission from blast furnace process and coke productions based on elementary carbon budget	Direct Communication, Apr 2007
N_2O from 2B	-1 325	No information provided	
CH_4 from 4A	-1 060	Updated equations and parameters according to GPG 2000 (recommendations made by ERT in 2005)	Direct Communication, Apr 2007
CH_4 from 4B	2 220	Updated parameters according to GPG 2000 and IEFs (recommendations made by ERT in 2005); updated share of AWMS for livestock for entire time period	Direct Communication, Apr 2007
N_2O from 4B	9 151	Updated share of AWMS for livestock for entire time period	Direct Communication, Apr 2007
N_2O from 4D	10 259	Corrected area for N-fixing crops and non-fixing crops; correction of N_2O IEF from synthetic fertilizers (recommendation of ERT 2005)	
CH_4 from 6A	-11 322	Application of new methodology for entire time period [2006 IPCC Guidelines, IPCC Waste Model]; additionally updated activities	Direct Communication, Apr 2007
CH_4 from 6B	3 476	Updated activities and metodology changes	Direct Communication, Apr 2007
N_2O from 6B	1 096	Completion and ajustment of the data for entire time period	Direct Communication, Apr 2007
CO_2 from Internat. Bunkers	1 947	Activity data verification and change of EFs	Direct Communication, Apr 2007
Portugal			
Total emissions excluding LUCF	-32		
N_2O from 1A3	-12	Revision of the km per vehicle class and mode	CRF 1990, Table 8(b)
CO_2 from 2C	-14	Correction of a calculation error.	CRF 1990, Table 8(b)
N_2O from 4D	-10	Correction of an activity data error.	CRF 1990, Table 8(b)
Slovakia			
Total emissions excluding LUCF	-341		
N_2O from 2B	244	Detailed explanation will be provided in NIR 2007. EFs for technological emissions from HNO3 production were revised. However, direct measurements of N_2O emissions were realized in major plant - Duslo, a.s. Šaľa in the period 2005 – 2006. From the results it follows that the emissions factors of N_2O in medium-pressure plant and high-pressure plant are 7 kg N_2O / 1 t HNO3 and 9 kg N_2O / 1 t HNO3, respectively. It is in agreement with the data presented by Norsk Hydro according to the Good Practice Guidance. It seems that discrepancy between previously and recently used EFs is based on the non-correct information about holding time of gasses at catalyst and temperature in reactor. The technology used in Chemko, a.s. is the same as in Duslo, a.s. (second major medium pressure plant). Therefore the recalculation of emissions of N_2O was necessary on the basis of Norsk Hydro data since 1990. The following emission factors were used: 4.5 kg N_2O / 1 t HNO3 for atmospheric plant, 7 kg N_2O / 1 t HNO3 for medium-pressure plant and 9 kg N_2O / 1 t HNO3 for high-pressure plant	Mar 2007, Direct Communication
CH_4 from 6A	-586	Detailed information will be provided in NIR 2007, the methodology for SWDS was change to FOD Tier 2 methodology in time series 1960-2005. The Monte Carlo uncertainty analysis was executed.	Mar 2007, Direct Communication
Slovenia			
Total emissions excluding LUCF	0		
Spain			
Total emissions	214		

	Absolute difference between latest and previous submission used for the EC inventory (Gg CO_2 equivalents)	Member States' explanation for recalculation	Information source of reasons for recalculations
excluding LUCF			
CO_2 from 6A	-45	new information based on questionnaires	NIR, Mar 2007, p.306
CH_4 from 6A	262	new information based on questionnaires	NIR, Mar 2007, p.306
N20 from 6	-4		
Sweden			
Total emissions excluding LUCF	0		
United Kingdom			
Total emissions excluding LUCF	-4 727		
CO_2 from 1A2	490	Revision to timeseries of emission factors for BFG change to EF for colliery methane	CRF 1990, Table 8 (b)
CO_2 from 1A3	-692	Revisions to jet kerosene in aviation gasoline in road transport and diesel oil in railways	CRF 1990, Table 8 (b)
CO_2 from 1A4	210	Revision to activity data for commercial diesel oil use and residential and agricultural gasoline use.	CRF 1990, Table 8 (b)
N_2O from 2B	-4 629	Emission factor change for nitric and adipic acid production	CRF 1990, Table 8 (b)

Table 10.2 Main recalculations in the Member States for 2004 and Member States' explanations for recalculations given in the CRF or in the NIR

	Absolute difference between latest and previous submission used for the EC inventory (Gg CO_2 equivalents)	Member States' explanation for recalculation	Information source of reasons for recalculations
Austria			
Total emissions excluding LUCF	-155		
CO_2 from 1A1	505	2005 ETS activity data (356 PJ) and CO_2 emissions (25 283 Gg CO_2) has been applied for *NFR 1A1 and 1A2* stationary sources (total 490 PJ and 35 538 Gg CO_2). *1 A 1 a Public Electricity and Heat Production:* Fuel consumption previously reported as *fuel wood* is now considered as *other solid biomass. 1 A 1 b Petroleum Refining* Error correction of double counting leads to slightly lower CO_2 emissions 1990: -4 kt CO_2 ; 2001: -3 kt CO_2. Update of 2002 to 2004 CO_2 emissions with reported plant emissions (2004: +272 kt CO_2).	NIR, Mar 2007, p. 327
CO_2 from 1A2	-212	Update of activity data is due to updates of the energy balance compiled by the federal statistics authority STATISTIK AUSTRIA.	NIR, Mar 2007, p. 326
CH_4 from 6A	-189	Activity data (1998 to 2004) has been updated. According to the Austrian Landfill Ordinance, the operators of landfill sites have to report their activity data annually. Based on reports received after the due date, there are major changes for 2004 values of activity data in this submission compared to the previous submission. During quality control checks a calculation error in non-residual waste categories was detected and corrected, the effects on emission are minor.	NIR, Mar 2007, p. 329
Belgium			
Total emissions excluding LUCF	-222		
CO_2 from 1A1	466	In the Flemish region most recalculations in the energy sector of the emission inventory 1990-2005 are performed in the last years (2003 and 2004) because more accurate information became available for these years. The year 2004 has undergone a complete	NIR, Mar 2007, p.44

	Absolute difference between latest and previous submission used for the EC inventory (Gg CO_2 equivalents)	Member States' explanation for recalculation	Information source of reasons for recalculations
		revision because the emissions of 2004 reported last year were reported on a temporary basis.	
CO_2 from 1A4	-249	In the Flemish region most recalculations in the energy sector of the emission inventory 1990-2005 are performed in the last years (2003 and 2004) because more accurate information became available for these years. The year 2004 has undergone a complete revision because the emissions of 2004 reported last year were reported on a temporary basis.	NIR, Mar 2007, p.44
CO_2 from 6C	-313	The municipal waste incineration emissions are now in the Walloon region allocated under 1A, Energy, in the categories "other fuels" and "biomass" taking into account the organic content of the waste.	NIR, Mar 2007, p.87
Czech Republic			
Total emissions excluding LUCF	19		
N_2O from 1A3	16	No information provided	
SF_6 from 2F	2	SF_6 use in secotr sound-ProofWindows is corrected (incorrect EF used)	NIR, May 2007, p.64
Denmark			
Total emissions excluding LUCF	122		
CO_2 from 1A2	-44	For stationary combustion plants the emission estimates have been updated according to latest energy statistics published by the Danish Energy Authority. The update includes the years 1990-2004. This is the main reason for the changes in this sector. However changed fuel type aggregation also caused imperceptible changes. The distribution of emissions from the industrial sector, 1A2 was updated based on new information from Statistics Denmark & Danish Energy Authority. The total emission from category 1A2 was not affected only the distribution between the sub sectors 1A2a-1A2f.	NIR, Mar 2007, p. 45-46
CO_2 from 1A4	88	The biggest changes for CO_2 are for agriculture, where updated stock information for tractors and harvesters 2001-2004, has given a fuel use and emissions increase for these years. A corresponding emission amount is subtracted from stationary sources, due to the overall national energy balance. 1) The residual fuel use amount from the fishery sector in the national energy statistics has been moved to the national sea transport category, resulting also in emission changes 1990-2004. 2) Some diesel oil fuel use has been subtracted from the fishery sector, in order to correct an error in last year's submission for 1990-2004.	NIR, Mar 2007, p. 45-46
N_2O from 4D	24	Small changes for emissions from the agricultural sector have taken place. These changes reflect increased emissions from years 1990-2004 by less than 1 %. There is no change in the calculation methodology. Based on the expert review team request, the feed consumption for dairy cattle 1990 – 1994 has been interpolated, in order to remove the time-series inconsistency. Another change is due to updated normdata for nitrogen excretion in 2003 and new data for export of living poultry from 1994.	NIR, Mar 2007, p. 47
Estonia			
Total emissions excluding LUCF	-210		
CO_2 from 1A1	-614	Recalculations carried out in the national GHG inventory (submission 2007 v 1.2) are in general caused by different reasons: 1. Corrected activity data: Statistical Office of Estonia has a practice to correct statistical data of previous years. Since Estonia has not made large scale recalculations before are in current GHG submission practically all activity data (1990-2004) over checked and updated if necessarily. 2. Changes in emission factors used: CO_2 emissions from combustion of other kerosene have been recalculated for whole period 1990-2004. The reason of	Direct Communication, Apr 2007

	Absolute difference between latest and previous submission used for the EC inventory (Gg CO_2 equivalents)	Member States' explanation for recalculation	Information source of reasons for recalculations
		recalculations is the changed value of carbon emission factor for other kerosene. CEF of other kerosene like CEF for diesel oil is equal to 20.2 tC/TJ (instead of 19.6 tC/TJ in former NIR submissions) because there are similar oil products only the sphere of application is different. In CRF 1.A.1: Energy Industry - some changes are connected with sub-sectors. In previous submissions there was no any sub sectors of 1.A.1. In current submission emissions of 1.A.1 are split into: 1.A.1.a Public Electricity and Heat Production; 1.A.1.b - Petroleum Refining (Oil Shale production in Estonia) and 1.A.1.c -Manufacture of Solid Fuels.	
CO_2 from 1A4	158	1. Activity data for whole time series (1990-2004) are over checked and updated if necessarily. 2. Changes in emission factors used: CO_2 EF of other kerosene has been changed - 20.2 (instead 19.6) tC/TJ. Other sectors (1.A.4) includes: 1.A.4A - Commercial/Institutional; 1.A.4.b - Residential and 1.A.4.c - Agriculture sectors. 1. A.4.b Residential (Household). The main improvements in this source category where connected with gasoline and diesel oil used by passenger cars. In previous inventories (1990 – 1999) CO_2, N_2O and CH_4 emissions from use of gasoline and diesel oil by private cares were included into Residential sector. After improvements all emissions from consumption of motor fuels are allocated to the Transport sector sub-category - 1.A.3.2. Road transportation.	Direct Communication, Apr 2007
N_2O from 4D	359	The recalculations were carried out based on updated activity data. As transcription errors were made in the process of the estimations in CRF 4.D sector, thus the recalculations were carried out.	Direct Communication, Apr 2007
Finland			
Total emissions excluding LUCF	-299		
CO_2 from 1A1	-255	Update of time series consistency, activity data and emission factors; corrections of errors.	NIR, Mar 2007, p.248
CO_2 from 1A2	510	Update of time series consistency, activity data and emission factors; corrections of errors.	NIR, Mar 2007, p.248
CO_2 from 1A4	-648	The most important changes were the updates of the heating energy calculation system and TYKO submodel	NIR, Mar 2007, p.248
France			
Total emissions excluding LUCF	-1 543		
CO_2 from 1A2	4 564	Consideration of emission data per site (1A2f)	NIR, Dec 2006, p.132-143
CO_2 from 1A4	-4 016	Update of energy consumption for wood, revision of estimation method for burning wood	NIR, Dec 2006, p.132
CH_4 from 1A4	-854	Update of energy consumption for wood, revision of estimation method for burning wood	NIR, Dec 2006, p.132
CO_2 from 2B	223	Update of emission declared in 2004	NIR, Dec 2006, p.132
CO_2 from 2C	402	Correction of carbon content	NIR, Dec 2006, p.132
Germany			
Total emissions excluding LUCF	9 684		
CO_2 from 1A1	6 168	Update of energy data, improvement of method, allocation of fuel use, elimination of inconsistencies	
CO_2 from 1A2	2 254	Allocation of secondary fuels used in 1A2d to 1A, change of calculation method (1A2a)	NIR, Dec 2006, p.132-143
CO_2 from 1A4	2 580	Application of consistent emission factor over the time series	NIR, Dec 2006, p.182
CH_4 from 1B1	-1 436	1B1c update of activity data, consideration of methane recovery	NIR, Dec 2006, p.204
CH_4 from 6A	-657	Recalculation of the entire time serie because of more detailed method (Tier 2) and data base	NIR, Dec 2006, p.391
CH_4 from 6D	557	Change of allocation from 6A to 6D	NIR, Dec 2006, p.401
Greece			

	Absolute difference between latest and previous submission used for the EC inventory (Gg CO_2 equivalents)	Member States' explanation for recalculation	Information source of reasons for recalculations
Total emissions excluding LUCF	0		
Hungary			
Total emissions excluding LUCF	-4 332		
N_2O from 4D	-2 033	Changes in Method: New Calculation Method for Direct Soil Emissions (GPG 2000), changes in activity data: Activity data rounded to the 6th decimal / Mistakes corrected / New activity data	CRF 2004, Table 8(b).2
N_2O from 1A4	-1 389	Changes in emission factor: old CS to IPCC, 2006 default max.-value	CRF 2004, Table 8(b).2
CH_4 from 1B2	514	Modified activity data	CRF 2004, Table 8(b).2
CH_4 from 6A	-679	No information provided	
CH_4 from 6B	-450	No information provided	
Ireland			
Total emissions excluding LUCF	199		
CO_2 from 1A2	735	New revised Energy Balance data for all years, 1990-2004.	Direct communication, Mar 2007
CO_2 from 1A4	-334	New revised Energy Balance data for all years, 1990-2004.	Direct communication, Mar 2007
N_2O from 4D	-238	Move to Tier 2-Cattle, More detailed categories; New Emission Factor; New N excretion rates, new populations, new AWMS proportioning, N from sludge considered	CRF 2004, Table 8(b).2
Italy			
Total emissions excluding LUCF	-325		
CO_2 from 1A1	-3 170	A revised version of the 2004 National Energy Balance has been supplied in december 2006; in addition 2004 CO_2 emission factors for natural gas and coal have been revised.	Direct communication, Mar 2007
CO_2 from 1A2	765	A revised version of the 2004 National Energy Balance has been supplied in december 2006; in addition 2004 CO_2 emission factors for natural gas and coal have been revised.	Direct communication, Mar 2007
CO_2 from 1A3	344		
CO_2 from 1A4	3 095	CO_2 emission recalculations, both from biogenic and non-biogenic incineration, are only due the new allocation from waste sector to energy sector because of updated information from specific incineration plants (energy vs. non energy recovery).	Direct communication, Mar 2007
Latvia			
Total emissions excluding LUCF	-31		
CO_2 from 1A1	-11	Updated activity data, due to updated statistical information and mistaken input data correction; improvements regarding methodolody (IPCC Tier 1) and emission factors, exclusion of emissions from biogas	NIR, Mar 2007, p. 32
CO_2 from 1A2	55	Overall activity data changes in all sub-sectors of 1.A.1 Energy industries and 1.A.2 Manufacturing industries and construction for all years from time period 1990 – 2004. Changes occurred due to the updated statistical information, mistaken input data correction and fuel consumption data division in IPCC categories. Data of fuel consumption from IEA/AIE – EUROSTAT – UNECE Annual questionnaires were used.	NIR, Mar 2007, p. 32
CH_4 from 6A	-43	Emission recalculation from solid waste disposal for 2004 was done due to new information became available about CH_4 recovery.	NIR, Mar 2007, p. 114
Lithuania			
Total emissions excluding LUCF	0		
Luxembourg			

	Absolute difference between latest and previous submission used for the EC inventory (Gg CO_2 equivalents)	Member States’ explanation for recalculation	Information source of reasons for recalculations
Total emissions excluding LUCF	0		
CH_4 from 4A	0,7		
Netherlands			
Total emissions excluding LUCF	359		
CO_2 from 1A1	-527	Data improvement: Re-calculation of CO_2 emissions from refineries based on detailed information from annual environmental reports of the companies. This results in recalculated emissions (0.4 to 1.1 Tg higher CO_2 emissions for the years 2002 – 2004) in category 1A1b from 2002 onwards; In category 1A1c, Manufacture of solid fuels and other energy industries information from the annual environmental reports was used to determine the emission factor of ‘own energy use’ in oil and gas production from 2003 onwards (in the precedent NIR, the general emission factor for natural gas of 56.8 was applied). Source allocation: part of the emissions formerly allocated in category 1Ab1, are now allocated in category 1B2. This change is based on detailed information from annual environmental reports of refineries	NIR, Mar 2007, p. 153
N_2O from 1A1	-20	Update of activity data	NIR, Mar 2007, p. 53
CO_2 from 1B2	873	Error Correction: in category 1B2, distribution of oil and gas, the whole time series (except 1990) was corrected (shifted one year); part of the emissions formerly allocated in category 1Ab1, are now allocated in category 1B2. This change is based on detailed information from annual environmental reports of refineries	NIR 2007, p. 153
Poland			
Total emissions excluding LUCF	8 588		
CO_2 from 1A1	3 265	New formulas for the calculation of EFs for hard coal and lignite; change of EFs for some other fuels according to IPCC 2006	Direct Communication, Apr 2007
CO_2 from 1A2	-1 282	New formulas for the calculation of EFs for hard coal and lignite; change of EFs for some other fuels according to IPCC 2006	Direct Communication, Apr 2007
CO_2 from 1A4	987	New formulas for the calculation of EFs for hard coal and lignite; change of EFs for some other fuels according to IPCC 2006 and verification some activity data	Direct Communication, Apr 2007
CO_2 from 1A5	3 503	New formulas for the calculation of EFs for hard coal and lignite; change of EFs for some other fuels according to IPCC 2006 and verification some activity data	Direct Communication, Apr 2007
CH_4 from 1B1	-1 759	Moving the fugitive emission from coking gas system from 1.B.2 to 1.B.1. (recommendation made by ERT 2005); changes of some activities	Direct Communication, Apr 2007
CH_4 from 6A	-1 418	Application of new methodology for entire time period [2006 IPCC Guidelines, IPCC Waste Model]; additionally updated activities	Direct Communication, Apr 2007
CH_4 from 6B	2 021	Updated activities and metodology changes	Direct Communication, Apr 2007
Portugal			
Total emissions excluding LUCF	303		
CO_2 from 1A1	235	Changes in Activity data: Updated activity data. Correction of errors detected in activity data - source not accounted.	CRF 2004, Table 8(b)
CO_2 from 1A2	229	Updated activity data. Correction of errors detected in activity data - source not accounted.	CRF 2004, Table 8(b)
CO_2 from 1B2	-179	Changes in Emission Factor: Revision of emission estimates using TANKS model, Changes in Acitvity Data: Revision of activity data	CRF 2004, Table 8(b).2
N_2O from 4D	-186	Updated activity data	CRF 2004, Table 8(b)
CH_4 from 6A	40	Municipal waste: correction of some errors and data updates; Industrial waste: data updates.	CRF 2004, Table 8(b)

	Absolute difference between latest and previous submission used for the EC inventory (Gg CO_2 equivalents)	Member States' explanation for recalculation	Information source of reasons for recalculations
Slovakia			
Total emissions excluding LUCF	-1 549		
CO_2 from 1A2	-2 118	SA energy balance was recalculated accrding the revision national code book of fuels in 2006. The several fuels categories were considered as waste fuels and bio. Detailed explanation will be provided in NIR 2007.	Mar 2007, direct communication
N_2O from 2B	416	Detailed explanation will be provided in NIR 2007. EFs for technological emissions from HNO3 production were revised. However, direct measurements of N_2O emissions were realized in major plant - Duslo, a.s. Šaľa in the period 2005 – 2006. From the results it follows that the emissions factors of N_2O in medium-pressure plant and high-pressure plant are 7 kg N_2O / 1 t HNO3 and 9 kg N_2O / 1 t HNO3, respectively. It is in agreement with the data presented by Norsk Hydro according to the Good Practice Guidance. It seems that discrepancy between previously and recently used EFs is based on the non-correct information about holding time of gasses at catalyst and temperature in reactor. The technology used in Chemko, a.s. is the same as in Duslo, a.s. (second major medium pressure plant). Therefore the recalculation of emissions of N_2O was necessary on the basis of Norsk Hydro data since 1990. The following emission factors were used: 4.5 kg N_2O / 1 t HNO3 for atmospheric plant, 7 kg N_2O / 1 t HNO3 for medium-pressure plant and 9 kg N_2O / 1 t HNO3 for high-pressure plant	Mar 2007, direct communication
CH_4 from 6A	111	Detailed information will be provided in NIR 2007, the methodology for SWDS was change to FOD Tier 2 methodology in time series 1960-2005. The Monte Carlo uncertainty analysis was executed.	Mar 2007, direct communication
Slovenia			
Total emissions excluding LUCF	-76		
CO_2 from 1A2	-78	Correction of mistake considering combustion of natural gas in manufacturing industry/other for 2004.	NIR, Mar 2007, p.159
CH_4 from 6A	-15	Correction of data set considering composition of waste for the period 2000-2004.	NIR, Mar 2007, p.159
N_2O from 6B	4	The new set of data for protein consumption for the period 2002-2004 has been obtained and N_2O emissions from human sewage have been recalculated accordingly for these years.	NIR, Mar 2007, p.159
Spain			
Total emissions excluding LUCF	-2 669		
CO_2 from 1A1	-111	updated activity data according to revised energy balance (2004), error correction (1991, 2003)	NIR, Mar 2007, p.306
CO_2 from 1A2	-2 791	updated activity data according to revised energy balance (2004), error correction (1991, 2003)	NIR, Mar 2007, p.306
CH_4 from 6A	434	new information based on questionnaires	NIR, Mar 2007, p.306
Sweden			
Total emissions excluding LUCF	-41		
CO_2 from 1A1	-36	CRF 1A and 1B: Thermal values for coal and coke were revised for 2004. CRF 1A1a: Combustion of waste (solid fuel) was added for one plant in 2004 (earlier missing), this increased the CO_2 emissions with about 4.5 Gg. A minor error concerning calculation of emissions of NOX in 1999 and 2000 was corrected, the changes in emissions are insignificant. CRF 1A1b: Residual fuel oil in Petroleum refining was redefined as refinery oil and emission factors for NOX and SO_2 were revised for all years. Emission factors for NOX and SO_2 for refinery gas	NIR, Jan 2007, p. 106-107

	Absolute difference between latest and previous submission used for the EC inventory (Gg CO_2 equivalents)	Member States' explanation for recalculation	Information source of reasons for recalculations
		were revised for all years. Activity data for three refinery plants were corrected in 2001, 2003 and 2004 due to new and better information, resulting in increasing CO_2 emissions in 2001 with about 26 Gg, increasing CO_2 emissions with about 4 Gg in 2003 and decreasing CO_2 emissions with about 62 Gg in 2004. Emissions of SO_2, NOX, CO from petroleum coke were excluded for refineries for all years, in order to avoid double-counting of emissions.	
CO_2 from 1B2	32	CRF 1B2a iv: Reported emissions of NMVOC from refineries were updated for 2002 – 2004 due to new measurements of the emissions at two of the refineries. CRF 1B2a v: Fugitive NMVOC emissions from handling of gasoline at depots were updated for 2004. Activity data, volume of gasoline, used for calculating fugitive emissions from distribution of gasoline were corrected for 2003 and 2004. CRF 1B2c: Data on flaring of gas for one plant was recalculated due to errors in previous calculations of emissions during 1995-2004 which resulted in an increase in CO_2 emissions with on average about 29 Gg every year.	NIR, Jan 2007, p. 108-109
CO_2 from 6C	-51	The CO_2 emissions were separately reported respecting the origin of the incinerated waste.	NIR, Jan. 2007, p. 226
United Kingdom			
Total emissions excluding LUCF	-4 906		
CO_2 from 1A1	-634	Revision to UK national statistics for fuel oil use from power stations and to natural gas consumption from petroleum refining	CRF 2004, Table 8 (b)
CO_2 from 1A2	-3 295	Decrease in Blast Furnace Gas emission factor, decrease in Coke oven coke emission factor, Decrease in Coke Oven Gas ef; Change in Natural gas activity data, fuel oil activity data and Coke oven gas	CRF 2004, Table 8 (b)
CO_2 from 1A3	-821	Changes in activity data for jet kerosene from aviation, gasoline for road transoport and diesel oil from railways	CRF 2004, Table 8 (b)
CO_2 from 1A4	325	Changes to coke oven coke emission factor; Revisions in UK national energy statistics causing revisions to activity data for other bituminous coal for Commercial/institutional, Agriculture/forestry/fishing and residential. Also changes to Diesel oil in commerical and residential sectors and fuel oil nad MSW in the commerical sector	CRF 2004, Table 8 (b)

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 LUCF have decreased in the latest submission compared to the previous submission by 5 399 Gg (0 0.13 %). EU-15 GHG emissions for 2004 increased by 508 Gg (+ 0.01 %) 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	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Total CO_2 equivalent emissions including LULUCF (absolute)	-17,890	-24,379	-28,311	-25,344	-35,335	-47,122	-52,412	-55,344	-35,589	-32,574	-34,843	-27,860	-36,273	-27,774	-14,339
Total CO_2 equivalent emissions including LULUCF (percent)	-0.4%	-0.6%	-0.7%	-0.7%	-0.9%	-1.2%	-1.3%	-1.4%	-0.9%	-0.8%	-0.9%	-0.7%	-0.9%	-0.7%	-0.4%
Total CO_2 equivalent emissions excluding LULUCF (absolute)	-5,399	-2,667	-3,212	-2,751	-4,755	-1,726	-4,112	-7,037	-3,579	-1,380	1,987	3,914	-1,737	7,196	508
Total CO_2 equivalent emissions excluding LULUCF (percent)	-0.13%	-0.1%	-0.1%	-0.1%	-0.1%	0.0%	-0.1%	-0.2%	-0.1%	0.0%	0.0%	0.1%	0.0%	0.2%	0.0%

Table 10.4 provides an overview of recalculations for the EU-15 key source categories for 1990 and 2004 (see Section 1.5 for information on identification of EU-15 key sources). The table shows that the largest recalculations in absolute terms for 1990 were made in the Key Source 2B: 'Chemical Industries' (- 4 629 Gg) and for 2004 in key source 1A2 'Other sectors' (2 494 Gg), followed by key source 2F Consumption of Halocarbons andSF_6 (-2 265 Gg).

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 2004. Large recalculations in absolute terms were made in the UK, Germany, Hungary and Poland. Recalculations in relative terms of more than 1 % ocurred in Ireland, Estonia, the Czech Republic, Hungary, Latvia and Poland.

Table 10.4 **Recalculations for the EU-15 key source categories 1990 and 2004 (difference between latest submission and previous submission in Gg of CO_2 equivalents and in percentage)**

Greenhouse Gas Source Categories	Gas	Recalculations 1990		Recalculations 2004	
		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
1A1 Energy Industries	CO_2	-1992	-0.2%	1571	0.1%
1A1 Energy Industries	N_2O	-44	-0.4%	-154	-1.1%
1A2 Manufacturing Industries	CO_2	2480	0.4%	2494	0.5%
1A3 Transport	CO_2	-665	-0.1%	-110	0.0%
1A3 Transport	CH_4	0	0.0%	-15	-0.6%
1A3 Transport	N_2O	-102	-1.3%	-20	-0.1%
1A4 Other Sectors	CO_2	66	0.0%	668	0.1%
1A4 Other Sectors	CH_4	-33	-0.3%	-892	-11.5%
1A5 Other	CO_2	131	0.6%	49	0.6%
1B1 Solid Fuels	CH_4	0	0.0%	-1455	-9.0%
1B2 Oil and Natural Gas	CH_4	-20	-0.1%	-16	-0.1%
2A Mineral Products	CO_2	-432	-0.4%	-22	0.0%
2B Chemical Industry	CO_2	-3	0.0%	287	0.9%
2B Chemical Industry	N_2O	-4629	-4.4%	-459	-1.0%
2C Metal Production	CO_2	193	0.2%	386	0.5%
2C Metal Production	PFC	0	0.0%	23	0.9%
2C Metal Production	SF_6	0	0.0%	0	0.0%
2E Production of Halocarbons and SF6	HFC	0	0.0%	-17	-0.3%
2F Consumption of Halocarbons and SF6	HFC	-1	-0.3%	-2265	-4.8%
2E Production of Halocarbons and SF6	PFC	233	3.3%	254	4.5%
2F Consumption of Halocarbons and SF6	SF_6	233	3.3%	254	4.5%
4A Enteric Fermentation	CH_4	-342	-0.3%	-140	-0.1%
4B Manure Management	CH_4	-103	-0.2%	-96	-0.2%
4B Manure Management	N_2O	-36	-0.1%	261	1.2%
4D Agricultural Soils	N_2O	-315	-0.1%	-393	-0.2%
6A Solid Waste Disposal on Land	CH_4	210	0.1%	-425	-0.5%
6B Waste-water Handling	CH_4	55	0.4%	22	0.2%
6B Waste incineration		37	0.7%	-237	-7.3%

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-25 and EU-15 recalculations of total GHG emissions without LUCF for 1990–2004 (difference between latest submission and previous submission Gg of CO_2 equivalents)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Austria	94	103	93	87	82	60	57	55	22	-51	-163	-89	-179	427	-155
Belgium	0	-52	-28	175	18	-196	-116	-101	-8	81	119	96	-33	510	-222
Denmark	-5	30	56	104	23	-17	25	27	30	38	33	42	8	99	122
Finland	59	-208	-68	16	105	82	102	42	268	171	69	-271	-252	-407	-299
France	247	291	411	474	776	975	1,190	1,275	1,103	1,227	2,643	4,662	2,046	-272	-1,543
Germany	-1,009	-1,608	-1,904	-1,712	-2,038	841	-664	-2,192	-2,310	-2,676	-3,034	1,823	-1,130	6,475	9,684
Greece	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ireland	-239	641	-23	531	330	448	705	-480	110	-46	398	373	-14	447	199
Italy	0	-4	-14	-17	-18	-98	-107	-163	77	-72	-11	-232	-605	-490	-325
Luxembourg	0	0	0	0	0	0	0	0	0	0	40	-1	-1	-1	1
Netherlands	0	0	0	0	0	0	0	0	0	0	0	0	790	1,152	359
Portugal	-32	-24	-25	-25	-28	-58	-58	-67	-42	-19	-111	-127	-195	-235	303
Spain	214	872	359	373	463	428	344	443	396	315	174	259	111	1,319	-2,669
Sweden	0	-35	0	0	0	0	0	0	20	17	58	59	37	-43	-41
UK	-4,727	-2,673	-2,069	-2,756	-4,469	-4,191	-5,590	-5,874	-3,244	-368	1,772	-2,680	-2,322	-1,784	-4,906
Cyprus															
Czech Republic	-75	-75	-75	-75	-75	0	5,603	-5,774	0	0	-141	-114	-97	-59	19
Estonia	572	580	846	1,076	1,213	1,179	1,263	778	386	326	454	540	12	382	-210
Hungary	-5,388	-4,309	-3,424	-2,765	-3,096	-3,241	-3,415	-3,458	-3,720	-3,198	-2,813	-3,610	-2,767	-2,139	-4,332
Latvia	549	1,153	930	76	414	300	104	114	103	114	121	82	95	94	-31
Lithuania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Malta															
Poland	0	0	0	0	0	0	0	0	0	0	19,341	19,332	17,004	18,938	8,588
Slovakia	-341	-444	-422	-408	-347	-294	-380	-205	-46	-73	-1,098	-988	-1,001	-1,207	-1,549
Slovenia	0	0	0	0	0	0	0	0	0	0	0	-1	-1	-2	-76
EU-25	**-10,081**	**-5,763**	**-5,356**	**-4,847**	**-6,647**	**-3,783**	**-937**	**-15,581**	**-6,855**	**-4,211**	**17,851**	**19,155**	**11,508**	**23,203**	**2,917**
EU-15	**-5,399**	**-2,667**	**-3,212**	**-2,751**	**-4,755**	**-1,726**	**-4,112**	**-7,037**	**-3,579**	**-1,380**	**1,987**	**3,914**	**-1,737**	**7,196**	**508**

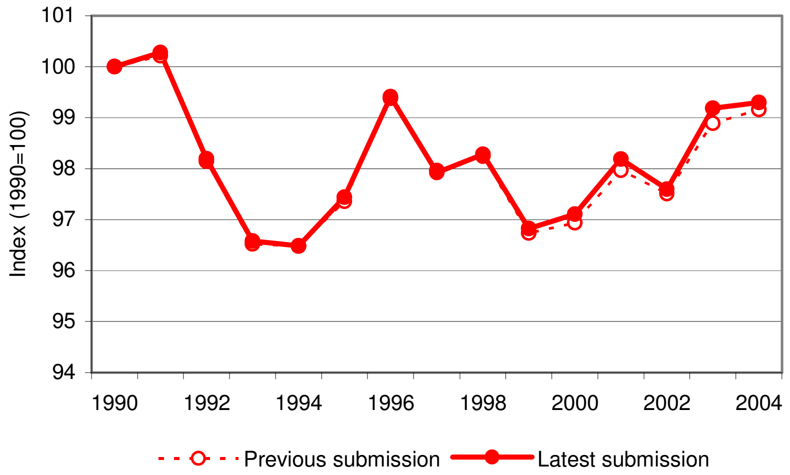
Table 10.6 Contribution of Member States to EU-25 and EU-15 recalculations of total GHG emissions without LUCF for 1990–2004 (difference between latest submission and previous submission in percentage)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Austria	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	-0.1	-0.2	-0.1	-0.2	0.5	-0.2
Belgium	0.0	0.0	0.0	0.1	0.0	-0.1	-0.1	-0.1	0.0	0.1	0.1	0.1	0.0	0.3	-0.2
Denmark	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.1	0.2
Finland	0.1	-0.3	-0.1	0.0	0.1	0.1	0.1	0.1	0.4	0.2	0.1	-0.4	-0.3	-0.5	-0.4
France	0.0	0.0	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.5	0.8	0.4	0.0	-0.3
Germany	-0.1	-0.1	-0.2	-0.2	-0.2	0.1	-0.1	-0.2	-0.2	-0.3	-0.3	0.2	-0.1	0.6	1.0
Greece	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ireland	-0.4	1.2	0.0	0.9	0.6	0.8	1.2	-0.8	0.2	-0.1	0.6	0.5	0.0	0.7	0.3
Italy	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1
Luxembourg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0
Netherlands	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.5	0.2
Portugal	-0.1	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1	0.0	-0.1	-0.2	-0.2	-0.3	0.4
Spain	0.1	0.3	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.0	0.1	0.0	0.3	-0.6
Sweden	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	-0.1	-0.1
UK	-0.6	-0.3	-0.3	-0.4	-0.6	-0.6	-0.8	-0.8	-0.5	-0.1	0.3	-0.4	-0.4	-0.3	-0.7
Cyprus															
Czech Republic	0.0	0.0	0.0	0.0	0.0	0.0	3.6	-3.6	0.0	0.0	-0.1	-0.1	-0.1	0.0	0.0
Estonia	1.3	1.4	2.8	4.6	5.0	5.4	5.5	3.4	1.9	1.7	2.4	2.8	0.1	1.8	-1.0
Hungary	-5.2	-4.5	-4.0	-3.2	-3.6	-3.8	-3.9	-4.1	-4.4	-3.8	-3.4	-4.3	-3.4	-2.5	-5.2
Latvia	2.1	4.9	4.9	0.5	3.0	2.5	0.8	1.0	0.9	1.1	1.2	0.8	0.9	0.9	-0.3
Lithuania	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Malta															
Poland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	5.1	4.6	4.9	2.2
Slovakia	-0.5	-0.7	-0.7	-0.7	-0.7	-0.6	-0.7	-0.4	-0.1	-0.1	-2.2	-1.9	-2.0	-2.4	-3.0
Slovenia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.4
EU-25	**-0.2**	**-0.1**	**-0.1**	**-0.1**	**-0.1**	**-0.1**	**0.0**	**-0.3**	**-0.1**	**-0.1**	**0.4**	**0.4**	**0.2**	**0.5**	**0.1**
EU-15	**-0.1**	**-0.1**	**-0.1**	**-0.1**	**-0.1**	**0.0**	**-0.1**	**-0.2**	**-0.1**	**0.0**	**0.0**	**0.1**	**0.0**	**0.2**	**0.0**

10.3 Implications for emission trends, including time series consistency

Figure 10.1 shows that due to the fact that both the 1990 and 2004 emissions have increased, the emission trend in the EU-15 has changed slightly. In the previous submission the trend of GHG excluding LUCF between 1990 and 2004 was – 0.8 %. In the latest submission this trend has decreased to – 0.7 %.

Figure 10.1 Comparison of EU-15 GHG emission trends 1990–2004 (excl. LUCF) 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 EC response to UNFCCC review

The following improvements were made in 2006 and 2007, most of them in response to UNFCCC reviews:

- **Energy:** detailed information on activity data and emission factors for the EC key sources and the description of sub-sectors of source category 1A2 Manufacturing industries.
- **Industrial processes:** more detailed information on methods used for the EC key sources and overviews of Member States' responses to UNFCCC review findings are included. In addition, CRF Table 2(II).F is provided for the first time in the 2007 submission.
- **Solvent use:** detailed descriptions of methods used by Member States are included.
- **Agriculture:** more detailed description of methods used, activity data, emissions factors and other relevant parameters; inclusion of background data and additional parameters in the EC CRF tables.
- **LULUCF:** the new LULUCF tables are provided for the EU-15 including background information on stock changes, amount of fertiliser applied and total amount of lime applied; the key categories are described for LULUCF.
- **Inventory system:** overview of Member States inventory systems in place.
- **Key category analysis:** the key category analysis was made at fuel level and for LULUCF.
- **QA/QC:** activities have been further extended on the basis of the EC QA/QC manual:
  - Implied emission factors have been checked for almost all EC key sources for all EU-27 Member States.
  - Active follow-up checks have been made on Member States' inventories: consistency reports have been prepared for 25 EC Member States; for 22 Member States follow-checks were made. Several Member States provided updated information/inventories in response of these checks.
- **Uncertainties:** A quantitative Tier 1 trend uncertainty analysis has been performed on the basis of Member States' Tier 1 uncertainty analysis.
- **Completeness:** overviews are provided of data availability of background data tables (see Chapter 1.8.5).
- **Consistency:** the EC CRF tables are internally consistent due to follow-up checks with Member States and reallocation of some source categories (see Chapter 1.4).
- **Recalculations:** more detailed information is provided for the EC key sources in the sector chapters
- **EU-27:** for the new Member States more information is included such as: (1) on inventory systems; (2) QA/QC procedures in place; (3) information on methods, emission factors and activity data; (4) reasons for recalculations.

10.4.2 Member States' responses to UNFCCC review

Since the improvement of the EC inventory depends on Member States' efforts regarding completeness of estimation and improvement of methods and parameters used, Table 10.7 provides an overview of Member States' responses to the UNFCCC review ([24]). The table shows that a considerable amount of improvements were made compared since the 2005 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.

([24]) Issues related to the NIR are not included in this table as already addressed in Table 1.11.

Table 10.7 **Improvements made by Member States in response to the UNFCCC review**

Member State	Improvements as recommended by the review team	Improvements in response to UNFCCC review as indicated in the NIR
Austria	The ERT identifies the following cross-cutting issues for improvement. The Party should: (a) Provide tier 1 quantified uncertainty estimates following the IPCC good practice guidance and use the results of this analysis to plan improvements to the inventory; (b) Improve time-series consistencies: (i) For those source categories where AD are derived from different data sources for different years; (ii) By extrapolation or interpolation of EFs and AD wherever such data for specific years are not available rather than keeping such values constant to avoid discontinuities in trends; (c) Provide more detailed descriptions of the methodologies used in cases where the country specific EFs deviate significantly from the IPCC default values or fall outside the ranges provided by the Revised 1996 IPCC Guidelines. (para 16) FCCC/ARR/2005/AUT	Tier 1 uncertainty analysis was made for several sources and provided in Annex 6. Time series consistencies have been checked for all sources and inconsistencies are planned to be improved. Emissions from source categories 1A2a (iron and steel), 2B1 (Ammonia), 4A (enteric fermentation), 4.B (manure management), 4D (agricultural soils) and 6A1 (managed waste disposal on land) have been recalculated in response to the 2005 inventory review. The emission factors for natural gas and industrial waste were adjusted in response to the 2005 inventory review. 2 B 1 Ammonia Production: During the in-country review 2007 the ERT found that there was a double counting concerning CO_2 emissions from ammonia. The double counting was corrected in this submission. 6 B Wastewater handling: The methodology for calculating N_2O emissions was changed according to the recommendation by the ERT during the in-country review 2007. Now also N_2O emissions are considered which do not arise in waste water treatment plants.
Belgium	The NIR identifies possible improvements in carbon EFs as a result of data becoming available in connection with the European Union Emissions Trading Scheme (ETS); better estimation of emissions of non-methane volatile organic compounds (NMVOCs); work on emissions from agricultural soils and manure management; the establishment of the geographical location of LULUCF activities and an evaluation of forest soil carbon; the inclusion of recovery of CH_4 from waste-water handling; and regional improvements in the estimation of emissions from waste, as identified below. Independent reviews by region and an external review involving experts from the Netherlands are planned. The overriding priority for Belgium is to continue working to present activity data (AD), EFs and methodologies in a transparent and consistent manner for the country as a whole. This is linked to the priority of developing current QA/QC practices into a coherent quality management system. Progress in recalculations requires adequate transparency, and Belgium should provide the CRF table 8(b) (Recalculations). The ERT understands that Belgium will submit this CRF table in its next submission. (para 13,14) FCCC/ARR/2005/BEL	The results of the draft centralized review report of the 2005 greenhouse gas inventory submission of Belgium are taken into account as much as possible during this submission. Following the centralised review report, the methane emissions from wetlands, unmanaged surface waters (rivers and lakes) and removals from forest, grassland and agricultural soils in Flanders are no longer reported in the national inventory. ETS data was used for the latest submission. QA/QC plans were developed and QA/QC procedures applied systematically.
Denmark, centralized review 2005	The inclusion of all LULUCF categories to the inventory is planned by the party. It is also planned to include estimates for CO_2 from soda ash use and limestone and dolomite use in its next inventory submission. The ERT mentions that the rationale for the detail (e.g. the need to relate to CORINAIR classification) could usefully be clarified. Similarly, more transparent information could be provided on the models used in the Agriculture sector, either by providing succinct summaries of technical material in annexes to the NIR or by giving references to background reports (in translation).(para 13,14) FCCC/ARR/2005/DNK	Considerable improvements of the inventories and the reporting have been made in response to the latest UNFCCC review process and as a result of an on-going working process. Stationary Combustion: The N_2O emission factor for coal combusted in large power plants has been changed for 1990-2003. Mobile sources (Inland waterways/ agriculture/ forestry/ household-gardening): A complete revision of the 1985-2003 time series of fuel use and emissions has been made using results from a specific Danish non road research project. Industry: Emissions of CO_2 from production of mineral wool and expanded clay products, refining of sugar, flue gas cleaning (wet process) in relation to waste incineration, combined heat and power plants and power plants have been included. Indirect emission of CO_2 and emission of NMVOC from asphalt roofing and road paving with asphalt has also been included. Emissions from limestone and dolomite use were estimated. Cropland, grassland and wetlands: Mineral soils are for the first time incorporated in the inventory. All major LULUCF categories were included. Agriculture: references to background reports provided. Detailed methodological descriptions for individual source or sink categories are provided in Annex 3. Issues raised by the review team which could not be solved

Member State	Improvements as recommended by the review team	Improvements in response to UNFCCC review as indicated in the NIR
		immediately are planned to be addressed in the next inventory.
Finland, centralized review 2005	The party identifies the following improvements: updating the time series of point source data, the reallocation of process emissions from Iron and Steel from the Energy to the Industrial Processes sector, further improvement of AD and EF for peat production, improved factors for carbon storage for the estimation of feedstocks and non-energy fuel use, improved non-CO_2 EFs for fuel combustion, the development of ways to verify the estimates of emissions of fluorinated gases (F-gases), the improvement of estimation parameters for enteric fermentation, additional data collection of manure management systems, and increased completeness in the LULUCF sector, including area estimates of grasslands before 1995, N_2O emissions from disturbance and soil drainage, and carbon (C) stock change in soil and dead organic matter pools on forest lands. The ERT recommends the precise descriptions of methodologies and parameters.(para 16,17) FCCC/ARR/2005/FIN	Most of the identified improvements have been implemented already in the 2006 submission. The point source data has been checked and updated, CO_2 emissions from iron and steel industry have been reallocated, and emissions from peat production have been recalculated with amended AD. Due to updated activity data and emission factors recalculations have been done in the agricultural sector. Also the reporting in the LULUCF sector has been improved. In addition emissions from composting (CRF 6. D) have been included for the first time as response to the review process of 2005.Updated activity data and new emission factors have been used in this submission. The revision of the estimation of feedstocks and non-energy fuel use was conducted for the 2007 submission.
France	The NIR identifies several areas for improvement: (a) Finalization of the report on methodologies (the OMINEA report); (b) Studies and further investigations to improve the accuracy of the estimates for key categories; (c) The provision of better uncertainty estimates for key categories; (d) Improvements to data collection and to the emissions estimates for sources with high uncertainties, such as the non-energy use of fossil fuels; (e) The development of a new method to estimate and report LULUCF emissions following the IPCC Good Practice Guidance for Land LULUCF. The ERT identifies the following cross-cutting issues for improvement. The Party should: (a) Provide more detailed descriptions on methodologies in the NIR, using the structure given in the revised UNFCCC reporting guidelines. Descriptions of methodologies in the NIR can be complemented with relevant references to detailed information reported in the OMINEA report. The OMINEA report then needs to be completed and finalized; (b) Use the notation keys in a way that is consistent with the revised UNFCCC reporting guidelines; (c) Provide more detailed information in the NIR regarding recalculations; (d) Consider the possibility of implementing a tier 2 key category analysis (linked with the improvement of uncertainty estimation). (para 20,21) FCCC/ARR/2005/FRA	The OMINEA report on methodologies has been updated. Nir has been expanded and references to OMINEA report were included. The LULUCF tables are provided as required by decision 13/CP.9. Information on recalculations is provided. A tier 2 uncertainty estimation is under evaluation. Use of notation keys improved.
Germany	The ERT recommends that the Party consider the following cross-cutting issues for improvement. The Party should: (a) Provide the reference approach in full detail for the years 2000 and later as these are essential as an independent cross-check on the quality of the reporting in Energy sector; (b) Report emissions from coke use in Iron and Steel Production in the Industrial Processes sector, rather than as part of fuel combustion activities in the Manufacturing Industries and Construction category; (c) Estimate and report (as memo items) emissions of CO_2 from biomass combustion, and to distinguish clearly and report separately the biomass fractions in solid fuels; (d) Improve the completeness of the CRF, especially the LULUCF tables; (e) Use the QA/QC and the uncertainty assessment to plan improvements to the inventory; (f) Quantify uncertainties for the LULUCF sector. (para 15,16) FCCC/ARR/2005/DEU	Several emission factors and activity data has been updated and recalculations have been made. Emissions from source categories 1A2 (manufacturing industries and construction), 1B1a (coal mining), 1B1b (solid fuel transformation) and 2C (metal production) were recalculated in response to inventory reviews. Emissions from biomass combustion are reported. Reference approach for recent years is provided. Emissions from coke were partly reported as pocess emissions. Complete reporting of CO_2 emissions from biomass as memo item. Improved estimation of emissions from non-energy fuel use.
Greece	The NIR identifies several areas for improvement. Many of the improvements are related to the collection of AD which are at present not available. The ERT identifies the following cross-cutting issues for improvement. Greece should:	Methodologies were upgraded for several source categories, new sources added and errors corrected. Recalculations were made according to the recommendations of the review process.

Member State	Improvements as recommended by the review team	Improvements in response to UNFCCC review as indicated in the NIR
	(a) Provide more comprehensive information on the methodologies, AD and EFs used in calculating the emissions estimates to further improve the transparency of inventory; and (b) Present more explanatory information related to source-specific uncertainties, QA/QC and verification in the NIR. (para 14,15) FCCC/ARR/2005/GRC	
Ireland, centralized review 2005	The most important improvement identified by the party is the development of a QA/QC system for the national inventory. Also an inventory improvement and the use of higher tier methodologies is planned. Ireland also plans to implement the IPCC good practice guidance for LULUCF and submit LULUCF reporting tables in accordance with decision 13/CP.9. The ERT identifies the following cross-cutting issues for improvement: (a) Use of tier 2 methods for key category analysis; (b) More extensive use of higher-tier methods for key categories, depending on available resources and AD; (c) Full use of the NIR structure set out in the revised UNFCCC reporting guidelines. (para 23,24) FCCC/ARR/2005/IRL	Substantial improvements have been made in the inventory. A QA/QC plan was developed and most emission estimates were done by applying the tier 2 methods. Many recalculations were undertaken. The inventory of the LULUCF sector was completed in accordance with the requirements of Decision 13/CP.9. The majority of the recommendations in the 2003 review report have now been implemented, following the extensive improvements and recalculations conducted for the 2006 submission. As these improvements cover issues such as the development of an expanded national inventory report in line with the structure specified in the UNFCCC reporting guidelines, the complete coverage of the LULUCF sector according to the requirements of Decision 13/CP.9 and detailed work to ensure full consistency between the NIR information and the CRF tables, they also address the main findings of the more recent centralised reviews in 2004 and 2005. The uncertainty estimation has been changed to reflect comments from the 2003 review. The FAO estimate of protein intake in the estimates for 2003 and the corresponding emissions in other years were recalculated as suggested by the 2003 in-country review. Enteric fermentation is calculated using Tier 2 as recommended by several reviews of the Irish inventory.
Italy, In country review 2005	Identified by the party: Establishment of a National Inventory System, including single national entity for inventory. Development of QA/QC system, including general and sectoral plans. (para 33) Identified by ERT: Complete and correct some key category analysis. Improve transparency of inventory by filling blank cells etc. Improve reporting on recalculations and document uncertainty estimates of tier 1 analysis. (para 35-36) **Energy:** Identified by the party: Provide information of carbon content of fuel in NIR. Improve documentation of national energy balance, Strenghten cooperation with other ministries to further analyse coal data.(para 63) Identified by ERT: Clear reference between cross categories in the NIR is needed. Provide in the NIR information on recalculations performed, a clearer explanation of the carbon flow within the iron and steel industry, the balance of data between the model used and the national statistics in road transport, and the methodology for calculating fugitive emissions from oil and gas.(para64) **Industrial processes and solvent use:** Identified by party: Improvements focus on better EFs and AD, consistency of the estimates of PFC emissions, updating AD and time series EFs etc. .(para 79, 80) Identified by ERT: More detailed information on methodologies used and further work with industries to improve AD and EFs. (para 81, 82) **Agriculture:** The ERT recommends to further improve transparency. (para 111) **LULUCF:** Identified by the party: Refinement of the forest land C estimates. Improvement of the land cover and land use change data. Collection of additional statistics on land management. Acquisition of data on hydroelectric reservois, flooded lands and urban forestry.(para 138-141) Identified by ERT: Improvements on the reporting on land classification and land representation over time. Increased characterization of land management practices and LUC patterns on cropland and grasland. (para 142, 143) **Waste:** The party planns to improve emission estimates from solid waste disposal on land. The ERT redommends some improvements related to transparency and improvement of estimated CH_4 emissions from solid waste disposal. (para	CO_2 emissions from the energy and the industrial processes sectors have been revised. Specifically, the full carbon cycle has been accounted for and emissions from iron and steel have been balanced between the energy and the industrial processes sectors. A complete balance of energy and carbon has been carried out. Recalculations also affected figures from limestone and dolomite use; emissions from sinter have been removed from this sector and included in the metal production sector. In addition for the chemical industry, the N_2O emission factor for nitric acid production has been checked with the relevant industry and the entire time series revised. For the agriculture sector, parameters to draw up N_2O emission estimates in the agriculture soils category have been updated. Regarding the LULUCF sector, CO_2 emissions from cropland and grassland remaining cropland and grassland have been deleted because not related to a real change in carbon content in soils. CH_4 emissions from the waste sector have been revised on account of the review process. Specifically, for solid waste disposal, the estimate of methane generation potential has been revised and emissions have been estimated accounting for specific different waste types. Moreover, the amount of waste landfilled has been collected from 1950 and also CH_4 recovered data have been revised. Finally, for domestic waste water handling, a different split in the treatment process of wastewater has been assumed, specifically 95% aerobically and 5% anaerobically, as suggested by the relevant reviewer. In addition, particular attention has been paid to check information and values with the relevant references and to the archiving of all the material used for the 2006 submission. Figures to draw up uncertainty analysis have been checked with the sectoral experts and are consistent with the IPCC Good Practice Guidance. The description of country specific methods and the rationale behind the choice of emission factors, activity data and other related parameters should have improved the transparency of the present NIR.

Member State	Improvements as recommended by the review team	Improvements in response to UNFCCC review as indicated in the NIR
	175, 176) FCCC/ARR/2005/ITA	
Luxembourg	No review of the 2005 inventory because Luxembourg did not submit a NIR	As the 2006 submission was the first NIR submitted to the UNFCCC there are no improvements in response to reviews.
Netherlands, centralized review 2005	The party explained that an improvement program started in 2000 and is almost finished. The ERT recommends the following improvements: a)Estimate emissions for sources that are still missing in the inventory (b) Incorporate the LULUCF categories into the key category analysis; (c) Provide auxiliary information to facilitate an assessment of the estimates for emission sources that are affected by confidentiality of data.(para 18,19) FCCC/ARR/2005/NLD	Some missing emission sources have been already estimated, some are considered to be negligible. The LULUCF sector has been included in the key source assessment.
Portugal, centralized review 2005	The key improvements identified by Portugal are greater completeness and a tier 2 key category analysis including LULUCF. The ERT identified the following cross-cutting issues for improvement: (a) Improvement in the completeness of the inventory, such as CH_4 from natural gas transportation and potential emissions of HFCs, PFCs and SF_6; (b) More extensive use of higher-tier methods for key categories, depending on available resources and AD; (c) A more comprehensive description of the QA/QC procedures, including subsections on QA/QC and verification, in the sectoral chapters; (d) Correct use of the notation keys in the CRF. (para 18,19) FCCC/ARR/2005/PRT	The party improved the use of Tier 2 analysis methods as far as sufficient data was available (e.g. 4A enteric fermentation). Completeness has also been improved to some extend. CH_4 emissions from natural gas are reported. IPCC default values are used for the CH_4 generation rate constant and the domestic CH_4 estimated emissions were compared with the “check method” proposed in the IPCC GPG as recommended by the in-depth review.
Spain	The ERT identifies the following cross-cutting issues for improvement. The Party should: (a) Improve the transparency of its reporting, including by providing bibliographic references, listing EFs, and providing national energy balances and worksheets; (b) Link its key category analysis to the choice of methodology; (c) Complete the development of a QA/QC management system, including better arrangements for internal data exchange; (d) Fill remaining gaps, especially in the LUCF sector, and report on LULUCF using the revised CRF tables. (para 14) FCCC/ARR/2005/ESP	Additional Annexes and tables with EFs provided QA/QC management system completed.
Sweden	The NIR identifies several areas for improvement. Many improvements relate to a review of existing methods for allocating emissions, the addition of some small sources not currently included and the collection of AD which at present are unavailable. The ERT identified the following cross-cutting issues for improvement. The Party should: (a) Provide additional detailed documentation on methods, data and assumptions; (b) Continue the development and implementation of the QA/QC system; (c) Improve the quantified uncertainty estimates; (d) Provide a national inventory report that is structured better to be in line with the UNFCCC reporting requirements on presenting source-specific information on AD, EFs, methodology, uncertainty estimates, time series consistency, QA/QC, verification, recalculations and planned improvements. (para 14,15) FCCC/ARR/2005/SWE	General • Information on the rationale behind recalculations is better described in the NIR. • Transparent explanation in Annex 2 on how uncertainties are estimated for activity data, emission factors and emissions. • More information about the quality assurance and verifications in the NIR. Energy • Factors influencing trends in activity data and emission factors have been better described. • Emissions from road transport calculated bottom-up by models have been compared with fuel delivery statistics (top-down approach). Industrial processes • Factors influencing trends in activity data and emission factors have been better described for CO_2. • Production data has been reported as activity data in CRF 2C1 instead of reducing agents and fuel consumption. • Emissions of CO_2 from cement production have been separated into emissions from clinker and dust in the NIR. • The reason for the low implied emission factor for CO_2 in lime production has been described in more detail. • A comparison between emissions of PFC from aluminum production calculated with the method used by the company and the IPCC default method is included in the NIR. • Consumption of halocarbons and SF_6 Potential emissions has been estimated for the whole time series, 1990-2004. Previously potential emissions were only estimated from 1995-2003. Agriculture

Member State	Improvements as recommended by the review team	Improvements in response to UNFCCC review as indicated in the NIR
		• Beef cows are included in the same group as dairy cattle in the GHG inventory as of the 2006 submission and beyond. • Sludge had been divided into direct and indirect emissions. The indirect emissions are reported in the CRF together with Atmospheric Deposition. • Activity data for the stable period has been changed for the years 1990 – 1994 due to the weak documentation of the supporting data. LULUCF • Sweden has reported all requested pools and more properly use the notation keys. Waste • The half-life of waste differed from the IPCC default values. It is assumed to be 7.5 years instead of 14.5 (the IPCC default). The rationale for this assumption is provided in NIR in submission 2006. • The per capita waste generation rate has been reported in kg/year in Table 6A. This re-porting mistake is corrected to kg/day in submission 2006. • The percentage figures on the composition of deposited waste are adjusted to add up to 100 per cent. The information is provided in the NIR as the ERT encouraged Sweden to do.
United Kingdom	The United Kingdom identified the following areas for improvement: (a) A review of the methods for estimating feedstocks and non-energy fuel use and the provision of further information about this category; (b) A review of the completeness of the GHG inventory of the United Kingdom; (c) A review of the allocation of emissions to IPCC sectors. The ERT identifies the following cross-cutting issues for improvement: (a) The key category analysis with and without LULUCF should be conducted and presented separately to be consistent with the IPCC good practice guidance for LULUCF, and the aggregation level chosen should be reconsidered; (b) The uncertainty estimation should be updated, and more analysis and discussion of uncertainties in the sectoral chapters of the NIR should be provided; (c) Consistency between the NIR and the CRF and within the NIR should be improved; (d) The transparency of the reporting of some key categories as indicated in the sectoral sections of this review report should be improved.	The UK addressed many issues raised by the review team as well as several unresolved recommendation from the two reviews before. A detailed list is provided in table 10.2 of chapter 10.4 of the UK NIR.

10.4.3 Improvements planned at EC level

The following activities are planned in 2007 at EC level with a view to improving the EC GHG inventory:

- Continue sector-specific QA/QC activities within the EC internal review;
- Test the newly developed CRF Aggregator database in order to ensure full functionality for the 2008 submission.
- Prepare for providing more background data in the CRF tables for Industrial processes (i.p. check the results of the Eurostat project for use in 2008, if already available).
- Compare emission estimates for avaition with Eurocontrol flight data.
- Further develop the EC QA/QC activities on the basis of the experience in 2006/2007.

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Units and abbreviations

t	1 tonne (metric) = 1 megagram (Mg) = 10^6 g
Mg	1 megagram = 10^6 g = 1 tonne (t)
Gg	1 gigagram = 10^9 g = 1 kilotonne (kt)
Tg	1 teragram = 10^{12} 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
ETC/ACC	European Topic Centre on Air and Climate Change
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
LUCF	land-use change and forestry
LULUCF	land-use, land-use change and forestry
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/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

Abbreviations in the source category tables in Chapters 3 to 9

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				