Technical report No 6/2008

Annual European Community greenhouse gas inventory 1990–2006 and inventory report 2008

Submission to the UNFCCC Secretariat

Version 27 May 2008

European Environment Agency

Title of inventory	**Annual European Community greenhouse gas inventory 1990–2006 and inventory report 2008**
Contact names	Erasmia Kitou (DG Environment) Andreas Barkman, Ricardo Fernandez (EEA), Bernd Gugele, Elisabeth Rigler, Sabine Goettlicher, Manfred Ritter (ETC/ACC)
Organisation	European Commission, DG Environment European Environment Agency
European Commission address	European Commission DG Environment BU9 6/134 B-1049 Brussels
Fax	(32-2) 296 99 70
Telephone	(32-2) 29 58 219
E-mail	env-climate@cec.eu.int
European Environment Agency address	Kongens Nytorv 6 DK-1050 Copenhagen
Telephone	(45) 33 36 71 00
Fax	(45) 33 36 71 99
E-mail	andreas.barkman@eea.europa.eu ricardo.fernandez@eea.europa.eu

Contents

Acknowledgements

This report was prepared on behalf of the European Commission (DG Environment) by the European Environment Agency's European Topic Centre for Air and Climate Change (ETC/ACC) supported by the Joint Research Centre and Eurostat. The coordinating author was Bernd Gugele (ETC). Other authors were, in alphabetical order, Francois Dejean (EEA), Ricardo Fernandez (EEA), Michael Gager (ETC), Jakob Graichen (ETC), Sabine Goettlicher (ETC), Giacomo Grassi (JRC), Ralph Harthan (ETC), Anke Herold (ETC), Traute Koether (ETC), Adrian Leip (JRC), Suvi Monni (Benviroc, Finland), Barbara Muik (ETC), Stephan Poupa (ETC), Nikolaos Roubanis (Eurostat), Elisabeth Rigler (ETC), Manfred Ritter (ETC), Barbara Schodl (ETC), Janka Szemesova (JRC). The EEA project managers were Andreas Barkman and Ricardo Fernandez. The EEA acknowledges the input received for the final version of this report and the comments received on the draft report from the EC Member States, which have been included in the final version of the report as far as practically feasible.

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.

This submission also constitutes the voluntary submission under the Kyoto Protocol.

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 7.7[2] % between 1990 and 2006 (430 million tonnes CO_2 equivalents). Emissions decreased by 0.3 % (-14 million tonnes CO_2 equivalents) between 2005 and 2006.

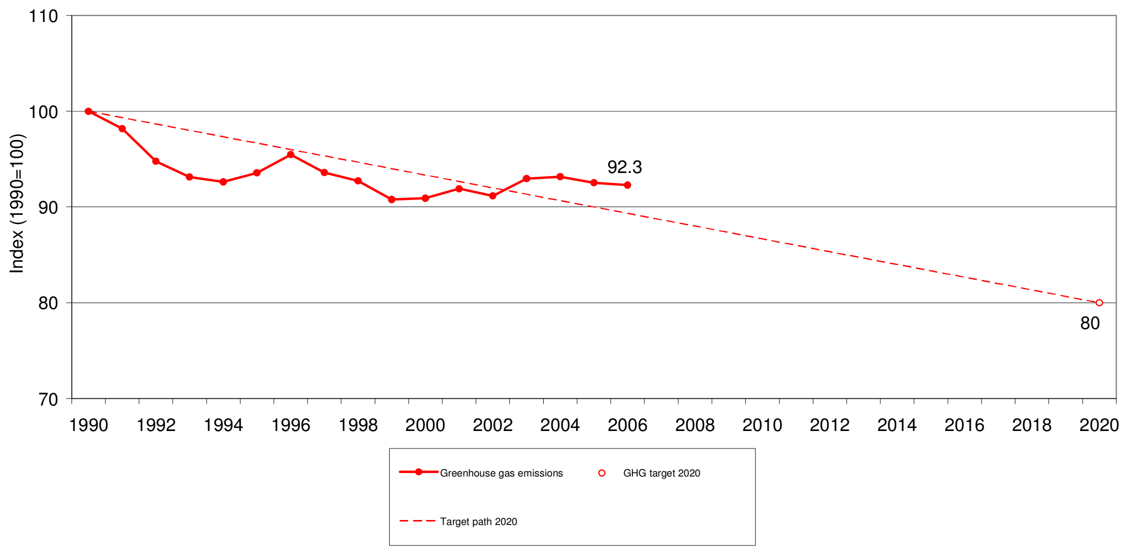
([1]) OJ L 49, 19.2.2004, p. 1. Note that Council Decision No 280/2004/EC entered into force in March 2004. Therefore, the compilation of the inventory report 2004 started under the previous Council Decision 1999/296/EC.

[2] Compared to the EC inventory report from 2007 the 1990 emission figures have dropped signficantly by ca. 48 million tonnes CO_2 equivalents due to recalculations. The result is that the overall decrease for EU-27 since 1990 in this year’s submissions is ca 0.5 percentage points less than in the 2007 submission despite a decrease of 0.3% between 2005 and 2006.

In 2007 the EU made a firm independent commitment to achieve at least a 20% reduction of greenhouse gas emissions by 2020 compared to 1990[3].

Assuming a linear target path from 1990 to 2020, in 2006 total EU-27 GHG emissions were 2.9 index points above this target path (Figure ES.1).

Figure ES.1 EU-27 GHG emissions 1990–2006 (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-27 emissions in 2006 are to a linear path of emissions reductions from 1990 to the unilateral commitement by the EU-27 for 2020, assuming that only domestic measures will be used. Therefore, it does not deliver a measure of (possible) compliance of the EU-27 with its GHG targets in 2020, but aims at evaluating overall EU-27 GHG emissions in 2006. The unit is index points with 1990 emissions being 100.

GHG emission data for the EU-27 as a whole do not include emissions and removals from LULUCF. In addition, no adjustments for temperature variations or electricity trade are considered.

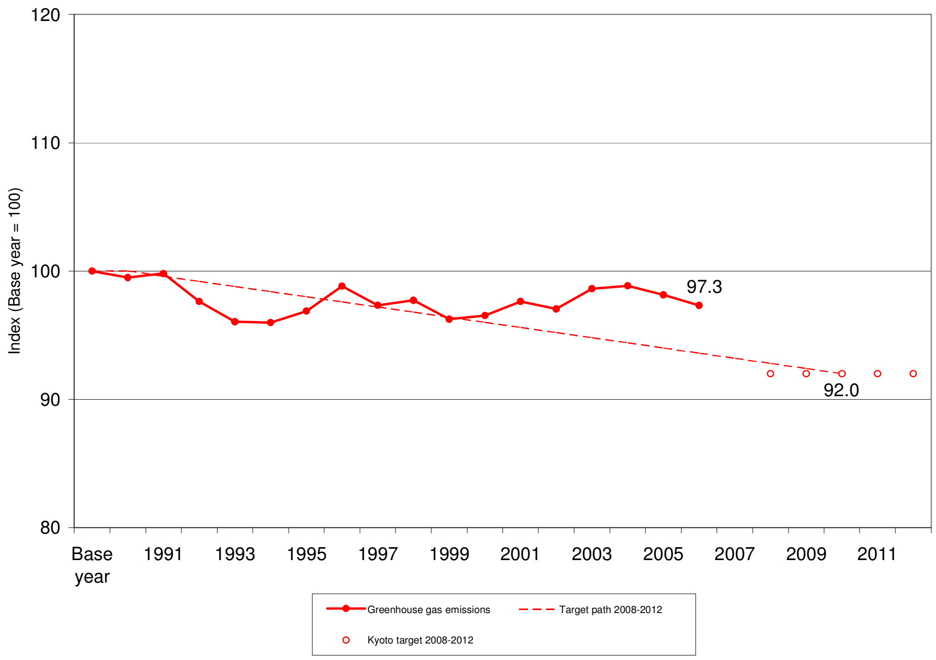
EU-15: In 2006 total GHG emissions in the EU-15, without LULUCF, were 2.2 % (93 million tonnes CO_2 equivalents) below 1990. Compared to the base year[4], emissions in 2006 were 2.7 % or 114 million tonnes CO_2 equivalents lower. Emissions decreased by 0.8 % (-34.9 million tonnes CO_2 equivalents) between 2005 and 2006.

Under 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 2006 total EU-15 GHG emissions were 3.7 index points above this target path (Figure ES.2).

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

[4] 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 deforestation for the Netherlands, Portugal and the UK (see tables 1.4 and 1.5).

Figure ES.2 EU-15 GHG emissions 1990–2006 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 2006 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 2006. 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 table 1.4).

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.

EU-27/15 trends: In 1990 EU-15 was responsible for 76.2% of EU-27's total GHG emissions. In 2006 EU-15 was responsbile for 80.7% of EU-27 emissions. Emissions in the EU-27 decreased more between 1990 and 2006 compared to the EU-15. This was mainly due to decreases in emissions from public electricity and heat production (-72.2 million tonnes) whereas emissions in this sector increased in the EU-15 (+69.3 million tonnes). Significant differences can also be observed for energy-related CO_2 emissions from manufacturing industries and construction excl. iron and steel (decreases in the EU-27 were by 69.6 million tonnes higher than in the EU-15), for CO_2 emissions from households and services (difference of 45.6 million tonnes) and for N_2O emissions from agricultural soils. In contrast, CO_2 emissions from road transport increased more strongly in the EU-27 than in the EU-15 (difference of 40.1 million tonnes).

EU27/15-main reasons for emissions changes 2005-2006

Between 2005 and 2006, relative emission decreases were higher in the EU-15 (-0.8 %) than in the EU-27 (-0.3 %). This was mainly due to larger increases of CO_2 emissions from public electricity and heat production, iron and steel production and road transport in the EU-27.

Table ES.0: EU27/15: Overview of Top decreasing/increasing source categories 2005-2006 (+/- 4 Million tonnes CO_2 equivalents)

Source category	EU-27	EU-15
	Million tonnes (CO_2 eq.)	
Households and services (CO_2 from 1A4)	-16.6	-18.8
Public Electricity and Heat Production (CO_2 from 1A1a)	+15.4	+6.1
Road transport (CO_2 from 1A3b)	+6.5	+2.1
Nitric acid production (N_2O from 2B2)	-6.3	-5.4
Manufacturing industries (excl. iron and steel) (Energy-related CO_2 from 1A2 excl. 1A2a)	-6.1	-2.6
Petroleum refining (CO_2 from 1A1b)	-5.4	-5.5
Adipic acid production (N_2O from 2B3)	-5.1	-5.1
Iron and steel production (CO_2 from 1A2a+2C1)	+5.0	-1.2
Total change 2005-2006	**-14.2**	**-34.9**

Notes: As the table only presents sectors that has increased/decreased equal or more than 4Mt CO_2 equivalents the sum for each country grouping EU27/15 does not neccsarily match the total change listed at the bottom of the table

EU-15 – main reasons for emission changes 2005-2006

The 34.9 million tonnes (CO_2 equivalents) decrease in GHG emissions between 2005-2006 was mainly due to:

- Lower CO_2 emissions from households and services (-18.8 million tonnes or -2.9 %).
  One important reason for the decrease are warmer weather conditions. The number of heating degree days decreased by 3.3 % between 2005 and 2006. Important decreases in CO_2 emissions from households and services were reported by France, Italy and the United Kingdom, while Germany reported substantial increases.
- Lower CO_2 emissions from petroleum refining (-5.5 million tonnes or -4.5 %) mainly in Italy and the UK.
- Lower N_2O emissions from Nitric Acid Production (-5.4 million tonnes or -16.3 %) mainly in Germany due to a decreased production rate.
- Lower N_2O emissions from Adipic Acid Production (-5.1 million tonnes or -43.6 %).
  The decrease of N_2O emissions from Adipic Acid Production is mainly caused by Italy due to abatement techniques.

Substantial increases in GHG emissions between 2005-2006 took place in the following source categories:

- CO_2 emissions from Public Electricity and Heat Production (+6.1 million tonnes or +0.6 %)
  CO_2 emissions from public electricity and heat production increased mainly in Denmark, Finland and the UK. In Denmark and Finland, this was mainly due to increased electricity production in coal-fired powerstations and decreased net imports of electricity. In Finland, reduced electricity production from hydropower was another reason for the emission reduction. In the UK, the decrease in CO_2 emissions was mainly caused by a fuel shift from gas to coal.
- HFC emissions from Refrigeration and Air Conditioning (+2.9 million tonnes or +8.1 %)

mainly in France and Germany.

EU-27 – main reasons for emission changes 2005-2006

Between 2005 and 2006, decreases in the EU-27 were mainly due to:

- CO_2 from households and services (-16.6 million tonnes or -2.2 %)
  Reductions in the EU-27 were lower than in the EU-15 due to a substantial increase in Poland´s households (+2.6 million tonnes). Especially the consumption of solid fuels increased.
- N_2O from nitric acid production (-6.3 million tonnes or -13.1 %) significantly in the EU-15 only.
- CO_2 from manufacturing industries excl. iron and steel (-5.4 million tonnes or -4.0 %). Emission decreases were mainly due to decreases in chemical industry in France and Hungary. Emissions from 'other' industries decreased in Poland, Romania and the UK. Significant increases in chemical industries occurred in the Czech Republic.

Substantial emission increases were due to:

- CO_2 from public electricity and heat production (+15.4 million tonnes or +1.1 %)
  In Poland, emissions increased by 7.6 million tonnes due to increased electricity production in thermal power plants.
- CO_2 from road transportation (+6.5 million tonnes or +0.7 %)
  Emissions from road transport increased in Spain and Poland, while they decreased in Germany. In Spain, the use of gasoline decreased by 4.6 %, whereas diesel consumption increased by 5.1 %. In Poland, both gasoline and diesel consumption increased by 6.1 % and 7.2 %, respectively. The German emissions reductions were mainly due to decreased gasoline consumption (-5.6 %)
- CO_2 from iron and steel production (+5.0 million tonnes or +4.6 %)
  Emissions increased mainly in Poland and Italy. In Italy, this was mainly due to an increase in solid fuel consumption (+8.6 %). In Germany and France, emissions decreased.

Overview of GHG emissions in EU Member States

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

MEMBER STATE	1990 (million tonnes)	Kyoto Protocol base year [1] (million tonnes)	2006 (million tonnes)	Change 2005–2006 (million tonnes)	Change 2005–2006 (%)	Change 1990-2006 (%)	Change base year–2006 (%)	Targets 2008–12 under Kyoto Protocol and "EU burden sharing" (%)
Austria	79,2	79,0	91,1	-2,2	-2,3%	15,1%	15,2%	-13,0%
Belgium	144,5	145,7	137,0	-5,4	-3,8%	-5,2%	-6,0%	-7,5%
Denmark	69,0	69,3	70,5	6,9	10,9%	2,1%	1,7%	-21,0%
Finland	70,9	71,0	80,3	11,3	16,3%	13,2%	13,1%	0,0%
France	563,3	563,9	541,3	-13,8	-2,5%	-3,9%	-4,0%	0,0%
Germany	1227,7	1232,4	1004,8	-0,2	0,0%	-18,2%	-18,5%	-21,0%
Greece	104,6	107,0	133,1	-0,7	-0,5%	27,3%	24,4%	25,0%
Ireland	55,5	55,6	69,8	-0,6	-0,8%	25,6%	25,5%	13,0%
Italy	516,9	516,9	567,9	-10,0	-1,7%	9,9%	9,9%	-6,5%
Luxembourg	13,2	13,2	13,3	0,03	0,2%	1,0%	1,2%	-28,0%
Netherlands	211,7	213,0	207,5	-4,3	-2,0%	-2,0%	-2,6%	-6,0%
Portugal	59,1	60,1	83,2	-4,2	-4,8%	40,7%	38,3%	27,0%
Spain	287,7	289,8	433,3	-7,5	-1,7%	50,6%	49,5%	15,0%
Sweden	72,0	72,2	65,7	-1,2	-1,7%	-8,7%	-8,9%	4,0%
United Kingdom	768,5	776,3	652,3	-3,0	-0,5%	-15,1%	-16,0%	-12,5%
EU-15	**4243,8**	**4265,5**	**4151,1**	**-34,9**	**-0,8%**	**-2,2%**	**-2,7%**	**-8,0%**
Bulgaria	116,7	132,6	71,3	0,8	1,2%	-38,9%	-46,2%	-8,0%
Cyprus	6,0	Not applicable	10,0	0,2	1,6%	66,0%	Not applicable	Not applicable
Czech Republic	194,2	194,2	148,2	2,5	1,7%	-23,7%	-23,7%	-8,0%
Estonia	41,6	42,6	18,9	-0,4	-2,3%	-54,6%	-55,7%	-8,0%
Hungary	98,2	115,4	78,6	-1,6	-2,0%	-20,0%	-31,9%	-6,0%
Latvia	26,5	25,9	11,6	0,5	4,4%	-56,1%	-55,1%	-8,0%
Lithuania	49,4	49,4	23,2	0,5	2,4%	-53,0%	-53,0%	-8,0%
Malta	2,2	Not applicable	3,2	-0,01	-0,3%	45,0%	Not applicable	Not applicable
Poland	453,6	563,4	400,5	14,1	3,7%	-11,7%	-28,9%	-6,0%
Romania	247,7	278,2	156,7	4,7	3,1%	-36,7%	-43,7%	-8,0%
Slovakia	73,7	72,1	48,9	-0,4	-0,9%	-33,6%	-32,1%	-8,0%
Slovenia	18,6	20,4	20,6	0,1	0,6%	10,8%	1,2%	-8,0%
EU-27	**5572,2**	**Not applicable**	**5142,8**	**-14,0**	**-0,3%**	**-7,7%**	**Not applicable**	**Not applicable**

([1]) The base year under the Kyoto Protocol for each Member State and EU-15 is further outlined in Table 1.4 and 1.5. As Cyprus, Malta and EU-27 do not have targets under the Kyoto Protocol and they do not have applicable Kyoto Protocol base years .

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 1990–2006. The most important GHG by far is CO_2, accounting for 83 % of total EU-27 emissions in 2006 excluding LULUCF. In 2006, EU-27 CO_2 emissions without LULUCF were 4 258 Tg, which was 3.1 % below 1990 levels. Compared to 2005, CO_2 emissions increased by 0.002 %.

Table ES.2 Overview of EU-27 GHG emissions and removals from 1990 to 2006 in CO_2 equivalents (Tg)

GREENHOUSE GAS EMISSIONS	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Net CO_2 emissions/removals	3.984	3.732	3.789	3.732	3.726	3.672	3.688	3.746	3.699	3.790	3.814	3.827	3.755
CO_2 emissions (without LULUCF)	4.392	4.141	4.242	4.154	4.142	4.076	4.100	4.179	4.155	4.263	4.283	4.258	4.258
CH_4	603	546	539	522	508	497	484	469	459	449	436	429	424
N_2O	525	464	470	468	445	423	422	416	405	405	409	404	392
HFCs	28	41	47	54	55	48	47	46	48	53	54	58	62
PFCs	20	14	13	11	10	10	8	8	9	8	6	6	5
SF_6	11	16	15	14	13	11	11	11	10	9	9	9	10
Total (with net CO_2 emissions/removals)	**5.171**	**4.812**	**4.873**	**4.800**	**4.757**	**4.661**	**4.660**	**4.695**	**4.631**	**4.714**	**4.729**	**4.733**	**4.647**
Total (without CO2 from LULUCF)	**5.579**	**5.221**	**5.326**	**5.222**	**5.174**	**5.065**	**5.072**	**5.128**	**5.087**	**5.187**	**5.198**	**5.163**	**5.150**
Total (without LULUCF)	**5.572**	**5.214**	**5.320**	**5.216**	**5.167**	**5.058**	**5.066**	**5.121**	**5.080**	**5.180**	**5.191**	**5.157**	**5.143**

EU-15: Table ES.3 gives an overview of the main trends in EU-15 GHG emissions and removals for 1990–2006. Also in the EU-15 the most important GHG is CO_2, accounting for 84 % of total EU-15 emissions in 2006. In 2006, EU-15 CO_2 emissions without LULUCF were 3 466 Tg, which was 3.4 % above 1990 levels. Compared to 2005, CO_2 emissions decreased by 0.6 %. The largest four key sources account for 79 % of total CO_2 emissions in 2006. The main reason for increases between 1990 and 2006 was growing road transport demand. The large increase in road transport-related CO_2 emissions was only partly offset by reductions mainly in energy-related emissions from Manufacturing Industries.

Table ES.3 Overview of EU-15 GHG emissions and removals from 1990 to 2006 in CO_2 equivalents (Tg)

GREENHOUSE GAS EMISSIONS	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Net CO_2 emissions/removals	3,085	3,006	3,032	3,009	3,062	3,042	3,056	3,119	3,089	3,147	3,183	3,197	3,109
CO_2 emissions (without LULUCF)	3,353	3,277	3,355	3,301	3,347	3,321	3,349	3,418	3,409	3,488	3,508	3,486	3,466
CH_4	439	413	407	395	385	377	366	353	343	331	320	314	308
N_2O	400	379	385	384	365	345	343	336	328	328	328	324	311
HFCs	28	41	47	53	54	47	46	44	46	49	50	53	56
PFCs	18	11	11	10	9	9	7	6	8	7	5	4	4
SF_6	11	15	15	14	13	11	11	10	9	9	9	9	9
Total (with net CO_2 emissions/removals)	**3,981**	**3,866**	**3,897**	**3,864**	**3,888**	**3,831**	**3,829**	**3,869**	**3,823**	**3,870**	**3,895**	**3,902**	**3,798**
Total (without CO2 from LULUCF)	**4,249**	**4,137**	**4,220**	**4,156**	**4,172**	**4,109**	**4,122**	**4,168**	**4,143**	**4,212**	**4,220**	**4,190**	**4,155**
Total (without LULUCF)	**4,244**	**4,133**	**4,216**	**4,152**	**4,168**	**4,105**	**4,118**	**4,164**	**4,139**	**4,207**	**4,216**	**4,186**	**4,151**

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

EU-27: Table 2.4 gives an overview of EU-27 GHG emissions in the main source categories for 1990–2006. The most important sector by far is Energy accounting for 80 % of total EU-27 emissions in 2006. 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 2006 in CO_2 equivalents (Tg)

GHG SOURCE AND SINK	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1. Energy	4.277	4.029	4.141	4.037	4.024	3.965	3.974	4.058	4.030	4.131	4.137	4.109	4.099
2. Industrial Processes	478	455	452	459	432	392	404	393	389	400	412	416	417
3. Solvent and Other Product Use	13	11	11	11	11	11	11	11	10	10	10	10	10
4. Agriculture	592	513	515	515	513	509	501	493	487	482	481	474	473
5. Land-Use, Land-Use Change and Forest	-401	-403	-446	-415	-410	-397	-405	-426	-449	-466	-463	-424	-496
6. Waste	216	210	206	198	191	185	179	171	167	161	155	151	148
7. Other	-3	-4	-4	-4	-4	-4	-4	-4	-3	-3	-3	-3	-3
Total (with net CO_2 emissions/removals)	**5.171**	**4.812**	**4.873**	**4.800**	**4.757**	**4.661**	**4.660**	**4.695**	**4.631**	**4.714**	**4.729**	**4.733**	**4.647**
Total (without LULUCF)	**5.572**	**5.214**	**5.320**	**5.216**	**5.167**	**5.058**	**5.066**	**5.121**	**5.080**	**5.180**	**5.191**	**5.157**	**5.143**

EU-15: Table ES.5 gives an overview of EU-15 GHG emissions in the main source categories for 1990–2006. 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 2006 in CO_2 equivalents (Tg)

GHG SOURCE AND SINK	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1. Energy	3,256	3,175	3,261	3,195	3,237	3,215	3,232	3,304	3,292	3,365	3,375	3,352	3,327
2. Industrial Processes	373	371	368	378	358	325	329	321	319	324	330	332	328
3. Solvent and Other Product Use	10.178	9	9	9	9	9	9	9	9	8	8	8.067	8
4. Agriculture	434	413	417	417	417	416	413	404	399	395	393	387	384
5. Land-Use, Land-Use Change and Forest	-263	-267	-319	-287	-280	-275	-289	-295	-316	-337	-321	-284	-353
6. Waste	175	169	165	157	151	144	139	130	125	118	113	110	107
7. Other	-3	-4	-4	-4	-4	-4	-4	-4	-4	-3	-3	-3	-3
Total (with net CO_2 emissions/removals)	**3,981**	**3,866**	**3,897**	**3,864**	**3,888**	**3,831**	**3,829**	**3,869**	**3,823**	**3,870**	**3,895**	**3,902**	**3,798**
Total (without LULUCF)	**4,244**	**4,133**	**4,216**	**4,152**	**4,168**	**4,105**	**4,118**	**4,164**	**4,139**	**4,207**	**4,216**	**4,186**	**4,151**

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 1990–2006. Member States show large variations in GHG emission trends.

Table ES.6 Overview of Member States' contributions to EC GHG emissions excluding LULUCF from 1990 to 2006 in CO_2 equivalents (Tg)

Member State	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Austria	79	81	84	83	83	81	81	85	87	93	92	93	91
Belgium	145	150	154	146	151	145	146	145	143	146	146	142	137
Denmark	69	76	90	80	76	73	68	69	69	74	68	64	70
Finland	71	71	77	76	72	72	70	75	77	85	81	69	80
France	563	555	571	564	577	561	556	558	549	552	552	555	541
Germany	1.228	1.095	1.115	1.077	1.052	1.021	1.019	1.036	1.017	1.030	1.028	1.005	1.005
Greece	105	110	114	119	124	124	128	130	129	134	134	134	133
Ireland	56	59	61	63	66	67	69	71	69	69	69	70	70
Italy	517	530	523	530	541	547	552	558	559	574	578	578	568
Luxembourg	13	10	10	10	9	10	10	10	11	12	13	13	13
Netherlands	212	224	232	225	227	214	214	215	215	216	218	212	207
Portugal	59	70	68	71	76	84	82	83	88	83	85	87	83
Spain	288	319	311	332	342	371	385	385	403	410	426	441	433
Sweden	72	74	77	73	73	70	68	69	70	71	70	67	66
United Kingdom	768	707	727	704	699	668	670	673	653	659	658	655	652
EU-15	**4.244**	**4.133**	**4.216**	**4.152**	**4.168**	**4.105**	**4.118**	**4.164**	**4.139**	**4.207**	**4.216**	**4.186**	**4.151**
Bulgaria	117	88	86	83	74	69	69	69	66	71	71	70	71
Cyprus	6	7	8	8	8	8	9	9	9	10	10	10	10
Czech Republic	194	153	160	153	145	140	147	149	145	146	147	146	148
Estonia	42	21	22	21	20	18	18	18	18	20	20	19	19
Hungary	98	79	81	80	79	79	78	79	77	81	79	80	79
Latvia	26	12	13	12	11	11	10	11	11	11	11	11	12
Lithuania	49	22	23	23	24	21	19	20	21	21	22	23	23
Malta	2	3	3	3	3	3	3	3	3	3	3	3	3
Poland	454	441	448	443	414	401	389	386	373	385	384	386	400
Romania	248	184	190	170	152	135	139	144	150	157	159	152	157
Slovakia	74	53	51	50	51	50	48	50	49	50	50	49	49
Slovenia	19	19	19	20	19	19	19	20	20	20	20	20	21
EU-27	**5.572**	**5.214**	**5.320**	**5.216**	**5.167**	**5.058**	**5.066**	**5.121**	**5.080**	**5.180**	**5.191**	**5.157**	**5.143**

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 339 million tonnes CO_2 euqivalents compared to 1990 (***5***).

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 share of 11 %. Italy's GHG emissions were about 10% above 1990 levels in 2006. Italian GHG emissions increased since 1990 primarily from road transport, electricity and heat production and petrol-refining. France's emissions were 4 % below 1990 levels in 2006. 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 2006.

Spain and Poland are the fifth and sixth largest emitters in the EU-27, both accounting for about 8 % of total EU-27 GHG emissions. Spain increased emissions by 51 % between 1990 and 2006. This was largely due to emission increases from road transport, electricity and heat production, and manufacturing industries. Poland decreased GHG emissions by 12 % between 1990 and 2006 (-29 % 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.

(***5***) The EU-15 as a whole needs emission reductions of total GHG of 8 %, i.e. 341 million tonnes on the basis of the 2008 inventory in order to meet the Kyoto target.

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 1990–2006. All emissions were reduced significantly from 1990 levels: the largest reduction was achieved in SO_2 (– 73 %), followed by CO (– 56 %), NMVOC (– 44 %) and NO_x (– 34 %).

Table ES.7 Overview of EU-15 indirect GHG and SO_2 emissions for 1990–2006 (Gg)

GREENHOUSE GAS EMISSIONS	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
	(Gg)												
NOx	13,575	11,911	11,639	11,222	11,016	10,734	10,423	10,189	9,884	9,708	9,463	9,205	8,893
CO	52,470	42,069	40,540	38,551	36,871	34,619	32,128	30,573	28,485	27,543	26,538	24,716	23,261
NMVOC	16,181	13,331	12,836	12,621	12,178	11,711	10,982	10,500	9,988	10,039	9,495	9,247	9,093
SO2	16,497	9,934	8,874	8,159	7,625	6,752	6,039	5,803	5,583	5,146	4,940	4,622	4,410

In the EU-27, SO_2 emissions decreased by 69 %, followed by CO (-53 %), NMVOC (-39 %) and NO_x (-34 %) (Table ES.8).

Table ES.8 Overview of EU-27 indirect GHG and SO_2 emissions for 1990–2006 (Gg)

GREENHOUSE GAS EMISSIONS	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
	(Gg)												
NOx	16,864	14,533	14,319	13,824	13,404	12,972	12,247	11,881	11,562	11,443	11,613	11,310	11,079
CO	64,480	51,517	50,622	48,187	45,914	43,391	38,087	35,928	33,755	32,811	34,789	32,512	30,443
NMVOC	18,240	15,144	14,751	14,488	14,005	13,459	12,219	11,982	11,611	11,598	11,428	11,144	11,079
SO2	24,976	16,620	15,434	14,412	12,751	11,294	9,947	9,634	9,145	8,698	8,515	8,002	7,795

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 2006. 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 ([6]).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 2007 submission by the European Commission to the UNFCCC Secretariat of the *Annual European Community greenhouse gas inventory 1990–2005 and inventory report 2007* (EEA, 2007a) and in the report entitled *Greenhouse gas emission trends and projections in Europe 2007* (EEA, 2007b).

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 and EU-27 although more detail is provided for EU-15 (for more information 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.

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 by its Member States.

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

Secondly, under the monitoring mechanism, the European Commission has to assess annually whether the actual and projected progress of Member States is sufficient to ensure fulfilment of the 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 ([7]). The purpose of this decision is to: (1) monitor all anthropogenic GHG emissions covered by the Kyoto Protocol in the Member States; (2) evaluate progress towards meeting GHG reduction commitments under the UNFCCC and the Kyoto Protocol; (3) implement the UNFCCC and the Kyoto Protocol as regards national programmes, greenhouse gas inventories, national systems and registries of the 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 ([8]). 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 information.

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

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

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. 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) ([9]).

Figure 1.1 Inventory system of the European Community

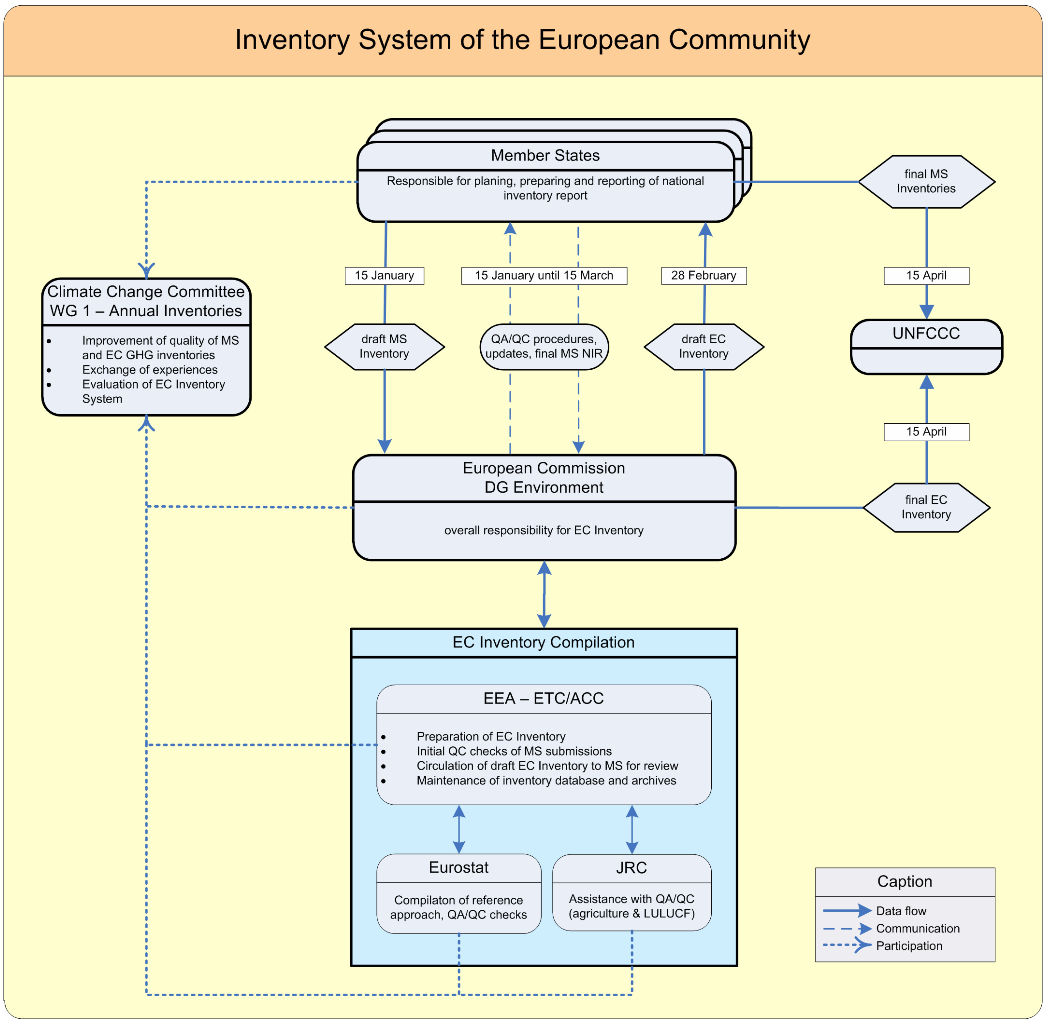


Table 1.1 shows the main institutions and persons involved in the compilation and submission of the EC inventory.

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

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 Wörlitzer Platz 1, D-06844 Dessau-Roßlau
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	Sorin Deaconu National Environmental Protection Agency Splaiul Independentei 294, Sector 6, Cod Postal 060841, Bucharest, Romania
Slovakia	Janka Szemesova Department of Emissions, Slovak Hydrometeorological Institute Jeseniova 17, 833 15 Bratislava, Slovak Republic

Member State/EU institution	Contact address
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 Environment S-103 33 Stockholm
United Kingdom	SL Choudrie AEA group 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)	Andreas Barkman, Ricardo Fernandez European Environment Agency Kongens Nytorv 6, DK-1050 Copenhagen, Denmark
European Topic Centre on Air and Climate Change (ETC/ACC)	Bernd Gugele, Elisabeth Rigler, Sabine Goettlicher, 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 EU15 Member States

MS	Content	Source
Austria	Austria has a centralized inventory system, with all the work related to inventory preparation being carried out at a single national entity. The most important legal arrangement is the Austrian Environmental Control Act (Umweltkontrollgesetz, Federal Law Gazette 152/1998). It defines the main responsibility for inventory preparation and identifies the Umweltbundesamt as the one single national entity with overall responsibility for inventory preparation. The "Inspection body for GHG inventory" within the Umweltbundesamt is responsible for the compilation of the GHG inventory. Sector experts collect activity data, emission factors and all relevant information needed for finally estimating emissions. The sector experts also have specific responsibilities regarding the choice of methods, data processing and archiving and for contracting studies, if needed. As part of the quality management system the head of the "Inspection body for GHG inventory" approves the methodological choices. Sector experts are also responsible for performing Quality Control (QC) activities that are incorporated in the Quality Management System (QMS). During the inventory preparation process, all data collected together with emission estimates are fed into a database, where data sources are well documented for future reconstruction of the inventory. The Austrian Inventory is based on the SNAP nomenclature and has to be transformed into the UNFCCC CRF to comply with the reporting obligations under the UNFCCC. In addition to the actual emission data, the background tables of the CRF are filled in by the sector experts, and finally QA/QC procedures as defined in the inventory planning process are carried out before the data are submitted to the UNFCCC. For inventory management reliable data management has been established to fulfil the data collecting and reporting requirements. This ensures the necessary documentation and archiving for future reconstruction of the inventory and consequently enables easy access to up-to-date and previously submitted data for the quantitative evaluation of recalculations. As part of the QMS (Corrective and Preventive Actions) an efficient process is established to grant transparency when collecting and analyzing findings by UNFCCC review experts or any other issues concerning the quality of activity data, emission factors, methods and other relevant technical elements of inventories. Any findings and discrepancies are documented; responsibilities, resources and a time schedule are attributed to each of these in the improvement plan. Measures, which include possible recalculations, are taken by the sector experts. The national energy balance is the most important data basis for the Austrian Air Emissions Inventory. The Austrian statistical office (Statistik Austria) is required by contract with the Federal Ministry of Agriculture, Forestry, Environment and Water Management and with the Federal Ministry of Economics and Labour to annually prepare the national energy balance. The compilation of several other relevant statistics is regulated by law. Other data sources include reporting obligations under national and European regulations and reports of companies and associations. The main data sources used for activity data were: • Energy Balance from Statistik Austria; EU-ETS; Steam boiler database (for the sector Energy) • National production statistics, import/export statistics; EU-ETS; direct information from industry or associations of industry (for the sector Industry) • Import/export statistics, production statistics, consumption statistics (for the sector Solvents) • National Studies, national agricultural statistics obtained from Statistik Austria (for the sector Agriculture) • National forest inventory obtained from the Austrian Federal Office and Research Centre for Forest (for the sector LULUCF) • Database on landfills Umweltbundesamt (for the sector Waste). The main sources for emission factors are: (1) national studies for country specific emission factors, (2) plant-specific data reported by plant operators (3) IPCC GPG (4) Revised IPCC 1996 Guidelines (5) EMEP/CORINAIR Guidebook.	Austria's Annual Greenhouse Gas Inventory 1990–2006 Jan 2008 pp. 15-17
Belgium	In the Belgian federal context, major responsibilities related to environment lie with the regions. Compiling GHG inventories is one of these responsibilities. Each region implements the necessary means to establish their own emission inventory in accordance with the IPCC guidelines. The emission inventories of the three regions are subsequently combined to form the national GHG 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 coordination 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 Coordination Committee for International Environmental Policy (CCIEP), where the different actors decide how the regional data will be aggregated to a national total, taking into account the specific characteristics and interests of each region as well as the available means. This working group consists of representatives of the 3 regions and of the federal public services. The Interregional Environment Unit (CELINE - IRCEL) is responsible for integrating the emission data from the inventories of the three regions and for compiling the national inventory. The National inventory report is then formally submitted to the National Climate Commission, established by the Cooperation agreement of 14 November 2002, for approval, before its submission to the secretariat of the United Nations Framework Convention on Climate Change and to the European Commission, under the Council Decision 280/2004/EC concerning a Mechanism for Monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol.	Belgium's GHG Inventory (1990 – 2006) National Inventory Report submitted under the United Nations Framework Convention on Climate Change Mar 2008 pp.1-2
Denmark	NERI (National Environmental Research Institute) is responsible for the annual preparation and submission to EU and to UNFCCC of the National Inventory Report and the GHG inventories in the Common Reporting Format in accordance with the UNFCCC Guidelines. NERI is since January 1, 2007 under the University of Aarhus. A new ministry has been formed in November 2007: The Ministry of Climate and Energy. The Danish Energy Authority is under this ministry. For mobile sources, national sea transport and fisheries, the fuel consumption of heavy oil and gas oil for national sea transport is calculated based on new research. Fuel adjustments are made in the fishery sector (gas oil) and stationary industry sources (heavy fuel oil) in order to maintain the grand national energy balance.	Danish Annual EC Greenhouse Gas Inventory 1990-2006 Jan 2008 p.1

MS	Content	Source
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 GHG inventory from the beginning of 2005. Statistics Finland is the general authority of the official statistics of Finland and is independently responsible for GHG emission inventory preparation, reporting and submission to the United Nations Framework Convention on Climate Change (UNFCCC). 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 GHG inventories. The quality requirements are fulfilled by implementing consistently the inventory quality management procedures. An advisory board of the GHG inventory set up by the Statistics Finland reviews the achieved quality of the inventory and decides about changes to the inventories 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. 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 the 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. 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. Separate agreements have been made on the division of responsibilities and co-operation between Statistics Finland and the ministries.	GHG Emissions in Finland 1990-2006 National Inventory Report to the European Union Draft Jan 2008 pp. 14-15
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)

<table>
<tr><th>MS</th><th>Content</th><th>Source</th></tr>
<tr><td>Germany</td><td>The national Inventory System in Germany complies with the requirements laid down in the Guidelines for National Systems (UNFCCC Decision 19/CMP.1). The use of the IPCC-Guidelines and IPCC Good Practice Guidance and a continuous Quality Management and continuous improvement of the inventory ensure a transparent, consistent, comparable, complete and accurate inventory. In the position paper “Nationales System” (June 2007) Umweltbundesamt was laid down as the national coordination centre for emission inventory reporting.
Other involved institutions and agencies:
• Federal Ministry of the Environment, Nature Conservation and Nuclear Safety (BMU)
• Federal Ministry for Consumer Protection, Food and Agriculture (BMELV)
• Federal Ministry of of the Interior (BMI)
• Federal Ministry of Defence (BMVg)
• Federal Ministry of Finace (BMF)
• Federal Ministry of Economis and Technology
• Federal Ministry of Transport, Building and Urban Affairs
Tasks of the national coordination centre (Umweltbundesamt)are:
Planning of the inventories
Compilation of the inventories
Archiving of the inventories
Quality control and Quality Assurance
To meet these tasks the national coordination centre has developed a database “Zentrale System Emissionen” (which is the main instrument for documentation and quality assurance on the level of data) and the Quality sytem “Emissionsinventare” (which regulates responsibilities and quality aims).
The national coordination centre within UBA cooperates with other working groups within UBA. For coordination of the tasks within UBA a working team “Arbeitskreis Emissionsinventare” was installed. Research centres contribute to inventory compilation with research projects that are carried out within the framework of the research programme “Umweltforschungsplan”. For the integration of non-governmental organisation a convention was devised that binds the respective entities to contribute to the inventory compilation.</td><td>Nationaler Inventarbericht Zum Deutschen Treibhausgasinventar 1990 - 2006 Mar 2008 pp. 51-57 (submited in German, translated)</td></tr>
<tr><td>Greece</td><td>The Ministry for the Environment, Physical Planning and Public Works (henceforth Ministry for the Environment, MINENV) 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 ministries involved, as well as of 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 and more specifically the Division of Air Pollution and Noise Control has the overall responsibility for the national GHG inventory, and the official consideration and approval of the inventory prior to its submission.
The entities participating in it are:
• The Ministry for the Environment designated as the national entity responsible for the national inventory, which keeps the overall responsibility, but also plays a more active role in the inventory planning, preparation and management.
• The National Technical University of Athens (NTUA) / School of Chemical Engineering, which has the technical and scientific responsibility for the compilation of the annual inventory.
• Governmental agencies and ministries, international associations, along with individual private industrial companies. The involvement of these entities is not limited to data providing but also concerns methodological issues as appropriate.
The Ministry for the Environment, designated as the national entity, has the overall responsibility for the national GHG inventory. Among its responsibilities are the following:
• The co-ordination of all ministries and governmental agencies involved, as well as any relevant public or private organization
• The official consideration and approval of the inventory prior to its submission
• The response to any issues raised by the inventory review process under Article 8 of the Kyoto Protocol, in co-operation with the NTUA Inventory Team
• The timely submission of the GHG inventory to the European Commission and to the
• UNFCCC Secretariat
• The keeping of the Centralised Inventory File, which is delivered to the technical responsible for the inventory institution (currently NTUA) at the beginning of each inventory cycle. Thus, the continuity of the inventory preparation process and knowledge transfer between the bodies which undertake the technical responsibility of the GHG inventory preparation is ensured
• The administration of the National Registry. Greece cooperates with the Member states of the European Union and with the supplementary transaction log and the registry of the European Community by maintaining the national registries in a consolidated system
MINENV has an active role in monitoring and participating in the inventory process through continuous communication and frequent scheduled and / or ad-hoc meetings with the Inventory Team of NTUA and the competent ministries involved.</td><td>Annual Inventory submission under the convention and the Kyoto Protocol for Greenhouse and other Gases for years 1990-2006, Apr 2008, pp.5-12</td></tr>
</table>

MS	Content	Source
Ireland	In 2005, UK consultants NETCEN carried out a scoping study to identify the essential elements and structure of a national inventory system for Ireland to meet the needs of Decision 280/2004/EC and to comply with obligations under Articles 5 and 7 of the Kyoto Protocol. The establishment of Ireland's national inventory system was completed by Government Decision in early 2007, building on the framework that has been applied for many years. It puts in place formal procedures for the planning, preparation and management of the national atmospheric inventory and identifies the roles and responsibilities of all the organisations involved in its compilation. All formal mechanisms together with the QA/QC procedures are fully operational in this present reporting cycle. The EPA Office of Climate, Licensing and Resource Use (OCLR) is the inventory agency and the EPA is also designated as the single national entity with overall responsibility for the annual greenhouse gas inventory. As a formal management system, the national system aims for continuous improvement to increase the quality and robustness of the national atmospheric inventory over time. In addition to the primary data received from the key data providers, the inventory team obtains considerable supplementary information from other teams in OCLR and the Office of Environmental Enforcement within the EPA. These sources include Annual Environmental Reports (AER) submitted by licensed companies and the National Waste Database. The inventory team also draws on national research related to greenhouse gas emissions and special studies undertaken from time to time to acquire the information needed to improve the estimates for particular categories and gases. The approval of the completed annual inventory involves sign-off by the QA/QC manager and the inventory manager before it is transmitted to the Board of the EPA via the Programme Manager of the Climate Change Unit in OCLR.	Ireland National Inventory Report 2008,GHG emissions 1990-2006 reported to the UNFCCC Mar 2008 pp.6-7
Italy	A Legislative Decree, issued on 27th February 2008, institutes the National System for the Italian Greenhouse Gas Inventory. The Agency for Environmental Protection and Technical Services (APAT) is the single entity in charge of the development and compilation of the national greenhouse gas emission inventory. The Ministry for the Environment, Land and Sea is responsible for the endorsement of the inventory and for the communication to the Secretariat of the Framework Convention on Climate Change and the Kyoto Protocol. The inventory is also submitted to the European Commission in the framework of the Greenhouse Gas Monitoring Mechanism. The Agency develops annually a national system document which includes all update information on institutional, legal and procedural arrangements for estimating emissions and removals of greenhouse gases and for reporting and archiving inventory information. A specific unit of the Agency is responsible for the compilation of the Italian Atmospheric Emission Inventory and the Italian Greenhouse Gas Inventory in the framework of both the Convention on Climate Change and the Convention on Long Range Transboundary Air Pollution. The whole inventory is compiled by the agency; scientific and technical institutions and consultants may help in improving information both on activity data and emission factors of some specific activities. All the measures to guarantee and improve the transparency, consistency, comparability, accuracy and completeness of the inventory are undertaken. APAT bears the responsibility for the general administration of the inventory, co-ordinates participation in reviews, publishes and archives the inventory results. Specifically, APAT is responsible for all aspects of national inventory preparation, reporting and quality management. Activities include the collection and processing of data from different data sources, the selection of appropriate emissions factors and estimation methods consistent with the IPCC 1996 Revised Guidelines, the IPCC Good Practice Guidance and Uncertainty management and the IPCC Good Practice Guidance for land use, land- use change and forestry, the compilation of the inventory following the QA/QC procedures, the assessment of uncertainty, the preparation of the National Inventory Report and the reporting through the Common Reporting Format, the response to the review process, the updating and data storage. Different institutions are responsible for statistical basic data and data publication, which are primary to APAT for carrying out emission estimates. These institutions are part of the National Statistical System (Sistan), which provides national official statistics, and therefore are asked periodically to update statistics; moreover, the National Statistical System ensures the homogeneity of the methods used for official statistics data through a coordination plan, involving the entire public administration at central, regional and local levels. The National Statistical System is coordinated by the Italian National Institute of Statistics (ISTAT). Ministries, public agencies and other bodies are obliged to provide the data and information specified in the annual statistical plan; the same obligations regard the private entities. All the data are protected by the principles of statistical disclosure control and can be distributed and communicated only at aggregate level. The main Sistan products, which are primarily necessary for the inventory compilation, are: • National Statistical Yearbooks, Monthly Statistical Bulletins, by ISTAT (National Institute of Statistics) • Annual Report on the Energy and Environment, by ENEA (Agency for New Technologies, Energy and the Environment) • National Energy Balance (annual), Petrochemical Bulletin (quarterly publication), by MSE (Ministry of Economic Development) • Transport Statistics Yearbooks, by MINT (Ministry of Transportation) • Annual Statistics on Electrical Energy in Italy, by GRTN (National Independent System Operator) • Annual Report on Waste, by APAT • National Forestry Inventory, by MIPAAF (Ministry of Agriculture, Food and Forest Policies). The national emission inventory itself is a Sistan product.	Italian Greenhouse Gas Inventory 1990-2006 National Inventory Report 2008, Apr 2008, pp.19-22

MS	Content	Source
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 pp.1-2 (no report for 2008 submission)
Netherlands	The Ministry of Housing, Spatial Planning and the Environment (VROM) has the 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 (PRTR system) and to co-ordinate the preparation of the NIR and filling the CRF. 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) QA/QC activities as part of the National System and coordination of the support/response to the UNFCCC review process. A Pollutant Emission Register (PRTR) 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. In April 2004 full co-ordination of the PRTR 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 PRTR 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 PRTR by performing calculations or submitting activity data. Among them are 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). The NIR is prepared by MNP. Since mid-2005, the NIR has been part of the PRTR project. Most institutes involved in the PRTR also contribute to the NIR (including CBS and TNO, among others). In addition, SenterNovem is involved in its role as NIE.	MNP report 500080009 /2008 Greenhouse Gas Emissions in the Netherlands 1990-2006 National Inventory Report Jan 2008 p. 16
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 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. Three bodies are established with differentiated responsibilities. The Institute for the Environment (IA) is responsible for the overall coordination and updating of the National Inventory of Emissions by Sources and Removals by Sinks of Air Pollutants (INERPA), the inventory's approval, after consulting the Focal Points and the involved entities; and its submission to EC and international bodies to which Portugal is associated. The sectoral Focal Points work with IA in the preparation of INERPA, and are responsible for for steering intra and inter-sectoral cooperation to ensure a more efficient use of resources. 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. The National Environmental Agency (Agência Nacional do Ambiente - APA) is the national entity responsible for the overall coordination of the Portuguese inventory of air pollutants emissions. According to these attributions, APA makes an annual compilation of the Portuguese Inventory of air emissions which includes GHGs and sinks, acidifying substances as well as other pollutants. The reporting obligations to the EU and the international instances are also under the responsibility of the APA. However many other institutions and agencies contributed to the inventory process, providing activity data, sectoral expert judgement, technical support and comments. Annually reported data, e.g. CRF tables, are stored both in paper and magnetic format.	Short Draft Portuguese National Inventory Report on Greenhouse Gases, 1990-2006, Jan 2008, pp. 5-9

MS	Content	Source
Spain	The "Directorate-General for Environmental Quality and Evaluation at the Ministry of the Environment" (DGCEA) is the National Authority for the National Air Pollutant Emissions Inventory System. The air pollutant emissions inventories are considered to be statistics for State purposes and as such, in accordance with article 149.1.31 of the Spanish Constitution, are performed on the basis of the exclusive responsibility of the State. In this sense, the regulatory frame of reference is provided by the Spanish Public Statistical Function Act (Law 12 dated May 9th, 1989) and by 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. The DGCEA is technically supported by AED-NSD-TWOBE. Further, DGCEA cooperates with Research Institutes and University Departments, e.g. with the • Escuela Técnica Superior de Ingenieros Industriales-Universidad Politécnica de Madrid (for projections) • Sistema y Technoligías de la Producción Animal-Universidad Politécnica de Valencia (for the Sector Agriculture) • Centro de Investigaciones Energéticas Medioambientales y Tecnológicas (for quality assurance in the Sector Energy) Further several ministries participate in the NIS. • Ministry of Agriculture, fisheries and food (Agriculture) • Ministry of Industry, Tourism and Trade (Energy and Industrial Processes) • The Tax Ministry (general statistics (e.g. census)) • Ministry of Public Safty (Transport Statistics) • Ministry of Development (Transport)	Inventario de Emisiones de gases de efecto invernadero de España, años 1990-2006 Apr 2008, Sec. 1.2 (submitted in Spanish, translated)
Sweden	The Swedish Ministry of Environment has overall responsibility and submits the inventory report to the European Commission and to the UNFCCC secretariat. The Swedish Environmental Protection Agency (Swedish EPA) co-ordinates the activities for developing the inventory report and is also responsible for the final quality control and quality assurance of the data before it 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 all sectors. A national system meeting the requirements laid down in article 5.1 of the Kyoto Protocol is developed and was fully in operation in 2006. The process of inventory preparation is carried out differently for the different sectors: • ENERGY- STATIONARY COMBUSTION: Activity data is collected for the following subgroups: Energy industries: Data from quarterly fuel statistics, a total survey conducted by Statistics Sweden at plant level and by fuel type. For some petroleum refining plants, data from the European Union Emission Trading Scheme (ETS) is used. Manufacturing industries: Data mainly from the quarterly fuel statistics, a sample survey conducted by Statistics Sweden. In some cases data from the industrial energy statistics is used as a complement. All data is at plant level and by fuel type. Other sectors: Data from official statistical reports prepared by Statistics Sweden at national level and by fuel type. • ENERGY- MOBILE COMBUSTION: Data on fuel consumption at national level and by fuel type is collected and used in combination with emissions data and fuel data from the National Road Administration, the National Rail Administration, the Civil Aviation Administration and the Swedish Military. • INDUSTRIAL PROCESSES: The reported data for industrial processes is mainly based on information from environmental reports. The data in the environmental reports refer to emissions derived from plant specific measurements or estimates such as mass balances. The use of default emission factors is limited. • SOLVENT AND OTHER PRODUCT USE: Data used for estimating emissions from solvent and other product use are based on emission factors and national activity data obtained from the Products register kept by the Swedish Chemicals Inspectorate. • AGRICULTURE: Data on animal numbers, crop areas, yields, sales of manure, manure management and stable periods are taken from official statistical reports. Some complementary information is collected from organisations and researchers, such as the Swedish Dairy Association, Swedish Poultry Meat Association, SLU and the Swedish Institute of Agricultural and Environmental Engineering. • LAND USE, LAND USE CHANGE AND FORESTRY: Estimates presented in the LULUCF sector are mainly based on data from the SLU. The SLU is responsible for the National Forest Inventory, which focuses on living biomass, and for the Swedish Forest Soil Inventory, that focuses on dry organic matter and on soil organic carbon. The two inventories are integrated and use the same infrastructure for the field sample. • WASTE: Statistics on deposited waste quantities, methane recovery and nitrogen emissions from wastewater handling, are provided by the Swedish Association of Waste Management (Avfall Sverige, former RVF), Statistics Sweden, the Swedish Forest Industries Federation and the Swedish EPA. If new data on organic content in household waste or other relevant research is published, such reports are also considered. A new system for handling emission data, entitled TPS, has been developed and used for the first time in submission 2007. It supports data input from Microsoft Excel sheets, and provides different types of quality gateways. For instance the system makes it possible for multiple users such as the SMED consortium and the national independent reviewers to plot time series and make comparisons between different years and submissions. For all CRF codes and sub-codes, time series from 1990-2005 of emission data, activity data, and implied emission factors where relevant can be presented. The system also allows for different types of data output, e.g. to the CRF Reporter.	Sweden's National Inventory Report 2008 Jan 2008 pp.26-28

MS	Content	Source
United Kingdom	The UK Greenhouse Gas Inventory is compiled and maintained by AEA Energy and Environment of AEA Technology plc – the Inventory Agency - under contract with the Climate, Energy and Ozone, Science and Analysis (CEOSA) Division in the UK Department for Environment, Food & Rural Affairs (Defra). AEA Energy and Environment is directly responsible for producing the emissions estimates for CRF categories Energy (CRF sector 1), Industrial Processes (CRF sector 2), Solvent and Other Product Use (CRF sector 3), and Waste (CRF Sector 6). AEA Energy and Environment is also responsible for inventory planning, data collection, QA/QC and inventory management and archiving. Agricultural sector emissions (CRF sector 4) are produced by the Defra's Sustainable Agriculture Strategy (SAS) Division by means of a contract with the Institute of Grassland and Environmental Research (IGER). Land-Use Change and Forestry emissions (CRF sector 5) are calculated by the UK Centre for Ecology and Hydrology (CEH), under separate contract to CEOSA. Defra is the Single National Entity responsible for submitting the UK's greenhouse gas inventory to the UNFCCC. 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) As the designated Single National Entity for the UK GHG National Inventory System (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 and organisational structure; implementation of legal instruments and contractual developments as required to meet guidelines.) As the designated Inventory Agency for the UK GHG National Inventory System, AEA Energy and Environment has the following roles and responsibilities: • Planning (co-ordination with Defra to deliver the NIS; review of current NIS performance and assessment of required development action; scheduling of tasks and responsibilities to deliver GHG inventory and NIS) • Preparation (drafting of agreements with key data providers; review of source data & identification of developments required to improve GHG inventory data quality. • Management (documentation & archiving; dissemination of information regarding NIS to Key Data Providers; management of inventory QA/QC plans, programmes and activities. • Inventory Compilation (data acquisition, processing and reporting; delivery of NIR)	UK Greenhouse Gas Inventory, 1990-2006 Annual Report for submission under the Framework Convention on Climate Change Mar 2008 pp. 43-48

Table 1.3 Summaries of institutional arrangments/national systems of new Member States

MS	Content	Source
Bulgaria	The Ministry of Environment and Water (MoEW) is the responsible institution for the national GHG inventory to the Secretariat of the UNFCCC. All activities on preparation of GHG inventory in Bulgaria are coordinated and managed on a state level by the Ministry of Environment and Water. The Executive Environment Agency (ExEA) is a subsidiary authority to the Ministry of Environment and Water that is responsible for the whole preparation of the GHG inventory. It coordinates all activities, related to collecting inventory data of GHG emissions by the following state authorities: • National Statistical Institute (NSI) • Ministry of Economy and Energy • Statistics Department within Ministry of Agriculture and Food Supplies (MAF) • State Forestry Agency; • Soil Resource Executive Agency within MAF • National Service for Plant Protection, Quarantine and Agro chemistry • Operators of large combustion plants and large points sources • Road Control Department (RCD) within the Ministry of Internal Affairs 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 wastewater, 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. The GHG inventory represents a process, covering the following main activities: • Collecting, processing and assessment of input data on used fuels, materials and other GHG emission sources • Selection and application of emission factors for estimating the emissions • Determination of the basic (key) GHG emission sources and assessment of the results uncertainty. An important inventory stage is the process of data transformation into a form, suitable for CRF. During this process, aggregation of the fuels by type is made (solid, liquid and gaseous), and further data is added. The basic source for emission factors for current inventory are the country specific practices, IPCC Revised Guidelines and the Good Practice Guidelines and CORINAIR methodology.	Short National Inventory Report of Greenhouse Gas Emissions in Republic Bulgaria 1988-2006 Jan 2008 pp.2-3

MS	Content	Source
Cyprus	The Ministry of Agriculture, Natural Resources and Environment (MANRE) is the Cyprus governmental body responsible for the development and implementation of environmental policy in Cyprus. In this context and by a Presidential Decision, the Ministry of Agriculture, Natural Resources and Environment, and more specifically the Environment Service has 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 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 other government agencies. The main data sources used are the Cyprus Statistical Service, the government agencies involved and private companies (National Statistical Service, Energy Service, Cyprus Electricity Authority, Verifiers Reports (2005, 2006), Ministry for Transport, Civil Aviation Authority, Industrial units, Department of Labour Inspection, Ministry of Agriculture,Natural Resources and Environment,UN Food and Agricultural Organisation, General Directorate for the Forests and the Natural Environment, Ministry of Interior The main methodological references for the estimation of GHG emissions/removals were the following: • Revised 2006 IPCC Guidelines for National Greenhouse Gas Inventories • Good Practice Guidance and Uncertainty Management in National GreenhouseGas Inventories • Good Practice Guidance for Land Use, Land Use Change and Forestry • CORINAIR methodology.	National Inventory Report 2006 2008 Submission Mar 2008 pp. 2-3
Czech Republic	In the Czech Republic, the Ministry of the Environment (MoE) is the national entity with overall responsibility for the NIS. The National Inventory System - NIS was established in accord with Decision 280/2004/EC, article 4.4. For this system rules were accepted from resolution 20/CP.7 (FCCC/CP/13/Add.3) that was approved by COP/MOP-1 in Montreal, December 2005. The Czech Hydrometeorological Institute (CHMI), founded by the MoE, is designated as the coordinating and managing organisation responsible for the compilation of the national greenhouse gas inventory and reporting its results. The main roles and responsibilities of the CHMI are: inventory management, general and cross-cutting issues, QA/QC, reporting data (CRF), preparation of NIR, communication with the relevant UNFCCC and EU bodies, etc. Sectoral inventories are prepared by specialized institutions (sectoral compilers), which are coordinated and controlled by the CHMI. The responsibilities for the GHG inventory compilation from individual sectors are allocated as follows: • KONEKO marketing, Ltd. (KONEKO): responsibility for the inventory compilation in the Energy sector, in particular for stationary sources and fugitive emissions • The Transport Research Centre (CDV): responsibility for the inventory compilation in the Energy sector, in particular for mobile sources • The Czech Hydrometeorological Institute (CHMI): responsibility for the inventory compilation in the Industrial Processes and Product Use sectors • The Institute of Forest Ecosystem Research (IFER: responsibility for the inventory compilation in the Agriculture and Land Use, Land Use Change and Forestry sectors • Charles University Environment Centre (CUEC): 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 the Article 3.1 of Decision No 280/2004/EC Jan 2008 pp. 1-2

MS	Content	Source
Estonia	Single national entity with overall responsibility for the Estonian GHG inventory is the Estonian Ministry of the Environment (MoE). Financial resources for the GHG inventory is planned in the State Budget. Practical work has been done on the basis of contracts. The inventory is produced in collaboration between the MoE, Estonian Environment Information Centre (EEIC) and Tallinn University of Technology (TUT). The Estonian Environmental Research Centre (EERC) is also involved since 2007. **The MoE is responsible for:** • Coordinating the overall inventory preparation process • Approving the inventory before official submission to the UNFCCC • Concluding the formal agreements with inventory compilers annually by 1st of July (TUT, EERC, etc) • Coordinating the cooperative work between the inventory compilers and UNFCCC • Informing the inventory compilers about the requirements of the national system and ensuring that existing information in national institutions is considered and used in the inventory where appropriate • Coordinating the UNFCCC inventory reviews. **Climate and Ozone Bureau in EEIC is responsible for:** • Completing the National Inventory Report according to the parts submitted by the inventory compilers • Reporting the greenhouse gas inventory to the UNFCCC, including the National Inventory Report and CRF tables • Coordinating the QA/QC plan • Preparation of the UNFCCC inventory reviews and coordinating the communication with the expert review team, including responses to the review findings • Overall archiving system The Department of Thermal Engineering and Department of Chemistry at Tallinn University of Technology prepare the estimates for the Energy, Industrial Processes, Agriculture, Waste and LULUCF sectors. They collect activity data, prepare relevant QC, fill in the sectoral data to the CRF Reporter and prepare sectoral parts of the NIR. They also have archiving system for the sectors that they are working with. The EERC is responsible for the industrial process sector together with the fluorinated gases estimates in the 2008 inventory preparation. The MoE has signed an agreement with TUT and EERC. Through these agreements, the institutions are committed to implement the QA/QC, uncertainty analysis and archiving procedures, documentation, making information available for review, and delivering data and information in a timely manner to meet the deadline for reporting to the UNFCCC. The main sources of data are from official Estonian statistics (the Statistical Office of Estonia, Estonian Animal Recording Center) and from company's annual emission reports.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.	Greenhouse Gas Emissions in Estonia 1990-2006 NIR 2007 Jan 2008 pp. 17-24
Hungary	The Minister for Environment and Water has overall responsibility for the Hungarian Greenhouse Gas Inventory and the Hungarian National System for Climate Reporting. He is responsible for the institutional, legal and procedural arrangements for the national system and the strategic development of the national inventory. Therefore the designated *single national entity* is the Ministry of Environment and Water. Within the ministry, the Climate Change and Energy Department administers this responsibility by supervising the national system. Based on a mandate of the minister, a GHG division was established in the Hungarian Meteorological Service (OMSZ) for the preparation and development of the inventory. This division is responsible for all inventory related tasks, prepares the greenhouse gas inventories and other reports with the involvement of external institutions and experts on a contractual base and supervises the maintenance of the system. The GHG division can be regarded as a core expert team of four people. The division of labour and the sectoral responsibilities within the team are laid down in the QA/QC plan and other official documents of OMSZ. The Head of Division coordinates the teamwork and organizes the cooperation with other institutions involved in inventory preparations. He is responsible for compilation of CRF tables and NIR. The GHG division coordinates the work with other involved ministries, government agencies, consultants, universities and companies in order to be able to draw up the yearly inventory report and other reports to the UNFCCC and the European Commission. Some parts of the inventory (mainly energy and waste) are prepared by the experts of the GHG division themselves. In the industry and solvent sector the former inventory compiler acted as sectoral expert, so he collected the data and prepared the inventory. The agriculture sector of the inventory has been prepared by the Research Institute for Animal Breeding and Nutrition for several years. This institute collects the data, chooses the calculation method, prepares the inventory in CRF format and sends it to the inventory compiler in xml format. For the forestry part of the LULUCF sector an internationally recognized expert is responsible for data collection, inventory preparation. For the revision of soil C stock changes Karcag Research Institute of University of Debrecen (Department of Soil Utilization and Rural Development) was contracted last year. For the preparation of the wastewater category of the inventory the Research Institute for Environmental and Water Management (VITUKI) is involved. The annual inventory cycle is carried out in accordance with the principles and procedures set out in the IPCC (1996) Guidelines and the IPCC Good Practice Guidance. Data are collected from the emitter if it is possible (especially in case of power stations, heating stations and industrial technologies) but statistical databases are also heavily used as source of information. The most important statistical publications are the Statistical Yearbook of Hungary, the Environmental Statistical Yearbook of Hungary both published by the Hungarian Central Statistical Office (HCSO) and the Energy Statistical Yearbook published by the Energy Efficiency, Environment and Energy Information Agency. Since the use of ETS data has several advantages, the inventory team was granted access to the verified emissions database held by the National Inspectorate for Environment, Nature and Water. Basically, the sectoral experts are responsible for the choice of methods and emission factors. The calculation method – allowing for a few exceptions – was chosen by taking into account the technologies available in Hungary and according to the recommendations of the IPCC Guidelines.	NIR for 1985-2006, Hungary (Draft Excerpts) Jan 2008 pp. 9-12

MS	Content	Source
Latvia	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 (MoE), Climate and Renewable Energy Department. LEGMA is a governmental institution under the supervision of the MoE and is responsible for preparing GHG inventory, including compilation of results, data management and archiving and QA/QC procedures. Activity data is mainly collected from other institutions and is used by LEGMA to calculate emissions. This is done at the Division Environmental Pollution of LEGMA. Before GHG inventory are reported to European Commission and UNFCCC secretariat it is forwarded to the MoE for final approval. The main data supplier for the Latvian air emission inventory is the Central Statistical Bureau of Latvia (CSB) with which LEGMA has signed a special agreement about supplying the necessary data. According to the above mentioned Ordinance, Ministry of Agriculture (MoA) is responsible for performing emission and removal calculations for the LULUCF sector. Latvia's GHG emissions inventories are based on the Revised 1996 Guidelines for National Greenhouse Gas Inventories (1997), IPCC Guidelines 2006, Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (2000) and Good Practice Guidance for Land Use, Land-Use Change and Forestry (2003) and EMEP/CORINAIR Emission Inventory Guidebook – 3rd editions (2002) according to the UNFCCC recommendations for inventories. The main sources for emission factors are: • National studies for country specific parameters and emission factors (e.g. CO_2 emission factors, aspects influencing SO_2 emission factors, distribution of animal waste management systems, average N excretion and etc.); • IPCC 1996; • IPCC GPG 2000; • IPCC GPG LULUCF 2003; • EMEP/CORINAIR Guidebook. The updated CRF Reporter version 3.2 is used for data compiling. To calculate GHG emissions, a supplemental locally developed database in Excel format was used for all sectors except for Road Transport and partly for Agriculture sector, where COPERT III and IPCC Software were used.	Latvia's Draft National Iventory Report 1990 – 2006 Jan 2008 pp.11-13
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 Ministry of Environment is responsible for: • Overall coordination of GHG inventory process • Final checking and approval of GHG inventory procedures • Approval of QA/QC plan and procedures • Checking of consistency of data, documenting, processing, archiving • Checking and approval of reports provided by the inventory experts. The Ministry of Environment annually submits GHG inventory reports to European Commission and UNFCCC secretariat. The Ministry of Environment establishes and operates the GHG inventory database and archive. The Ministry of Environment is a single location where archives of GHG submissions and all supporting reference material is stored and maintained. Backups are prepared on regular basis following the MoE information management procedures. 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. Before submission, reports are forwarded to the National Climate Change Committee for final approval. 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. The Inventory preparation is coordinated by the Center for Environmental Policy which is responsible for compilation of the final report based on the sectoral reports provided by the experts/consultants. The most important data providers are Statistics department of Lithuania, Environmental Protection Agency, Lithuanian Energy Institute, State Forest Survey Service, Lithuanian Forest Research Institute, Institute of Physics, Lithuanian Institute of Agrarian Economics, Lithuanian Institute of Agriculture, Geological Survey of Lithuania, industry companies etc. The tasks and responsibilities of the participants in inventory-related activities are defined as follows: Data providers are responsible for: collection of activity data, applying QC procedures (documentation in checklists to be provided to Center for Environmental Policy) and the evaluation of uncertainties of the initial data. Among the responsibilities of the GHG Inventory experts team are the evaluation of requirements for new data, based on internal and external reviews, the determination of activity data, the determination of appropriate emission factors, the data quality control and the filling sectoral CRF tables. The team is made of technical experts responsible for GHG inventory in separate sectors. The group has to meet in decided periods but at least two times per year to discus new items related to GHG inventory. Among the responsibilities of the Center for Environmental Policy are the checking and archiving of supplied input data, the checking of assumptions and data selection criteria, the checking of data processing procedures and emission calculations and the coordination of QA/QC activities and preparation of QC and QA procedures. Further, the Center for Environmental Policy assigns the QA/QC coordinator, who is responsible for ensuring that QA/QC system is implemented and functions. The Center for Environmental Policy as a coordinating institution is responsible also for establishing quality assurance system comprising review procedures conducted by personnel not directly involved in inventory compilation/development	National GHG Emission Inventory Report 2007 of the Republic of Lithuania, Dec 2007 pp. 10-13
Malta	A standardized Quality Assurance/Quality Control system within the national inventory system is needed. This need is addressed in the ongoing development of the system in general. A QA/QC system will incorporate a series of tasks which when completed will ensure the quality and reliability of the activity data, emission factors and emission estimates, in line with the principles of transparency, accuracy, consistency, comparability and completeness. An effort has been made to ensure as high a level of quality and reliability as possible.	National Greenhouse Gas Emissions Inventory Report for Malta 1990 - 2006 Mar 2008 pp.10-11

MS	Content	Source
Poland	The GHG inventory is compiled by the National Emission Centre established in 2000 at the Institute of Environmental Protection in Warsaw. The National Emission Centre has been commissioned by the Polish Ministry of Environment to carry out inventories for the GHGs and other air pollutants. Since 2006 NEC is located within the National Administrator of Emission Trading Scheme established also in the Institute of Environmental Protection. When compiling the inventory, the National Emission Centre collaborates with a number of individual experts as well as institutions. Among the latter are: Central Statistical Office), Agency of Energy Market, Institute of Ecology of Industrial Areas in Katowice, Institute of Automobile Transport as well as Office for Forest Planning and Management The GHG emission estimates are based on methodologies elaborated by the Intergovernmental Panel on Climate Change (IPCC) and recommended by the UNFCCC, while emissions of indirect gases according to methodology elaborated by UN ECE/EMEP. Wherever necessary and possible, domestic methodologies and emission factors have been developed to reflect specific national conditions. The most important features of the inventory preparation and archiving can be briefly summarized in the following way: • activity data are mostly taken from official public statistics or when required data are not directly available, (commissioned) research reports or expert estimates are used instead, • emission factors for the main emission categories are mostly taken from reports on domestic research; IPCC default data are used in cases where the emission factors are highly uncertain (e.g. N_2O emissions from animal waste in agriculture, and CH_4 and N_2O emission from stationary combustion), or when particular source category contribution to national total is insignificant, • all activity data, emission factors and resulting emission data are stored at the National Emission Centre database, which is constantly updated and extended to meet the ever changing requirements for emission reporting, with respect to UNFCCC and LTRAP as well as their protocols.	Republic of Poland Minister of Environment Report for the European Commission fulfilling obligations under Article 3.1 of Decision 280/2004/EC Jan 2008 p.3
Romania	The Governmental Decision no. 1570/2007 establishing the National System for the estimation of the anthropogenic GHG emissions levels from sources and removals by sinks, is regulating all the institutional and procedural aspects in order to support the estimation of the GHG emissions levels and the reporting and the archiving of the Greenhouse Gas Inventory information. The aim of the Governmental Decision is to ensure the fulfillment of the provisions and of the obligations Romania assumed through the Kyoto Protocol and the European Community legislation. The competent authority, which is responsible for administrating the National System, is the National Environmental Protection Agency (NEPA), in the subordination of the Ministry of Environment and Sustainable Development (MESD). NEPA has also the obligation of the preparation of the NGHGI. Central public authorities and the institutions under their authority, in their coordination or subordination, different research institutes, the economic operators and the ownership and professional associations have all different responsibilities of delivering relevant activity data. However, the main activity data supplier remains the National Institute for Statistics (NIS) through the yearly-published documents like National Statistical Yearbook and the Energy Balance. In 2002, the Ministry of Environment and the National Institute for Statistics signed a protocol of co-operation. Under this protocol, NIS agreed to provide, besides its yearly publication, additional data, necessary for the inventory preparation. Starting with the 2006 – 2nd submission of the NGHGI, the LULUCF sector began to be prepared by NEPA experts. Previously, the LULUCF sector has been prepared by the Forest Research Institute (ICAS), under a contract with the National Research and Development Institute for Environmental Protection (ICIM Bucharest; the entity previously responsible for inventory preparation). MESD submits the National Greenhouse Gas Inventory to the United Nations Framework Convention on Climate Change Secretariat, to the European Commission and to the European Environment Agency taking into account the specific deadlines.	Romania's Greenhouse Gas Inventory 1989-2006 National Inventory Report Mar 2008 pp.25-28
Slovakia	The Slovak Ministry of the Environment (MoE) is responsible for national environmental policy including climate change and air protection issues as a National Focal Point. The official publication about National inventory system for GHG emissions and projection under Article 5 of the Kyoto Protocol was published in the official journal of the Ministry of Environment of the Slovak Republic http://www.enviro.gov.sk/servlets/files/16715. Supporting institutions founded by the Ministry of Environment include the Slovak Hydrometeorological Institute (SHMI) (www.shmu.sk), the Water Research Institute, and the Slovak Environmental Agency. National emission inventories are compiled on contractual bases annually, in cooperation with external consultants, NGOs, scientific institutes and universities (e.g., Agricultural University, Research Institute for Transport, Chemical Technical University, Forestry Research Institute, Association for cooling and air condition technique, Central register for waste and wastewater etc.). The SHMI is developing and maintaining a National Emission Inventory System (NEIS) – i.e. a database of stationary sources to follow development of emissions of SO2, NOx, CO at regional level and to fulfil reporting commitments of national and EU Directives. The SHMI is annually updating the incoming information and activity data with the corresponding statistical information from Statistic Office of the Slovak Republic and other national statistics. Setting up a National Inventory System of emissions in compliance with the Kyoto Protocol and Council Decision 280/2004/EC is the priority of capacity development in the Slovak Republic at all levels identified also as a middle-term objective (2003–2007) of the Strategy of Slovak Republic.	National GHG Emission Inventory Report 2007 of the Republic of Lithuania (Reported Inventory 1990-2006), Apr 2007 pp. 16-18

MS	Content	Source
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 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. The Environmental Agency of the Republic of Slovenia has decided to implement a unified system of collecting data for the purposes of making inventories. 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 A Memorandum of Understanding has been concluded with institutions that participate in the preparation. These institutions are bound to submit quality and verified data to the Environmental Agency in due time.	Slovenia's National Inventory Report 2008 Jan 2008 pp. 5-8

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 for the years 2007-2010. The ETC/ACC involves 10 organisations and institutions in eight European countries. The technical annex for the 2008 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 xml-files into the CRF aggregator database which was developped for aggregating the EC submission from MS submissions. From the CRF aggregator the aggregated EU inventory is transferred into the CRF reporter software for preparing the official EU GHG inventory submission.

Table 1.3 Annual process of submission and review of Member States inventories and compilation of the 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).

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 ([10]). 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 EU-15 Member States and EU-15. Table 1.5 shows the base year emissions for the new EC Member States.

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

EU-15 MS	CO_2, CH_4, N_2O	HFC, PFC, SF_6	Base year emissions 1) (Tonnes CO_2 equivalents)
Austria	1990	1990	79,049,657
Belgium	1990	1995	145,728,763
Denmark 2)	1990	1995	69,323,336
Finland	1990	1995	71,003,509
France	1990	1990	563,925,328
Germany	1990	1995	1,232,429,543
Greece	1990	1995	106,987,169
Ireland	1990	1995	55,607,836
Italy	1990	1990	516,850,887
Luxembourg	1990	1995	13,167,499
Netherlands	1990	1995	213,034,498
Portugal	1990	1995	60,147,642
Spain	1990	1995	289,773,205
Sweden	1990	1995	72,151,646
United Kingdom 2)	1990	1995	776,337,201
EU-15	1990	1990 (AT, FR, IT) 1995 (other MS)	4,265,517,719

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) The base year emissions relate to the EC territory of Denmark and the UK.

Source: Initial review reports of the EU-15 Member States (www.unfccc.int)

Table 1.5 Base year emissions for the new Member States

New MS	CO_2, CH_4, N_2O	HFC, PFC, SF_6	Base year emissions 1) (Tonnes CO_2 equivalents)
Bulgaria	1988	1995	132,618,640
Cyprus	Not relevant	Not relevant	
Czech Republic	1990	1995	194,248,218
Estonia	1990	1995	42,622,310
Hungary	1985-87	1995	115,397,149
Latvia	1990	1995	25,909,160
Lithuania	1990	1995	49,414,386
Malta	Not relevant	Not relevant	
Poland	1988	1995	563,442,774
Romania	1989	1989	278,225,022
Slovakia	1990	1990	72,050,764
Slovenia	1986	1995	20,354,042

1) Base-year emissions exclude emissions and removals from the LULUCF sector but include emissions due to deforestation in the case of Member States for which LULUCF constituted a net source of emissions in 1990.

Source: Initial review reports of the new Member States (www.unfccc.int) except for Bulgaria and Romania; for Bulgaria and Romania the intial reports have been used.

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

The reference approach is calculated for the EU-15 on the basis of Eurostat energy data (see Section 3.6) and the key source analysis (Section 1.5) is separately performed at EU-15 level ([11]).

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

([11]) 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.

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 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 2008. 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. Member States use notation keys like IE or C if they cannot provide an emission estimate for a certain sub-category. At Member State level, the use of the notation keys makes transparent the reason for not providing emission estimates. However, at EU-15 level, the sub-category emission value is the sum of Member States emission values and the information of the notation keys used by some Member States is lost in the EU-15 CRF submission. In order to make this more transparent, the CRF tables now include the values or notation keays reported by the MS as comments. In addition, 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 1.6 lists the procedures applied:

Table 1.6 Internal consistency of the EU-15 CRF tables and reallocation of sources

Industrial processes	
• Table 2(I):	- the sum of 2B was included in 2B5 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.
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 - CH_4 removals are missing the CRF tables because CRF Reporter software does not allow entry of negative emissions in this source category for EU-27, but is included in sector 7.
• 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.

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[12]. 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 2006 and a trend assessment was performed for the base year to 2006. 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 2006. The key category analysis including LULUCF resulted in 85 key categories. The results of the EU-15 key category analysis including LULUCF is presented in Table 1.7.

- In addition to the key category analysis for the EU-15 also a key category analysis for the EU-27 was made. More details related to the key category analysis are included in Annex 1.

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

Table 1.7 Key categories for the EU-15 (million tonnes)

Key category	1990	2006
1 A 1 a Public Electricity and Heat Production: Gaseous Fuels (CO_2)	60	233
1 A 1 a Public Electricity and Heat Production: Liquid Fuels (CO_2)	124	67
1 A 1 a Public Electricity and Heat Production: Other Fuels (CO_2)	14	31
1 A 1 a Public Electricity and Heat Production: Solid Fuels (CO_2)	750	687
1 A 1 a Public Electricity and Heat Production: Solid Fuels (N_2O)	7	6
1 A 1 b Petroleum refining: Gaseous Fuels (CO_2)	4	9
1 A 1 b Petroleum refining: Liquid Fuels (CO_2)	99	109
1 A 1 b Petroleum refining: Solid Fuels (CO_2)	4	1
1 A 1 c Manufacture of Solid fuels and Other Energy Industries: Gaseous Fuels (CO_2)	17	20

[12] 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.

Key category	1990	2006
1 A 1 c Manufacture of Solid fuels and Other Energy Industries: Solid Fuels (CO_2)	73	31
1 A 2 a Iron and Steel: Gaseous Fuels (CO_2)	16	21
1 A 2 a Iron and Steel: Liquid Fuels (CO_2)	7	4
1 A 2 a Iron and Steel: Solid Fuels (CO_2)	94	72
1 A 2 b Non-Ferous Metals: Solid Fuels (CO_2)	4	2
1 A 2 c Chemicals: Gaseous Fuels (CO_2)	28	31
1 A 2 c Chemicals: Liquid Fuels (CO_2)	31	22
1 A 2 c Chemicals: Other Fuels (CO_2)	3	7
1 A 2 c Chemicals: Solid Fuels (CO_2)	8	5
1 A 2 d Pulp, Paper and Print: Gaseous Fuels (CO_2)	11	19
1 A 2 d Pulp, Paper and Print: Liquid Fuels (CO_2)	10	6
1 A 2 e Food Processing, Beverages and Tobacco: Gaseous Fuels (CO_2)	13	23
1 A 2 e Food Processing, Beverages and Tobacco: Liquid Fuels (CO_2)	15	10
1 A 2 e Food Processing, Beverages and Tobacco: Solid Fuels (CO_2)	5	2
1 A 2 f Other: Gaseous Fuels (CO_2)	105	143
1 A 2 f Other: Liquid Fuels (CO_2)	126	115
1 A 2 f Other: Other Fuels (CO_2)	3	6
1 A 2 f Other: Solid Fuels (CO_2)	120	38
1 A 3 a Civil Aviation: Jet Kerosene (CO_2)	16	25
1 A 3 b Road Transportation: Diesel oil (CO_2)	266	499
1 A 3 b Road Transportation: Diesel oil (N_2O)	3	8
1 A 3 b Road Transportation: Gasoline (CH_4)	4	1
1 A 3 b Road Transportation: Gasoline (CO_2)	363	289
1 A 3 b Road Transportation: Gasoline (N_2O)	3	9
1 A 3 b Road Transportation: LPG (CO_2)	7	5
1 A 3 c Railways: Liquid Fuels (CO_2)	8	6
1 A 3 d Navigation: Gas/Diesel Oil (CO_2)	12	14
1 A 3 d Navigation: Residual Oil (CO_2)	6	8
1 A 3 e Other Transportation: Gaseous Fuels (CO_2)	2	4
1 A 4 a Commercial/Institutional: Gaseous Fuels (CO_2)	59	99
1 A 4 a Commercial/Institutional: Liquid Fuels (CO_2)	74	57
1 A 4 a Commercial/Institutional: Solid Fuels (CO_2)	28	2
1 A 4 b Residential: Gaseous Fuels (CO_2)	162	239
1 A 4 b Residential: Liquid Fuels (CO_2)	170	153
1 A 4 b Residential: Solid Fuels (CO_2)	75	10
1 A 4 c Agriculture/Forestry/Fisheries: Gaseous Fuels (CO_2)	10	11
1 A 4 c Agriculture/Forestry/Fisheries: Liquid Fuels (CO_2)	57	51
1 A 4 c Agriculture/Forestry/Fisheries: Solid Fuels (CO_2)	4	1
1 A 5 a Stationary: Solid Fuels (CO_2)	5	0
1 A 5 b Mobile: Liquid Fuels (CO_2)	14	6
1 B 1 a Coal Mining: (CH_4)	44	11
1 B 2 a Oil: (CO_2)	10	10
1 B 2 b Natural gas: (CH_4)	26	20
1 B 2 c Venting and flaring: (CO_2)	6	6
2 A 1 Cement Production: (CO_2)	81	85
2 A 2 Lime Production: (CO_2)	17	18
2 A 3 Limestone and Dolomite Use: (CO_2)	6	8
2 B 1 Ammonia Production: (CO_2)	17	16
2 B 2 Nitric Acid Production: (N_2O)	37	28
2 B 3 Adipic Acid Production: (N_2O)	59	7
2 B 5 Other: (CO_2)	10	15
2 B 5 Other: (N_2O)	5	2
2 C 1 Iron and Steel Production: (CO_2)	72	66
2 C 3 Aluminium production: (PFC)	13	2

Key category	1990	2006
2 E 1 By-product Emissions: (HFC)	21	4
2 E 1 By-product Emissions: (SF_6)	2	0
2 E 3 Other : (HFC)	4	0
2 F 1 Refrigeration and Air Conditioning Equipment : (HFC)	0	40
2 F 2 Foam Blowing: (HFC)	0	3
2 F 4 Aerosols/ Metered Dose Inhalers: (HFC)	0	8
2 F 9 Other: (SF_6)	4	3
4 A 1 Cattle: (CH_4)	113	100
4 A 3 Sheep: (CH_4)	16	14
4 B 1 Cattle: (CH_4)	23	20
4 B 13 Solid Storage and Dry Lot: (N_2O)	23	21
4 B 8 Swine: (CH_4)	18	22
4 D 1 Direct Soil Emissions: (N_2O)	115	98
4 D 2 Pasture, Range and Paddock Manure: (N_2O)	28	26
4 D 3 Indirect Emissions: (N_2O)	81	68
5 A 1 Forest Land remaining Forest Land: (CO_2)	-306	-362
5 A 2 Land converted to Forest Land: (CO_2)	-40	-58
5 B 1 Cropland remaining Cropland: (CO_2)	18	10
5 B 2 Land converted to Cropland: (CO_2)	41	32
5 C 1 Grassland remaining Grassland: (CO_2)	22	22
5 C 2 Land converted to Grassland: (CO_2)	-18	-17
5 E 2 Land converted to Settlements: (CO_2)	14	12
6 A 1 Managed Waste disposal on Land: (CH_4)	130	72
6 A 2 Unmanaged Waste Disposal Sites: (CH_4)	13	7
6 B 2 Domestic and Commercial Wastewater: (CH_4)	9	7
6 B 2 Domestic and Commercial Wastewater: (N_2O)	9	10

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 1.8).

Table 1.8 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 xml-files into the ETC/ACC CRF aggregator database. The version of the data received by ETC/ACC are numbered, in order to be traced back to their source. The ETC/ACC CRF aggregator database is 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, 2007b); the report identifies sectoral indicators, for socioeconomic driving forces of greenhouse gas emissions, by using Member States indicator submissions under Council decision 280/2004 or data from Eurostat and from Member States' detailed inventories. In addition, it compares and analyses Member States' emission trends in the 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 2007, the internal review focused on the uncertainty estimates by identifying potential outliers of MS uncertainty estimates. In 2006 the following source categories have been reviewed by Member States experts: 1A1 'Energy industries', 1A2a 'Iron and steel production', 1.B 'Fugitive emissions from fuels', 2.A 'Mineral products', 2B 'Chemical industry', 2C 'Iron and steel production' and fluorinated gases, 2.E 'Production of halocarbons and SF_6' and 2.F 'Consumption of halocarbons and SF_6'. In 2005, the 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 Tables 1.9 and 1.10 give an overview of QA/QC procedures in place for the EU-15 Member States and the new Member States at Member State level. The information is taken from the Member State national inventory reports 2006, 2007 and 2008.

Table 1.9 Overview of quality assurance and quality control procedures in place for EU15 MS at Member State level (NIR descriptions)

MS	Description of the national QA/QC activities	Source
Austria	A quality management system (QMS) has been designed to achieve the objectives of GPG, 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. Since December 2005 the Umweltbundesamt has been accredited as inspection body (Id.No.241) in accordance with the Austrian Accreditation Law. The implementation of QA/QC procedures as required by the IPCC-GPG support the development of national GHG 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 2007.	Austria's Annual Greenhouse Gas Inventory 1990–2006 Jan 2008 p. 21
Belgium	The Working Group on « Emissions » of the Co-ordination Committee for International Environmental Policy (CCIEP) with representatives of the 3 regions and of the federal public services has conducted quality assurance 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 gives, besides the quality and assurance controls carried out within the responsible regions, extra control of the regional emission inventories as well. After compiling the Belgian greenhouse gas emission inventory by the national compiler, the regions carry out a last validation of the national inventory before the official submission takes place. Independent audits of the greenhouse gas inventories of the regions and the national inventory have started in the course of 2002 and the results became available in 2003. The difference between the actual situation in Belgium at that time and the fulfilling of the IPCC Guidelines was mainly the absence of the complete implementation of the IPCC Good PracticeGuidance for the Belgian emission inventory with respect to setting up a quality system. Calculations of uncertainties on greenhouse gas emissions on the national level are calculated on Tier 1-level. In Flanders, the procedures to prepare the Flemish energy balance are part of a certified ISO 9001 system since July 2000. A complete development of the QA/QC system as well as a first internal review became operational in the course of 2005. A responsible for the quality management system of the Flemish greenhouse gas inventory was nominated at that time. A full implementation of the quality system for all sectors and on the most detailed level is started in the beginning of 2006. 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. In Wallonia, the inventory is conducted by the cell Air, which is part of the General Directorate for Natural Resources and Environment, who has obtained an EMAS certification. An ISO 9001 certification is also foreseen in the near future. 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. The emissions from energy consumption constitute nearly all the emissions of this urban region in Belgium.	Belgium's GHG Inventory (1990 – 2006) National Inventory Report submitted under the United Nations Framework Convention on Climate Change Mar 2008 pp.9-12
Denmark	The Quality Control (QC) and Quality Assurance (QA) plan for greenhouse gas emission inventories performed by the Danish National Environmental Research Institute is in accordance with the guidelines provided by the UNFCCC (IPCC, 1997), and the Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC, 2000). The ISO 9000 standards are also used as important input for the plan. The QA/QC work is supported by an inventory file system, where all data, models and QA/QC procedures and checks are stored. The QA/QC plan will continuously improve these activities in the future. The Danish Quality Concept foresees quality management, quality planning, quality control, quality assurance and quality improvement. The strategy for process-oriented QC is based on setting up a system for the process of the inventory work.	Denmark's National Inventory Report 2008, Apr 2008, Section 1.6

MS	Description of the national QA/QC activities	Source
Finland	The quality management system is an integrated part of the national system. It ensures that the GHG 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 GHG. 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 GHG inventory at the national level. The expert organisations contributing to estimates of emission or removal are responsible for the quality of their own inventory calculations. 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. The QA/QC process of the inventory 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. The quality coordinator steers and facilitates the QA/QC process. The experts implement and document the QA/QC procedures in their respective inventory sectors. The inventory working group is established to advance communication between the inventory unit and the expert organisations in charge of the different sectors. The QA/QC related issues are discussed in the meetings of the inventory working group (4-7 meetings per year) and in the bilateral quality meetings between the inventory unit and the expert organisations (once a year). An electronic quality manual including e.g. guidelines, annual plans, templates, QA/QC plans and checklists is in place and available to all parties of the national inventory system via the Internet. Statistics Finland bears the responsibility for archiving the quality manual and for submissions of annual inventories (CRF tables and NIR). Expert organisations contributing to the sectoral calculation archive the primary data used, internal documentation of calculations and sectoral CRF tables. Statistics Finland co-ordinates the participation of the partners of the national system in the reviews, as well as responses to issues raised by the reviews of the UNFCCC Secretariat.	GHG Emissions in Finland 1990-2006 National Inventory Report to the European Union Draft Jan 2008 pp.21-22
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	The quality system “Qualitässystem Emissionsinventare” (QSE) is built on the requirements of the IPCC Good Practise Guidance (defined in chapter 8), the national requirements in Germany and the internal Structure within Umweltbundesamt (the national Coordination Centre for GHG inventory compilation). QSE covers all steps of the inventory preparation. Within Umweltbundesamt the UBA-Hausanordnung 11/2005 (a regulatory framework) is binding. QSE regulates responsibilities within the QA/QC system. The quality control checks for Tier 1 (pursuant paragraph 14 (g) of the Guidelines for National Systems) were carried out in 2005 the first time. They were sent to the experts together with the request for data. QC-checks were defined as quality aims. The fulfillmet or the absence of the fulfilment of these aims had to be justified. A general description of quality aims is given in the QSE-Handbook (derived from the IPCC Good Practise Guidance). According to the requirements for the IPCC GPG and Paragraph 12 (d) of the Guidelines for National Systems the necessary QA/QC activities should be summarised in a QA/QC plan. The QA/QC plan is combined with the checklist for QA/QC. Thus, both the QA/QC plans and QA/QC checklists are an instrument for the inspection of the fulfilment of the international requirements and allow for control over the quality of the inventory. In the quality improvement plan potential for improvement and findings from the independent inventory review are documented. Data are documented in a central archive. Either data are stored in the central archive directly or if for a given reason (e.g. confidentiality of the data) data is not stored in the central archive reference is given to place were the data is stored.	Nationaler Inventarbericht Zum Deutschen Treibhausgasinventar 1990 - 2006 Apr 2008 pp. 58-63 (submitted in German, translated)

MS	Description of the national QA/QC activities	Source
Greece	The QA/QC system is being implemented since April 2004. For the implementation of the QA/QC system the National Technical University of Athens is responsible (in close co-operation with the Ministry for the Environment). The system is based on the ISO 9001:2000 standard and its quality objectives, as stated in the quality management handbook, arethe following: • Compliance with the IPCC guidelines and the UNFCCC reporting guidelines while estimating and reporting emissions/removals. • Continuous improvement of GHG emissions/removals estimates. • Timely submission of necessary information in compliance with relevant requirements defined in international conventions, protocols and agreements. The accomplishment of the above-mentioned objectives can only be ensured by the implementation, from all the members of the Inventory Team. • The QA/QC system developed covers the following processes • QA/QC system management, comprising all activities that are necessary for the management and control of the inventory agency in order to ensure the accomplishment of the quality objectives. • Quality control that is directly related to the estimation of emissions. The process includes activities related to (a) data inquiry, collection and documentation, (b) methodological choice in accordance with IPCC Good Practice Guidance, (c) quality control checks for data from secondary sources and (d) record keeping. • Archiving inventory information, comprising activities related to centralised archiving of inventory information and the compilation of the national inventory report. • Quality assurance, comprising activities related to the different levels of review processes including the review of input data from experts, if necessary, and comments from the public • Estimation of uncertainties, defining procedures for estimating and documenting uncertainty estimates per source / sink category and for the whole inventory • Inventory improvement, that is related to the preparation and the justification of any • recalculations made.	Annual Inventory submissionunder the convention and the Kyoto Protocol for Greenhouse and other Gases for years 1990-2006, Apr 2008, pp.26-29
Ireland	In early 2005, the inventory agency in Ireland commissioned a project with UK consultants to establish formal QA/QC procedures in emission inventories that would meet the needs of the UNFCCC reporting requirements. The project developed a QA/QC system including a documented QA/QC plan and procedures along with a QA/QC manual. The manual provides a general overview to the QA/QC system and guidance on the application of the plan and procedures. The QA/QC plan identifies the specific data quality objectives related to the principles of transparency, consistency, completeness, comparability and accuracy required for Ireland's national inventory and provides specific guidance and documentation forms and templates for the practical implementation of QA/QC procedures. The QA/QC procedures cover such elements as data selection and acquisition, data processing and reporting so that the international requirements under the Kyoto Protocol and Decision 280/2004/EC are met. The manual provides guidance and templates for appropriate quality checking, documentation and traceability, the selection of source data and calculation methodologies and peer review and expert review of inventory data and outlines the annual requirements for continuous improvement for the inventory. The inventory agency used the 2006 reporting cycle to begin implementation of the basic elements of the new approach to QA/QC and its application was substantially completed in delivering the 2007 submission. The system facilitates record keeping related to the chain of activities from data capture, through emissions calculations and checking, to archiving and the identification of improvements. Ireland's calculation spreadsheets in all sectors have been restructured and reorganised to facilitate the QA/QC process and to facilitate more efficient analysis and to ensure ease of transfer of the outputs to the CRF Reporter Tool. This facilitates rapid year-on-year extension of the time-series and efficient updating and recalculation, where appropriate, in the annual reporting cycle. Internal aggregation to various levels corresponding to the CRF tables provides immediate and complete checks on the results. External reviews of the agriculture sector and of the entire ETS results for 2005 were conducted as important new components of quality assurance at the beginning of 2007. Inventory development continues to benefit from the internal review procedures that are ongoing with regard to the EU and its Member States.	Ireland National Inventory Report 2008,GHG emissions 1990-2006 reported to the UNFCCC Mar 2008 pp.15-7

MS	Description of the national QA/QC activities	Source
Italy	APAT has elaborated an inventory QA/QC plan which describes specific QC procedures to be implemented during the inventory development process, facilitates the overall QA procedures to be conducted, to the extent possible, on the entire inventory and establishes quality objectives. Particularly, an inventory QA/QC procedures manual has been drawn up which describes QA/QC procedures and verification activities to be followed during the inventory compilation and helps in the inventory improvement. Quality control checks and quality assurance procedures together with some verification activities are applied both to the national inventory as a whole and at sectoral level. Future planned improvements are prepared for each sector, by the relevant inventory compiler. Each expert identifies areas for sectoral improvement based on his own knowledge and in response to inventory UNFCCC reviews and other kind of processes. Checklists are compiled annually by the inventory experts and collected by the QA/QC coordinator. These lists are also registred in the 'reference' database. General QC procedures also include data and documentation gathering. Specifically, the inventory analyst for a source category maintains a complete and separate project archive for that source category; the archive includes all the materials needed to develop the inventory for that year and is kept in a transparent manner. All the information used for the inventory compilation is traceable back to its source. The inventory is composed by spreadsheets to calculate emission estimates; activity data and emission factors. Particular attention is paid to the archiving and storing of all inventory data, supporting information, inventory records as well as all the reference documents. After each reporting cycle, all database files, spreadsheets and official submissions are archived as 'read-only' mode in a master computer. Quality assurance procedures regard some verification activities of the inventory as a whole and at sectoral level. The inventory is presented to a Technical Committee on Emissions (CTE), coordinated by the Ministry for the Environment, Land and Sea, where all the relevant Ministries and local authorities are represented; within this task emission figures and results are shared and discussed. Moreover, at European level, voluntary reviews of the European inventory are undertaken by experts from different Member States for critical sectoral categories. The only official review, apart from those by the UNFCCC, was performed by Ecofys, in 2000, in order to verify the effectiveness of policies and measures undertaken by Italy to reduce GHG emissions to the levels established by the Kyoto Protocol. In this framework an independent review and checks on emission levels were carried out as well as controls on the transparency and consistency of methodological approaches. Comparisons between national activity data and data from international databases are usually carried out in order to find out the main differences and to find explanations to the differences Comparisons between emission estimates from industrial sectors and those published by the industry itself in the Environmental reports are carried out annually in order to assess the quality and the uncertainty of the estimates.	Italian Greenhouse Gas Inventory 1990-2006 National Inventory Report 2008, April 2008, pp.29-32
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

MS	Description of the national QA/QC activities	Source
Netherlands	As part of its National System, the Netherlands has developed and implemented a QA/QC programme. This programme is yearly assessed and updated, if needed. The Monitoring protocols were elaborated and implemented in order to improve the transparency of the inventory (including methodologies, procedures, tasks, roles and responsibilities with regard to inventories of GHGs). During the review of the National System and the NIR2006, some remarks and recommendations were made by the ERT concerning QA/QC and the documentation in the NIR. The ERT noted some inconsistencies between the CRF and NIR. As a response, the NIR 2008 contains an updated key category analysis (included in Annex 1, to be updated in the final version) as well as the CRF Files. The ERT recommended to provide more information in the NIR report that was until now included in protocols. The Netherlands decided to pay more attention to the timely availability of the English translation of the (annually updated) protocols. Furthermore, the transparency with respect to the linkage between the protocols and the NIR will be improved. In the next few years, the Netherlands will reconsider what information to include in the NIR and what information in protocols. A number of general QC checks have also been introduced as part of the annual work plan of the PRTR (Pollutant Release and Transfer Register). The general QC for the present inventory is largely performed in the PRTR. Quality Assurance for the current NIR includes the following activities: A peer and public review on the basis of the draft NIR in January 2008. In preparing this NIR, the results of former UNFCCC reviews – including the results of the In Country Review of the National System in April 2007 and the Synthesis and Assessment Report of NIR 2007 – have been taken into account. As part of the evaluation process of the previous cycle, internal audits were performed through SenterNovem on the use of the protocols and the implementation of QC checks. These audits showed that the monitoring protocols could be well implemented and did not provide major problems. Also the designed QC procedures were basically considered appropriate and well workable. The QA/QC activities generally aim at a high-quality output of the PRTR and the National System, taking into account the iso 9001/2000 certification of MNP (Netherlands Environmental Assessment Agency) and the international QA/QC requirements (IPCC 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 includes quality objectives for the National System, the QA/QC plan and a time schedule for implementation of the activities. It will be 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 PRTR 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 PRTR process, products and the time schedule (planning), emission estimation methods – among which are the monitoring protocols for the GHGs – 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 • 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 PRTR to judge whether or not to use the validated data of individual companies to assess the national total emissions. • Agreements/covenants between MNP and institutes ('outside agencies') that are involved in the annual PRTR 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 PRTR work plan. • The following specific procedures and agreements have been set out and described in the QA/QC plan and the annual PRTR work plan: (1) QC on data input and data processing, (2) Documentation of consistency, completeness and correctness of the CRF data (3) Peer reviews of CRF and NIR by the SenterNovem (assigned as NIE) and institutions not basically involved in the PRTR process. (4) Public review of the draft NIR, (5) Audits: in the context of the annual work plan, (5) Archiving and documentation (6) Evaluation and improvement (7) Source-specific QC.	MNP report 50008000 9 /2008 Greenhouse Gas Emissions in the Netherlands 1990-2006 National Inventory Report Jan 2008 pp 20-22
Portugal	A Plan for QA/QC has been developed. The Institute for the Environment is the national responsible entity for the Quality Assurance and Quality Control System of the inventory. The conceptualization of the system has been developed 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). It includes three technical instruments • Quality Control and Quality Assurance System (SCGQ) • Methodological Development Programme (PDM) • Integrated Management System (SIGA) The SCGQ is composed of a Quality Control and Quality Assurance Programme and a Procedures Manual. The first schedules the application of the general (QC1) and specific (QC2) Quality Control as well as Quality Assurance (QA) procedures, described in detail in the manual. The procedures were defined according to Good Practice and Uncertainty Management Guide (IPCC, 2000) and adapted to the specific National Inventory (INERPA) characteristics. Quality Control tier 1 procedures defined in the QA/QC Manual include a series of checklists, which consider basic checks on the accuracy of data acquisition processes (including, e.g, transcription errors) and checks on calculation procedures, data and parameters. It includes also cross-checking among subcategories in terms of data consistency, verification of NIR and CRF tables. Documentation and archiving procedures include checks on information handling which should enable the recalculation of the inventory. QC tier 2 procedures, on the other hand, include technical verifications of emission factors, activity data and comparison of results among different approaches.	Short Draft Portuguese National Inventory Report on Greenhouse Gases, 1990-2006 Jan 2008, pp. 12-13

MS	Description of the national QA/QC activities	Source
Spain	The plan for quality control and assurance is an internal document with the aim to improve the inventory. The quality control and assurance plan is revised periodically and adopted to changers in the procedures of inventory preparation. The objectives of the quality assurance and control plan are • Timeliness: to reach this target a time schedule for specific tasks and respective check points are established • Completeness • Consisitency: A parameter or variable is only introduced once in the data base. This assures that a parameter that is used several times in the inventory is always the same. Consistency of time series is achieved by subjecting primary data to quality control. Outliers in the time series are identified and checked. • Comparability: The Spanish Inventory should be comparable with inventories from other countries. To achieve this goal definitions and nomenclature are based on SNAP and CRF. • Accuracy: Priority for the use of methods of higher tier is given to key categories • Transparency: The reproducibility of the inventory should be granted. For this aim processes that generate emissions, the variables of activities and their origins, the algorithms and emission factors and the estimated emissions are documented in SNAP format. • Improvement of the inventory. DGCEA as single national entity of the NIS is responsible for the quality control and quality assurance system. For this task DGCEA receives technical assistance from AED-NDS-TWOBE.	Inventario de Emisiones de gases de efecto invernadero de España, años 1990-2006 Apr 2008, Sec. 1.6 (submitted in Spanish, translated)
Sweden	The Swedish Environmental Protection Agency (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 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. Key sources should be subject to external peer review according to the Tier 2 of the GPG. The new QA/QC system includes national peer reviews by sectoral authorities. 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. In Sweden's National Inventory Report 2008, general Tier 1 QC measures and source specific Tier 2 QC measures have been carried out. 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. 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 2008 Jan 2008 pp.33-34
United Kingdom	Description of the QA/QC current system The National Atmospheric Emissions Inventory and the UK Greenhouse Gas Inventory are compiled and maintained by 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 responsibleor co-ordinating inventory-wide QA/QC activities. UK emission estimates are prepared via a central database of activity data and emission factors. Numerous QA/QC procedures are built into the data processing system. These include checks before data are entered into the national database of GHG emissions, and when data are extracted from the database. The database contains activity data and emission factors for all the srces 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. AEA Enery and Environment is currently accredited to BS EN ISO 9001:200. At the end of each reporting cycle, all the database files, spreadsheets, on-line manual, electronic source data, paper source data, output files are in effect frozen and archived. An annual report outlining the methodology of the inventory and data sources is produced. Electronic information is stored on hard disks that are regularly backed up. Paper information is also archived. Many of the data received by AEA Energy&Environment come from other government departments, agencies, research establishments or consultants. Some of these organisations (e.g. DBERR, IGER and BGS) would qualify as the *National Statistical Agencies* referred to in the Guidance. Other organisations (e.g. CEH) compile significant parts of the Inventory. Data complied by other organisations are used to compile significant parts of the inventory (e.g. the Pollution Inventory). These organisations are invited to show how their QA/QC systems comply with IPCC Good Practice Guidance. A list collating and prioritising improvements identified by the Inventory Agency, and from Expert and Peer Reviews, is maintained by the Inventory Agency. These improvements to the inventory are implemented as necessary. During 2002, the UK implemented a programme of peer reviews by experts outside of the organisation responsible for the estimates. A second Peer Review on agriculture was carried out in March 2005.	UK Greenhouse Gas Inventory, 1990-2006 Annual Report for submission under the Framework Convention on Climate Change, Mar 2008 pp. 60-678

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

MS	Description of the national QA/QC activities	Source
Bulgaria	To assure the quality of information reported to UNFCCC and UNECE, the Minister of Environment and Water has issued an ordinance, regulating the activities related to elaboration and submission of reports to the European Commission and European Environment Agency, the Secretariat to Convention of Long-Range Transboundary Air Pollution (CLRTAP), and the UNFCCC Secretariat. The quality monitoring of the GHG Inventory and the National Inventory Report shall take place in conformity with the following order: • The Directorates within the Ministry of Environment and Water – "Climate Change Policy Department", "Air Protection Directorate" and Directorate "Environment Monitoring" within the Environment Executive Agency – declare their expert positions, containing data evaluation from the processed inventory and/or the calculations made. When necessary, the above listed Directorates present proposals for supplementations and/or rectifications; • The Inventory and/or the calculations, shall be presented to the attention of at least two independent experts. • The data originating from the processed Inventory and/or calculations made, shall be approved by the Ecological Expert Council of the Environment Executive Agency. Each organization (data source) solves the quality management issues in accordance with its internal rules and provisions. With some of the sources as the National Statistical Institute, the Statistics Department within Ministry of Agriculture and Food Supplies, etc., those rules follow strictly the international practices. For example, quality assessment/quality control procedures with the National Statistical Institute have been harmonized with the relevant instructions and provisions of EUROSTAT. Strict rules on data processing and storage have been harmonized with international organizations. 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.	Short National Inventory Report of Greenhous e Gas Emissions in Republic Bulgaria 1988-2006 Jan 2008 pp.3-4
Cyprus	The procedures used for quality assurance and quality control procedures for the preparation of the national emission inventory are considered to be preliminary as it is the second time they have been implemented. In the following years 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 • 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 • 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 ny recalculations made.	National Inventory Report 2006 2008 Submissio n Mar 2008 p. 11
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. The QA/QC plan is elaborated by the NIS manager. The QC procedures are performed according to the *IPCC* GPG, 2000. 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. 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). For the implementation of QA procedures experts from the Slovak Hydrometeorological Institute (responsibility for the GHG inventory in Slovakia) regularly perform a detailed review of the draft GHG estimates in December. As part of the approval process, the Ministry of the Environment 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 deficiencies.	Reporting under the Article 3.1 of Decision No 280/2004/ EC Jan 2008 pp. 2-3

MS	Description of the national QA/QC activities	Source
Estonia	During preparation of the Estonian 2006 national GHG inventory, "Estonia's National Greenhouse Gas Inventory Quality Control Plan" was implemented. Specific checks were completed. The 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 All institutions involved in the inventory process ((Estonian Ministry of the Environment) MoE, (Estonian Environment Information Centre) EEIC; (Tallinn University of Technology) TUT and (Estonian Environmental Research Centre) EERC) are responsible for implementing QC procedures to meet the data quality objectives. MoE as the national entity is responsible for overall QC and is in charge of checking on an annual basis that the appropriate QC procedures are implemented internally in TUT; EERC and EEIC. The EEIC has an overall responsibility for QC of the data of the emission inventory. EEIC checks the QC reports of TUT and EERC. When EEIC disagrees with the report then the errors are discussed and changes are made if necessary. Each institution is responsible for reporting on their completion of the QC procedures on an annual basis. This reporting is based on a checklist of general and source-specific QC checks and a textual description of possible recalculations, issues to be followed up before the next submissions, and other relevant information. MoE as the national entity is responsible for the overall QA of the national system, including the UNFCCC reviews and any national reviews undertaken. Also public review is planned for the next cycle. One part of QA is UNFCCC reviews. The reviews are performed by a team of experts (sectoral experts and generalist) from other countries. They are examining the data and methods that Estonia is using, checking the documentation, archiving system and national system. In conclusion they report whether Estonia's overall performance is in accordance with current guidelines. The review report indicates the specific areas where the inventory is in need of improvements. The sectoral experts send their CRF tables to the compiler (EEIC) who puts all the sectors together and completes the CRF tables. During that time the numbers are cross-checked in the CRF reporter to make sure that no mistakes were made during the importing process. Also the CRF completeness check is carried out to make sure that all the necessary data is filled. When the CRF tables are finalized, the experts will start preparing the sectoral chapters of the NIR. These parts are also sent to the compiler who adds the introduction part and puts the draft NIR together. The compiler arranges the different chapters into one uniform document and makes sure that the structure of the report follows the IPCC guidelines. All figures on emissions and removals in tables and text are checked to make sure that they are consistent with those reported in the CRF. It is also checked that all methodological changes, recalculations, trends in emission and removals are well explained. When the draft NIR is completed it is sent to the MoE.	Greenhouse Gas Emissions in Estonia 1990-2006 NIR 2007 Jan 2008 pp. 25-28
Hungary	QA/QC activities are performed in two levels: based on the ISO 9001 standards and following the IPCC recommendations. **ISO activities:** The Hungarian Meteorological Service introduced the quality management system ISO 9001:2000 in 2002 for the *whole range* of its activities. However, GHG inventory preparation was not among its activities in that time. Therefore, the scope of our ISO accreditation had to be modified and lots of efforts have been made to bring also the national system under the umbrella of the ISO QM system. Several regulatory ISO documents were created, among others. The basic document is the Procedure on the activities of the GHG Division. It contains the basic principles of the inventory preparation and reporting processes, prescribes the obligation of making a QA/QC plan, and regulates the documentation and archiving activities. The QA/QC plan, which is an audited ISO document, consists of the following elements: • Specification of the sectoral responsibilities of the core team • Nomination of an officer responsible for the QA/QC system: the QA/QC coordinator • Documentation • Data quality check • Reviews • Development plan • The Hungarian Meteorological Service funds three research projects for the improvement of the inventory • Incorporation of ETS data in broader extent for revision of the used EFs and for better sectoral allocation of emissions • Revision of the LULUCF sector will be continued. • Training. Having an ISO system in place has an advantage of being subject to regular internal and external audits. During our last external audit the activities of the GHG Division were audited as well. **Other QA/QC activities:** Although not documented, many elements of the general Tier1 QC procedure are applied. The used parameters and factors, the consistency of data are checked regularly. Completeness checks are undertaken and previous estimates are compared every time. *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 were not available, those from the Central Statistical Office were 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. 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 of them could provide factual information on the reliability of the data supplied. *Emission factors:* The emission factors were selected in accordance with the Revised 1996, the GPG and the new 2006 Guidelines. The quality of the inventory has been greatly improved by the use of national factors in a greater extent. *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. The work continues to refine the used QA/QC procedures and implement further elements.	NIR for 1985-2006, Hungary (Draft Excerpts) Jan 2008, pp. 18-20

MS	Description of the national QA/QC activities	Source
Latvia	At present the Ministry of Environment works on development of legislation which will designate an institution to be responsible for the coordination of QA/QC procedures for every institution. LEGMA is responsible for coordination of the whole process of the annual GHG inventory and has an approved QA/QC programme. The QA/QC programme consists of aims related to the GHG inventory and the QA/QC planned. Defined responsibilities as well as inner documentation (protocols with detailed emission calculation procedures, used activity data, etc. from each sector (except from LULUCF)) as well as sectoral data checking are described. The QC plan determines internal expert reviewer per category for stated specific category (for example, an expert who is responsible for the Energy sector reviews Transport sector).The plan includes Tier 1 General Inventory Level QC procedures outlined in Table 8.1 of IPCC GPG 2000. QC activities were carried out at the various stages of the inventory compilation process - processing, handling, and documenting, cross-checking, recalculations.These activities are implemented by sector experts and the inventory compiler.The QC system includes various activities aimed to ensure transparent data flow through the entire inventory process: • Assumptions and criteria for the selection of activity data and emission factors • Transcription errors in data input and references • Correctness of calculations of emissions • Correctness of emission parameters, units, conversion factors • Integrity of database files • Consistency in data between source categories are documented For submission 2008, each expert reviewer checked and filled in a QC form for each category taking into account above mentioned criteria's. After checking the QC form was submitted to sectoral expert who is responsible for the respective sector. The sectoral expert filled comments in the QC form and sent it back to the expert reviewer and NIC. All these QC forms were archived. The National inventory report was send to CSB and Ministries of Environment and Agriculture for approving. 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.	Direct Communication, Mar 2008
Lithuania	The QA/QC plan establishes *good practice* consistent with the IPCC GPG aimed at improving transparency, consistency, comparability, completeness, and confidence in the national inventory of emissions estimates. The QA/QC system consists of inventory planning, inventory preparation phase, inventory quality checking and follow-up improvements which are integrated into the annual cycle of NIR planning and preparation. The QC system incorporates various activities aimed at ensuring transparent data flow through all inventory process including data collection and processing, documentation, archiving and reporting. The general QC checks to be performed during the inventory 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 • Correctness of transcription and aggregation of intermediate data • Correctness of calculation of uncertainties • Integrity of archiving arrangements in the organisations involved in the inventory process The QC activities also include review of internal documentation, supporting data, comparison of emission estimates to previous estimates, consistency and completeness of time series, etc. A Quality manual as stated in the ISO 9001 4.2.2 will be prepared in 2008. In this document references to normative and descriptive documents (procedures) which govern the inventory and reporting, structure and relationships between all participants acting in preparation of the NIR will be made. One of the purposes of the document is to describe how the coordinated quality system works as a whole and how its different parts work together. This objective will be attained by preparation and implementation of appropriate working procedures. Inventory data as well as background information on activity data and emission factors are archived by the Center for Environmental Policy. Backups of each year´s data and supportive material are kept as a separate CD.	National GHG Emission Inventory Report 2007 of the Republic of Lithuania, Dec 2007 pp. 16-20
Malta	The Malta Environment and Planning Authority (MEPA) is the authority entrusted with the role of compiling national emission inventories, with the National Emissions Inventory Team being delegated the main responsibility for developing and managing the system and for preparing the relevant submissions. The National Emissions Inventory System Team is responsible for all functions of the inventory system, from data collection, through data management to preparation of reports. Activity data used for the preparation of this inventory was obtained from Malta's past GHG inventory compilation, the National Statistics Office, government entities (ministries, departments), other public bodies such as regulatory authorities, private establishments and published reports. The methodologies and emission factors used were principally obtained from the following guidelines: • Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories • 2006 IPCC Guidelines for National Greenhouse Gas Inventories • EMEP/Corinair Emission Inventory Guidebook – 2002 • EMEP/Corinair Emission Inventory Guidebook – 2006 • EMEP/Corinair Emission Inventory Guidebook – 2007	National Greenhouse Gas Emissions Inventory Report for Malta 1990 - 2006 Mar 2008, pp.8-10

MS	Description of the national QA/QC activities	Source
Poland	The national entity – National Emission Centre– which is responsible for preparation of GHG inventories, is also responsible for coordination and implementing the QA/QC activities. The National Emission Centre is located in the Institute of Environmental Protection (IEP), and since 2006 included within structure of the National Administrator of Emission Trading System situated in the Institute. Each IPCC sector undergoes detail QC procedure which is carried out firstly by the responsible person for the respective category/subcategory. Further, checks are made by an additional National Emission Centre expert. Depending on methodology used for emission estimation within categories Tier 1 or Tier 2 check procedures are carried out. The extended QC procedure for checking the correctness of emissions estimations is used for these categories where country specific emission factors are established. Source of activity data used for estimation of GHG emissions and removals come mostly from the Central Statistical Office (GUS) and Agency of Energy Market (ARE) undergoing internal revision and checking process of published data. If necessary specific data are collected from collaborating individual experts and research institutions. Additionally to QC procedures conducted as part of Tier 1 for all IPCC categories an extended QC procedure is carried out (Tier 2 methods) for the key categories within such sectors like energy, industrial processes, agriculture and waste. Source category–specific QC procedures include expert personal reviews of activity and emission factor data, and methods especially extensively used for the energy sector responsible for majority of CO_2 emissions in Poland. As a first part of QA procedures external reviewers from R&D Institutes, Branch Associations, Industrial Chambers, individual plants as well as independent experts verify the inventory assumptions and results. The direct contact is initiated for exchanging comments and setting the proper data. The final approval of Polish GHG inventory is made by the Department Global Environmental Problems and Climate Change in the Ministry of Environment. Additional verification for entire inventory results is made using CRF-Reporter as well as NIR files. For archiving procedures and internal documentation associated with particular aspects of inventory preparation, check and reporting the Data Management Manual has been elaborated in National Emission Centre.	Annex to Poland's Report under Art. 3.1.f to the Decision 280/2004/ EC, Mar 2008 pp. 1-5

MS	Description of the national QA/QC activities	Source
Romania	Romania established a QA/QC Programme based on the UNFCCC and Kyoto Protocol's provisions related to the GHG Inventory and the National System, the IPCC 1996 and IPCC GPG 2000 provisions, and to the Governmental Decision no. 1570/2007 establishing the National System for the estimation of the anthropogenic GHG emissions levels from sources and removals by sinks. The document comprises information on: • the national authority responsible for the coordination of QA/QC activities • the objectives of the QA/QC Programme • the QA/QC Plan • the QC procedures • the QA procedures • the reporting, documenting and archiving procedures According to the provisions of the Governmental Decision no.1570/2007 establishing the national system, NEPA represents the competent authority responsible for the coordination of the QA/QC activities under the NGHGI. For this purpose, NEPA is performing the following activities: • ensuring that the objectives of the QA/QC programme are established • developing and regularly updating a QA/QC plan • implementing the QA/QC procedures • establishing and ensuring the implementation of reporting, documenting and archiving procedures The QA/QC coordinator is represented by the same person designated to fulfill the tasks of the NGHGI general coordinator. The overall objective of the QA/QC programme is to develop the NGHGI in line with the requirements of the IPCC 1996, IPCC GPG 2000 and IPCC GPG 2003 and with the provisions of the Decision 280/2004/EC of the European Parliament and of the Council and Decision 166/2005/EC of the European Commission. Romania's QA/QC plan closely follows the definitions, guidelines and processes presented in Chapter 8 – Quality Assurance and Quality Control of the IPCC GPG 2000. The QA/QC plan constitutes the heart of the QA/QC programme. It outlines the current and planned QA/QC activities. The specific QA/QC activities are performed during all stages of the inventory preparation. The QA/QC plan will be reviewed periodically if needed and can be modified as appropriate when changes in processes occur or based on the advice from independent reviewers. The QA/QC plan is intended to ensure the fulfillment of the GHG Inventory principles in Romania. The objectives of the plan include: • applying greater QC effort for key source categories and for those source categories where data and methodological changes have occurred recently • periodically checking the validity of all information as changes in reporting, methods of collection or frequency of data collection occur • conducting the general procedures outlined in QC procedures (Tier 1) on all parts of the inventory over a complete exercise • balancing efforts between development and implementation of QA/QC procedures and continuous improvement of inventory estimates • customizing the QC procedures to the resources available and the particular characteristics of Romania's greenhouse gas inventory • confirming the national statistical institute and other agencies supplying activity data to NEPA have implemented QC procedures Specific NGHGI data are archived as follows • electronically – most of the documents • on paper – the documents specific to the early period of the time series In order to ensure the security of databases and the confidentiality of the background data, both paper and electronical data are kept under strict access conditions. Furthermore, electronic data backup activities are undertaken on NEPA's server with daily frequency during the generation of the official submission and within a three-day interval frequency in rest of cases. The manager of the archiving system is represented by the same person designated to fulfill the tasks of the NGHGI general coordinator.	Romania's Greenhouse Gas Inventory 1989-2006 National Inventory Report Mar 2008 pp.33-38
Slovakia	Slovak Hydrometeorological Institute is a company which has build and introduced the quality management system according to the requirements of the EN ISO 9001:2000 standard of conformity for the following activities. • Monitoring of the parameters to characterise the actual state of air and waters on the Slovak territory • Assessment, archiving and interpretation of data and information on the state and regime of air and water • Providing data and information on the state and regime of air and waters • Study and description of the atmosphere and hydrosphere phenomena • Education and training within the activity of institute. Sectoral experts are applying the QA/QC methodology for specific sectors based on their own plans for improvements. They are yearly collecting the data from relevant providers and processing calculations of emission inventory in the particular sector. They prepare partial reports with information on quality and reliability of data on activities and emissions. These partial conclusions serve as a basis to estimate total uncertainties in emission inventories by a coordinator for uncertainties for all sectors.Complete emission inventories of GHGs are subject to critical review by independent experts from the Czech Republic. At present a project was completed which aimed at providing software to archive methodological procedures, database of input and output data in particular IPCC sectors, including the publishing of information in accordance with requirements of 20/CP.7.	Slovak Republic Annual Report 2008 Jan 2008 p. 4

MS	Description of the national QA/QC activities	Source
Slovenia	The Republic of Slovenia has not yet fully developed and implemented a QA/QC plan as recommended by IPCC GPG (2000). The Manual of Procedures 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 and intermediate and final calculations of emissions where deviations between real life emission factors and factors as calculated from the CRF table are reviewed. In 2006 an 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). The 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. A database is containing 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 is being established. On defined control points QC procedures will be included and documented. Only one peer-review has been performed so far.	Slovenia's National Inventory Report 2008 Jan 2008 p. 12

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 1.11 lists the most important workshops.

Table 1.11 Overview of workshops and expert meetings organised under the EC GHG Monitoring Mechamism

Workshop/expert meeting	Date and venue
2nd workshop on data consistency between National GHG inventories and reporting under the EU ETS	13-14 September 2007, EEA, Copenhagen, Denmark
Expert meeting on the estimation of CH_4 emissions from solid waste disposal sites with the First Order Decay method	8-9 March 2006, EEA, Copenhagen, Denmark
Workshop on data consistency between National GHG inventories and reporting under the EU ETS	9-10 February 2006, EEA, Copenhagen, Denmark
Training workshop on the use of CRF Reporter for the experts of the European 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

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

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

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

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

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

Table 1.12 Trend uncertainty for EU-15 emissions 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 1.12, 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[13].

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

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

cannot actually be the case when uncertainties are >100%. However, these issues do not seem to have any major effect on the results, as can be seen from Table 1.13, where waste sector uncertainties are presented both with analytical method and Monte Carlo simulation. When uncertainty increases, also the difference between the two methods increases.

Table 1.13 Comparison of trend uncertainty estimates 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 1.14 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 (48 % - 98 %). For agriculture a range of level uncertainties is provided 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 4.7 % and 9.2 %.

With regard to trend uncertainty estimates the lowest uncertainty estimates are for stationary fuel combustion (+/- 0.3 percentage points), the highest estimates are for agriculture (9 percentage points). Overall trend uncertainty of all EU-15 GHG emissions is estimated to be 1 percentage point.

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

Table 1.14 Tier 1 uncertainty estimates of EU-15 GHG emissions

Source category	Gas	Emissions 1990	Emissions 2006 [1)]	Emission trends 1990-2006	Level uncertainty estimates based on MS uncertainty estimates	Trend uncertainty estimates based on MS uncertainty estimates
Fuel combustion stationary	all	2.461.263	2.397.250	-3%	1%	0,3
Transport	all	697.930	877.915	26%	3%	1
Fugitive emissions	all	96.554	51.775	-46%	10%	5
Industrial processes	all	372.987	327.953	-12%	6%	4
Agriculture	all	433.859	386.815	-11%	57% (48%-98%)	9
Waste	all	174.548	107.062	-39%	19%	9
Total	**all**	**4.243.821**	**4.151.079**	**-2%**	**5.4% (4.7%-9.2%)**	**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 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

Tables 1.15 (EU-15) and 1.16 (new MS) give an overview of information provided by Member States on uncertainty estimates in their national inventory reports 2006, 2007 or 2008 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 1.15 **Overview of uncertainty estimates available from EU-15 Member States**

Member State	Austria		Belgium	Denmark	Finland		France	Germany	Greece
Citation	NIR Apr 2008, pp.46-54		NIR Apr 2008, pp. 17-23+ Uncertainty Table	Uncerainty table + NIR Apr 2008 pp.51-54	NIR Apr 2008, pp. 30-32		NIR, March 2007, pp. 53-56 + uncertainty table	NIR Apr 2008 , pp. 88-91	Uncertainty Table
Method used	Tier 1, Tier 2		Tier 1	Tier 1	Tier 1, Tier 2		Tier 1	Tier 1	Tier 1
Documentation in NIR (according to Table 6.1/6.2 of GPG)	Yes (Annex 6)		Yes	Yes	Yes (Annex 1)		Yes	Yes (almost): Annex 7	Yes
Years and sectors included	emissions: 2006; trends: 1990-2006; almost all categories (e. L.)		emissions: 2005 and 2006; trends: BY-2005 and BY-2006; all categories, (e. L.)	emissions: 2006; trend BY-2006; all categories	emissions: 1990, 2006; trends: BY-2006; almost all categories		emissions: 2006; trends: 1990-2006; all categories	emissions: 2006; all categories (i.L.)	emissions: 2006; trend: BY-2006; almost all categories (>99%)
Uncertainty (%)	Tier 1	Tier 2	Tier 1	Tier 1 (i. L.)	Tier 1 (i. L.)	Tier 2 (e. L.)	Tier 1	Tier 1	Tier 1
CO_2				2.9%					i. L.: 4.8% e. L.: 3.5%
CH_4				24%					i. L.: 31.9% e. L.: 37.9%
N_2O				50%					i. L.: 81.8 e. L.: 81.8%
F-gases				48%					i. L.: 127.2% e. L.: 127.2%
Total	3.8%	5.3%	2005: 7.7% 2006:7.6%	5.7%	2006: 50.1%	1990: -10%/+10% 2006: 0%/+0%	i. L.: 22% e. L.: 17.6%	12.5%	i. L.: 10% e. L.: 9.3%
Uncertainty in trend (%)	Tier 1	Tier 2		Tier 1 (i. L.)	Tier 1 (i. L.)	Tier 2 (e. L.)	Tier 1	Tier 1	Tier 1
CO_2				±2.5 % points					
CH_4				±10.1% points					
N_2O				±15% points					
F-gases				±65% points					
Total	2.3%	2.3%	1990-2005: 3.4% 1990-2006: 2.5%	2.6% points	16.7%	0/20%	i. L.: 4.5% e. L.: 3.1%		i. L.: 11.6% e. L.: 11%

Member State	Ireland	Italy	Luxem-bourg	Nether-lands	Portugal	Spain	Sweden	United Kingdom	
Citation	Uncertainty Table + NIR Apr 2008, pp. 16-22	NIR May 2008, pp.32 33	Uncertainty table	NIR Apr 2008 p. 33-37 + Uncertainty Table	NIR Apr 2008, pp.13-15	NIR Apr 2008, Sec. 1.7	NIR Apr 2008, p.35-37	NIR Apr 2008 pp. 65-66 + Uncertainty Table	
Method used	Tier 1	Tier1	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)	Yes	YES (Annex I)	Yes	Yes	No	Yes: Table A7.1 and A7.2	Annex 2	Yes, Annex 7	
Years and sectors included	emissions: 2006; trend: 1990-2006; all categories	emissions: 2006; trend: BY-2006; all categories	emissions: 2006, trend: BY-2006; allmost all categories	emissions: 2006; trend: 1990-2006; all categories	emissions and trends : BY-2006; all categories (i.L.)	emissios: 2004, 2005; trend: BY-2004; BY-2005; all categories (e. L.)	emissions: 1990 and 2006; trends: 1990-2006; all categories (e.	emissions: 2006, trend: BY - 2006, all categories	
Uncertainty (%)	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 2 (incl. LULUCF)
CO_2	i. L.: 1.7% e. L.: 1.2%			i. L.: 2.5%; e. L.: 2%	1990: 8.2% 2006: 4.5%	-	2.4% (1990) 2.3% (2006)		19% (1990) 2% (2006)
CH_4	i. L.: 2.1% e. L.: 2.1%			i. L.: 17%; e. L.: 17%	1990: 28.3% 2006: 23.0%	-	2.8% (1990) 2.0% (2006)		26% (1990) 22% (2006)
N_2O	i. L.: 5.7; e. L.: 5.6%			i. L.: 43%; e. L.: 43%	1990: 111.6% 2006: 102.0%	-	5.3 % (1990) 5.2% (2006)		173% (1990) 231% (2006)
F-gases	i. L.: 0.2% e. L.: 0.2%			i. L.: 32%; e. L.: 32%	1990: ? 2006: 64.8%		0.2% (1990) 0.4% (2006)		(1990 and 2006) HFC 15% PFC 6% SF6 24%
Total	i. L.: 6.3% e. L.: 6.1%	i. L.: 8.6% e. L.: 3.2%	6.8%	i. L.: 4.3%; e. L.: 4.1%	1990: 12.9% 2006: 9.9%	2004: 12.2% 2005: 10.9%	6.5% (1990) 6.0% (2006)	i. L.: 15.9% e. L.: 15.8%	15% (1990) 14% (2006)
Uncertainty in trend (%)	Tier 1	Tier 1	Tier 1	Tier 1 (i. L.)	Tier 1	Tier 1	Tier 1	Tier 1	Tier 2
CO_2	i. L.: 2.1%; e. L.: 1.8%			3 % points					-8.8 to -3.8
CH_4	i. L.: 1.8%; e. L.: 1.8%			10 % points					-56 to -48
N_2O	i. L.: 2.5%; e. L.: 2.6%			16 % points					-59 to -27
F-gases	i. L.: 0.2%; e. L.: 0.2%			8 % points					HFC -34 to 0% PFC -81 to -77% SF6 -40 to -21%
Total	i. L.: 3.7%; e. L.: 3.6%	i. L.: 7.9% e. L.: 2.6%	4.7%	3 % points	14.2%	BY-2004: 10.6% BY-2005: 12.3%	2.6%	i. L.: 2.7%; e. L.: 2.7%	-18.3 to -13.1

Table 1.16 Overview of uncertainty estimates available from new Member States

Member State	Bulgaria	Cyprus	Czech Republic	Estonia	Hungary	Latvia	Lithuania	Malta	Poland	Romania	Slovakia	Slovenia
Citation	Uncertainty Table + NIR pp. 29-34	NIR, March 2008, pp. 11-12	NIR Apr 2008 pp. 23-27 + Uncertainty Table	Annex 8, Uncertainty Analysis	NIR Apr 2008, p. 23 + Uncertainty table	NIR Apr 2008, p.18	Short NIR, Dec 2007, p. 16		Uncertainty assessment of the 2006 inventory	Uncertainty Table and Direct Communication	Uncertainty Table	NIR 2008, Apr 2008, p. 19 and Annex 7
Method used	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1		Tier 1	Tier 1	Tier 1	Tier 1
Documentation in NIR (according to Table 6.1/6.2 of GPG)	Yes		No	Yes	Yes (extra table)	Yes	Yes: Annex 2 for 2004 (?)		Yes	Yes	Yes	Yes
Years and sectors included	emissions: 2006; BY-2006; all categories (e. L.)	emissions: 1990-2006; trends: 1990-2006; most categories (with LULUCF)	emissions: 2006; trend: 1990- 2006; all categories (e. L.)	emissions: 1990; all categories	emissions: 2006; trend: BY-2006; all categories (e. L)	emissions: 2006; trend: 1990-2006; almost all categories (e. L.)	emissions: 2006; trends: BY-2006, allmost all categories (e. L.)	no uncer-tainty assessment	emissions: 2006 ; all sources	emissions: 2006; trend: 1989 to 2006; all categories	emissions 1990 and 2006; trend: 1990-2006; almost all categories	emissions: 1986, 2006; trend: 1968-2006; all categories
Uncertainty (%)	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1		Tier 1		Tier 1	Tier 1	Tier 1 (i. L.)	Tier 1
CO_2					2-4%	3.5%	1.7%		8.0%			
CH_4					15-25%	17%	3%		20.1%			
N_2O					80-90%	28%	7.7%		47.7%			
F-gases									HFC 43.7% PFC 20% SF6 100%			
Total	13.3%	1990: 14.1% 2005: 13% 2006: 1.4%	6.2%	i. L.: 44.4%; e. L.: 6.5%	5%	5%	8.4%			e. L.: 18.1% i. L.: 33.5%	1990: 16.2%; 2006: 12.7%	e. L.: 8.9% (1986) and 7.0% (2006); i. L.: 9.9% (1986) and 11.3% (2006)
Uncertainty in trend (%)	Tier 1		Tier 1		Tier 1					Tier 1	Tier 1 (i. L.)	Tier 1
CO_2		2005: 6.9% 2006: 6.5%				1.5%						
CH_4		2005: 1.7% 2006: 6.5%				7%						
N_2O		2005: 16.1% 2006: 6.5%				14%						
F-gases		HFC´s 2005: 0.5% 2006:6.5%										
Total	3.9%	1990: 21.1% 2005: 49% 2006: 76.2%	3.1%		2.4%	2.3%	1.9%			e. L.: 4.4%; i. L.: 11.5%	7.8%	6%

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.

Tables 1.17 and 1.18 summarise timeliness and completeness of the Member States' submissions in 2008. It shows that GHG inventories for 2006 were submitted by all 27 Member States. All Member States submitted all or almost all tables (i.e. more than 90 %) of the CRF tables for 1990–2006. The completeness of national submissions with regard to individual CRF tables can be found in the status reports in Annex 3.

Table 1.17 Date of latest submission or update, years covered and CRF tables available from EU-15 Member States in 2008

MS	Submission dates	Latest data available	CRF Tables[1)]	New LULUCF tables	Official XML file (version)	NIR
Austria	15 Jan 2008	2006	All	1990-2006	3.2.0	15 Jan 2008 (short NIR)
	14 Mar 2008	2006	All	1990-2006	3.2.0	14 Mar 2008
	15 Apr 2008	2006	All	1990-2006	3.2.0	15 Apr 2008
Belgium	15 Jan 2008	2006	All	1990-2006	3.2.0	-
	18 Mar 2008	2006	All	1990-2006	3.2.0	14 Mar 2008
	-	-	-	-	-	16 Apr 2008
Denmark	15 Jan 2008	2006	All	1990-2006	3.2.0	15 Jan 2008 (short NIR)
	14 Mar 2008	2006	All	1990-2006	3.2.0	14 Mar 2008
	15 Apr 2008	2006	All	1990-2006	3.2.0	15 Apr 2008
Finland	11 Jan 2008	2006	All	1990-2006	3.2.1	15 Jan 2008
	14 Mar 2008	2006	All	1990-2006	3.2.1	14 Mar 2008
	1 Apr 2008	2006	All	1990-2006	3.2.1	-
	11 Apr 2008	2006	All	1990-2006	3.2.1	11 Apr 2008
France	15 Jan 2008	2006	All	1990-2006	3.2.1	-
	14 Mar 2008	2006	All	1990-2006	3.2.1	14 Mar 2008
	18 Mar 2008	2006	All (Kyoto)	1990-2006	3.2.1	-
Germany	12 Feb 2008	2006	All	1990-2006	3.2.0	Mar 2008
	13 May 2008	-	-	-	-	13 May 2008
Greece	19 Mar 2008	2006	All	1990-2006	-	-
	1 Apr 2008	2006	All	1990-2006	3.2.1	-
	7 Apr 2008	2006	All	1990-2006	3.2.1	14 Apr 2008
Ireland	15 Jan 2008	2006	All	1990-2006	3.2.1	-
	14 Mar 2008	2006	All	1990-2006	3.2.1	14 Mar 2008
Italy	17 Mar 2008	2006	All	1990-2006	3.2.1	-
	16 Apr 2008	2006	All	1990-2006	3.2.1	16 Apr 2008
Luxembourg	21 Jan 2008	2006	All	1990-2006	3.2.0	-
	23 Apr 2008	2006	All	1990-2006	3.2.1	
Netherlands	15 Jan 2008	2006	All	1990-2006	3.2.0	15 Jan 2008
	15 Mar 2008	2006	All	1990-2006	3.2.1	15 Mar 2008
	15 Apr 2008	2006	All	1990-2006	3.2.1	15 Apr 2008
Portugal	15 Jan 2008	2006	All	2006	-	-
	13 Feb 2008	2006	All	1990-2006	3.2.1	19 Feb 2008 (short NIR)
	19 Mar 2008	2006	All	1990-2006	3.2.1	-

MS	Submission dates	Latest data available	CRF Tables[1)]	New LULUCF tables	Official XML file (version)	NIR
	24 Apr 2008	2006	All	1990-2006	3.2.1	24 Apr 2008
	20 May 2008	2006	All	1990-2006	3.2.1	20 May 2008
Spain	13 Mar 2008	2006	All	1990-2006	3.2.0	13 Mar 2008 (Spanish)
	22 Apr 2008	2006	All	1990-2006	3.2.0	22 Apr 2008 (Spanish)
Sweden	14 Jan 2008	2006	All	1990-2006	3.2.0	14 Jan 2008
	14 Apr 2008	2006	All	1990-2006	3.2.0	14 Apr 2008
United Kingdom	15 Jan 2008	2006	All (incl. CDs and OTs)	1990-2006	3.2.0	-
	21 Feb 2008	2006	All (excl. CDs and OTs)	1990-2006	3.2.0	-
	14 Mar 2008	2006	All (excl. CDs and OTs)	1990-2006	3.2.0	14 Mar 2008
	15 Apr 2008	2006	All (incl. CDs and OTs)	1990-2006	3.2.0	15 Apr 2008

([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).

Table 1.18 Date of latest submission or update, years covered and CRF tables available from new Member States in 2008

MS	Submission dates	Latest data available	CRF Tables[1)]	New LULUCF tables	Official XML file (version)	NIR
Bulgaria	15 Jan 2008	2006	All	1988-2006	3.2.0	15 Jan 2008 (short NIR)
	19 Mar 2008	2006	All	1988-2006	3.2.0	19 Mar 2008
	-	-	-	-	-	31 Mar 2008
	14 Apr 2008	2006	All	1988-2006	3.2.0	14 Apr 2008
Cyprus	31 Mar 2008	2006	All	2005-2006	-	-
	4 Apr 2008	2006	All	1990-2006	3.2.0	2 Apr 2008
Czech Republic	16 Jan 2008	2006	All	1990-2006	3.2.0	21 Mar 2008
	9 Apr 2008	2006	All	1990-2006	3.2.1	9 Apr 2008
Estonia	15 Jan 2008	2006	All	1990-2006	3.2.0	15 Jan 2008
	14 Mar 2008	2006	All	1990-2006	3.2.0	14 Mar 2008
	15 May 2008	2006	All	1990-2006	3.2.0	
Hungary	16 Jan 2008	2006	All	1985-2006	3.2.0	15 Jan 2008 (draft NIR)
	14 Mar 2008	2006	All	1985-2006	3.2.2	14 Mar 2008
	14 Apr 2008	2006	All	1985-2006	3.2.2	14 Apr 2008
Latvia	9 Jan 2008	2006	All	1990-2006	3.2.0	9 Jan 2008 (draft NIR)
	14 Mar 2008	2006	All	1990-2006	3.2.0	14 Mar 2008
	15 Apr 2008	2006	All	1990-2006	3.2.0	15 Apr 2008
Lithuania	15 Jan 2008	2006	All	1990-2006	InterReporter 3.2.1	15 Jan 08
	19 Mar 2008	2006	All	1990-2006	3.2.1	-
Malta	16 Jan 2008	2006	All	1990-2006	3.2.0	-
	18 Mar 2008	2006	All	1990-2006	3.2.0	18 Mar 2008
	6 May 2008	2006	All	1990-2006	3.2.0	6 May 2008
Poland	6 Mar 2008	2006	All	2006	-	15 Jan 2008 (short NIR)
	14 Mar 2008	-	-	-	3.2.1	-
	27 Mar 2008	2006	All	1988-2006	3.2.1	-
	21 Apr 2008	2006	All	1988-2006	-	-

MS	Submission dates	Latest data available	CRF Tables[1)]	New LULUCF tables	Official XML file (version)	NIR
	20 May 2008	2006	All	1988-2006	3.2.1	20 May 2008
Romania	15 Jan 2008	2006	All	1989-2006	3.2.1	-
	15 Mar 2008	2006	All	1989-2006	3.2.1	15 Mar 2008
	15 Apr 2008	2006	All	1989-2006	3.2.1	15 Apr 2008
Slovakia	15 Jan 2008	2006	All	1990-2006	3.2.1	15 Jan 2008 (short NIR)
	-	-	-	-	-	15 Mar 2008
	15 Apr 2008	2006	All	1990-2006	3.2.1	15 Apr 2008
Slovenia	15 Jan 2008	2006	All	1986-2006	3.2.0	15 Jan 2008 (short NIR)
	13 Mar 2008	2006	All	1986-2006	3.2.1	13 Mar 2008
	15 Apr 2008	2006	All	1986-2006	3.2.1	15 Apr 2008

([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).

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' ([14]) 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.[15]

Gap filling in GHG inventory submissions 2008

For the EC Member States 2006 F-gas estimates are missing from Cyprus, Estonia and Malta (Table 1.19). Member States affected by gap filling have the opportunity to provide feedback and incorporated the estimates in their national submissions.

Table 1.19 Overview of missing data by April 2008

Member State	HFCs	PFCs	SF_6
Cyprus		1990-2006	1990-2006
Estonia		1990-2006	
Malta	1990-2006	1990-2006	1990-2006

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

[15] 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:

Malta
HFC
Emissions estimated on basis of average per capita emissions of ES, GR, IT and PT for 2F1 'Refrigeration and air conditioning equipment' for 1990-2006
SF_6
Emissions estimated on basis of average emissions per electricity consumption of ES, GR, IT and PT for 2F8 'Electrical equipment' for 1990-2005 and extrapolated to 2006

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 2008 EC GHG inventory data consist of:

- the GHG submissions of the Member States to the Commission in 2008;
- previous GHG submissions, in cases where Member States did not provide the complete time series for each gas in 2008;
- 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).

Tables 1.20 to 1.23 show the data basis of the 2008 EC GHG inventory. Values in white cells without a frame are data provided by Member States in 2008 in the CRF Table Summary 1.A. Framed cells indicate that the emission data has been taken from the EC GHG inventory 2007. 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 CO_2 emissions excluding LULUCF (Tg)

EC Member State	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Austria	62	64	67	67	67	66	66	70	72	78	78	80	77
Belgium	119	124	128	122	128	123	124	124	123	127	127	123	119
Denmark	53	61	74	64	60	58	53	55	54	59	54	50	58
Finland	57	58	64	63	59	59	57	62	65	72	68	57	68
France	393	389	402	396	416	406	403	409	401	408	412	416	404
Germany	1,032	921	943	913	906	880	883	901	887	901	900	877	880
Greece	82	87	89	94	99	98	104	106	106	110	110	110	110
Ireland	33	35	37	39	41	42	45	47	46	45	46	48	47
Italy	435	446	439	444	455	460	464	470	472	488	491	492	488
Luxembourg	12	9	9	9	8	9	9	9	10	11	12	12	12
Netherlands	159	171	178	171	173	168	170	175	176	180	181	176	172
Portugal	43	53	50	54	58	65	64	65	69	64	66	69	64
Spain	229	256	243	263	271	296	308	312	331	335	352	368	360
Sweden	56	58	62	57	57	55	53	54	55	56	55	53	52
United Kingdom	588	547	568	545	548	538	547	558	542	554	555	556	555
EU-15	**3,353**	**3,277**	**3,355**	**3,301**	**3,347**	**3,321**	**3,349**	**3,418**	**3,409**	**3,488**	**3,508**	**3,486**	**3,466**
Bulgaria	86	66	65	63	55	51	50	52	49	54	53	54	55
Cyprus	5	6	6	6	6	6	7	7	7	7	8	8	8
Czech Republic	164	131	138	132	124	120	127	128	125	126	127	126	128
Estonia	36	18	19	18	17	16	15	15	15	17	17	16	16
Hungary	73	62	63	62	61	61	59	61	59	62	60	62	60
Latvia	19	9	9	9	8	8	7	7	7	8	8	8	8
Lithuania	36	15	16	15	16	13	12	13	13	13	14	14	15
Malta	2	2	2	2	2	2	2	2	2	3	3	3	3
Poland	369	366	375	369	341	329	320	317	306	317	317	318	331
Romania	172	130	135	121	107	92	95	100	106	111	112	106	111
Slovakia	62	44	42	41	42	41	40	42	40	41	41	41	40
Slovenia	15	15	16	16	16	15	15	16	16	16	16	17	17
EU-27	**4,392**	**4,141**	**4,242**	**4,154**	**4,142**	**4,076**	**4,100**	**4,179**	**4,155**	**4,263**	**4,283**	**4,258**	**4,258**

Note: Values in white cells without a frame are data provided by Member States in 2008 in the CRF Table Summary 1.A. Framed cells indicate that the emission data has been taken from the EC GHG inventory 2007. 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.

Table 1.21 Data basis of CH_4 emissions in CO_2 equivalents (Tg)

EC Member State	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Austria	9	9	8	8	8	8	8	8	7	7	7	7	7
Belgium	10	10	10	9	9	9	9	8	8	8	7	7	7
Denmark	6	6	6	6	6	6	6	6	6	6	6	6	6
Finland	6	6	6	6	6	6	5	5	5	5	5	4	5
France	70	70	70	67	66	66	65	64	62	61	59	58	57
Germany	99	81	78	75	69	69	65	61	58	54	50	48	46
Greece	9	9	9	9	9	9	9	8	8	8	8	8	8
Ireland	13	14	14	14	14	14	14	13	13	14	13	13	13
Italy	42	44	44	45	44	44	44	43	42	41	40	40	38
Luxembourg	0	0	0	0	0	0	0	0	0	0	0	0	0
Netherlands	25	24	23	22	21	20	19	19	18	18	17	17	16
Portugal	10	11	11	12	12	12	12	12	12	13	12	12	12
Spain	28	31	32	34	35	35	36	37	37	38	38	38	38
Sweden	7	7	7	7	6	6	6	6	6	6	6	6	6
United Kingdom	103	90	88	83	78	73	68	62	59	53	51	49	49
EU-15	**439**	**413**	**407**	**395**	**385**	**377**	**366**	**353**	**343**	**331**	**320**	**314**	**308**
Bulgaria	20	16	15	14	14	13	13	12	12	13	13	12	11
Cyprus	1	1	1	1	1	1	1	1	1	1	1	1	1
Czech Republic	19	14	14	13	13	12	12	12	12	12	12	12	12
Estonia	3	2	2	2	2	2	2	2	2	2	2	2	2
Hungary	9	8	8	8	8	8	8	8	8	8	8	8	8
Latvia	4	2	2	2	2	2	2	2	2	2	2	2	2
Lithuania	6	4	4	4	4	3	3	3	3	3	3	3	3
Malta	0	0	0	0	0	0	0	0	0	0	0	0	0
Poland	50	46	45	46	45	44	41	40	39	40	39	39	40
Romania	45	34	34	30	28	27	28	28	29	30	29	29	29
Slovakia	5	5	5	5	5	5	5	5	5	5	5	5	5
Slovenia	2	2	2	2	2	2	2	2	2	2	2	2	2
EU-27	**603**	**546**	**539**	**522**	**508**	**497**	**484**	**469**	**459**	**449**	**436**	**429**	**424**

Note: Values in white cells without a frame are data provided by Member States in 2008 in the CRF Table Summary 1.A. Framed cells indicate that the emission data has been taken from the EC GHG inventory 2007. 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.

Table 1.22 Data basis of N_2O emissions in CO_2 equivalents (Tg)

EC Member State	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Austria	7	7	7	7	7	7	7	6	6	6	6	6	6
Belgium	11	12	12	12	12	12	12	11	11	10	10	10	9
Denmark	11	9	9	9	9	9	8	8	8	8	7	7	7
Finland	8	7	7	7	7	7	7	7	7	7	7	7	7
France	94	91	92	93	86	79	78	76	74	71	69	68	66
Germany	85	78	79	76	62	59	59	60	60	62	65	66	63
Greece	12	11	11	11	11	11	11	11	11	11	11	10	10
Ireland	9	10	10	10	10	11	10	10	9	9	9	9	8
Italy	38	39	39	40	40	41	41	41	41	40	42	40	35
Luxembourg	0	1	1	1	1	1	1	1	1	1	1	1	1
Netherlands	20	21	21	21	21	20	19	18	17	17	17	17	17
Portugal	6	6	6	6	6	6	6	6	6	6	6	6	6
Spain	28	27	30	29	30	32	33	31	31	32	31	30	30
Sweden	9	8	9	8	9	8	8	8	8	8	8	8	8
United Kingdom	64	53	53	55	54	44	43	41	40	40	40	40	38
EU-15	**400**	**379**	**385**	**384**	**365**	**345**	**343**	**336**	**328**	**328**	**328**	**324**	**311**
Bulgaria	11	6	6	5	4	5	5	5	4	4	4	4	4
Cyprus	1	1	1	1	1	1	1	1	1	1	1	1	1
Czech Republic	12	8	8	8	8	8	8	8	8	7	8	8	7
Estonia	2	1	1	1	1	1	1	1	1	1	1	1	1
Hungary	15	9	10	9	10	9	10	10	9	9	10	10	10
Latvia	4	1	1	1	1	1	1	1	1	1	1	2	2
Lithuania	7	3	4	4	4	4	4	4	5	5	5	5	5
Malta	0	0	0	0	0	0	0	0	0	0	0	0	0
Poland	37	31	30	30	30	29	29	29	28	28	28	28	30
Romania	29	19	19	18	16	16	15	15	15	15	17	17	16
Slovakia	6	4	4	4	4	3	4	4	4	4	4	4	4
Slovenia	1	1	1	1	1	1	1	1	1	1	1	1	1
EU-27	**525**	**464**	**470**	**468**	**445**	**423**	**422**	**416**	**405**	**405**	**409**	**404**	**392**

Note: Values in white cells without a frame are data provided by Member States in 2008 in the CRF Table Summary 1.A. Framed cells indicate that the emission data has been taken from the EC GHG inventory 2007. 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.

Table 1.23 Data basis of actual HFCs, PFCs and SF_6 emissions in CO_2 equivalents (Gg)

Member State		1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Austria	HFC	23	267	347	427	495	542	596	694	781	863	897	908	858
	PFC	1,079	69	66	97	45	64	72	82	87	102	126	125	136
	SF_6	503	1,139	1,218	1,120	908	684	633	637	641	594	513	286	480
Belgium	HFC	439	439	527	639	779	817	952	1,083	1,303	1,466	1,508	1,494	1,595
	PFC	2,434	2,335	2,220	1,224	686	348	361	223	82	209	306	141	152
	SF_6	1,662	2,205	2,121	526	271	122	112	129	112	100	84	84	75
Denmark	HFC	IA,NE,NO	218	329	324	411	503	605	647	672	695	749	805	835
	PFC	IA,NE,NO	1	2	4	9	12	18	22	22	19	16	14	16
	SF_6	44	107	61	73	59	65	59	30	25	31	33	22	36
Finland	HFC	0	29	77	168	245	319	502	657	463	652	695	864	748
	PFC	0	0	0	0	0	28	22	20	13	15	12	10	15
	SF_6	94	69	72	76	53	52	51	55	51	42	23	20	40
France	HFC	3,657	3,249	5,287	5,644	5,860	6,698	7,681	8,356	9,444	10,696	11,516	12,404	13,383
	PFC	4,293	2,562	2,338	2,425	2,846	3,529	2,487	2,191	3,477	3,164	2,266	1,714	1,694
	SF_6	2,022	2,244	2,286	2,214	2,331	2,020	1,848	1,487	1,329	1,326	1,491	1,321	1,194
Germany	HFC	4,369	6,472	5,853	6,384	6,951	7,192	6,469	7,878	8,542	8,381	8,669	9,362	9,815
	PFC	2,708	1,750	1,714	1,369	1,473	1,243	786	723	795	858	830	718	582
	SF_6	4,785	7,220	6,929	6,903	6,701	5,310	5,078	4,898	4,197	4,311	4,486	4,734	5,333
Greece	HFC	935	3,337	3,929	4,247	4,741	5,564	4,486	4,150	4,369	4,286	4,373	4,580	4,648
	PFC	258	83	72	165	204	132	148	91	88	77	72	72	71
	SF_6	3	4	4	4	4	4	4	4	4	4	4	4	4
Ireland	HFC	1	45	76	132	191	197	230	251	277	350	386	435	506
	PFC	0	75	103	131	62	196	305	296	212	229	182	168	148
	SF_6	35	83	102	132	94	69	56	69	70	119	67	96	69
Italy	HFC	351	671	450	756	1,182	1,524	1,986	2,550	3,100	3,796	4,515	5,267	5,932
	PFC	1,808	491	243	252	270	258	346	451	424	498	350	361	282
	SF_6	333	601	683	729	605	405	493	795	738	465	492	460	390
Luxembourg	HFC	14	14	20	26	31	37	43	51	59	67	75	83	87
	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
	SF_6	3	3	3	3	3	3	4	4	4	4	4	4	4
Netherlands	HFC	4,432	6,020	7,678	8,300	9,341	4,859	3,824	1,469	1,541	1,379	1,511	1,353	1,559
	PFC	2,264	1,938	2,155	2,344	1,829	1,472	1,582	1,489	2,187	621	286	266	257
	SF_6	217	301	312	345	329	317	320	325	286	248	251	250	215
Portugal	HFC	IA,NE,NO	53	74	108	149	210	307	393	497	607	684	785	851
	PFC	NA,NE	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	6	7	7	8	8	8	9	10	12	13	14	15
Spain	HFC	2,403	4,645	5,197	6,126	5,809	7,164	8,170	5,284	3,892	5,033	4,680	5,006	5,550
	PFC	883	833	797	820	769	704	412	240	264	267	272	244	248
	SF_6	67	108	115	130	139	175	205	183	207	208	254	272	324
Sweden	HFC	4	126	205	313	386	489	564	611	664	709	769	795	823
	PFC	377	343	303	280	272	291	241	236	261	258	254	257	245
	SF_6	107	127	108	153	99	102	94	111	104	69	81	142	111
United Kingdom	HFC	11,375	15,493	16,723	19,185	17,272	10,835	9,087	9,680	9,908	10,218	8,908	9,182	9,157
	PFC	1,401	471	493	417	431	361	485	419	310	264	331	251	296
	SF_6	1,030	1,239	1,267	1,226	1,262	1,426	1,798	1,425	1,509	1,324	1,127	1,094	878
EU-15	HFC	40,921	33,608	41,078	46,772	52,778	53,845	46,950	45,502	43,756	45,511	49,199	49,935	53,323
	PFC	15,009	12,255	10,950	10,507	9,528	8,896	8,639	7,264	6,483	8,223	6,581	5,304	4,342
	SF_6	14,330	14,119	15,457	15,288	13,640	12,868	10,763	10,763	10,162	9,287	8,854	8,925	8,803
Bulgaria	HFC	IA,NE,NO	3	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
	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
	SF_6	0	1	1	2	2	2	2	2	3	3	4	4	5
Cyprus	HFC	0	2	4	6	10	14	19	25	31	38	44	136	53
	PFC	0	0	0	0	0	0	0	0	0	0	0	NA	NA
	SF_6	1	2	3	3	3	2	2	2	3	4	4	0	0
Czech Republic	HFC	NA,NO	1	101	245	317	268	263	393	391	590	600	594	872
	PFC	NA,NO	0	4	1	1	3	9	12	14	25	17	10	23
	SF_6	78	75	78	95	64	77	142	169	68	101	52	86	83
Estonia	HFC	NA,NO	0	1	1	2	3	4	5	6	7	7	8	75
	PFC	NA,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	1	1	1	1	2	4	5	5	6	1
Hungary	HFC	NA,NO	2	2	45	125	347	206	281	404	499	526	518	607
	PFC	271	167	159	161	193	210	211	199	203	190	201	209	2
	SF_6	40	70	69	68	68	127	140	107	120	162	178	201	244
Latvia	HFC	IA,NE,NO	0	1	2	5	7	9	10	12	13	16	19	35
	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
	SF_6	0	0	0	1	1	1	1	2	3	4	5	8	7
Lithuania	HFC	NA,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	19	113
	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
	SF_6	0	0	0	0	0	0	0	0	0	2	1	1	2
Malta	HFC	IA,NE,NO	2	5	8	11	15	22	29	32	42	47	51	76
	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
	SF_6	0	1	1	1	1	1	1	1	1	1	1	1	1
Poland	HFC	NA,NE	26	97	154	167	206	595	1,073	1,519	1,816	2,414	3,015	2,844
	PFC	NA,NE	250	236	249	251	240	224	270	287	278	285	260	270
	SF_6	0	31	25	24	25	25	24	24	24	22	23	28	30
Romania	HFC	NA,NE	0	0	1	2	2	3	3	3	5	7	4	22
	PFC	2,116	1,774	1,769	390	416	415	413	429	445	472	513	570	610
	SF_6	0	0	0	0	0	0	0	0	0	0	0	0	0
Slovakia	HFC	NA,NO	22	38	61	41	65	76	82	102	132	153	172	199
	PFC	271	114	35	35	25	14	12	16	14	22	20	20	36
	SF_6	0	10	11	11	12	13	13	14	15	15	16	17	17
	HFC	NA,NO	29	27	33	27	24	31	39	50	64	80	96	112

Note: Values in white cells without a frame are data provided by Member States in 2008 in the CRF Table Summary 1.A. Framed cells indicate that the emission data has been taken from the EC GHG inventory 2007. 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

Tables 1.24 and Table 1.25 show the geographical coverage of the Member States' national inventories. As the EU-15 and the EU-27 inventories are the sum of the Member States' inventories, the EC inventories cover the same geographical area as the inventories of the Member States.

Table 1.24 Geographical coverage of the EU-15 inventory

Member State	Geographical coverage
Austria	Austria
Belgium	Belgium consisting of Flemish Region, Walloon Region and Brussels Region
Denmark	Denmark (excluding Greenland and the Faeroe Islands)
Finland	Finland including Åland Islands
France	France and the overseas departments (Guadeloupe, Martinique, Guyana and Reunion). Note that the EU GHG inventory excludes the French overseas territories (New Caledonia, Wallis and Futuna, French Polynesia, Mayotte, Saint-Pierre and Miquelon)
Germany	Germany
Greece	Greece
Ireland	Ireland
Italy	Italy
Luxembourg	Luxembourg
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.
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.
Spain	Spanish part of Iberian mainland, Canary Islands, Balearic Islands, Ceuta and Melilla
Sweden	Sweden
United Kingdom	England, Scotland, Wales and Northern Ireland. Note that the EU GHG inventory excludes emissions from the UK Crown Dependencies (Jersey, Guernsey and the Isle of Man) and the UK Overseas Territories.

Table 1.25 Geographical coverage of the new Member States

Member State	Geographical coverage
Bulgaria	Bulgaria
Cyprus	Cyprus
Czech Republic	Czech Republic
Estonia	Estonia
Hungary	Hungary
Latvia	Latvia
Lithuania	Lithuania
Malta	Malta
Poland	Poland
Romania	Romania
Slovakia	Slovakia
Slovenia	Slovenia

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. All chapters and annexes of this report refer to EU-15 and to EU-27, but the level of detail for the information provided varies, e.g. the Chapters 3-9 include more detailed information for the EU-15 Member States. In any case, all the detailed information provided in previous reports for the EU-15 is also available in this report.

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 1.26 provides explanations for not including the annexes as required by the UNFCCC reporting guidelines.

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

Annex required in the UNFCCC reporting guidelines	Comment
Annex 1: Key categories	This annex is included in the 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 1.27 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 1.27 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	Included in Annex 2	Comment
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	Yes	
Table 5. B	Yes	
Table 5. C	Yes	
Table 5. D	Yes	
Table 5. E	Yes	
Table 5. F	Yes	
Table 5 (I)	Yes	
Table 5 (II)	Yes	
Table 5 (III)	Yes	
Table 5 (IV)	Yes	
Table 5 (V)	Partly	Emissions are included, activity data is not estimated because type of activity data used by the MS varies
Waste		
Table 6	Yes	
Table 6. A, C	Partly	Emissions and some activity data are included
Table 6. B	Partly	Emissions are included, activity data is not estimated because of limited data availability
Summary Tables		
Summary 1.A	Yes	
Summary 1.B	Yes	
Summary 2	Yes	
Summary 3	Yes	
Other Tables		
Table 7	Yes	
Table 8(a)	Yes	
Table 8(b)	Partly	It is indicated in which MS recalcualtions were performed. In addition, 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 1.28 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 1.28 Activity data reported by Member States in CRF background data tables

Table	Source category		Activity data reported by MS

Table	Source category		Activity data reported by MS
Table 1B2	1. B. 2. a. Oil (3)		
		I. Exploration	number of wells drilled crude oil number of wells drilled/tested
		ii. Production	Oil throughput PJ of oil produced Crude oil and NGL production Crude oil produced Oil and gas produced
		iii. Transport	oil loaded in tankers PJ Loaded Crude oil imports Transport of crude oil Offshore loading of oil only
		iv. Refining / Storage	Oil refined (SNAP 0401) PJ oil refined crude oil & products kt oil refined Refinery input (crude oil and NGL) Refery input: crude oil, NGL crude oil & products Oil refinery throughput
		v. Distribution of Oil Products	Gasoline Consumption (SNAP 0505) kt oil refined Domestic supply of gasoline Oil products
		vi. Other	Transfer loss gas works gas onshore loading of oil only
	1. B. 2. b. Natural Gas		
		i. Exploration	natural gas number of wells drilled/tested
		ii. Production (4) / Processing	Gas throughput PJ gas produced natural gas from crude oil extraction Natural gas production Mm3 gas produced
		iii. Transmission	Pipelines length (km) total amount of gas consumed PJ gas consumed Length of transmission pipeline Mm3 gas transported gas transported PJ gas (NCV) Pressure levelling losses
		iv. Distribution	Distribution network length consumption distribution net PJ gas distributed via local networks PJ gas consumed Length of distribution mains Mm3 gas transported
		v. Other Leakage	PJ gas consumed t of natural gas released from pipelines
	1. B. 2. c. Venting (5)		
		i. Oil	PJ oil produced kt oil refined Crude oil and NGL production
		ii. Gas	PJ gas produced Sour Natural gas production
		iii. Combined	
	Flaring		
		i. Oil	PJ gas consumption kt oil refined Consumed Crude oil and NGL production Mm3 gas consumption oil produced Refinery gas other liquid fuels

Table	Source category		Activity data reported by MS
		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
		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	**Source category**		**Activity data reported by MS**
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.

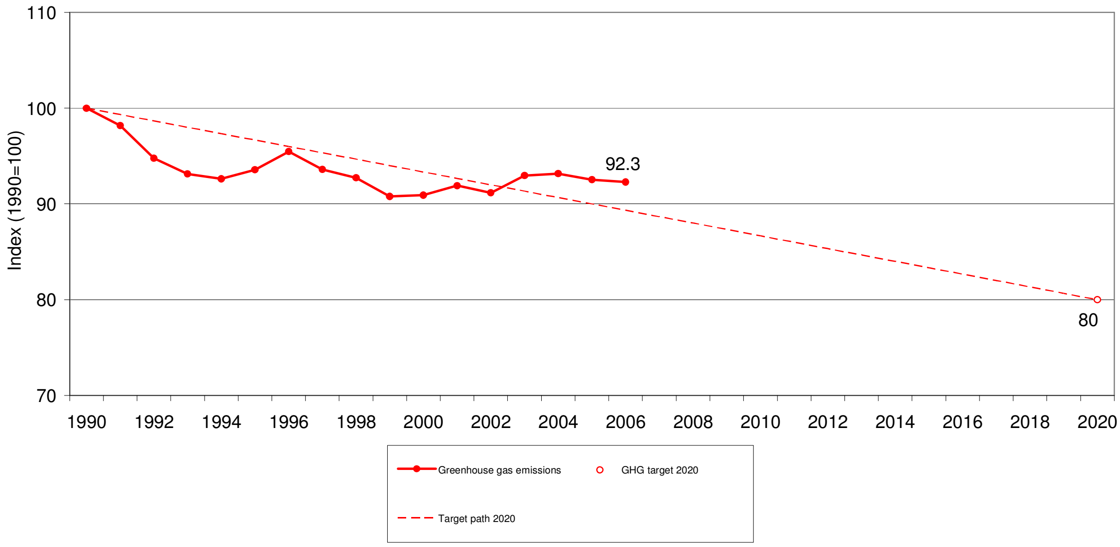
2.1 Aggregated greenhouse gas emissions

EU-27: Total GHG emissions without LULUCF in the EU-27 decreased by 7.7[16] % between 1990 and 2006 (Figure 2.1). Emissions decreased by 0.3 % (-14 million tonnes) between 2005 and 2006.

In 2007 the EU made a firm independent commitment to achieve at least a 20% reduction of greenhouse gas emissions by 2020 compared to 1990[17].

Assuming a linear target path from 1990 to 2020, in 2006 total EU-27 GHG emissions were 2.9 index points above this target path (Figure 2.1).

Figure 2.1 EU-27 GHG emissions 1990–2006 (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-27 emissions in 2006 are to a linear path of emissions reductions from 1990 to the unilateral commitement by the EU-27 for 2020, assuming that only domestic measures will be used. Therefore, it does not deliver a measure of (possible) compliance of the EU-27 with its GHG targets in 2020, but aims at evaluating overall EU-27 GHG emissions in 2006. The unit is index points with 1990 emissions being 100.

GHG emission data for the EU-27 as a whole do not include emissions and removals from LULUCF. In addition, no adjustments for temperature variations or electricity trade are considered.

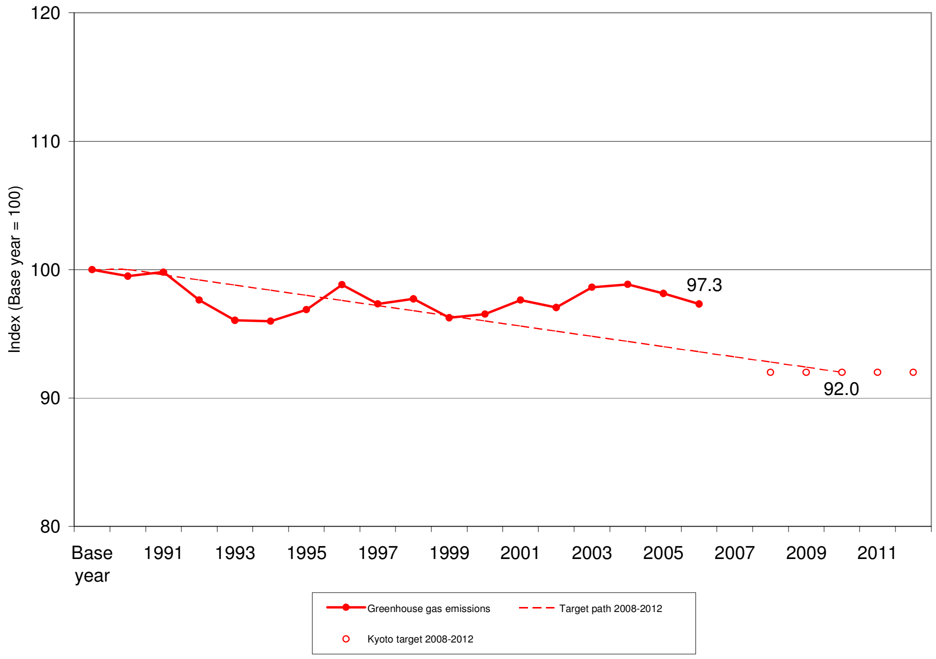
[16] Compared to the EC inventory report from 2007 the 1990 emission figures have dropped signficantly by ca. 48 million tonnes CO_2 equivalents due to recalculations. The result is that the overall decrease for EU-27 since 1990 in this year's submissions is ca 0.5 percentage points less than in the 2007 submission despite a decrease of 0..3% between 2005 and 2006.

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

EU-15: In 2006 total GHG emissions in the EU-15, without LULUCF, were 2.2 % (93 million tonnes CO_2 equivalents) below 1990. Compared to the base year[18], emissions in 2006 were 2.7 % or 114 million tonnes CO_2 equivalents lower. Emissions decreased by 0.8 % (-34.9 million tonnes CO_2 equivalents) between 2005 and 2006.

Under 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 2006 total EU-15 GHG emissions were 3.7 index points above this target path (Figure 2.2).

Figure 2.2 EU-15 GHG emissions 1990–2006 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 2006 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 2006. 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 table 1.4).

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.

EU-27/15 trends: In 1990 EU-15 was responsible for 76.2% of EU-27's total GHG emissions. In 2006 EU-15 was responsbile for 80.7% of EU-27 emissions. Emissions in the EU-27 decreased more between 1990 and 2006 compared to the EU-15. This was mainly due to decreases in emissions from public electricity and heat production (-72.2 million tonnes) whereas emissions in this sector increased in the EU-15 (+69.3 million tonnes). Significant differences can also be observed for energy-related CO_2 emissions from manufacturing industries and construction excl. iron and steel (decreases in the EU-27 were by 69.6 million tonnes higher than in the EU-15), for CO_2 emissions

[18] 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 deforestation for the Netherlands, Portugal and the UK (see tables 1.4 and 1.5).

from households and services (difference of 45.6 million tonnes) and for N_2O emissions from agricultural soils. In contrast, CO_2 emissions from road transport increased more strongly in the EU-27 than in the EU-15 (difference of 40.1 million tonnes).

EU27/15-main reasons for emissions changes 2005-2006

Between 2005 and 2006, relative emission decreases were higher in the EU-15 (-0.8 %) than in the EU-27 (-0.3 %). This was mainly due to larger increases of CO_2 emissions from public electricity and heat production, iron and steel production and road transport in the EU-27.

Table 2.0: EU27/15: Overview of Top decreasing/increasing source categories 2005-2006 (+/- 4 Million tonnes CO_2 equivalents)

Source category	EU-27	EU-15
	Million tonnes (CO_2 eq.)	
Households and services (CO_2 from 1A4)	-16.6	-18.8
Public Electricity and Heat Production (CO_2 from 1A1a)	+15.4	+6.1
Road transport (CO_2 from 1A3b)	+6.5	+2.1
Nitric acid production (N_2O from 2B2)	-6.3	-5.4
Manufacturing industries (excl. iron and steel) (Energy-related CO_2 from 1A2 excl. 1A2a)	-6.1	-2.6
Petroleum refining (CO_2 from 1A1b)	-5.4	-5.5
Adipic acid production (N_2O from 2B3)	-5.1	-5.1
Iron and steel production (CO_2 from 1A2a+2C1)	+5.0	-1.2
Total change 2005-2006	**-14.2**	**-34.9**

Notes: As the table only presents sectors that has increased/decreased equal or more than 4Mt CO_2 equivalents the sum for each country grouping EU27/15 does not neccsarily match the total change listed at the bottom of the table

EU-15 – main reasons for emission changes 2005-2006

The 34.9 million tonnes (CO_2 equivalents) decrease in GHG emissions between 2005-2006 was mainly due to:

- Lower CO_2 emissions from households and services (-18.8 million tonnes or -2.9 %). One important reason for the decrease are warmer weather conditions. The number of heating degree days decreased by 3.3 % between 2005 and 2006. Important decreases in CO_2 emissions from households and services were reported by France, Italy and the United Kingdom, while Germany reported substantial increases.
- Lower CO_2 emissions from petroleum refining (-5.5 million tonnes or -4.5 %) mainly in Italy and the UK.
- Lower N_2O emissions from Nitric Acid Production (-5.4 million tonnes or -16.3 %) mainly in Germany due to a decreased production rate.
- Lower N_2O emissions from Adipic Acid Production (-5.1 million tonnes or -43.6 %). The decrease of N_2O emissions from Adipic Acid Production is mainly caused by Italy due to abatement techniques.

Substantial increases in GHG emissions between 2005-2006 took place in the following source categories:

- CO_2 emissions from Public Electricity and Heat Production (+6.1 million tonnes or +0.6 %) CO_2 emissions from public electricity and heat production increased mainly in Denmark, Finland and the UK. In Denmark and Finland, this was mainly due to increased electricity production in coal-fired powerstations and decreased net imports of electricity. In Finland, reduced electricity production from hydropower was another reason for the emission reduction. In the UK, the decrease in CO_2 emissions was mainly caused by a fuel shift from gas to coal.

- HFC emissions from Refrigeration and Air Conditioning (+3.0 million tonnes or +8.2 %) mainly in France and Germany.

EU-27 – main reasons for emission changes 2005-2006

Between 2005 and 2006, decreases in the EU-27 were mainly due to:

- CO_2 from households and services (-16.6 million tonnes or -2.2 %)
  Reductions in the EU-27 were lower than in the EU-15 due to a substantial increase in Poland´s households (+2.6 million tonnes). Especially the consumption of solid fuels increased.
- N_2O from nitric acid production (-6.3 million tonnes or -13.1 %) significantly in the EU-15 only.
- CO_2 from manufacturing industries excl. iron and steel (-5.4 million tonnes or -4.0 %). Emission decreases were mainly due to decreases in chemical industry in France and Hungary. Emissions from 'other' industries decreased in Poland, Romania and the UK. Significant increases in chemical industries occurred in the Czech Republic.

Substantial emission increases were due to:

- CO_2 from public electricity and heat production (+15.4 million tonnes or +1.1 %)
  In Poland, emissions increased by 7.6 million tonnes due to increased electricity production in thermal power plants.
- CO_2 from road transportation (+6.5 million tonnes or +0.7 %)
  Emissions from road transport increased in Spain and Poland, while they decreased in Germany. In Spain, the use of gasoline decreased by 4.6 %, whereas diesel consumption increased by 5.1 %. In Poland, both gasoline and diesel consumption increased by 6.1 % and 7.2 %, respectively. The German emissions reductions were mainly due to decreased gasoline consumption (-5.6 %)
- CO_2 from iron and steel production (+5.0 million tonnes or +4.6 %)
  Emissions increased mainly in Poland and Italy. In Italy, this was mainly due to an increase in solid fuel consumption (+8.6 %). In Germany and France, emissions decreased.

Table 2.1 shows that between 2005 and 2006, Poland and Finland saw the largest emission increases in absolute terms (Poland +14.1 and Finland +11.3 million tonnes CO_2 equivalents). On the positive side, 2006 saw emission reductions from France (-13.8 million tonnes CO_2 equivalents) and Italy (-10.0 million tonnes CO_2 equivalents):

- In Poland, emission increases are mainly due to CO_2 from electricity and heat production (+7.6 million tonnes), CO_2 from households (+2.6 million tonnes) and CO_2 from road transport (+2.1 million tonnes).

- Finnish emission increases mainly occurred in CO_2 from electricity and heat production (+10.8 million tonnes). The increase in energy related emissions is due to an increase in electricity generation from fossil thermal power stations (+43 %) and a decrease in electricity generation from hydropower plants (-17 %). Total exports of electricity in 2006 were about 3 times higher than in 2005, whereas total imports decreased by 21 %.

- The French emission reductions occurred primarily in CO_2 from households and services (-3.8 million tonnes), CO_2 from public electricity and heat production (-3.4 million tonnes), energy-related CO_2 from manufacturing industries and construction (-2.6 million tonnes) and from N_2O emissions from agricultural soils (-1.5 million tonnes). France's reduction in the energy sector are primarily the effect of an increased electricity production from hydropower (+8 %) and a reduced electricity generation from fossil thermal power stations (-9 %). Decreased use of synthetic nitrogen fertilzer led to a reduction of N_2O emissions from agricultural soils.

- In Italy, emission reductions are mainly due to N_2O from adipic acid production (-4.7 million tonnes) and CO_2 from households (-4.1 million tonnes). Reduced CO_2 emissions from households were mainly due to warmer weather conditions and a shift from fossil fuels to biomass; a reduction of N_2O emissions from adipic acid production was achieved by abatement techniques.

Overview of GHG emissions in EU Member States

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

MEMBER STATE	1990 (million tonnes)	Kyoto Protocol base year [1] (million tonnes)	2006 (million tonnes)	Change 2005–2006 (million tonnes)	Change 2005–2006 (%)	Change 1990-2006 (%)	Change base year–2006 (%)	Targets 2008–12 under Kyoto Protocol and "EU burden sharing" (%)
Austria	79,2	79,0	91,1	-2,2	-2,3%	15,1%	15,2%	-13,0%
Belgium	144,5	145,7	137,0	-5,4	-3,8%	-5,2%	-6,0%	-7,5%
Denmark	69,0	69,3	70,5	6,9	10,9%	2,1%	1,7%	-21,0%
Finland	70,9	71,0	80,3	11,3	16,3%	13,2%	13,1%	0,0%
France	563,3	563,9	541,3	-13,8	-2,5%	-3,9%	-4,0%	0,0%
Germany	1227,7	1232,4	1004,8	-0,2	0,0%	-18,2%	-18,5%	-21,0%
Greece	104,6	107,0	133,1	-0,7	-0,5%	27,3%	24,4%	25,0%
Ireland	55,5	55,6	69,8	-0,6	-0,8%	25,6%	25,5%	13,0%
Italy	516,9	516,9	567,9	-10,0	-1,7%	9,9%	9,9%	-6,5%
Luxembourg	13,2	13,2	13,3	0,03	0,2%	1,0%	1,2%	-28,0%
Netherlands	211,7	213,0	207,5	-4,3	-2,0%	-2,0%	-2,6%	-6,0%
Portugal	59,1	60,1	83,2	-4,2	-4,8%	40,7%	38,3%	27,0%
Spain	287,7	289,8	433,3	-7,5	-1,7%	50,6%	49,5%	15,0%
Sweden	72,0	72,2	65,7	-1,2	-1,7%	-8,7%	-8,9%	4,0%
United Kingdom	768,5	776,3	652,3	-3,0	-0,5%	-15,1%	-16,0%	-12,5%
EU-15	**4243,8**	**4265,5**	**4151,1**	**-34,9**	**-0,8%**	**-2,2%**	**-2,7%**	**-8,0%**
Bulgaria	116,7	132,6	71,3	0,8	1,2%	-38,9%	-46,2%	-8,0%
Cyprus	6,0	Not applicable	10,0	0,2	1,6%	66,0%	Not applicable	Not applicable
Czech Republic	194,2	194,2	148,2	2,5	1,7%	-23,7%	-23,7%	-8,0%
Estonia	41,6	42,6	18,9	-0,4	-2,3%	-54,6%	-55,7%	-8,0%
Hungary	98,2	115,4	78,6	-1,6	-2,0%	-20,0%	-31,9%	-6,0%
Latvia	26,5	25,9	11,6	0,5	4,4%	-56,1%	-55,1%	-8,0%
Lithuania	49,4	49,4	23,2	0,5	2,4%	-53,0%	-53,0%	-8,0%
Malta	2,2	Not applicable	3,2	-0,01	-0,3%	45,0%	Not applicable	Not applicable
Poland	453,6	563,4	400,5	14,1	3,7%	-11,7%	-28,9%	-6,0%
Romania	247,7	278,2	156,7	4,7	3,1%	-36,7%	-43,7%	-8,0%
Slovakia	73,7	72,1	48,9	-0,4	-0,9%	-33,6%	-32,1%	-8,0%
Slovenia	18,6	20,4	20,6	0,1	0,6%	10,8%	1,2%	-8,0%
EU-27	**5572,2**	**Not applicable**	**5142,8**	**-14,0**	**-0,3%**	**-7,7%**	**Not applicable**	**Not applicable**

([1]) The base year under the Kyoto Protocol for each Member State and EU-15 is further outlined in Table 1.4 and 1.5. As Cyprus, Malta and EU-27 do not have targets under the Kyoto Protocol and they do not have applicable Kyoto Protocol base years .

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 1990–2006. The most important GHG by far is CO_2, accounting for 83 % of total EU-27 emissions in 2006 excluding LULUCF. In 2006, EU-27 CO_2 emissions without LULUCF were 4 258 Tg, which was 3.1 % below 1990 levels. Compared to 2005, CO_2 emissions increased by 0.002 %.

Table 2.2 Overview of EU-27 GHG emissions and removals from 1990 to 2006 in CO_2 equivalents (Tg)

GREENHOUSE GAS EMISSIONS	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Net CO_2 emissions/removals	3.984	3.732	3.789	3.732	3.726	3.672	3.688	3.746	3.699	3.790	3.814	3.827	3.755
CO_2 emissions (without LULUCF)	4.392	4.141	4.242	4.154	4.142	4.076	4.100	4.179	4.155	4.263	4.283	4.258	4.258
CH_4	603	546	539	522	508	497	484	469	459	449	436	429	424
N_2O	525	464	470	468	445	423	422	416	405	405	409	404	392
HFCs	28	41	47	54	55	48	47	46	48	53	54	58	62
PFCs	20	14	13	11	10	10	8	8	9	8	6	6	5
SF_6	11	16	15	14	13	11	11	11	10	9	9	9	10
Total (with net CO_2 emissions/removals)	**5.171**	**4.812**	**4.873**	**4.800**	**4.757**	**4.661**	**4.660**	**4.695**	**4.631**	**4.714**	**4.729**	**4.733**	**4.647**
Total (without CO2 from LULUCF)	**5.579**	**5.221**	**5.326**	**5.222**	**5.174**	**5.065**	**5.072**	**5.128**	**5.087**	**5.187**	**5.198**	**5.163**	**5.150**
Total (without LULUCF)	**5.572**	**5.214**	**5.320**	**5.216**	**5.167**	**5.058**	**5.066**	**5.121**	**5.080**	**5.180**	**5.191**	**5.157**	**5.143**

EU-15: Table 2.3 gives an overview of the main trends in EU-15 GHG emissions and removals for 1990–2006. Also in the EU-15 the most important GHG is CO_2, accounting for 84 % of total EU-15 emissions in 2006. In 2006, EU-15 CO_2 emissions without LULUCF were 3 466 Tg, which was 3.4 % above 1990 levels (Figure 2.3). Compared to 2005, CO_2 emissions decreased by 0.6 %. The largest four key sources account for 79 % of total CO_2 emissions in 2006. Figure 2.4 shows that the main reason for increases between 1990 and 2006 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 2006 in CO_2 equivalents (Tg)

GREENHOUSE GAS EMISSIONS	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Net CO_2 emissions/removals	3,085	3,006	3,032	3,009	3,062	3,042	3,056	3,119	3,089	3,147	3,183	3,197	3,109
CO_2 emissions (without LULUCF)	3,353	3,277	3,355	3,301	3,347	3,321	3,349	3,418	3,409	3,488	3,508	3,486	3,466
CH_4	439	413	407	395	385	377	366	353	343	331	320	314	308
N_2O	400	379	385	384	365	345	343	336	328	328	328	324	311
HFCs	28	41	47	53	54	47	46	44	46	49	50	53	56
PFCs	18	11	11	10	9	9	7	6	8	7	5	4	4
SF_6	11	15	15	14	13	11	11	10	9	9	9	9	9
Total (with net CO_2 emissions/removals)	**3,981**	**3,866**	**3,897**	**3,864**	**3,888**	**3,831**	**3,829**	**3,869**	**3,823**	**3,870**	**3,895**	**3,902**	**3,798**
Total (without CO2 from LULUCF)	**4,249**	**4,137**	**4,220**	**4,156**	**4,172**	**4,109**	**4,122**	**4,168**	**4,143**	**4,212**	**4,220**	**4,190**	**4,155**
Total (without LULUCF)	**4,244**	**4,133**	**4,216**	**4,152**	**4,168**	**4,105**	**4,118**	**4,164**	**4,139**	**4,207**	**4,216**	**4,186**	**4,151**

Figure 2.3 CO_2 emissions without LULUCF 1990 to 2006 in CO_2 equivalents (Tg) and share of largest key source categories in 2006 for EU-15

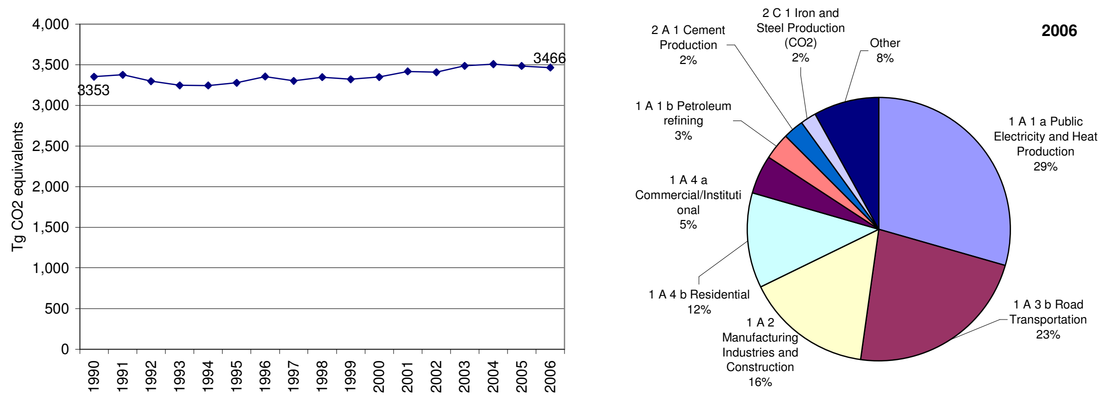
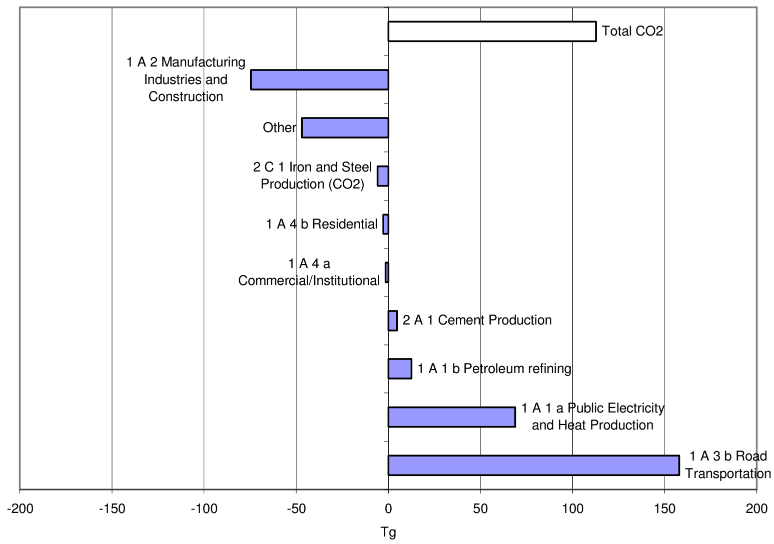


Figure 2.4 Absolute change of CO_2 emissions by large key source categories 1990 to 2006 in CO_2 equivalents (Tg) for EU-15



CH_4 emissions account for 7.4 % of total EU-15 GHG emissions and decreased by 29.8 % since 1990 to 308 Tg CO_2 equivalents in 2006 (Figure 2.5). The two largest key sources account for 56 % of CH_4 emissions in 2006. Figure 2.6 shows that the main reasons for declining CH_4 emissions were reductions in solid waste disposal on land and coal mining.

Figure 2.5 **CH_4 emissions 1990 to 2006 in CO_2 equivalents (Tg) and share of largest source categories in 2006 for EU-15**

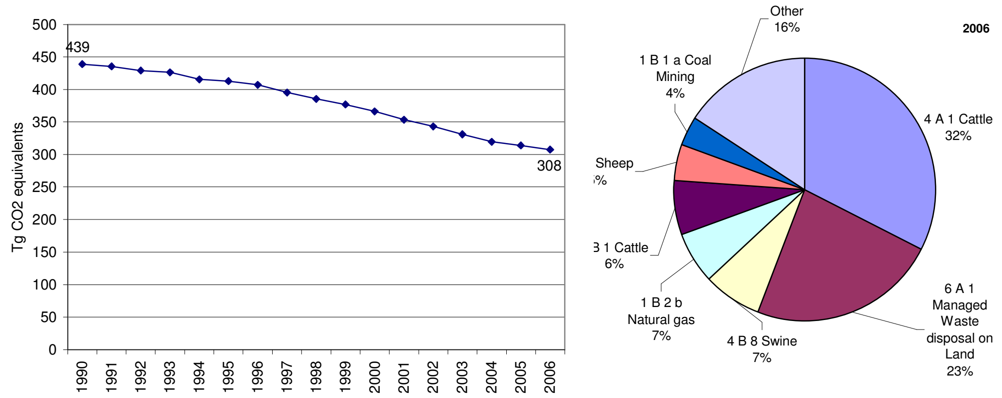
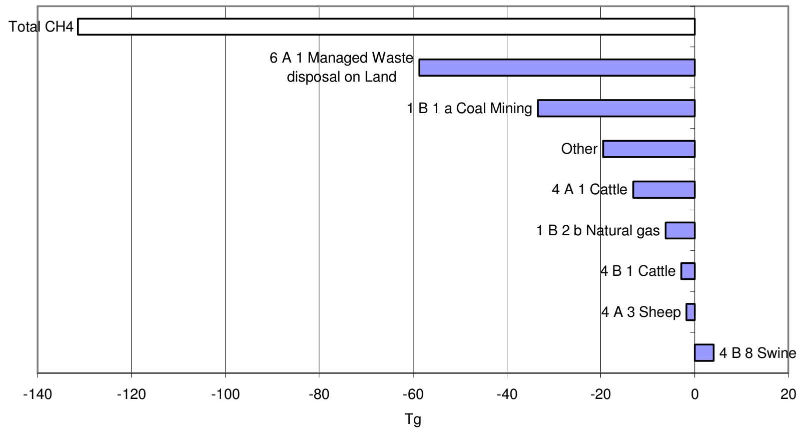


Figure 2.6 **Absolute change of CH_4 emissions by large key source categories 1990 to 2006 in CO_2 equivalents (Tg) for EU-15**



N_2O emissions are responsible for 7 % of total EU-15 GHG emissions and decreased by 22.3 % to 311 Tg CO_2 equivalents in 2006 (Figure 2.7). The two largest key sources account for about 53 % of N_2O emissions in 2006. 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 2006 in CO_2 equivalents (Tg) and share of largest source categories in 2006 for EU-15**

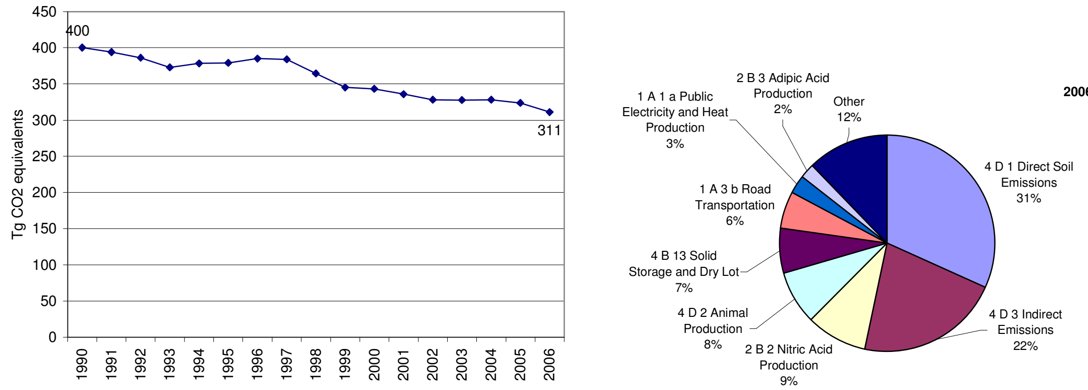
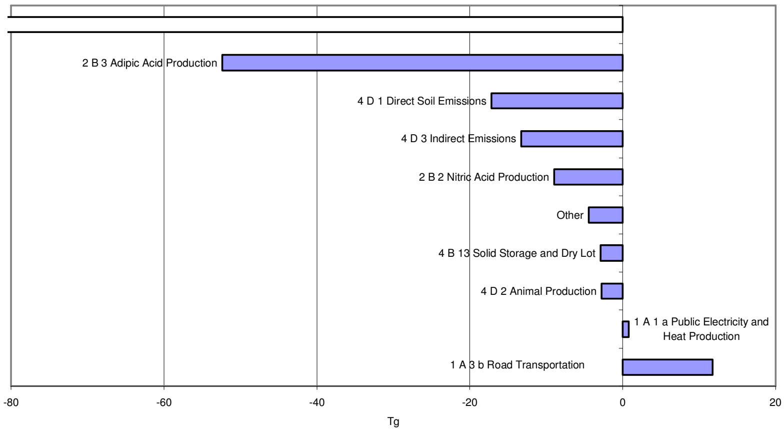


Figure 2.8 Absolute change of N_2O emissions by large key source categories 1990 to 2006 in CO_2 equivalents (Tg) for EU-15



Fluorinated gas emissions account for 1.7 % of total EU-15 GHG emissions. In 2006, emissions were 70 Tg CO_2 equivalents, which was 23 % above 1990 levels (Figure 2.9). The two largest key sources account for 82 % of fluorinated gas emissions in 2006. Figure 2.10 shows that HFCs from consumption of halocarbons showed large increases between 1990 and 2006. 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 2006 in CO_2 equivalents (Tg) and share of largest source categories in 2006 for EU-15

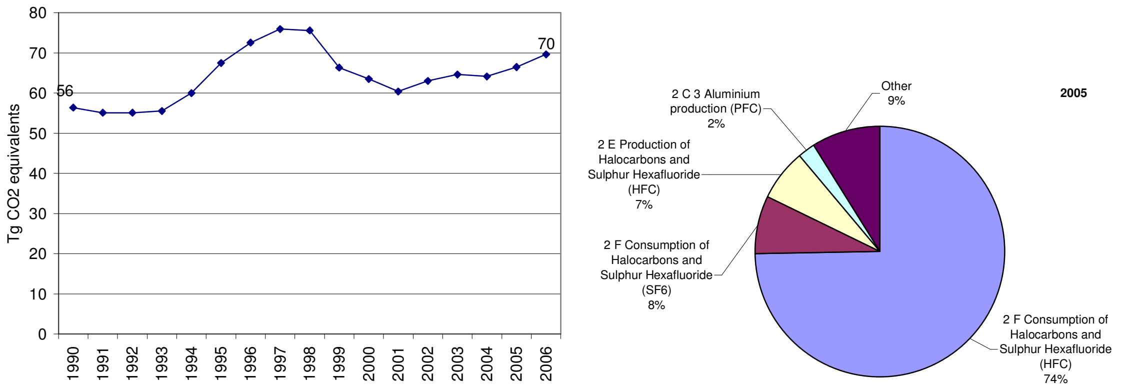
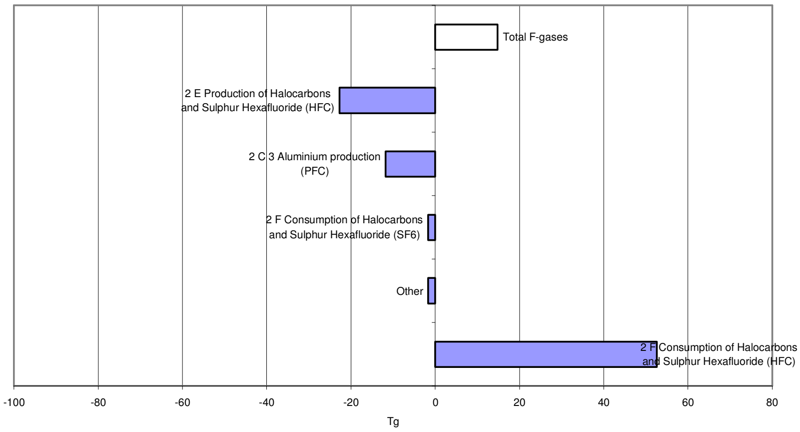


Figure 2.10 Absolute change of fluorinated gas emissions by large key source categories 1990 to 2006 in CO_2 equivalents (Tg) for EU-15



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 1990–2006. The most important sector by far is Energy accounting for 80 % of total EU-27 emissions in 2006. 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 2006 in CO_2 equivalents (Tg)

GHG SOURCE AND SINK	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1. Energy	4.277	4.029	4.141	4.037	4.024	3.965	3.974	4.058	4.030	4.131	4.137	4.109	4.099
2. Industrial Processes	478	455	452	459	432	392	404	393	389	400	412	416	417
3. Solvent and Other Product Use	13	11	11	11	11	11	11	11	10	10	10	10	10
4. Agriculture	592	513	515	515	513	509	501	493	487	482	481	474	473
5. Land-Use, Land-Use Change and Forest	-401	-403	-446	-415	-410	-397	-405	-426	-449	-466	-463	-424	-496
6. Waste	216	210	206	198	191	185	179	171	167	161	155	151	148
7. Other	-3	-4	-4	-4	-4	-4	-4	-4	-3	-3	-3	-3	-3
Total (with net CO_2 emissions/removals)	**5.171**	**4.812**	**4.873**	**4.800**	**4.757**	**4.661**	**4.660**	**4.695**	**4.631**	**4.714**	**4.729**	**4.733**	**4.647**
Total (without LULUCF)	**5.572**	**5.214**	**5.320**	**5.216**	**5.167**	**5.058**	**5.066**	**5.121**	**5.080**	**5.180**	**5.191**	**5.157**	**5.143**

EU-15: Table 2.5 gives an overview of EU-15 GHG emissions in the main source categories for 1990–2006. 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 2006 in CO_2 equivalents (Tg)

GHG SOURCE AND SINK	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1. Energy	3,256	3,175	3,261	3,195	3,237	3,215	3,232	3,304	3,292	3,365	3,375	3,352	3,327
2. Industrial Processes	373	371	368	378	358	325	329	321	319	324	330	332	328
3. Solvent and Other Product Use	10.178	9	9	9	9	9	9	9	9	8	8	8.067	8
4. Agriculture	434	413	417	417	417	416	413	404	399	395	393	387	384
5. Land-Use, Land-Use Change and Forest	-263	-267	-319	-287	-280	-275	-289	-295	-316	-337	-321	-284	-353
6. Waste	175	169	165	157	151	144	139	130	125	118	113	110	107
7. Other	-3	-4	-4	-4	-4	-4	-4	-4	-4	-3	-3	-3	-3
Total (with net CO_2 emissions/removals)	**3,981**	**3,866**	**3,897**	**3,864**	**3,888**	**3,831**	**3,829**	**3,869**	**3,823**	**3,870**	**3,895**	**3,902**	**3,798**
Total (without LULUCF)	**4,244**	**4,133**	**4,216**	**4,152**	**4,168**	**4,105**	**4,118**	**4,164**	**4,139**	**4,207**	**4,216**	**4,186**	**4,151**

2.4 Emission trends by Member State

Table 2.6 gives an overview of Member States’ contributions to the EC GHG emissions for 1990–2006. 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 2006 in CO_2 equivalents (Tg)

Member State	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Austria	79	81	84	83	83	81	81	85	87	93	92	93	91
Belgium	145	150	154	146	151	145	146	145	143	146	146	142	137
Denmark	69	76	90	80	76	73	68	69	69	74	68	64	70
Finland	71	71	77	76	72	72	70	75	77	85	81	69	80
France	563	555	571	564	577	561	556	558	549	552	552	555	541
Germany	1.228	1.095	1.115	1.077	1.052	1.021	1.019	1.036	1.017	1.030	1.028	1.005	1.005
Greece	105	110	114	119	124	124	128	130	129	134	134	134	133
Ireland	56	59	61	63	66	67	69	71	69	69	69	70	70
Italy	517	530	523	530	541	547	552	558	559	574	578	578	568
Luxembourg	13	10	10	10	9	10	10	10	11	12	13	13	13
Netherlands	212	224	232	225	227	214	214	215	215	216	218	212	207
Portugal	59	70	68	71	76	84	82	83	88	83	85	87	83
Spain	288	319	311	332	342	371	385	385	403	410	426	441	433
Sweden	72	74	77	73	73	70	68	69	70	71	70	67	66
United Kingdom	768	707	727	704	699	668	670	673	653	659	658	655	652
EU-15	**4.244**	**4.133**	**4.216**	**4.152**	**4.168**	**4.105**	**4.118**	**4.164**	**4.139**	**4.207**	**4.216**	**4.186**	**4.151**
Bulgaria	117	88	86	83	74	69	69	69	66	71	71	70	71
Cyprus	6	7	8	8	8	8	9	9	9	10	10	10	10
Czech Republic	194	153	160	153	145	140	147	149	145	146	147	146	148
Estonia	42	21	22	21	20	18	18	18	18	20	20	19	19
Hungary	98	79	81	80	79	79	78	79	77	81	79	80	79
Latvia	26	12	13	12	11	11	10	11	11	11	11	11	12
Lithuania	49	22	23	23	24	21	19	20	21	21	22	23	23
Malta	2	3	3	3	3	3	3	3	3	3	3	3	3
Poland	454	441	448	443	414	401	389	386	373	385	384	386	400
Romania	248	184	190	170	152	135	139	144	150	157	159	152	157
Slovakia	74	53	51	50	51	50	48	50	49	50	50	49	49
Slovenia	19	19	19	20	19	19	19	20	20	20	20	20	21
EU-27	**5.572**	**5.214**	**5.320**	**5.216**	**5.167**	**5.058**	**5.066**	**5.121**	**5.080**	**5.180**	**5.191**	**5.157**	**5.143**

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 339 million tonnes CO_2 euqivalents compared to 1990 ([19]).

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 10% above 1990 levels in 2006. Italian GHG emissions increased since 1990 primarily from road transport, electricity and heat production and petrol-refining. France's emissions were 4 % below 1990 levels in 2006. 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 2006.

Poland and Spain are the fifth and sixth largest emitters in the EU-27, both accounting for about 8 % of total EU-27 GHG emissions. Spain increased emissions by 51 % between 1990 and 2006. This was largely due to emission increases from road transport, electricity and heat production, and manufacturing industries. Poland decreased GHG emissions by 12 % between 1990 and 2006 (-29 % 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.

([19]) The EU-15 as a whole needs emission reductions of total GHG of 8 %, i.e. 341 million tonnes on the basis of the 2008 inventory in order to meet the Kyoto target.

2.5 Emission trends for indirect greenhouse gases and sulphur dioxide

Emissions of CO, NO_x, NMVOC and SO_2 have to be reported to the UNFCCC Secretariat because they influence climate change indirectly: CO, NO_x and NMVOC are precursor substances for ozone which itself is a greenhouse gas. Sulphur emissions produce microscopic particles (aerosols) that can reflect sunlight back out into space and also affect cloud formation. Table 2.7 shows the total indirect GHG and SO_2 emissions in the EU-15 between 1990–2006. All emissions were reduced significantly from 1990 levels: the largest reduction was achieved in SO_2 (– 73 %), followed by CO (– 56 %), NMVOC (– 44 %) and NO_x (– 34 %).

Table 2.7 Overview of EU-15 indirect GHG and SO_2 emissions for 1990–2006 (Gg)

GREENHOUSE GAS EMISSIONS	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
	(Gg)												
NOx	13,575	11,911	11,639	11,222	11,016	10,734	10,423	10,189	9,884	9,708	9,463	9,205	8,893
CO	52,470	42,069	40,540	38,551	36,871	34,619	32,128	30,573	28,485	27,543	26,538	24,716	23,261
NMVOC	16,181	13,331	12,836	12,621	12,178	11,711	10,982	10,500	9,988	10,039	9,495	9,247	9,093
SO2	16,497	9,934	8,874	8,159	7,625	6,752	6,039	5,803	5,583	5,146	4,940	4,622	4,410

In the EU-27, SO_2 emissions decreased by 69 %, followed by CO (-53 %), NMVOC (-39 %) and NO_x (-34 %) (Table 2.8).

Table 2.8 Overview of EU-27 indirect GHG and SO2 emissions for 1990–2006 (Gg)

GREENHOUSE GAS EMISSIONS	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
	(Gg)												
NOx	16,864	14,533	14,319	13,824	13,404	12,972	12,247	11,881	11,562	11,443	11,613	11,310	11,079
CO	64,480	51,517	50,622	48,187	45,914	43,391	38,087	35,928	33,755	32,811	34,789	32,512	30,443
NMVOC	18,240	15,144	14,751	14,488	14,005	13,459	12,219	11,982	11,611	11,598	11,428	11,144	11,079
SO2	24,976	16,620	15,434	14,412	12,751	11,294	9,947	9,634	9,145	8,698	8,515	8,002	7,795

Table 2.9 shows the NO_x emissions of the EU-27 Member States between 1990–2006. The largest emitters, the UK, Spain, Germany and France, made up 53 % of total NO_x emissions in 2006. Most EU-27 Member States reduced their emissions, only Austria, Greece, Portugal, Spain and Hungary had emission increases between 1990 and 2006.

Table 2.9 Overview of Member States' contributions to EU-15 and EU-27 NO_x emissions for 1990–2006 (Gg)

Member State	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Austria	192	181	204	193	208	199	205	215	225	236	233	237	225
Belgium	444	421	404	396	395	370	374	360	347	260	256	244	230
Denmark	274	266	304	259	236	221	205	203	199	208	193	184	185
Finland	295	245	248	240	225	220	211	211	208	217	203	175	193
France	1,841	1,698	1,683	1,642	1,653	1,607	1,557	1,525	1,490	1,464	1,442	1,429	1,364
Germany	2,862	2,132	2,048	1,966	1,919	1,888	1,815	1,735	1,640	1,580	1,532	1,447	1,394
Greece	280	298	302	309	324	314	305	317	320	320	317	329	316
Ireland	124	125	129	130	134	133	136	138	128	123	123	124	119
Italy	1,943	1,808	1,732	1,655	1,555	1,454	1,374	1,352	1,258	1,250	1,181	1,112	1,062
Luxembourg	14	6	6	5	3	3	4	4	3	3	3	3	0
Netherlands	545	449	427	395	390	397	386	376	369	366	346	330	317
Portugal	246	278	270	269	280	288	287	288	296	279	275	277	253
Spain	1,231	1,334	1,296	1,341	1,351	1,423	1,445	1,429	1,480	1,483	1,513	1,515	1,466
Sweden	314	280	271	261	253	242	220	209	204	198	188	181	175
United Kingdom	2,967	2,390	2,315	2,163	2,088	1,975	1,899	1,828	1,715	1,721	1,659	1,620	1,595
EU-15	**13,575**	**11,911**	**11,639**	**11,222**	**11,016**	**10,734**	**10,423**	**10,189**	**9,884**	**9,708**	**9,463**	**9,205**	**8,893**
Bulgaria	242	151	145	141	136	123	128	138	134	147	137	149	159
Cyprus	19	24	25	25	26	22	22	22	22	22	19	15	15
Czech Republic	742	430	446	470	414	391	396	332	319	325	333	279	283
Estonia	100	46	48	49	46	41	40	44	46	51	52	51	52
Hungary	8	185	192	196	198	197	185	183	183	211	185	203	202
Latvia	67	40	40	40	40	39	37	38	38	39	40	40	44
Lithuania	136	51	55	56	61	53	46	44	48	51	53	53	61
Malta	10	10	10	10	10	10	9	9	9	10	9	9	9
Poland	1,280	1,120	1,154	1,114	991	951	498	395	382	378	804	825	879
Romania	462	387	430	376	336	290	305	328	345	356	372	337	348
Slovakia	222	178	135	128	133	121	109	109	101	98	98	98	87
Slovenia	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	49	50	49	48	48	47	47
EU-27	**16,864**	**14,533**	**14,319**	**13,824**	**13,404**	**12,972**	**12,247**	**11,881**	**11,562**	**11,443**	**11,613**	**11,310**	**11,079**

Table 2.10 shows the CO emissions of the EU-27 Member States between 1990–2006. The largest emitters, France, Germany and Italy that made up 44 % of the total CO emissions in 2006, reduced their emissions from 1990 levels substantially. Also all other Member States, except Malta and Romania, reduced emissions.

Table 2.10 Overview of Member States' contributions to EU-15 and EU-27 CO emissions for 1990–2006 (Gg)

Member State	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Austria	1,444	1,267	1,246	1,155	1,109	1,034	959	930	899	900	857	823	785
Belgium	1,585	1,234	1,193	1,075	1,040	1,011	1,041	1,009	943	753	691	505	515
Denmark	761	702	686	625	584	545	543	559	543	563	559	592	591
Finland	709	634	623	621	616	608	588	580	570	558	540	510	499
France	11,734	10,281	9,661	9,088	8,870	8,346	7,703	7,116	6,902	6,614	6,708	6,203	5,680
Germany	12,118	6,671	6,280	6,155	5,762	5,406	5,134	4,907	4,634	4,484	4,317	4,201	4,006
Greece	1,295	1,328	1,354	1,355	1,384	1,310	1,356	1,266	1,230	1,193	1,155	1,052	956
Ireland	404	306	311	296	305	271	243	233	215	203	193	183	175
Italy	7,183	7,167	6,868	6,607	6,197	5,892	5,159	5,081	4,459	4,373	4,197	3,822	3,588
Luxembourg	132	63	58	36	12	15	15	16	13	13	10	12	0
Netherlands	1,067	804	772	725	701	611	647	625	603	582	583	551	544
Portugal	956	933	868	820	843	795	810	742	746	911	716	743	648
Spain	3,883	3,475	3,595	3,490	3,416	3,116	2,998	2,964	2,739	2,821	2,717	2,530	2,433
Sweden	974	908	881	831	766	742	710	673	660	651	616	608	578
United Kingdom	8,225	6,297	6,144	5,673	5,266	4,916	4,221	3,871	3,329	2,923	2,681	2,379	2,263
EU-15	**52,470**	**42,069**	**40,540**	**38,551**	**36,871**	**34,619**	**32,128**	**30,573**	**28,485**	**27,543**	**26,538**	**24,716**	**23,261**
Bulgaria	790	644	610	531	641	618	635	583	678	654	674	646	665
Cyprus	71	74	71	67	65	93	92	91	88	89	50	40	33
Czech Republic	1,063	926	958	974	807	722	676	683	582	622	617	551	532
Estonia	273	199	222	232	206	195	196	215	210	216	217	208	212
Hungary	167	645	646	636	632	592	592	579	574	600	585	585	596
Latvia	382	314	322	313	303	301	302	308	305	316	322	328	330
Lithuania	499	279	306	354	368	313	1,529	218	218	222	183	189	201
Malta	24	30	31	31	31	31	30	29	29	28	28	31	31
Poland	7,406	4,547	4,837	4,700	4,301	4,363	237	942	856	757	3,426	3,321	2,766
Romania	824	1,370	1,715	1,435	1,344	1,209	1,196	1,238	1,298	1,321	1,718	1,481	1,419
Slovakia	512	420	364	364	346	335	313	315	292	308	310	299	290
Slovenia	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	162	154	141	135	121	117	108
EU-27	**64,480**	**51,517**	**50,622**	**48,187**	**45,914**	**43,391**	**38,087**	**35,928**	**33,755**	**32,811**	**34,789**	**32,512**	**30,443**

Table 2.11 shows the NMVOC emissions of the EU-27 Member States between 1990–2006. The largest emitters France, Germany and Italy that made up 47 % of the total NMVOC emissions in 2006, reduced their emissions from 1990 levels. All Member States except for Portugal, Hungary and Poland reduced emissions.

Table 2.11 Overview of Member States' contributions to EU-15 and EU-27 NMVOC emissions for 1990–2007 (Gg)

Member State	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Austria	283	229	222	207	192	178	177	188	189	183	176	164	172
Belgium	394	330	310	299	288	275	253	245	227	200	183	140	126
Denmark	172	161	158	147	137	132	129	122	120	115	116	116	110
Finland	229	192	185	180	176	171	165	162	156	151	147	136	132
France	3,934	3,608	3,408	3,421	3,277	3,309	3,136	2,987	2,809	3,103	2,699	2,712	2,735
Germany	3,768	2,094	2,005	1,969	1,932	1,777	1,613	1,524	1,451	1,390	1,402	1,385	1,349
Greece	308	343	348	348	357	353	354	350	347	339	332	286	291
Ireland	105	101	107	108	110	88	78	74	68	64	60	58	57
Italy	1,988	2,006	1,953	1,886	1,781	1,686	1,502	1,429	1,332	1,293	1,261	1,215	1,176
Luxembourg	8	8	8	7	7	6	6	6	6	6	6	6	3
Netherlands	456	316	271	247	249	234	218	198	188	175	168	168	163
Portugal	683	718	719	721	721	713	707	710	712	714	715	713	711
Spain	1,094	1,030	1,060	1,074	1,107	1,101	1,088	1,061	1,022	1,039	1,027	990	965
Sweden	373	268	261	250	238	229	220	208	206	207	203	200	195
United Kingdom	2,386	1,927	1,822	1,756	1,609	1,457	1,337	1,236	1,156	1,061	1,000	959	909
EU-15	**16,181**	**13,331**	**12,836**	**12,621**	**12,178**	**11,711**	**10,982**	**10,500**	**9,988**	**10,039**	**9,495**	**9,247**	**9,093**
Bulgaria	117	94	87	72	87	78	79	82	87	86	96	103	109
Cyprus	14	16	15	15	15	16	16	16	16	16	14	11	11
Czech Republic	311	215	265	272	267	247	244	220	203	203	198	182	179
Estonia	36	29	30	30	25	21	23	24	24	27	28	25	23
Hungary	62	170	169	164	169	165	166	162	160	169	157	176	187
Latvia	94	59	61	62	61	61	56	55	57	59	60	63	65
Lithuania	110	72	77	83	83	76	70	66	66	80	75	90	84
Malta	6	7	12	10	10	9	4	8	5	5	3	3	3
Poland	831	769	766	774	730	731	184	450	592	479	808	793	911
Romania	335	281	335	293	280	259	265	266	282	301	359	321	296
Slovakia	141	101	98	92	90	84	78	84	82	87	88	83	78
Slovenia	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	10	NA,NE,NO	51	50	48	47	46	48	41
EU-27	**18,240**	**15,144**	**14,751**	**14,488**	**14,005**	**13,459**	**12,219**	**11,982**	**11,611**	**11,598**	**11,428**	**11,144**	**11,079**

Table 2.12 shows the SO_2 emissions of the EU-15 Member States between 1990–2006. The largest emitters, Poland, Spain and Bulgaria, that made up 44 % of the total SO_2 emissions in 2006, reduced their emissions from 1990 levels. All other Member States except for Greece and Hungary reduced emissions.

Table 2.12 Overview of Member States' contributions to EU-15 and EU-27 SO_2 emissions for 1990–2006 (Gg)

Member State	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Austria	74	47	45	40	36	34	32	33	32	32	27	27	28
Belgium	319	227	215	200	188	151	145	142	133	131	134	125	112
Denmark	178	137	172	99	76	55	29	27	25	32	25	22	25
Finland	249	105	110	101	93	91	81	90	89	101	83	68	84
France	1,357	999	975	830	849	734	643	590	544	539	535	512	478
Germany	5,353	1,724	1,448	1,207	969	796	637	641	601	605	582	574	558
Greece	472	539	529	522	530	548	499	504	516	554	548	545	536
Ireland	183	160	148	165	176	157	137	129	99	78	72	71	60
Italy	1,795	1,320	1,210	1,134	997	900	755	705	622	526	488	408	389
Luxembourg	14	6	5	4	2	1	1	1	1	1	1	1	0
Netherlands	190	128	116	102	94	88	72	73	67	63	63	65	64
Portugal	320	334	273	294	344	344	307	296	296	202	214	214	191
Spain	2,169	1,786	1,556	1,738	1,581	1,595	1,458	1,433	1,536	1,270	1,312	1,264	1,170
Sweden	108	71	69	62	59	48	46	44	45	45	41	40	39
United Kingdom	3,717	2,352	2,003	1,661	1,633	1,209	1,198	1,095	978	967	812	688	676
EU-15	**16,497**	**9,934**	**8,874**	**8,159**	**7,625**	**6,752**	**6,039**	**5,803**	**5,583**	**5,146**	**4,940**	**4,622**	**4,410**
Bulgaria	1,517	1,300	1,311	1,311	1,192	1,056	1,045	1,096	983	1,043	998	957	1,030
Cyprus	45	43	45	47	48	50	53	53	51	45	45	41	34
Czech Republic	1,876	1,095	934	981	442	269	264	251	237	232	227	219	211
Estonia	257	138	143	140	125	116	115	114	111	130	128	123	124
Hungary	10	707	671	656	593	598	489	404	365	348	249	147	123
Latvia	101	48	54	39	36	29	10	8	6	5	4	4	3
Lithuania	214	85	86	76	99	69	42	38	38	38	41	42	42
Malta	16	29	30	32	33	30	24	26	25	27	12	12	12
Poland	3,210	2,376	2,368	2,181	1,897	1,719	1,202	1,172	1,088	1,019	1,241	1,232	1,203
Romania	707	619	685	585	477	432	439	469	484	493	479	474	497
Slovakia	526	246	231	205	184	173	127	131	103	106	97	89	88
Slovenia	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	98	68	71	66	54	41	18
EU-27	**24,976**	**16,620**	**15,434**	**14,412**	**12,751**	**11,294**	**9,947**	**9,634**	**9,145**	**8,698**	**8,515**	**8,002**	**7,795**

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 improvement compared to the inventory report 2007 is the inclusion of detailed information on emission trends and methods, activity data and emission factors used for the new MS in a separate chapter.

3.1 Overview of sector (EU-15)

CRF Sector 1 Energy contributes 80 % to total GHG emissions and is the largest emitting sector in the EU-15. Total GHG emissions from this sector increased by 2.2 % from 3 256 Tg in 1990 to 3 327 Tg in 2006 (Figure 3.1). In 2006, emissions decreased by 0.7 % compared to 2005.

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: 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 1990–2006**

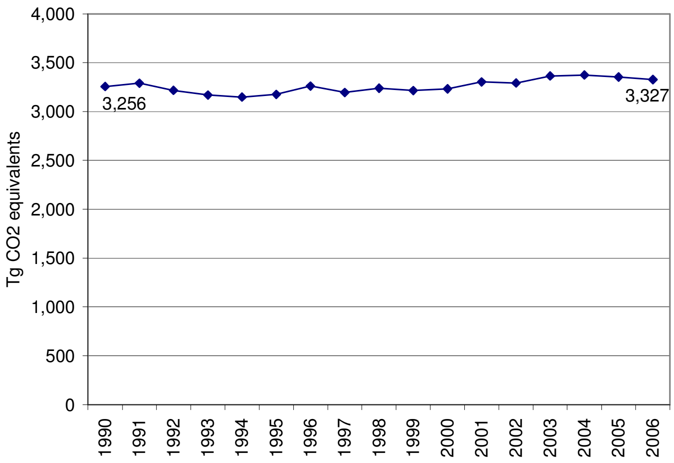
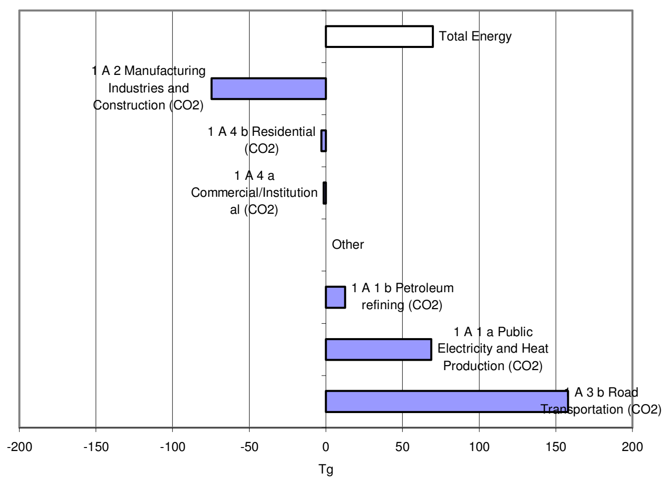
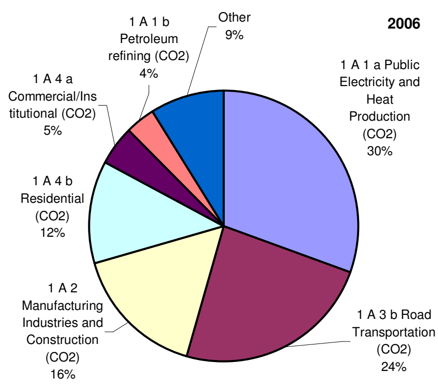


Figure 3.2 shows that CO_2 emissions from road transport had the highest increase in absolute terms of all energy-related emissions, while CO_2 emissions from 1A2 Manufacturing Industries decreased substantially between 1990 and 2006. The increases in road transport occurred in almost all Member States, whereas the emission reductions from manufacturing industries mainly occurred in Germany after the reunification. The decline of coal-mining (CH_4) and decreasing CO_2 emissions from 1A1c Manufacture of Solid Fuels and Other Energy Industries are the main reasons for the large absolute emission reductions from Other in Figure 3.2. Figure 3.2 shows that the six largest key sources account for 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 1990–2006 and share of largest key source categories in 2006**





3.2 Source categories (EU-15)

3.2.1 Energy industries (CRF Source Category 1A1)

Energy industries (CRF 1A1) comprises emissions from fuels combusted by the fuel extraction or energy-producing industries. For the EU-15, this source category includes three key sources: CO_2 from '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 2006, which is mainly dominated by CO_2 emissions from public electricity and heat production. CO_2 from 1A1a currently represents about 85 % 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 43 Tg CO_2 equivalent, or 3.7 %, between 1990 and 2006. About 85 % of the gross increase was accounted for by emissions from public electricity and heat production (70 Tg) and the remaining 15 % by petroleum refining (12 Tg). Greenhouse gas emissions from the manufacturing of solid fuels fell by 40 Tg over the 1990-2006 period.

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

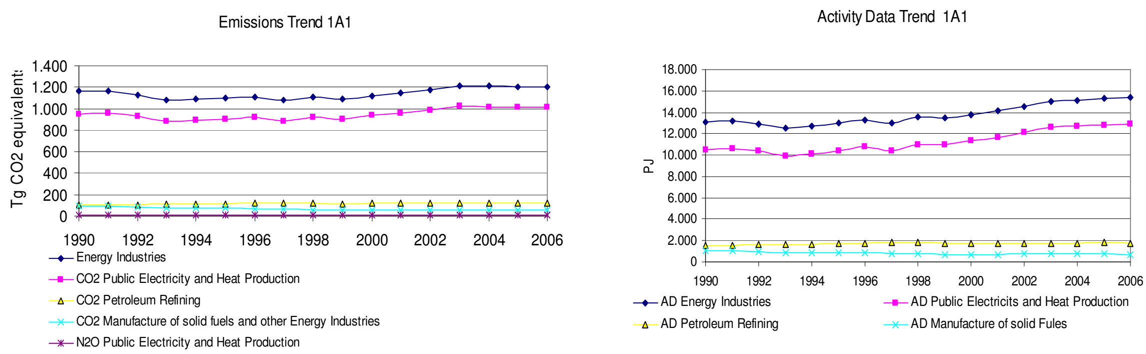


Table 3.1 summarises the information by Member State. Greenhouse gas emissions from energy industries increased in eleven Member States and fell in four. Of the eleven countries where emissions were higher in 2006 than in 1990, 55 % of the increase was accounted for by Spain and Italy alone. Of the four countries were emissions fell over the 1990-2006 period, about 95 % of the reductions came from Germany and the UK. The change in the EU-15 was a net increase of 43 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 2006 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO_2 emissions in 2006 (Gg)	N_2O emissions in 1990 (Gg CO_2 equivalents)	N_2O emissions in 2006 (Gg CO_2 equivalents)
Austria	13,844	15,508	13,792	15,426	48	76
Belgium	30,171	27,692	29,947	27,554	218	125
Denmark	26,315	29,878	26,173	29,470	119	168
Finland	19,185	32,897	19,055	32,541	122	330
France	66,824	65,346	66,157	64,480	593	835
Germany	419,686	370,171	414,936	366,139	4,572	3,903
Greece	42,559	54,944	42,445	54,744	106	183
Ireland	11,576	15,428	11,159	14,907	417	520
Italy	134,791	159,819	134,092	159,108	504	575
Luxembourg	1,305	1,472	1,302	1,462	2	9
Netherlands	52,703	62,287	52,492	61,913	140	239
Portugal	16,010	22,268	15,944	22,120	61	140
Spain	77,694	117,176	77,357	116,322	283	710
Sweden	10,414	11,374	10,050	10,867	342	433
United Kingdom	238,454	218,340	236,423	216,471	1,887	1,648
EU-15	**1,161,533**	**1,204,601**	**1,151,325**	**1,193,524**	**9,414**	**9,893**

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 Denmark, Finland and Greece. Figure 3.5 shows the absolute contributions to EU-15 greenhouse gas emissions from energy industries, which are clearly dominated by Germany and the UK. These two countries represent about half of the EU's greenhouse gas emissions from energy industries.

Figure 3.4: Share of greenhouse gas emissions from energy industries in total greenhouse gas emissions by Member State in 2006

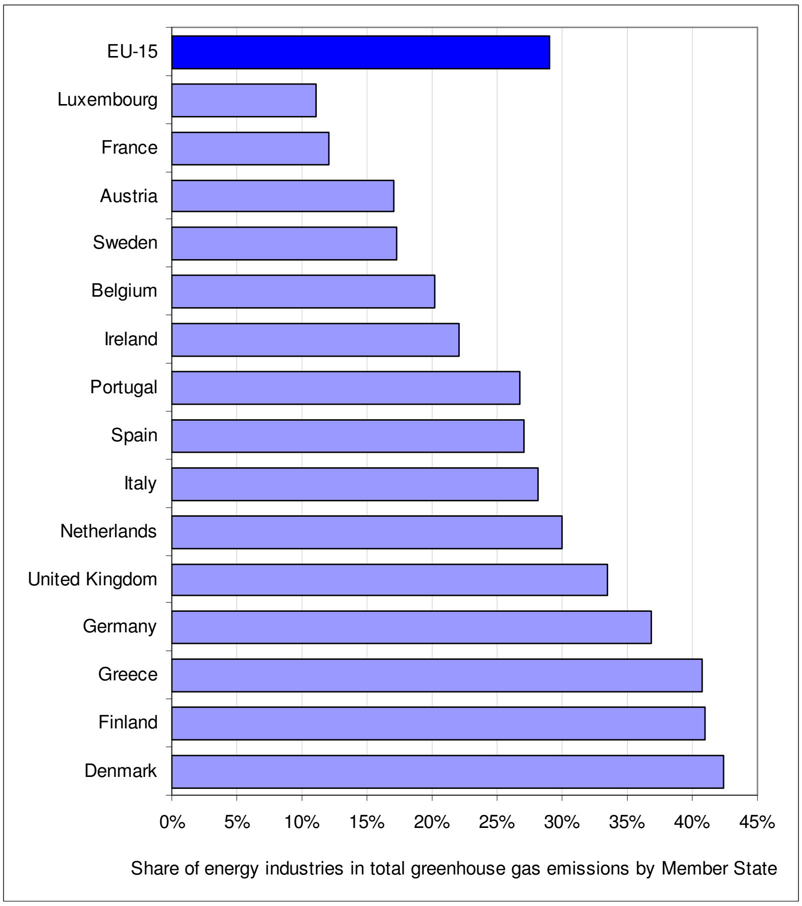
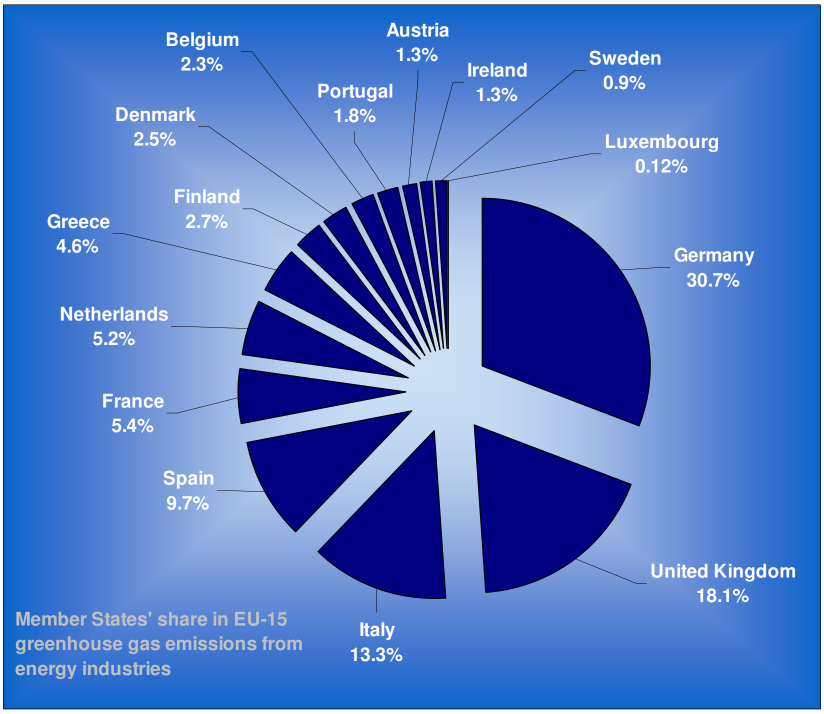


Figure 3.5: Member States' share of greenhouse gas emissions from energy industries in EU-15



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 of 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 2006.

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 2005 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 2005 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2005		Main explanations
	Gg	Percent	Gg	Percent	
Austria	133	1,0	262	1,7	Correction of NCVs; shift between categories 1.A.1 and 1.A.2 and/or between final energy consumption and transformation input; calculation of emissions from natural gas distribution losses
Belgium	84	0,3	-465	-1,6	As the year 2005 contains a temporary estimation of the emissions during the 2007 submission, this year was almost completely revised during the January 15, 2008 submission.
Denmark	0	0,0	6	0,0	
Finland	0	0,0	19	0,1	
France	22	0,0	4.858	7,7	1990: update of coke production; 2005: changed fuel consumption; change in GIC data base; changed AD for district heating
Germany	-146	0,0	174	0,0	New available energy data; 1A1b: mode of truncation;
Greece	-754	-1,7	-528	-0,9	EF of CO2 emissions from the combustion of lignite was changed
Ireland	0	0,0	0	0,0	
Italy	0	0,0	-638	-0,4	Update of emission factor for natural gas, coal and fuel oil; other minor liquid fuels have been added
Luxembourg	34	2,7	1.059	297,3	Revised AD for CRF category 1.A.1.a - other fuels (MSW incineration)
Netherlands	0	0,0	9	0,0	
Portugal	0	0,0	1.420	6,0	update of activity data for some LPS
Spain	0	0,0	12	0,0	
Sweden	0	0,0	-83	-0,7	Revised AD
UK	-6	0,0	3.105	1,5	Addition of emission factor for petroleum coke in power stations; Revision to activity data in power stations for gas oil (increase), Fuel oil (decrease) and coal. All due to change in activity data in National statistics. Addition of petroleum coke. Increase in activity data due to change in national statistics for natural gas used in petroleum refining; Reallocation of coal from other industrial combustion to power stations
EU-15	**-632**	**-0,1**	**9.210**	**0,8**	

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 2005 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 2005 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)**

	1990		2005		Main explanations
	Gg	Percent	Gg	Percent	
Austria	0	0,2	4	6,3	
Belgium	9	4,5	-86	-39,4	New estimate of underground mining activity; allocation to 1B1a
Denmark	0	0,0	0	0,1	
Finland	0	0,0	26	11,7	Plant level data corrected; correction in combustion technology
France	-139	-19,0	-256	-22,6	New EF for electricity production
Germany	3	0,1	-57	-1,5	New available energy data
Greece	-1.673	-94,0	-2.115	-91,6	EFs of N2O emissions from the combustion of solid and liquid fuels were changed
Ireland	1	0,3	12	2,2	
Italy	-1.180	-70,0	-1.461	-71,3	Other minor liquid fuels have been added
Luxembourg	2	-	5	-	
Netherlands	11	9,0	100	69,8	Revised emission factor for waste incineration
Portugal	0	0,0	39	34,4	
Spain	0	0,0	3	0,3	
Sweden	0	0,0	-3	-0,7	
UK	3	0,2	22	1,4	
EU-15	**-2.960**	**-23,9**	**-3.766**	**-27,8**	

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

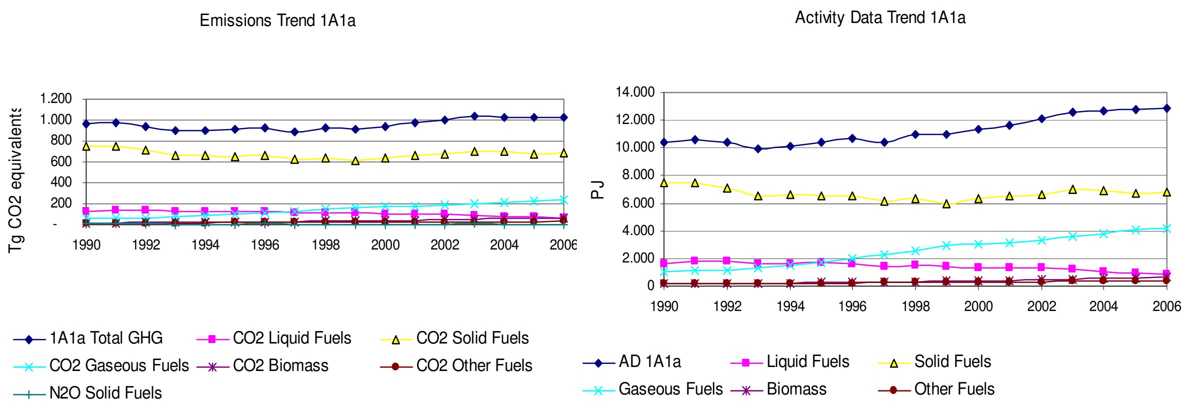
According to the IPCC, emissions from public electricity and heat production (CRF 1A1a) should include emissions from main activity producers of electricity generation, combined heat and power generation, and heat plants. Main activity producers (i.e. public utilities) are defined as those undertakings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

CO_2 emissions from electricity and heat production is the largest key source in the EU-15 accounting for about one quarter of total greenhouse gas emissions in 2006 and for 99 % of greenhouse gas emissions from public heat and electricity production. Between 1990 and 2006, CO_2 emissions from electricity and heat production increased, on average, by just over 7 % 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 2006. It also shows the activity data behind the emissions[20].

[20] 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.

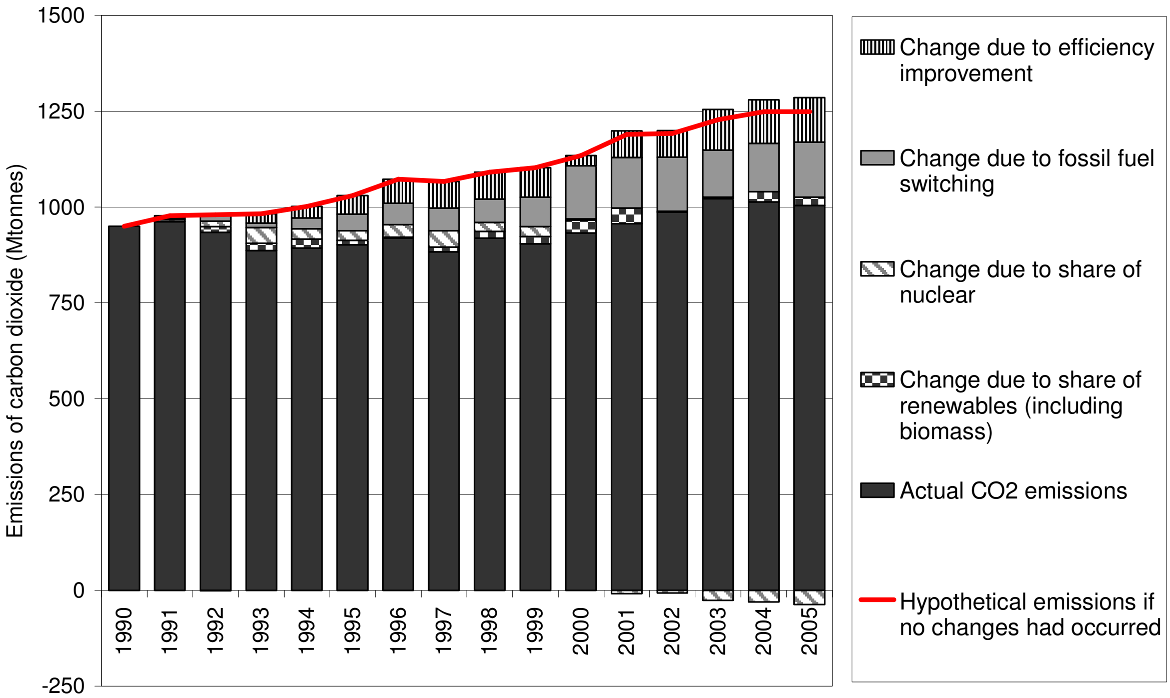
Figure 3.6: **1A1a-Public Electricity and Heat Production: Total, CO_2 and N_2O emission and activity trends**



Fuel used for public heat and electricity production increased by almost 25 % in the EU-15 between 1990 and 2006. 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 2006, and its share stands at just about below one third of all the fuel used for the production of heat and electricity in the EU. Liquid fuels still account for some 7 % but its use has declined gradually during the past 16 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 1990–2005. The main explanatory factors at the EU-15 level during the past 16 years have been improvements in energy efficiency and (fossil) fuel switching from coal to gas.

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 2005.**



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 2005, 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 1990-2005, but emissions would have risen by over 30 %, 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 1990-2005 can be explained by the following factors:

- An improvement in the thermal efficiency of electricity and heat production. During 1990-2005, there was a 9 % 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 12 % reduction in the CO_2 emissions per unit of fossil-fuel input during 1990-2005.

- The lower combined share of nuclear and renewable energy for electricity and heat production in 2005 compared to 1990[21]. During 1990-2005, the share of electricity from fossil

[21] 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-

fuels in total electricity production increased by 1 %.

These three factors interact with each other in a multiplicative way: Actual CO_2 emissions change = 1.31 (increase in electricity production) X 0.91 (efficiency improvement) X 0.88 (fossil fuel switching) X 1.01 (lower nuclear-renewable share) = 1.06. The combined effect was an increase of about 6 % in CO_2 emissions in 2005 compared to the 1990 level.

Returning to the 2008 inventory, table 3.4 summarises emissions arising from the production of public heat and electricity by Member State. CO_2 emissions increased in eleven Member States and fell in four. Of the eleven countries where emissions were higher in 2006 than in 1990, close to 40 % of the increase was accounted for by Spain alone. Of the remaining four countries, were emissions fell, more than two thirds of the reduction came from the UK. The change in the EU-15 was a net increase of about 69 Tg.

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

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006	
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	10,888	12,744	12,049	1.2%	-695	-5%	1,161	11%
Belgium	23,504	24,462	22,637	2.2%	-1,825	-7%	-867	-4%
Denmark	24,736	19,603	26,858	2.6%	7,255	37%	2,121	9%
Finland	16,448	18,654	29,412	2.9%	10,758	58%	12,964	79%
France	47,925	50,289	46,883	4.6%	-3,406	-7%	-1,042	-2%
Germany	335,864	325,341	329,294	32.3%	3,954	1%	-6,570	-2%
Greece	39,878	53,823	50,945	5.0%	-2,878	-5%	11,067	28%
Ireland	10,876	15,136	14,411	1.4%	-726	-5%	3,534	32%
Italy	107,136	119,968	121,579	11.9%	1,611	1%	14,443	13%
Luxembourg	1,302	1,415	1,462	0.1%	47	3%	160	12%
Netherlands	39,923	53,970	49,312	4.8%	-4,658	-9%	9,389	24%
Portugal	13,960	22,598	19,508	1.9%	-3,090	-14%	5,549	40%
Spain	64,341	110,042	101,361	10.0%	-8,681	-8%	37,020	58%
Sweden	7,691	8,400	8,125	0.8%	-275	-3%	434	6%
United Kingdom	204,603	175,763	184,504	18.1%	8,741	5%	-20,099	-10%
EU-15	**949,076**	**1,012,210**	**1,018,341**	**100.0%**	**6,131**	**1%**	**69,265**	**7%**

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 Denmark, Greece and Finland. 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.

mentioned fuel-switching and efficiency factors.

Figure 3.8: Share of CO_2 emissions from public electricity and heat production in total greenhouse gas emissions by Member State in 2006

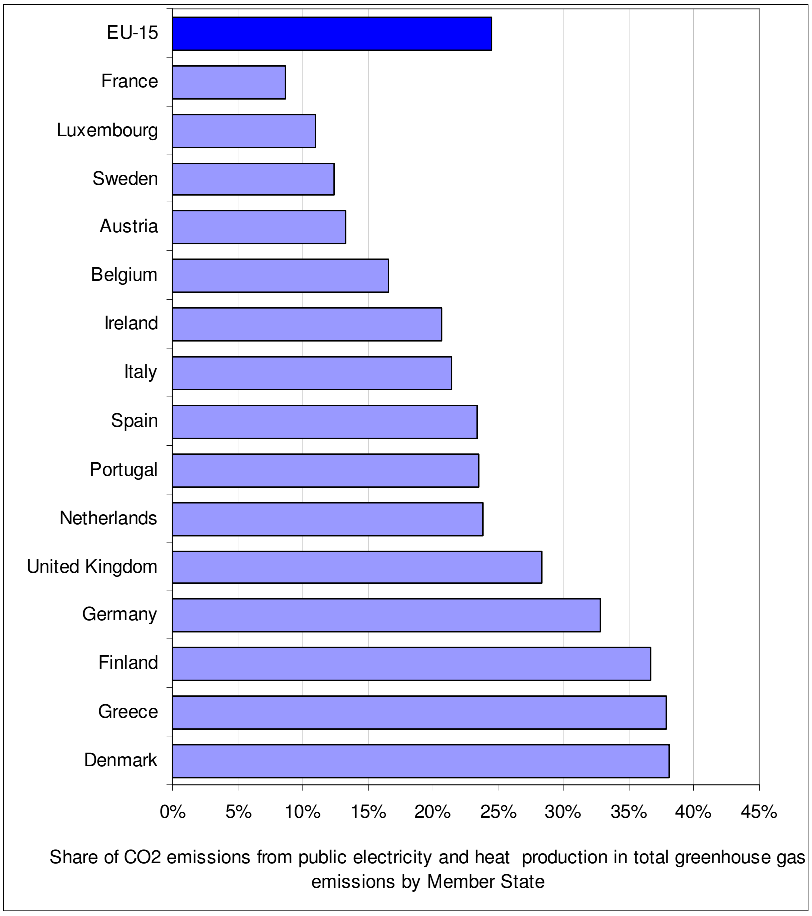
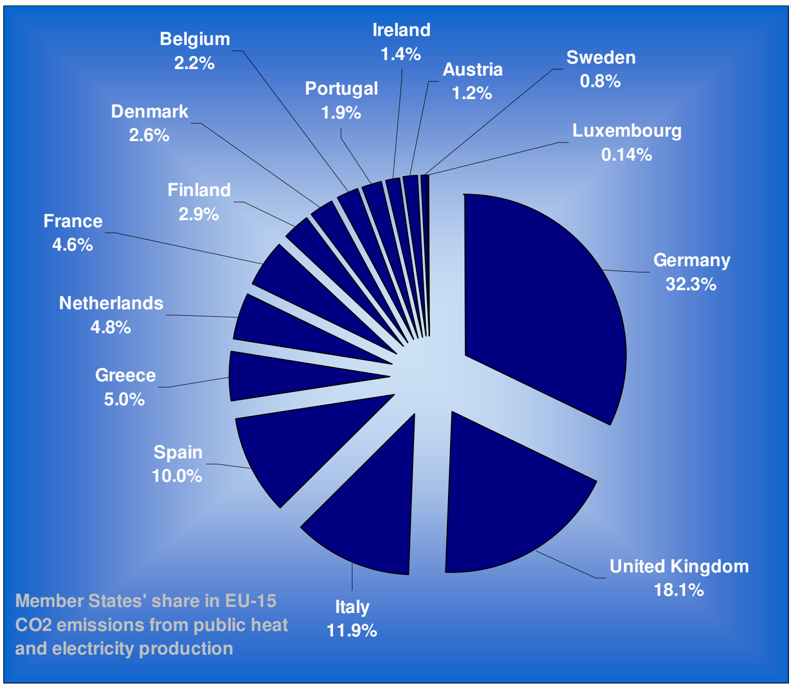


Figure 3.9: Member States' share of CO_2 emissions from public heat and electricity production in EU-15



Finally, N_2O emissions currently represent about 1 % of greenhouse gas emissions from public electricity and heat production. They increased by 10 % between 1990 and 2006 (Table 3.5). Emissions from this source category only declined in the United Kingdom, Germany and Belgium.

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

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006	
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	43	61	70	0.8%	9	14%	27	63%
Belgium	86	54	76	0.9%	23	42%	-9	-11%
Denmark	103	113	138	1.6%	25	22%	35	34%
Finland	104	230	307	3.6%	77	34%	203	195%
France	452	735	693	8.2%	-42	-6%	241	53%
Germany	3,658	3,528	3,608	42.6%	80	2%	-51	-1%
Greece	101	185	172	2.0%	-13	-7%	71	70%
Ireland	412	551	510	6.0%	-41	-7%	99	24%
Italy	326	343	343	4.1%	0	0%	17	5%
Luxembourg	2	8	9	0.1%	0	-	6	-
Netherlands	132	230	227	2.7%	-3	-1%	96	73%
Portugal	52	140	129	1.5%	-10	-8%	78	151%
Spain	197	633	607	7.2%	-27	-4%	410	208%
Sweden	305	376	393	4.6%	17	5%	88	29%
United Kingdom	1,669	1,080	1,183	14.0%	104	10%	-485	-29%
EU-15	**7,641**	**8,267**	**8,466**	**100.0%**	**199**	**2%**	**825**	**11%**

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 46 % between 1990 and 2006 (Table 3.6).

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

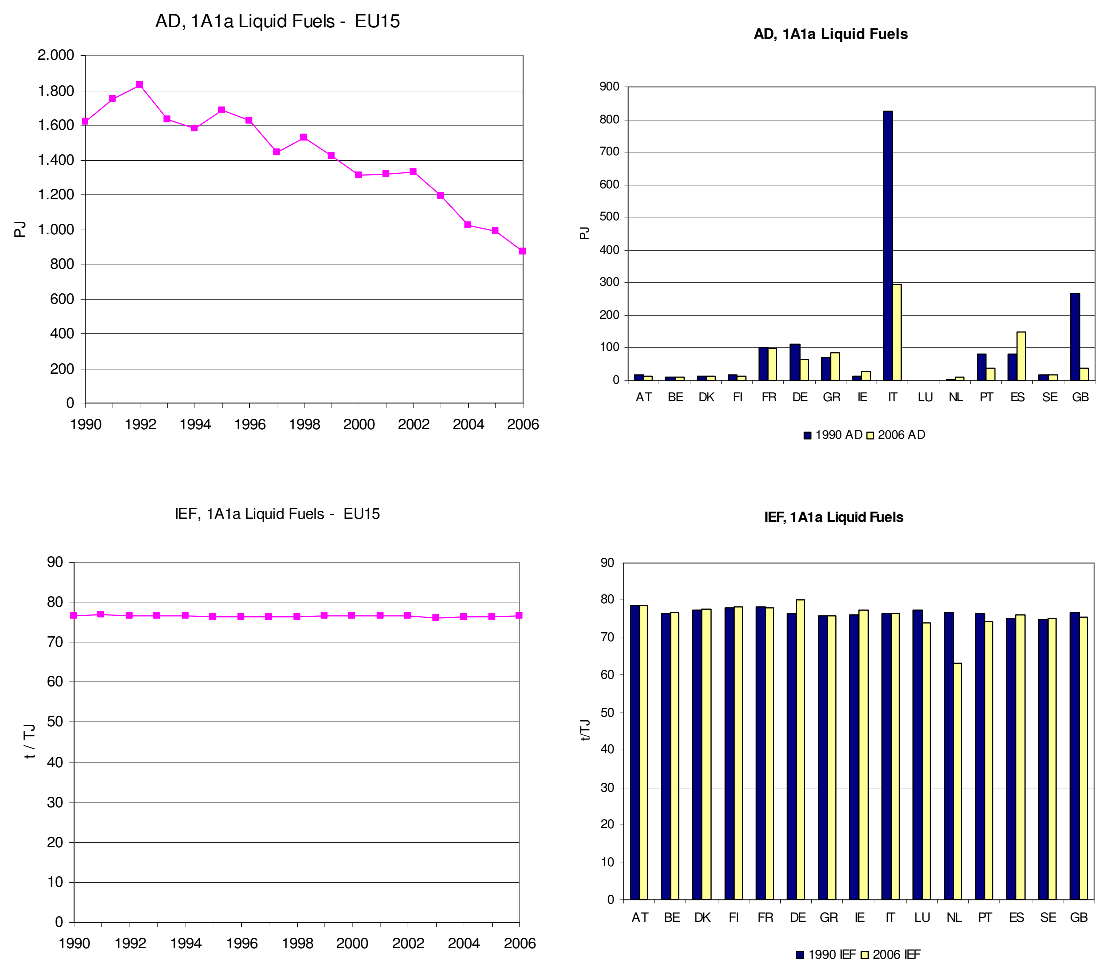
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	1,229	1,091	1,171	1.8%	80	7%	-58	-5%	T2	NS, PS	CS, PS
Belgium	659	1,144	848	1.3%	-296	-26%	189	29%	CS/T3	PS/Q/AS	CS/D
Denmark	947	1,072	1,168	1.7%	96	9%	221	23%	C	NS/PS	CS/C/D
Finland	1,242	975	1,134	1.7%	158	16%	-108	-9%	T3	PS	CS, D
France	7,894	8,544	7,538	11.3%	-1,007	-12%	-356	-5%	C	PS	CS
Germany	8,507	6,152	5,050	7.5%	-1,102	-18%	-3,457	-41%	CS	NS	CS
Greece	5,375	6,265	6,415	9.6%	150	2%	1,040	19%	T2	NS	PS
Ireland	1,087	2,563	2,222	3.3%	-341	-13%	1,135	105%	T3	NS	PS
Italy	63,047	23,016	22,427	33.5%	-588	-3%	-40,620	-64%	T3	NS, PS	CS
Luxembourg	9	12	12	0.0%	0	0%	3	35%	T1	NS PS	D
Netherlands	207	2,150	734	1.1%	-1,416	-66%	527	255%	T2	NS	CS
Portugal	6,301	5,434	2,784	4.2%	-2,650	-49%	-3,516	-56%	T2	PS,NS	D,C,PS
Spain	6,007	12,960	11,277	16.9%	-1,683	-13%	5,270	88%	T2	PS, Q	PS, C
Sweden	1,278	1,258	1,368	2.0%	109	9%	90	7%	T1, T2, T3	PS	CS
United Kingdom	20,691	3,012	2,741	4.1%	-271	-9%	-17,951	-87%	T2	NS,AS	CS
EU-15	**124,478**	**75,649**	**66,888**	**100.0%**	**-8,760**	**-12%**	**-57,589**	**-46%**			

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 (77 t/Tj in 2006). The largest emitters in 2006 were Italy and Spain, together responsible for half the EU emissions, although emissions have fallen markedly in Italy compared to 1990.

Germany had in 2006 the highest IEF of all EU-15 countries (80 t/Tj). Its IEF declined up to 1998 but has gone up since then. This can be explained by the increase in the use of pet coke to generate electricity. The high IEF of 80 arises from the category 'other mineral oil products', a mixture of diverse mineral products, and it is based on expert judgement. In the Netherlands, the IEF declined from 71 t/Tj in 1994 to about 60 t/Tj in 1995 and onwards. This is explained by the sharp increase in liquid fuel use since 1994/1995 and the use of residual chemical gas[22].

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



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

[22] For CO_2 arising from residual chemical gas, source-specific emission factors are used since 1995 - based on data from selected years. For 1995-2003, for 16 individual plants this fuel is either hydrogen, for which the specific emission factor of 0 is used (see gaseous fuels), or phosphorous oven gas, for which the specific emission factor of 149.5 is used This gas is made from coke and therefore included in solid fuels. For another 9 companies, plant-specific emission factors were used based on annual reporting by the companies (most in the 50-55 range, with exceptional values of 23 and 95). For 1990, an average sector-specific value for the chemical industry was calculated using the plant-specific factors for 1995 from the 4 largest companies and the amounts used per company in 1990. For more details see Annex 2 of the Netherlands' NIR 2005, page A-15.

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 8 % between 1990 and 2006 (Table 3.7).

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

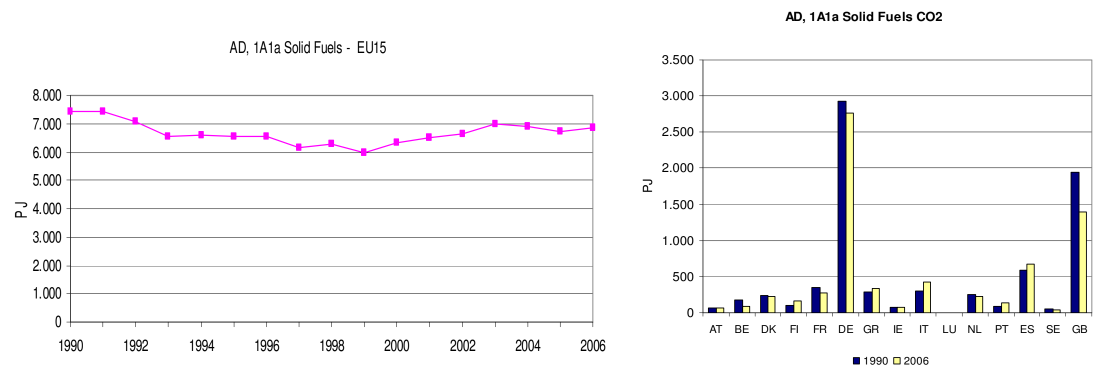
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	6,247	5,844	5,643	0.8%	-201	-3%	-604	-10%	T2	NS, PS	CS, PS
Belgium	19,345	12,065	10,408	1.5%	-1,657	-14%	-8,937	-46%	CS/T3	PS/Q/AS	CS/D
Denmark	22,462	13,687	20,525	3.0%	6,838	50%	-1,937	-9%	C	NS/PS	CS/C
Finland	9,281	6,854	14,921	2.2%	8,067	118%	5,640	61%	T3	PS	CS
France	36,565	31,090	28,589	4.2%	-2,502	-8%	-7,976	-22%	C	PS	CS
Germany	304,774	280,828	284,723	41.4%	3,895	1%	-20,052	-7%	CS	NS	CS
Greece	34,503	43,912	40,280	5.9%	-3,632	-8%	5,777	17%	T2	NS	CS
Ireland	7,909	7,910	6,966	1.0%	-943	-12%	-943	-12%	T3	NS	PS
Italy	28,148	39,614	40,030	5.8%	416	1%	11,883	42%	T3	NS, PS	CS
Luxembourg	1,234	NO	NO	-	-	-	-1,234	-100%	T1	PS	D
Netherlands	25,776	25,734	23,617	3.4%	-2,116	-8%	-2,159	-8%	T2	NS	CS
Portugal	7,659	12,157	12,150	1.8%	-7	0%	4,491	59%	T2	PS	D,C,PS
Spain	57,787	75,996	65,583	9.5%	-10,413	-14%	7,795	13%	T2	PS, Q	PS
Sweden	5,376	5,442	5,052	0.7%	-390	-7%	-325	-6%	T1, T2, T3	PS	CS
United Kingdom	183,150	116,327	128,541	18.7%	12,214	10%	-54,608	-30%	T2	NS,AS	CS
EU-15	**750,217**	**677,459**	**687,028**	**100.0%**	**9,568**	**1%**	**-63,189**	**-8%**			

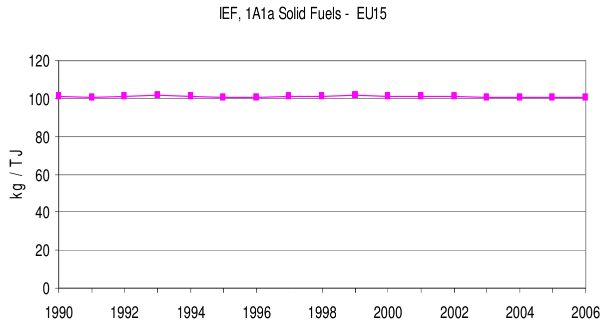
Abbreviations explained in the Chapter 'Units and abbreviations'.

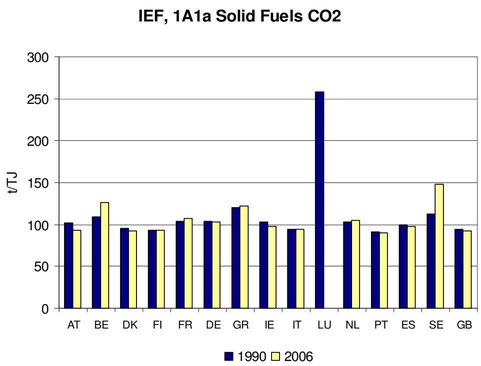
Figure 3.11 shows the relevant activity data and implied emission factors. The weight of solid fuels fell gradually up to 1999 and has somewhat increased thereafter. The EU-15 implied emission factor has remained fairly stable (100 t/Tj in 2006). The largest emitters in 2006 were Germany and the UK, jointly responsible for 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). In Belgium, the IEF increased sharply in the last few years (from 103 t/Tj in 1998 to 126 t/Tj in 2006) and it has become the second largest in the EU. The main reason behind such increase is the use of blast furnace gas.

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







The related N_2O emissions from the use of solid fuels are responsible for almost 1 % of all greenhouse gas emissions in the heat and power sector. For the EU-15, emissions in 2006 fell by 7 %, although this is the net effect of averaging Member States' trends (Table 3.8) . In Spain and Finland, emissions more than doubled whereas in Austria, Belgium and Sweden emissions more than halved. The UK showed the largest reduction in absolute terms.

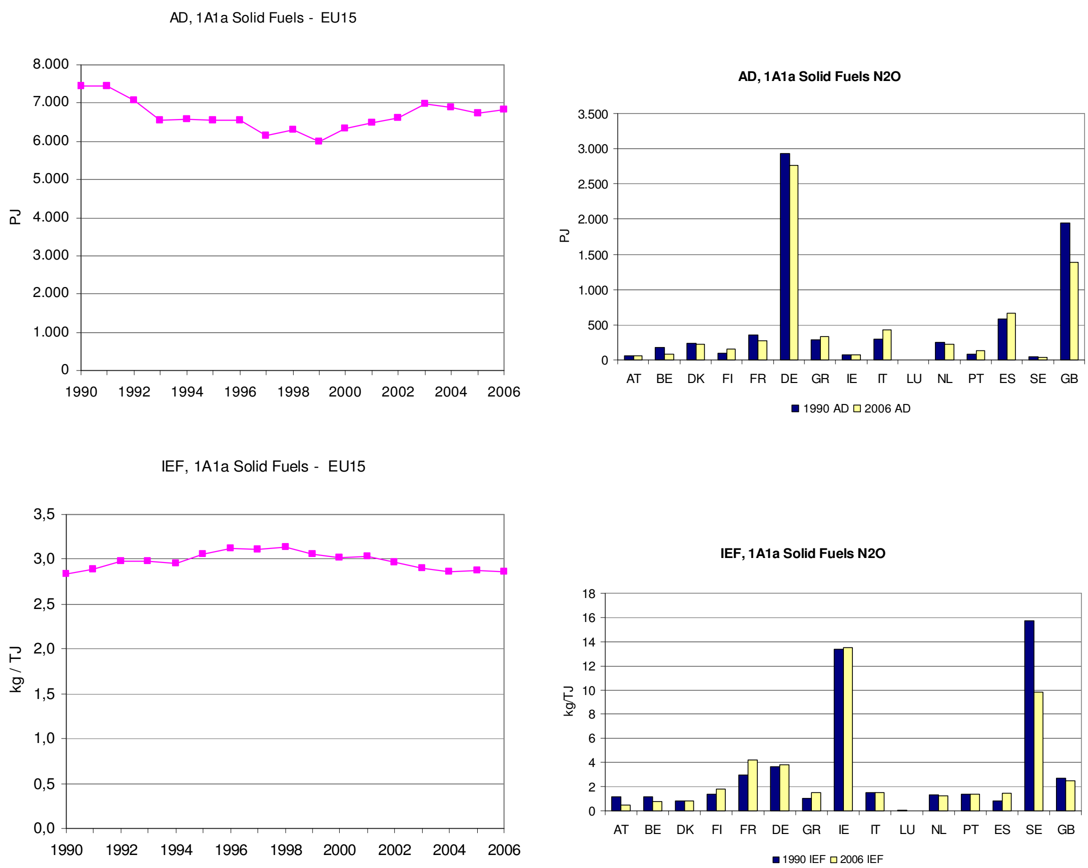
Table 3.8: 1A1a Electricity and heat production, solid fuels: Member States' contributions to N_2O emissions

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	23	10	9	0.2%	0	-2%	-14	-59%	T2	NS, PS	CS
Belgium	66	23	19	0.3%	-5	-20%	-47	-72%	T2	PS/Q/AS	D/CS
Denmark	63	36	55	0.9%	19	54%	-8	-12%	C	NS/PS	CS/C
Finland	43	41	88	1.4%	46	112%	45	106%	T3	PS	CS
France	321	388	351	5.8%	-36	-9%	30	9%	C	PS	CS
Germany	3,335	3,201	3,267	53.8%	66	2%	-68	-2%	T2	NS	CS
Greece	91	167	154	2.5%	-14	-8%	62	68%	T2	NS	D
Ireland	318	335	298	4.9%	-37	-11%	-20	-6%	T3	NS	CR
Italy	138	198	197	3.2%	-1	0%	59	43%	T3	NS, PS	C, D
Luxembourg	0	NO	NO	-	-	-	-0.1	-100%	T1	NS PS	D
Netherlands	101	91	89	1.5%	-1	-2%	-11	-11%	T1	NS	D
Portugal	36	58	58	0.9%	0	0%	21	59%	T2	PS	C,D
Spain	146	349	301	5.0%	-49	-14%	155	107%	T2	PS	D, C, OTH
Sweden	233	99	104	1.7%	5	5%	-128	-55%	T1, T2, T3	PS	CS
United Kingdom	1,609	986	1,087	17.9%	102	10%	-521	-32%	T2	NS, AS	CS
EU-15	**6,521**	**5,981**	**6,077**	**100.0%**	**96**	**2%**	**-445**	**-7%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.12 shows the related activity data and implied emission factors for N_2O. The EU-15 implied emission factor has somewhat remained stable compared to 1990, and stood at 2.5 kg/Tj in 2006. The largest emitter in 2006 was Germany, accounting for over half of EU emissions. The IEF in Ireland was in 2006 the highest among all EU countries (13.5 Kg/Tj in 2006) because of the use of a CORINAIR90 emission factor based on large point sources. Ireland will review this in their 2009 submission. In Sweden, there was a gradual but strong decline in the IEF during 1990-2006. This was due to the increased use of blast furnace gas and a lower use of coal. Since the IEF for coal is ten times higher than the IEF for blast furnace gas, the IEF for solid fuels declined overall during the period. The Swedish IEF stood at about 10 kg/Tj in 2006. This comparatively high implied emission factor is regularly reviewed and found to be correct for Swedish conditions.

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



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

CO_2 emissions from the combustion of gaseous fuels accounted for about 23 % of all greenhouse gas emissions from public electricity and heat generation in 2006. Emissions increased by a factor of almost four in the EU-15 between 1990 and 2006 (Table 3.9). In all EU Member States the consumption of gas was higher in 2006 than in 1990.

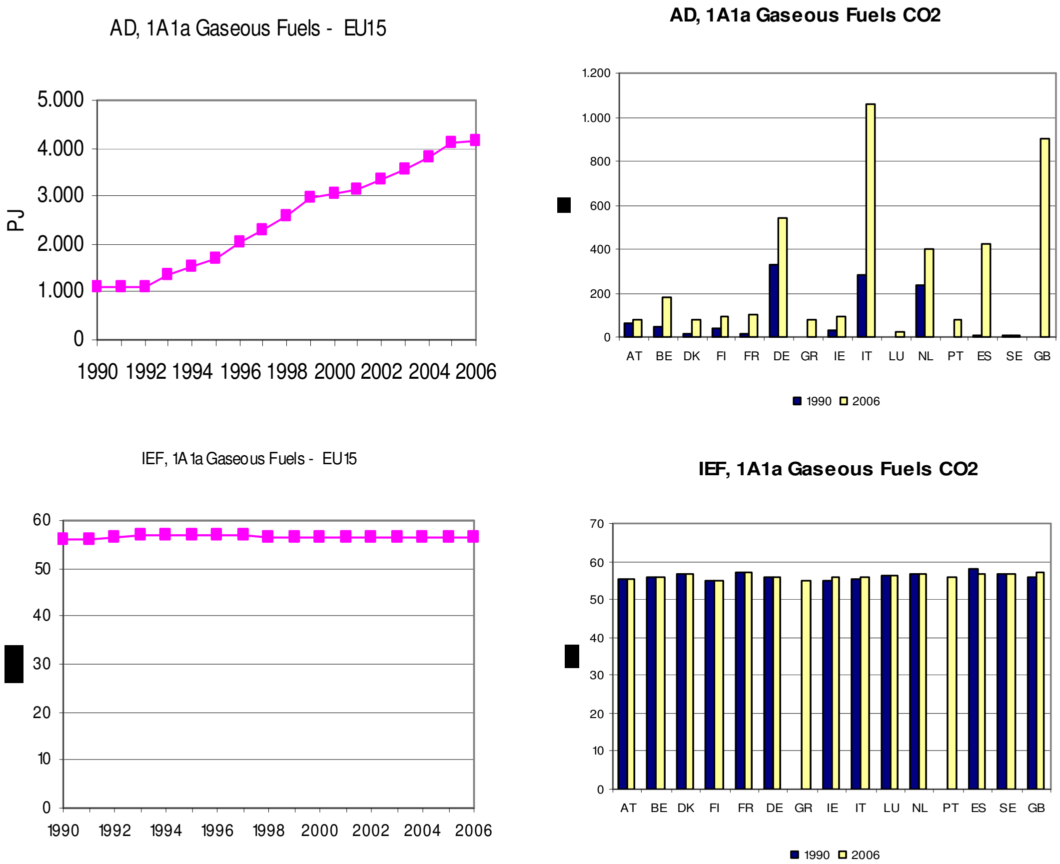
Table 3.9 1A1a Electricity and heat production, gaseous fuels: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	3,294	5,319	4,540	2.0%	-779	-15%	1,246	38%	T2	NS, PS	CS
Belgium	2,751	9,812	9,894	4.2%	83	1%	7,144	260%	CS/T3	PS/Q/AS	CS/D
Denmark	1,000	4,234	4,521	1.9%	287	7%	3,521	352%	C	NS/PS	CS/C
Finland	1,976	4,861	5,129	2.2%	269	6%	3,154	160%	T3	PS	CS, D
France	984	5,643	5,771	2.5%	128	2%	4,787	487%	C	PS	CS
Germany	18,462	30,308	30,236	13.0%	-72	0%	11,774	64%	CS	NS	CS
Greece	NO	3,646	4,250	1.8%	603	17%	4250	-	T2	NS	PS
Ireland	1,881	4,664	5,223	2.2%	559	12%	3,342	178%	T3	NS	PS
Italy	15,787	57,028	58,932	25.3%	1,905	3%	43,145	273%	T3	NS, PS	CS
Luxembourg	25	1,342	1,386	0.6%	44	3%	1,360	5413%	T1	NS PS	D
Netherlands	13,348	23,976	22,846	9.8%	-1,130	-5%	9,498	71%	T2	NS	CS
Portugal	NO	4,651	4,226	1.8%	-425	-9%	4,226	-	T2	PS	D,C,PS
Spain	427	20,375	23,814	10.2%	3,439	17%	23,387	5475%	T2	PS, Q	PS, CS
Sweden	485	556	590	0.3%	34	6%	105	22%	T1, T2, T3	PS	CS
United Kingdom	16	54,770	51,456	22.1%	-3,314	-6%	51,440	322643%	T2	NS, AS	CS
EU-15	**60,436**	**231,184**	**232,813**	**100.0%**	**1,630**	**1%**	**172,378**	**285%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.13 shows the activity data and implied CO_2emission factors from gaseous fuels. Gas use in the power generating sector increased strongly after 1992. The EU-15 implied emission factor has remained fairly stable (56 t/Tj in 2006). 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 largest emitters in 2006 were the UK and Italy, jointly responsible for close to half the EU emissions.

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



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

In 2006, 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 'other fuels' are used in heat and power generation. Other fuels should cover the fossil part of municipal solid waste incineration where there is energy recovery, including plastics (Table 3.10).

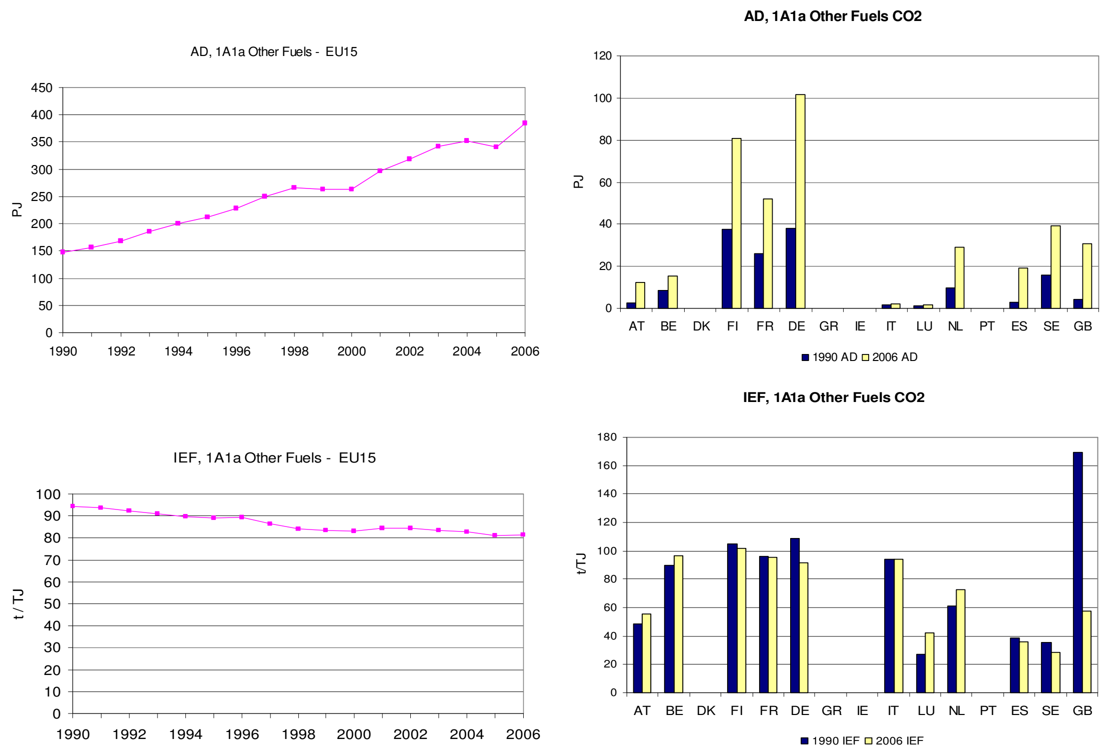
Table 3.10: 1A1a Public Electricity and Heat Production, other fuels: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	118	490	695	2.2%	205	42%	577	489%	NO	NO	NO
Belgium	749	1,441	1,486	4.7%	45	3%	737	98%	CS/T3	PS/Q/AS	CS/D
Denmark	328	610	643	2.0%	33	5%	316	96%	C	NS/PS	CS/C
Finland	3,950	5,963	8,228	26.0%	2,265	38%	4,278	108%	T3	PS	CS
France	2,483	5,012	4,986	15.8%	-26	-1%	2,503	101%	C	PS	CS
Germany	4,121	8,053	9,287	29.4%	1,233	15%	5,166	125%	CS	NS	CS
Greece	NO	NO	NO	-	-	-	-	-	0.0	0.0	0.0
Ireland	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Italy	153	311	189	0.6%	-122	-39%	35	23%	T3	NS, PS	CS
Luxembourg	33	61	64	0.2%	3	5%	31	93%	T2	NS Q	D
Netherlands	592	2,110	2,115	6.7%	5	0%	1,523	257%	T2	NS	CS
Portugal	NO	357	348	-	-	-	-	-	T2	PS	D,C,PS
Spain	120	712	687	2.2%	-24	-3%	567	472%	T2	PS, Q	PS, CS, C
Sweden	553	1,144	1,116	3.5%	-28	-2%	564	102%	T1, T2, T3	PS	CS
United Kingdom	746	1,653	1,766	5.6%	113	7%	1,020	137%	T2	NS	CS
EU-15	**13,946**	**27,918**	**31,611**	**100.0%**	**3,694**	**13%**	**17,666**	**127%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.14 shows the activity data and implied emission factors. The EU-15 implied emission factor has fallen gradually since 1990, standing at about 82 t/Tj in 2006. The chart does not show the emission factor for Denmark. CO_2 emissions from the combustion of the plastic content of municipal waste are correctly reported under other fuels but the split is not applied to the activity data, and so the full fuel consumption of municipal waste is included under biomass. The largest emitters in 2006 were Germany, Finland and France, which together accounted for more than 70 % of EU emissions.

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



In Germany, the IEF declined continuously between 1990 and 2006 (from 109 to 92). This is because the combustion of industrial waste has been greatly reduced in the early 1990s whereas the combustion of residential waste for electricity and heat has increased in the complete reporting period; furthermore, the calorific value of the applied waste has increased due to a better national waste separation management.

Figure 3.14 shows the share of Finnish activity in the EU is disproportionally high. This is due to the reporting of 'peat' under 'other fuels' instead of under 'solid fuels' as recommended by the revised 1996 IPCC Guidelines. This apparent mis-allocation is clearly explained and argued[23] and is consistent with national energy statistics as well as with the IPCC 2006 Guidelines. In the Netherlands, the IEF increases sharply after 2003 to reach 73 t/Tj in 2006. This was due to the increase in the share of plastics (with a high carbon fraction) in combustible waste – as explained in table 8.6 of the Dutch NIR about the composition of incinerated waste. In the United Kingdom, the IEF fell by a factor of 3 between 1990 and 2006 to stand at about 57 t/Tj. The reason is the way emissions and activity data for the Overseas Territories and Crown Dependencies are factored in under 'other fuels' – something which will be rectified in the 2009 submission.

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

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

CO_2 emissions from petroleum refining is the sixth largest key source in the EU-15 accounting for 2.9 % of total greenhouse gas emissions in 2006. Between 1990 and 2006, EU CO_2 emissions increased by 12 % - although fell compared to 2006 (Table 3.11). Emissions in 2006 were above 1990 levels in all Member States, with the exception of the UK and the Netherlands.

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

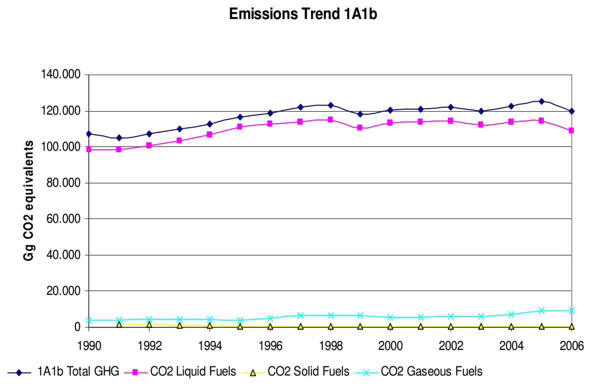
Table 3.11 1A1b Petroleum Refining: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006	
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	2,394	2,827	2,830	2.4%	3	0%	436	18%
Belgium	4,299	4,353	4,522	3.8%	169	4%	223	5%
Denmark	897	932	982	0.8%	50	5%	84	9%
Finland	2,260	2,642	2,732	2.3%	90	3%	472	21%
France	13,239	13,965	13,832	11.6%	-133	-1%	593	4%
Germany	20,006	20,832	20,224	17.0%	-608	-3%	218	1%
Greece	2,465	3,757	3,709	3.1%	-48	-1%	1,244	50%
Ireland	182	411	377	0.3%	-35	-8%	195	107%
Italy	16,337	26,479	25,273	21.3%	-1,206	-5%	8,936	55%
Luxembourg	NO	NO	NO	0.0%	-	-	-	-
Netherlands	11,041	11,338	10,673	9.0%	-664	-6%	-368	-3%
Portugal	1,910	2,583	2,612	2.2%	29	1%	702	37%
Spain	10,906	13,092	12,916	10.9%	-176	-1%	2,010	18%
Sweden	1,997	2,355	2,373	2.0%	18	1%	376	19%
United Kingdom	18,275	18,719	15,685	13.2%	-3,034	-16%	-2,591	-14%
EU-15	**106,208**	**124,285**	**118,739**	**100.0%**	**-5,546**	**-4%**	**12,531**	**12%**

Figure 3.15 shows the trends in emissions originating from the refining of petroleum by fuel in the EU-15 between 1990 and 2006. More than 90 % of greenhouse 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 2006. Liquid fuels represent over 90 % of all fuel used in the refining of petroleum. Gaseous 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



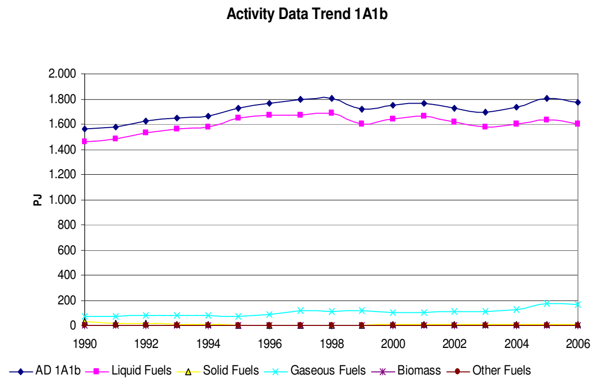


Figure 3.16 shows the relative importance of CO_2 emissions from petroleum refining in total greenhouse gas emissions by Member State, ranging from the relatively low share in Ireland to relatively high share in the Netherlands. Figure 3.17 shows the absolute contributions to EU-15 CO_2 emissions from petroleum refining. Italy was the largest EU emitter in 2006, 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 2006

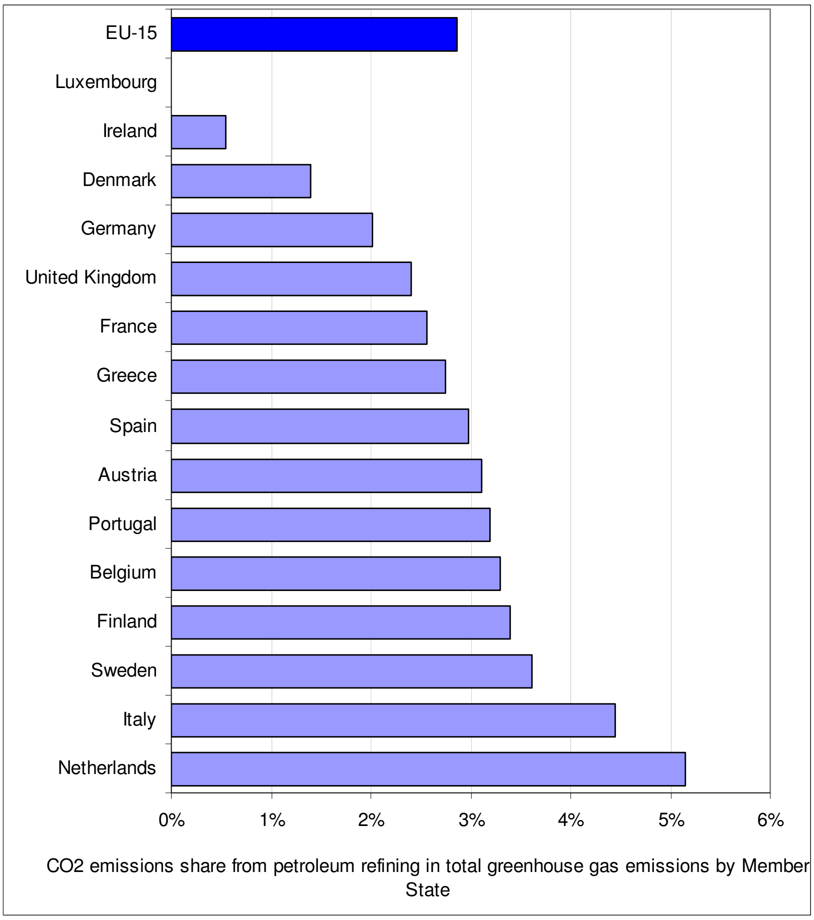
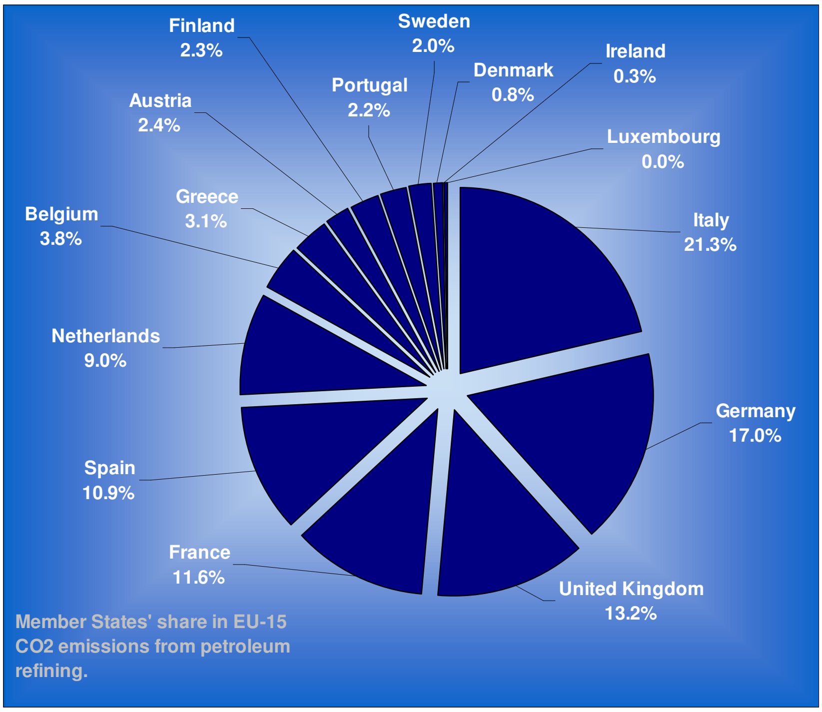


Figure 3.17: Member States' share of CO_2 emissions from petroleum refining in EU-15



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 2006. Emissions increased by 10 % between 1990 and 2006 (Table 3.12). With the exception of France, the Netherlands and the UK, Member State emissions from liquid fuels were higher in 2006 than in 1990. More than half of the gross increase in EU-15 emissions (and more than 80 % in net terms) between 1990 and 2006 was due to Italy alone.

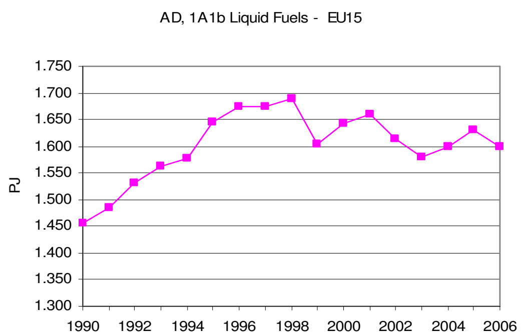
Table 3.12 1A1b Petroleum Refining, liquid fuels: Member States' contributions to CO_2 emissions

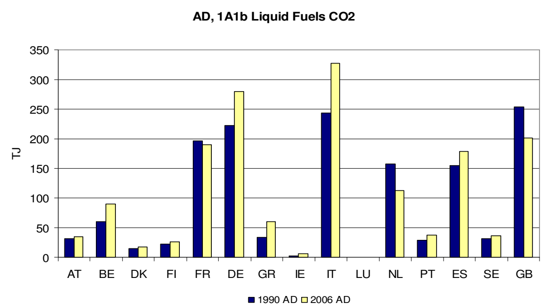
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	1,958	2,149	2,153	2.0%	5	0%	196	10%	T2	NS	PS
Belgium	4,285	4,142	4,317	4.0%	175	4%	32	1%	CS/T3	PS	PS
Denmark	897	932	982	0.9%	50	5%	84	9%	C	NS/PS	CS/C
Finland	1,603	1,783	1,765	1.6%	-18	-1%	162	10%	T3	PS	CS, PS
France	12,732	12,295	11,971	11.0%	-324	-3%	-761	-6%	C	PS	CS
Germany	15,315	19,834	19,304	17.8%	-530	-3%	3,989	26%	CS	NS	CS
Greece	2,465	3,757	3,709	3.4%	-48	-1%	1,244	50%	T2	NS	PS
Ireland	182	411	377	0.3%	-35	-8%	195	107%	T3	NS	PS
Italy	16,178	25,723	24,547	22.6%	-1,176	-5%	8,369	52%	T3	NS, PS	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Netherlands	9,999	8,851	8,028	7.4%	-823	-9%	-1,971	-20%	T2	NS	CS
Portugal	1,910	2,572	2,598	2.4%	26	1%	688	36%	T2	PS	D,C,PS
Spain	10,861	11,622	11,683	10.7%	62	1%	822	8%	T2	PS	PS, C
Sweden	1,997	2,286	2,312	2.1%	26	1%	315	16%	T1, T2, T3	PS	CS
United Kingdom	18,226	17,722	14,983	13.8%	-2,739	-15%	-3,243	-18%	T2	NS	CS
EU-15	**98,607**	**114,077**	**108,729**	**100.0%**	**-5,348**	**-5%**	**10,121**	**10%**			

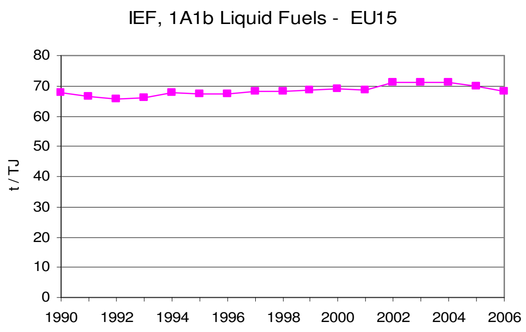
Abbreviations explained in the Chapter 'Units and abbreviations'.

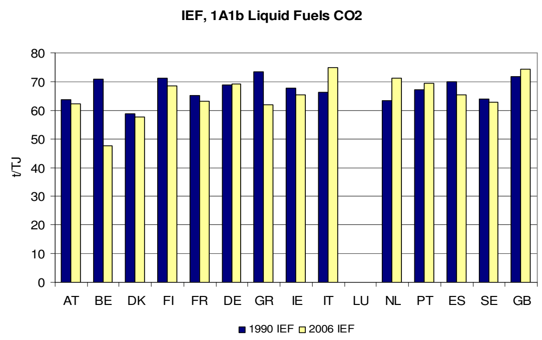
Figure 3.18 shows the activity data and implied emission factors for CO_2 emissions from liquid fuels. The use of liquid fuels increased rapidly from 1990 to 1998 and fell somewhat thereafter. The EU-15 implied emission factor has varied between 66 t/Tj and 71 t/Tj. The increase in the EU-15 factor can 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 2006 were Italy, Germany and the UK, which together contributed to more than half of EU emissions.

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









In Belgium, the IEF factor fell from about 71 t/Tj in 1990 to 48 t/Tj in 2006, although with significant variations during the period. The IEF is also the lowest of all EU countries. There are two reasons for its relatively low IEF: the reported activity data includes both own use of fuels as well as the calculated differences between input in refineries and output. This difference is considered a 'loss', which was particularly high in 2006, and it is not reflected in the emissions from this key source category. The reported loss will be looked at in more depth, which may result in a revised 2006 estimate in a future submission. Moreover, another reason for the decrease in the IEF was the increasing share of refinery gas from 1990 to 2006 which has a much lower IEF compared to other liquid fuels.

In the Netherlands, the IEFs are significantly higher from 2002 and onwards compared to the 1990-2001 period. This is explained by the use of plant-specific emission factors for refinery gas since 2002 and by ex-post adjustments of the emission factor for refinery gas to match the total calculated CO_2 emissions and the total CO_2 emissions officially reported by the refineries[24].

1A1b Petroleum Refining - Solid Fuels (CO_2)

CO_2 emissions from the combustion of solid fuels in petroleum refining represented less than 1 % of all greenhouse gas emissions from 1A1b in 2006. There are only three countries reporting emissions in the EU-15, almost all of which find their origin in France and Germany. EU-emissions fell by about 80 % on average between 1990 and 2006 (Table 3.13).

[24] For years prior to 2002 not all residual refinery gases and other residual fuels seem to have been accounted for in the national energy statistics - since the energy and carbon balance of the oil products produced does not match the total crude oil input and of fuel used for combustion. It is assumed that part of the residual refinery gases and other residual fuels are all combusted (or incinerated by flaring) but not monitored/reported by the industry and are thus unaccounted for. The CO_2 emissions from this varying fuel consumption are included in the fuel type ‘liquids’ (see also section 3.3.2 NIR 2008 for the Netherlands).

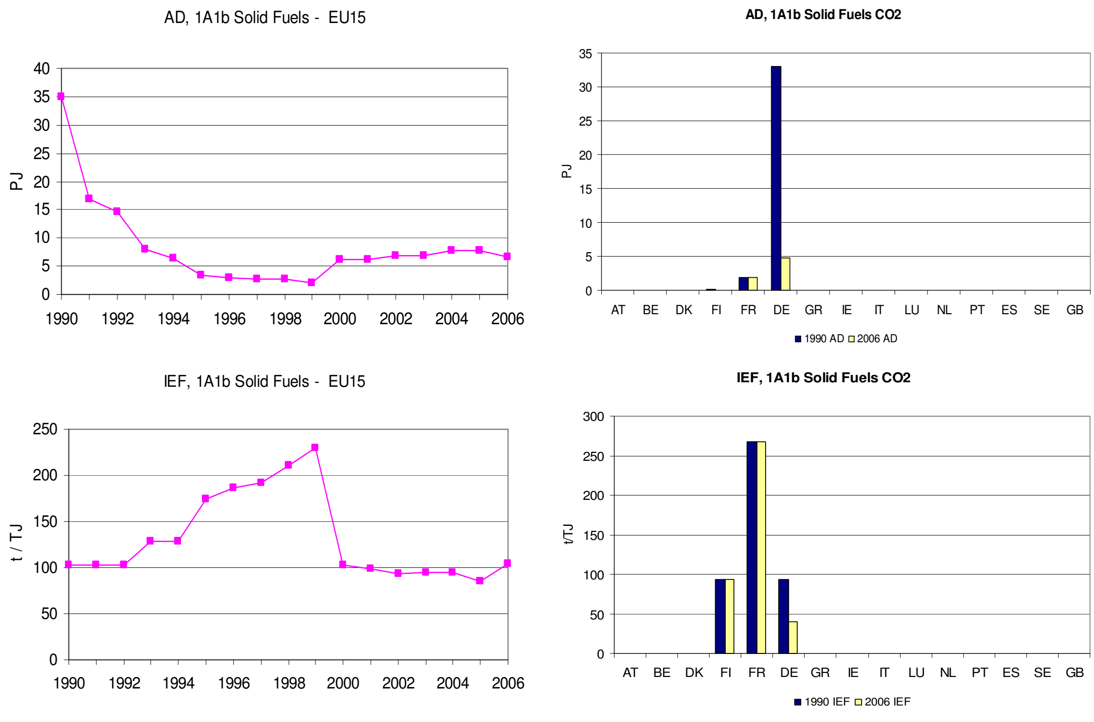
Table 3.13 **1A1b Petroleum Refining, solid fuels: Member States' contributions to CO_2 emissions**

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Belgium	0	0	0	-	-	-	-	-	CS/T3	PS	PS
Denmark	NO	NO	NO	-	-	-	-	-	0.0	Not Occuring	0.0
Finland	12	4	2	0.3%	-1	-32%	-10	-80%	T3	PS	CS
France	492	402	508	72.3%	106	26%	16	3%	C	PS	CS
Germany	3,076	245	192	27.4%	-53	-22%	-2,884	-94%	CS	NS	CS
Greece	NO	NO	NO	-	-	-	-	-	0.0	0.0	0.0
Ireland	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Italy	NO	NO	NO	-	-	-	-	-	NA	NA	NA
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Netherlands	NO	NO	NO	-	-	-	-	-	NA	NA	NA
Portugal	NO	NO	NO	-	-	-	-	-	T2	PS	D,C,PS
Spain	NA	NA	NA	-	-	-	-	-	NO	NO	NO
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA	NA
United Kingdom	NO	NO	NO	-	-	-	-	-	T2	NS	CS
EU-15	**3,581**	**651**	**703**	**100.0%**	**52**	**8%**	**-2,878**	**-80%**			

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 104 t/Tj in 2006. The variation in the EU-15 factor can be partly explained by the declining use of solid fuels in petroleum refining in Germany between 1990 and 1999. This explains the bigger contribution of the much higher implied emission factor of France. The relatively higher emission factor in France is due to the use of blast furnace gas in the Dunkerque refinery. In Germany, there was a decline in the IEF in the early 1990s compared to a rather stable IEF since the mid-1990s. The reason is that the use of - mainly - lignite has constantly been reduced in favour of cokery gas.

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 2006, CO_2 emissions from the combustion of gaseous fuels used for petroleum refining accounted for about 8 % of total greenhouse gas emissions from 1A1b. Emissions in the EU-15 increased by a factor of almost 2.5 between 1990 and 2006 (Table 3.14). Emissions only fell in Germany. More than two thirds of the gross increase in EU-15 emissions between 1990 and 2006 was due to France, Spain and the Netherlands.

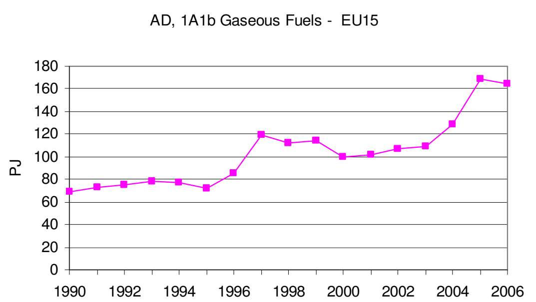
Table 3.14 1A1b Petroleum Refining, gaseous fuels: Member States' contributions to CO_2 emissions

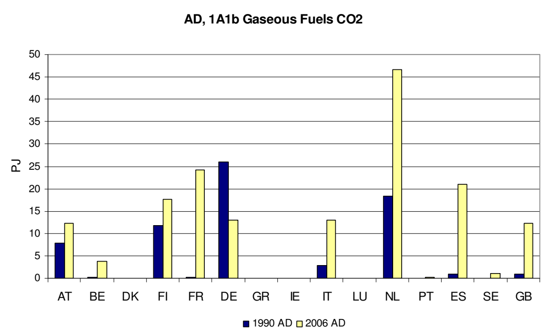
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	437	678	677	7.3%	-2	0%	240	55%	T2	NS	CS, PS
Belgium	14	211	204	2.2%	-6	-3%	191	1379%	CS/T3	PS	PS
Denmark	NO	NO	NO	-	-	-	-	-	0.0	Not Occuring	0.0
Finland	644	856	964	10.4%	109	13%	320	50%	T3	PS	CS
France	14	1,268	1,353	14.5%	85	7%	1,339	9436%	C	PS	CS
Germany	1,441	753	728	7.8%	-26	-3%	-714	-50%	CS	NS	CS
Greece	NO	NO	NO	-	-	-	-	-	0.0	0.0	0.0
Ireland	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Italy	159	756	727	7.8%	-30	-4%	567	356%	T3	NS, PS	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Netherlands	1,042	2,487	2,646	28.4%	159	6%	1,603	154%	T2	NS	CS
Portugal	NO	11	14	0.2%	3	-	14	-	T2	PS	D,C,PS
Spain	45	1,470	1,232	13.2%	-238	-16%	1,187	2634%	T2	PS	PS, CS
Sweden	NO	69	61	0.7%	-8	-11%	61	-	T1, T2, T3	PS	CS
United Kingdom	49	997	702	7.5%	-296	-30%	652	1320%	T2	NS	CS
EU-15	**3,846**	**9,557**	**9,308**	**100.0%**	**-249**	**-3%**	**5,462**	**142%**			

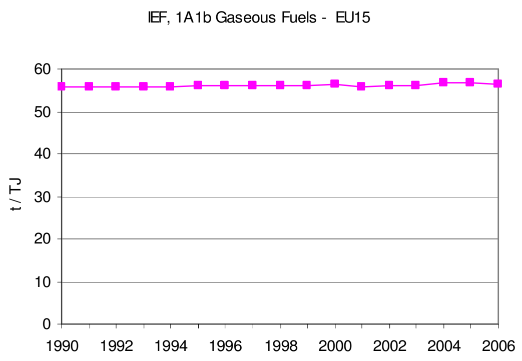
Abbreviations explained in the Chapter 'Units and abbreviations'.

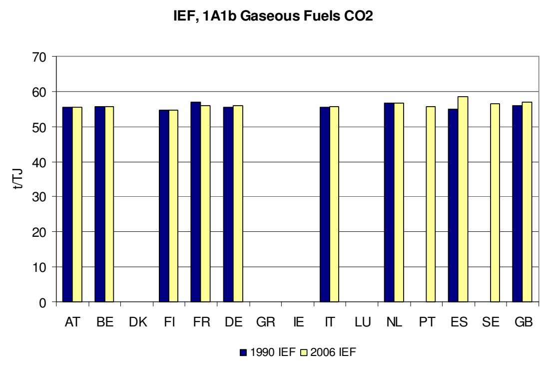
Figure 3.20 shows the activity data and implied emission factors for CO_2 emissions from gaseous fuels. The use of gaseous fuels increased by over a factor of 2 between 1990 and 2006. The EU-15 implied emission factor has remained broadly stable, reaching 56 t/Tj in 2006. The largest emitter in 2006 was the Netherlands with 28 % of all EU emissions, followed by France and Spain.

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









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

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

CO_2 emissions from the manufacture of solid fuels accounted for 1.4 % of total greenhouse gas emissions in 2006. Between 1990 and 2006, CO_2 emissions fell by over 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 gaseous fuels have steadily increased during the 1990s and fell since 2002 – mirroring to some extent emissions from solid fuels.

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

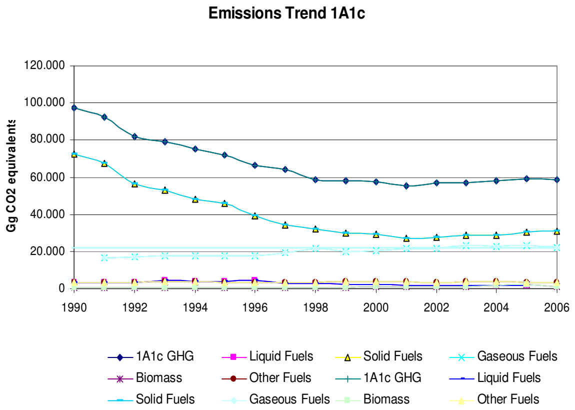
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006	
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	510	525	547	1.0%	22	4%	37	7%
Belgium	2,144	429	395	0.7%	-33	-8%	-1,749	-82%
Denmark	540	1,602	1,631	2.9%	29	2%	1,092	202%
Finland	347	394	397	0.7%	2	1%	50	14%
France	4,993	3,771	3,764	6.7%	-6	0%	-1,229	-25%
Germany	59,066	15,953	16,620	29.4%	668	4%	-42,446	-72%
Greece	102	71	89	0.2%	18	26%	-13	-12%
Ireland	100	110	120	0.2%	10	9%	20	20%
Italy	10,620	12,792	12,256	21.7%	-536	-4%	1,636	15%
Luxembourg	NO	NO	NO	-	-	-	-	-
Netherlands	1,528	2,057	1,927	3.4%	-130	-6%	399	26%
Portugal	75	NO	NO	0.0%	-	-	-75	-100%
Spain	2,110	2,039	2,045	3.6%	6	0%	-64	-3%
Sweden	361	346	368	0.7%	22	6%	7	2%
United Kingdom	13,545	17,858	16,282	28.8%	-1,576	-9%	2,737	20%
EU-15	**96,041**	**57,946**	**56,443**	**100.0%**	**-1,502**	**-3%**	**-39,598**	**-41%**

Figure 3.21 shows the trends in emissions from this source category by fuel in the EU-15 between 1990 and 2006. About 90 % of greenhouse gas emissions from the manufacture of solid fuels can be

accounted for by CO_2 emissions from solid (54 %) and gaseous (36 %) fuels. The figure also shows the activity data behind the emissions.

Fuel used for manufacturing solid fuels fell by over 30 % in the EU-15 between 1990 and 2006. In 2006, solid fuels represented 40 % of all fuel use, whereas gaseous fuels took a share of 50%.

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



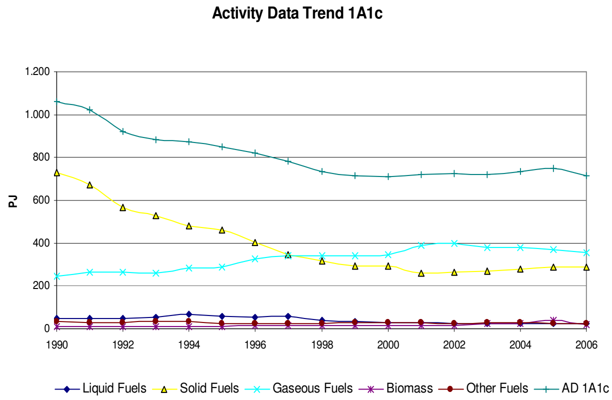


Figure 3.22 shows the relative importance of CO_2 emissions from the manufacture of solid fuels in total greenhouse gas emissions by Member State. The country shares range from the highest in the UK to the lowest of Luxembourg and Portugal, which do not have emissions from this key source category. Figure 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 2006**

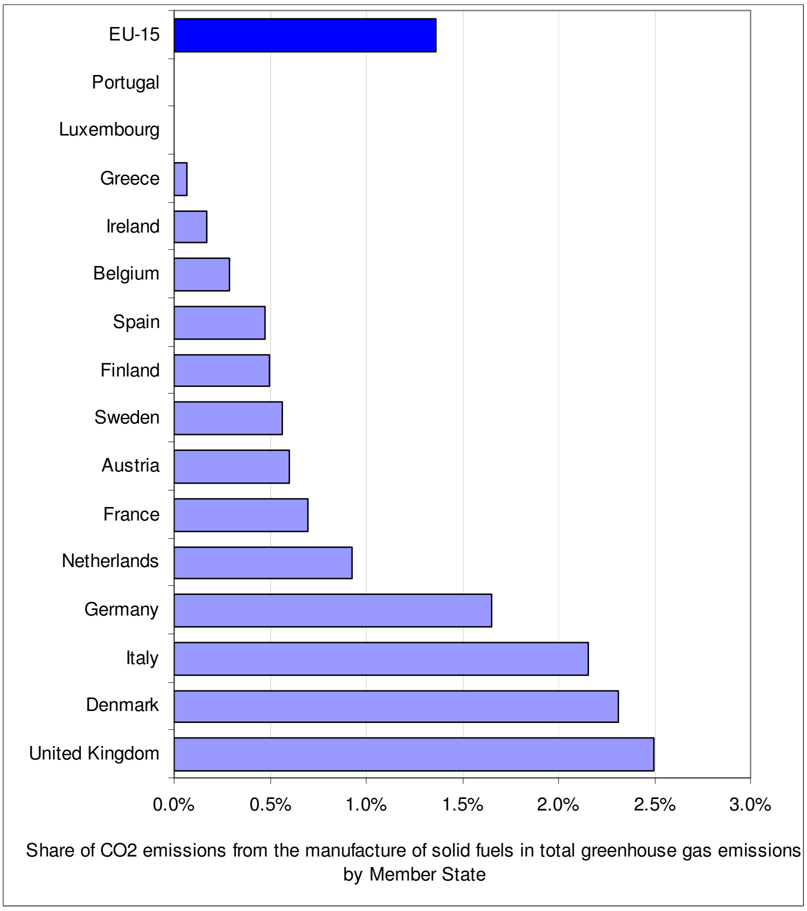
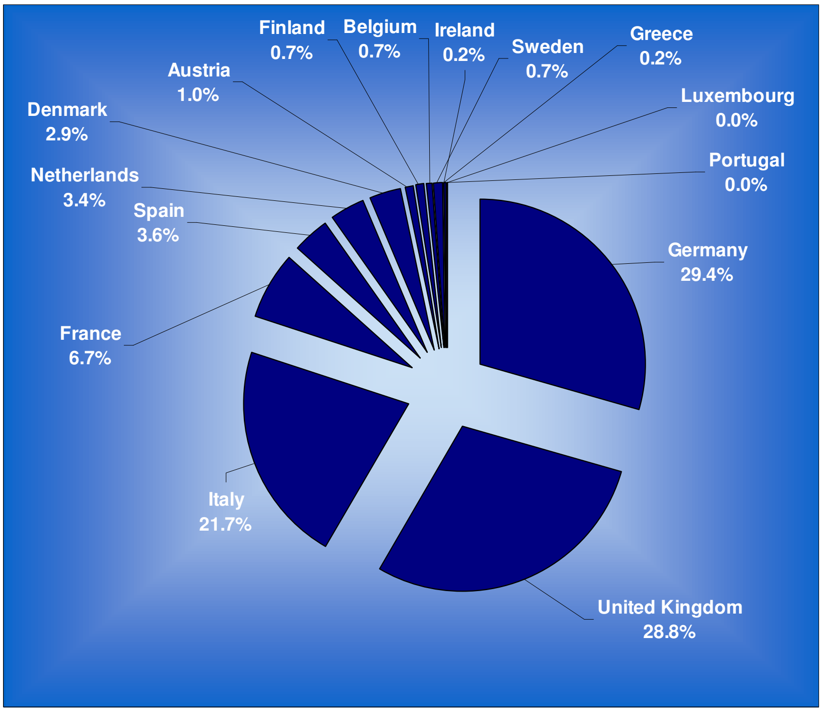


Figure 3.23: Member States' share of CO_2 emissions from the manufacture of solid fuels in EU-15



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 36 % of total greenhouse gas emissions from 1A1c in 2006. Emissions in the EU-15 increased steadily by over 20 % (Table 3.16) since 1990, although there has been a significant reduction in the last few years. About 70 % of the gross increase in EU-15 emissions between 1990 and 2006 was due to the UK alone.

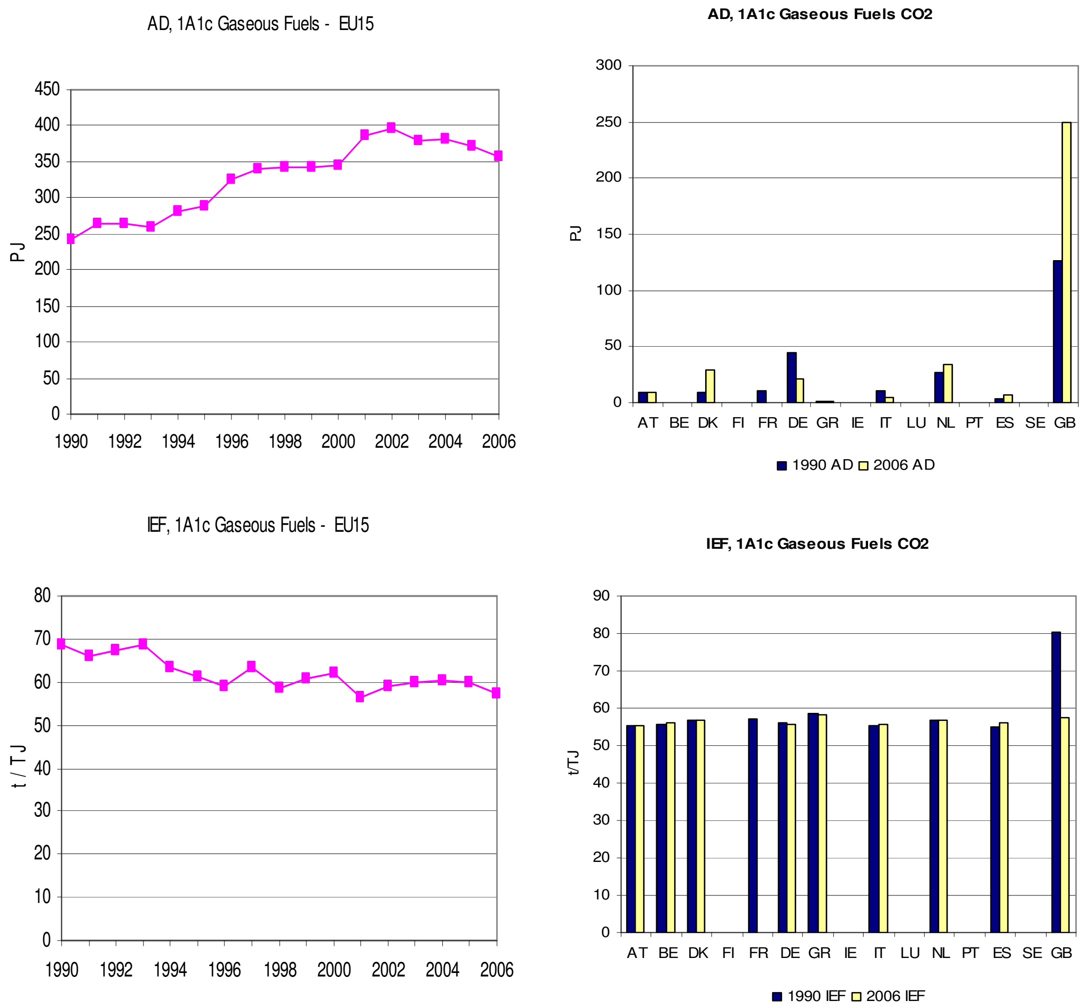
Table 3.16 1A1c Manufacture of Solid Fuels and Other Energy Industries, gaseous fuels: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	506	525	547	2.7%	22	4%	41	8%	T2	NS	CS
Belgium	3	0	1	-	1	-	-2	-68%	CS/T3	PS	PS
Denmark	540	1,602	1,631	8.0%	29	2%	1,092	202%	C	NS	CS/C
Finland	NO	NO	NO	-	-	-	-	-	T3	PS	CS
France	586	NO	NO	-	-	-	-586	-	C	AS/ PS	CS
Germany	2,501	1,172	1,195	5.9%	23	2%	-1,306	-52%	CS	NS	CS
Greece	102	71	89	0.4%	18	26%	-13	-12%	T2	NS	PS
Ireland	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Italy	615	376	259	1.3%	-117	-31%	-356	-58%	T2	NS	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Netherlands	1,526	2,056	1,927	9.4%	-129	-6%	400	26%	T2	NS	CS
Portugal	NO	NO	NO	-	-	-	-	-	T2	NS	D,C,PS
Spain	205	307	390	1.9%	83	27%	185	90%	T2	PS, NS	CS
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA	NA
United Kingdom	10,124	16,185	14,360	70.4%	-1,825	-11%	4,236	42%	T2	NS	CS
EU-15	**16,708**	**22,294**	**20,400**	**100.0%**	**-1,894**	**-8%**	**3,692**	**22%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.24 shows the activity data and implied emission factors for CO_2. The use of gaseous fuels increased by a factor of 1.5 between 1990 and 2006. The EU-15 implied emission factor has declined gradually since 1990 to about 57 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 2006 was the UK, which represented more than 70 % 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 54 % of total greenhouse gas emissions from 1A1c in 2006. Emissions in the EU-15 more than halved, mainly during the 1990s (Table 3.17). This was almost-entirely due to a strong decline in emissions in Germany.

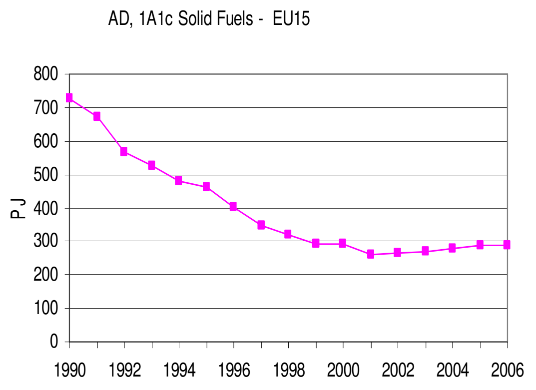
Table 3.17 1A1c Manufacture of Solid Fuels and Other Energy Industries, solid fuels: Member States' contributions to CO_2 emissions

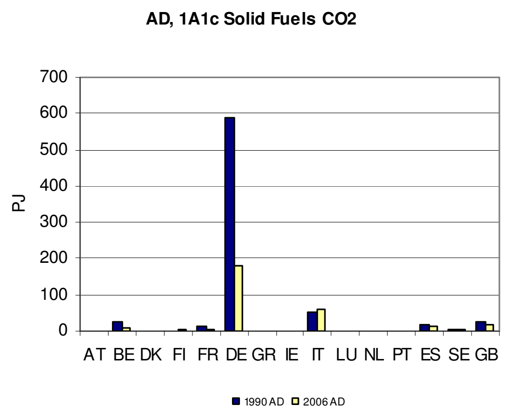
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	NO	NO	NO	-	-	-	-	-	IE	IE	IE
Belgium	2,137	429	394	1.3%	-34	-8%	-1,743	-82%	CS/T3	PS	PS
Denmark	NO	NO	NO	-	-	-	-	-	0.0	Not Occuring	0.0
Finland	347	394	397	1.3%	2	1%	50	14%	T3	PS	CS
France	1,315	315	315	1.0%	0	0%	-1,000	-76%	C	AS/ PS	CS
Germany	54,999	14,622	15,272	49.5%	649	4%	-39,728	-72%	CS	NS	CS
Greece	NO	NO	NO	-	-	-	-	-	0.0	0.0	0.0
Ireland	100	110	120	0.4%	10	9%	20	20%	T1	NS	CS
Italy	9,062	12,336	11,915	38.6%	-421	-3%	2,853	31%	T2	NS	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Netherlands	IE	NO	NO	-	-	-	-	-	NA	NA	NA
Portugal	25	NO	NO	-	0	-	-25	-100%	T2	PS	D,C,PS
Spain	1,847	943	895	2.9%	-47	-5%	-952	-52%	T2	PS, NS	PS, CS
Sweden	360	345	365	1.2%	20	6%	5	1%	T1, T2, T3	PS	CS
United Kingdom	2,326	908	1,157	3.8%	249	27%	-1,169	-50%	T2	NS	CS
EU-15	**72,520**	**30,402**	**30,831**	**100.0%**	**428**	**1%**	**-41,689**	**-57%**			

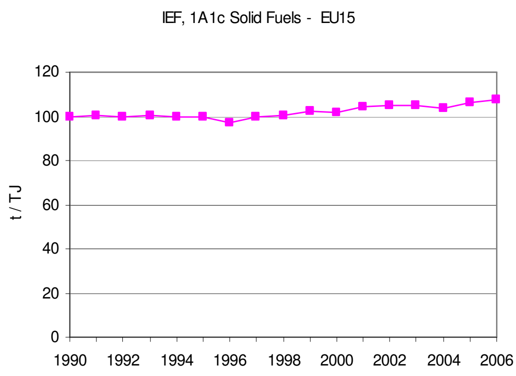
Emissions of the Netherlands are included in 1A2.A
Abbreviations explained in the Chapter 'Units and abbreviations'.

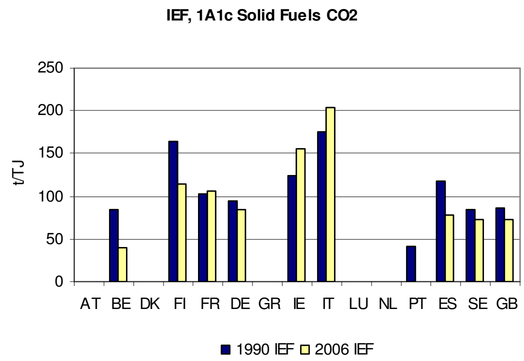
Figure 3.25 shows the relevant activity data and implied emission factors. Solid fuels have fallen steadily to less than half the 1990 level. The EU-15 implied emission factor has increased to reach 107 t/Tj in 2006. This increase is mainly due to a decline in the German share in EU emissions and a parallel increase in the share of Italy, which has a significantly higher implied emission factor. The largest emitters in 2006 were Italy and Germany, jointly responsible for almost 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





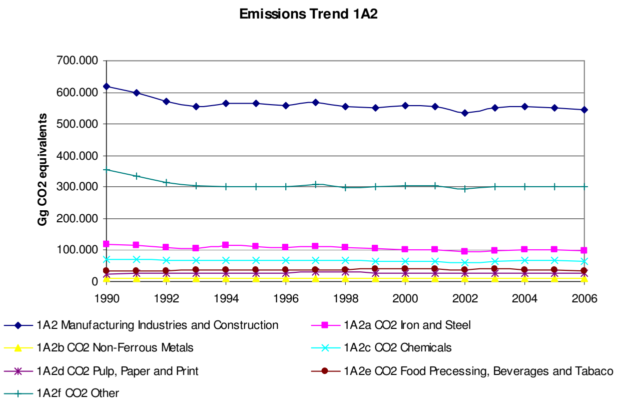




3.2.2. *Manufacturing industries and construction (CRF Source Category 1A2)*

Figure 3.26 shows the emission trends within source category 1A2, which is mainly dominated by CO_2 from 1A2f Other contributing by 55% 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



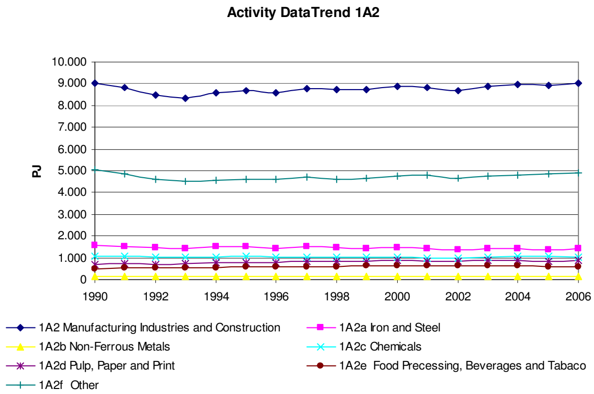


Table 3.18 summarises information by Member State on GHG emission trends and CO_2 emissions from 1A2 Manufacturing Industries and Construction.

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 2006 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO_2 emissions in 2006 (Gg)
Austria	13,615	15,984	13,445	15,812
Belgium	33,261	27,630	33,126	27,523
Denmark	5,493	5,712	5,424	5,630
Finland	13,417	11,725	13,231	11,548
France	85,753	77,237	84,801	76,233
Germany	156,320	102,424	154,482	101,394
Greece	10,444	9,684	10,370	9,549
Ireland	4,107	5,889	3,969	5,688
Italy	90,607	83,778	88,937	82,083
Luxembourg	5,315	1,670	5,303	1,665
Netherlands	33,135	27,557	33,045	27,487
Portugal	9,260	9,972	9,155	9,817
Spain	46,729	70,643	46,266	69,840
Sweden	11,497	11,350	10,943	10,742
United Kingdom	101,363	83,966	99,422	82,336
EU-15	**620,317**	**545,221**	**611,921**	**537,347**

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 2006. Between 1990 and 2006, CO_2 emissions from manufacturing industries declined by 12 % 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 2006 as in 1990. A shift from solid and liquid fuels to mainly natural gas took place and a minor increase of biomass and other fuels has been recorded.

Between 1990 and 2006, Germany shows by far the largest emission reductions in absolute terms. Also United Kingdom, France, Italy, Belgium, the Netherlands and Luxembourg show emission reductions of more than three million tonnes CO_2, whereas large emission increases occurred mainly in Spain. The main reason for the large decline in Germany was the restructuring of the industry and efficiency improvements after German reunification.

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 2005 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 2005 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

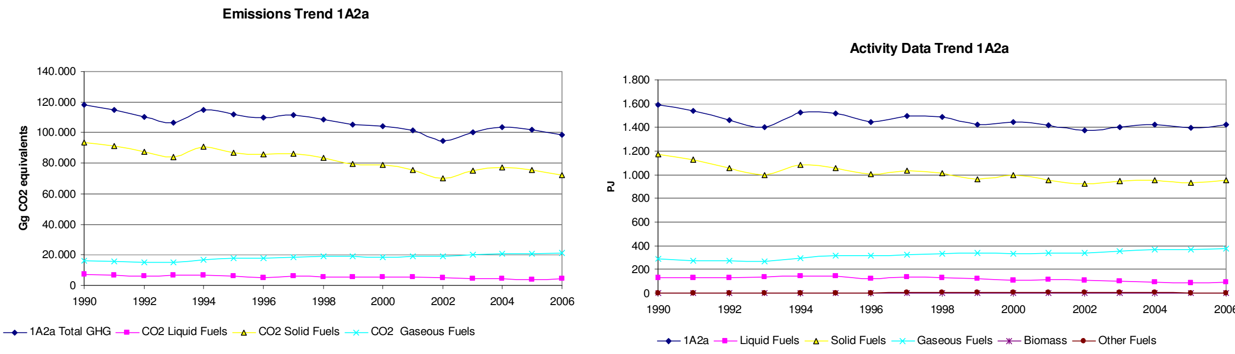
	1990		2005		Main explanations
	Gg	Percent	Gg	Percent	
Austria	-133	-1,0	370	2,4	correction of NCVs; shift between categories 1.A.1 and 1.A.2 and/or between final energy consumption and transformation input; updated natural gas activity data;
Belgium	273	0,8	142	0,5	No explanation provided
Denmark	0	0,0	35	0,6	Fuel consumption data for residual oil has been updated based on a research project improving the fuel consumption estimate for national sea traffic.
Finland	-47	-0,4	-111	-1,0	1990: Correction of plant specific factors. 1990,2005: Plant level data corrected; reallocation of plants
France	2.472	3,0	-2.641	-3,2	new methodology for estimating CO2 emissions from 1A2a; Amélioration de la comptabilisation de la biomasse en distinguant la liqueur noire et le bois et dérivés pour le secteur Papier - Carton; Ajustement des gaz sidérurgiques consommés par les GIC de la sidérurgie sous estimés dans l'édition précédente
Germany	0	0,0	863	0,8	new statistical data from a research project; 1A2d: new statistical data from industry
Greece	-87	-0,8	-153	-1,8	Disaggregation into different activities
Ireland	0	0,0	383	7,0	Revised fuel data in national energy balance
Italy	0	0,0	-263	-0,3	update of emission factor for natural gas, coal and fuel oil; minor sources of emissions in the cement industry have been added
Luxembourg	12	0,2	-774	-33,7	revised AD for CRF category 1.A.2.b; reallocation between liquid and gaseous fuels categories for CRF category 1.A.2.b;
Netherlands	0	0,0	0	0,0	
Portugal	-3	0,0	-298	-2,8	Revision of the EF for certain fuels (old tires)
Spain	0	0,0	-259	-0,4	The CO2 emission factor corresponding to natural gas used in gas turbines and stationary engines has been reviewed after detection of an incorrect value in the emission factor applied. This review affects only to the installations considered as area sources in the inventory; General revision of the 2005 energy balance as its version in the previous emission inventory was a provisional one.
Sweden	-120	-1,1	86	0,8	1990: Revised activity data due to double counting of liquid fuels; 2005: Revised thermal values for coke oven gas and blast furnace gas; revised activity data
UK	-131	-0,1	-1.431	-1,7	1990: Improvement to methodology for estimates from cement production in the Cayman Islands; Revision to emission factors for petroleum coke based on a review of pet coke used. Revision to EF for scrap tyres based on cement industry data. Revision to colliery methane EF based on average natural gas EF; Reallocation of gas oil to reflect new rail emission methodology; 2005: Change to emission factor for coal from other industrial combustion. Emission factor takes into account changes in GCVs. Emission factor revisions for coal from autogeneration, waste solvent and scrap tyres from cement production (due to better available data); Revision to gas oil for other industrial combustion due to change in UK National statistics and also due to the reallocation of gas oil as a result of a change in rail emission methodology;
EU-15	**2.237**	**0,4**	**-4.050**	**-0,7**	

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

This chapter provides information about emission trends, Member States contribution, activity data and emission factors for category 1A2a on a fuel base. CO_2 emissions from 1A2a Iron and Steel account for 17.9% of 1A2 source category and 2.4 % of total GHG emissions in 2006.

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 17 %, mainly due to improved efficiency of restructured iron and steel plants in the increased share of gaseous fuels. Emissions from solid fuels decreased by 23 % and from liquid fuels by 41%. As follow up increasing emissions were reported for gaseous fuels (+29 %). Some Member States report emissions from blast furnace gas under categories 1A1a or 1A2 where it is used for energy recovery in the respective industrial branches. Emissions from coke ovens of integrated iron and steel plants are sometimes not reported in the respective category 1A1c but included in this category. Emissions from blast furnace and coke oven gas flaring without energy recovery are partly reported under category 1B. The methodology of splitting emissions from blast furnaces into energy related and process related emissions reported under category 2C1 does not follow a specific standard. E.g. Germany reports 21% of total CO_2 emissions from categories 1A2a and 2C1 under this category and France reports 84%. However, the main driver of category 1A2a CO_2 emissions is blast furnace iron (BFI) production which decreased from about 95 mio tonnes to 64 mio tonnes since 1990 (www.worldsteel.org statistics) wheras total steel production increased since 1990 from about 143 mio tonnes to 172 mio tonnes (www.worldsteel.org statistics).

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



Between 1990 and 2006, CO_2 emissions from 1A2a Iron and Steel decreased by 17 % in the EU-15 (Table 3.20), mainly due to decreases in the United Kingdom, Belgium, Italy and Luxembourg. Between 2005 and 2006 emissions decreased by -3 %.

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

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006	
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	4,944	6,447	6,450	6.6%	2	0%	1,505	30%
Belgium	14,213	9,469	9,315	9.5%	-154	-2%	-4,897	-34%
Denmark	441	510	511	0.5%	1	0%	70	16%
Finland	2,555	3,668	3,790	3.9%	122	3%	1,235	48%
France	19,433	16,980	16,015	16.4%	-965	-6%	-3,418	-18%
Germany	12,578	15,822	11,664	11.9%	-4,158	-26%	-914	-7%
Greece	475	185	175	0.2%	-10	-6%	-300	-63%
Ireland	162	2	2	0.0%	0	0%	-159	-99%
Italy	20,729	15,537	16,671	17.0%	1,135	7%	-4,058	-20%
Luxembourg	3,238	256	310	0.3%	54	21%	-2,928	-90%
Netherlands	4,011	4,538	4,601	4.7%	62	1%	590	15%
Portugal	623	180	213	0.2%	32	18%	-411	-66%
Spain	8,726	8,113	7,993	8.2%	-119	-1%	-733	-8%
Sweden	1,057	1,184	1,218	1.2%	34	3%	161	15%
United Kingdom	24,101	17,881	18,893	19.3%	1,012	6%	-5,208	-22%
EU-15	**117,286**	**100,774**	**97,821**	**100.0%**	**-2,953**	**-3%**	**-19,465**	**-17%**

1A2a Iron and Steel - Liquid Fuels (CO_2)

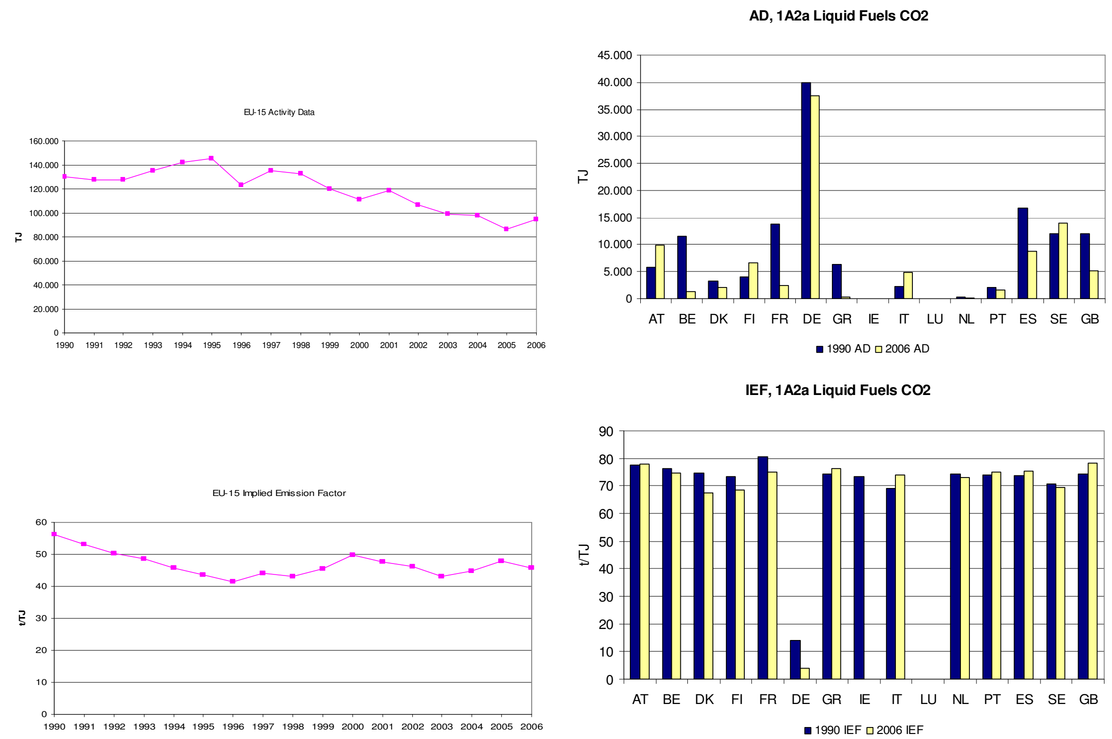
In 2006 CO_2 from liquid fuels had a share of 4 % within this category compared to 6 % in 1990. Between 1990 and 2006 emissions decreased by 41 % (Table 3.21). Significant absolute decreases could be achieved in Belgium, France, Greece, Spain and the United Kingdom wheras Italy, Finland, and Austria 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 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	448	793	768	17.8%	-25	-3%	319	71%	T2	NS, PS	CS, PS
Belgium	879	103	91	2.1%	-12	-12%	-788	-90%	T3	PS/RS	PS
Denmark	238	138	139	3.2%	1	0%	-100	-42%	C	NS	CS/C
Finland	303	429	456	10.6%	27	6%	154	51%	T3, M	PS	CS
France	1,106	259	180	4.2%	-79	-31%	-926	-84%	C	NS/ AS/ PS	CS
Germany	560	121	141	3.3%	21	17%	-418	-75%	T2	NS	CS
Greece	475	14	19	0.4%	5	34%	-456	-96%	T2	NS	PS
Ireland	3	NO	NO	-	-	-	-3	-100%	T1	NS	CS
Italy	153	324	356	8.3%	32	10%	203	132%	T2	NS	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Netherlands	21	11	11	0.2%	-1	-5%	-10	-48%	T2	NS	CS
Portugal	154	97	123	2.9%	27	28%	-31	-20%	T2	NS,PS	D,C,PS
Spain	1,231	594	657	15.2%	63	11%	-574	-47%	T2	PS, AS, NS	PS, C
Sweden	849	946	969	22.5%	24	2%	120	14%	T1, T2, T3	PS	CS
United Kingdom	894	310	404	9.4%	94	30%	-491	-55%	T2	NS,AS	CS
EU-15	**7,315**	**4,139**	**4,314**	**100.0%**	**175**	**4%**	**-3,001**	**-41%**			

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 27 % between 1990 and 2006. The implied emission factor of EU-15 was 45.7 t/TJ in 2006. Germany reports total fuel consumption of blast furnaces under category 1A2a but reports only 21% of total 1A2a + 2C CO_2 emissions here which results in the low emission factor.

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 2006, CO_2 from solid fuels had a share of 73 % within this category and 79 % in 1990. Between 1990 and 2006 the emissions decreased by 23 % (Table 3.22). Between 1990 and 2006 major decreases show the United Kingdom, Spain, Luxembourg, Belgium, Italy and France. Between 2005 and 2006, Germany reported a substantial decrease of -37 %.

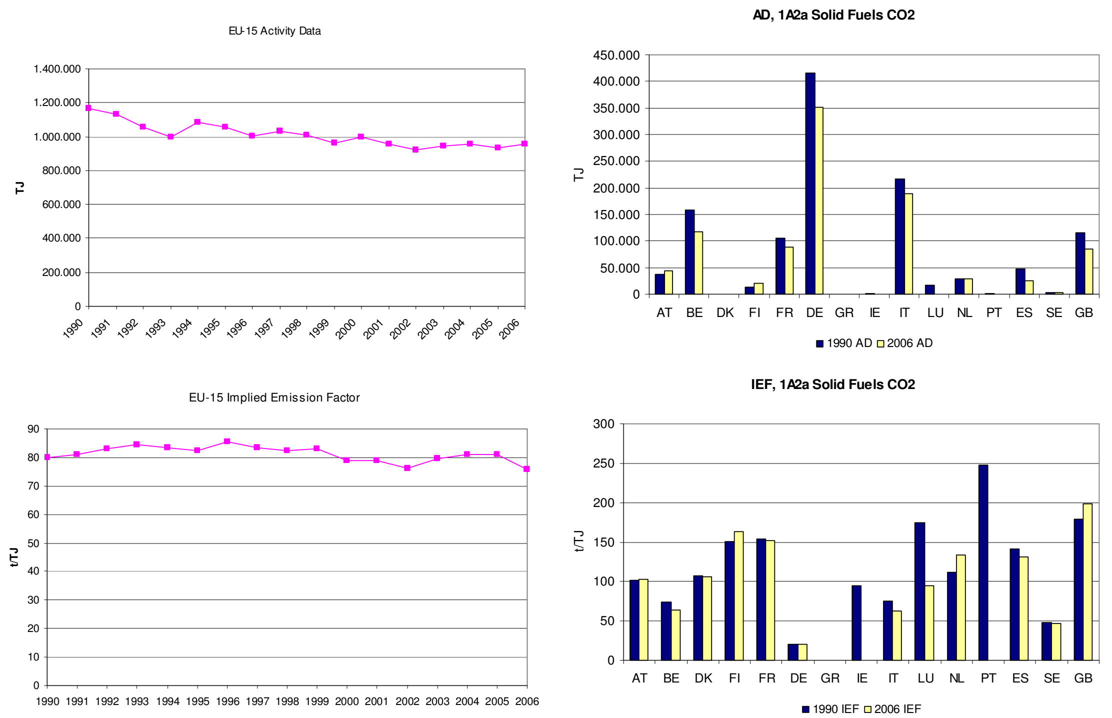
Table 3.22 1A2a Iron and Steel, solid fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	3,846	4,491	4,521	6.2%	30	1%	675	18%	T2	NS, PS	CS, PS
Belgium	11,849	7,578	7,513	10.4%	-65	-1%	-4,336	-37%	T3	PS/RS	PS
Denmark	17	0	0	0.0%	0	1%	-17	-100%	C	NS	CS/C
Finland	2,146	3,104	3,207	4.4%	102	3%	1,061	49%	T3	PS	CS, D
France	16,401	14,574	13,497	18.7%	-1,077	-7%	-2,904	-18%	C	NS/ AS/ PS	CS
Germany	8,518	11,816	7,393	10.2%	-4,423	-37%	-1,125	-13%	T2	NS	CS
Greece	NO	NO	NO	-	-	-	-	-	0.0	0.0	0.0
Ireland	115	NO	NO	-	-	-	-115	-100%	T1	NS	CS
Italy	16,300	10,638	11,880	16.4%	1,243	12%	-4,419	-27%	T2	NS	CS
Luxembourg	2,954	1	1	0.0%	0	0%	-2,953	-100%	T1	PS	D
Netherlands	3,323	3,816	3,930	5.4%	115	3%	608	18%	T2	NS	CS
Portugal	466	NO	NO	-	-	-	-466	-100%	T2	NS	D,C,PS
Spain	6,771	3,787	3,415	4.7%	-372	-10%	-3,356	-50%	T2	PS, AS, NS	PS, CS, C
Sweden	182	172	193	0.3%	22	13%	11	6%	T1, T2, T3	PS	CS
United Kingdom	20,744	15,768	16,792	23.2%	1,024	6%	-3,952	-19%	T2	NS,AS	CS
EU-15	**93,631**	**75,745**	**72,343**	**100.0%**	**-3,402**	**-4%**	**-21,288**	**-23%**			

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 almost 80% of the CO_2 emissions from solid fuels in 1A2a. Fuel combustion in the EU-15 decreased by 18 % between 1990 and 2006. The implied emission factor in 2006 of EU-15 was 75.8 t/TJ. Germany reports total fuel consumption of blast furnaces under category 1A2a but reports only 21% of total CO_2 emissions from 1A2a+2C under this category which results in the low emission factor. Sweden, Belgium and Italy report fuel consumption under this category which was not used for the calculation of the CO_2 emissions which results untypically low CO_2 emission factors.

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



1A2a Iron and Steel - Gaseous Fuels (CO_2)

In 2006 CO_2 from gaseous fuels had a share of 21 % within source category 1A2a (compared to 14 % in 1990). Between 1990 and 2006 the emissions increased by 29 % (Table 3.23). Between 1990 and

2006 all Member States except Ireland, the Netherlands and the United Kingdom reported increases. The highest increase occurred in Spain (+442 %), Sweden (+118 %) and Denmark (+101 %).

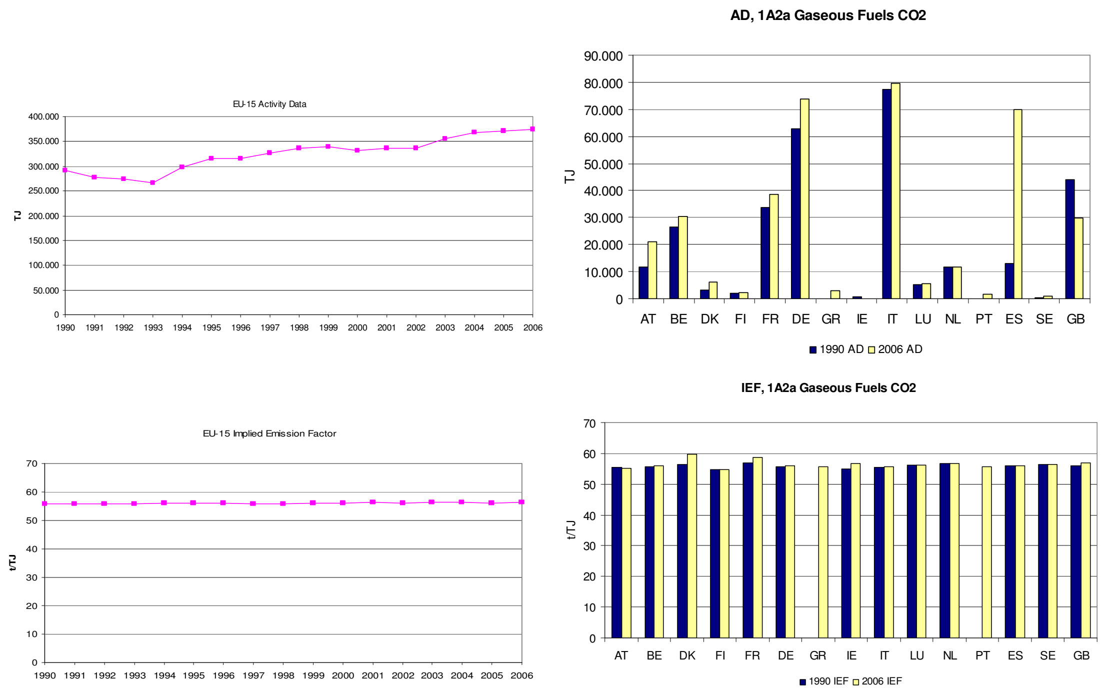
Table 3.23 1A2a Iron and Steel, gaseous fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	650	1,163	1,160	5.5%	-3	0%	511	79%	T2	NS, PS	CS, PS
Belgium	1,485	1,788	1,712	8.1%	-76	-4%	227	15%	T3	PS/RS	PS
Denmark	185	372	373	1.8%	0	0%	187	101%	C	NS	CS/C
Finland	107	135	127	0.6%	-8	-6%	20	19%	T3	PS	CS
France	1,926	2,078	2,269	10.8%	191	9%	343	18%	C	NS/ AS/ PS	CS
Germany	3,500	3,886	4,130	19.6%	244	6%	629	18%	T2	NS	CS
Greece	NO	172	157	0.7%	-15	-9%	157	-	T2	NS	PS
Ireland	44	2	2	0.0%	0	-	-41	-95%	T1	NS	CS
Italy	4,276	4,574	4,435	21.0%	-140	-3%	159	4%	T2	NS	CS
Luxembourg	284	255	309	1.5%	54	21%	25	9%	T1	PS	D
Netherlands	667	711	660	3.1%	-52	-7%	-8	-1%	T2	NS	CS
Portugal	NO	83	88	0.4%	5	7%	88	-	T2	NS,PS	D,C,PS
Spain	724	3,731	3,922	18.6%	190	5%	3,198	442%	T2	PS, AS, NS	CS
Sweden	25	67	55	0.3%	-12	-18%	30	118%	T1, T2, T3	PS	CS
United Kingdom	2,463	1,803	1,697	8.0%	-106	-6%	-766	-31%	T2	NS,AS	CS
EU-15	**16,337**	**20,821**	**21,095**	**100.0%**	**274**	**1%**	**4,758**	**29%**			

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 Belgium, France, Germany, Italy, Spain and the United Kingdom which contribute 86% to CO_2 emissions from solid fuels in 1A2a. Gaseous fuel consumption in the EU-15 increased by 29 % between 1990 and 2006. The implied emission factor of EU-15 was 56.3 t/TJ in 2006. The higher implied emission factor in 2006 of Denmark is due to a preliminary estimate (distribution model) of natural gas CO_2 emissions for all 1A2 sub categories which is not consistent with sectoral activity data.

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

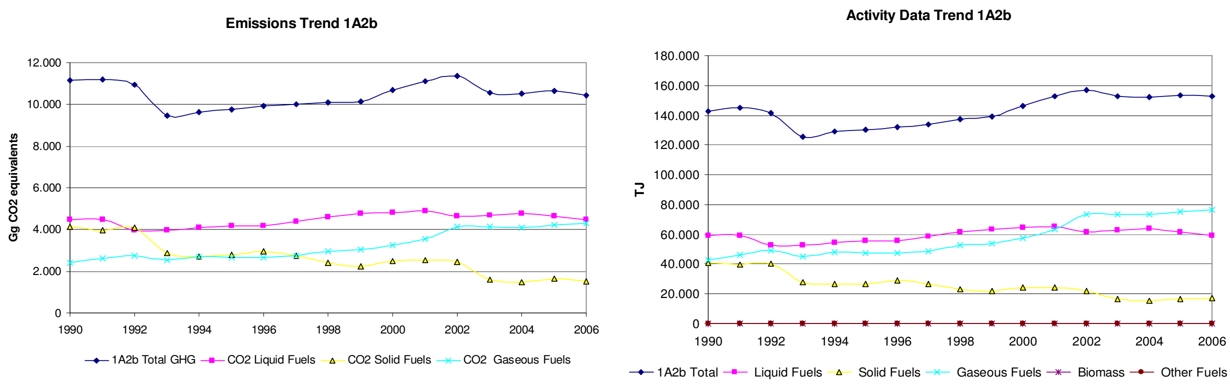


3.2.2.2. Non Ferrous Metals (1A2b) (EU-15)

In this chapter information is provided about emission trends, Member States contribution, activity data and emission factors for category 1A2b by fuels. CO_2 emissions from 1A2b Non-Ferrous Metals account for 1.9% of 1A2 source category and 0.2 % of total GHG emissions in 2006.

Figure 3.31 shows the emission trend within the category 1A2b, which is in 2006 mainly dominated by CO_2 emissions from liquid, and gaseous fuels. The share of solid fuels emissions decreased from 37% in 1990 to 14 % in 2006. Total GHG emissions reached the same level as in 1990. Increasing emissions were reported for gaseous fuels (+78 %).

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



Although the EU-15 emissions of 1990 and 2006 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 137 % (Table 3.24).

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

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006	
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	132	219	228	2.2%	10	4%	96	73%
Belgium	624	501	488	4.7%	-13	-3%	-136	-22%
Denmark	17	15	15	0.1%	0	0%	-2	-14%
Finland	336	97	98	1.0%	1	1%	-238	-71%
France	4,009	2,130	2,218	21.5%	88	4%	-1,791	-45%
Germany	1,600	503	528	5.1%	25	5%	-1,072	-67%
Greece	1,261	1,632	1,399	13.6%	-233	-14%	138	11%
Ireland	810	1,420	1,190	11.6%	-230	-16%	380	47%
Italy	738	1,169	1,177	11.4%	8	1%	440	60%
Luxembourg	38	51	56	-	5	10%	17	45%
Netherlands	216	230	217	2.1%	-13	-6%	1	0%
Portugal	IE,NO	IE	IE	0.0%	-	-	-	-
Spain	1,095	2,476	2,596	25.2%	120	5%	1,501	137%
Sweden	142	89	92	0.9%	3	3%	-50	-35%
United Kingdom	IE	IE	IE	-	-	-	-	-
EU-15	**11,019**	**10,531**	**10,302**	**100.0%**	**-230**	**-2%**	**-717**	**-7%**

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 2006 CO_2 from solid fuels had a share of 14 % within source category 1A2b category (compared to 37 % in 1990). Between 1990 and 2006 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'. Substantial decreases between 1990 and 2006 were reported by France and Germany.

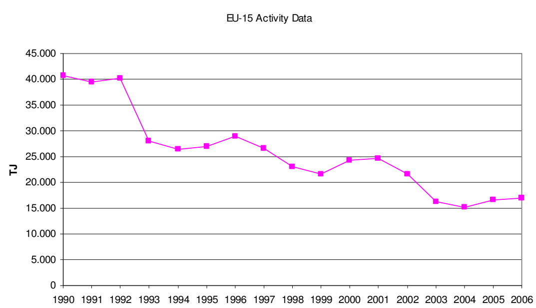
Table 3.25 1A2b Non ferrous Metals, solid fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

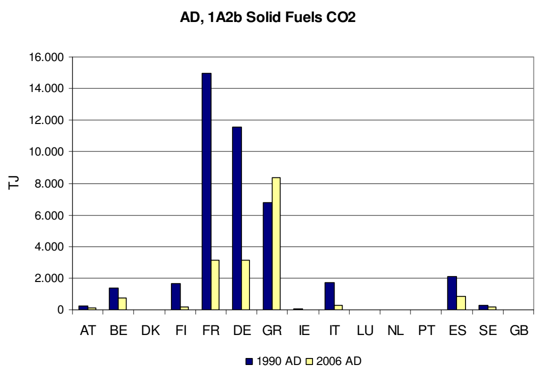
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	22	14	13	0.8%	-1	-5%	-9	-42%	T2	NS	CS
Belgium	146	71	78	5.2%	7	10%	-68	-46%	T1	PS/RS	D
Denmark	NO	NO	NO	-	-	-	-	-	0.0	Not Occuring	0.0
Finland	155	20	20	1.3%	0	0%	-136	-87%	T3	PS	CS, PS
France	1,540	283	363	24.1%	80	28%	-1,176	-76%	C	NS/ PS	CS
Germany	1,205	301	326	21.7%	25	8%	-879	-73%	0.0	NS	CS
Greece	653	819	573	38.0%	-246	-30%	-80	-12%	T2	NS	PS
Ireland	4	NO	NO	-	-	-	-4	-100%	T1	NS	CS
Italy	163	31	28	1.8%	-3	-10%	-135	-83%	T2	NS	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Netherlands	0	NO	NO	-	-	-	-0.4	-100%	NA	NA	NA
Portugal	IE	IE	IE	-	-	-	-	-	T2	NS	D,C
Spain	221	91	89	5.9%	-1	-2%	-132	-60%	T2	PS, AS	CS
Sweden	22	17	16	1.0%	-1	-6%	-6	-28%	T1, T2, T3	PS	CS
United Kingdom	IE	IE	IE	-	-	-	-	-	IE	IE	IE
EU-15	**4,131**	**1,647**	**1,507**	**100.0%**	**-140**	**-9%**	**-2,625**	**-64%**			

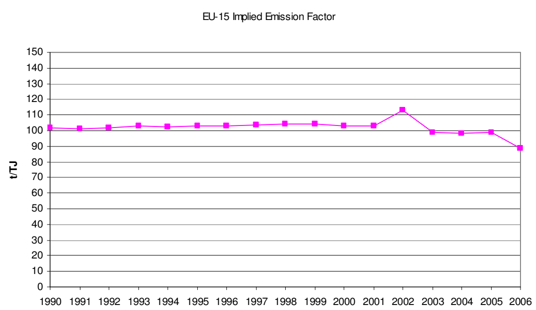
UK includes emissions under 1A2f.
Portugal includes emissions under 1A2f because the separation of AD between ferrous and non-ferrous industry not available
Abbreviations explained in the Chapter 'Units and abbreviations'.

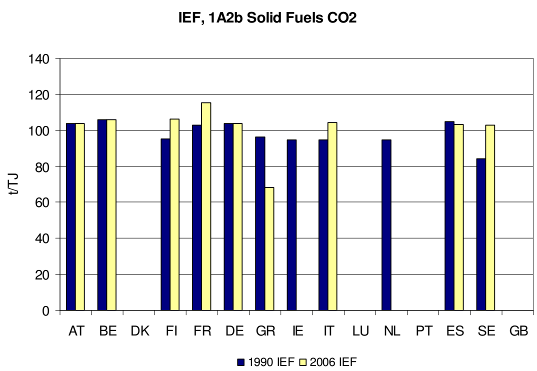
Figure 3.32 shows activity data and implied emission factors for CO_2 comparing the EU-15 average and the Member States. The largest emissions are reported by Germany, Greece and France; together they cause 84 % in 2006 of the CO_2 emissions from solid fuels in 1A2b and 82 % in 1990. Consumption of solid fuels in the EU-15 decreased by 58 % between 1990 and 2006. The implied emission factor of EU-15 was 88.6 t/TJ in 2006. The low implied emission factor of Greece in the year 2006 is an outlier which will be updated in the next submission.

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 2006 CO_2 from gaseous fuels had a share of 41 % within source category 1A2b (compared to 22 %

in 1990). Between 1990 and 2006 the emissions increased by +78 % (Table 3.26). Between 1990 and 2006 all Member States reported increases. The highest increase ocurred in Spain (+1 552 %). Also between 2005 and 2006 emissions increased in all Member States except Belgium and Greece.

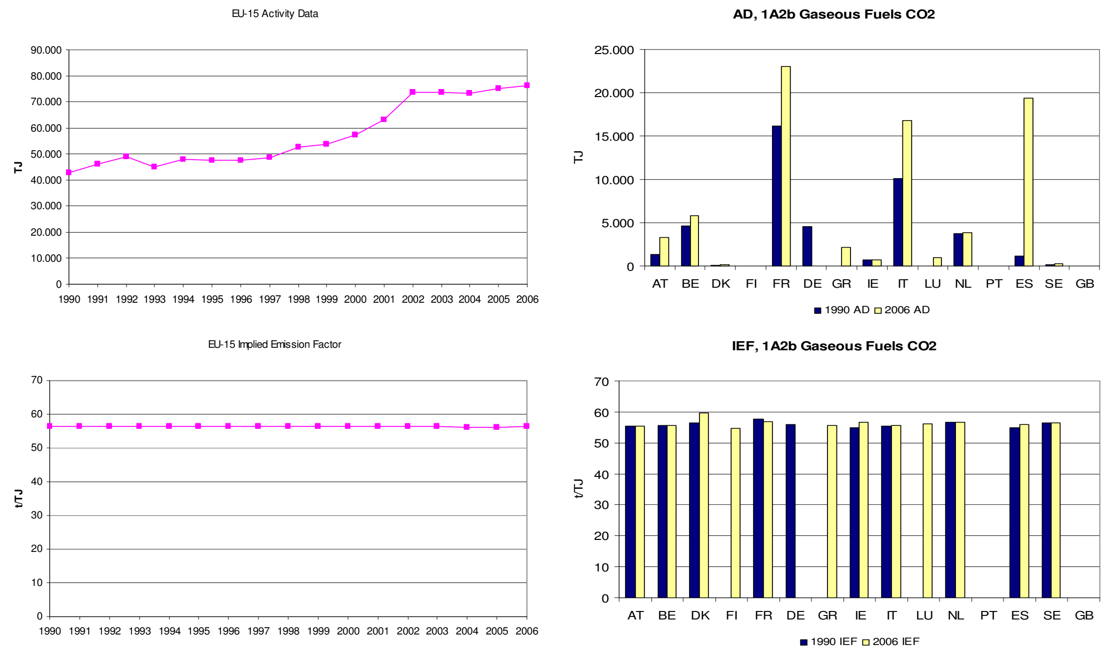
Table 3.26 1A2b Non ferrous Metals, gaseous fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	75	174	181	4.2%	7	4%	106	141%	T2	NS	CS
Belgium	260	332	323	7.5%	-9	-3%	63	24%	T1	PS/RS	D
Denmark	7	9	9	0.2%	0	0%	2	32%	C	NS	CS/C
Finland	NO	1	1	0.0%	0	2%	1	-	T3	PS	CS, PS
France	929	1,218	1,315	30.6%	97	8%	386	42%	C	NS/ PS	CS
Germany	253	IE	IE	0.0%	-	-	-253	-100%	0.0	NS	CS
Greece	NO	146	117	2.7%	-28	-19%	117	-	T2	NS	PS
Ireland	40	39	41	1.0%	3	-	2	4%	T1	NS	CS
Italy	558	936	935	21.7%	-2	0%	377	68%	T2	NS	CS
Luxembourg	NO	51	56	1.3%	5	10%	56	-	NA	NO	NA
Netherlands	213	230	217	5.0%	-13	-6%	3	2%	T2	NS	CS
Portugal	NO	IE	IE	-	-	-	-	-	T2	NS	D,C
Spain	66	1,069	1,086	25.3%	17	2%	1,020	1552%	T2	PS, AS	CS
Sweden	10	17	18	0.4%	0	2%	7	68%	T1, T2, T3	PS	CS
United Kingdom	IE	IE	IE	-	-	-	-	-	IE	IE	IE
EU-15	**2,411**	**4,220**	**4,297**	**100.0%**	**78**	**2%**	**1,886**	**78%**			

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 CO_2 implied emission factors for EU-15 and the Member States. The largest emissions are reported by France, Italy and Spain; together they cause around 78 % of the CO_2 emissions in 2006 from gaseous fuels in 1A2b. Consumption of gaseous fuels in the EU-15 rose by 78% between 1990 and 2006. The implied emission factor of EU-15 was 56.3 t/TJ in 2006. The higher implied emission factor in 2006 of Denmark is due to a preliminary estimate (distribution model) of natural gas CO_2 emissions for all sub categories of 1A2 which is not consistent with sectoral activity data.

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

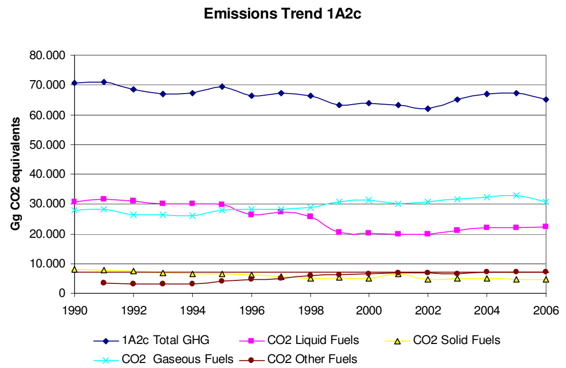


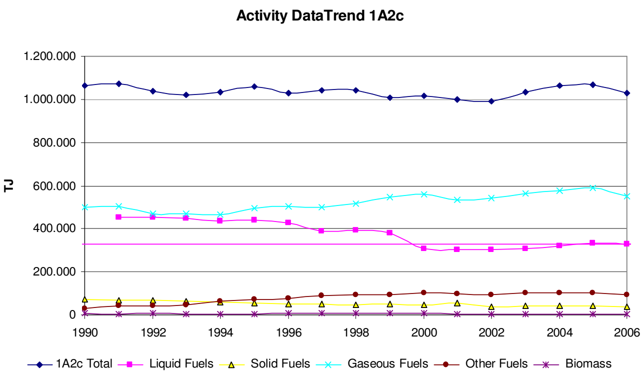
3.2.2.3. Chemicals (1A2c) (EU-15)

In this chapter information about emission trends, Member States contribution, activity data and emission factors is provided for category 1A2c on a fuel base. CO_2 emissions from 1A2c Chemicals account for 11.8% of 1A2 category and 1.6 % of total GHG emissions in 2006.

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 8 %, mainly due to decreases in emissions from solid (-44 %) and liquid (-27 %) fuels. Increasing emissions were reported for gaseous fuels (+10 %) and other fuels (+ 101 %).

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





Between 1990 and 2006, CO_2 emissions from 1A2c Chemicals decreased by 8 % in the EU-15 (Table 3.27), mainly due to decreases in Italy and the Netherlands; Spain reported a substantial increase of 69 % in this period. Between 2005 and 2006 emissions in all Member States decreased except Belgium, Greece, Ireland and Italy.

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

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006	
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	883	1,588	1,432	2.2%	-156	-10%	550	62%
Belgium	6,585	7,751	7,806	12.1%	55	1%	1,221	19%
Denmark	360	506	508	0.8%	1	0%	148	41%
Finland	1,286	1,325	916	1.4%	-409	-31%	-370	-29%
France	14,177	17,638	15,313	23.7%	-2,324	-13%	1,136	8%
Germany	IE	IE	IE	-	-	-	-	-
Greece	1,304	1,116	1,189	1.8%	73	7%	-116	-9%
Ireland	411	486	450	0.7%	-36	-7%	40	10%
Italy	20,052	12,071	11,761	18.2%	-310	-3%	-8,291	-41%
Luxembourg	NO	NO	NO	-	-	-	-	-
Netherlands	17,176	11,738	12,442	19.3%	704	6%	-4,734	-28%
Portugal	1,479	1,827	1,860	2.9%	32	2%	381	26%
Spain	5,458	9,260	9,250	14.3%	-10	0%	3,793	69%
Sweden	1,183	1,594	1,628	2.5%	34	2%	445	38%
United Kingdom	IE	IE	IE	-	-	-	-	-
EU-15	**70,352**	**66,900**	**64,556**	**100.0%**	**-2,344**	**-4%**	**-5,796**	**-8%**

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 2006, CO_2 from liquid fuels had a share of 34 % within source category 1A2c (compared to 43 %

in 1990). Between 1990 and 2006 the emissions decreased by 27 % (Table 3.28). Seven 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 2006, reports a minor increase between 1990 and 2006.

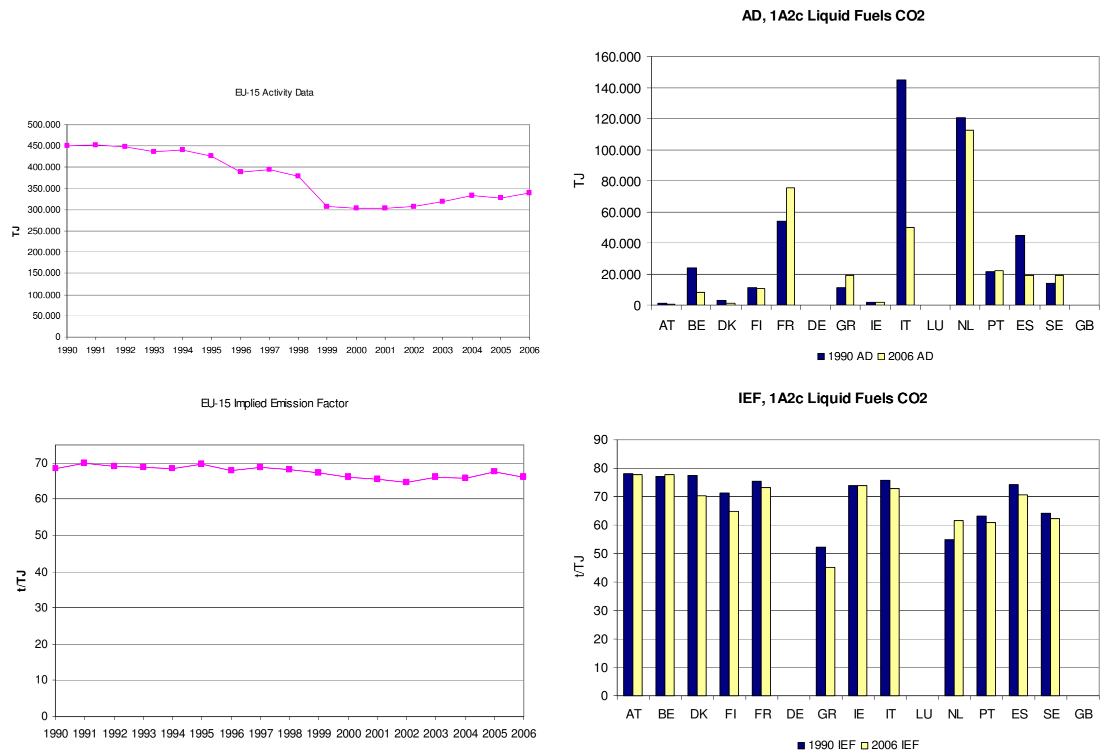
Table 3.28 1A2c Chemicals, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	82	50	46	0.2%	-5	-10%	-37	-45%	T2	NS, PS	CS, PS
Belgium	1,835	741	624	2.8%	-117	-16%	-1,211	-66%	T1	PS/RS	D
Denmark	205	86	87	0.4%	0	0%	-118	-58%	C	NS	CS/C
Finland	772	835	679	3.0%	-156	-19%	-93	-12%	T3	PS	CS, PS
France	4,063	5,954	5,507	24.6%	-447	-8%	1,445	36%	C	NS/ PS	CS
Germany	IE	IE	IE	-	-	-	-	-	0.0	0.0	IE
Greece	584	810	868	3.9%	58	7%	284	49%	T2	NS	PS
Ireland	131	154	135	0.6%	-19	-12%	4	3%	T1	NS	CS
Italy	10,956	3,756	3,634	16.2%	-122	-3%	-7,322	-67%	T2	NS	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Netherlands	6,613	5,821	6,926	30.9%	1,105	19%	313	5%	T2	NS	CS
Portugal	1,372	1,363	1,359	6.1%	-4	0%	-13	-1%	T2	PS,NS	D,C
Spain	3,295	1,512	1,337	6.0%	-175	-12%	-1,958	-59%	T2	NS	CS, C
Sweden	885	1,060	1,190	5.3%	130	12%	305	34%	T1, T2, T3	PS	CS
United Kingdom	IE	IE	IE	-	-	-	-	-	IE	IE	IE
EU-15	**30,793**	**22,144**	**22,392**	**100.0%**	**248**	**1%**	**-8,401**	**-27%**			

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 contributions are reported by France, Italy and the Netherlands; together they cause around 72 % of the CO_2 emissions from liquid fuels in 1A2c. Fuel combustion in the EU-15 decreased by 25 % between 1990 and 2006. The implied emission factor of EU-15 was 66.1 t/TJ in 2006. The low implied emission factor of Greece is because non-energy use is included in activity data. The low implied emission factor of the Netherlands is because chemical gases are included in liquid fuels.

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



1A2c Chemicals - Solid Fuels (CO_2)

In 2006, solid fuels had a share of 7 % within source category 1A2c (compared to 11 % in 1990). Between 1990 and 2006 the emissions decreased by 44 % (Table 3.29). Between 1990 and 2006 France and the Netherlands reported significant decreases in absolute terms. Germany and the UK include emissions from this source category in source category 1A2f.

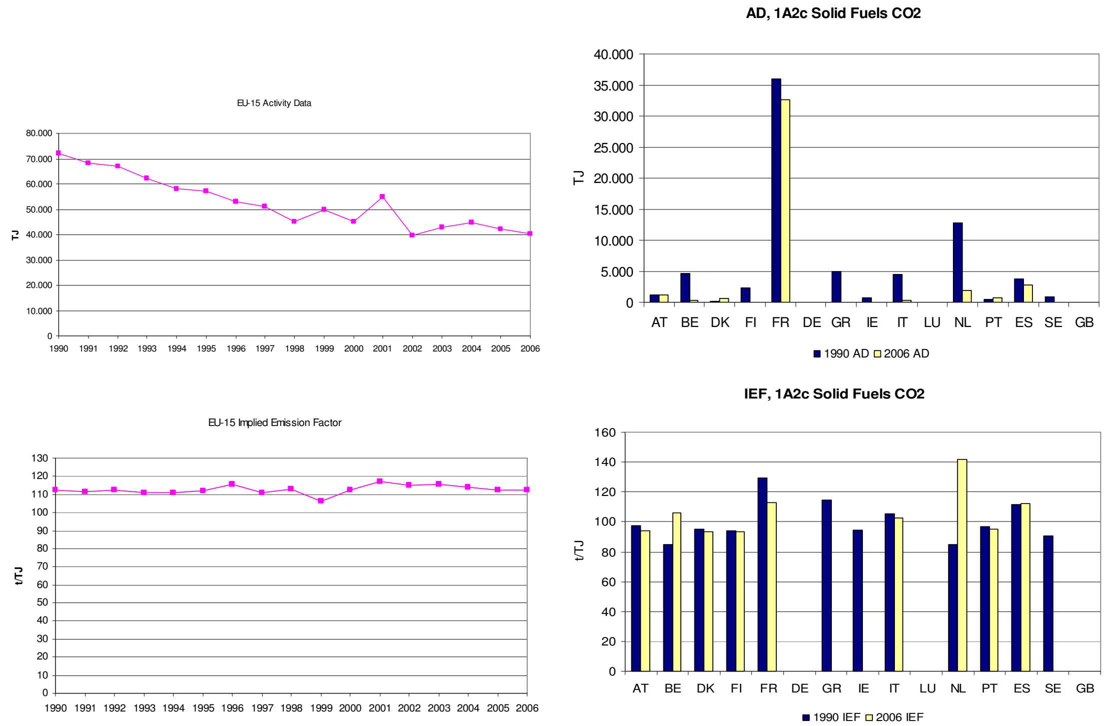
Table 3.29 1A2c Chemicals, solid fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	107	149	105	2.3%	-44	-30%	-2	-2%	NO	NO	NO
Belgium	397	0	31	-	31	-	-365	-92%	T1	PS/RS	D
Denmark	7	59	59	1.3%	1	1%	52	702%	C	NS	CS/C
Finland	214	223	4	0.1%	-218	-98%	-210	-98%	T3	PS	CS, PS
France	4,643	3,793	3,682	80.9%	-112	-3%	-962	-21%	C	NS/ PS	CS
Germany	IE	IE	IE	-	-	-	-	-	0.0	0.0	IE
Greece	561	NO	NO	-	-	-	-561	-100%	0.0	0.0	0.0
Ireland	72	NO	NO	-	-	-	-72	-100%	T1	NS	CS
Italy	478	24	28	0.6%	3	13%	-450	-94%	T2	NS	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Netherlands	1,087	255	263	5.8%	8	3%	-824	-76%	T2	NS	CS
Portugal	44	59	75	1.6%	16	27%	30	69%	T2	NS	D,C
Spain	424	181	302	6.6%	121	67%	-122	-29%	T2	NS	CS, C
Sweden	79	NO	NO	-	-	-	-79	-100%	NA	NA	NA
United Kingdom	IE	IE	IE	-	-	-	-	-	IE	IE	IE
EU-15	**8,114**	**4,744**	**4,549**	**100.0%**	**-195**	**-4%**	**-3,566**	**-44%**			

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 93 % of the CO_2 emissions from solid fuels in 1A2c. Fuel combustion in the EU-15 decreased by -44 % between 1990 and 2006. The implied emission factor of EU-15 was 112.7 t/TJ in 2006.

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



1A2c Chemicals – Gaseous Fuels (CO_2)

In 2006, CO_2 from gaseous fuels had a share of 47 % within source category 1A2c (compared to 40 % in 1990). Between 1990 and 2006 the emissions increased by 10 % (Table 3.30). Between 1990 and 2006 all Member States except the Netherlands, Italy and Finland reported increases. The highest increase ocurred in Belgium. Germany and the United Kingdom include emissions from this source category in source category 1A2f.

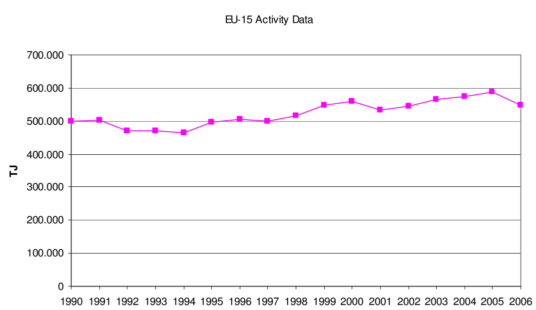
Table 3.30 1A2c Chemicals, gaseous fuels: Member States' contributions to CO_2 and information on method applied, activity data and emission factor

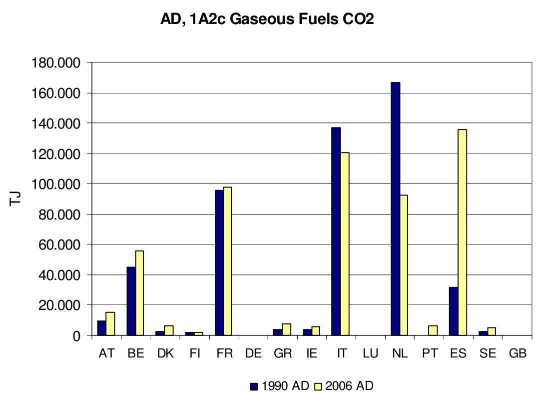
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	519	925	829	2.7%	-96	-10%	310	60%	T2	NS, PS	CS
Belgium	2,519	2,991	3,126	10.2%	135	5%	606	24%	T1	PS/RS	D
Denmark	147	361	361	1.2%	0	0%	214	145%	C	NS	CS/C
Finland	98	39	88	0.3%	50	128%	-10	-10%	T3	PS	CS, PS
France	5,471	7,328	5,553	18.0%	-1,775	-24%	82	1%	C	NS/ PS	CS
Germany	IE	IE	IE	-	-	-	-	-	0.0	0.0	IE
Greece	159	306	321	1.0%	15	5%	162	102%	T2	NS	PS
Ireland	208	331	315	1.0%	-16	-5%	107	52%	T1	NS	CS
Italy	7,561	6,841	6,705	21.8%	-136	-2%	-857	-11%	T2	NS	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Netherlands	9,476	5,662	5,253	17.1%	-409	-7%	-4,222	-45%	T2	NS	CS
Portugal	NO	320	341	1.1%	21	6%	341	-	T2	NS	D,C
Spain	1,739	7,567	7,611	24.7%	44	1%	5,873	338%	T2	NS	CS
Sweden	154	323	289	0.9%	-35	-11%	134	87%	T1, T2, T3	PS	CS
United Kingdom	IE	IE	IE	-	-	-	-	-	IE	IE	IE
EU-15	**28,051**	**32,993**	**30,792**	**100.0%**	**-2,202**	**-7%**	**2,740**	**10%**			

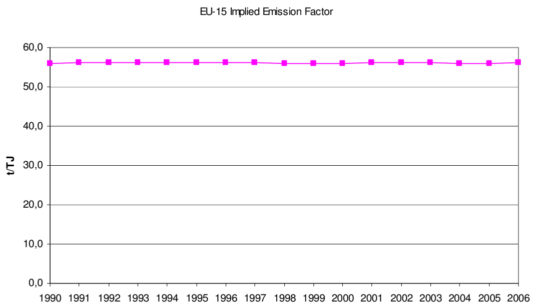
Emissions of Germany are included in 1A2f.
Emissions of the UK are included in 1A2f.
Abbreviations explained in the Chapter 'Units and abbreviations'.

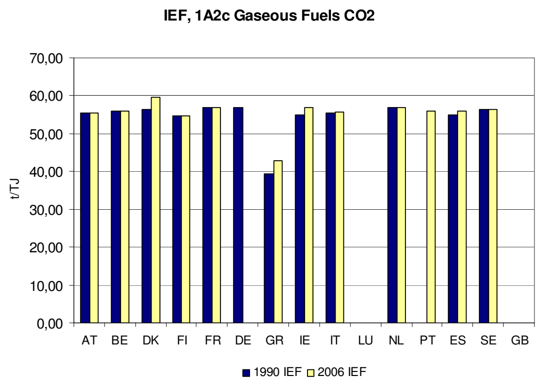
Figure 3.37 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by France, Italy, the Netherlands and Spain; together they cause more than 82 % of the CO_2 emissions from gaseous fuels in 1A2c. Gaseous fuel consumption in the EU-15 rose by 10 % between 1990 and 2006. The implied emission factor of EU-15 was 56.1 t/TJ in 2006. The low implied emission factor of Greece is because non-energy use is included in activity data.

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









1A2c Chemicals - Other Fuels (CO_2)

In 2006 , CO_2 from other fuels had a share of 10 % within source category 1A2c (compared to 5 % in 1990). Between 1990 and 2006 the emissions increased by 101 % (Table 3.31). Greece, Ireland, Denmark, Luxembourg, the Netherlands and Spain report emissions as 'Not occuring' or 'Not applicable', the UK and Germany include emissions in 1A2f. Major absolute increases were reported by Belgium and France between 1990 and 2006. Belgium reports recovered fuels from cracking units or other processes under this category.

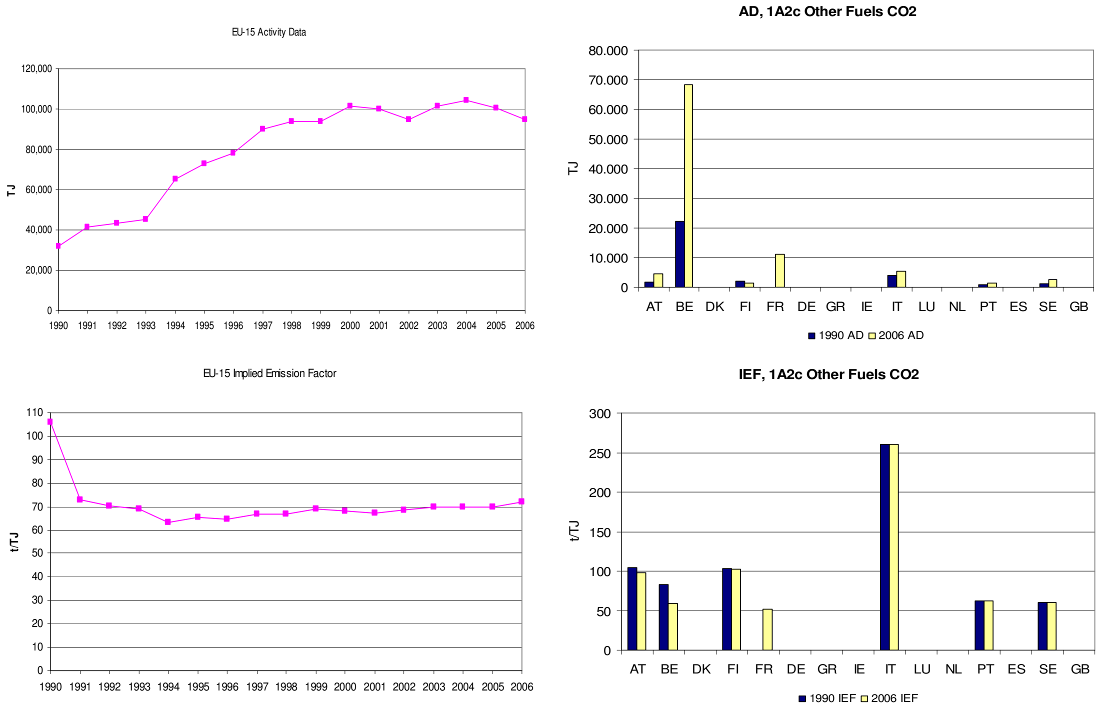
Table 3.31 1A2c Chemicals, other fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	174	464	453	6.6%	-11	-2%	279	160%	T2	NS, PS	D, PS
Belgium	1,834	4,019	4,025	59.0%	6	0%	2,191	120%	T3	PS/RS	PS
Denmark	NO	NO	NO	-	-	-	-	-	0.0	Not Occuring	0.0
Finland	202	229	145	2.1%	-84	-37%	-57	-28%	T3	PS	CS, PS
France	NO	563	572	8.4%	9	2%	572	-	C	NS/ PS	CS
Germany	IE	IE	IE	-	-	-	-	-	0.0	0.0	IE
Greece	NO	NO	NO	-	-	-	-	-	0.0	0.0	0.0
Ireland	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Italy	1,057	1,449	1,395	20.4%	-54	-4%	338	32%	T2	NS	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Netherlands	NO	NO	NO	-	-	-	-	-	NA	NA	NA
Portugal	63	85	85	1.2%	0	0%	23	36%	T2	PS,NS	D,C
Spain	NA	NA	NA	-	-	-	-	-	NO	NO	NO
Sweden	64	211	150	2.2%	-61	-29%	86	134%	T1, T2, T3	PS	CS
United Kingdom	IE	IE	IE	-	-	-	-	-	IE	IE	IE
EU-15	**3,393**	**7,019**	**6,824**	**100.0%**	**-196**	**-3%**	**3,430**	**101%**			

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

Figure 3.38 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by Belgium, France and Italy; together they cause 88 % of the CO_2 emissions from other fuels in 1A2c. Other fuel consumption in the EU-15 increased by 196 % between 1990 and 2006. The implied emission factor of EU-15 was 72.1 t/TJ in 2006.

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

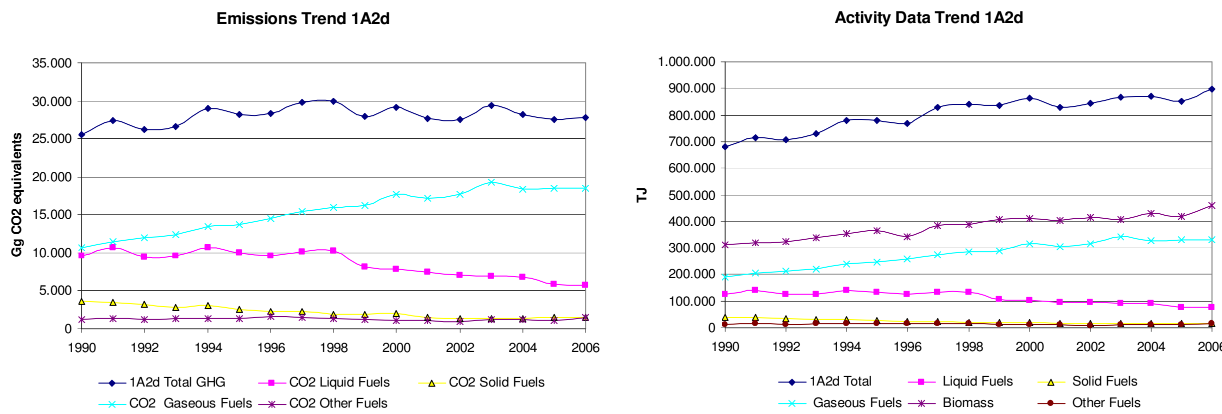


3.2.2.4. Pulp, Paper and Print (1A2d) (EU-15)

In this chapter information about emission trends, Member States contribution, activity data and emission factors is provided for category 1A2d by fuels. CO_2 emissions from 1A2d Pulp, Paper and Print account for 5.0 % of 1A2 source category and 0.7 % of total GHG emissions in 2006.

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 9 %. 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 2006, CO_2 emissions from 1A2d Pulp, Paper and Print increased by 9 % in the EU-15 (Table 3.32), mainly due to increases in Italy and Spain; Finland reported a relevant decrease in this period. Between 2005 and 2006 emissions increased by 1 %.

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

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006	
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	2,213	2,283	2,183	8.0%	-100	-4%	-30	-1%
Belgium	637	619	678	2.5%	59	9%	40	6%
Denmark	363	214	214	0.8%	0	0%	-149	-41%
Finland	5,336	3,538	4,039	14.9%	502	14%	-1,297	-24%
France	5,206	4,813	4,934	18.2%	121	3%	-273	-5%
Germany	4	16	17	0.1%	1	7%	13	369%
Greece	301	231	270	1.0%	39	17%	-32	-10%
Ireland	28	85	77	0.3%	-8	-9%	49	172%
Italy	3,076	4,576	4,578	16.9%	3	0%	1,502	49%
Luxembourg	NO	NO	NO	-	-	-	-	-
Netherlands	1,743	1,690	1,616	6.0%	-74	-4%	-127	-7%
Portugal	743	874	843	3.1%	-31	-4%	100	13%
Spain	3,212	5,893	5,640	20.8%	-254	-4%	2,428	76%
Sweden	2,186	2,124	2,069	7.6%	-54	-3%	-117	-5%
United Kingdom	IE	IE	IE	-	-	-	-	-
EU-15	**25,051**	**26,956**	**27,159**	**100.0%**	**203**	**1%**	**2,108**	**8%**

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 2006 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 40 % (Table 3.33). Between 1990 and 2006 all Member States except Sweden reported decreasing CO_2 emissions from this source category.

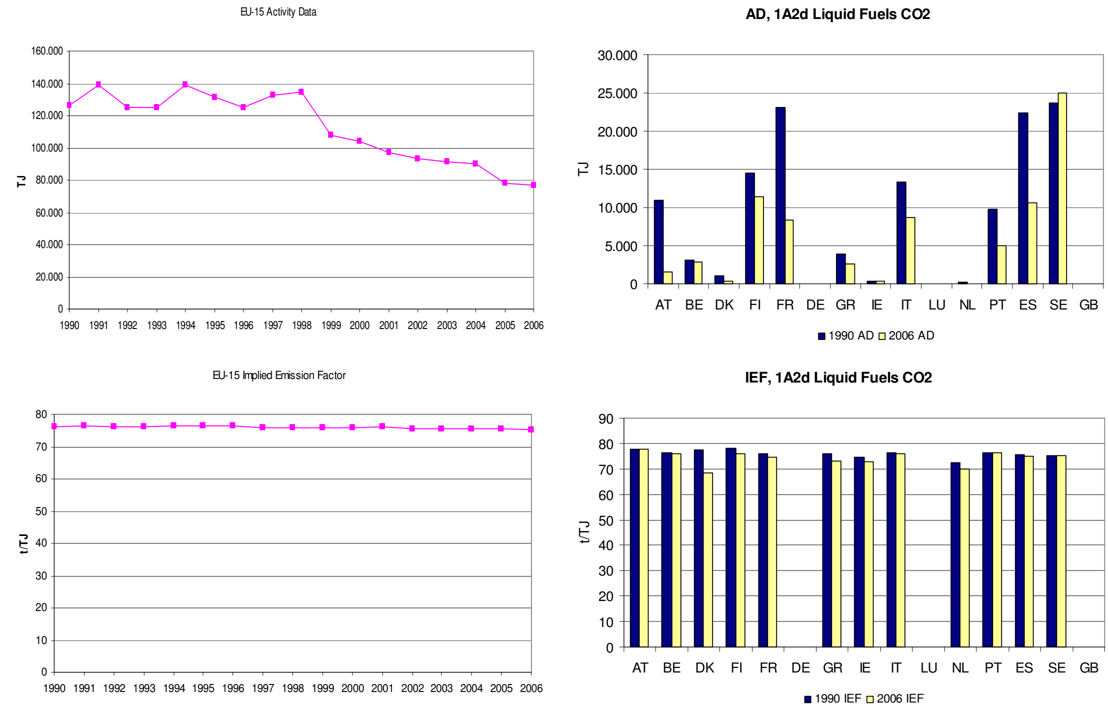
Table 3.33 1A2d Pulp, Paper and Print, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	853	137	123	2.1%	-13	-10%	-729	-86%	T2	NS, PS	CS, PS
Belgium	232	191	215	3.7%	24	13%	-17	-7%	T1	PS/RS	D
Denmark	86	23	24	0.4%	0	0%	-62	-72%	C	NS	CS/C
Finland	1,132	802	873	15.1%	71	9%	-259	-23%	T3	PS	CS, PS
France	1,755	727	618	10.7%	-109	-15%	-1,138	-65%	C	NS/ PS	CS
Germany	IE	IE	IE	-	-	-	-	-	T2	NS	CS
Greece	297	169	193	3.3%	24	14%	-104	-35%	T2	NS	PS
Ireland	28	24	22	0.4%	-2	-10%	-7	-23%	T1	NS	CS
Italy	1,015	617	661	11.4%	44	7%	-354	-35%	T2	NS	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Netherlands	20	2	3	0.1%	1	35%	-17	-86%	T2	NS	CS
Portugal	743	458	377	6.5%	-81	-18%	-367	-49%	T2	PS,NS	D,C
Spain	1,693	833	789	13.6%	-44	-5%	-904	-53%	T2	PS, NS, AS	PS, C
Sweden	1,786	1,896	1,881	32.6%	-15	-1%	95	5%	T1, T2, T3	PS	CS
United Kingdom	IE	IE	IE	-	-	-	-	-	IE	IE	IE
EU-15	**9,641**	**5,879**	**5,778**	**100.0%**	**-101**	**-2%**	**-3,863**	**-40%**			

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

Figure 3.40 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by Finland, France, Italy, Spain and Sweden; together they cause 83% of the CO_2 emissions from liquid fuels in 1A2d. Fuel consumption in the EU-15 decreased by 39 % between 1990 and 2006. The implied emission factor of EU-15 was 75.3 t/TJ in 2006.

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 2006 CO_2 from solid fuels had a share of 5 % within source category 1A2d (compared to 14 % in 1990). Between 1990 and 2006 the emissions decreased by 59 % (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

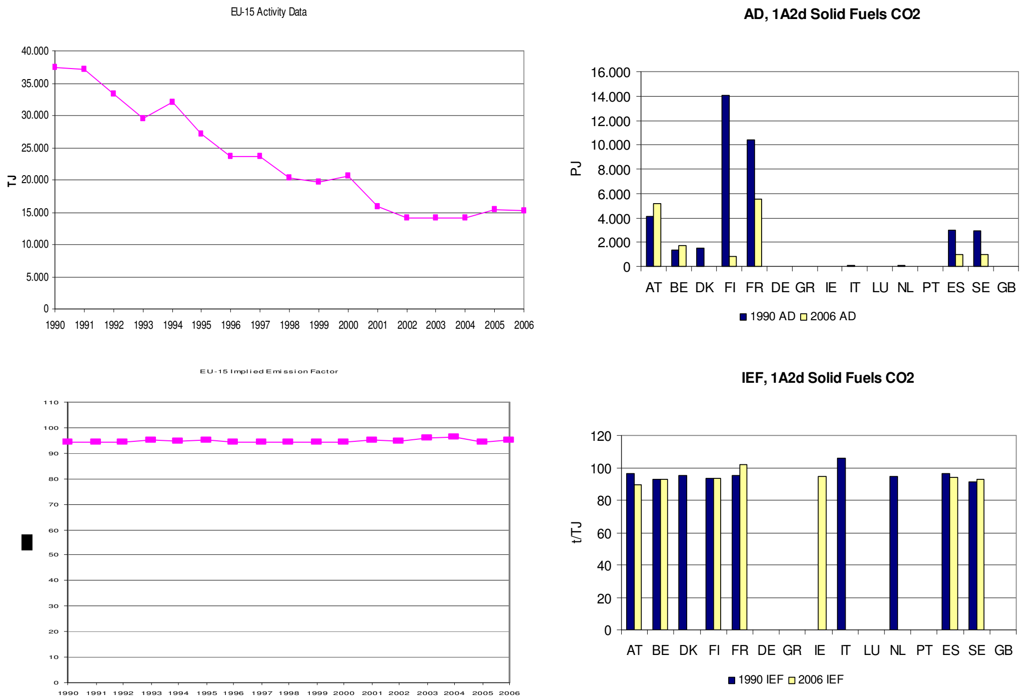
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006	
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	397	438	466	32.1%	28	6%	68	17%
Belgium	125	131	158	10.9%	27	20%	33	26%
Denmark	143	NO	NO	-	-	-	-143	-100%
Finland	1,318	62	80	5.5%	18	28%	-1,238	-94%
France	990	612	565	39.0%	-48	-8%	-425	-43%
Germany	IE	IE	IE	-	-	-	-	-
Greece	NO	NO	NO	-	-	-	-	-
Ireland	NO	2	1	0.1%	-	-	1	-
Italy	6	NO	NO	-	-	-	-6	-100%
Luxembourg	NO	NO	NO	-	-	-	-	-
Netherlands	8	NO	NO	-	-	-	-8	-100%
Portugal	NO	NO	NO	-	-	-	-	-
Spain	286	103	88	6.1%	-14	-14%	-198	-69%
Sweden	263	100	92	6.3%	-8	-8%	-171	-65%
United Kingdom	IE	IE	IE	-	-	-	-	-
EU-15	**3,536**	**1,447**	**1,450**	**100.0%**	**3**	**0%**	**-2,086**	**-59%**

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

Figure 3.41 shows activity data and implied emission factors for CO_2 for EU-15 and the Member

States. The largest emissions are reported by Austria 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 59 % between 1990 and 2006. The implied emission factor of EU-15 was 95.2 t/TJ in 2006.

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 2006, CO_2 from gaseous fuels had a share of 67 % within source category 1A2d (compared to 42 % in 1990). Between 1990 and 2006 the emissions increased by 74 % (Table 3.35). In all EU-15 Member States emissions increased between 1990 and 2006 except in Finland and the Netherlands. Germany and the United Kingdom include emissions in 1A2f.

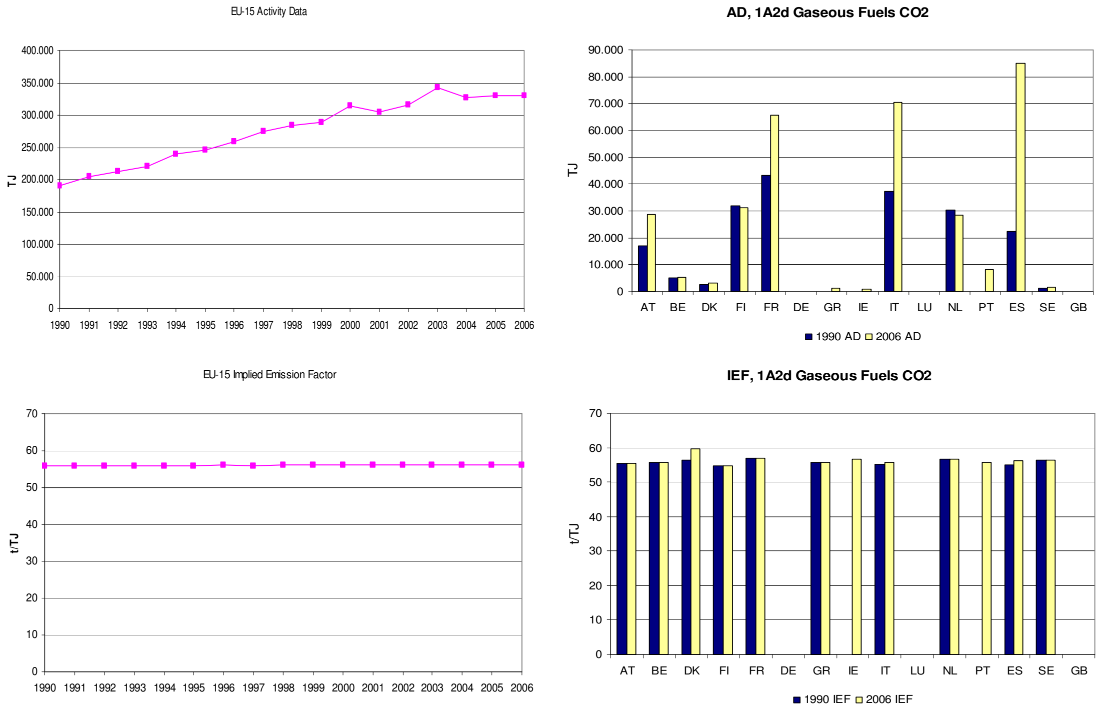
Table 3.35 1A2d Pulp, Paper and Print, gaseous fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	943	1,694	1,587	8.6%	-107	-6%	645	68%	T2	NS, PS	CS
Belgium	280	297	305	1.6%	8	3%	25	9%	T1	PS/RS	D
Denmark	134	190	191	1.0%	0	0%	56	42%	C	NS	CS/C
Finland	1,748	1,633	1,707	9.2%	74	5%	-41	-2%	T3	PS	CS, PS
France	2,461	3,473	3,749	20.2%	275	8%	1,288	52%	C	NS/ PS	CS
Germany	IE	IE	IE	-	-	-	-	-	T2	NS	CS
Greece	5	62	77	0.4%	15	25%	72	1516%	T2	NS	PS
Ireland	NO	59	54	0.3%	-5	-	54	-	T1	NS	CS
Italy	2,055	3,959	3,917	21.1%	-41	-1%	1,862	91%	T2	NS	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Netherlands	1,715	1,688	1,613	8.7%	-75	-4%	-102	-6%	T2	NS	CS
Portugal	NO	416	467	2.5%	50	12%	467	-	T2	PS,NS	D,C
Spain	1,233	4,958	4,763	25.7%	-195	-4%	3,530	286%	T2	PS, NS, AS	CS
Sweden	66	92	96	0.5%	5	5%	31	46%	T1, T2, T3	PS	CS
United Kingdom	IE	IE	IE	-	-	-	-	-	IE	IE	IE
EU-15	**10,640**	**18,522**	**18,526**	**100.0%**	**4**	**0%**	**7,886**	**74%**			

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

Figure 3.42 shows activity data and implied emission factors for CO_2 comparing the EU-15 average and the Member States. The largest emissions are reported by France, Italy and Spain; together they cause around 67 % of the CO_2 emissions from gaseous fuels in 1A2d. Fuel consumption in the EU-15 rose by 73 % between 1990 and 2006. The implied emission factor of EU-15 was 56.1 t/TJ in 2006.

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

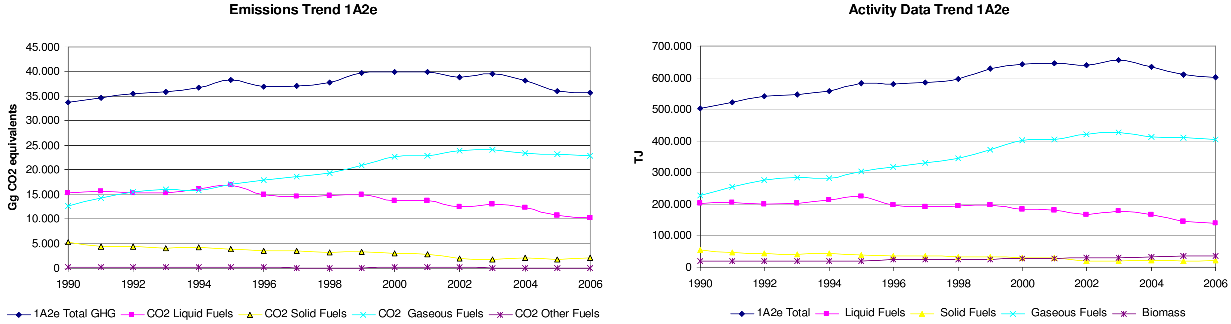


3.2.2.5. Food Processing, Beverages and Tobacco (1A2e) (EU-15)

In this chapter information about emission trends, Member States contribution, activity data and emission factors is provided for category 1A2e by fuels. CO_2 emissions from 1A2e Food Processing, Beverages and Tobacco account for 6.5% of 1A2 source category and for 0.9 % of total GHG emissions in 2006.

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 6 %, mainly due to increases in emissions from gaseous fuels (+79 %), 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 2006, CO_2 emissions from 1A2e Food Processing, Beverages and Tobacco increased by 6 % in the EU-15 (Table 3.36), mainly due to increases in France, Italy and Spain. Between 2005 and 2006 emissions decreased by 1 %.

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 2006	Change 2005-2006		Change 1990-2006	
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	870	831	842	2.4%	11	1%	-28	-3%
Belgium	2,998	2,209	2,044	5.8%	-166	-7%	-954	-32%
Denmark	1,534	1,215	1,220	3.5%	4	0%	-314	-20%
Finland	815	205	193	0.5%	-12	-6%	-622	-76%
France	10,156	11,199	11,570	32.7%	371	3%	1,414	14%
Germany	1,989	146	636	1.8%	490	336%	-1,353	-68%
Greece	902	766	858	2.4%	92	12%	-44	-5%
Ireland	1,018	1,096	1,140	3.2%	44	4%	122	12%
Italy	3,853	6,485	5,732	16.2%	-753	-12%	1,879	49%
Luxembourg	NO	NO	NO	-	-	-	-	-
Netherlands	4,079	3,918	3,769	10.7%	-148	-4%	-310	-8%
Portugal	822	776	879	2.5%	103	13%	58	7%
Spain	3,376	6,145	5,814	16.5%	-331	-5%	2,438	72%
Sweden	949	612	638	1.8%	27	4%	-310	-33%
United Kingdom	IE	IE	IE	-	-	-	-	-
EU-15	**33,361**	**35,603**	**35,335**	**100.0%**	**-268**	**-1%**	**1,974**	**6%**

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 2006 CO_2 from liquid fuels decreased to a share of 29 % within source category 1A2e (compared to 45 % in 1990). Between 1990 and 2006 the emissions decreased by 33 % (Table 3.37). Between 1990 and 2006 all Parties show emission reductions except Italy.

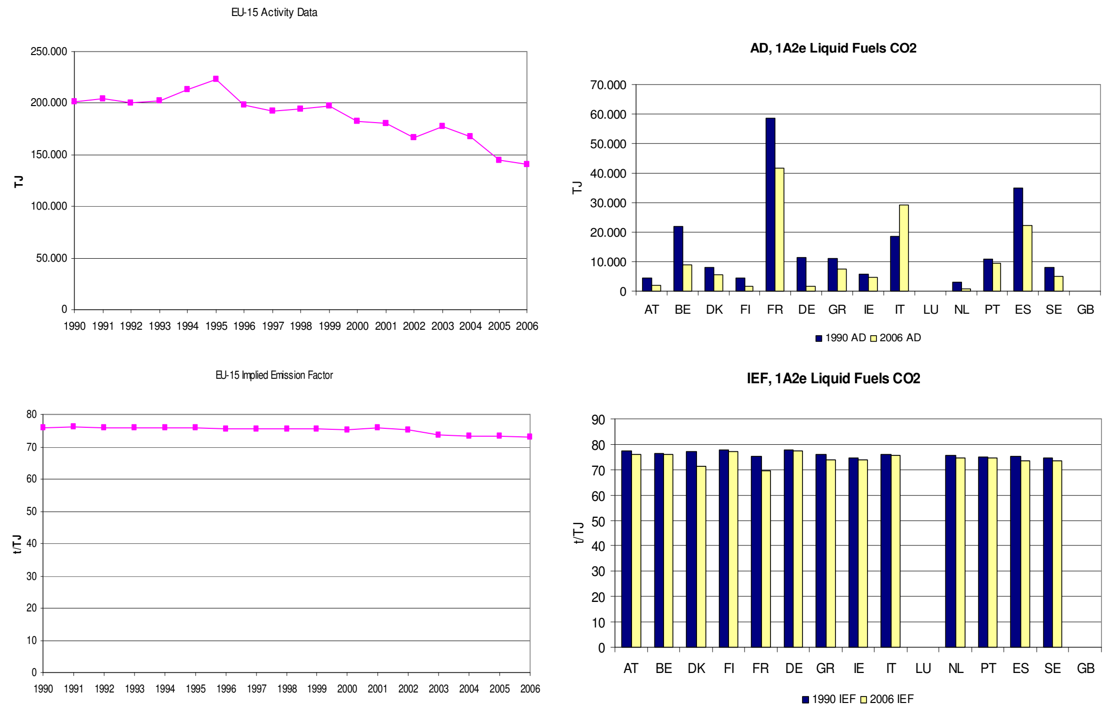
Table 3.37 1A2e Food Processing, Beverages and Tobacco, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	345	138	145	1.4%	7	5%	-200	-58%	T2	NS, PS	CS, PS
Belgium	1,671	668	669	6.5%	0	0%	-1,003	-60%	T1	PS/RS	D
Denmark	613	385	387	3.8%	2	0%	-227	-37%	C	NS	CS/C
Finland	353	127	124	1.2%	-3	-2%	-228	-65%	T3	PS	CS, PS
France	4,427	3,099	2,901	28.2%	-198	-6%	-1,526	-34%	C	NS/ PS	CS
Germany	889	69	128	1.2%	58	84%	-761	-86%	CS	NS	CS
Greece	847	490	564	5.5%	74	15%	-282	-33%	T2	NS	PS
Ireland	433	400	352	3.4%	-48	-12%	-81	-19%	T1	NS	CS
Italy	1,421	2,261	2,215	21.6%	-47	-2%	794	56%	T2	NS	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Netherlands	235	50	67	0.7%	17	33%	-168	-72%	T2	NS	CS
Portugal	820	636	706	6.9%	70	11%	-114	-14%	T2	NS	D,C
Spain	2,636	1,941	1,640	16.0%	-300	-15%	-996	-38%	T2	NS	C
Sweden	597	396	374	3.6%	-22	-6%	-223	-37%	T1, T2, T3	PS	CS
United Kingdom	IE	IE	IE	-	-	-	-	-	IE	IE	IE
EU-15	**15,288**	**10,662**	**10,272**	**100.0%**	**-390**	**-4%**	**-5,015**	**-33%**			

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 30 % between 1990 and 2006. The implied emission factor of EU-15 was 73.1 t/TJ in 2006.

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 2006 solid fuels had a share of 6 % within source category 1A2e (compared to 15 % in 1990). Between 1990 and 2006 the emissions decreased by 58 % (Table 3.38) and all Member States reported decreasing CO_2 emissions from this source category.

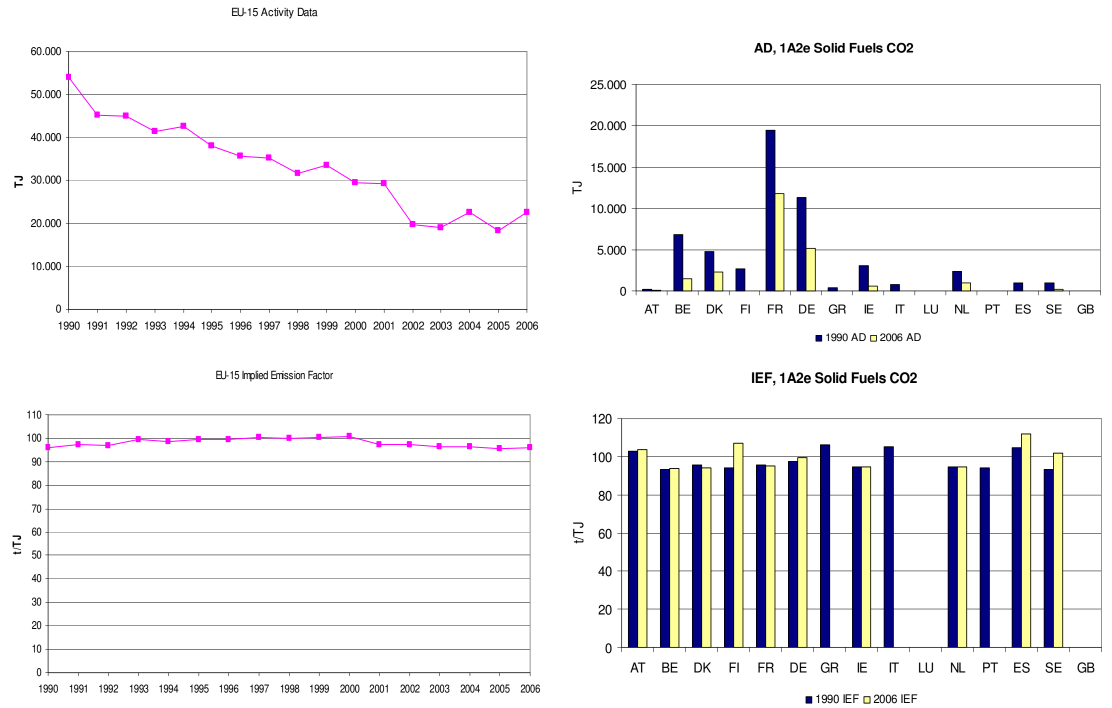
Table 3.38 1A2e Food Processing, Beverages and Tobacco, solid fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	18	13	11	0.5%	-3	-21%	-8	-42%	T2	NS, PS	CS, PS
Belgium	638	132	135	6.2%	3	2%	-503	-79%	T1	PS/RS	D
Denmark	455	215	217	10.0%	2	1%	-238	-52%	C	NS	CS/C
Finland	257	7	5	0.2%	-1	-22%	-252	-98%	T3	PS	CS, PS
France	1,868	1,152	1,125	51.9%	-27	-2%	-743	-40%	C	NS/ PS	CS
Germany	1,100	76	508	23.4%	432	566%	-592	-54%	CS	NS	CS
Greece	47	NO	NO	-	-	-	-47	-100%	0.0	0.0	0.0
Ireland	292	87	52	2.4%	-36	-	-240	-82%	T1	NS	CS
Italy	86	NO	NO	-	-	-	-86	-100%	T2	NS	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Netherlands	227	55	91	4.2%	36	65%	-136	-60%	T2	NS	CS
Portugal	1	NO	NO	-	-	-	-1	-100%	T2	NS	D,C
Spain	109	0	1	0.1%	1	291%	-107	-99%	T2	NS	C
Sweden	90	11	24	1.1%	13	125%	-66	-73%	T1, T2, T3	PS	CS
United Kingdom	IE	IE	IE	-	-	-	-	-	IE	IE	IE
EU-15	**5,186**	**1,749**	**2,169**	**100.0%**	**420**	**24%**	**-3,017**	**-58%**			

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 75 % of the CO_2 emissions from solid fuels in 1A2e. Fuel consumption in the EU-15 decreased by 58 % between 1990 and 2006. The implied emission factor of EU-15 was 96.0 t/TJ in 2006.

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 2006 CO_2 from gaseous fuels had a share of 64 % within source category 1A2e (compared to 38 % in 1990). Between 1990 and 2006 the emissions increased by 79 % (Table 3.39). Between 1990 and 2006 all Member States except Belgium, Finland and Sweden reported increasing CO_2 emissions from this source category. Major absolute increases ocurred in Spain, Italy and France. Germany reports emissions for the years 1995 to 2001 only.

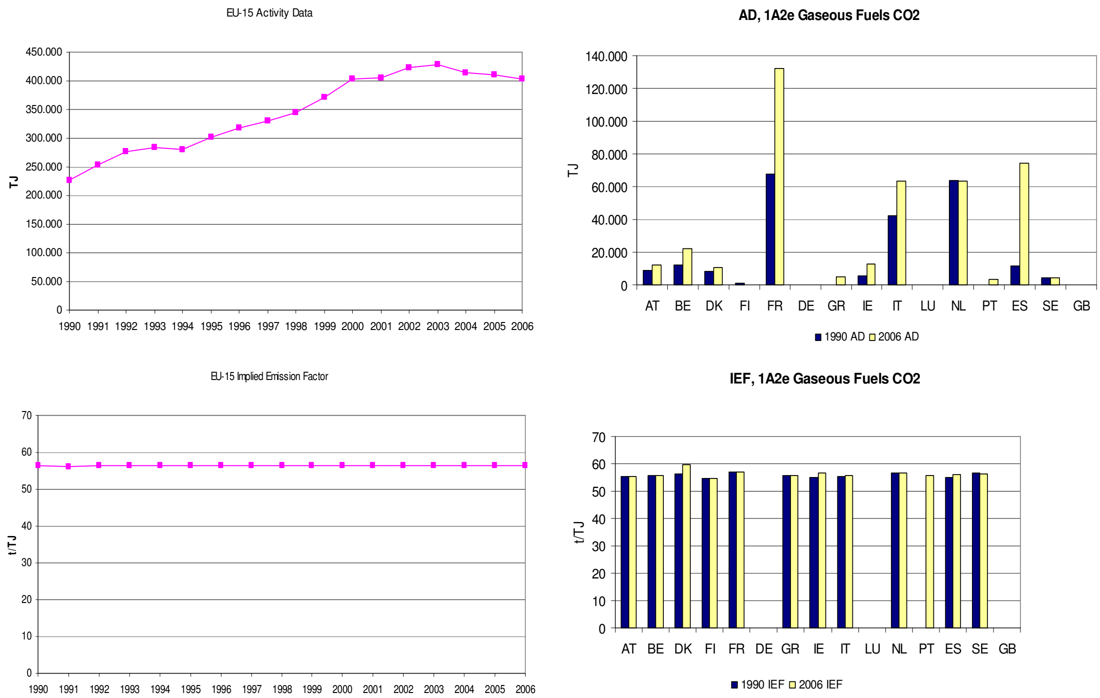
Table 3.39 1A2e Food Processing, Beverages and Tobacco, gaseous fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	507	680	687	3.0%	6	1%	180	36%	T2	NS, PS	CS
Belgium	681	1,409	1,240	5.4%	-169	-12%	559	82%	T1	PS/RS	D
Denmark	466	615	616	2.7%	1	0%	150	32%	C	NS	CS/C
Finland	67	19	12	0.1%	-6	-34%	-55	-82%	T3	PS	CS, PS
France	3,861	6,948	7,544	33.0%	596	9%	3,683	95%	C	NS/ PS	CS
Germany	NE	NE	NE	-	-	-	-	-	CS	NS	CS
Greece	9	276	294	1.3%	18	6%	285	3166%	T2	NS	PS
Ireland	293	609	736	3.2%	128	21%	443	151%	T1	NS	CS
Italy	2,346	4,223	3,517	15.4%	-706	-17%	1,171	50%	T2	NS	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Netherlands	3,617	3,812	3,611	15.8%	-201	-5%	-6	0%	T2	NS	CS
Portugal	NO	140	173	0.8%	32	23%	173	-	T2	NS	D,C
Spain	631	4,204	4,173	18.3%	-31	-1%	3,542	561%	T2	NS	CS
Sweden	253	198	240	1.0%	42	21%	-14	-5%	T1, T2, T3	PS	CS
United Kingdom	IE	IE	IE	-	-	-	-	-	IE	IE	IE
EU-15	**12,732**	**23,133**	**22,842**	**100.0%**	**-291**	**-1%**	**10,111**	**79%**			

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 83 % of the CO_2 emissions from gaseous fuels in 1A2e. Fuel consumption in the EU-15 rose by 79 % between 1990 and 2006. The implied emission factor of EU-15 was 56.5 t/TJ in 2006.

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

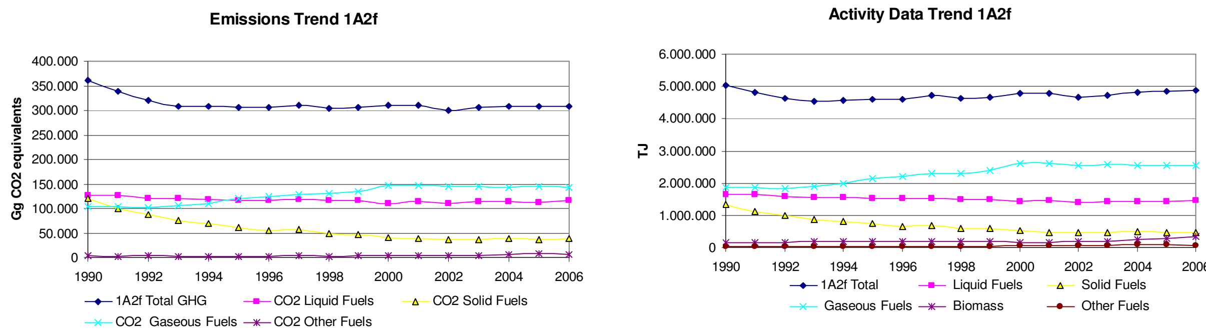


3.2.2.6. Other (1A2f) (EU-15)

In this chapter information about emission trends, Member States contribution, activity data and emission factors is provided for category 1A2f by fuels. CO_2 emissions from 1A2f Other account for 55.4 % for 1A2 source category and for 7.3 % of total GHG emissions in 2006.

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 (-69 %) and liquid (-9 %) fuels.

Figure 3.47 1A2f Other: Total and CO_2 emission trends



Between 1990 and 2006, CO_2 emissions from 1A2f Other decreased by 15 % in the EU-15 (Table 3.40), mainly due to decreases in Germany (-36 %) and the United Kingdom (-16%). Spanish emissions increased by 58 % in the same period.

Table 3.40 1A2f Other: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006	
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	4,404	4,539	4,677	1.5%	138	3%	273	6%
Belgium	8,069	7,275	7,192	2.4%	-83	-1%	-877	-11%
Denmark	2,709	3,147	3,162	1.0%	16	1%	453	17%
Finland	2,902	2,463	2,511	0.8%	49	2%	-391	-13%
France	31,819	26,047	26,184	8.7%	136	1%	-5,635	-18%
Germany	138,312	87,157	88,548	29.3%	1,391	2%	-49,764	-36%
Greece	6,126	4,347	5,659	1.9%	1,312	30%	-467	-8%
Ireland	1,541	2,747	2,828	0.9%	81	3%	1,287	84%
Italy	40,489	41,860	42,164	14.0%	303	1%	1,675	4%
Luxembourg	2,026	1,214	1,299	0.4%	85	7%	-727	-36%
Netherlands	5,820	5,067	4,842	1.6%	-226	-4%	-978	-17%
Portugal	5,488	6,559	6,022	2.0%	-536	-8%	534	10%
Spain	24,399	39,032	38,546	12.8%	-486	-1%	14,147	58%
Sweden	5,427	4,887	5,096	1.7%	209	4%	-330	-6%
United Kingdom	75,321	65,781	63,443	21.0%	-2,338	-4%	-11,878	-16%
EU-15	**354,852**	**302,123**	**302,174**	**100.0%**	**51**	**0%**	**-52,678**	**-15%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A2f Other - Liquid (CO_2)

In 2006 liquid fuels had a share of 38 % within source category 1A2f (compared to 35 % in 1990). Between 1990 and 2006 the emissions decreased by 9 % (Table 3.41). Between 1990 and 2006 the highest absolute decrease achieved Germany, the United Kingdom and France. The highest absolut increases are reported by Spain (+40 %) anfd Greece (+54 %).

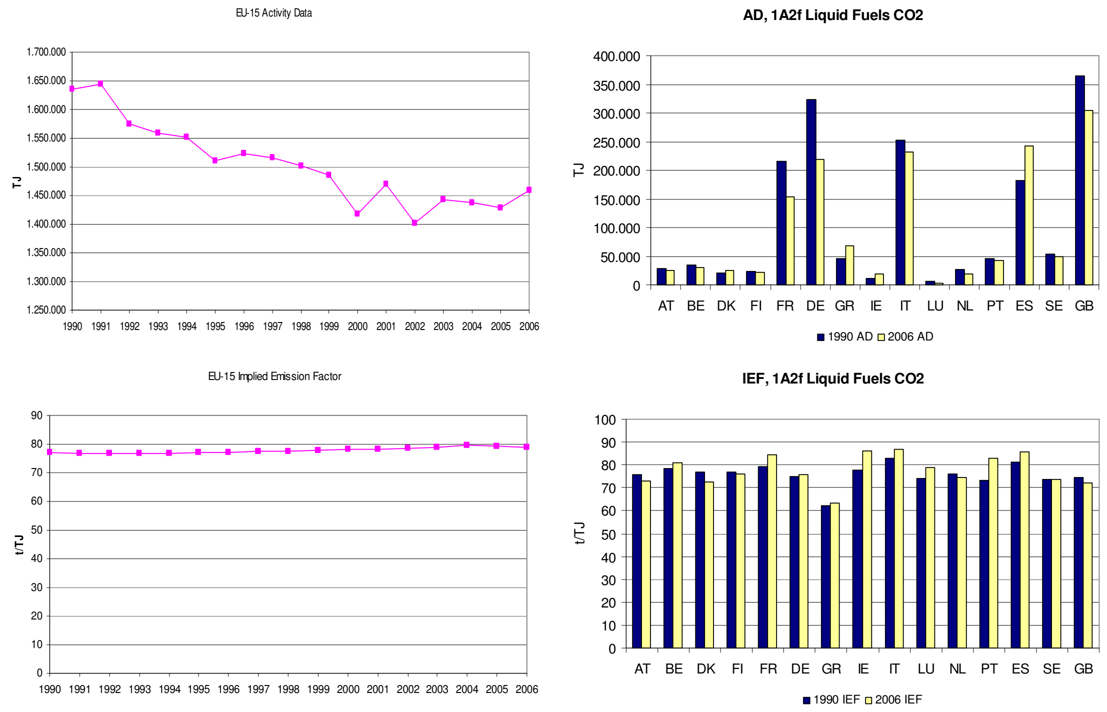
Table 3.41 1A2f Other, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	2,136	1,961	1,884	1.6%	-77	-4%	-252	-12%	T2	NS, PS	CS, PS
Belgium	2,698	2,626	2,508	2.2%	-118	-4%	-190	-7%	T1	PS/RS	D
Denmark	1,532	1,811	1,820	1.6%	9	0%	288	19%	C	NS	CS/C
Finland	1,808	1,644	1,662	1.4%	18	1%	-146	-8%	T3	PS	CS, PS
France	17,095	13,440	13,040	11.3%	-400	-3%	-4,055	-24%	C	NS/ PS	CS
Germany	24,307	14,900	16,635	14.4%	1,735	12%	-7,672	-32%	CS/ T2	NS	CS
Greece	2,828	3,008	4,359	3.8%	1,351	45%	1,531	54%	T2	NS	PS
Ireland	864	1,743	1,641	1.4%	-102	-6%	777	90%	T1	NS	CS
Italy	20,965	19,864	20,188	17.5%	324	2%	-777	-4%	T2	NS	CS
Luxembourg	442	273	241	0.2%	-32	-12%	-201	-45%	T1	PS	D
Netherlands	2,101	1,493	1,385	1.2%	-108	-7%	-716	-34%	T2	NS	CS
Portugal	3,368	3,982	3,581	3.1%	-401	-10%	213	6%	T2	NS	D,C
Spain	14,856	21,171	20,836	18.1%	-336	-2%	5,980	40%	T2, T3	PS, AS, NS, Q	CS, C
Sweden	4,019	3,503	3,656	3.2%	152	4%	-364	-9%	T1, T2, T3	PS	CS
United Kingdom	27,174	21,645	21,949	19.0%	304	1%	-5,226	-19%	T2	NS,AS	CS
EU-15	**126,193**	**113,064**	**115,383**	**100.0%**	**2,319**	**2%**	**-10,810**	**-9%**			

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 13 % between 1990 and 2006. The implied emission factor of EU-15 was 79.1 t/TJ in 2006. The low implied emission factor of Greece is because non-energy use is included in activity data.

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



1A2f Other - Solid (CO_2)

In 2006 CO_2 from solid fuels had a share of 12 % within source category 1A2f (compared to 33 % in 1990). Between 1990 and 2006 the emissions decreased by 69 % (Table 3.42). Between 1990 and 2006 all Member States except Ireland and Sweden reported a significant decrease of emissions where the most absolute decrease is reported by Germany (-74 %) and the United Kingdom (-62%). Between 2005 and 2006 EU-15 emissions slightly increased by 2 % .

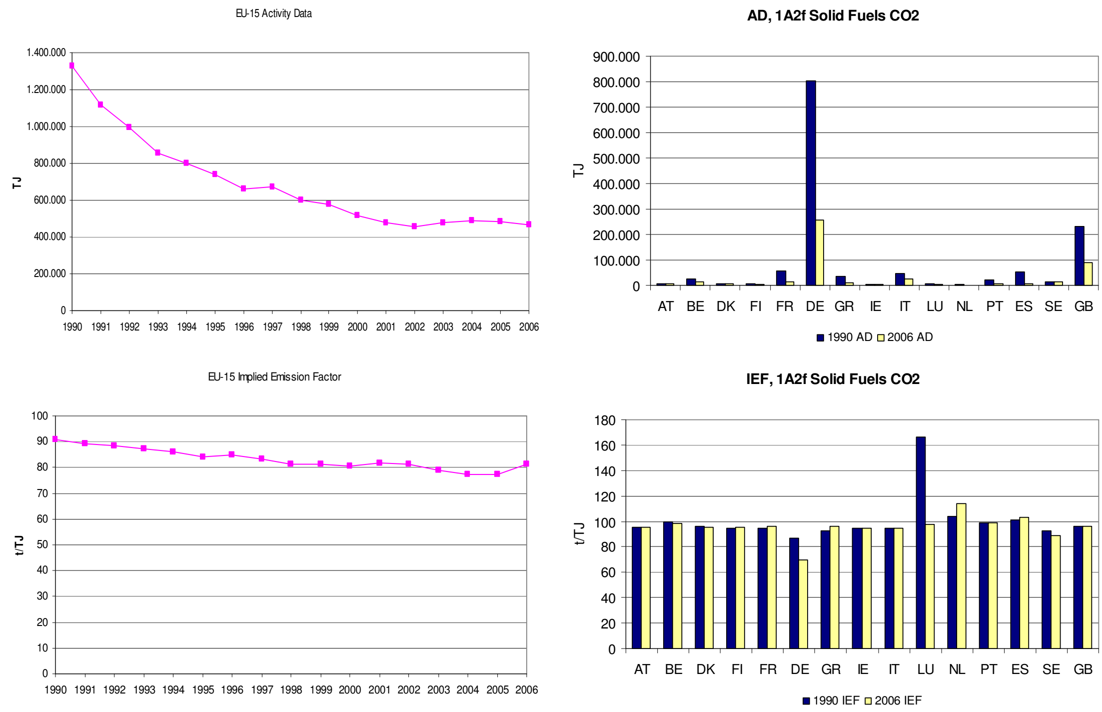
Table 3.42 1A2f Other, solid fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	625	374	551	1.5%	177	47%	-74	-12%	T2	NS, PS	CS, PS
Belgium	2,600	1,109	1,313	3.5%	204	18%	-1,288	-50%	T1	PS/RS	D
Denmark	822	605	611	1.6%	6	1%	-212	-26%	C	NS	CS/C
Finland	815	488	491	1.3%	3	1%	-324	-40%	T3	PS	CS, PS
France	5,409	1,379	1,532	4.0%	153	11%	-3,877	-72%	C	NS/ PS	CS
Germany	69,322	17,499	17,816	47.1%	318	2%	-51,506	-74%	CS/ T2	NS	CS
Greece	3,295	1,094	1,016	2.7%	-79	-7%	-2,279	-69%	T2	NS	PS
Ireland	389	582	473	1.3%	-109	-19%	85	22%	T1	NS	CS
Italy	4,233	2,416	2,474	6.5%	57	2%	-1,759	-42%	T2	NS	CS
Luxembourg	1,272	306	296	0.8%	-11	-4%	-976	-77%	T1	PS	D
Netherlands	388	172	166	0.4%	-5	-3%	-221	-57%	T2	NS	CS
Portugal	2,103	539	539	1.4%	0	0%	-1,565	-74%	T2	NS	D,C
Spain	5,497	513	770	2.0%	257	50%	-4,727	-86%	T2	PS, AS, NS, Q	CS, C
Sweden	1,229	1,219	1,272	3.4%	53	4%	42	3%	T1, T2, T3	PS	CS
United Kingdom	22,312	8,812	8,545	22.6%	-267	-3%	-13,767	-62%	T2	NS,AS	CS
EU-15	**120,311**	**37,107**	**37,864**	**100.0%**	**756**	**2%**	**-82,448**	**-69%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.49 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are still reported by Germany and the United Kingdom; together they cause about 70 % of the CO_2 emissions from solid fuels in 1A2f. Fuel consumption in the EU-15 decreased by 65 % between 1990 and 2006. The implied emission factor of EU-15 was 81.3 t/TJ in 2006. The high implied emission factor in 1990 of Luxembourg is because blast furnace gas is included in this activity.

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



1A2f Other - Gaseous (CO_2)

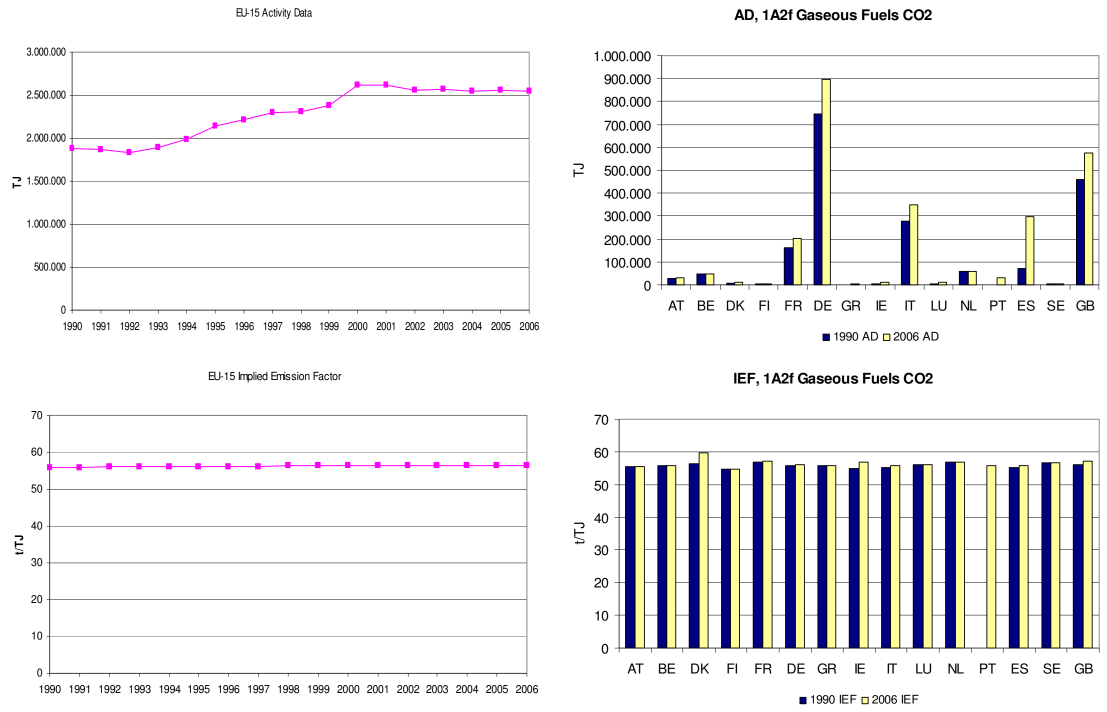
In 2006 CO_2 from gaseous fuels had a share of 47 % within source category 1A2f (compared to 29 % in 1990). Between 1990 and 2006 the emissions increased by 36 % (Table 3.43). Between 1990 and 2006, all Member States show increasing emissions except Sweden and the Netherlands. The United Kingdom, Spain, Italy 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 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	1,573	1,834	1,840	1.3%	6	0%	268	17%	T2	NS, PS	CS
Belgium	2,559	2,963	2,746	1.9%	-217	-7%	188	7%	T1	PS/RS	D
Denmark	354	661	662	0.5%	1	0%	307	87%	C	NS	CS/C
Finland	171	201	200	0.1%	-1	0%	30	17%	T3	PS	CS, PS
France	9,314	11,227	11,611	8.1%	384	3%	2,296	25%	C	NS/ PS	CS
Germany	41,787	48,685	50,241	35.1%	1,556	3%	8,454	20%	CS/ T2	NS	CS
Greece	4	245	285	0.2%	40	16%	281	7174%	T2	NS	PS
Ireland	288	422	714	0.5%	291	69%	425	148%	T1	NS	CS
Italy	15,290	19,581	19,502	13.6%	-79	0%	4,212	28%	T2	NS	CS
Luxembourg	313	634	762	0.5%	128	20%	450	144%	T1	PS	D
Netherlands	3,331	3,403	3,290	2.3%	-112	-3%	-40	-1%	T2	NS	CS
Portugal	NO	2,012	1,877	1.3%	-135	-7%	1,877	-	T2	NS	D,C
Spain	4,046	17,001	16,577	11.6%	-424	-2%	12,531	310%	T2	PS, AS, NS, Q	CS
Sweden	178	145	169	0.1%	24	16%	-9	-5%	T1, T2, T3	PS	CS
United Kingdom	25,833	35,142	32,744	22.9%	-2,398	-7%	6,911	27%	T2	NS,AS	CS
EU-15	**105,041**	**144,157**	**143,221**	**100.0%**	**-936**	**-1%**	**38,180**	**36%**			

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 83 % of the CO_2 emissions from gaseous fuels in 1A2f. Fuel combustion in the EU-15 rose by 35 % between 1990 and 2006. The implied emission factor of EU-15 was 56.3 t/TJ in 2006.

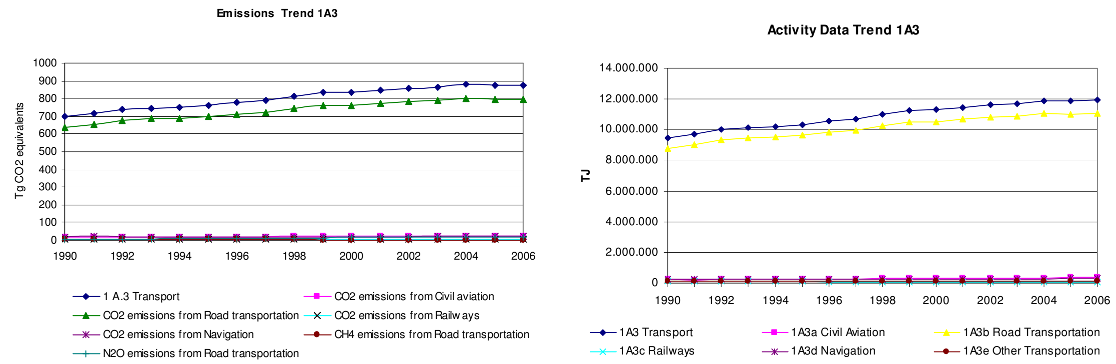
Figure 3.50 1A2f Other, gaseous fuels: Activity Data and Implied Emission Factors for CO_2



3.2.3. Transport (CRF Source Category 1A3) (EU-15)

Greenhouse gas emissions from 1A3 Transport are shown in Figure 3.51. CO_2 emissions from this source category account for 21 %, CH_4 for 0.04 %, N_2O for 0.4 % of total GHG emissions. Between 1990 and 2006, 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 2006 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO_2 emissions in 2006 (Gg)	N_2O emissions in 1990 (Gg CO_2 equivalents)	N_2O emissions in 2006 (Gg CO_2 equivalents)
Austria	12,669	23,119	12,426	22,808	179	288
Belgium	20,596	26,102	20,092	25,222	387	824
Denmark	10,700	13,583	10,528	13,417	116	137
Finland	12,824	14,358	12,551	13,680	174	631
France	118,817	138,604	117,953	137,763	498	721
Germany	164,418	162,011	162,458	160,642	674	1,207
Greece	14,656	24,126	14,375	23,352	167	586
Ireland	5,168	13,719	5,039	13,483	83	208
Italy	103,952	133,198	101,461	128,531	1,717	4,105
Luxembourg	2,779	7,288	2,720	6,997	40	270
Netherlands	26,439	36,147	26,009	35,644	272	453
Portugal	10,052	20,137	9,828	19,494	152	590
Spain	57,530	108,619	56,506	105,592	783	2,849
Sweden	18,439	20,191	18,174	19,969	160	187
United Kingdom	118,889	136,715	116,967	130,989	1,300	5,566
EU-15	**697,930**	**877,915**	**687,086**	**857,583**	**6,703**	**18,623**

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 2005 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 2005 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2005		Main explanations
	Gg	Percent	Gg	Percent	
Austria	25	0,2	-15	-0,1	
Belgium	144	0,7	150	0,6	Changed methodology to calculate emissions from air transport and the transport between North Sea ports
Denmark	184	1,8	-9	-0,1	The gasoline fuel consumption (and hence CO_2 emissions) generally increases, due to a reduced gasoline consumption calculated for non road working machinery in the same years. This latter fuel amount is being subtracted from the road transport sales of gasoline reported by the Danish energy authorities, prior to NERI road transport model input; National sea transport and fisheries: new activity data based on new research findings
Finland	0	0,0	-1	0,0	
France	-242	-0,2	-903	-0,6	Improved methodology for civil aviation; modification du PARC; revised methodology for fuels from agriculture
Germany	-29	0,0	-124	-0,1	1990: emission factor adapted to value in 2000+; 2005: 1A3b: CO2-Emissions from Biomass now reported separatly; 1A3c: new activity data available
Greece	-980	-6,4	-60	-0,3	Reallocation_LPG & lubricans reported separately
Ireland	-6	-0,1	-145	-1,1	New model for road transport. COPERT 4 version 4.0
Italy	0	0,0	68	0,1	Update of emission factor for natural gas; update of activity data for gasoline consumed in leisure boats
Luxembourg	-5	-0,2	-1	0,0	
Netherlands	0	0,0	-11	0,0	
Portugal	0	0,0	-64	-0,3	Top-down calibration with fuel balance affecting international emissions from aviation and navigation; correction of the H/C ratio for Natural Gas used in road transport
Spain	-6	0,0	225	0,2	The CO2 EFs for Landing and Taking Off cycles (LTO) have been modified after detection of an error in the conversion of the original data (expressed by mass of fuel consumed) to the processed data (expressed by LTO). The EFs by LTO have been individually estimated for each airport. General revision of the 2005 energy balance as its version in the previous emission inventory was a provisional one.
Sweden	0	0,0	2	0,0	
UK	126	0,1	26	0,0	Emissions estimates have been included for pipeline compressors (these emissions had been omitted in the previous inventory edition as the corresponding emission factors had not been input to the database)
EU-15	**-787**	**-0,1**	**-862**	**-0,1**	

Table 3.46 provides information on the contribution of Member States to EU-15 recalculations in N_2O from 1A3 Transport for 1990 and 2005.

Table 3.46 1A3 Transport: Contribution of MS to EU-15 recalculations in N_2O for 1990 and 2005 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

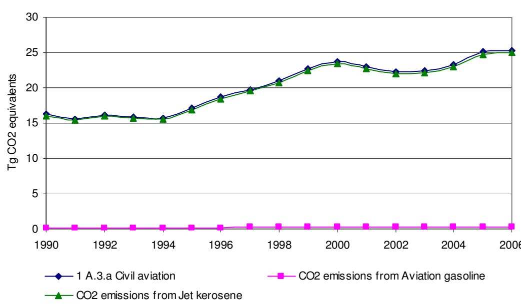
	1990		2005		Main explanations
	Gg	Percent	Gg	Percent	
Austria	-84	-32,0	37	13,5	Updated emission factors according to the EU project ARTEMIS; updated statistical energy data
Belgium	35	9,8	-13	-1,6	CopertIII methodology was used to calculate emissions from 1A3b
Denmark	-22	-16,2	-305	-68,8	Some CH_4 and N_2O emission changes occur from 1985-2005, due to updates of the CH_4 and N_2O hot start emission factors for passenger cars and vans in the NERI model. In addition a new cold start calculation module has been implemented in the model. The NERI model changes are based on the updated COPERT IV methodology and emission data.
Finland	0	0,0	0	0,0	
France	-1.153	-69,8	-3.710	-83,7	Changed EF; improved methodology for civil aviation; modification du PARC; revised methodology for fuels from agriculture
Germany	0	0,0	-32	-2,4	1A3c: new activity data available
Greece	-9	-4,9	0	0,0	
Ireland	-18	-17,6	-263	-55,5	New model for road transport. COPERT 4 version 4.0
Italy	0	0,0	2	0,1	
Luxembourg	-6	-13,5	6	2,3	
Netherlands	0	0,0	-29	-6,1	
Portugal	12	8,7	-37	-6,1	Top-down calibration with fuel balance affecting international emissions from aviation and navigation
Spain	0	0,0	9	0,3	
Sweden	0	0,0	0	0,0	
UK	22	1,7	11	0,2	
EU-15	**-1.224**	**-15,4**	**-4.324**	**-19,1**	

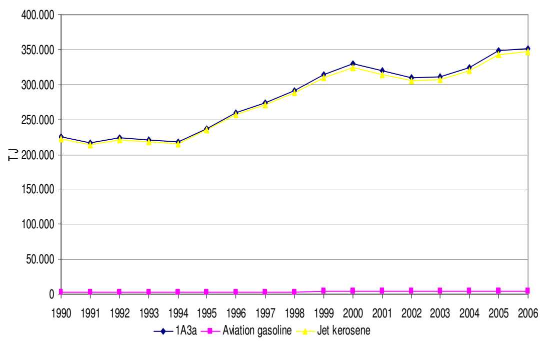
3.2.3.1. Civil Aviation (1A3a) (EU-15)

CO_2 emissions from 1A3a Civil Aviation account for 3 % of total transport-related GHG emissions in 2006. Between 1990 and 2006, CO_2 emissions from civil aviation increased by 56 % 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 2005 and 2006, CO_2 emissions from civil aviation increased by 1 % in the EU-15 (Table 3.47).

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 (68 %). Most Member States increased emissions from civil aviation between 1990 and 2006. The Member States with the highest increases in absolute terms were Germany, Italy, Spain and the UK. The countries with most reductions were Denmark and Finland (Table 3.47). Compared to last year's submission Greece revised the time series now showing an emissions increase between 1990 and 2006.

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 2006	Change 2005-2006		Change 1990-2006	
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	32	217	227	0.9%	10	5%	195	610%
Belgium	12	9	10	0.0%	1	17%	-2	-17%
Denmark	243	133	141	0.6%	8	6%	-101	-42%
Finland	385	329	325	1.3%	-4	-1%	-60	-16%
France	4,241	4,952	4,691	18.5%	-261	-5%	450	11%
Germany	2,869	5,072	5,290	20.9%	218	4%	2,421	84%
Greece	588	1,238	1,112	4.4%	-126	-10%	524	89%
Ireland	59	108	113	0.4%	6	5%	54	92%
Italy	1,597	2,652	2,772	10.9%	120	5%	1,175	74%
Luxembourg	0	1	1	-	-	-	-	-
Netherlands	41	41	41	0.2%	0	0%	0	0%
Portugal	165	416	436	1.7%	20	5%	271	164%
Spain	4,130	6,854	7,204	28.5%	350	5%	3,074	74%
Sweden	673	663	623	2.5%	-40	-6%	-50	-7%
United Kingdom	1,210	2,403	2,335	9.2%	-68	-3%	1,126	93%
EU-15	**16,244**	**25,087**	**25,321**	**100.0%**	**234**	**1%**	**9,077**	**56%**

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 56 % (Table 3.48). The largest absolute increase occurred in Spain, Germany and Italy. Between 2005 and 2006, the emissions increased by 1 %.

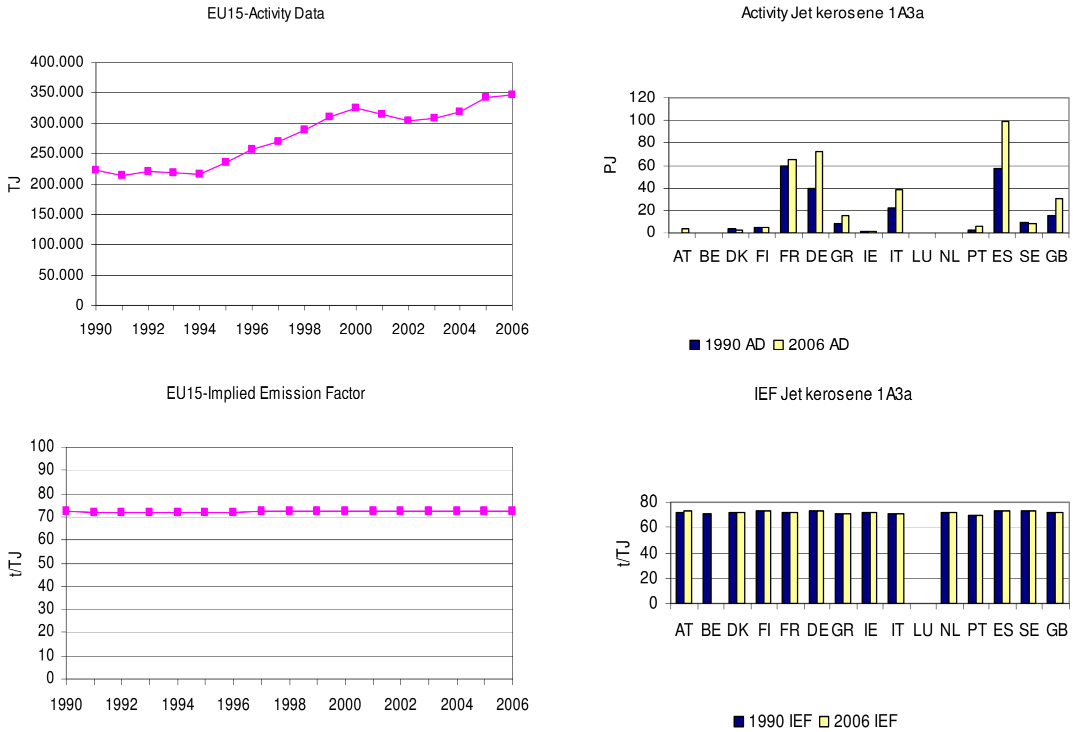
Table 3.48 1A3a Civil Aviation, jet kerosine: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	24	209	218	0.9%	10	5%	194	803%	T1	0.0	D
Belgium	5	0	0	-	-	-	-5	-100%	CS	RS	C
Denmark	234	126	134	0.5%	8	6%	-100	-43%	C	NS	C
Finland	377	326	321	1.3%	-5	-1%	-56	-15%	T2b	NS	CS
France	4,241	4,952	4,691	18.7%	-261	-5%	450	11%	M	NS	M
Germany	2,869	5,072	5,290	21.1%	218	4%	2,421	84%	T1	NS	CS
Greece	578	1,194	1,065	4.3%	-129	-11%	487	84%	T2	NS	D
Ireland	59	108	113	0.5%	6	5%	54	92%	T2	NS	CS
Italy	1,563	2,608	2,722	10.9%	114	4%	1,159	74%	T1, T2a	NS	CS
Luxembourg	NO	NO	NO	0.0%	-	-	-	-	NA	NO	NA
Netherlands	16	16	16	0.1%	0	0%	0	0%	T2	NS	CS
Portugal	164	412	432	1.7%	20	5%	268	164%	T2	NS,AS	D
Spain	4,130	6,854	7,204	28.8%	350	5%	3,074	74%	T2	NS	D
Sweden	668	660	621	2.5%	-39	-6%	-47	-7%	T1	NS	CS
United Kingdom	1,128	2,240	2,192	8.8%	-48	-2%	1,064	94%	T3	NS,AS	CS
EU-15	**16,056**	**24,778**	**25,020**	100.0%	242	1%	8,964	56%			

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 2006 (Figure 3.53). The IEF for the EU-15 is 72.24 t/TJ Jet kerosene in 2006.

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



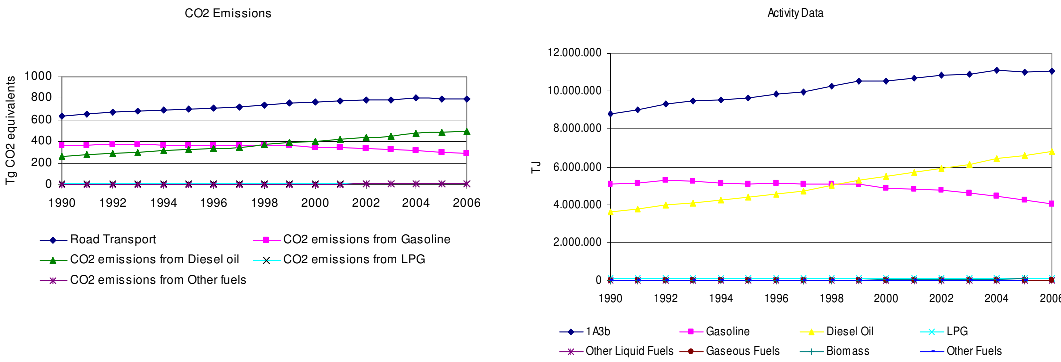
3.2.3.2. Road Transportation (1A3b) (EU-15)

CO_2 emissions from 1A3b Road Transportation

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 2006. Between 1990 and 2006, 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, excepting Germany (-1%), increased emissions from road transportation between 1990 and 2006. The Member States with the highest increases in absolute terms were Spain, Italy and France. The countries with the lowest increase in relative terms were Finland 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 2006	Change 2005-2006		Change 1990-2006	
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	11,943	23,051	21,932	2.8%	-1,118	-5%	9,989	84%
Belgium	19,270	24,928	24,441	3.1%	-487	-2%	5,171	27%
Denmark	9,275	12,229	12,594	1.6%	365	3%	3,319	36%
Finland	10,872	11,796	11,944	1.5%	148	1%	1,072	10%
France	110,738	129,476	129,105	16.2%	-372	0%	18,366	17%
Germany	150,358	152,231	148,882	18.7%	-3,349	-2%	-1,477	-1%
Greece	11,759	18,847	19,825	2.5%	978	5%	8,065	69%
Ireland	4,701	12,355	13,093	1.6%	737	6%	8,392	179%
Italy	93,616	117,009	118,271	14.9%	1,262	1%	24,655	26%
Luxembourg	2,686	7,153	6,969	0.9%	-184	-3%	4,283	159%
Netherlands	25,472	33,902	34,880	4.4%	978	3%	9,407	37%
Portugal	9,249	18,541	18,782	2.4%	241	1%	9,533	103%
Spain	50,442	92,666	95,140	12.0%	2,473	3%	44,697	89%
Sweden	16,629	18,506	18,523	2.3%	17	0%	1,895	11%
United Kingdom	109,686	120,128	120,528	15.2%	400	0%	10,841	10%
EU-15	**636,699**	**792,818**	**794,907**	**100.0%**	**2,089**	**0.3%**	**158,209**	**25%**

1A3b Road Transportation – Diesel Oil (CO_2)

CO_2 emissions from Diesel oil account for 63 % of CO_2 emissions from 1A3b Road Transport in 2006 (Figure 3.54). All Member States increased emissions from Diesel oil between 1990 and 2006 (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.

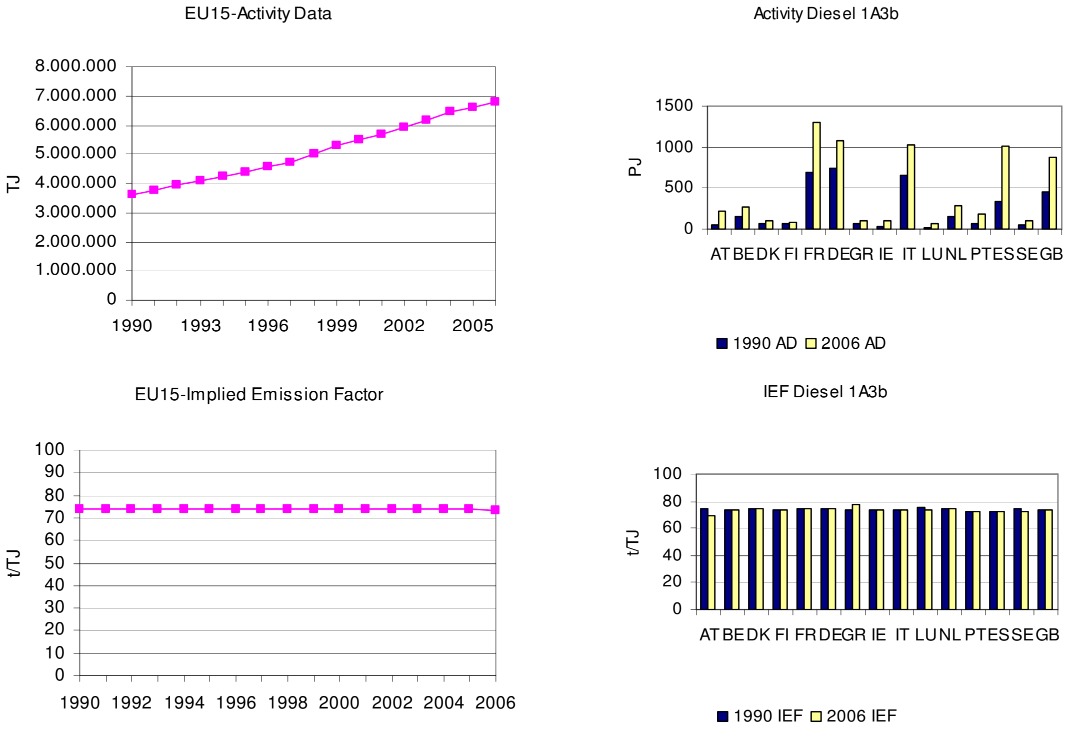
Table 3.50 1A3b Road Transport, diesel oil: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	4,013	16,658	15,788	3.2%	-870	-5%	11,775	293%	T1	NS	D
Belgium	10,892	19,396	19,769	4.0%	373	2%	8,877	81%	Copert3/D	NS/RS	C
Denmark	4,436	6,547	7,046	1.4%	498	8%	2,609	59%	COPERT3	NS	C
Finland	4,956	6,338	6,545	1.3%	208	3%	1,589	32%	T3	NS	CS
France	52,077	93,996	96,231	19.3%	2,236	2%	44,155	85%	M	NS	M
Germany	54,458	79,447	80,162	16.0%	715	1%	25,704	47%	T3	NS	CS
Greece	4,326	7,074	7,376	1.5%	302	4%	3,050	71%	COPERT III	NS	COPERT III
Ireland	1,922	7,021	7,576	1.5%	555	8%	5,654	294%	T1	NS	CS
Italy	48,020	71,695	75,513	15.1%	3,818	5%	27,493	57%	COPERT 3	NS, AS	CS
Luxembourg	1,378	5,627	5,565	1.1%	-62	-1%	4,186	304%	COPERT III	NS	D
Netherlands	11,832	19,863	20,696	4.1%	833	4%	8,863	75%	T2	NS	CS
Portugal	4,947	12,854	13,473	2.7%	620	5%	8,527	172%	T2	NS	C
Spain	24,436	69,416	72,962	14.6%	3,545	5%	48,526	199%	COPERT III	NS	C
Sweden	4,204	6,957	7,289	1.5%	332	5%	3,085	73%	T1	NS	CS
United Kingdom	33,717	61,471	63,718	12.8%	2,246	4%	30,001	89%	T3	NS,AS	CS
EU-15	**265,613**	**484,359**	**499,709**	**100.0%**	**15,349**	**3.2%**	**234,095**	**88%**			

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 2006 (Figure 3.55). The IEF for the EU-15 is 73.45 t/TJ Diesel in 2006.

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 2006, CO_2 emissions from gasoline decreased by 21 % 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.

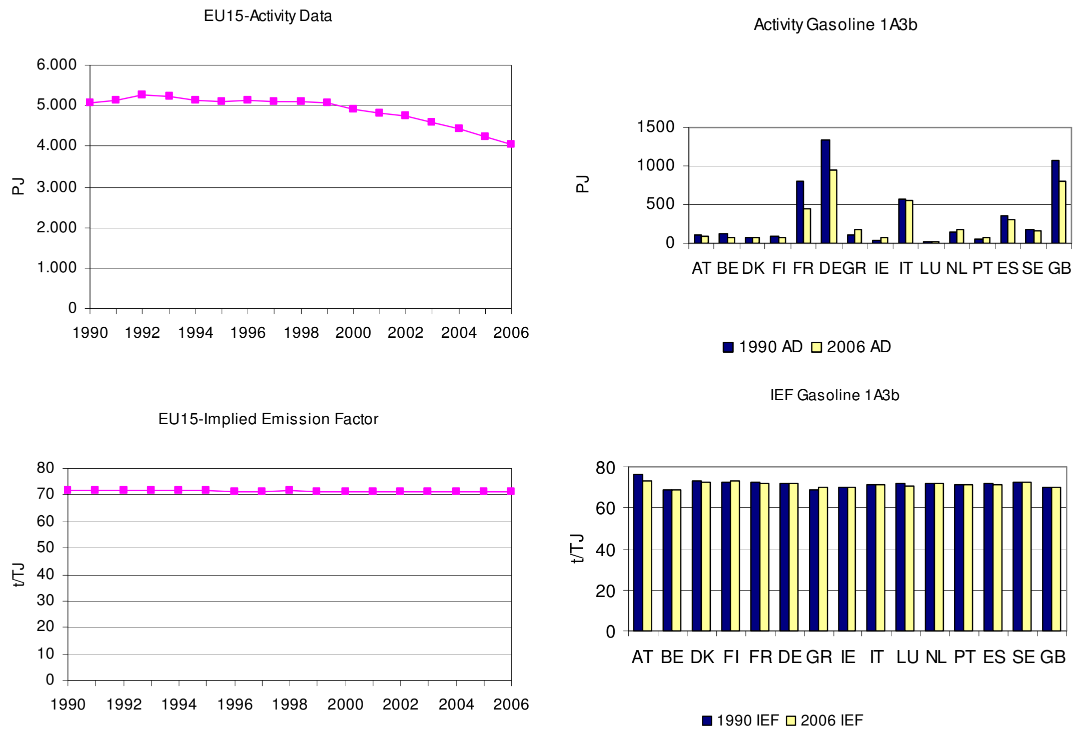
Table 3.51 1A3b Road Transport, gasoline: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	7,930	6,393	6,144	2.1%	-249	-4%	-1,786	-23%	T1	NS	D
Belgium	8,223	5,313	4,418	1.5%	-895	-17%	-3,806	-46%	Copert3/D	NS/RS	C
Denmark	4,838	5,682	5,549	1.9%	-133	-2%	711	15%	COPERT3	NS	C
Finland	5,916	5,452	5,390	1.9%	-62	-1%	-526	-9%	T3	NS	CS
France	58,478	34,972	32,397	11.2%	-2,575	-7%	-26,082	-45%	M	NS	M
Germany	95,794	72,602	68,536	23.8%	-4,066	-6%	-27,258	-28%	T3	NS	CS
Greece	7,294	11,670	12,341	4.3%	671	6%	5,047	69%	COPERT III	NS	COPERT III
Ireland	2,761	5,332	5,514	1.9%	182	3%	2,754	100%	T1	NS	CS
Italy	41,084	41,329	38,765	13.5%	-2,563	-6%	-2,319	-6%	COPERT 3	NS, AS	CS
Luxembourg	1,306	1,525	1,404	0.5%	-122	-8%	97	7%	COPERT III	NS	D
Netherlands	10,902	12,970	13,206	4.6%	236	2%	2,304	21%	T2	NS	CS
Portugal	4,303	5,601	5,219	1.8%	-382	-7%	916	21%	T2	NS	C
Spain	25,928	23,114	22,054	7.7%	-1,060	-5%	-3,874	-15%	COPERT III	NS	C
Sweden	12,422	11,499	11,178	3.9%	-321	-3%	-1,244	-10%	T1	NS	CS
United Kingdom	75,430	57,889	56,039	19.4%	-1,849	-3%	-19,391	-26%	T3	NS,AS	CS
EU-15	**362,612**	**301,342**	**288,155**	**100.0%**	**-13,188**	**-4%**	**-74,457**	**-21%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

France, Germany, Italy, Spain and the United Kingdom account for 75 % of activity data and CO_2 emissions (Figure 3.56). The IEF for the EU-15 is 71.3 t/TJ Gasoline in 2006.

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 2006, CO_2 emissions from LPG decreased by 28 % 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 2005 and 2006 emissions declined by 4 % (Table 3.52).

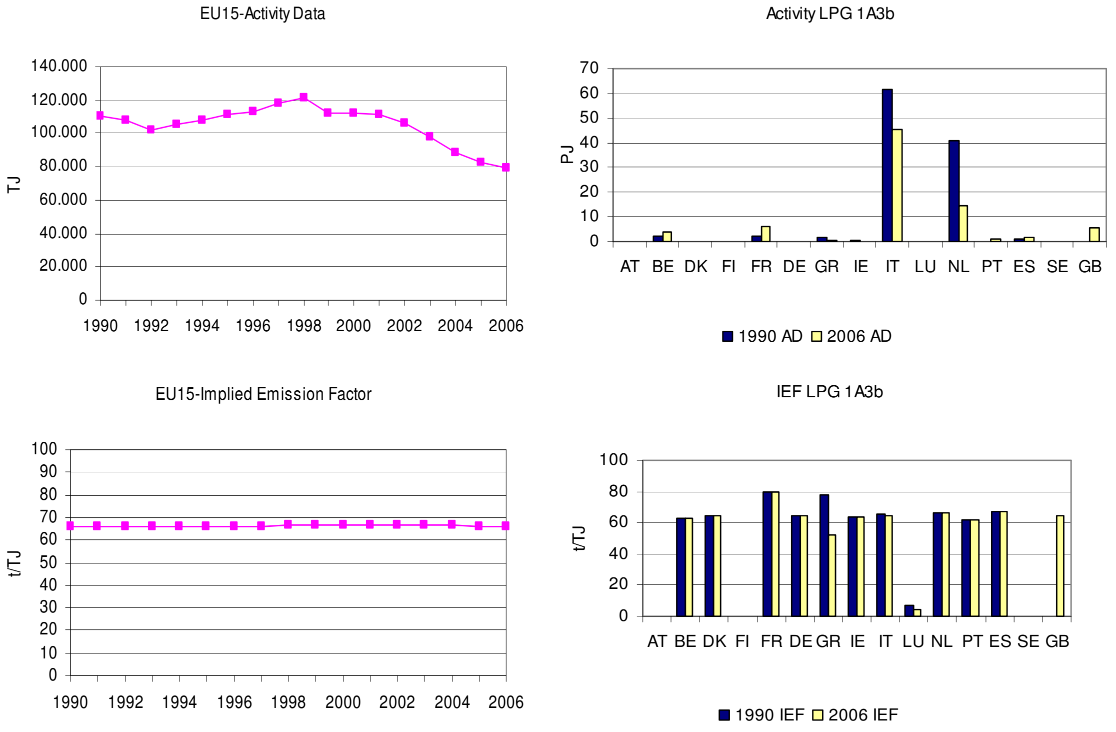
Table 3.52 1A3b Road Transport, LPG: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Belgium	154	219	254	4.8%	36	16%	100	65%	Copert3/D	NS/RS	C
Denmark	1	0	0	0.0%	0	-4%	-1	-97%	COPERT3	NS	C
Finland	NO	NO	NO	-	-	-	-	-	T1	NS	CS
France	183	509	476	9.1%	-33	-6%	293	160%	M	NS	M
Germany	9	7	7	0.1%	0	-	-2	-28%	T3	NS	CS
Greece	110	26	27	0.5%	1	5%	-83	-75%	COPERT III	NS	COPERT III
Ireland	19	3	3	0.1%	0	-2%	-16	-85%	T1	NS	CS
Italy	4,020	3,081	2,955	56.2%	-126	-4%	-1,065	-26%	COPERT 3	NS, AS	CS
Luxembourg	1	0	0	-	0	34%	-1	-74%	COPERT III	NS	D
Netherlands	2,738	1,069	977	18.6%	-92	-9%	-1,760	-64%	T2	NS	CS
Portugal	0	58	62	1.2%	4	7%	62	105321%	T2	NS	C
Spain	79	136	124	2.4%	-12	-9%	45	58%	COPERT III	NS	C
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA	NA
United Kingdom	NO	354	372	7.1%	18	5%	372	-	T3	NS,AS	CS
EU-15	**7,314**	**5,462**	**5,258**	**100.0%**	**-204**	**-4%**	**-2,056**	**-28%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Belgium, France, Italy, the Netherlands and the United Kingdom account for 96 % of emission and for 96 % of activity data (Figure 3.57). The IEF for the EU-15 is 66.1 t/TJ LPG in 2006.

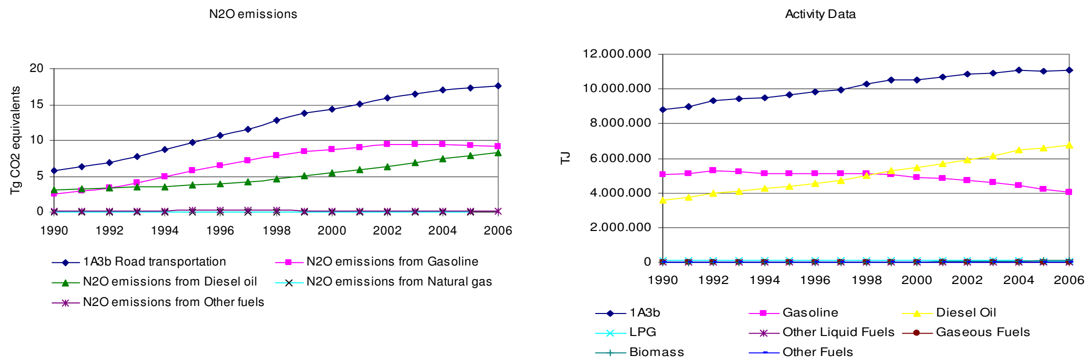
Figure 3.57 1A3b Road Transport, LPG: Activity data and implied emission factors for CO_2



N_2O emissions from 1A3b Road Transportation

N_2O emissions from 1A3b Road Transportation account for 0.4 % of total EU-15 GHG emissions in 2006. 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 2006 by 202 % (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, Denmark, France, Germany, the Netherlands and Sweden had an increase higher than 100 %. Between 2005 and 2006 five Member States (Austria, Denmark, Germany, Luxembourg 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 (version III) has a constant N_2O emission factor for cars with catalytic converters, independently of the legislation class. With the finishing of the new COPERT IV version the emission factors are reclined on the Emission Handbook, the emission factors also depending on the legislation class. Two Member states, Ireland and Denmark, used the new COPERT IV version for calculating N_2O emissions yet. Whit the emissions factors of this new model version the IEF are higher in the early nineties (big stock of older technology classes) and lower in recent years (new vehivle fleet).

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 2006	Change 2005-2006		Change 1990-2006	
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	168	299	277	1.6%	-22	-7%	109	65%
Belgium	333	775	773	4.4%	-2	0%	440	132%
Denmark	97	126	125	0.7%	-1	-1%	28	29%
Finland	160	592	617	3.5%	26	4%	458	287%
France	433	635	642	3.7%	7	1%	209	48%
Germany	608	1,170	1,097	6.2%	-73	-6%	489	80%
Greece	123	542	542	3.1%	0	0%	419	341%
Ireland	54	185	189	1.1%	4	2%	135	248%
Italy	1,605	3,891	3,980	22.6%	89	2%	2,374	148%
Luxembourg	37	280	267	1.5%	-12	-4%	231	625%
Netherlands	271	445	451	2.6%	6	1%	181	67%
Portugal	137	564	580	3.3%	15	3%	442	322%
Spain	679	2,591	2,717	15.5%	125	5%	2,037	300%
Sweden	99	139	131	0.7%	-8	-6%	32	32%
United Kingdom	1,025	5,088	5,190	29.5%	103	2%	4,165	406%
EU-15	**5,830**	**17,321**	**17,578**	**100.0%**	**257**	**1%**	**11,748**	**202%**

1A3b Road Transportation – Diesel Oil (N_2O)

N_2O emissions from Diesel oil account for 47 % of N_2O emissions from 1A3b "Road Transportation" in 2006. N_2O emissions from Diesel oil increased in all Member States between 1990 and 2006; within the EU-15 the emission increased by 167 %. The smallest increase in absolute terms is reported by Sweden, Finland and Greece. Between 2005 and 2006, EU-15 emissions rose by 5 %, the only Member State reporting a stagnancy is Belgium (Table 3.54).

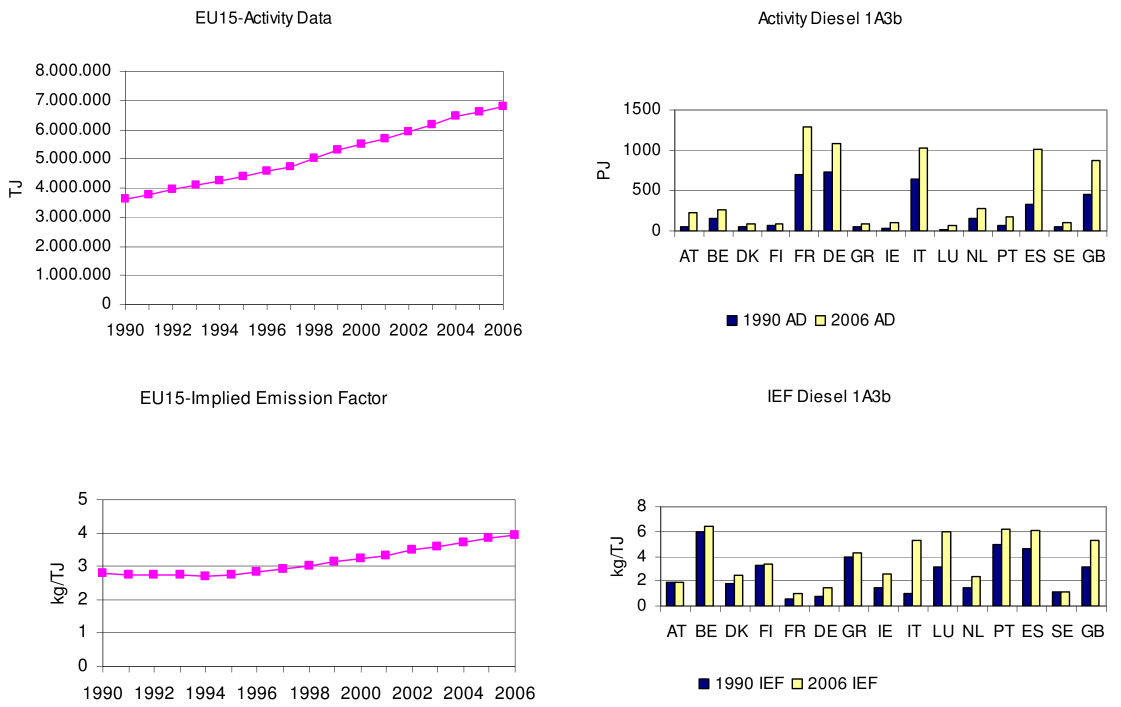
Table 3.54 1A3b Road Transport, diesel oil: Member States' contributions to N_2O emissions

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	32	140	137	1.7%	-3	-2%	106	333%	T1	NS	D
Belgium	273	539	539	6.5%	0	0%	266	97%	Copert3/D	NS/RS	C
Denmark	33	65	72	0.9%	7	10%	38	115%	COPERT3	NS	C
Finland	68	89	92	1.1%	3	3%	24	35%	T3	NS	CS
France	118	386	412	5.0%	26	7%	294	248%	M	NS	M
Germany	188	490	504	6.1%	14	3%	316	168%	T3	NS	CS/ M
Greece	72	135	127	1.5%	-9	-6%	55	76%	COPERT III	NS	COPERT III
Ireland	12	75	85	1.0%	10	13%	73	634%	T3	NS	COPERT 4
Italy	1,155	2,111	2,237	27.0%	126	6%	1,082	94%	COPERT 3	NS, AS	CS
Luxembourg	18	143	141	1.7%	-2	-2%	123	686%	COPERT III	NS	D
Netherlands	72	191	202	2.4%	11	6%	130	182%	T2	NS	CS
Portugal	105	334	356	4.3%	22	7%	250	238%	T3	NS,AS	C
Spain	481	1,784	1,901	23.0%	117	7%	1,421	296%	COPERT III	NS	C
Sweden	19	33	35	0.4%	2	7%	16	80%	M	NS	M
United Kingdom	450	1,350	1,434	17.3%	84	6%	984	218%	T3	NS,AS	COPERT III
EU-15	**3,096**	**7,865**	**8,273**	**100.0%**	**409**	**5%**	**5,178**	**167%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Belgium, France, Germany, Italy, Spain and the United Kingdom account for 85 % of the emissions and 82 % of activity data (Figure 3.59). The IEF for the EU-15 is 3,9 kg/TJ Diesel in 2006.

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 52 % of N_2O emissions from 1A3b "Road Transportation" in 2006. Between 1990 and 2006, N_2O emissions from gasoline increased by 255 % in the EU-15, all Member States except Denmark and France reported increased emissions. The Portugal, Luxembourg and the UK had the highest absolute increase. Between 2005 and 2006, nearly all Member States show a decreasing trend, except Finland, Greece, Portugal, Spain and the UK. The EU-15 total sank by 2 % (Table 3.55).

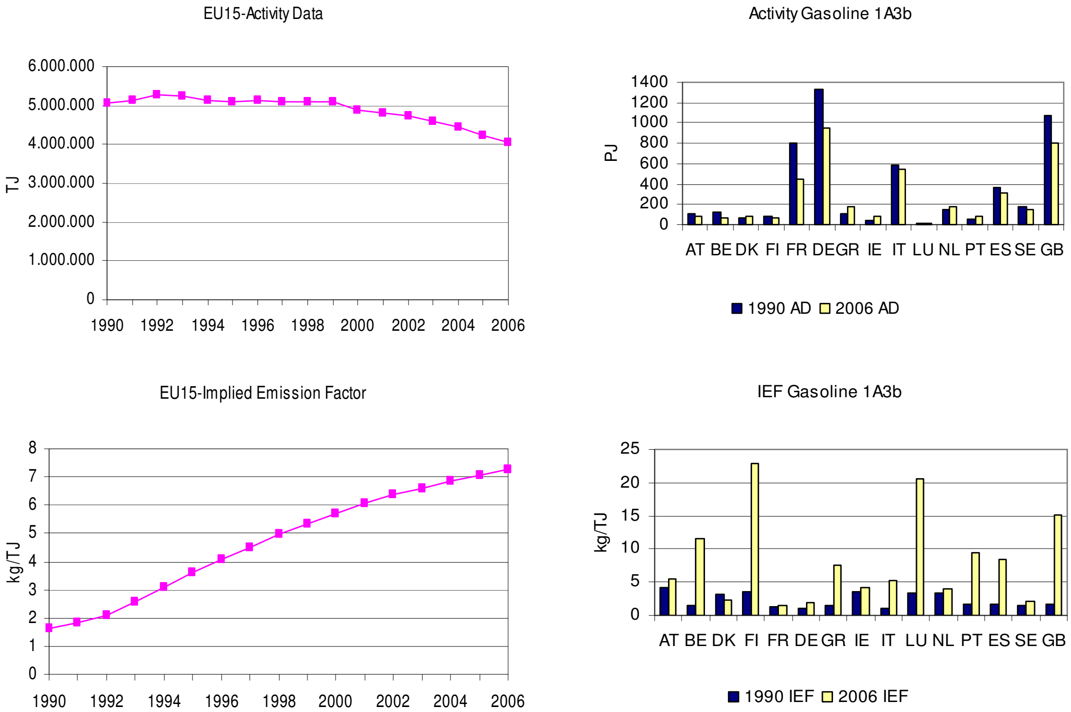
Table 3.55 1A3b Road Transport, gasoline: Member States' contributions to N_2O emissions

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	136	159	140	1.5%	-19	-12%	3	3%	T1	NS	D
Belgium	57	231	229	2.5%	-2	-1%	172	304%	Copert3/D	NS/RS	C
Denmark	63	61	53	0.6%	-8	-13%	-10	-16%	COPERT3	NS	C
Finland	91	503	525	5.8%	23	4%	434	475%	T3	NS	CS
France	315	239	217	2.4%	-22	-9%	-97	-31%	M	NS	M
Germany	421	648	556	6.1%	-92	-14%	135	32%	T3	NS	CS/ M
Greece	48	406	414	4.6%	9	2%	366	757%	COPERT III	NS	COPERT III
Ireland	43	110	104	1.1%	-6	-5%	61	143%	T3	NS	COPERT 4
Italy	327	1,665	1,626	17.9%	-39	-2%	1,299	397%	COPERT 3	NS, AS	CS
Luxembourg	19	136	127	1.4%	-10	-7%	108	568%	COPERT III	NS	D
Netherlands	156	229	226	2.5%	-3	-1%	70	44%	T2	NS	CS
Portugal	32	229	217	2.4%	-12	-5%	184	571%	T3	NS,AS	C
Spain	197	804	812	8.9%	8	1%	615	312%	COPERT III	NS	C
Sweden	80	106	96	1.1%	-11	-10%	16	20%	M	NS	M
United Kingdom	573	3,732	3,751	41.3%	19	1%	3,178	554%	T3	NS,AS	COPERT III
EU-15	**2,559**	**9,258**	**9,093**	**100.0%**	**-165**	**-2%**	**6,534**	**255%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Finland, Germany, Italy, Spain und the United Kingdom account for 80% of emission and for 66 % of activity data (Figure 3.60). The IEF for the EU-15 is 7,26 kg/TJ Gasoline in 2006.

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

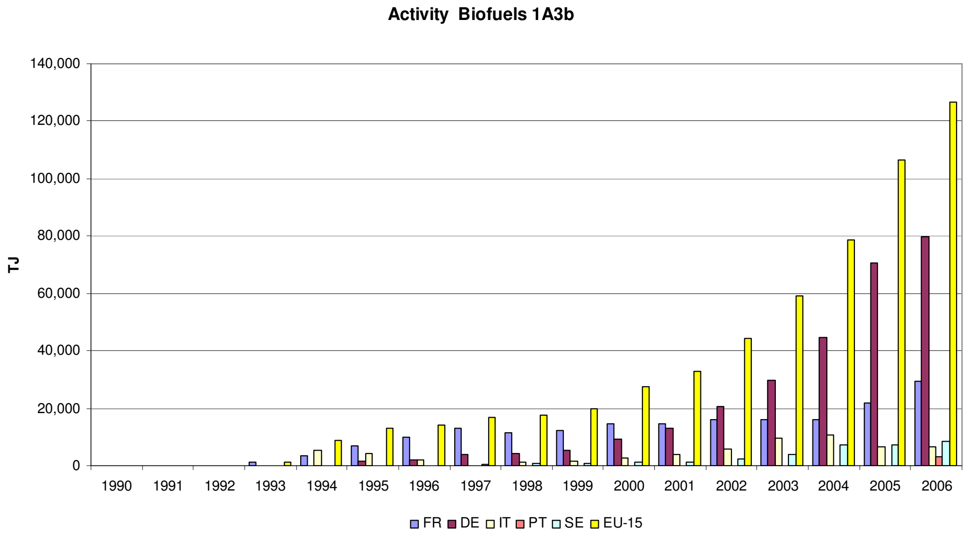


1A3b Road Transportation – Activity Data Biofuels

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 2006, activity data of biofuel increased from 25 TJ to 126.596 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 (63 % of total EU-15 activity in 2006) over the last years, followed by France. Other countries have also placed biofuels on their markets, but they do not report biofuels separately from gasoline or diesel oil (additive). In this case the use of biofuels is visisble in a decreasing trend of the IEFs of gasoline or diesel (e.g. Austria).

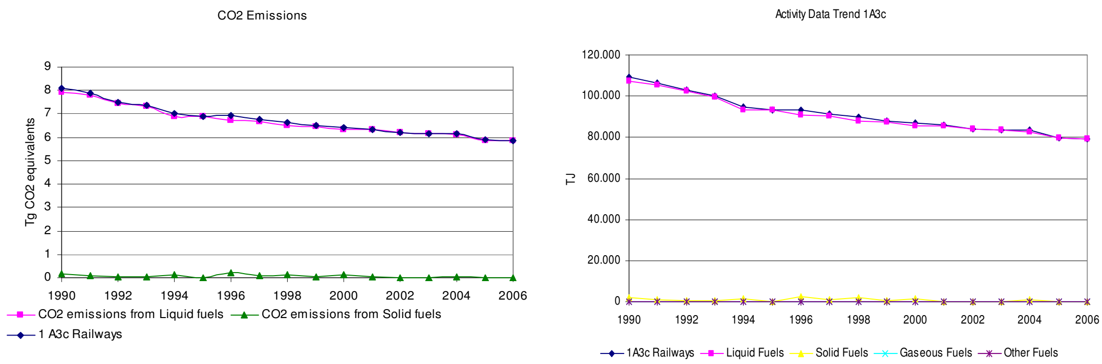
Figure 3.61 1A3b Road Transport, biofuels: Trend of Activity data of biofuels



3.2.3.3. Railways (1A3c) (EU-15)

CO_2 emissions from 1A3c Railways account for 0.1 % of total EU-15 GHG emissions in 2006. Between 1990 and 2006, CO_2 emissions from rail transportation decreased by 28 % 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 26 % between 1990 and 2006.

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 2006, only 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 2006	Change 2005-2006		Change 1990-2006	
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	174	149	144	2.5%	-4	-3%	-30	-17%
Belgium	202	115	119	2.0%	4	4%	-83	-41%
Denmark	297	232	227	3.9%	-5	-2%	-70	-24%
Finland	191	127	129	2.2%	2	2%	-62	-32%
France	1,070	633	615	10.5%	-19	-3%	-455	-43%
Germany	2,879	1,367	1,272	21.8%	-95	-7%	-1,608	-56%
Greece	203	126	129	2.2%	3	2%	-74	-36%
Ireland	133	122	122	2.1%	0	0%	-11	-8%
Italy	441	303	350	6.0%	47	15%	-91	-21%
Luxembourg	27	22	22	0.4%	0	0%	-6	-21%
Netherlands	91	106	97	1.7%	-9	-9%	6	6%
Portugal	173	80	75	1.3%	-5	-7%	-98	-57%
Spain	414	305	303	5.2%	-2	-1%	-111	-27%
Sweden	103	64	64	1.1%	0	0%	-39	-38%
United Kingdom	1,682	2,128	2,173	37.2%	45	2%	491	29%
EU-15	**8,080**	**5,878**	**5,839**	**100.0%**	**-39**	**-1%**	**-2,241**	**-28%**

1A3c Railways –Liquid Fuels (CO_2)

Between 1990 and 2006, CO_2 emissions from liquid fuels decreased by 26 % in the EU-15. In Italy, Belgium, Finland, Greece annd the United Kingdom emissions increased. Between 2005 and 2006, total EU-15 emissions changed marginally (-1 %) (Table 3.57).

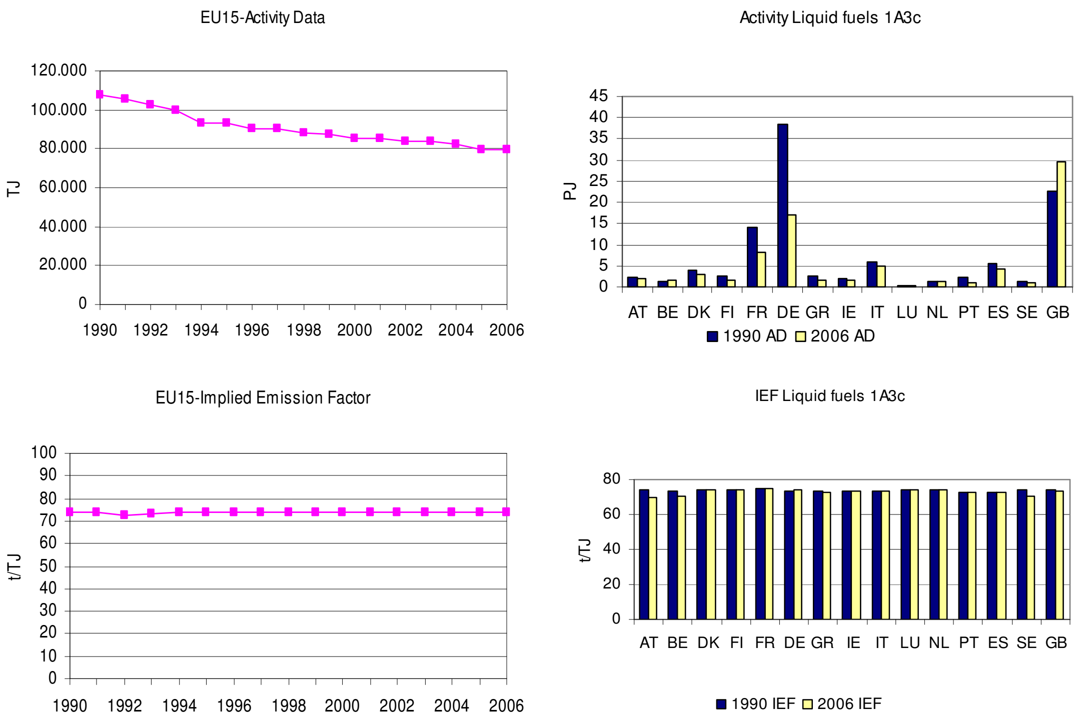
Table 3.57 1A3c Railways, liquid fuels: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	167	146	142	2.4%	-4	-3%	-25	-15%	CS	NS	CS
Belgium	102	115	119	2.0%	4	4%	17	17%	CS	RS	CS
Denmark	297	232	227	3.9%	-5	-2%	-70	-24%	C	NS	C
Finland	191	127	129	2.2%	2	2%	-62	-32%	T1	NS	CS
France	1,070	633	615	10.5%	-19	-3%	-455	-43%	C	NS	CS
Germany	2,826	1,367	1,272	21.8%	-95	-7%	-1,554	-55%	T1	NS	CS
Greece	200	126	129	2.2%	3	2%	-71	-36%	T1	NS	D
Ireland	133	122	122	2.1%	0	0%	-11	-8%	T1	NS	CS
Italy	441	303	350	6.0%	47	15%	-91	-21%	D	NS	CS
Luxembourg	27	22	22	0.4%	0	0%	-6	-21%	T1	PS	D
Netherlands	91	106	97	1.7%	-9	-9%	6	6%	CS	NS	CS
Portugal	173	80	75	1.3%	-5	-7%	-98	-57%	T1	NS	OTH
Spain	414	305	303	5.2%	-2	-1%	-111	-27%	T2	Q	C
Sweden	103	64	64	1.1%	0	0%	-39	-38%	CS	NS	CS
United Kingdom	1,682	2,128	2,173	37.2%	45	2%	491	29%	T2	NS,AS	CS
EU-15	**7,917**	**5,876**	**5,837**	**100.0%**	**-39**	**-1%**	**-2,080**	**-26%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

France, Germany, Italy and the United Kingdom account for 76 % 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 2006.

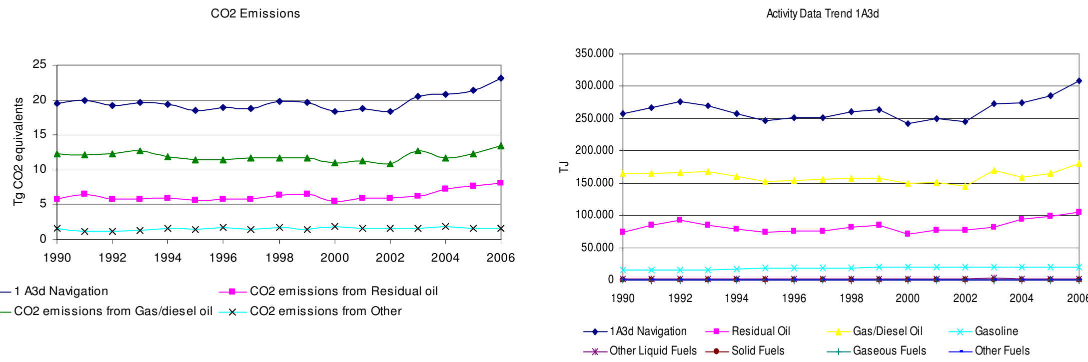
Figure 3.63 1A3c Railways, liquid fuels: Activity data and implied emission factors for CO_2



3.2.3.4. Navigation (1A3d) (EU-15)

CO_2 emissions from 1A3d Navigation account for 0.6 % of total EU-15 GHG emissions in 2006. Between 1990 and 2006, CO_2 emissions from navigation increased by 19 % in the EU-15 (Table 3.58). The emissions from this key source are due to fossil fuel consumption in navigation. The total CO_2 emission trend is dominated by emissions from gas/diesel oil and residual oil (Figure 3.64).

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 (74%). Most Member States increased emissions from navigation between 1990 and 2006, except for Germany, Ireland, Portugal, Sweden and Denmark. The Member States with the highest increases in absolute terms were Spain, France and the United Kingdom (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 2006	Change 2005-2006		Change 1990-2006	
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	52	52	52	0.2%	0	1%	0	1%
Belgium	411	485	498	2.1%	13	3%	87	21%
Denmark	713	462	455	2.0%	-7	-2%	-259	-36%
Finland	441	532	569	2.5%	37	7%	128	29%
France	1,691	2,609	2,764	11.9%	155	6%	1,073	63%
Germany	2,050	998	855	3.7%	-143	-14%	-1,195	-58%
Greece	1,825	2,072	2,281	9.8%	210	10%	456	25%
Ireland	84	60	4	0.0%	-56	-94%	-80	-95%
Italy	5,401	6,112	6,105	26.4%	-7	0%	704	13%
Luxembourg	6	6	6	0.0%	0	0%	0	0%
Netherlands	405	626	626	2.7%	0	0%	222	55%
Portugal	240	191	201	0.9%	10	5%	-39	-16%
Spain	1,500	2,513	2,763	11.9%	250	10%	1,263	84%
Sweden	538	536	484	2.1%	-52	-10%	-54	-10%
United Kingdom	4,122	4,179	5,502	23.8%	1,323	32%	1,380	33%
EU-15	**19,479**	**21,433**	**23,165**	**100.0%**	**1,732**	**8%**	**3,686**	**19%**

1A3d Navigation – Residual Oil (CO_2)

CO_2 emissions from Residual oil account for 35% of CO_2 emissions from 1A3d Navigation in 2006. Between 1990 and 2006, CO_2 emissions from Residual oil increased by 42 % 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 Ireland. Austria, Belgium, Germany, Luxembourg and the Netherlands report emissions as 'Not occuring', 'Not estimated' or '0' (Table 3.59).

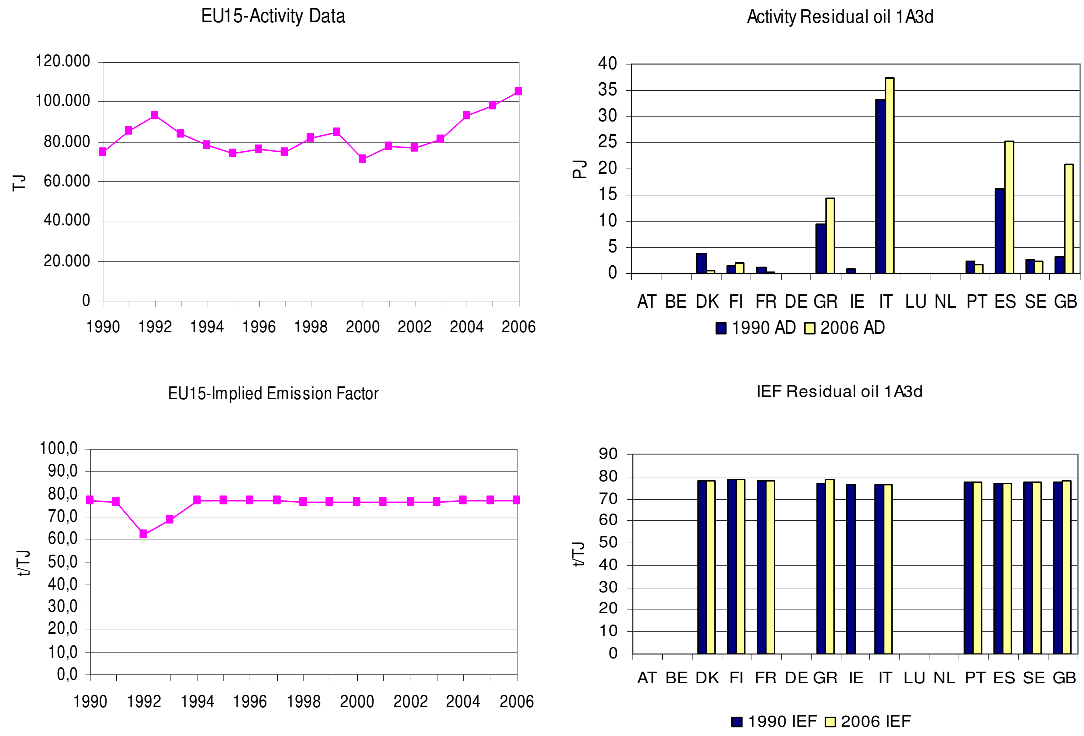
Table 3.59 1A3d Navigation, residual oil: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	NO	NO	NO	-	-	-	-	-	T1	0.0	D
Belgium	0	126	0	0.0%	-126	-	0	-	M	RS	CS
Denmark	300	53	50	0.6%	-3	-5%	-249	-83%	C	NS	C
Finland	123	151	164	2.0%	13	9%	41	33%	T2	NS	CS
France	102	40	33	0.4%	-7	-17%	-69	-68%	C	NS	CS
Germany	NO	NO	NO	-	-	-	-	-	T1	NS	CS
Greece	730	1,014	1,117	13.7%	103	10%	387	53%	T1	NS	D
Ireland	63	56	NO	-	-56	-100%	-63	-100%	T1	NS	CS
Italy	2,553	2,861	2,859	35.2%	-3	0%	306	12%	T1, T2	NS	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Netherlands	NO	NO	NO	-	-	-	-	-	NA	NA	NA
Portugal	173	131	148	1.8%	17	13%	-25	-14%	C	NS,AS	C
Spain	1,234	1,768	1,944	23.9%	176	10%	710	58%	T2	NS, AS	C
Sweden	194	231	182	2.2%	-49	-21%	-12	-6%	T1	NS	CS
United Kingdom	251	1,144	1,625	20.0%	481	42%	1,374	547%	T2	NS,AS	CS
EU-15	**5,723**	**7,575**	**8,122**	**100.0%**	**547**	**7%**	**2,399**	**42%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Italy, the United Kingdom and Spain account for 79 % of emissions and for 79 % of activity data (Figure 3.65). The IEF for the EU-15 is 77.2 t/TJ Residual oil in 2006.

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 58 % of CO_2 emissions from 1A3d "Navigation" in 2006 (Table 3.60). The CO_2 emissions from Gas/Diesel oil increased by 10% between 1990 and 2006. Member States with the highest increase in percent were Belgium and Spain. The countries with the highest decrease were Germany and Ireland.

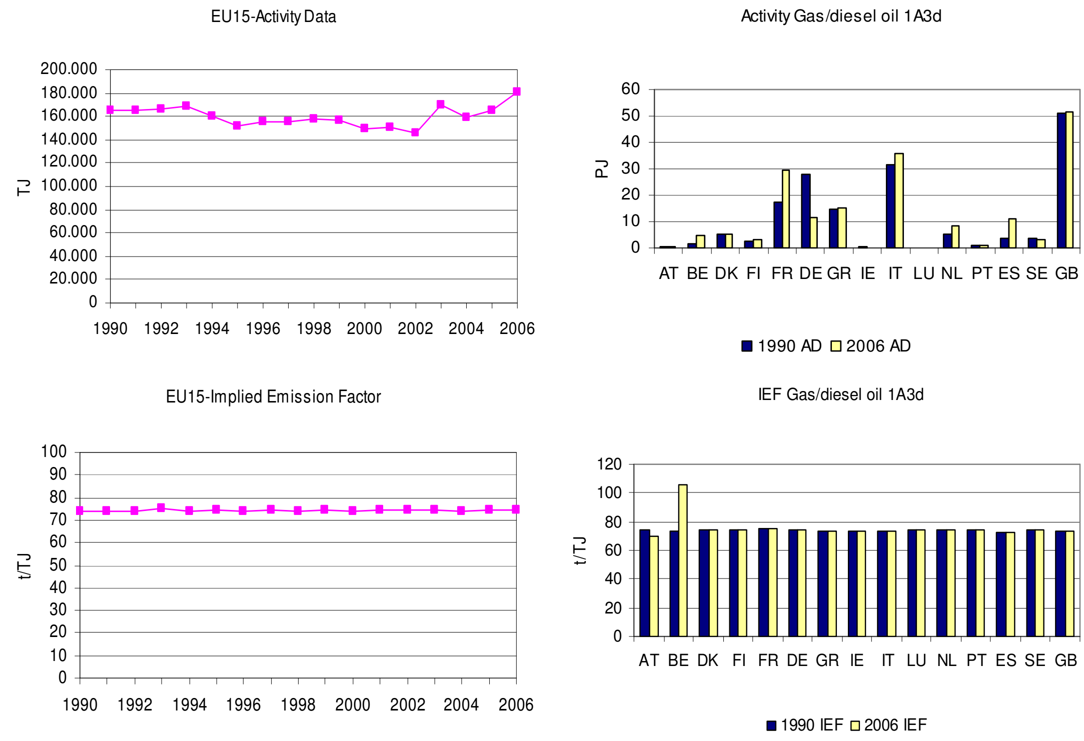
Table 3.60 1A3d Navigation, gas/diesel oil: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	43	43	44	0.3%	0	1%	1	2%	T1	0.0	D
Belgium	102	359	498	3.7%	139	39%	396	388%	M	RS	CS
Denmark	391	380	377	2.8%	-4	-1%	-14	-4%	C	NS	C
Finland	186	220	237	1.8%	17	8%	51	27%	T2	NS	CS
France	1,291	2,056	2,217	16.4%	162	8%	926	72%	C	NS	CS
Germany	2,050	998	855	6.3%	-143	-14%	-1,195	-58%	T1	NS	CS
Greece	1,068	1,040	1,135	8.4%	95	9%	67	6%	T1	NS	D
Ireland	21	4	4	0.0%	0	5%	-18	-82%	T1	NS	CS
Italy	2,299	2,629	2,624	19.4%	-5	0%	325	14%	T1, T2	NS	CS
Luxembourg	6	6	6	0.0%	0	0%	0	0%	T1	TÜV	D
Netherlands	405	626	626	4.6%	0	0%	222	55%	T2	NS	CS
Portugal	67	60	53	0.4%	-7	-12%	-14	-21%	C	NS,AS	C
Spain	266	745	819	6.1%	74	10%	553	208%	T2	NS, AS	C
Sweden	269	231	228	1.7%	-4	-2%	-42	-16%	T1	NS	CS
United Kingdom	3,763	2,934	3,780	28.0%	847	29%	17	0%	T2	NS,AS	CS
EU-15	**12,228**	**12,331**	**13,503**	**100.0%**	**1,172**	**10%**	**1,275**	**10%**			

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 74,6 t/TJ residual oil in 2006.

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



3.2.3.5. Other (1A3e) (EU-15)

CO_2 emissions from 1A3e Other account for 0.2 % of total EU-15 GHG emissions in 2006. 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 27% between 1990 and 2006. (Table 3.61). A fuel shift occurred from oil to gas.

Two Member States (Germany and Italy) contributed most to the emissions from this source (64 %). Between 1990 and 2006 all Member States except Belgium (-21 %) reported increasing emissions. Denmark, Luxembourg, the Netherlands, and Portugal report emissions as 'Not occuring' or '0' (Table 3.61).

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

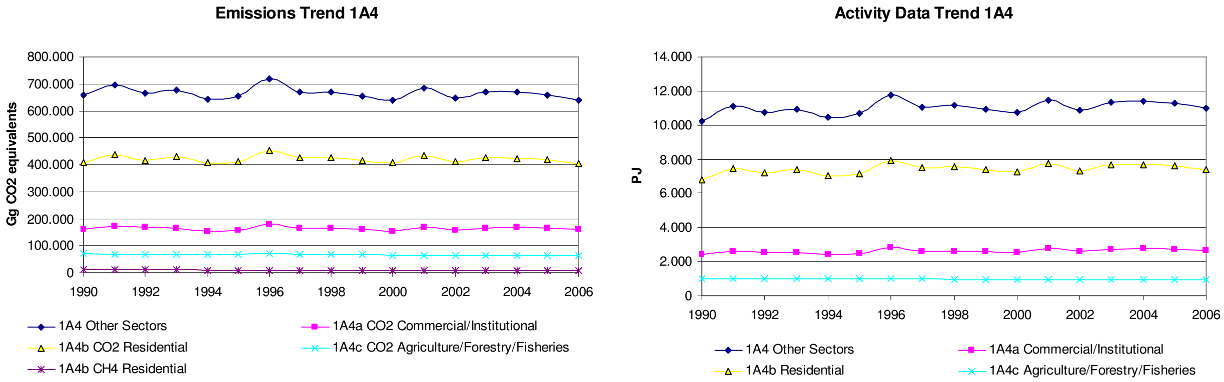
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006	
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	224	545	452	5.4%	-93	-17%	227	101%
Belgium	196	131	155	1.9%	23	18%	-41	-21%
Denmark	NO	NO	NO	-	-	-	-	-
Finland	661	708	713	8.5%	5	1%	52	8%
France	213	963	589	7.1%	-374	-39%	376	176%
Germany	4,302	4,415	4,343	52.0%	-71	-2%	41	1%
Greece	NO	4	5	0.1%	1	29%	5	-
Ireland	62	151	151	1.8%	0	0%	89	144%
Italy	406	884	1,035	12.4%	151	17%	628	155%
Luxembourg	NA	NA	NA	-	-	-	-	-
Netherlands	NO	NO	NO	-	-	-	-	-
Portugal	NO	NO	NO	-	-	-	-	-
Spain	20	321	182	-	-139	-43%	162	800%
Sweden	231	274	275	3.3%	1	0%	44	19%
United Kingdom	268	443	451	5.4%	8	2%	183	68%
EU-15	**6,584**	**8,840**	**8,351**	**100.0%**	**-489**	**-6%**	**1,767**	**27%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

3.2.4. Other Sectors (CRF Source Category 1A4) (EU-15)

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 1A4a Commercial/Residential. The emissions of the large key sources fluctuated in time series between 1990 and 2006, 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 2006 CO_2 emissions from 1A4 Other Sectors decreased by 2 % , CH_4 decreased by 43% and N_2O emissions decreased by 11%.

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 2006 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO_2 emissions in 2006 (Gg)	CH_4 emissions in 1990 (Gg CO_2 equivalents)	CH_4 emissions in 2006 (Gg CO_2 equivalents)
Austria	15,078	14,176	14,396	13,646	389	246
Belgium	27,595	28,791	27,215	28,490	241	168
Denmark	9,150	7,087	8,954	6,779	90	204
Finland	7,310	5,305	7,040	5,036	183	196
France	99,025	103,968	93,680	100,407	4,033	2,150
Germany	207,921	170,970	204,341	169,638	2,593	747
Greece	8,781	14,313	8,126	14,020	78	74
Ireland	10,469	10,944	10,065	10,563	95	48
Italy	78,218	88,405	76,508	86,091	309	576
Luxembourg	1,304	1,322	1,290	1,312	10	8
Netherlands	38,305	38,479	37,868	38,076	393	364
Portugal	4,610	5,915	4,025	5,443	348	315
Spain	26,399	37,897	25,280	36,910	819	655
Sweden	11,287	4,822	10,721	4,301	248	228
United Kingdom	111,893	107,028	109,397	105,937	1,538	473
EU-15	**657,344**	**639,422**	**638,907**	**626,650**	**11,369**	**6,454**

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 2005 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 2005 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2005		Main explanations
	Gg	Percent	Gg	Percent	
Austria	130	0,9	-767	-5,1	Updated activity data (heating type split, new boiler sales statistics, energy data)
Belgium	0	0,0	-69	-0,2	As the year 2005 contains a temporary estimation of the emissions during the 2007 submission, this year was almost completely revised during the January 15, 2008 submission.
Denmark	-185	-2,0	-138	-1,9	The activity data for gasoline fuelled working machinery has been updated from 1985-2005, and this cause the emissions from this sector to decrease in the same time period.
Finland	0	0,0	154	3,1	Correction of data; realloction of plants
France	0	0,0	2.605	2,6	Transfert des consommations des GIC + mise à jour du bilan de l'OE
Germany	28	0,0	2.830	1,7	1A4a,c: new available energy data; 1A4b: new available data for peat;
Greece	0	0,0	-43	-0,3	Activity data correction: by mistake the TJ of NG used were based on GCV and not NCV as should be.
Ireland	0	0,0	193	1,8	Revised fuel data in national energy balance
Italy	1	0,0	-1.122	-1,2	Update of emission factor for natural gas, coal and fuel oil; update of natural gas and industrial waste activity data
Luxembourg	44	3,6	48	3,8	Corrected AD
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	-2	0,0	
UK	-54	0,0	-943	-0,8	1990: Revisions to activity data for overseas territories; Reallocation of gas oil to reflect new rail emission methodology; 2005: Review and revisions to methodolgy for estimates of emissions from UK Oversea's Territories; Revision of UK National activity statistics for natural gas from public sector combustion and domestic combustion. Reallocation of gas oil to reflect new rail emission methodology
EU-15	**-35**	**0,0**	**2.748**	**0,4**	

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 2005.

Table 3.64 1A4 Other Sectors: Contribution of MS to EU-15 recalculations in CH_4 for 1990 and 2005 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

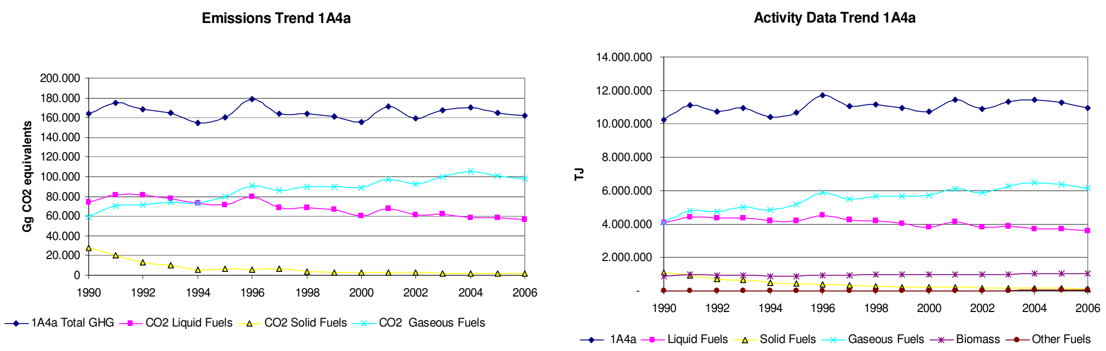
	1990		2005		Main explanations
	Gg	Percent	Gg	Percent	
Austria	0	0,1	-3	-1,2	
Belgium	112	87,2	82	91,5	Harmonization of the applied emission factors for CH_4 and N_2O (switch to IPCC 2006 EFs in all regions)
Denmark	-1	-0,8	1	0,7	
Finland	2	1,3	0	0,2	
France	50	1,3	77	3,4	Mise à jour FE CH4 pour les différents combustibles
Germany	0	0,0	23	3,1	1A4a,c: new available energy data; 1A4b: new available data for peat;
Greece	-135	-63,3	-142	-65,7	Change of EF; update / correction of AD; Change of Lignite NCV (from industry to average)
Ireland	0	0,0	0	-1,0	
Italy	0	0,0	0	0,0	
Luxembourg	-1	-8,7	-1	-6,3	
Netherlands	0	0,0	1	0,4	
Portugal	0	0,0	0	0,0	
Spain	0	0,0	0	0,0	
Sweden	0	0,0	0	0,0	
UK	-11	-0,7	-13	-2,7	
EU-15	**18**	**0,2**	**26**	**0,4**	

3.2.4.1. Commercial/Institutional (1A4a) (EU-15)

In this chapter information about emission trends, Member states' contribution, activity data, and emission factors is provided for category 1A4a by fuels. CO_2 emissions from 1A4a Commercial/Institutional are the fifth largest key source of GHG emissions in the EU-15 and account for 4 % of total GHG emissions in 2006.

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 decreased by 1 %, mainly due to decreases in emissions from solid (-94 %) and liquid (-23 %) fuels.

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



Between 1990 and 2006, CO_2 emissions from 1A4a decreased by 1 % 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 11 % between 1990 and 2006, 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

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006	
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	2,651	3,301	3,403	2.1%	102	3%	752	28%
Belgium	4,272	6,149	6,042	3.8%	-107	-2%	1,770	41%
Denmark	1,403	913	957	0.6%	43	5%	-446	-32%
Finland	1,951	1,107	1,131	0.7%	24	2%	-820	-42%
France	27,895	30,449	30,339	18.9%	-110	0%	2,444	9%
Germany	63,950	45,879	45,976	28.7%	97	0%	-17,974	-28%
Greece	527	1,527	1,599	1.0%	71	5%	1,072	203%
Ireland	2,339	2,755	2,698	1.7%	-56	-2%	360	15%
Italy	16,171	25,099	23,594	14.7%	-1,505	-6%	7,423	46%
Luxembourg	605	622	616	0.4%	-6	-1%	11	2%
Netherlands	7,501	9,771	10,643	6.6%	873	9%	3,142	42%
Portugal	744	3,421	2,375	1.5%	-1,046	-31%	1,632	219%
Spain	3,745	9,590	8,819	5.5%	-772	-8%	5,074	135%
Sweden	2,541	657	473	0.3%	-184	-28%	-2,068	-81%
United Kingdom	25,541	22,636	21,696	13.5%	-940	-4%	-3,845	-15%
EU-15	**161,834**	**163,877**	**160,362**	**100.0%**	**-3,515**	**-2%**	**-1,473**	**-1%**

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

In 2006 CO_2 from liquid fuels had a share of 35 % within source category 1A4a (compared to 45 % in 1990). Between 1990 and 2006 the emissions decreased by 23 % (Table 3.66). Four Member States had increases in this time, with the highest in absolute terms in Spain and Portugal. The highest absolute reduction was achieved in Germany. Between 2005 and 2006 EU-15 total emission decreased by 3 %.

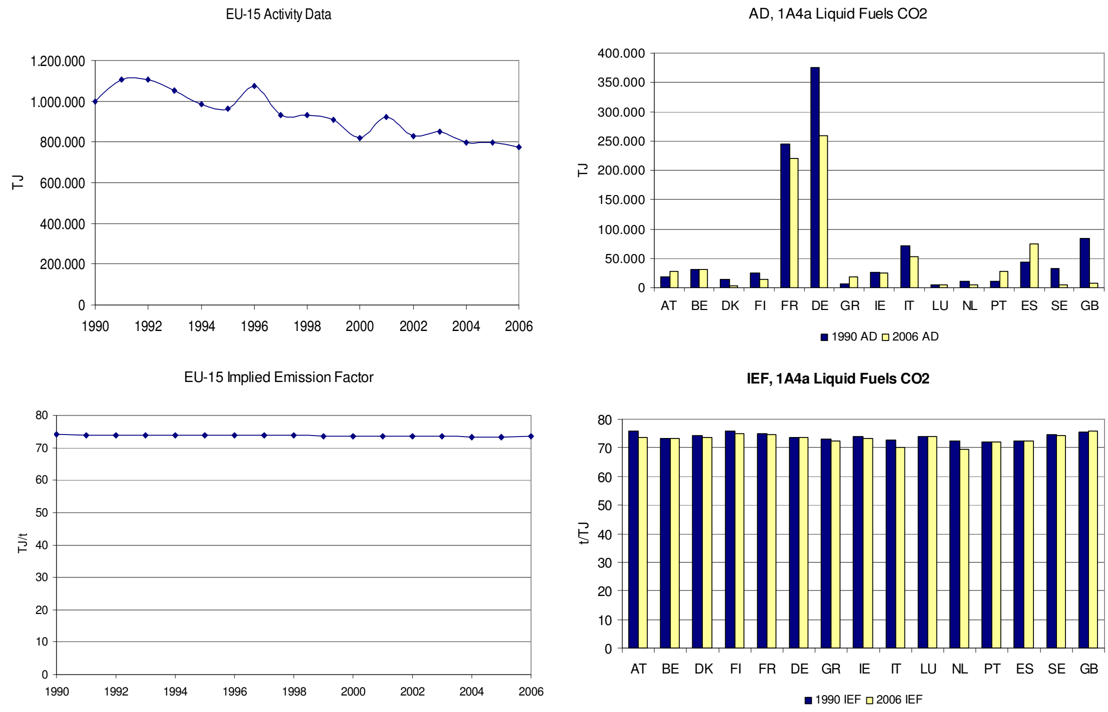
Table 3.66 1A4a Commercial/Institutional, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	1,448	1,626	2,040	3.6%	414	25%	592	41%	T2	NS	CS
Belgium	2,312	2,356	2,219	3.9%	-136	-6%	-92	-4%	T1	RS	D
Denmark	1,008	318	265	0.5%	-53	-17%	-743	-74%	C	NS	CS/C
Finland	1,885	979	1,005	1.8%	26	3%	-880	-47%	T1	NS	CS
France	18,284	16,050	16,449	28.9%	399	2%	-1,834	-10%	C	NS	CS
Germany	27,633	18,168	19,068	33.5%	899	5%	-8,565	-31%	CS	NS	CS
Greece	505	1,348	1,392	2.4%	44	3%	887	176%	T2	NS	D
Ireland	1,977	1,871	1,794	3.1%	-77	-4%	-183	-9%	T1	NS	CS
Italy	5,142	4,291	3,691	6.5%	-601	-14%	-1,451	-28%	T2	NS	CS
Luxembourg	351	341	313	0.5%	-28	-8%	-38	-11%	T1	NS	D
Netherlands	739	282	311	0.5%	29	10%	-427	-58%	T2	NS	CS
Portugal	744	3,094	2,005	3.5%	-1,089	-35%	1,262	170%	T2	NS	D,C
Spain	3,196	6,103	5,403	9.5%	-701	-11%	2,207	69%	T2	NS	C
Sweden	2,455	548	365	0.6%	-184	-33%	-2,091	-85%	T1, T2, T3	NS	CS
United Kingdom	6,309	1,076	624	1.1%	-452	-42%	-5,685	-90%	T2	NS,AS	CS
EU-15	**73,987**	**58,453**	**56,944**	**100.0%**	**-1,508**	**-3%**	**-17,042**	**-23%**			

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 72 % of the CO_2 emissions from liquid fuels in 1A4a. Fuel consumption in the EU-15 decreased by 22 % between 1990 and 2006. The implied emission factor of EU-15 was 73.4 t/TJ in 2006.

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 2006, CO_2 from solid fuels had a share of 1 % within source category 1A4a (compared to 17 % in 1990). Between 1990 and 2006 the emissions decreased by 94 % (Table 3.67). Denmark, Sweden, Greece, Italy, Finland and Portugal report emissions as 'Not occuring' in 2006. All Member States decreased emissions. Between 2005 and 2006 EU-15 emissions declined by 2 %.

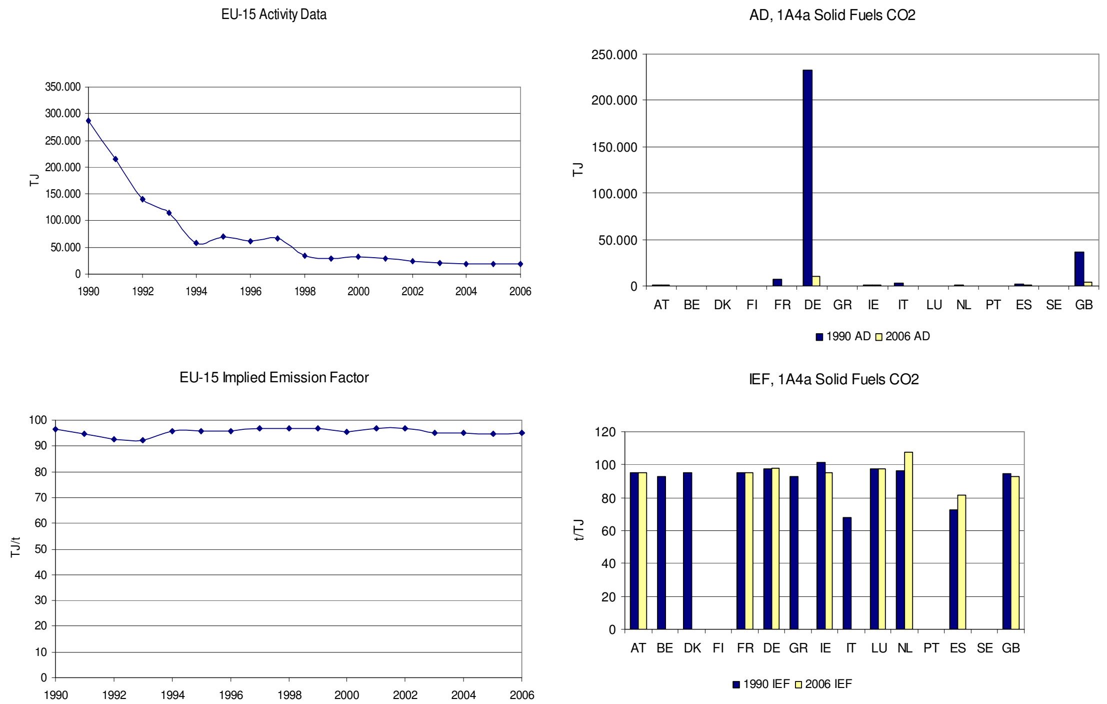
Table 3.67 1A4a Commercial/Institutional, solid fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	90	50	64	3.7%	14	29%	-26	-29%	T2	NS	CS
Belgium	9	2	0	0.0%	-2	-100%	-9	-100%	T1	RS	D
Denmark	8	NO	NO	-	-	-	-8	-100%	C	NS	CS/C
Finland	NO	NO	NO	-	-	-	-	-	T1	NS	CS
France	698	12	20	1.2%	9	72%	-678	-97%	C	NS	CS
Germany	22,712	1,005	984	57.5%	-22	-2%	-21,728	-96%	CS	NS	CS
Greece	10	8	NO	-	-8	-100%	-10	-100%	0.0	0.0	0.0
Ireland	138	105	105	6.2%	0	0%	-33	-24%	T1	NS	CS
Italy	218	NO	NO	-	-	-	-218	-100%	T2	NS	CS
Luxembourg	46	3	3	0.2%	-1	-22%	-44	-94%	T1	NS	D
Netherlands	128	29	23	1.3%	-6	-21%	-105	-82%	T2	NS	CS
Portugal	NO	NO	NO	-	-	-	-	-	T2	NS	D,C
Spain	154	125	123	7.2%	-2	-2%	-32	-20%	T2	NS	C
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA	NA
United Kingdom	3,454	410	389	22.7%	-21	-5%	-3,066	-89%	T2	NS,AS	CS
EU-15	**27,666**	**1,748**	**1,710**	**100.0%**	**-38**	**-2%**	**-25,956**	**-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 still reported by Germany and the Unitded Kingdom; together in 2006 they cause up to 80 % of the CO_2 emissions from solid fuels in 1A4a. Fuel consumption in the EU-15 decreased by 94 % between 1990 and 2006. The implied emission factor of EU-15 was 95.2 t/TJ in 2006. The implied emission factor of Italy is comparably low because of a high share of gas works gas is included.

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 2006 CO_2 from gaseous fuels had a share of 61 % within source category 1A4a (compared to 36 % in 1990). Between 1990 and 2006 the emissions increased by 67 % (Table 3.68). All Member States reported increasing emissions. The highest absolute increase occurred in Germany and Italy. Between 2005 and 2006 EU-15 emissions decreased by -2 %.

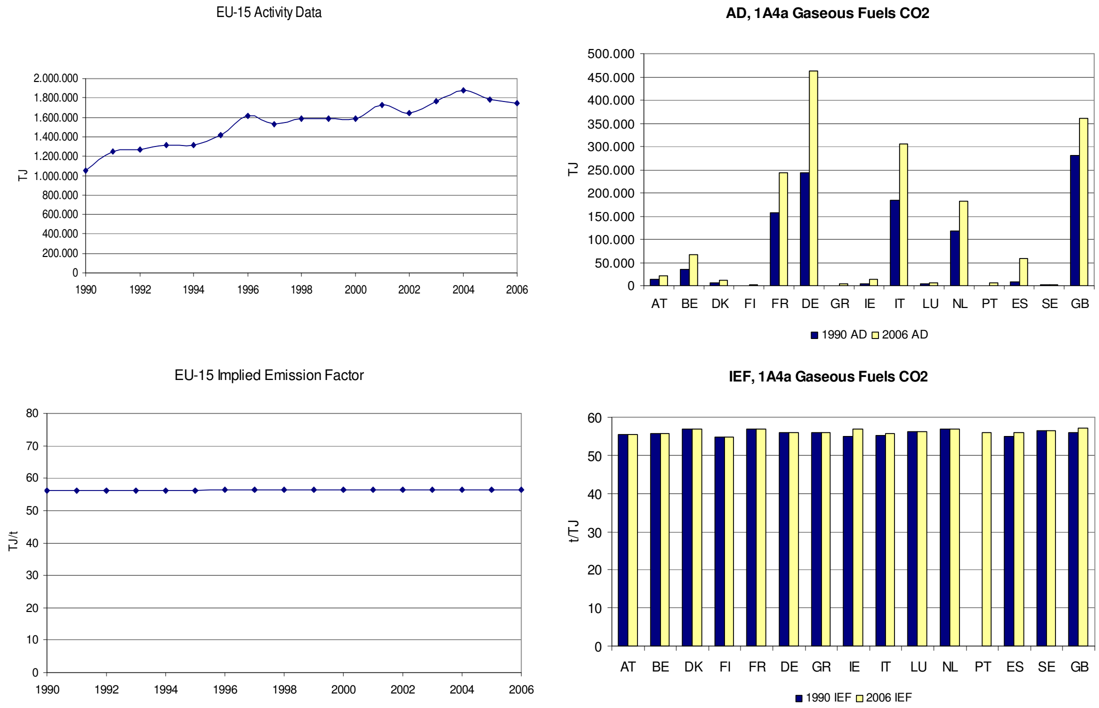
Table 3.68 1A4a Commercial/Institutional, gaseous fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	763	1,554	1,223	1.2%	-331	-21%	460	60%	T2	NS	CS
Belgium	1,921	3,716	3,747	3.8%	31	1%	1,826	95%	T1	RS	D
Denmark	365	593	662	0.7%	69	12%	297	81%	C	NS	CS/C
Finland	50	119	111	0.1%	-8	-6%	61	121%	T1	NS	CS
France	8,910	14,386	13,869	14.1%	-517	-4%	4,959	56%	C	NS	CS
Germany	13,605	26,706	25,925	26.3%	-781	-3%	12,320	91%	CS	NS	CS
Greece	12	172	206	0.2%	35	20%	194	1612%	T2	NS	D
Ireland	224	778	800	0.8%	21	3%	576	258%	T1	NS	CS
Italy	10,243	18,043	17,026	17.3%	-1,017	-6%	6,783	66%	T2	NS	CS
Luxembourg	208	278	301	0.3%	23	8%	93	45%	T1	NS	D
Netherlands	6,634	9,460	10,309	10.5%	850	9%	3,675	55%	T2	NS	CS
Portugal	NO	327	370	0.4%	43	13%	370	-	T2	NS	D,C
Spain	395	3,362	3,293	3.3%	-69	-2%	2,898	734%	T2	NS	CS
Sweden	86	108	108	0.1%	0	0%	22	26%	T1, T2, T3	NS	CS
United Kingdom	15,717	21,110	20,643	20.9%	-467	-2%	4,925	31%	T2	NS	CS
EU-15	**59,133**	**100,712**	**98,593**	**100.0%**	**-2,119**	**-2%**	**39,460**	**67%**			

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 66 % between 1990 and 2006. The implied emission factor of EU-15 was 56.4 t/TJ in 2006.

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

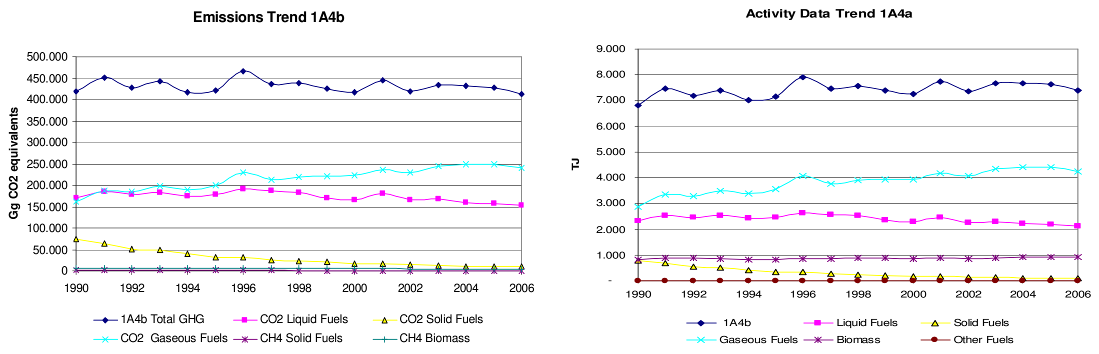


3.2.4.2. Residential (1A4b) (EU-15)

In this chapter information about emission trends, Member States' contribution, activity data, and emission factors is provided for category 1A4b by fuels. CO_2 emissions from 1A4b Residential are the fourth largest key source of GHG emissions in the EU-15 and account for 10 % of total GHG emissions in 2006.

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 a similar level as in 1990, although CO_2 emissions from gaseous fuels increased strongly (+54 %) which 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 2006, CO_2 emissions from households decreased by 1 % 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 8 % between 1990 and 2006, with a fuel shift from coal and oil to gas.

Between 1990 and 2006, the largest reduction in absolute terms was reported by Germany reducing emissions by 12 million tonnes. Austria, the Netherlands, and Denmark show emission reductions of more than 1 million tonne each and Sweden more than 4 million tonnes. Greece, Spain and France had the largest emission increases in absolute terms. One reason for the performance of the Nordic countries and Austria is increased use of district heating. As district heating replaces heating boilers in households, an increase in the share of district heating reduces CO_2 emissions from households (but increases emissions from energy industries if fossil fuels are used). In Germany, efficiency improvements and the fuel switch in eastern German households are two reasons for the emission reductions.

Table 3.69 1A4b Residential: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006	
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	9,906	9,344	8,666	2.1%	-679	-7%	-1,241	-13%
Belgium	20,213	21,918	20,112	5.0%	-1,805	-8%	-101	0%
Denmark	5,059	3,933	3,695	0.9%	-238	-6%	-1,364	-27%
Finland	3,072	2,193	2,204	0.5%	11	0%	-868	-28%
France	55,173	64,483	60,932	15.1%	-3,551	-6%	5,759	10%
Germany	129,474	115,028	117,164	29.0%	2,136	2%	-12,310	-10%
Greece	4,671	9,861	9,540	2.4%	-321	-3%	4,869	104%
Ireland	7,066	7,126	7,039	1.7%	-87	-1%	-28	0%
Italy	51,990	58,377	54,257	13.4%	-4,120	-7%	2,267	4%
Luxembourg	607	625	620	0.2%	-5	-1%	13	2%
Netherlands	19,495	18,179	17,407	4.3%	-772	-4%	-2,087	-11%
Portugal	1,621	2,261	2,191	0.5%	-71	-3%	570	35%
Spain	12,979	19,675	18,110	4.5%	-1,565	-8%	5,131	40%
Sweden	6,421	2,409	1,798	0.4%	-611	-25%	-4,623	-72%
United Kingdom	78,712	83,358	79,962	19.8%	-3,396	-4%	1,250	2%
EU-15	**406,460**	**418,770**	**403,697**	**100.0%**	**-15,073**	**-4%**	**-2,763**	**-1%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A4b Residential – Liquid Fuels (CO_2)

In 2006 CO_2 from liquid fuels had a share of 37 % within source category 1A4b (compared to 40 % in 1990). Between 1990 and 2006 the emissions decreased by 10 % (Table 3.70). The highest absolute increases show Greece, Ireland and the United Kingdom. The highest absolute decrease was reported by Italy. Between 2004 and 2006 EU-15 emissions decreased by 3 %.

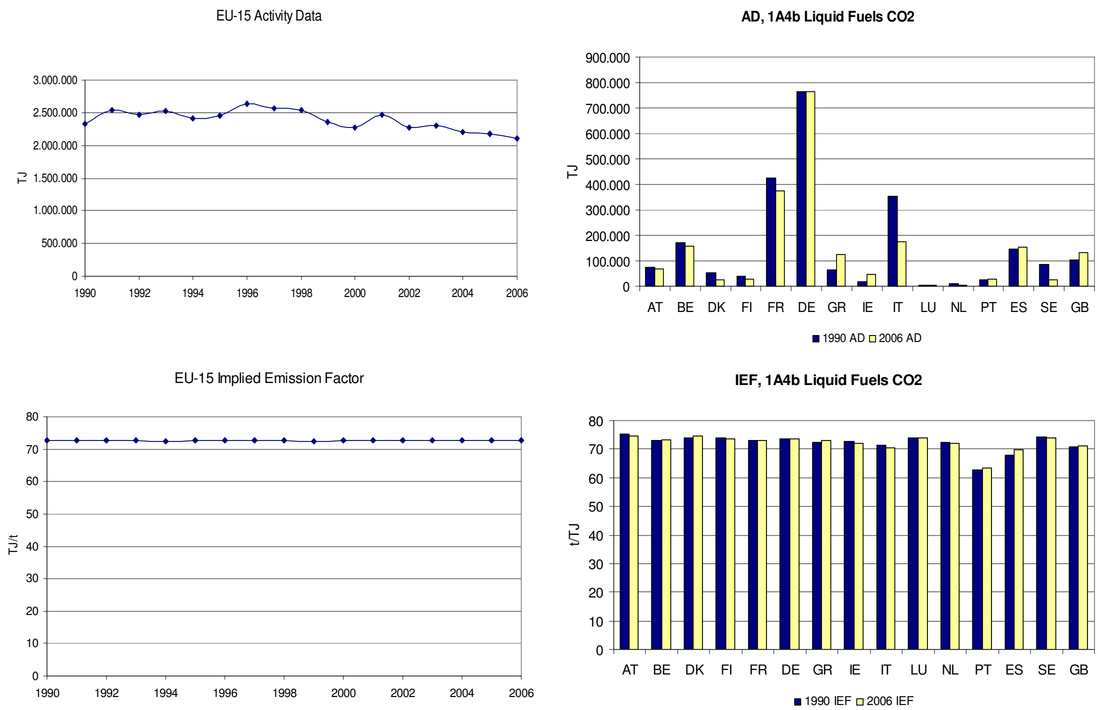
Table 3.70 1A4b Residential, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	5,603	5,454	5,144	3.4%	-309	-6%	-458	-8%	T2	NS	CS
Belgium	12,609	13,216	11,435	7.5%	-1,780	-13%	-1,174	-9%	T1	RS	D
Denmark	3,999	2,166	1,987	1.3%	-179	-8%	-2,011	-50%	C	NS	CS/C/D
Finland	2,951	2,078	2,077	1.4%	-1	0%	-875	-30%	T1	NS	CS
France	30,992	29,827	27,496	17.9%	-2,331	-8%	-3,496	-11%	C	NS	CS
Germany	56,344	53,102	56,152	36.6%	3,050	6%	-193	0%	CS	NS	CS
Greece	4,585	9,681	9,214	6.0%	-467	-5%	4,629	101%	T2	NS	D
Ireland	1,190	3,524	3,443	2.2%	-81	-2%	2,253	189%	T1	NS	CS
Italy	25,165	13,742	12,282	8.0%	-1,459	-11%	-12,882	-51%	T2	NS	CS
Luxembourg	353	343	316	0.2%	-27	-8%	-37	-10%	T1	NS	D
Netherlands	737	273	266	0.2%	-7	-3%	-472	-64%	T2	NS	CS
Portugal	1,621	1,838	1,762	1.1%	-76	-4%	140	9%	T2	NS	D,C
Spain	9,971	11,821	10,598	6.9%	-1,222	-10%	627	6%	T2	NS	C
Sweden	6,335	2,323	1,730	1.1%	-593	-26%	-4,604	-73%	T1, T2, T3	NS	CS
United Kingdom	7,253	9,052	9,505	6.2%	453	5%	2,252	31%	T2	NS,AS	CS
EU-15	**169,708**	**158,438**	**153,407**	**100.0%**	**-5,031**	**-3%**	**-16,301**	**-10%**			

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 70 % of the CO_2 emissions from liquid fuels in 1A4b. Fuel consumption in the EU-15 decreased by 10 % between 1990 and 2006. The implied emission factor of EU-15 was 72.7 t/TJ in 2006. The implied emission factor of Portugal is lower than for other countries because a high share of city gas and LPG is used by the domestic sector.

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



1A4b Residential –Solid Fuels (CO_2)

In 2006 CO_2 from solid fuels had a share of 3 % within source category 1A4b (compared to 18 % in 1990). Between 1990 and 2006 the emissions decreased by 86 % (Table 3.71). All Member States reported decreasing emissions with the highest reductions in absolute terms in Germany, the UK, Ireland and France. Between 2005 and 2006 EU-15 emissions declined by 7 %, although three Member States reported rising emissions. France, Sweden and Portugal report emissions for 2006 as

‘Not occuring’.

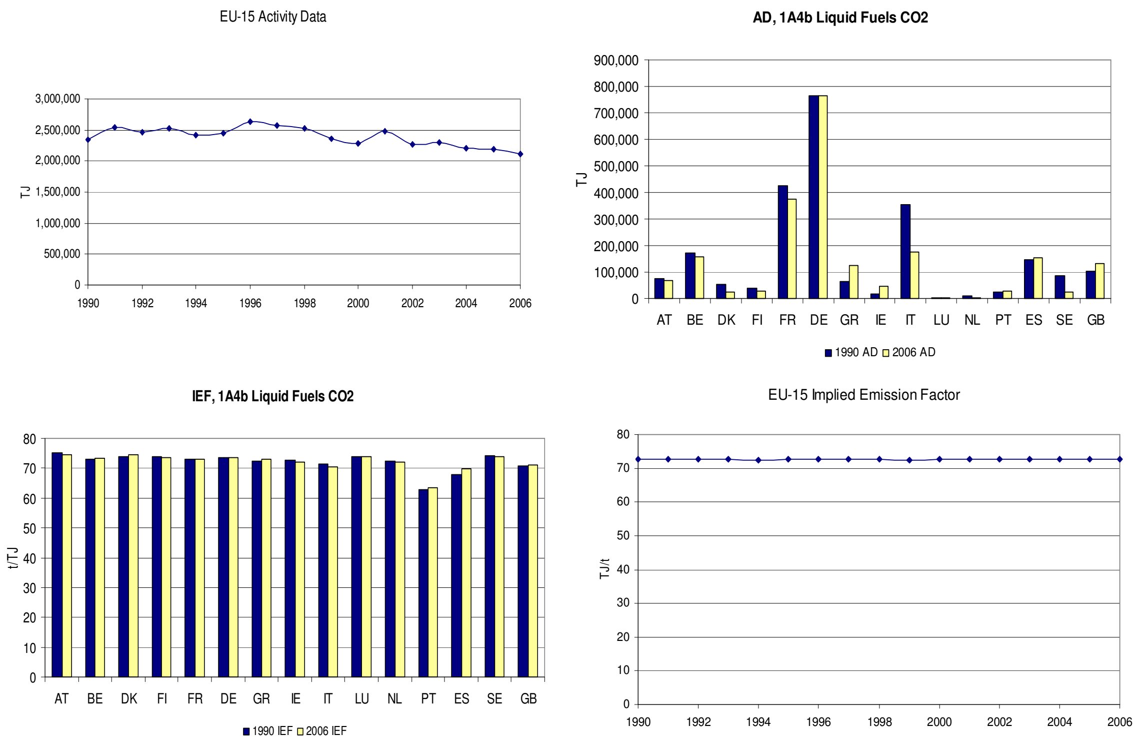
Table 3.71 1A4b Residential, solid fuels: Member States’ contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	2,512	512	487	4.6%	-25	-5%	-2,026	-81%	T2	NS	CS
Belgium	1,759	522	481	4.6%	-41	-8%	-1,279	-73%	T1	RS	D
Denmark	72	1	0	0.0%	0	-49%	-72	-99%	C	NS	CS/C/D
Finland	33	1	1	0.0%	0	0%	-32	-96%	T1	NS	CS
France	3,350	43	75	0.7%	31	72%	-3,275	-98%	C	NS	CS
Germany	41,415	4,470	4,061	38.7%	-409	-9%	-37,354	-90%	CS	NS	CS
Greece	82	11	6	0.1%	-6	-51%	-76	-93%	T2	NS	D
Ireland	5,607	2,159	2,092	19.9%	-67	-3%	-3,515	-63%	T1	NS	CS
Italy	702	32	32	0.3%	0	1%	-670	-95%	T2	NS	CS
Luxembourg	46	3	3	0.0%	-1	-22%	-44	-94%	T1	NS	D
Netherlands	61	19	19	0.2%	-1	-3%	-42	-70%	T2	NS	CS
Portugal	NO	NO	NO	-	-	-	-	-	T2	NS	D,C
Spain	2,091	427	420	4.0%	-7	-2%	-1,671	-80%	T2	NS	C
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA	NA
United Kingdom	16,821	3,044	2,819	26.9%	-224	-7%	-14,002	-83%	T2	NS,AS	CS
EU-15	**74,552**	**11,244**	**10,495**	**100.0%**	**-749**	**-7%**	**-64,057**	**-86%**			

Abbreviations explained in the Chapter ‘Units and abbreviations’.

Figure 3.74 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions – Germany, Ireland and the United Kingdom; together cause 85 % of the CO_2 emissions from gaseous fuels in 1A4b. Fuel consumption in the EU-15 decreased by 87 % between 1990 and 2006. The implied emission factor of EU-15 was 100,2 t/TJ in 2006.

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



1A4b Residential – Gaseous Fuels (CO_2)

In 2006, CO_2 from gaseous fuels had a share of 58 % within source category 1A4b (compared to 39 % in 1990). Between 1990 and 2006 the emissions increased by 48 % (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 2005 and 2006, EU-15 emissions dercreased by -4 %; six Member States reported an increase.

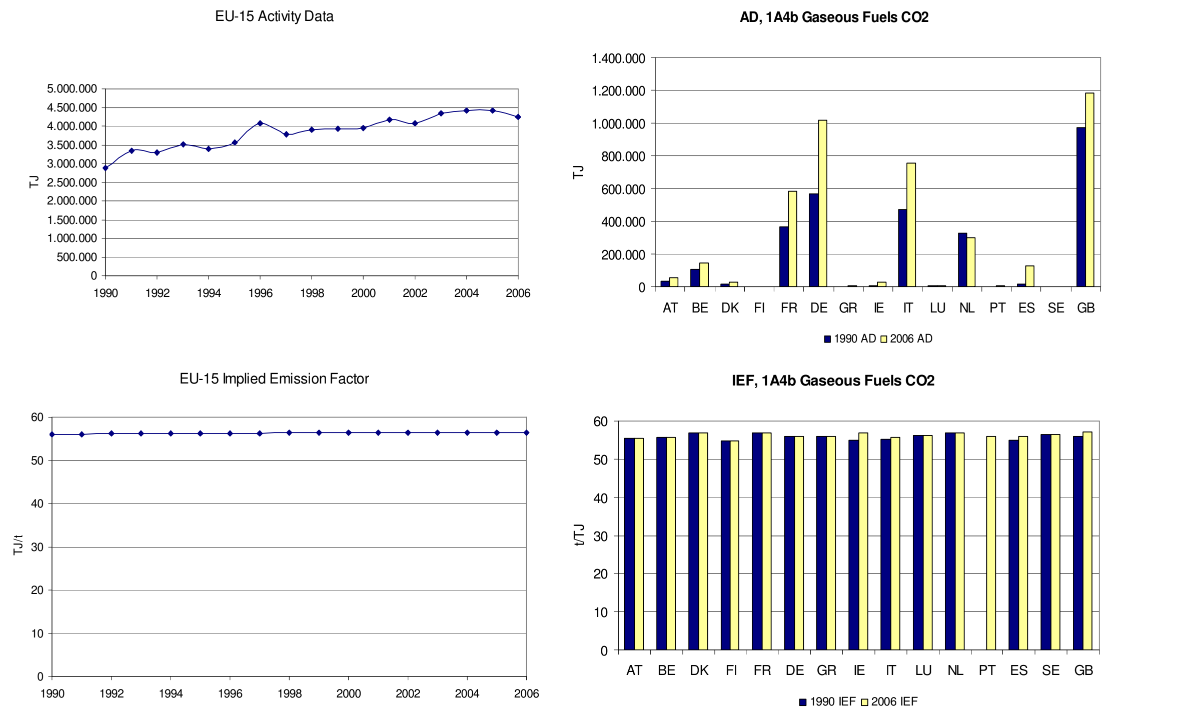
Table 3.72 1A4b Residential, gaseous fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	1,791	3,378	3,034	1.3%	-344	-10%	1,243	69%	T2	NS	CS
Belgium	5,824	8,166	8,181	3.4%	15	0%	2,357	40%	T1	RS	D
Denmark	988	1,766	1,707	0.7%	-59	-3%	719	73%	C	NS	CS/C/D
Finland	22	67	78	0.0%	11	16%	56	255%	T1	NS	CS
France	20,764	34,516	33,275	13.9%	-1,241	-4%	12,511	60%	C	NS	CS
Germany	31,714	57,456	56,951	23.8%	-505	-1%	25,237	80%	CS	NS	CS
Greece	5	169	321	0.1%	152	90%	316	6419%	T2	NS	D
Ireland	270	1,443	1,504	0.6%	61	4%	1,234	458%	T1	NS	CS
Italy	26,123	44,604	41,942	17.5%	-2,661	-6%	15,819	61%	T2	NS	CS
Luxembourg	208	278	301	0.1%	23	8%	93	45%	T1	NS	D
Netherlands	18,696	17,887	17,123	7.2%	-764	-4%	-1,573	-8%	T2	NS	CS
Portugal	NO	423	429	0.2%	6	1%	429	-	T2	NS	D,C
Spain	918	7,427	7,092	3.0%	-335	-5%	6,174	673%	T2	NS	CS
Sweden	86	86	67	0.0%	-18	-21%	-19	-22%	T1, T2, T3	NS	CS
United Kingdom	54,473	71,031	67,406	28.2%	-3,625	-5%	12,934	24%	T2	NS	CS
EU-15	**161,882**	**248,698**	**239,413**	**100.0%**	**-9,284**	**-4%**	**77,532**	**48%**			

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 47 % between 1990 and 2006. The implied emission factor of EU-15 was 56.4 t/TJ in 2006.

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 2006. Between 1990 and 2006, CH_4 emissions from households decreased by 30 % in the EU-15 (Table 3.73). France is reponsible for 36 % of total CH_4 emissions and achieved between 1990 and 2006 a reduction of 47 %. All Member States except Denmark, Finland and Italy reported a decrease in emissions.

Between 2005 and 2006 EU-15 emissions decreased by 4%.

Table 3.73 1A4b Residential: Member States' contributions to CH_4 emissions

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006	
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	377	228	216	3.7%	-12	-5%	-161	-43%
Belgium	208	139	136	2.3%	-3	-2%	-72	-35%
Denmark	67	148	154	2.6%	6	4%	87	130%
Finland	164	177	180	3.1%	3	1%	16	10%
France	3,941	2,273	2,073	35.5%	-200	-9%	-1,868	-47%
Germany	1,200	691	678	11.6%	-12	-2%	-522	-43%
Greece	70	65	65	1.1%	0	-1%	-5	-7%
Ireland	90	42	41	0.7%	-1	-3%	-50	-55%
Italy	260	411	443	7.6%	32	8%	183	70%
Luxembourg	6	4	4	0.1%	0	-2%	-3	-42%
Netherlands	355	329	317	5.4%	-12	-3%	-38	-11%
Portugal	344	312	311	5.3%	-1	0%	-33	-10%
Spain	775	614	613	10.5%	-1	0%	-163	-21%
Sweden	239	232	218	3.7%	-13	-6%	-21	-9%
United Kingdom	1,448	395	396	6.8%	1	0%	-1,051	-73%
EU-15	**9,545**	**6,058**	**5,844**	**100.0%**	**-214**	**-4%**	**-3,701**	**-39%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A4b Residential – Biomass (CH_4)

In 2006 CH_4 from biomass had a share of 1.1 % within source category 1A4b (compared to 1.5 % in 1990). Between 1990 and 2006 the emissions decreased by 24 % (Table 3.74). France reported the highest absolute decrease, while Germany's (113 %), Denmarks's (120 %) and Italys (109 %) CH_4 emissions increased significantly. Between 2005 and 2006, EU-15 emissions decreased by -4 %.

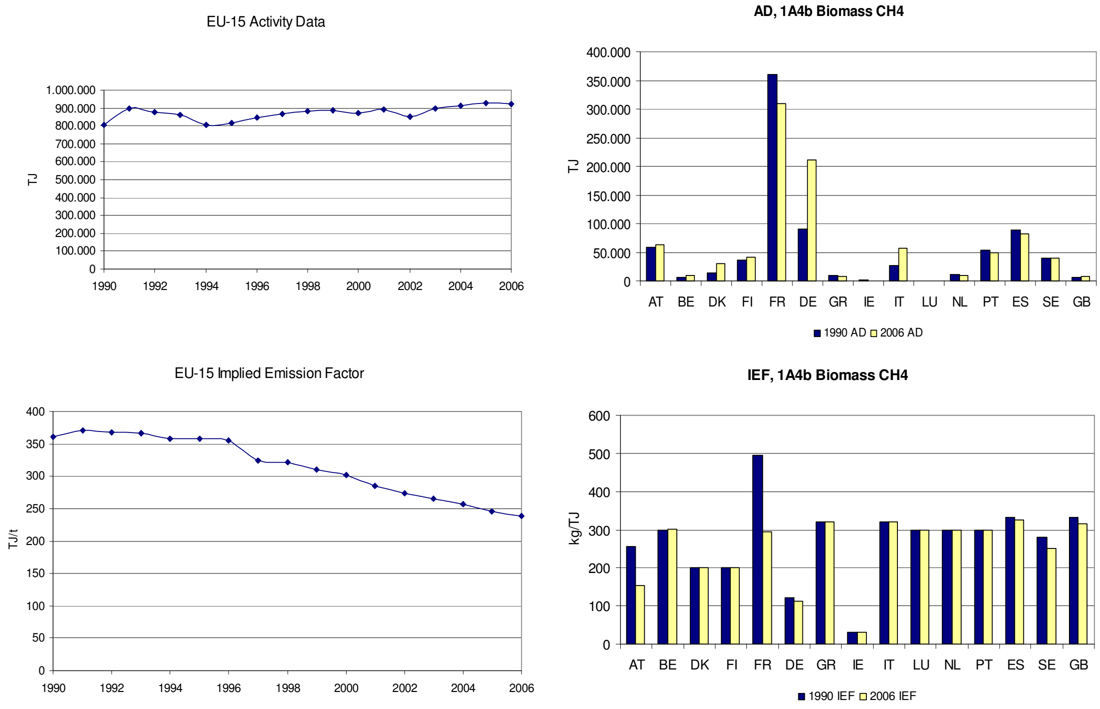
Table 3.74 1A4b Residential, biomass: Member States' contributions to CH_4 emissions and information on method applied, activity data and emission factor

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006	
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	312	215	204	4.4%	-11	-5%	-108	-35%
Belgium	42	51	55	1.2%	5	9%	13	31%
Denmark	59	123	129	2.8%	6	5%	71	120%
Finland	152	171	173	3.8%	3	2%	21	14%
France	3,737	2,108	1,913	41.5%	-194	-9%	-1,824	-49%
Germany	235	506	501	10.9%	-5	-1%	267	113%
Greece	63	57	57	1.2%	0	0%	-6	-9%
Ireland	1	0	0	0.0%	0	5%	-1	-62%
Italy	183	347	384	8.3%	37	11%	201	109%
Luxembourg	2	2	2	0.0%	0	0%	0	4%
Netherlands	73	59	59	1.3%	0	0%	-14	-19%
Portugal	343	311	310	6.7%	-1	0%	-34	-10%
Spain	621	562	562	12.2%	0	0%	-59	-9%
Sweden	229	222	209	4.5%	-13	-6%	-20	-9%
United Kingdom	46	54	54	1.2%	0	0%	8	17%
EU-15	**6,099**	**4,787**	**4,613**	**100.0%**	**-173**	**-4%**	**-1,486**	**-24%**

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 65 % of the CH_4 emissions from biomass fuels in 1A4b. Fuel consumption in the EU-15 rose by 14 % between 1990 and 2006. The implied emission factor of EU-15 was 238,5 kg/TJ in 2006.

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

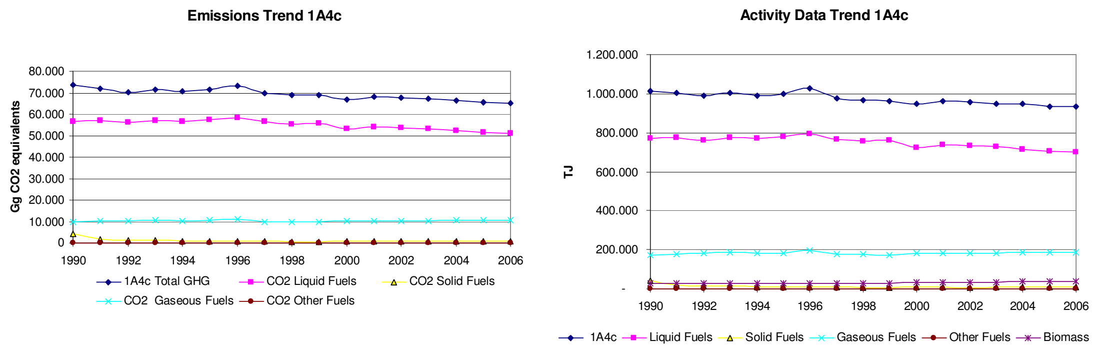


3.2.4.3. Agriculture/Forestry/Fisheries (1A4c) (EU-15)

In this chapter information about emission trends, Member States' contribution, activity data, and emission factors is provided for category 1A4c by fuels. CO_2 emissions from 1A4c Agriculture/Forestry/Fisheries account for 1.5 % of total EU-15 GHG emissions in 2006. Between 1990 and 2006, 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 (-10 %).

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



The Member States France, Germany, Italy, the Netherlands and Spain contributed the most to the emissions from this source (70 %). The Member State with the highest increase in absolute terms between 1990 and 2006 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

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006	
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	1,839	1,634	1,577	2.5%	-57	-3%	-262	-14%
Belgium	2,730	2,382	2,336	3.7%	-47	-2%	-394	-14%
Denmark	2,493	2,192	2,128	3.4%	-64	-3%	-365	-15%
Finland	2,017	1,875	1,701	2.7%	-174	-9%	-316	-16%
France	10,612	9,238	9,137	14.6%	-102	-1%	-1,475	-14%
Germany	10,917	6,437	6,498	10.4%	61	1%	-4,419	-40%
Greece	2,927	2,729	2,882	4.6%	152	6%	-46	-2%
Ireland	660	862	825	1.3%	-36	-4%	165	25%
Italy	8,347	8,371	8,240	13.2%	-131	-2%	-107	-1%
Luxembourg	78	75	75	0.1%	0	0%	-3	-4%
Netherlands	10,872	9,722	10,025	16.0%	304	3%	-847	-8%
Portugal	1,660	904	877	1.4%	-27	-3%	-783	-47%
Spain	8,556	9,868	9,981	15.9%	113	1%	1,425	17%
Sweden	1,759	2,032	2,030	3.2%	-2	0%	271	15%
United Kingdom	5,144	4,469	4,279	6.8%	-189	-4%	-865	-17%
EU-15	**70,613**	**62,791**	**62,592**	**100.0%**	**-199**	**0%**	**-8,020**	**-11%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

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

In 2006 CO_2 from liquid fuels had a share of 79 % within source category 1A4c (compared to 77 % in 1990). Between 1990 and 2006 the emissions decreased by 10 % (Table 3.76). Three Member States (Ireland, Spain and Sweden) reported increasing emissions with the highest increases in absolute terms in Spain. Between 2005 and 2006 EU-15 emissions declined by 0.5 %, the highest change reported Finnland (-10 %).

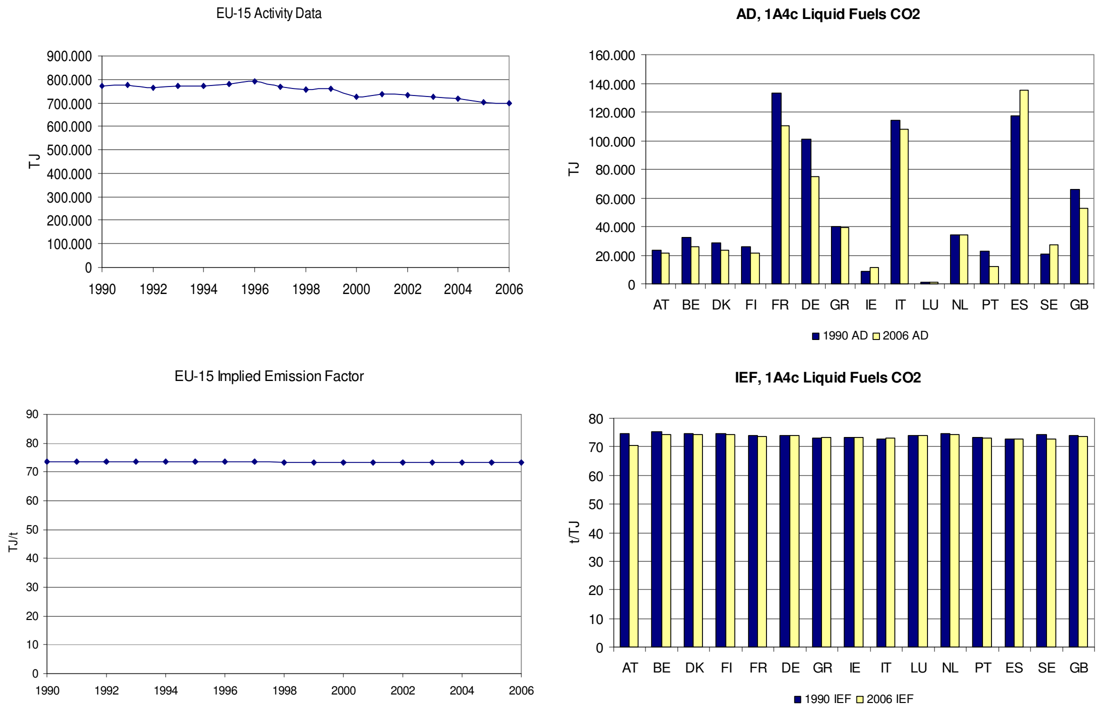
Table 3.76 1A4c Agriculture/Forestry/Fisheries, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	1,768	1,586	1,533	3.0%	-52	-3%	-234	-13%	T2	NS	CS
Belgium	2,455	1,940	1,932	3.8%	-8	0%	-523	-21%	T1	RS	D
Denmark	2,121	1,749	1,718	3.4%	-31	-2%	-403	-19%	C	NS	CS/C
Finland	1,932	1,781	1,606	3.1%	-175	-10%	-326	-17%	T1	NS	CS
France	9,875	8,233	8,131	15.9%	-102	-1%	-1,744	-18%	C	NS	CS
Germany	7,484	5,439	5,527	10.8%	89	2%	-1,957	-26%	CS	NS	CS
Greece	2,917	2,720	2,866	5.6%	147	5%	-50	-2%	T2	NS	D
Ireland	660	862	825	1.6%	-36	-4%	165	25%	T1	NS	CS
Italy	8,295	7,974	7,890	15.4%	-84	-1%	-406	-5%	T2	NS	CS
Luxembourg	75	75	75	0.1%	0	0%	0	0%	T1	TÜV	D
Netherlands	2,544	2,551	2,556	5.0%	5	0%	12	0%	T2	NS	D, CS
Portugal	1,660	898	876	1.7%	-22	-2%	-785	-47%	T2	NS	D,C
Spain	8,513	9,703	9,836	19.2%	132	1%	1,323	16%	T2, T3	NS, Q	C
Sweden	1,569	1,976	1,992	3.9%	16	1%	423	27%	T1, T2, T3	NS	CS
United Kingdom	4,914	4,029	3,895	7.6%	-134	-3%	-1,019	-21%	T2	NS,AS	CS
EU-15	**56,783**	**51,515**	**51,259**	**100.0%**	**-256**	**0%**	**-5,524**	**-10%**			

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 2006. The implied emission factor of EU-15 was 73.3 t/TJ in 2006.

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 2006 CO_2 from solid fuels had a share of 1 % within source category 1A4c (compared to 6 % in 1990). Between 1990 and 2006 the emissions decreased by 81 % (Table 3.77). All Member States except Greece reported decreasing emissions. Ireland, Italy, the Netherlands, Luxembourg, Portugal, Spain and Sweden report CO_2 emissions from this source category in 2006 as 'Not ocurring'. Between 2005 and 2006 EU-15 emissions increased by 2 %. The long term emissions trend is dominated by the emissions trend of Germany.

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

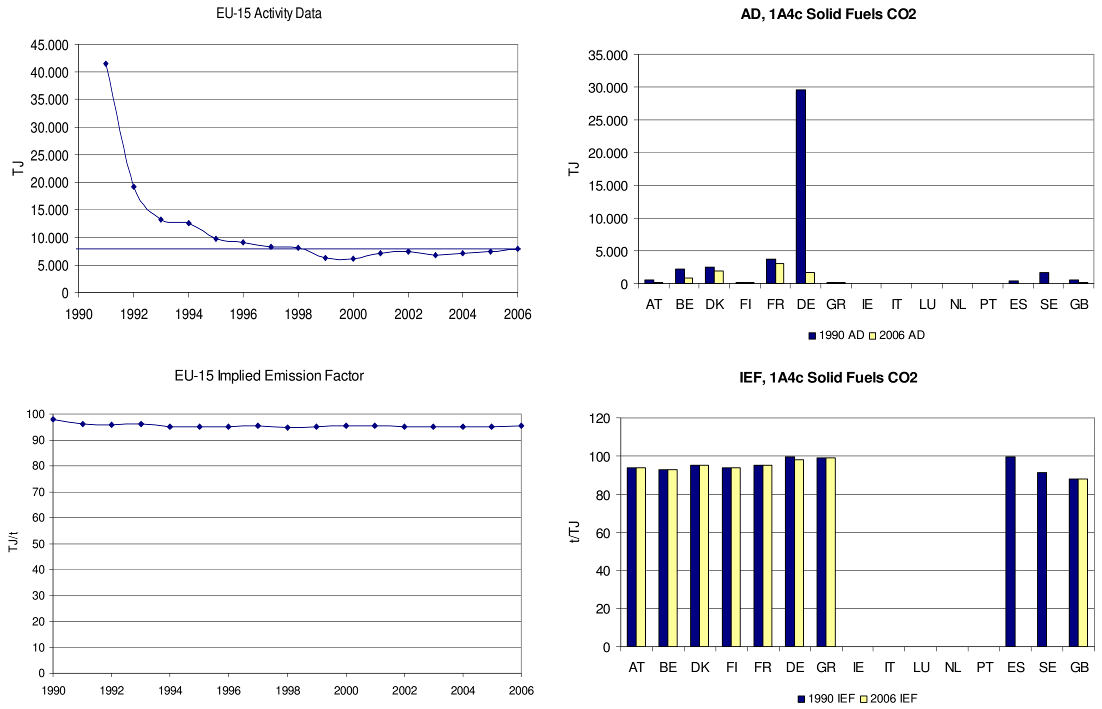
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	51	10	10	1.3%	-1	-6%	-42	-81%	T2	NS	CS
Belgium	208	76	76	9.9%	0	0%	-132	-64%	T1	RS	D
Denmark	239	170	190	24.9%	20	12%	-49	-20%	C	NS	CS/C
Finland	13	11	10	1.3%	-1	-5%	-3	-23%	T1	NS	CS
France	353	287	287	37.6%	0	0%	-66	-19%	C	NS	CS
Germany	2,948	167	164	21.4%	-4	-2%	-2,785	-94%	CS	NS	CS
Greece	11	10	15	2.0%	6	60%	4	41%	T2	NS	D
Ireland	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Italy	NO	NO	NO	-	-	-	-	-	T2	NS	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Netherlands	NO	NO	NO	-	-	-	-	-	NA	NA	NA
Portugal	NO	NO	NO	-	-	-	-	-	T2	NS	D,C
Spain	37	NA	NA	-	-	-	-37	-100%	T2	NS	C
Sweden	157	NO	NO	-	-	-	-157	-100%	NA	NA	NA
United Kingdom	48	21	12	1.5%	-9	-44%	-37	-76%	T2	NS,AS	CS
EU-15	**4,066**	**752**	**764**	**100.0%**	**12**	**2%**	**-3,303**	**-81%**			

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 84 % of the CO_2 emissions from solid fuels in 1A4b. Fuel consumption in the EU-15 decreased by 81 % between 1990 and 2006. The implied emission factor of EU-15 was 95.3 t/TJ in 2006.

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 2006, CO_2 from gaseous fuels had a share of 16 % within source category 1A4c (compared to 13 % in 1990). Between 1990 and 2006 the emissions increased by 8 % (Table 3.78). All Member States reported increasing emissions except Finland, Luxembourg and the Netherlands.The highest relative increase ocurred in Spain (+2265 %). Between 2005 and 2006 EU-15 emissions hardly changed.

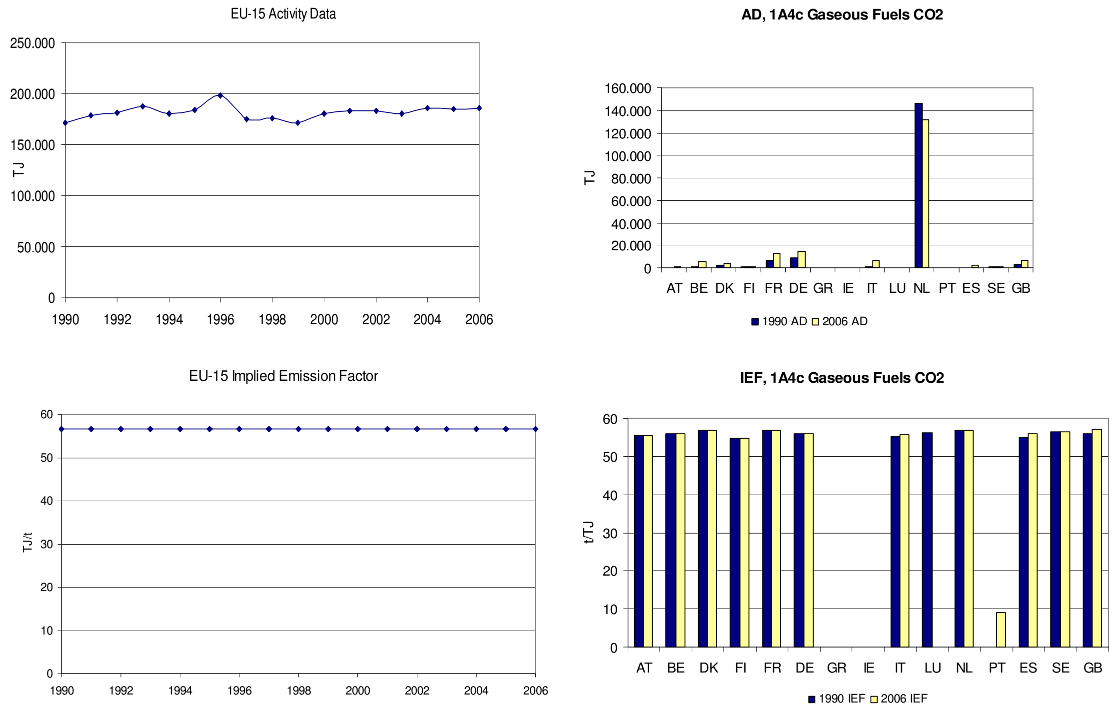
Table 3.78 1A4c Agriculture/Forestry/Fisheries, gaseous fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	20	38	34	0.3%	-4	-10%	14	69%	T2	NS	CS
Belgium	67	367	328	3.1%	-38	-10%	261	390%	T1	RS	D
Denmark	132	273	219	2.1%	-54	-20%	87	66%	C	NS	CS/C
Finland	32	30	30	0.3%	0	0%	-2	-7%	T1	NS	CS
France	383	718	718	6.8%	0	0%	335	88%	C	NS	CS
Germany	485	832	807	7.7%	-24	-3%	322	67%	CS	NS	CS
Greece	NO	NO	NO	-	-	-	-	-	0.0	0.0	0.0
Ireland	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Italy	52	397	350	3.3%	-47	-12%	298	578%	T2	NS	CS
Luxembourg	3	NO	NO	-	-	-	-3	-100%	T1	EJ	D
Netherlands	8,328	7,170	7,469	71.0%	299	4%	-859	-10%	T2	NS	CS
Portugal	NO	6	1	0.0%	-5	-76%	1	-	T2	NS	D,C
Spain	6	165	146	1.4%	-19	-12%	139	2265%	T2	NS	CS
Sweden	33	56	38	0.4%	-18	-32%	5	15%	T1, T2, T3	NS	CS
United Kingdom	182	418	372	3.5%	-46	-11%	190	105%	T2	NS	CS
EU-15	**9,723**	**10,471**	**10,514**	**100.0%**	**43**	**0%**	**791**	**8%**			

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 71 % of the CO_2 emissions from gaseous fuels in 1A4c. Fuel consumption in the EU-15 increased by 8 % between 1990 and 2006. The implied emission factor of EU-15 was 56.6 t/TJ in 2006. The comparatively low emission factor of Portugal is an error in actvity data reporting and will be revised.

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) (EU-15)

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 use	CRF Table 1.s.2
Denmark	Mobile: Military use	CRF Table 1.s.2
Finland	Stationary: Other non-specified & Non-energy use of fuel, Non-specified emissions of Fuels from non-energy use, Indirect N_2O emissions from NOx 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 and 'Not occuring' from 1995 on. Mobile: other non-specified	CRF Table 1.s.2
Spain	Emissions are 'Not occuring'	CRF Table 1.s.2
Sweden	Stationary: other non-specified Mobile: Military use and Other non-specified	CRF Table 1.s.2
United Kingdom	Mobile: military use	CRF Table 1.s.2

Figure 3.81 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 64 % between 1990 and 2006.

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

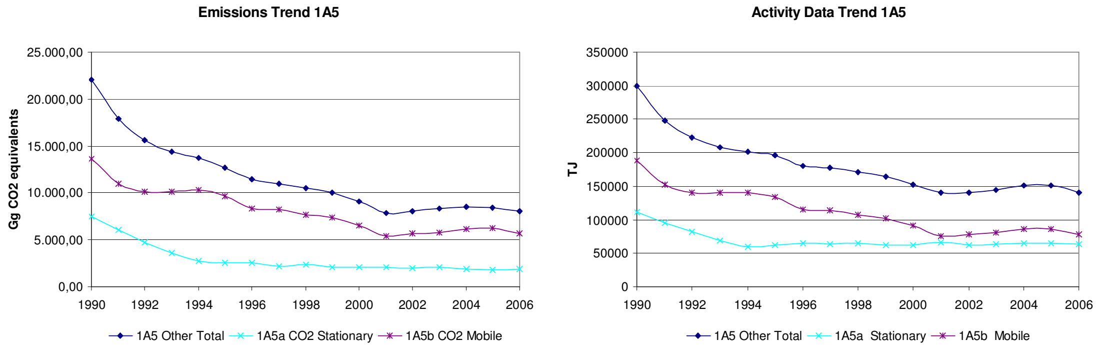


Table 3.80 shows total GHG and CO_2 emissions by Member State from 1A5. CO_2 emissions from 1A5 Other account for 0.2 % of total GHG emissions in 2006. Between 1990 and 2006, CO_2 emissions from this source decreased by 64 % in the EU-15. Between 1990 and 2006, the largest reduction in absolute terms 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 2006 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO_2 emissions in 2006 (Gg)
Austria	36	128	35	125
Belgium	168	95	166	95
Denmark	120	128	119	126
Finland	1,642	1,550	1,191	1,251
France	NO	NO	NO	NO
Germany	12,099	1,562	11,798	1,546
Greece	NO	NO	0	NA
Ireland	NO	NO	NO	NO
Italy	1,114	1,058	1,041	982
Luxembourg	0	0	IE,NO	IE,NO
Netherlands	577	388	566	381
Portugal	104	76	103	75
Spain	0	0	NO	NO
Sweden	872	246	845	241
United Kingdom	5,337	2,774	5,285	2,747
EU-15	**22,069**	**8,006**	**21,149**	**7,570**

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 2005 and main explanations for the largest recalculations in absolute terms.

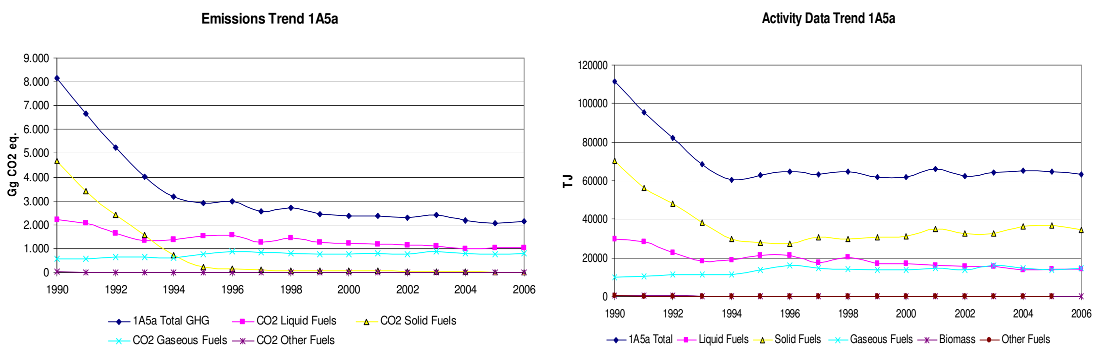
Table 3.81 1A5 Other: Contribution of MS to EU-15 recalculations in CO_2 for 1990 and 2005 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2005		Main explanations
	Gg	Percent	Gg	Percent	
Austria	0	0,0	0	0,0	
Belgium	0	0,0	0	-0,2	
Denmark	0	0,0	0	0,0	
Finland	-134	-10,1	-371	-24,0	1990: Correction of data. NOx emissions have been calculated; reallocation of a plant in 1.A.2.c; 2005: Correction of data
France	NE	0,0	NE	0,0	
Germany	-28	-0,2	-59	-3,4	1990:new emission faktor for jet kerosine; 2005:new available energy data
Greece	0	-0,2	0	0,0	
Ireland	0	-0,2	0	0,0	
Italy	0	0,0	0	0,0	
Luxembourg	-	0,0	-	0,0	
Netherlands	0	0,0	0	0,0	
Portugal	95	1.171,0	NE	0,0	Addition of the emissions from jet fuel used for military purposes and classified in the fuel balance as "Serviços"; Correction of calculation errors
Spain	0	0,0	NE	0,0	
Sweden	0	0,0	0	0,0	
UK	0	0,0	0	0,0	
EU-15	**-67**	**-0,3**	**-358**	**-4,3**	

3.2.5.1. Stationary (1A5a) (EU-15)

In this chapter information about emission trends, Member States' contribution, activity data, and emission factors is provided for category 1A5a by fuels. CO_2 emissions from 1A5a Stationary account for 0.04 % of total EU-15 GHG emissions in 2006. 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 74 %, mainly due to decreases in emissions from solid fuels (-99.7 %) and liquid fuels (-54 %).

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



In only three Member States (Finland, Germany and Portugal) emissions from this key source are reported. Between 1990 and 2006 Finland had a decrease of -5 % and Germany a decrease of 88 %. Portugal reports emissions from 1990 to 1994 only. This led to an EU-15 decrease of 75 %. Between 2005 and 2006 Finland had an increase of 7 % and Germany a decrease of 1 %. (Table 3.82). This led to an EU-15 increase of 4 %.

Table 3.82 1A5a Stationary: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006	
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	NA	NA	NA	-	-	-	-	-
Belgium	NA	NA	NA	-	-	-	-	-
Denmark	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Finland	1,133	1,009	1,081	58.2%	72	7%	-52	-5%
France	NO	NO	NO	-	-	-	-	-
Germany	6,329	783	776	41.8%	-7	-1%	-5,554	-88%
Greece	0	0	NA	-	-	-	-	-
Ireland	NO	NO	NO	-	-	-	-	-
Italy	NA	NA	NA	-	-	-	-	-
Luxembourg	IE,NO	IE,NO	IE,NO	-	-	-	-	-
Netherlands	NA	NA	NA	-	-	-	-	-
Portugal	8	NO	NO	-	-	-	-8	-100%
Spain	NO	NO	NO	-	-	-	-	-
Sweden	NA,NO	NA,NO	NA,NO	-	-	-	-	-
United Kingdom	NA	NA	NA	-	-	-	-	-
EU-15	**7,470**	**1,793**	**1,857**	**100.0%**	**64**	**4%**	**-5,613**	**-75%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A5a Stationary – Solid Fuels (CO_2)

In 2006 CO_2 from solid fuels had a share of 1 % within source category 1A5a (compared to 57 % in 1990). Between 1990 and 2006 the emissions decreased by 99.7 % (Table 3.83). In 2006 only Germany reported emissions for this key source.

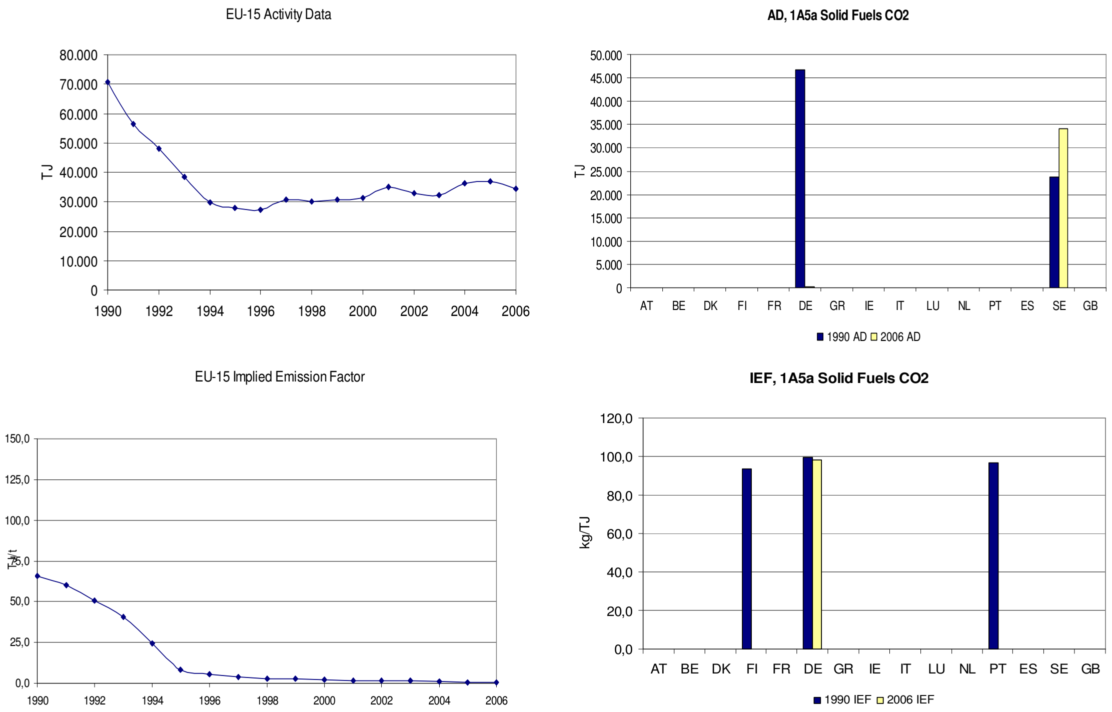
Table 3.83 1A5a Stationary, solid fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	NA	NA	NA	-	-	-	-	-	NO	NO	NO
Belgium	NA	NA	NA	-	-	-	-	-	NA	NA	NA
Denmark	NO	NO	NO	-	-	-	-	-	0.0	Not Occuring	0.0
Finland	1	NO	NO	-	-	-	-1	-100%	T1	NS	CS
France	NO	NO	NO	-	-	-	-	-	NA	NA	NA
Germany	4,657	15	13	100.0%	-2	-15%	-4,644	-100%	CS	NS	CS
Greece	0	0	NA	-	-	-	-	-	0.0	0.0	0.0
Ireland	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Italy	NA	NA	NA	-	-	-	-	-	NA	NA	NA
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Netherlands	NA	NA	NA	-	-	-	-	-	NA	NA	NA
Portugal	8	NO	NO	-	-	-	-8	-100%	T1	NS	D,C
Spain	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Sweden	NA	NA	NA	-	-	-	-	-	NA	NA	NA
United Kingdom	NA	NA	NA	-	-	-	-	-	NO	NO	NO
EU-15	**4,667**	**15**	**13**	**100.0%**	**-2**	**-15%**	**-4,654**	**-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 2006. Fuel combustion in the EU-15 decreased by 99,7 % between 1990 and 2006. The implied emission factor is 98 t/TJ in 2006. Sweden reports transformation losses of energy in iron ore based iron and steel industry as activity data without any emissions (for reason of consistency with the Reference Approach).

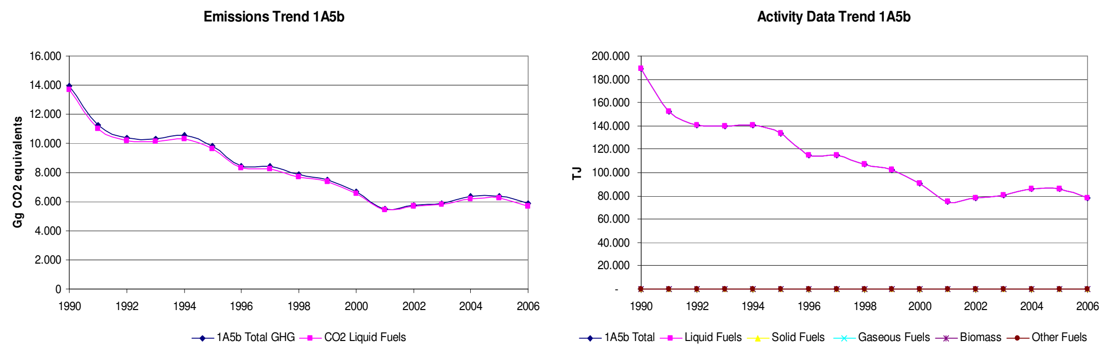
Figure 3.83 1A5a Stationary, solid fuels: Activity Data and Implied Emission Factors for CO_2



3.2.5.2. Mobile (1A5b) (EU-15)

In this chapter information about emission trends, Member States' contribution, activity data, and emission factors is provided for category 1A5a by fuels. CO_2 emissions from 1A5b Mobile account for 0.1 % of total EU-15 GHG emissions in 2006. 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 58 %.

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



Four Member States report emissions as 'Not occuring' and/or "Included elsewhere". The United Kingdom has the highest emissions in 2006 and – together with Germany - decreased most between 1990 and 2006. Austria and Finland reported a rise of more than 100 %. Between 2005 and 2006 Italy had the largest absolute reduction. The EU-15 emissions decreased by 8% between 2005 and 2006 (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 2006	Change 2005-2006		Change 1990-2006	
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	35	120	125	2.2%	5	4%	90	258%
Belgium	166	95	95	1.7%	0	0%	-71	-43%
Denmark	119	271	126	2.2%	-144	-53%	7	6%
Finland	58	166	170	3.0%	5	3%	112	194%
France	NO	NO	NO	-	-	-	-	-
Germany	5,468	914	770	13.5%	-144	-16%	-4,698	-86%
Greece	0	0	NA	-	-	-	-	-
Ireland	NO	NO	NO	-	-	-	-	-
Italy	1,041	1,198	982	17.2%	-216	-18%	-59	-6%
Luxembourg	IE,NO	IE,NO	IE,NO	-	-	-	-	-
Netherlands	566	375	381	6.7%	6	2%	-185	-33%
Portugal	95	73	75	1.3%	3	4%	-20	-21%
Spain	NO	NO	NO	-	-	-	-	-
Sweden	845	223	241	4.2%	18	8%	-604	-71%
United Kingdom	5,285	2,788	2,747	48.1%	-42	-1%	-2,538	-48%
EU-15	**13,679**	**6,223**	**5,714**	**100.0%**	**-509**	**-8%**	**-7,965**	**-58%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A5b Mobile – Liquid Fuels (CO_2)

In 2006, CO_2 from liquid fuels had a share of 98 % within source category 1A5b (compared to 98 % in 1990). Between 1990 and 2006 the emissions decreased by 58 % (Table 3.85). France, Greece, Ireland, Luxembourg and Spain report emissions as 'Not occuring', or 'Included Elsewhere'. The highest decrease was achieved in Germany (-86 %), while Austria and Finland had increases of more than 100 %.

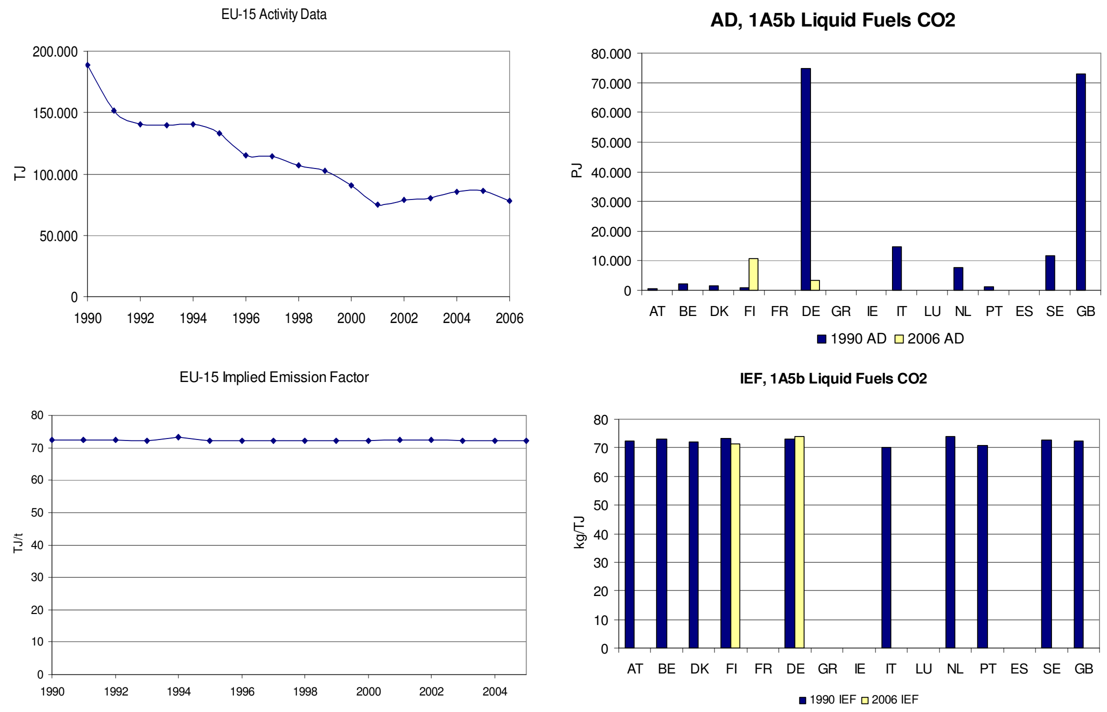
Table 3.85 1A5b Mobile, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	35	120	125	2.2%	5	4%	90	258%	NA	NA	NA
Belgium	166	95	95	1.7%	0	0%	-71	-43%	C	RS	C
Denmark	119	271	126	2.2%	-144	-53%	7	6%	C	NS	CS/C
Finland	58	166	170	3.0%	5	3%	112	194%	T1	NS	CS
France	NO	NO	NO	-	-	-	-	-	NA	NA	NA
Germany	5,468	914	770	13.5%	-144	-16%	-4,698	-86%	CS	NS	CS
Greece	0	0	NA	-	-	-	-	-	0.0	0.0	0.0
Ireland	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Italy	1,041	1,198	982	17.2%	-216	-18%	-59	-6%	T2	NS	CS
Luxembourg	IE	IE	IE	-	-	-	-	-	NA	IE	NA
Netherlands	566	375	381	6.7%	6	2%	-185	-33%	T2	NS	D
Portugal	95	73	75	1.3%	3	4%	-20	-21%	T1	NS	D,C
Spain	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Sweden	845	223	241	4.2%	18	8%	-604	-71%	T1	NS	CS
United Kingdom	5,285	2,788	2,747	48.1%	-42	-1%	-2,538	-48%	T2,T3	NS,AS	CS
EU-15	**13,679**	**6,223**	**5,714**	**100.0%**	**-509**	**-8%**	**-7,965**	**-58%**			

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 59 % between 1990 and 2006. The implied emission factor of EU-15 was 73.4 t/TJ in 2006.

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



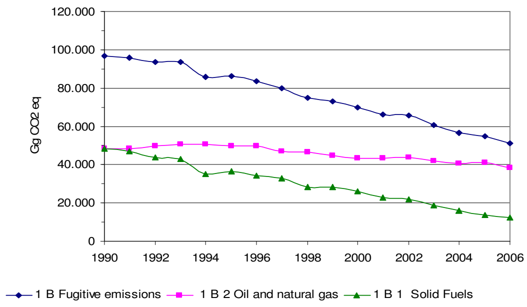
3.2.6. Fugitive emissions from fuels (CRF Source Category 1.B) (EU-15)

This chapter describes gaseous or volatile emissions which occur during extraction, handling and consumption of fossil fuels. In 2006, 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 1.2% 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 have been steadily declining (Figure 3.86). Between 1990 and 2006, the total fugitive GHG emissions decreased by 46 %. This was mainly due to the decrease in underground mining activities: the source category 1B1a.i Underground mines is responsible for three fourths of the total decrease in absolute terms. Between 1990 and 2006, emissions from 1B1 Solid Fuels decreased by 74 %, while emissions from 1B2 Oil and Natural Gas decreased only by 18 %. As a result, while emissions from the two sources (1B1 Solid Fuels and 1B2 Oil and Natural Gas) represented each 50% of total fugitive emissions in 1990, fugitive emissions from 1B1 Solid Fuels represented only 24% of total fugitive emissions in 2006.

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

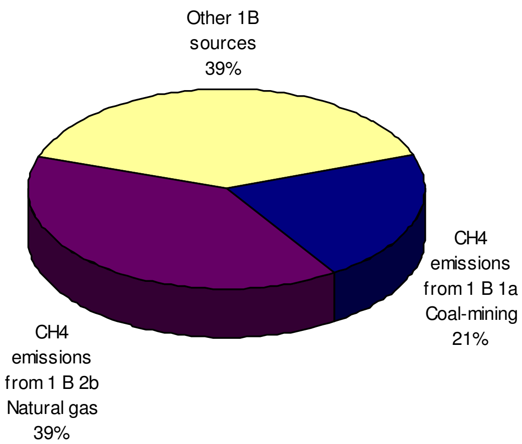


Fugitive emissions include four key sources:

- 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 61 % 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) (EU-15)

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 24 % of total fugitive emissions in the EU-15:

- 87 % 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.
- 11% of these emissions are CO_2 emissions due to both solid fuel transformation (6 %) 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

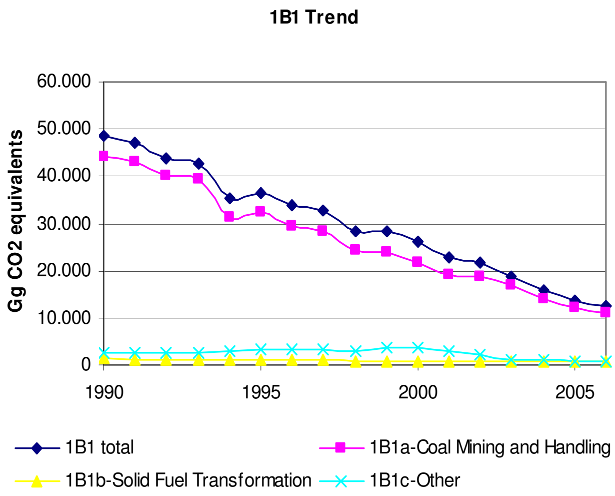


Table 3.86 shows that in 2006, ten EU-15 Member States report positive fugitive emissions from solid fuels: ten report positive fugitive CH_4 emissions and five report positive fugitive CO_2 emissions. Three countries represent 82 % of total fugitive emissions from solid fuels: Germany (39 %), United Kingdom (31 %) 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 2006 (Gg CO_2 equivalents)	CH_4 emissions in 1990 (Gg CO_2 equivalents)	CH_4 emissions in 2006 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO_2 emissions in 2006 (Gg)
Austria	11	IE,NA,NO	11	0.03	IE,NA,NO	IE,NA,NO
Belgium	334	12	334	12	NA	NA,NO
Denmark	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Finland	NO	NO	NO	NO	NO	NO
France	4,331	35	4,331	35	IE,NA,NO	IE,NA,NO
Germany	20,240	4,926	20,240	4,926	NE,NO	NE,NO
Greece	1,095	1,463	1,095	1,362	NE,NO	101
Ireland	NE, NO	NO	NE,NO	NO	NE,NO	NO
Italy	122	54	122	54	NA	NA
Luxembourg	NO	NO	NO	NO	NO	NO
Netherlands	433	472	30	23	403	449
Portugal	75	IE, NO	66	IE,NO	9	IE,NO
Spain	1,835	1,055	1,818	930	18	125
Sweden	791	581	0.1	0.1	789	579
United Kingdom	19,148	3,930	18,290	3,789	856	140
EU-15	**48,416**	**12,527**	**46,337**	**11,131**	**2,074**	**1,394**

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 76 % between 1990 and 2006. Large 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. Fugitive emissions from both coke production sites are included. High CO_2 emissions observed in 1996 in comparison with other years, due to operational problems occurring that year. No fugitive emissions from coal mining and handling activities (1B1a); 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:** Methane emissions from closed coal mines are accounted for within Sector 1B1a of the UK inventory. Most of the emissions reported under 1B1b relate to the manufacture of solid smokeless fuel (SSF) rather than coke oven coke. Fugitive emissions from coke ovens are small in comparison. In terms of activity data however, the production of coke is much greater than the production of solid smokeless fuel. The IEF for 1B1b therefore largely represents the relationship between production of coke and emissions from manufacture of solid smokeless fuel, but these are two entirely separate processes. 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 from SSF manufacture are estimated using a carbon balance approach (difference between the carbon in coal used as a feedstock and the carbon in the manufactured smokeless fuel). The tonnage of coal used is quite high in some years compared with the tonnage of solid smokeless fuel made and this results in larger emissions in those years. **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).

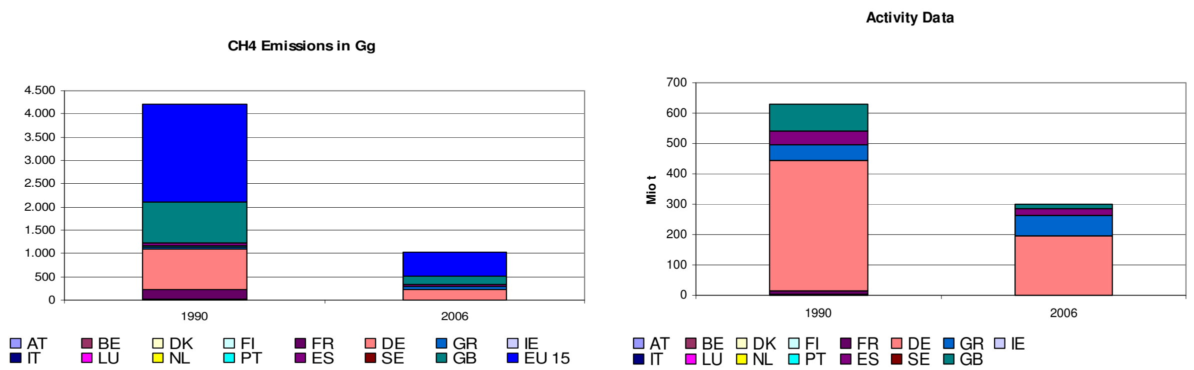
CH_4 emissions from 1B1a Coal-Mining account for 0.3 % of total GHG emissions in 2006 and for 21 % of all fugitive emissions in the EU-15. CH_4 emissions from this source decreased by 75 % in the EU-15 between 1990 and 2006 and by 11% just between 2005 and 2006. Seven Member States report emissions occuring from this source. In 2006, the largest share on total emissions from this source had Germany and the United Kingdom, both together accounting for 79 % of EU-15 emissions (Table 3.88). Both Member States have substantially reduced their emissions between 1990 and 2006 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 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	11	0.03	0.03	0.0%	0	8%	-11	-100%	T1	NS	C
Belgium	299	NO	NO	-	-	-	-299	-100%	D	NS	D
Denmark	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Finland	NO	NO	NO	-	-	-	-	-	NO	NO	NO
France	4,279	4	4	0.0%	0	0%	-4,275	-100%	C	AS	CS
Germany	18,415	5,686	4,835	44.4%	-851	-15%	-13,580	-74%	T2	NS	CS
Greece	1,095	1,465	1,362	12.5%	-103	-7%	266	24%	T1	NS	D
Ireland	NE,NO	NO	NO	-	-	-	-	-	NO	NO	NO
Italy	55	21	5	0.0%	-16	-78%	-50	-92%	T1	NS	D, CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Netherlands	NA	NA	NA	-	-	-	-	-	NA	NA	NA
Portugal	66	IE,NO	IE,NO	-	-	-	-66	-100%	T1	NS	D
Spain	1,794	919	909	8.3%	-10	-1%	-885	-49%	T2, CS	NS, AS	CS
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA	NA
United Kingdom	18,271	4,079	3,779	34.7%	-301	-7%	-14,492	-79%	T2	AS	CS
EU-15	**44,285**	**12,174**	**10,893**	**100.0%**	**-1,281**	**-11%**	**-33,392**	**-75%**			

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 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 2006. Within the EU-15 coal mining in underground mines decreased substantially (more than

77%), whereas the implied emissions factor increased from 8 to 9 kg/t coal produced.

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

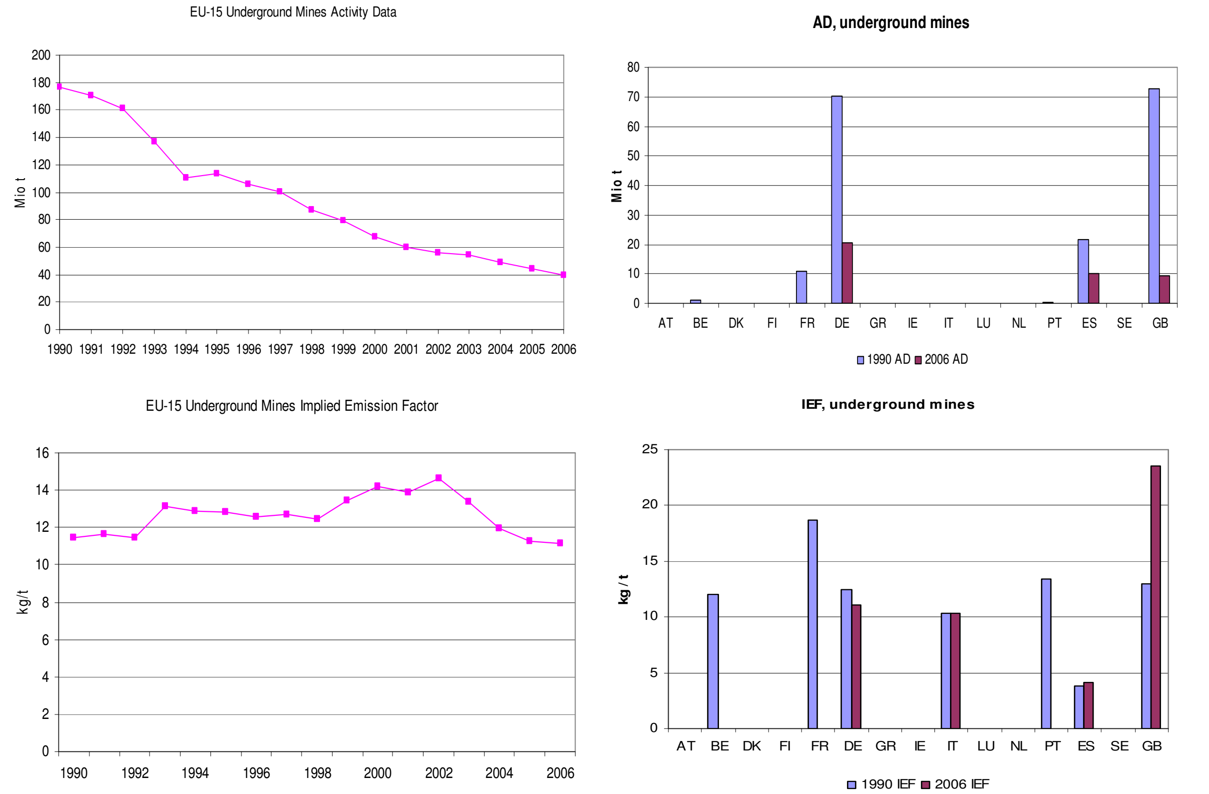
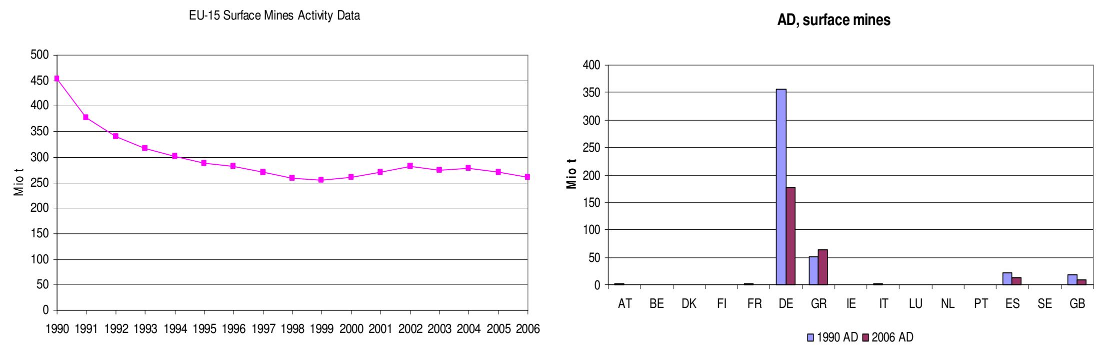
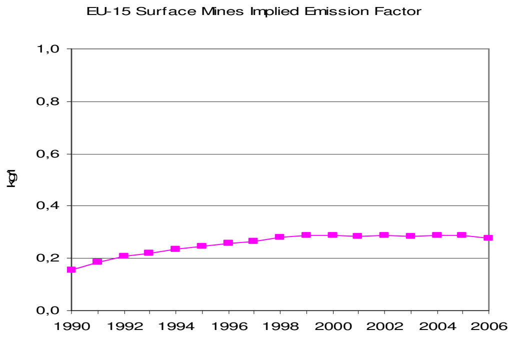


Figure 3.91 shows how activity data and emission factors for CH_4 emissions from surface coal mines changed between 1990 and 2006. Overall, in the EU-15 coal production from surface mines decreased by 42 % between 1990 and 2006. Coal mining in surface mines decreased in most Member States except in Greece, 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





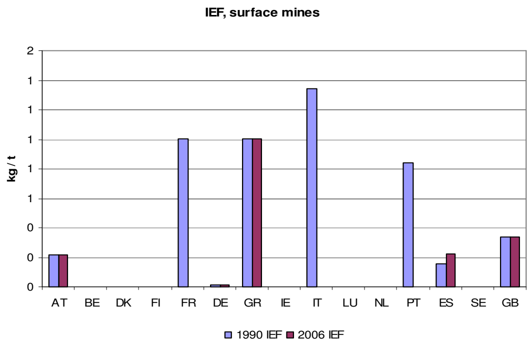


Table 3.89 provides information on the contribution of Member States to EU-15 recalculations in CH_4 from 1B1 Solid fuels for 1990 and 2005 and main explanations for the largest recalculations in absolute terms.

Table 3.89 1B1 Fugitive Emissions from Solid Fuels: Contribution of MS to EU-15 recalculations in CH_4 for 1990 and 2005 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2005		Main explanations
	Gg	Percent	Gg	Percent	
Austria	0,0	0,0	0,0	100,0	
Belgium	298,8	838,4	0,0	0,0	Allocation of underground mining activities from 1A1c to 1B1a
Denmark	0,0	0,0	0,0	0,0	
Finland	0,0	0,0	0,0	0,0	
France	0,0	0,0	-25,0	-40,8	Corrected AD
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	0,0	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	-2,0	-0,1	-1,9	-0,2	
Sweden	0,0	0,0	0,0	-0,7	
UK	0,0	0,0	282,1	7,4	Emission factor revision for methane from underground mines
EU-15	**296,9**	**0,6**	**255,3**	**2,1**	

3.2.6.2. Fugitive emissions from oil and natural gas (1B2) (EU-15)

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 0.9 % of the total GHG emissions in 2006 and for 76 % of all fugitive emissions in the EU-15.

Of all fugitive emissions from oil and natural gas, in 2006:

- 53 % are CH_4 emissions from natural gas (production, processing, transport and distribution).
- 25% are CO_2 emissions from oil refining and storage.
- 15% are due to flaring (14% CO_2 and 1% 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

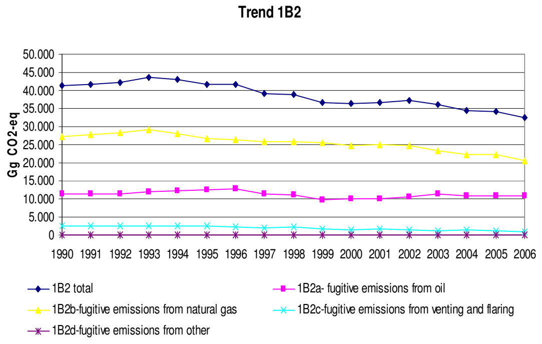


Table 3.90 shows fugitive emissions from oil and natural gas arise in all Member States. Total greenhouse gas emissions from 1B2 decreased by 18 % between 1990 and 2006 (Table 3.91). This trend is mainly due to the reduction of fugitive CH_4 emissions from natural gas activities, which decreased by 21 % over that period.

In 2006, 77% of all fugitive GHG emissions from oil and natural gas were emitted by four countries: the United Kingdom, Italy, Germany and France. Between 1990 and 2006, emissions decreased in eight Member States and increased in seven Member States. The largest reductions (in absolute terms) were observed in the United Kingdom (mainly CH_4 emissions) and in Italy (both CH_4 and CO_2 emissions), while emissions increased most in Spain (in absolute terms) and in Portugal (relative increase by a factor 10 between 1990 and 2006).

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 2006 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO_2 emissions in 2006 (Gg)	CH_4 emissions in 1990 (Gg CO_2 equivalents)	CH_4 emissions in 2006 (Gg CO_2 equivalents)
Austria	476	931	102	232	374	699
Belgium	610	538	85	132	525	407
Denmark	304	515	263	415	40	98
Finland	238	169	226	113	11	55
France	7,331	6,092	4,508	4,156	2,786	1,886
Germany	7,008	6,841	0	0	7,008	6,841
Greece	89	151	0	9	89	142
Ireland	270	162	139	60	131	102
Italy	10,640	7,369	3,341	2,189	7,298	5,179
Luxembourg	28	59	IE,NA,NE,NO	IE,NA,NE,NO	28	59
Netherlands	2,414	1,754	775	1,068	1,639	686
Portugal	150	1,492	115	748	35	743
Spain	2,375	2,892	1,744	2,268	631	624
Sweden	98	174	93	166	5	5
United Kingdom	16,107	10,109	5,760	4,809	10,304	5,263
EU-15	**48,138**	**39,248**	**17,151**	**16,366**	**30,903**	**22,788**

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 oil/gas activities are reported by the national association of gas and oil industries. CO_2 emissions from the refinery resulting from combustion processes (including flaring) are included in 1A1b 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**: CO_2 emissions from oil/gas activities are derived from CO_2 content of explored natural gas which is different for the diverse oil/gas fields (consistent with 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. A large maintenance leakage on Zeeland in 1995 led to a significant increase in in natural gas emission from the transmission networks that year. **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 2006. The introduction of natural gas in the Greek energy system started in 1996. **Activity data:** National Energy Balance, Public Gas Corporation **Emission factor:** Tier 1
Ireland	**General:** only fugitive emissions of natural gas considered. Ireland has one oil refinery (approx 3,000 kilotonnes/annum) which reports no fugitive CO_2 or CH_4 emissions (only NMVOCs which are reported in the appropriate CRF Table). The opening of a new gas well in 2003 was responsible for a peak in methane emissions that year. **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. The closure of 1 of 3 refineries in the early 1990s led to an important increase of emission factor between 1993 and 1995. **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

	Methodology
Sweden	**General:** includes catalytic cracking, desulphurisation, storage and handling of oil, gasoline distribution and storage. Transfer losses of gas works gas are reported in sector 1B2a vi. This is not related to activities in refineries. Flaring 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 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 1995-2006. For oil production (1B2a ii), the activity data used is taken directly from UK National Statistics (Digest of UK Energy Statistics), whereas emissions data are based on operator returns. The two data sets are not directly comparable. For fugitive emissions from natural gas activities (1B2b), the amount of leakage from the gas distribution network is proportional to the state of the pipes in the network (not to the amount of gas used). Leakage data are supplied by the network operators. **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)

<u>Definition</u>: 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 0.3 % of total EU-15 GHG emissions in 2006 and for 21 % of all fugitive emissions in the EU-15. Between 1990 and 2006, CO_2 emissions from this source increased by 3.4 % in the EU-15 (Table 3.92), with a remarkable 2.4 % increase between 2005 and 2006. By contrast, during the same period 1990-2006, CH_4 emissions of this source category were reduced by 47 %.

France is the largest emitter in the EU-15, followed by Spain and Italy (Table 3.103). During the period 1990-2006, the largest decreases in CO_2 emissions (in absolute terms) were observed in Italy and the United Kingdom, while emissions increased most in the Netherlands, in Portugal (by more than 7 times) and, in Spain.

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 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	43	122	140	1.4%	18	15%	97	226%	CS	AS	CS
Belgium	0	0	0	-	-	-	-	-	NA	NA	NA
Denmark	NA	NA	NA	-	-	-	-	-	NA	NA	NA
Finland	1.0	1.2	1.3	0.0%	0.1	9%	0	36%	T1	NS	CS
France	3,428	3,125	3,347	33.8%	222	7%	-80	-2%	C	PS/ NS	CS
Germany	NE,NO	NE,NO	NE,NO	-	-	-	-	-	NA	0.0	NA
Greece	NE	0.04	0.03	0.0%	-0.002	-6%	0.03	-	T1	NS	D
Ireland	NE,NO	NE,NO	NE,NO	-	-	-	-	-	NO	NO	NO
Italy	2,627	1,875	1,957	19.7%	83	4%	-670	-25%	T2	NS	CS
Luxembourg	NE,NO	NE,NO	NE,NO	-	-	-	-	-	NA	NE	NA
Netherlands	IE,NA,NE	945	931	9.4%	-14	-2%	931	-	CS	NS	CS
Portugal	65	533	558	5.6%	25	5%	493	763%	M	AS,NS,PS	D,PS
Spain	1,564	1,934	2,018	20.4%	84	4%	454	29%	T2	PS	PS
Sweden	22	2	3	0.0%	1	42%	-19	-86%	T1	NS	CS
United Kingdom	1,840	1,147	959	9.7%	-189	-16%	-882	-48%	T2	NS	CS
EU-15	**9,590**	**9,685**	**9,915**	**100.0%**	**230**	**2%**	**325**	**3%**			

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)

<u>Definition</u>: 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 2006 and for 40 % of all fugitive emissions in the EU-15. Between 1990 and 2006, CH_4 emissions from this source decreased by 21 % in the EU-15 (Table 3.93), with a 3 % decrease observed between 2005 and 2006.

In 2006, CH_4 fugitive emissions from Germany, the United Kingdom and Italy represented 75 % of CH_4 emissions from this source (Table 3.93). The emission decreases observed in the United Kingdom (–44 %) and in Italy (-30 %) contributed most significantly to the overall reduction in the EU-15 between 1990 and 2006.

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 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	273	556	578	2.8%	22	4%	305	112%	T1	NS	D
Belgium	519	389	403	1.9%	14	3%	-116	-22%	CS/M	AS	CS
Denmark	6	5	7	0.0%	1	23%	1	18%	CS	NS	CS
Finland	4	55	45	0.2%	-9	-17%	42	1165%	M, T1	NS	CS, D, M
France	2,683	1,876	1,851	8.9%	-25	-1%	-832	-31%	C	PS	CS
Germany	6,782	6,846	6,711	32.3%	-136	-2%	-71	-1%	CS	0.0	CS
Greece	10	88	88	0.4%	0	0%	78	815%	T1	NS	D
Ireland	131	57	102	0.5%	45	79%	-29	-22%	CS	NS	CS
Italy	7,067	5,214	4,913	23.6%	-301	-6%	-2,153	-30%	T2	NS	CS
Luxembourg	28	59	59	0.3%	0	0%	32	116%	C	NS	C
Netherlands	373	405	388	1.9%	-17	-4%	15	4%	T2, T3	NS	CS
Portugal	NO	808	699	3.4%	-109	-13%	699	-	T1	AS,NS	C,OTH
Spain	466	474	493	2.4%	20	4%	27	6%	C, CS	NS, AS, Q	C, CS
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA	NA
United Kingdom	7,955	4,695	4,455	21.4%	-240	-5%	-3,500	-44%	T2	NS,AS	CS
EU-15	**26,295**	**21,528**	**20,791**	**100.0%**	**-736**	**-3%**	**-5,504**	**-21%**			

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 2006 and for 13 % of all fugitive emissions in the EU-15. The United Kingdom is responsible for two thirds of the emissions from this source.

Between 1990 and 2006, CO_2 emissions from this source decreased by 11.0 % in the EU-15 (Table 3.94). After fluctuating above (1991-2001) and below (2002-2004) 1990 levels, emission were back at 1990 levels in 2005 and decreased by 10.7 % in 2006. This strong decrease within just one year was mainly to the reduction that occurred in the United Kingdom (following a strong increase in 2005). The 1990-2006 overall reduction is largely due to reductions that occured in the Netherlands (-82%) and in Italy (-69%).

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 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	IE	IE	IE	-	-	-	-	-	IE	IE	IE
Belgium	84	104	130	2.3%	26	25%	46	55%	T3	PS	PS
Denmark	263	435	415	7.2%	-20	-5%	151	57%	C	NS/PS	CS
Finland	123	77	64	1.1%	-12	-16%	-59	-48%	T2	NS	CS
France	297	495	455	7.9%	-39	-8%	158	53%	C	PS	CS
Germany	IE,NE	IE,NE	IE,NE	-	-	-	-	-	NA	0.0	NA
Greece	NE	9	9	0.2%	0	-5%	8.92	-	T1	NS	D
Ireland	IE,NO	IE,NO	IE,NO	-	-	-	-	-	CS	NS	CS
Italy	681	215	211	3.7%	-4	-2%	-470	-69%	T2	NS	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Netherlands	774	129	137	2.4%	9	7%	-637	-82%	T2	NS	PS
Portugal	49	49	50	0.9%	0	1%	1	2%	D	AS,NS	D
Spain	179	218	250	4.4%	32	15%	70	39%	T1, T2, CS	PS	CS
Sweden	71	90	163	2.8%	74	82%	93	131%	T2	PS	CS, D
United Kingdom	3,920	4,601	3,850	67.1%	-751	-16%	-70	-2%	T2	NS	CS
EU-15	**6,441**	**6,419**	**5,733**	**100.0%**	**-686**	**-11%**	**-707**	**-11%**			

Table 3.95 1B2b Fugitive CH_4 emissions from natural gas: Information on activity data, emission factors by Member State

		1990					2006				
Member State	GHG source category	Activity data: Description	Unit	Value	Implied emission factor (kg/unit)	CH4 emissions (Gg)	Activity data: Description	Unit	Value	Implied emission factor (kg/unit)	CH4 emissions (Gg)
Austria	**Natural Gas**					**12.98**					**27.50**
	i. Exploration			1288	IE	IE			1819	IE	IE
	ii. Production (4) / Processing	Gas throughput (a)	10^6 m^3	1288	IE	IE	Gas throughput (a)	10^6 m^3	1819	IE	IE
	iii. Transmission	Pipelines length (km)	km	1032	2900.00	2.99	Pipelines length (km)	km	1548	2900.00	4.49
	iv. Distribution	Distribution network length	km	15200	657.43	9.99	Distribution network length	km	35350	651.04	23.01
	v. Other Leakage	(e.g. PJ gas consumed)	PJ	1500	NO	NO	(e.g. PJ gas consumed)	PJ	2962	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**					**19.17**
	i. Exploration										
	ii. Production (4) / Processing								163	4415.50	0.72
	iii. Transmission	(e.g. PJ gas consumed)	PJ	401	5079.35	2.04	(e.g. PJ gas consumed)	PJ	616	11311.81	6.97
	iv. Distribution	PJ gas consumed	PJ	401	56470.77	22.67	PJ gas consumed	PJ	453	25336.32	11.48
	v. Other Leakage										
	at industrial plants and power stations										
	in residential and commercial sectors										
Denmark	**Natural Gas**					**0.27**					**0.31**
	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	10878	IE	IE
	iii. Transmission	Gas transmission	10^6 m^3	2739	88.62	0.24	Gas transmission	10^6 m^3	7600	28.68	0.22
	iv. Distribution	Gas distributed	10^6 m^3	1574	14.56	0.02	Gas distributed	10^6 m^3	3319	29.06	0.10
	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**					**2.15**
	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	162	2787.05	0.45
	iv. Distribution	PJ gas distributed via local networks	PJ	5	NO	NO	PJ gas distributed via local networks	PJ	7	233516.48	1.70
	v. Other Leakage	t of natural gas released from pipelines		NO	NO	NO	t of natural gas released from pipelines		NO	NO	NO
	at industrial plants and power stations			NO	NO	NO			NO	NO	NO
	in residential and commercial sectors			NO	NO	NO			NO	NO	NO
France	**Natural Gas**					**127.77**					**88.15**
	i. Exploration			309	1614.89	0.50			133	980.99	0.13
	ii. Production (4) / Processing	PJ Production	PJ	1055	120586.04	127.27	PJ Production	PJ	1653	53242.17	88.02
	iii. Transmission	PJ Consumed	PJ	NA	NA	NA	PJ Consumed	PJ	NA	NA	NA
	iv. Distribution			NO	NO	NO			NO	NO	NO
	v. Other Leakage			NO	NO	NO			NO	NO	NO
	at industrial plants and power stations			NO	NO	NO			NO	NO	NO
	in residential and commercial sectors			NO	NO	NO			NO	NO	NO

		1990					2006				
Germany	**Natural Gas**					**322.93**					**319.55**
	i. Exploration	(natural gas)	TJ	IE	IE	IE	(natural gas)	TJ	IE	IE	IE
	ii. Production (4) / Processing	(natural gas from crude oil extraction)	TJ	563382	101.94	57.43	(natural gas from crude oil extraction)	TJ	589884	89.00	52.50
	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	160.05
	v. Other Leakage	(gas consumed)	TJ	893519	40.71	36.37	(gas consumed)	TJ	1594304	42.00	66.96
	at industrial plants and power stations		TJ	IE	IE	IE		TJ	IE	IE	IE
	in residential and commercial sectors	(gas consumed)	TJ	893519	40.71	36.37	(gas consumed)	TJ	1594304	42.00	66.96
Greece	**Natural Gas**					**0.46**					**4.17**
	i. Exploration			NE	NE	0.00			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	28	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				NE	NE
	at industrial plants and power stations			NE	NE	NE				NE	NE
	in residential and commercial sectors			NE	NE	NE				NE	NE
Ireland	**Natural Gas**					**6.24**					**4.86**
	i. Exploration			IE	IE	IE			IE	IE	IE
	ii. Production (4) / Processing	PJ of Gas produced	PJ	79	14330.75	1.13	PJ of Gas produced	PJ	17	153184.74	2.63
	iii. Transmission	(e.g. PJ gas consumed)		IE	IE	IE	(e.g. PJ gas consumed)		IE	IE	IE
	iv. Distribution	PJ of gas consumed	PJ	24	214519.35	5.12	PJ of gas consumed	PJ	66	33965.34	2.23
	v. Other Leakage	(e.g. PJ gas consumed)	PJ	NO	NO	NO	(e.g. PJ gas consumed)	PJ	NO	NO	NO
	at industrial plants and power stations		PJ	NO	NO	NO		PJ	NO	NO	NO
	in residential and commercial sectors		PJ	NO	NO	NO		PJ	NO	NO	NO
Italy	**Natural Gas**					**336.52**					**233.97**
	i. Exploration	not available		NA	IE	IE	not available		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	10837	1611.00	17.46
	iii. Transmission	(Mm3 gas transported)	10^6 m^3	45684	822.12	37.56	(Mm3 gas transported)	10^6 m^3	87990	414.38	36.46
	iv. Distribution	(Mm3 gas transported)	10^6 m^3	20632	12049.80	248.61	(Mm3 gas transported)	10^6 m^3	34656	5195.38	180.05
	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	gas exploration		NO	NO	NO	gas exploration		NO	NO	NO
	ii. Production (4) / Processing	gas produced		NO	NO	NO	gas produced		NO	NO	NO
	iii. Transmission	gas consumed	PJ	18	71041.21	1.31	gas consumed	PJ	52	54110.90	2.83
	iv. Distribution	gas consumed		IE	IE	IE	gas consumed		IE	IE	IE
	v. Other Leakage	(specify)		IE	IE	IE	(specify)		IE	IE	IE
	at industrial plants and power stations	gas leakage		IE	IE	IE	gas leakage		IE	IE	IE
	in residential and commercial sectors	gas leakage		IE	IE	IE	gas leakage		IE	IE	IE

		1990					2006				
Netherlands	**Natural Gas**					**17.79**					**18.49**
	i. Exploration	number of wells drilled/tested	number	79	IE	IE	number of wells drilled/tested	number	39	IE	IE
	ii. Production (4) / Processing	gas produced	PJ	2292	IE	IE	gas produced	PJ	2238	IE	IE
	iii. Transmission	gas transported	PJ	2292	2468.91	5.66	gas transported	PJ	3051	1790.53	5.46
	iv. Distribution	natural gas distribution network	10^3 km	100	121283.21	12.13	natural gas distribution network	10^3 km	NE	NE	13.03
	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**					**33.27**
	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	4650	7153.41	33.27
	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**					**23.50**
	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	3	70889.00	0.19
	iii. Transmission	PJ gas (NCV)	PJ	218	759.33	0.17	PJ gas (NCV)	PJ	1336	551.92	0.74
	iv. Distribution	PJ gas consumed (NCV)	PJ	226	81503.15	18.40	PJ gas consumed (NCV)	PJ	1347	16759.42	22.57
	v. Other Leakage	(e.g. PJ gas consumed)	0	NE	NE	NE	(e.g. PJ gas consumed)		NE	NE	NE
	at industrial plants and power stations			NE	NE	NE			NE	NE	NE
	in residential and commercial sectors			NE	NE	NE			NE	NE	NE
Sweden	**Natural Gas**					**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)	0	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			NO	NO	NO			NO	NO	NO
	in residential and commercial sectors			NO	NO	NO			NO	NO	NO
United Kingdom	**Natural Gas**					**378.80**					**212.15**
	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	3188	66553.71	212.15
	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	Not applicable		NE	NE	NE	Not applicable		NE	NE	NE
	in residential and commercial sectors	Not Applicable		NE	NE	NE	Not Applicable		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 2005 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 2005 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2005		Main explanations
	Gg	Percent	Gg	Percent	
Austria	0,0	0,0	0,0	0,0	
Belgium	0,0	0,0	-41,0	-27,9	No explanation provided
Denmark	0,0	0,0	0,0	0,0	
Finland	-0,2	-0,1	-0,4	-0,3	
France	0,0	0,0	-1,0	0,0	
Germany	0,0	0,0	0,0	0,0	
Greece	-70,2	-	0,0	-	
Ireland	0,0	0,0	0,0	0,0	
Italy	0,0	0,0	-0,1	0,0	
Luxembourg	-	0,0	-	0,0	
Netherlands	0,0	0,0	0,0	0,0	
Portugal	0,0	0,0	36,9	5,2	Revision of time series
Spain	0,0	0,0	1,0	0,0	
Sweden	0,0	0,0	0,0	0,0	
UK	0,0	0,0	0,0	0,0	
EU-15	**-70,4**	**-0,4**	**-4,5**	**0,0**	

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 2005 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2005		Main explanations
	Gg	Percent	Gg	Percent	
Austria	0,0	0,0	3,8	0,6	
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	225,9	8,8	18,6	1,0	Révision de la méthodologie comme annoncé au dernier GCIIE suite aux contacts pris avec GDF pour intégrer les émissions diffuses des stations de compression
Germany	0,0	0,0	0,0	0,0	
Greece	-2,9	-3,1	0,0	0,0	
Ireland	0,0	0,0	0,0	0,0	
Italy	25,0	0,3	-151,0	-2,7	Correction of the distribution between CH4 and NMVOC for natural gas; update of emission factor for natural gas production on account of new information from the industry; emissions from minor operators have been included
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	-2,7	-0,3	
Sweden	0,0	0,0	0,0	0,0	
UK	0,0	0,0	0,0	0,0	
EU-15	**248,1**	**0,8**	**-131,3**	**-0,5**	

3.3 Methodological issues and uncertainties (EU-15)

The previous section presented for each EU-15 key source in CRF Sector 1 an overview of the Member States' contributions to the key source in terms of level and trend, and information on methodologies, emission factors, completeness and qualitative uncertainty estimates. Detailed information on national methods and circumstances is available in the Member States' national inventory reports.

Table 3.98 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 1A2 (gaseous 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	Gas	Emissions 1990	Emissions 2006 [1)]	Emission trends 1990-2006	Level uncertainty estimates based on MS uncertainty estimates	Trend uncertainty estimates based on MS uncertainty estimates
1.A.1.a Public electricity and heat production	Gaseous	CO_2	60.436	232.813	285%	3%	2,8
1.A.1.a Public electricity and heat production	Liquid	CO_2	124.478	66.888	-46%	1%	0,8
1.A.1.a Public electricity and heat production	Other	CO_2	13.946	31.611	127%	3%	3,4
1.A.1.a Public electricity and heat production	Solid	CO_2	750.217	687.028	-8%	2%	0,2
1.A.1.b Petroleum refining	Gaseous	CO_2	3.846	9.308	142%	1%	4,8
1.A.1.b Petroleum refining	Liquid	CO_2	98.607	108.729	10%	3%	0,3
1.A.1.c Manufacture of solid fuels	Gaseous	CO_2	16.708	20.400	22%	21%	5,4
1.A.1.c Manufacture of solid fuels	Liquid	CO_2	3.401	1.763	-48%	20%	5,7
1.A.1.c Manufacture of solid fuels	Solid	CO_2	72.520	30.831	-57%	7%	5,1
1.A.2 Manufacturing industries and construction	Gaseous	CO_2	175.211	240.772	37%	2%	1,2
1.A.2 Manufacturing industries and construction	Liquid	CO_2	193.698	162.637	-16%	3%	0,9
1.A.2 Manufacturing industries and construction	Other	CO_2	8.101	14.058	74%	19%	26,4
1.A.2 Manufacturing industries and construction	Solid	CO_2	234.910	119.880	-49%	3%	1,5
1.A.4.a Commercial/institutional	Gaseous	CO_2	59.133	98.593	67%	6%	1,9
1.A.4.a Commercial/institutional	Liquid	CO_2	73.987	56.944	-23%	8%	4,3
1.A.4.a Commercial/institutional	Other	CO_2	1.048	3.114	197%	18%	16,4
1.A.4.a Commercial/institutional	Solid	CO_2	27.666	1.710	-94%	16%	21,2
1.A.4.b Residential	Gaseous	CO_2	161.882	239.413	48%	3%	0,6
1.A.4.b Residential	Liquid	CO_2	169.708	153.407	-10%	7%	1,1
1.A.4.b Residential	Other	CO_2	319	381	20%	10%	2,4
1.A.4.b Residential	Solid	CO_2	74.552	10.495	-86%	12%	5,7
1.A.4.c Agriculture/Forestry/Fisheries	Gaseous	CO_2	9.723	10.514	8%	10%	-7,1
1.A.4.c Agriculture/Forestry/Fisheries	Liquid	CO_2	56.783	51.259	-10%	6%	2,4
1.A.4.c Agriculture/Forestry/Fisheries	Solid	CO_2	4.066	764	-81%	16%	10,1
1.A.5 Other	Liquid	CO_2	15.893	15.893	0%	6%	3,2
1.A.5 Other	Solid	CO_2	4.667	4.667	0%	0%	11,2
1.A.1 Energy Industries	Biomass	CH_4	78	233	199%	31%	77,2
1.A.1 Energy Industries	Gaseous	CH_4	127	522	310%	31%	12,5
1.A.1 Energy Industries	Liquid	CH_4	152	112	-26%	44%	11,9
1.A.1 Energy Industries	Other	CH_4	33	58	79%	57%	98,0
1.A.1 Energy Industries	Solid	CH_4	404	260	-36%	45%	23,7
1.A.2 Manufacturing industries and construction	Biomass	CH_4	137	166	21%	73%	6,5
1.A.2 Manufacturing industries and construction	Gaseous	CH_4	205	360	76%	32%	6,9
1.A.2 Manufacturing industries and construction	Liquid	CH_4	184	158	-14%	104%	34,1
1.A.2 Manufacturing industries and construction	Other	CH_4	13	11	-14%	63%	6,5
1.A.2 Manufacturing industries and construction	Solid	CH_4	640	398	-38%	28%	18,5
1.A.4 Other Sectors	Biomass	CH_4	6.257	4.886	-22%	37%	14,9
1.A.4 Other Sectors	Gaseous	CH_4	582	722	24%	75%	25,7
1.A.4 Other Sectors	Liquid	CH_4	439	358	-18%	77%	8,4
1.A.4 Other Sectors	Other	CH_4	19	23	24%	76%	0,0
1.A.4 Other Sectors	Solid	CH_4	4.073	464	-89%	51%	17,1
1.A.5 Other	Gaseous	CH_4	0,1	0,4	447%	61%	292,2
1.A.5 Other	Liquid	CH_4	38	12	-67%	28%	0,2
1.A.5 Other	Solid	CH_4	210	0	-100%	0%	150,3
1.A.1 Energy Industries	Biomass	N_2O	178	702	294%	72%	67,4
1.A.1 Energy Industries	Gaseous	N_2O	390	1.075	175%	496%	2010,9
1.A.1 Energy Industries	Liquid	N_2O	1.375	1.251	-9%	130%	29,0
1.A.1 Energy Industries	Other	N_2O	188	517	175%	159%	269,5
1.A.1 Energy Industries	Solid	N_2O	7.283	6.348	-13%	69%	11,2
1.A.2 Manufacturing industries and construction	Biomass	N_2O	464	702	51%	217%	31,3
1.A.2 Manufacturing industries and construction	Gaseous	N_2O	926	1.366	48%	585%	446,2
1.A.2 Manufacturing industries and construction	Liquid	N_2O	3.402	3.520	3%	151%	19,4
1.A.2 Manufacturing industries and construction	Other	N_2O	63	92	47%	109%	79,5

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

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 CH_4 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 2006 1)	Emission trends 1990-2006	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	1.394	-33%	27%	5
1.B.2 Oil and natural gas	CO_2	17.151	16.366	-5%	12%	4
1.B.1 Solid fuels	CH_4	46.337	11.131	-76%	37%	11
1.B.2 Oil and natural gas	CH_4	30.903	22.788	-26%	11%	3
1.B.1 Solid fuels	N_2O	4	3	-37%	51%	28
1.B.2 Oil and natural gas	N_2O	84	93	12%	100%	17
Total	**all**	**96.554**	**51.775**	**-46%**	**10%**	**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

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 1A3b shows the highest uncertainty estimates, CO_2 from 1A3b and CO_2 from 1A2e the lowest.

Table 3.100 1A3 Transport: Uncertainty estimates for EU-15

Source category	Gas	Emissions 1990	Emissions 2006 1)	Emission trends 1990-2006	Level uncertainty estimates based on MS uncertainty estimates	Trend uncertainty estimates based on MS uncertainty estimates
1.A.3.a Civil aviation	CO_2	16.244	25.321	56%	26%	14
1.A.3.b Road transport	CO_2	636.699	794.907	25%	2%	0
1.A.3.c Railways	CO_2	8.080	5.839	-28%	4%	3
1.A.3.d Navigation	CO_2	19.479	23.165	19%	8%	3
1.A.3.e Other	CO_2	6.584	8.351	27%	3%	0
1.A.3.a Civil aviation	CH_4	11	11	0%	52%	16
1.A.3.b Road transport	CH_4	4.047	1.610	-60%	23%	9
1.A.3.c Railways	CH_4	12	8	-29%	48%	15
1.A.3.d Navigation	CH_4	55	64	17%	57%	4
1.A.3.e Other	CH_4	17	15	-10%	39%	13
1.A.3.a Civil aviation	N_2O	158	277	75%	137%	110
1.A.3.b Road transport	N_2O	5.830	17.578	202%	66%	121
1.A.3.c Railways	N_2O	424	411	-3%	139%	41
1.A.3.d Navigation	N_2O	185	211	14%	177%	55
1.A.3.e Other	N_2O	105	147	39%	91%	7
Total	**all**	**697.930**	**877.915**	**26%**	**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 (EU-15)

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'. In 2008, N_2O from road transport will be subject to the Ec intrnal review.

Since the inventory 2005 plant-specific data is available from the EU Emission Trading Scheme (EU ETS). This information has been used by EU Member States for quality checks and as input for calculating total CO_2 emissions for the sectors Energy and Industrial Processes in this report.

After the annual compilation of the GHG inventory Eurostat checks with Member States remaining differences found when comparing the Member States’ reference approach with the Eurostat reference approach. This crosscheck between the the European energy reporting system and the EU GHG inventory system is an important QA/QC element of the EU GHG inventrory compilation.

The quality of the EU GH inventory is directly affected by the quality of Member States and EU energy statistics systems. Currently EU energy statistics are collected on the basis of gentlemen's' agreement. The Joint Eurostat/IEA/UNECE energy questionnaires are used for gathering nationally collected data. Since its creation in the early fifties, when the European energy statistics were essentially a collection of the main national aggregated data, the system has followed the development of energy policies and markets and adapted to meet new demands. Recent developments have been:

- a new questionnaire (in 2000) covering Renewable Energy Sources; intensive efforts at national level and EU financial support since the early 1990's lead to the successful adoption of this questionnaire alongside the already established existing four joint questionnaires
- expanded electricity questionnaire (in 2004) to allow coherence with the UNFCC CO_2 emissions reporting system
- development of CHP (2004) statistics, following pilot projects over a decade

In 2007 the Commission presented the energy statistics regulation as part of the energy package. This regulation aims at collecting detailed statistical data on energy flows by energy commodity at annual and monthly level. It ensures harmonised and coherent reporting of national energy data, which is indispensable for the assessment of EU energy policies and targets. The content and structure of this regulation reflects the essence of the existing European statistical system, a system that is part of the international energy statistical system, and is in direct link with the national statistical structures (classifications) and methodologies. It also has concrete links to other statistical domains, such as economic, environment, trade and business statistics. These links provide an additional dimension in safeguarding data quality assurance. The energy statistics regulation was adopted by the European Parliament and Council in 2008 and will be in force from 2009 onwards.

The European energy statistics system and the quality of the EU inventory will be directly affected by this regulation that will:

- ensure a stable and institutional basis for energy statistics in the EU,
- guarantee long-term availability of energy data for EU policies,
- reinforce available resources for the production of the basic energy statistics at national level

The energy statistics regulation will help improving the QA/QC of the EU inventory as it will:

- make available more detailed energy statistics by fuel,

- allow the estimation of CO_2 emissions from energy with the reference and sectoral approach
- assure the quality of the underlying energy statistics
- improve timeliness of energy statistics
- provide a formal legal framework assuring consistency between national and Eurostat data

Moreover, Article 6, paragraph 2 stipulates that:

'Every reasonable effort shall be undertaken to ensure coherence between energy data declared in the energy statistics regulation, and data declared in accordance with Commission Decision No 280/2004/EC of the European Parliament and of the Council concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol'.

It also foresees the further development of the energy statistics system setting a time frame for the production of more detailed data on renewable energy and final energy consumption, stating:

'With a view to improving the quality of energy statistics, the Commission (Eurostat), in collaboration with the Member States, shall make sure that these statistics are comparable, transparent, detailed and flexible by:

(a) reviewing the methodology used to generate renewable energy statistics in order to make available additional, pertinent, detailed statistics on each renewable energy source, annually and in a cost effective manner. The Commission (Eurostat) shall present and disseminate the statistics generated from 2010 (reference year) onwards

(b) reviewing and determining the methodology used at national and Community level to generate final energy consumption statistics (sources, variables, quality, costs) based on the current state of play, existing studies and feasibility pilot-studies, as well as cost-benefit analysis yet to be conducted; and evaluating the findings of the pilot studies and cost benefit analysis with the view to establishing breakdown keys for final energies by sector and main energy uses and gradually integrating the resulting elements in the statistics from 2012 (reference year) onwards.'

3.5 Sector-specific recalculations (EU-15)

Table 3.102 shows that in the energy sector the largest recalculations in absolute terms in 1990 and 2005 were made for N_2O. In relative terms the recalculations of N_2O emissions in 1990 were -19.9 % and in 2005, they were at - 21.9 %.

Table 3.102 Sector 1 Energy: Recalculations of total GHG emissions and recalculations of GHG emissions for the years 1990 and 2005 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	-50.392	-1,6%	-851	-0,2%	-8.415	-2,1%	5	0,0%	617	3,7%	-51	-0,5%
Energy	644	0,0%	95	0,1%	-7.725	-19,9%	NO	NO	NO	NO	NO	NO
2005												
Total emissions and removals	33.796	1,1%	2.011	0,6%	-11.037	-3,3%	220	0,4%	-35	-0,6%	-70	-0,8%
Energy	6.679	0,2%	-417	-0,9%	-11.694	-21,9%	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, France and Germany had the most influence on CO_2 recalculations in the EU-15 in 2005, due to updated activity data and new methodologies. N_2O recalculations were mainly influenced by France, Greece and Italy. 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 2005 by gas (difference between latest submission and previous submission Gg of CO_2 equivalents)

	1990						2005					
	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
Austria	155	3	-84	NO	NO	NO	-150	9	37	NO	NO	NO
Belgium	502	444	-937	NO	NO	NO	-282	93	-953	NO	NO	NO
Denmark	0	-3	-26	NO	NO	NO	-105	-38	-303	NO	NO	NO
Finland	-181	2	0	NO	NO	NO	-310	-1	24	NO	NO	NO
France	2.252	-118	-1.291	NO	NO	NO	3.919	-237	-3.929	NO	NO	NO
Germany	-175	0	3	NO	NO	NO	3.683	5	-133	NO	NO	NO
Greece	-1.891	-138	-2.110	NO	NO	NO	-784	-135	-2.992	NO	NO	NO
Ireland	-6	9	-16	NO	NO	NO	430	-16	-237	NO	NO	NO
Italy	1	-99	-3.308	NO	NO	NO	-1.954	-431	-3.271	NO	NO	NO
Luxembourg	86	3	-1	NO	NO	NO	332	3	16	NO	NO	NO
Netherlands	0	0	11	NO	NO	NO	-1	7	71	NO	NO	NO
Portugal	92	0	13	NO	NO	NO	1.167	9	2	NO	NO	NO
Spain	-6	-2	0	NO	NO	NO	-20	43	10	NO	NO	NO
Sweden	-120	0	-2	NO	NO	NO	-1	0	-2	NO	NO	NO
UK	-65	-7	25	NO	NO	NO	757	271	-32	NO	NO	NO
EU-15	**644**	**95**	**-7.725**	**NO**	**NO**	**NO**	**6.679**	**-417**	**-11.694**	**NO**	**NO**	**NO**

Abbreviations explained in the Chapter 'Units and abbreviations'.

3.6 Comparison between the sectoral approach and the reference approach (EU-15)

The IPCC reference approach for CO_2 from fossil fuels for the EU-15 is based on Eurostat energy data (NewCronos database, March 2008 version). This submission includes the reference approach tables for 1990–2006.

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'. '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 2006 as provided in Tables 1.A(b). Total fossil fuel energy consumption increased by 10 % between 1990 and 2006. Large increases had gas consumption (+69 %), whereas solid fuel combustion declined by 27 %.

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 3.2 % and 3.6 % respectively between 1990 and 2006; the percentage differences between the two data sets are -0.2 % in 2006 and -1.0 % in 1998.

Table 3.104 Reference Approach: Apparent EU-15 energy consumption (in PJ) (Eurostat data)

Fuel types	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Liquid Fuels	22,151	23,332	23,726	23,668	24,147	23,886	23,420	24,034	23,749	23,940	23,842	23,674	23,334
Solid Fuels	12,555	9,828	9,738	9,285	9,281	8,615	9,008	9,072	9,068	9,329	9,378	9,039	9,114
Gaseous Fuels	9,355	11,519	12,791	12,675	13,215	13,787	14,204	14,543	14,655	15,335	15,761	16,156	15,827
Total	**44,061**	**44,680**	**46,255**	**45,629**	**46,643**	**46,288**	**46,633**	**47,649**	**47,473**	**48,604**	**48,981**	**48,869**	**48,276**

Table 3.105 IPCC Reference approach (Eurostat data) and sectoral approach (Member State data) for EU-15 (in Tg)

CO2 emissions	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Sectoral approach	3,110	3,041	3,127	3,066	3,113	3,092	3,112	3,186	3,175	3,252	3,266	3,245	3,223
Reference approach	3,128	3,054	3,150	3,084	3,144	3,096	3,117	3,192	3,195	3,267	3,287	3,255	3,229
Percentage difference	-0.6%	-0.4%	-0.7%	-0.6%	-1.0%	-0.2%	-0.1%	-0.2%	-0.6%	-0.5%	-0.7%	-0.3%	-0.2%

Table 3.106 provides an overview by Member State on differences between the Eurostat and national reference approach for 1990 and 2005/2006, 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. Recently Eurostat has revised the CVs for liquid fuels which led to improved consistency with MS energy balance data which is also reflected in the comparisons below.

Table 3.116 shows the comparison between Eurostat and national reference approach for apparent consumption and CO_2 from fuel combustion for the EU-15 MS. For the EU-15 as a whole the re is a difference of 0.5 % between the two approaches for apparent consumption in 2006. Most MS are within 2 % (Austria, Belgium, Denmark, Finland, Greece, Luxembourg, Netherlands, Portugal, Spain, Sweden and the UK). Differences of more than 5 % can be observed only for Ireland. Further analysis is needed in order to explain this large difference.

The differences of CO_2 emissions for 2006 range from -0.4 % (Belgium) to 11.4 % (Greece). For the EU-15 as a whole the difference for CO_2 emissions is -0.5 % in 2005.

A comparison of these tables with the tables provided in the 2007 submission shows that eleven EU-15 Member States have now a better fit for apparent consumption than in 2007. For CO_2 emissions nine Member States show a better fit in 2008 than in 2007.

Table 3.106 Comparison between Eurostat and national reference approach for CO_2 from fuel combustion for EU-15 (CRF 1.A) ([25])

EU-15

1990	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	22,150,766	1,424,852	22,167,837	1,433,488	0.1%	0.6%
Solid fossil fuels	12,555,030	1,190,066	12,555,429	1,186,376	0.0%	-0.3%
Gaseous fossil fuels	9,355,246	513,439	9,392,679	510,049	0.4%	-0.7%
Total	**44,061,042**	**3,128,357**	**44,115,945**	**3,129,912**	**0.1%**	**0.0%**

2005	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	23,674,073	1,505,172	24,039,639	1,512,698	1.5%	0.5%
Solid fossil fuels	9,038,620	855,274	8,932,033	833,912	-1.2%	-2.5%
Gaseous fossil fuels	16,156,345	894,162	16,074,682	890,571	-0.5%	-0.4%
Total	**48,869,038**	**3,254,608**	**49,046,355**	**3,237,182**	**0.4%**	**-0.5%**

2006	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	23,333,947	1,490,241	23,664,214	1,490,433	1.4%	0.0%
Solid fossil fuels	9,114,397	862,006	9,006,469	844,150	-1.2%	-2.1%
Gaseous fossil fuels	15,827,491	876,259	15,830,731	877,288	0.0%	0.1%
Total	**48,275,835**	**3,228,507**	**48,501,414**	**3,211,872**	**0.5%**	**-0.5%**

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	439,094	28,984	432,378	28,302	-1.5%	-2.4%
Solid fossil fuels	169,451	16,145	168,749	15,917	-0.4%	-1.4%
Gaseous fossil fuels	217,048	11,844	219,239	12,238	1.0%	3.3%
Total	**825,593**	**56,972**	**820,366**	**56,457**	**-0.6%**	**-0.9%**

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	581,307	38,852	585,184	38,912	0.7%	0.2%
Solid fossil fuels	169,587	16,332	166,350	15,705	-1.9%	-3.8%
Gaseous fossil fuels	342,417	18,917	345,876	19,307	1.0%	2.1%
Total	**1,093,310**	**74,101**	**1,097,410**	**73,924**	**0.4%**	**-0.2%**

2006	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	579,280	38,200	589,188	38,698	1.7%	1.3%
Solid fossil fuels	168,339	16,154	167,618	15,803	-0.4%	-2.2%
Gaseous fossil fuels	312,236	17,219	315,391	17,605	1.0%	2.2%
Total	**1,059,855**	**71,573**	**1,072,196**	**72,106**	**1.2%**	**0.7%**

([25]) Minus means that Member State-based estimates are lower than the Eurostat-based estimates.

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	730,699	48,003	747,727	48,745	2.3%	1.5%
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	**1,481,576**	**104,630**	**1,533,728**	**108,712**	**3.5%**	**3.9%**

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	985,883	56,588	986,138	54,957	0.0%	-2.9%
Solid fossil fuels	225,769	20,995	228,483	21,251	1.2%	1.2%
Gaseous fossil fuels	617,114	33,764	618,798	33,856	0.3%	0.3%
Total	**1,828,765**	**111,348**	**1,833,419**	**110,064**	**0.3%**	**-1.2%**

2006	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	938,740	54,585	945,312	54,027	0.7%	-1.0%
Solid fossil fuels	215,511	20,008	216,318	20,083	0.4%	0.4%
Gaseous fossil fuels	627,808	34,384	629,520	34,478	0.3%	0.3%
Total	**1,782,059**	**108,978**	**1,791,150**	**108,588**	**0.5%**	**-0.4%**

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	317,673	22,181	318,561	22,425	0.3%	1.1%
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	**648,653**	**50,074**	**653,970**	**51,172**	**0.8%**	**2.2%**

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	306,075	21,646	307,507	21,953	0.5%	1.4%
Solid fossil fuels	157,042	14,572	164,265	15,414	4.6%	5.8%
Gaseous fossil fuels	184,195	10,282	184,194	10,333	0.0%	0.5%
Total	**647,311**	**46,499**	**655,967**	**47,700**	**1.3%**	**2.6%**

2006	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	308,579	21,857	310,411	22,198	0.6%	1.6%
Solid fossil fuels	229,283	21,270	238,161	22,402	3.9%	5.3%
Gaseous fossil fuels	189,937	10,602	189,937	10,655	0.0%	0.5%
Total	**727,799**	**53,729**	**738,509**	**55,256**	**1.5%**	**2.8%**

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	406,125	26,140	443,738	29,139	9.3%	11.5%
Solid fossil fuels	223,043	21,551	224,367	20,382	0.6%	-5.4%
Gaseous fossil fuels	94,646	5,265	91,620	5,058	-3.2%	-3.9%
Total	**723,814**	**52,955**	**759,725**	**54,579**	**5.0%**	**3.1%**

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	418,628	28,230	409,457	25,190	-2.2%	-10.8%
Solid fossil fuels	206,187	20,079	205,604	18,646	-0.3%	-7.1%
Gaseous fossil fuels	150,643	8,368	151,008	8,307	0.2%	-0.7%
Total	**775,458**	**56,677**	**766,068**	**52,143**	**-1.2%**	**-8.0%**

2006	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	428,735	29,343	419,778	25,875	-2.1%	-11.8%
Solid fossil fuels	311,741	30,154	306,651	28,499	-1.6%	-5.5%
Gaseous fossil fuels	162,277	9,001	162,684	8,906	0.3%	-1.0%
Total	**902,753**	**68,498**	**889,114**	**63,281**	**-1.5%**	**-7.6%**

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	3,575,699	230,418	3,534,399	223,844	-1.2%	-2.9%
Solid fossil fuels	798,967	74,308	803,792	74,941	0.6%	0.9%
Gaseous fossil fuels	1,089,913	59,368	1,089,913	59,718	0.0%	0.6%
Total	**5,464,579**	**364,093**	**5,428,104**	**358,502**	**-0.7%**	**-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	3,666,675	235,705	3,833,696	242,987	4.6%	3.1%
Solid fossil fuels	581,588	54,144	605,724	56,381	4.1%	4.1%
Gaseous fossil fuels	1,719,802	94,609	1,721,370	94,765	0.1%	0.2%
Total	**5,968,065**	**384,458**	**6,160,790**	**394,133**	**3.2%**	**2.5%**

2006	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	3,629,973	232,423	3,600,001	223,943	-0.8%	-3.6%
Solid fossil fuels	541,749	50,567	521,220	48,321	-3.8%	-4.4%
Gaseous fossil fuels	1,658,979	91,350	1,653,120	91,081	-0.4%	-0.3%
Total	**5,830,701**	**374,340**	**5,774,341**	**363,345**	**-1.0%**	**-2.9%**

Germany

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	5,103,565	317,654	4,978,351	323,087	-2.5%	1.7%
Solid fossil fuels	5,506,539	531,051	5,483,640	521,343	-0.4%	-1.8%
Gaseous fossil fuels	2,301,913	126,753	2,302,935	124,428	0.0%	-1.8%
Total	**12,912,017**	**975,457**	**12,764,926**	**968,858**	**-1.1%**	**-0.7%**

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	4,913,726	291,859	4,859,993	306,282	-1.1%	4.9%
Solid fossil fuels	3,466,885	333,258	3,318,279	303,131	-4.3%	-9.0%
Gaseous fossil fuels	3,385,287	187,307	3,281,276	179,311	-3.1%	-4.3%
Total	**11,765,897**	**812,424**	**11,459,548**	**788,725**	**-2.6%**	**-2.9%**

2006	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	4,907,354	292,661	4,884,271	307,159	-0.5%	5.0%
Solid fossil fuels	3,443,142	330,819	3,350,493	304,367	-2.7%	-8.0%
Gaseous fossil fuels	3,328,311	184,127	3,313,541	181,048	-0.4%	-1.7%
Total	**11,678,807**	**807,606**	**11,548,305**	**792,574**	**-1.1%**	**-1.9%**

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	507,230	35,841	512,864	36,388	1.1%	1.5%
Solid fossil fuels	338,766	33,343	337,788	39,359	-0.3%	18.0%
Gaseous fossil fuels	5,783	248	5,783	261	0.0%	5.2%
Total	**851,780**	**69,432**	**856,435**	**76,009**	**0.5%**	**9.5%**

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	722,508	51,282	733,055	52,202	1.5%	1.8%
Solid fossil fuels	374,483	37,054	379,212	45,836	1.3%	23.7%
Gaseous fossil fuels	98,538	5,402	97,149	5,329	-1.4%	-1.3%
Total	**1,195,529**	**93,738**	**1,209,416**	**103,368**	**1.2%**	**10.3%**

2006	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	721,774	50,777	764,980	54,120	6.0%	6.6%
Solid fossil fuels	351,197	34,756	347,211	42,001	-1.1%	20.8%
Gaseous fossil fuels	115,022	6,320	113,400	6,223	-1.4%	-1.5%
Total	**1,187,993**	**91,853**	**1,225,591**	**102,344**	**3.2%**	**11.4%**

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	185,617	13,022	178,814	12,628	-3.7%	-3.0%
Solid fossil fuels	143,033	13,864	146,769	14,647	2.6%	5.6%
Gaseous fossil fuels	78,417	4,046	78,575	3,327	0.2%	-17.8%
Total	**407,067**	**30,931**	**404,158**	**30,602**	**-0.7%**	**-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	318,324	22,412	362,011	25,734	13.7%	14.8%
Solid fossil fuels	112,401	10,780	113,149	11,158	0.7%	3.5%
Gaseous fossil fuels	145,266	8,109	145,592	8,270	0.2%	2.0%
Total	**575,991**	**41,302**	**620,752**	**45,163**	**7.8%**	**9.3%**

2006	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	316,038	22,122	350,892	24,850	11.0%	12.3%
Solid fossil fuels	101,747	9,774	102,273	10,088	0.5%	3.2%
Gaseous fossil fuels	168,019	9,379	168,288	9,559	0.2%	1.9%
Total	**585,804**	**41,274**	**621,452**	**44,497**	**6.1%**	**7.8%**

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	3,719,292	247,637	3,751,511	251,530	0.9%	1.6%
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	87,140	0.7%	-3.0%
Total	**5,964,353**	**394,320**	**6,010,404**	**396,059**	**0.8%**	**0.4%**

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	3,369,436	220,771	3,526,814	226,504	4.7%	2.6%
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	163,320	0.7%	-0.6%
Total	**7,017,310**	**449,340**	**7,195,087**	**454,731**	**2.5%**	**1.2%**

2006	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	3,317,573	217,966	3,512,594	225,733	5.9%	3.6%
Solid fossil fuels	697,442	64,815	698,331	65,738	0.1%	1.4%
Gaseous fossil fuels	2,896,923	160,975	2,916,171	160,359	0.7%	-0.4%
Total	**6,911,938**	**443,756**	**7,127,097**	**451,830**	**3.1%**	**1.8%**

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	61,990	4,437	63,497	4,548	2.4%	2.5%
Solid fossil fuels	47,493	4,952	48,530	4,980	2.2%	0.6%
Gaseous fossil fuels	17,983	1,004	17,983	1,004	0.0%	0.0%
Total	**127,466**	**10,393**	**130,009**	**10,532**	**2.0%**	**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	111,228	7,998	109,529	7,877	-1.5%	-1.5%
Solid fossil fuels	3,412	316	4,910	380	43.9%	20.0%
Gaseous fossil fuels	49,346	2,754	49,346	2,768	0.0%	0.5%
Total	**163,987**	**11,069**	**163,786**	**11,025**	**-0.1%**	**-0.4%**

2006	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	107,532	7,731	109,445	7,871	1.8%	1.8%
Solid fossil fuels	4,623	429	6,257	498	35.3%	16.1%
Gaseous fossil fuels	51,664	2,884	51,664	2,898	0.0%	0.5%
Total	**163,818**	**11,043**	**167,366**	**11,267**	**2.2%**	**2.0%**

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	994,800	55,531	964,000	49,701	-3.1%	-10.5%
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	**2,669,000**	**161,261**	**2,637,000**	**155,641**	**-1.2%**	**-3.5%**

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	1,251,620	69,513	1,251,000	55,189	0.0%	-20.6%
Solid fossil fuels	339,599	31,426	346,490	32,157	2.0%	2.3%
Gaseous fossil fuels	1,478,939	80,659	1,480,000	81,846	0.1%	1.5%
Total	**3,070,157**	**181,598**	**3,077,490**	**169,193**	**0.2%**	**-6.8%**

2006	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	1,214,510	69,952	1,221,258	54,602	0.6%	-21.9%
Solid fossil fuels	330,314	30,525	325,359	30,241	-1.5%	-0.9%
Gaseous fossil fuels	1,434,356	78,416	1,435,138	79,597	0.1%	1.5%
Total	**2,979,180**	**178,893**	**2,981,755**	**164,439**	**0.1%**	**-8.1%**

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	466,044	29,060	491,139	30,430	5.4%	4.7%
Solid fossil fuels	108,009	10,017	115,571	10,463	7.0%	4.5%
Gaseous fossil fuels	0	0	NO	NE,NO		
Total	**574,053**	**39,077**	**606,709**	**40,892**	**5.7%**	**4.6%**

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	628,976	40,466	628,850	39,124	0.0%	-3.3%
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	**926,135**	**62,224**	**926,528**	**60,561**	**0.0%**	**-2.7%**

2006	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	536,448	34,922	570,221	36,429	6.3%	4.3%
Solid fossil fuels	138,481	12,840	138,597	12,501	0.1%	-2.6%
Gaseous fossil fuels	152,383	8,506	150,501	8,401	-1.2%	-1.2%
Total	**827,312**	**56,267**	**859,319**	**57,331**	**3.9%**	**1.9%**

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	1,872,881	121,265	1,867,157	120,424	-0.3%	-0.7%
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	**2,871,751**	**206,693**	**2,871,619**	**209,042**	**0.0%**	**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	2,825,895	189,266	2,805,183	183,668	-0.7%	-3.0%
Solid fossil fuels	866,593	80,418	875,802	83,109	1.1%	3.3%
Gaseous fossil fuels	1,249,511	69,377	1,252,287	69,813	0.2%	0.6%
Total	**4,941,998**	**339,061**	**4,933,273**	**336,590**	**-0.2%**	**-0.7%**

2006	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	2,808,113	189,687	2,786,316	183,820	-0.8%	-3.1%
Solid fossil fuels	748,400	69,406	768,389	73,083	2.7%	5.3%
Gaseous fossil fuels	1,298,737	72,155	1,301,623	72,381	0.2%	0.3%
Total	**4,855,250**	**331,247**	**4,856,328**	**329,284**	**0.0%**	**-0.6%**

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	592,827	36,570	634,706	39,264	7.1%	7.4%
Solid fossil fuels	112,328	10,644	119,645	8,213	6.5%	-22.8%
Gaseous fossil fuels	24,156	1,348	24,002	1,356	-0.6%	0.6%
Total	**729,312**	**48,562**	**778,353**	**48,833**	**6.7%**	**0.6%**

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	595,598	37,204	592,271	36,462	-0.6%	-2.0%
Solid fossil fuels	110,069	10,457	103,297	7,032	-6.2%	-32.8%
Gaseous fossil fuels	35,279	1,969	31,741	1,793	-10.0%	-8.9%
Total	**740,946**	**49,630**	**727,309**	**45,287**	**-1.8%**	**-8.8%**

2006	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	583,316	36,033	584,057	35,060	0.1%	-2.7%
Solid fossil fuels	112,650	10,661	104,645	7,512	-7.1%	-29.5%
Gaseous fossil fuels	36,922	2,061	33,206	1,876	-10.1%	-9.0%
Total	**732,887**	**48,755**	**721,907**	**44,448**	**-1.5%**	**-8.8%**

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	3,177,230	208,108	3,248,997	213,032	2.3%	2.4%
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	**7,810,030**	**563,505**	**7,860,439**	**564,023**	**0.6%**	**0.1%**

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	2,978,196	193,380	3,048,950	195,656	2.4%	1.2%
Solid fossil fuels	1,595,034	148,230	1,589,666	146,158	-0.3%	-1.4%
Gaseous fossil fuels	3,584,948	199,530	3,580,894	202,762	-0.1%	1.6%
Total	**8,158,178**	**541,139**	**8,219,510**	**544,577**	**0.8%**	**0.6%**

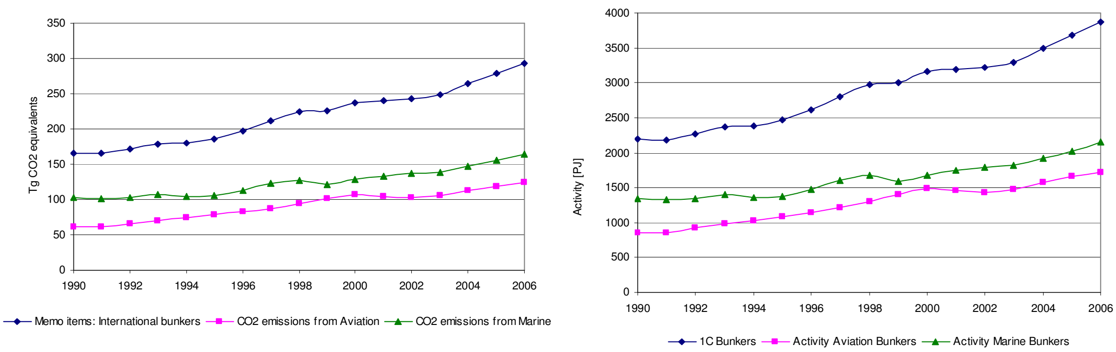
2006	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	2,935,985	191,984	3,015,489	196,050	2.7%	2.1%
Solid fossil fuels	1,719,777	159,830	1,714,946	163,012	-0.3%	2.0%
Gaseous fossil fuels	3,393,919	188,880	3,396,548	192,220	0.1%	1.8%
Total	**8,049,681**	**540,694**	**8,126,983**	**551,282**	**1.0%**	**2.0%**

3.7 International bunker fuels (EU-15)

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 ([26]). Between 1990 and 2006, greenhouse gas emissions from international bunker fuels increased by 76 % 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).

([26]) The definitions in Tables 2.8 and 2.9 of the IPCC good practice guidance are based on activities within 'one country". This means domestic aviation is defined for individual countries. The decision tree in Figure 2.8 of the IPCC good practice guidance considers 'national fuel statistics' for domestic aviation. As the EC is neither a country nor a nation, the EC's interpretation of the good practice guidance is that the emission estimate at EC level has to be the sum of Member States estimates for domestic air or marine transport as they are the countries or nations addressed in the definition and decision trees of the IPCC good practice guidance.

Figure 3.93 International bunker fuels: GHG emission trend and activity data



3.7.1. Aviation bunkers (EU-15)

CO_2 emissions from Aviation Bunkers account for 3.0 % of total GHG emissions in 2006 but are not included in the national total GHG emissions. Between 1990 and 2006, CO_2 emissions from Aviation bunkers increased by 102 % in the EU-15 (Table 3.107).

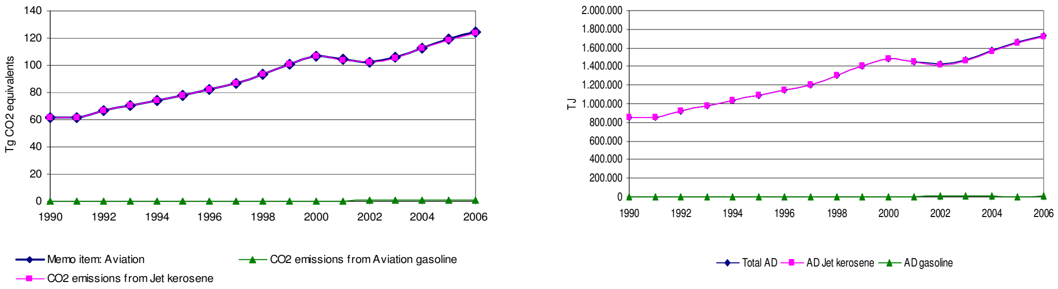
The Member States France, the Netherlands, Germany and the United Kingdom contributed the most to the emissions from this source (68 %). All Member States increased emissions from Aviation bunkers between 1990 and 2006. The Member States with the highest increases in absolute terms were the United Kingdom, Germany and France. The countries with the lowest increase in absolute terms were Greece, Finland and Sweden.

Table 3.107 Aviation bunkers: Member States' contributions to CO_2

Member State	CO2 emissions in Gg			Share in EU15 emissions in 2006	Change 1990-2006		Change 2005-2006	
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	886	1,731	1,810	1.5%	924	104%	79	4%
Belgium	3,096	3,538	3,701	3.0%	606	20%	163	4%
Denmark	1,736	2,575	2,583	2.1%	847	49%	8	0%
Finland	1,008	1,290	1,435	1.2%	427	42%	144	10%
France	8,549	15,532	16,419	13.2%	7,871	92%	887	5%
Germany	11,474	20,286	21,159	17.0%	9,685	84%	873	4%
Greece	2,448	2,387	2,863	2.3%	415	17%	476	17%
Ireland	1,061	2,458	2,843	2.3%	1,782	168%	385	14%
Italy	4,116	8,543	9,224	7.4%	5,107	124%	680	7%
Luxembourg	400	1,326	1,241	1.0%	841	210%	-85	-7%
Netherlands	4,540	10,876	10,975	8.8%	6,434	142%	99	1%
Portugal	1,486	2,159	2,262	1.8%	776	52%	103	5%
Spain	3,432	9,519	10,012	8.1%	6,581	192%	493	5%
Sweden	1,335	1,936	2,006	1.6%	671	50%	71	4%
United Kingdom	15,737	35,070	35,602	28.7%	19,865	126%	532	1%
EU-15	**61,303**	**119,226**	**124,135**	**100.0%**	**62,832**	**102%**	**4,909**	**4%**

CO_2 emissions from Jet kerosene account for 99,6 % of total emissions from "Aviation bunkers" in 2006 (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 and Ireland. The country with the lowest increase was Belgium.

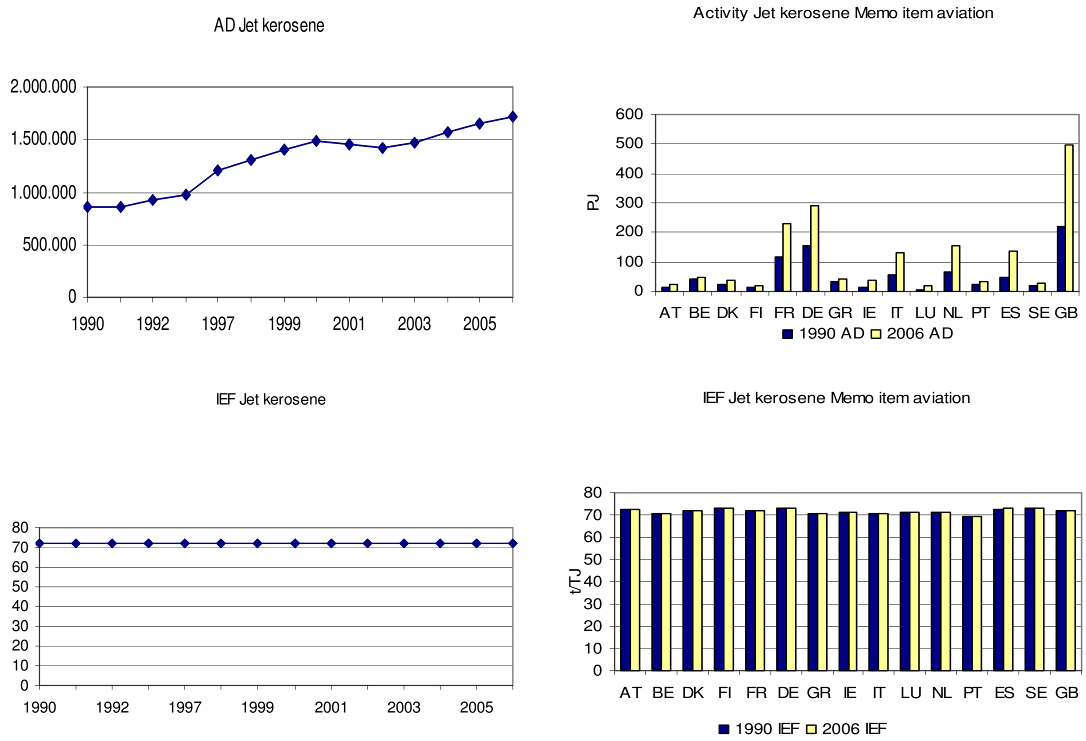
Figure 3.94 Aviation bunkers: Trend of CO_2 Emissions and Activity Data



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 101 % between 1990 and 2006. The EU-15 implied emission factor was at 72 t/TJ in 2006.

Figure 3.95 Aviation bunkers, Jet kersoene: Activity Data and Implied Emission Factors for CO_2



3.7.2. Marine bunkers (EU-15)

CO_2 emissions from "Marine bunkers" account for 4.0 % of total GHG emissions in 2006 and are also not included in the national total GHG emissions. Between 1990 and 2006, CO_2 emissions from Marine bunkers increased by 60 % 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 2006. Only Finland decreased the emissions from Marine bunkers. The Member States with the highest increase in absolute terms were also Spain, the Netherlands and Belgium.

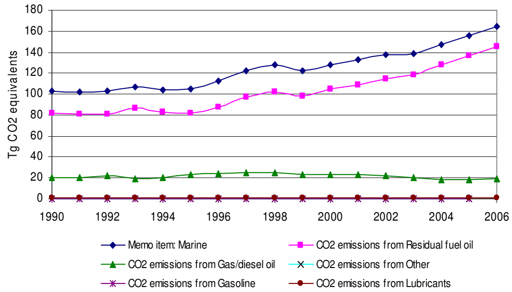
Table 3.108 Marine bunkers: Member States' contributions to CO_2 emissions

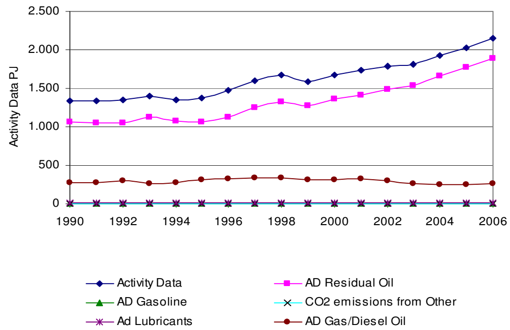
Member State	CO2 emissions in Gg			Share in EU15 emissions in 2006	Change 1990-2006		Change 2005-2006	
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Belgium	13,303	24,956	27,285	16.5%	13,982	105%	2,328	9%
Denmark	3,087	2,636	3,433	2.1%	345	11%	797	23%
Finland	1,842	1,651	1,816	1.1%	-26	-1%	165	9%
France	7,954	8,762	9,108	5.5%	1,153	15%	346	4%
Germany	7,980	8,582	8,582	5.2%	602	8%	0	0%
Greece	8,028	9,079	9,800	5.9%	1,773	22%	722	7%
Ireland	57	330	404	0.2%	347	612%	74	18%
Italy	4,389	6,210	6,541	4.0%	2,152	49%	331	5%
Luxembourg	NA,NE	NA,NE	NA,NE	-	-	-	-	-
Netherlands	34,357	54,091	56,158	34.0%	21,801	63%	2,067	4%
Portugal	1,421	1,570	1,701	1.0%	280	20%	131	8%
Spain	11,528	25,139	26,244	15.9%	14,716	128%	1,105	4%
Sweden	2,228	6,640	7,140	4.3%	4,912	220%	500	7%
United	6,680	5,860	6,807	4.1%	127	2%	948	14%
EU-15	**102,855**	**155,505**	**165,019**	**100.0%**	**62,165**	**60%**	**9,514**	**6%**

CO_2 emissions from Residual fuel oil account for 88 % of total emissions from "Marine bunkers" in 2006 (Figure 3.96). Between 1990 and 2006, CO_2 emissions from Residual fuel oil increased by 77 % in the EU-15. Most Member States increased emissions from Residual oil between 1990 and 2006. Member States with the highest increase in percent were Ireland and Sweden. The countries with the lowest increase were Belgium, Finland and Denmark.

CO_2 emissions from Gas/Diesel oil account for 12 % of total emissions from "Marine bunkers" in 2006. Between 1990 and 2006, CO_2 emissions from Gas/Diesel oil decreased by 4 % in the EU-15.

Figure 3.96 Marine bunkers: Trend of CO_2 Emissions and Activity Data

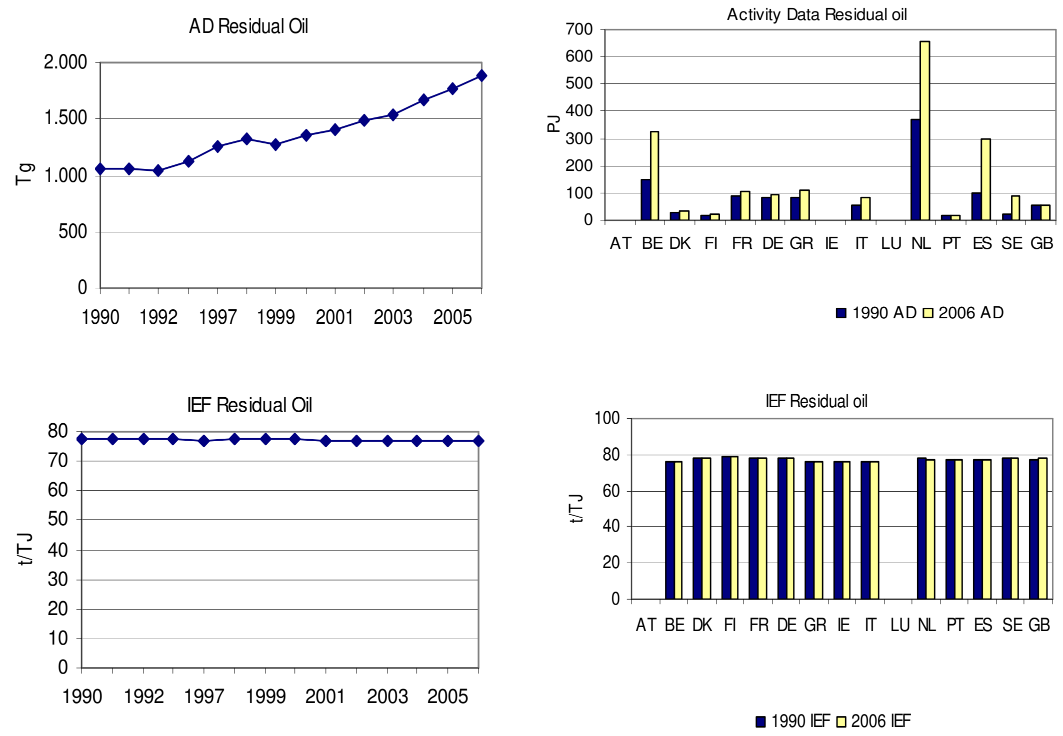




Marine Bunkers – Residual Oil (CO_2)

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 77 % between 1990 and 2006. The EU-15 implied emission factor was at 77.2 t/TJ in 2006.

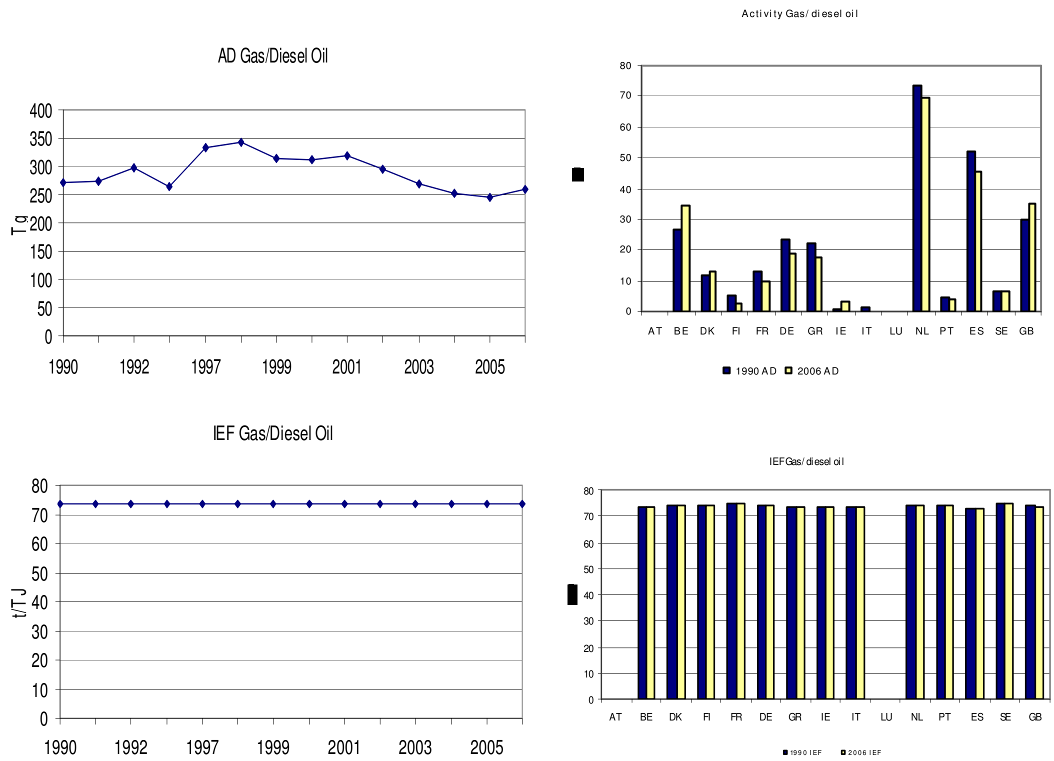
Figure 3.97 Marine bunkers' – Residual Oil: Activity Data and Implied Emission Factors for CO_2



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 4 % between 1990 and 2006. The EU-15 implied emission factor was at 73.73 t/TJ in 2006.

Figure 3.98 Marine bunkers, Gas/Diesel Oil: Activity Data and Implied Emission Factors for CO_2



QA/QC activities

The European Topic Centre on Air and Climate Change conducted a study in 2007 based on aviation emission estimates from Member States and calculations by the European Organisation for the Safety of Air Navigation (Eurocontrol). The purpose of the study was to compare emissions reported by Member States with modelling results provided by Eurocontrol to assess the quality of the emissions estimates and help identify areas in need for improvement. The calculations by Eurocontrol are based on flight movement data using an independent data set whereas most Member States use fuel sale statistics. The study assessed three questions: (i) how consistent are estimates for total fuel consumption between the two data sets; (ii) how consistent are estimates for the share of domestic aviation between the two data sets; (iii) does the consistency between the two estimates depend on the type of methodology applied by Member States. The main conclusions of the study were:

(1) Comparing country estimates for fuel burn, CO_2 emissions and NOx with Eurocontrol calculations is a genuine quality assurance exercise which can help both sides in improving their data. Despite significant uncertainties in the estimates the comparison was able to identify countries for which the differences could not be easily explained and where countries as well as Eurocontrol might need to do further analysis. Especially for the share of domestic aviation Eurocontrol data might be of use to several countries in the future.

(2) The analysis showed that although in theory CO_2 estimates from aviation do not depend on the tier chosen, in practice countries applying higher tiers also had more consistent carbon dioxide emission estimates. One of the reasons might be that the application of higher tiers requires detailed statistics in the aviation sector which might also be reflected in the fuel sale estimates.

(3) The use of bottom-up data for the determination of the split between domestic and international aviation could improve the accuracy of inventory estimates. The small country approach is a good and very easy methodology for countries without domestic IFR/GAT aviation; research projects can produce good estimates for the share of domestic emissions. Out of the 29 countries assessed those applying expert judgement or top-down data had the highest discrepancies compared to Eurocontrol.

(4) In general, the European countries tend to overestimate domestic emissions. This is a conservative approach as it increases the emissions included in the emission reduction commitment under the Kyoto Protocol. For the same reason it would be in the interest of the concerned countries to improve their estimates: greenhouse gas emissions from aviation have increased substantially since 1990 and overestimating the domestic share will exacerbate the efforts for reaching the national targets. Applying the share of domestic aviation as calculated by Eurocontrol to total fuel consumption in the EU 15 leads to an overestimation of domestic emissions from aviation by 6.2 Mt CO_2 in 2005.

(5) In theory, Eurocontrol data could be used to compile national inventory reports for its Member States. The data has several advantages, most importantly the timely preparation and estimation of emissions using a Tier 3 methodology without additional resource requirements for inventory agencies. However, several issues need to be solved before Eurocontrol data can be used:

- Consistent time series: Eurocontrol has no data for the years 1990 – 1995 and only limited information for 1996 – 2002. Additional information will be necessary to compile a consistent time series.

- Consistency with national statistics: National statistics could be used to complement the modelled data to ensure consistency and completeness with the reference approach. In addition, energy statistics often have a lower uncertainty than the fuel consumption data calculated with ANCAT 3.

- Completeness: Eurocontrol only covers certain geographic areas and certain types of flights.

Inventory agencies will need to ensure that all emissions are covered in the national inventory report independent of the coverage of Eurocontrol.

3.8 Feedstocks and non-energy use of fuels

The following table provides an overview on how Member States treat emissions from feedstocks and non-energy use of fuels.

Table 3.109: Information related to feedstocks and non-energy use from Member States' NIRs

MS	Information on feedstocks and non-energy use of fuels	Source
Austria	Non-energy use of fuels is considered in the national energy balance. Below explanations for the reported non-energy use is provided together with information on where CO_2 emissions due to the manufacture, use and disposal of carbon containing products are considered. For fraction of carbon stored the IPCC default values are applied for all fuels except for coke oven coke, of which the amount carbon stored in steel was calculated. **Lubricants** **manufacture:** emissions are assumed to be included in total emissions from category 1 A 1 b petroleum refinery. **use:** emissions from the use of motor oil are included in CO_2 emissions from transport. VOC emissions from lubricants used in rolling mills are considered in category 2 C 1. It is assumed that other uses of lubricants do not result in VOC or CO_2 emissions due to the low vapour pressure of lubricants. **disposal:** emissions from incineration of lubricants (waste oil) are either included in categories 1 A 1 a and 1 A 2 if waste oil is used as fuels or in category 6 C respectively if energy is not recovered. **Bitumen** **manufacture:** emissions from the production of bitumen are assumed to be included in total emissions of category 1 A 1 b petroleum refinery. **use:** indirect CO_2 emissions from the use of bitumen for road paving and roofing that should be reported in categories 2 A 5 and 2 A 6 are included in sector 3 solvent and other product use. **disposal:** CO_2 emissions from the disposal from bitumen are assumed to be negligible. Recycling is not considered. **Natural Gas** **manufacture:** emissions from the use of natural gas as a feedstock in ammonia production are accounted for in the industrial processes sector (category 2 B 1). **use/disposal:** not applicable, no CO_2 emissions result from the use or disposal of ammonia. **Coke oven coke** **manufacture:** emissions from the production of coke are considered in category 1 A 2 a. **use:** CO_2 emissions from coke used in iron and steel industry are reported under 2 C. **disposal:** not applicable. **Other bituminous coal** Non energy use is reported for the manufacture of electrodes. **manufacture:** No information about emissions from manufacture of electrodes is currently available. Therefore it is not clear if emissions are not estimated or not applicable. **use:** Emissions from the use of electrodes are considered in category 2 B 4 carbide production and 2 C metal production. **disposal:** not applicable. **Other oil products** **manufacture:** emissions from the production of ethylene and propylene are included in total emissions of category 1 A 1 b petroleum refinery. CO_2 emissions from solvent use are considered in sector 3 solvent and other product use. **use:** CO_2 emissions from solvent use are considered in sector 3. **disposal:** emissions from the disposal of plastics in landfills are considered in 6 A and from the use of plastic waste as a fuel in 1 A 2; emissions from the incineration of plastic in waste without energy recovery is included in 6 C; emissions from incineration of plastics in waste with energy recovery are considered in 1 A 1 a.	Austria's National Inventory Report 2008, April 2008, pp.140-141

MS	Information on feedstocks and non-energy use of fuels	Source
Belgium	The emissions of non-energy use of fuels and related emissions (emissions from recovered fuels from processes) are reported under categories 1A2, 2B1 and 2B5. As a result of the in-country review performed by the expert review team of UNFCCC in June 2007, the emissions reported in category 2G during the previous submissions are no longer included in the Belgian emission inventory. In this category 2G the emissions from the non-energy use of fuel were reported, estimated by using the IPCC default emission factors of carbon stored during the use of lubricants and solvents. Following the advise of the expert review team, these emissions of CO_2 from the use of solvents and lubricants will only arise when they are burned or destroyed. As a consequence these emissions are excluded out of the Belgian emission inventory during this submission. In Flanders, a recalculation of the non-energy use and related CO_2 emissions was performed during the 2005 submission, based on the results of a study conducted in 2003. The default % of carbon stored in the IPCC Guidelines were considered to be inaccurate in the Flemish situation. The default % of carbon stored are not well defined in the 1996 IPCC guidelines: it is not clear what is included or excluded in these default %. Belgium participated in an European network on the CO_2-emissions from non-energy use and one of the conclusions of this network is that the new IPCC guidelines need to give more information on this subject. Since the petrochemical industry is important in Flanders and Belgium and the emissions from the feed stocks are a key source in the Belgian inventory, the study mentioned above was conducted to get more detailed, country-specific information. A distinction was made between: 1. The use of recovered fuels from cracking units or other processes where a fuel is used as a raw material and where part of this fuel (or transformed product) is recovered for energy purposes. These emissions are reported under category 1A2c 'other fuels'. This is the largest source of CO_2 emissions. The involved industry is reporting the CO_2 emissions and PJ for these recovered fuels. 2. CO_2 emissions occurring during chemical processes, for example the production of ammonia based on natural gas or the production ethylene oxide where CO_2 is formed in a side reaction (reported respectively under 2B1 and 2B5 other). The industry involved is reporting these CO_2 emissions directly for these processes. 3. Waste treatment of final products is not included in the study. This is practically impossible due to import/export of plastic products, etc (it is also not clear if the waste phase is included in the default IPCC carbon stored % or not). The emissions of waste incineration are therefore calculated separately and are reported under the sector of waste (category 6C) or under the sector of energy (category 1A1a), whether or not energy recuperation takes place during the process. The result of the study made a recalculation possible for all years. The effect of the recalculation was greater in the more recent years because the petrochemical industry has expanded its activities in the beginning of the nineties (that's one of the reasons this sector is a key source). The resulting emissions are reported under different sections. The first and largest part (recovered fuels) of the resulting emissions is reported under 1A2c, under 'other fuels'. This includes other fuels in the chemical sector, a result of recovered fuels in the steam cracking units in petrochemical industry (approx. 2/3) and other recovered fuels from the chemical industry (approx. 1/3). These recovered fuels are reported directly in the yearly surveys carried out by the chemical federation in cooperation with the Vito to establish a yearly Flemish energy balance. The choice was made to allocate these fuels under 'other fuels' and not 'liquid fuels' or 'gaseous fuels', for transparency reasons. Another part of the emissions surveyed in the study, are considered to be process emissions and are reported under 2B. These include the CO_2-emission during the production of ammonia (2B1) and other process CO_2 emissions (2B5) reported by the chemical industry in Flanders (for example production of ethylene oxide, production of acrylic acid from propene, production of cyclohexanone from cyclohexane, production of paraxylene/meta-xylene, etc). These CO_2 emissions result from the same surveys in the chemical sector in Flanders as those reported under 1A2c. In the survey, more sources of emissions from chemical processes are reported than are described in the IPCC 1996 guidelines.	Belgium´s Greenhouse Gas Inventory 1990-2006, March 2008, pp.67-68
Denmark	Emissions from non-energy use of fuels have not been included in the Danish inventory, to date, but the non-energy use of fuels is, however, included in the reference approach for Climate Convention reporting. The Danish energy statistics include three fuels used for non-energy purposes: bitumen, white spirit and lube oil. The fuels used for non-energy purposes add up to about 2% of the total fuel consumption in Denmark.	Denmark's National Inventory Report 2008, April 2008, p. 83
Finland	The methodology for estimating the CO_2 emissions from feedstock and non-energy use of fuels was revised, because there was obvious double counting. The ILMARI system includes point source (bottom-up) data on feedstock combustion in the petrochemical industry as well as recycled waste oil combustion in different sectors in industry, and they are reported in corresponding CRF categories 1.A 2. These known energy uses of feedstock and lubricants are subtracted from the corresponding total amounts. For the rest of the feedstock 100% (previously 90%) of carbon is estimated to be stored in products (mainly plastics). For the rest of lubricants, 33% of carbon is estimated to be stored in products (recycled lubricants) and 67% of carbon released as CO_2 either in burning of lubricants in motors or illegal combustion of waste oil in small boilers. Emissions from natural gas used as feedstock are calculated and reported in sector 1.B 2. These non-specified emissions from feedstock (which are not reported in 1.A 2 or 1.B 2) are now included in category 1.A 5.	Greenhouse Gas emissions in Finland 1990-2006, April 2008, p. 94

MS	Information on feedstocks and non-energy use of fuels	Source
Germany	Germany uses the results of the research project "Estimating CO_2 Emissions from the Non- Energy Use of Fossil Fuels in Germany" in order to improve the inventory of non-energy use of fuels. In this research project non-energy use of fossil fuels is calculated with the NEAT-Model (Non-energy Use Emission Accounting Tables) that was developed at Utrecht University (Netherlands). NEAT calculates the non-energy use of fossil fules and the resulting emissons with a mass-balance and a material-flow analysis. These calculations are almost independent from data from the official energy balance but require data from production and external trade and detailed knowledge of the structure of the of the chemical industry. The emissions from the ammonia production are considerably higher with the NEAT model than with the IPCC sectoral approach. This is mainly due to the assumption of rather efficient plants in the NEAT model. The emissions from aluminium production are considerably higher with the NEAT model than with the IPCC sectoral approach. The main reason for this difference is the lower emission factor used in the IPCC sectoral approach. Based on the results of the research project Germany plans further improvements.	National Inventory Report – 2007, May 2007, p. 465-472
Greece	Non-energy use of fuels in Greece refers to the consumption of: • naphtha, natural gas, and lignite (for the period 1990 – 1991) in chemical industry, • petroleum coke in the production of non-ferrous metals, • lubricants in transport (including off-road transportation), • bitumen in construction and • other petroleum products in the industrial and residential sectors Data on the non-energy consumption of fuels derive from the national energy balance. However, the availability of more detailed data regarding non-energy consumption of fuels and industrial activity in Greece should be examined, as current data do not provide adequate information. • The non-energy use for ammonia production is included in the non-energy consumption of the chemical industry but the available information does not allow for the allocation of the total figure to individual industrial sub-sectors. Thus, CO_2 emissions from ammonia production are reported under the energy sector instead of the industrial processes sector. Non-energy use of lignite (for 1990 and 1991) refers only to ammonia production (in one installation) and as a result the fraction of carbon stored is equal to 0. The operation of this installation ended at 1998 while it did not produce ammonia for the period 1992 – 1998. • No data regarding non-energy use in the iron and steel industry are reported in the national energy balance and, as a result, CO_2 emissions from the use of fuels as reduction agents, are only reported under the industrial processes sector. • Solid fuels consumption in the ferroalloys production industry is included (in the national energy balance) in the solid fuels consumption of the non-ferrous metals sector. However, the available information does not allow for the allocation of the total figure to individual industrial sub-sectors and, as a result, CO_2 emissions from ferroalloys production are reported under the energy sector instead of the industrial processes sector. • The non-energy use of petroleum coke (see Table 3.28) refers exclusively to the primary aluminium production. Given that the relevant emissions are reported under the industrial processes sector, petroleum coke consumption is not taken into account in the energy sector. On the basis of the above-mentioned clarifications, the possibility to double-count or underestimate CO_2 emissions from the non-energy use of fuels is minor. However, there are two cases (ammonia and ferroalloys production) that need further consideration as emissions are not reported under the more appropriate sector (i.e. industrial processes).	Annual Inventory submission under the convention and the Kyoto Protocol for Greenhouse and other Gases for years 1990-2006, Apr 2008, pp.96-98
Ireland	Naphtha was previously the only petroleum product to be considered in relation to non-energy fuel-use, where the carbon is not fully released as in combustion. The IPCC default value of 0.50, 0.75 and 1.0 are used for the proportion of carbon stored in lubricants, naphtha and bitumen respectively. Ireland's only oil refinery is a small hydroskimming refinery where there is no production of other petroleum products normally used for non-energy purposes, such as bitumen, lubricants, plastics and asphalt. The expanded SEI energy balance sheets now record the import of some of these products, thereby allowing improved completeness in the Reference Approach estimation of CO_2 emissions and carbon storage. A significant amount of natural gas feedstock was traditionally used in ammonia production in Ireland but the company closed in 2002 and there is consequently no feedstock use of natural gas since 2002.	Ireland National Inventory Report 2008, March 2008, p. 44

MS	Information on feedstocks and non-energy use of fuels	Source
Italy	Data on petrochemical and other non-energy use of fuels are based on a rather detailed yearly report available by the Ministry of Economic Development (MSE). The report summarizes answers from a detailed questionnaire that all operators in Italy prepare monthly. The data are more detailed than those normally available by international statistics and refer to: - input to plants (gross input); - quantities of fuels returned to the marked (with possibility to estimate the net input); - fuels used internally for combustion; - quantities stored in products. In the energy balances only the input and output quantities from the petrochemical plants are reported, so it may be that the output quantity is greater than the input quantity, due to internal transformation. Therefore it is possible to have negative values for some products mainly gasoline, refinery gas, fuel oil. With these data it is possible to estimate the quantities of fuels stored in product in percentage on net and gross petrochemical input. There is a sizeable difference of the estimated quantities of fuel stored in product if reference is made to "net" or "gross" input. Moreover the estimation of quantities stored in product are quite different from those reported in the Revised 1996 IPCC Guidelines for National GHG Inventories, Reference Manual. An attempt was made to estimate the quantities stored in products using IPCC percentage values and the fuels reported as "petrochemical input. The resulting estimate of about 6,880 kt of products for the year 2006, is more than 50% bigger than the quantities reported, 4,570. At national level this methodology seems the most precise according to the available data. The European Project "Non Energy use-CO_2 emissions" ENV4-CT98-0776 has analysed the Italian methodology performing a mass balance between input fuels and output products in a sample year. The results of the project confirm the reliability of the reported data.	Italian Greenhouse Gas Inventory 1990-2006 National Inventory Report 2008, April 2008, pp.69-70
Netherlands	At the present time the following emissions are accounted for as feedstocks and other non-energy use: • CO_2 emissions from the use of feedstock and other non-energy uses of fuels: feedstocks from natural gas and oil products in the chemical industry (IPCC categories 2B1 and 2B5) and coke and coal inputs in blast furnaces in the iron and steel industry (part of 2C1); • CO_2 emissions from other non-energy uses of fuels for their physical properties in other industrial • sectors: coke for soda ash production (part of 2A4), coke (2D2), lubricants and waxes (2G4); • Indirect CO_2 emissions from solvents and other product use (3); • CO_2 emissions from 'Waste Incineration' (6C, in the Netherlands reported under 1A1a); • CO_2 emissions from the combustion of by-products produced in the Industry sector (e.g. blast furnace gas, chemical waste gas and refinery gas), reported as combustion emissions in the Energy sector under 1A1a 'Electricity and Heat Production' and 1A1c 'Manufacturing Industry and Construction'. **Key sources** The major CO_2 sources reported under 'Industrial Processes' are identified as key sources: 'Ammonia Production' (2B1). 'Other Chemical Product Manufacture' (2B5) and 'Carbon Inputs in Blast Furnaces' (2C1). However, it should be noted that the Netherlands accounts for most of the use of chemical waste gas and of blast furnace gas separately as combustion in the source categories 1A1a, 1A2a and 1A2c. As the former may be included in feedstock emissions by other countries, with significant levels of CO_2 emissions, they would then become key sources when assessed separately. **Methodological issues** Clearly, not all CO_2 emissions from the use of feedstock and other non-energy uses of fuels are allocated under sector 2. This is mainly because the Netherlands allocates a large part of the chemical waste gas produced in the industry sector into the energy sector. In addition, significant parts of chemical waste gas and blast furnace gas are combusted in a sector (i.e. public power generation) other than the one in which they were produced, making it logical to allocate these combustion emissions to sector 1 Energy rather than to sector 2 Industrial Processes. This allocation applies to the chemical waste gases from the production of silicon carbide, carbon black, ethylene and methanol. In addition, the Netherlands reports waste combustion emissions under fuel combustion by the Energy sector (1A1a) since most of these facilities also produce commercial energy (heat and/or electricity). Country-specific methodologies are used for the emissions from feedstock use and feedstock product use with country-specific or default IPCC emission factors (see Annex 2). Only indirect CO_2 emissions from domestic uses of petrochemical products are reported here. A full description of the methodology is provided in the monitoring protocol 8101: CO_2 , CH_4 and N_2O emissions from the stationary combustion of fossil fuels and protocol 8102: CO_2 , CH_4 and N_2O process emissions from fossil fuel use. In the Sectoral Approach, the Netherlands uses the following data sources to estimate these emissions: • Sectoral energy consumption statistics by fuel type on feedstock and other non-energy uses of fuels as part of Total sectoral energy consumption, based on information provided by the companies, including chemical waste gas produced from feedstock uses of fuels; • Plant-specific fuel consumption data to identify a particular industrial process – for example, soda ash production; • Production data for estimating the net oxidation fractions – for example, urea production; • NMVOC emissions from solvents and other products; • Emissions from waste: the amount (and composition in order to calculate the fraction and amount of fossil carbon) of waste incinerated. This approach in which all statistics on feedstock and other non-energy uses of fuels are considered as activity data for sources of CO_2 complemented with industrial production data necessary for a more accurate estimation of these emissions, each with a specific allocation to CRF subcategories, guarantees completeness of reporting of these sources.	Greenhouse Gas Emissions in the Netherlands 1990-2006pp.103-104

MS	Information on feedstocks and non-energy use of fuels	Source
Portugal	Emissions of greenhouse gas emissions from feedstock use are only clearly accounted in the inventory in the following situations: • emission of CO_2 resulting from use of feedstock sub-products as energy sources. That is the case for emissions from consumption of fuel gas in refinery and petrochemical industry; • emission of CO_2 liberated as sub-product in production processes such as ammonia production; • emission of NMVOC from fossil fuel origin, and occurring from solvent use and evaporation. Although in this case it is not possible to establish which part results from feedstock consumption in Portugal in the energy balance. However, some potential emissions are not estimated or are only partly estimated. Those that are estimated in the reference approach but not in sectoral approach are: • emissions from mineral oil use as lubricants; • emissions from wear of bitumen in roads. It is evident that more efforts should be made to estimate other emissions from feedstock use, although it is expected that reporting guidelines should give more clear guidance in the future.	Portuguese National Inventory Report on Greenhouse Gases 1990-2006, April 2008 p. 205
Spain	The consumption of fuel for non-energy use is accounted for in the energy balance. The quantities of each fuel type are included in the reference approach. For each fuel type a split into two parts is given: a) the part that stays in the product and b) the part that is set free and causes the corresponding CO_2 emissions.	Inventario de emissiones de gases de efecto invernadero de Espana años 1990-2006, March 2008, p. 1.23
Sweden	Activity data on feedstocks and non-energy use of fuels is collected from the quarterly fuel statistics. In the survey form for the quarterly fuel statistics, respondents are among many other things asked to specify whether fuels are used as raw materials or for energy purposes. This facilitates the use of data for CRF table 1Ad, non-energy use of fuels. Data on carbon from coke, bound in produced ferroalloys is collected directly from the only ferroalloy producer and is added to the remaining data on carbon from coke. Estimates of carbon stored are derived by multiplying given energy amount with emission factors for CO_2 multiplied by 12/44 (the weight of one atom of carbon is by definition 12/44 the weight of one molecule of CO_2). For submission 2008 CO_2 emissions derived from non-energy use of fuels and reported under CRF 1B and CRF 2 (e.g. flaring of gases and iron and steel process emissions) are added under CRF 1Ad and linked to the CRF 1Ab as carbon stored	Sweden’s National Inventory Report 2008, April 2008, p. 108

MS	Information on feedstocks and non-energy use of fuels	Source
United Kingdom	The UK reports emissions from the combustion of fuels only with emissions from the non-energy use of fuels assumed to be zero (i.e. the carbon is assumed to be sequestered as products), except for the following cases where emissions could be identified and included in the inventory: • Catalytic crackers – regeneration of catalysts • Ammonia production • Aluminium production – consumption of anodes • Benzoles and tars – produced in coke ovens and emissions assigned to the waste sector • Combustion of waste lubricants and waste solvents • Incineration of fossil carbon in products disposed of as waste. Estimates of the quantities of lubricants burnt are based on data from Recycling Advisory Unit, 1999; Oakdene Hollins Ltd, 2001 & BLF/UKPIA/CORA, 1994. Separate estimates are produced for power stations, cement kilns, and other industry. In addition, an estimate is made of lubricants burnt in vehicle engines. Carbon emissions from these sources are calculated using a carbon factor derived from analysis of eight samples of waste oil (Passant, 2004). In 2005, the combustion of lubricating oils within engines was reviewed. Analysis by UK experts in transport emissions and oil combustion have lead to a revision to the assumptions regarding re-use or combustion of lubricating oils from vehicle and industrial machinery. The fate of the unrecovered oil has now been allocated across several IPCC source sectors including road, rail, marine, off-road and air transport. Some of the unrecovered oil is now allocated to non-oxidising fates such as coating on products, leaks and disposal to landfill. Fossil carbon destroyed in MSW incinerators and clinical waste incinerators is included in the GHG inventory, as is carbon emitted by chemical waste incinerators. As part of our review of the base year GHG inventory estimates, the UK has reviewed the treatment of stored carbon in the UK GHG inventory and the fate of carbon from the non-energy use (NEU) of products and the breakdown of those products. This appraisal included a review of the National Inventory Reports (NIRs) of other countries. The US NIR contained a detailed methodology of the approach used in the US inventory to estimate emissions of stored carbon, and the US NIR presents 'storage factors' for a range of products. Some of these factors have been used in the new UK method. The UK Inventory Agency has conducted a series of calculations to estimate the fate of carbon contained in those petroleum products shown in the NEU line of the UK commodity balance tables. The analysis indicates that most of the carbon is stored, although a significant quantity does appear to be emitted. Some of the emitted carbon has been included in previous versions of the GHG inventory, e.g. carbon from chemical waste incinerators; most has not. A summary of the estimates of emitted/stored carbon has been produced and these have been presented in a separate technical report . The study also provides subjective, qualitative commentary regarding the quality of the estimates. The analysis also includes an assessment of the fate of carbon from the use of coal tars and benzoles. Benzoles and coal tars are shown as an energy use in the DBERR DUKES and up until the 2002 version of the GHG inventory, the carbon was included in the coke ovens carbon balance as an emission of carbon from the coke ovens. When the carbon balance methodology was improved for the 2003 GHG inventory, the UK inventory treated the carbon in these benzoles and coal tars as a non-emissive output from the coke ovens. However, we were not sure what the ultimate fate of the carbon was but were unable to research this in time for the 2003 GHG inventory. It was therefore treated as an emission from the waste disposal sector - thus ensuring that total UK carbon emissions were not altered until we had sufficient new information to judge what the fate of the carbon was. New information from Corus UK Ltd (the sole UK operator of coke ovens) indicates that the benzoles & coal tars are recovered and sold on for other industrial uses, the emissions from which are already covered elsewhere within the inventory. Hence the carbon content from these coke oven by-products is now considered as stored and the carbon emissions included in previous inventories has been removed from the new version of the GHG inventory. The analysis estimates emissions from the energy uses of coal tars and benzoles, and NEU of petroleum products. Since emissions of carbon are estimated, carbon which is not emitted (i.e. stored) can be calculated from the DBERR DUKES consumption data by difference. The analysis divides the various fossil fuels into six categories: (1) coal tars & benzoles, (2) lubricants, (3) petroleum coke, (4) petroleum waxes, (5) bitumen, (6) chemical feedstocks (ethane, propane, butane, other gases, naphtha, industrial spirit, white spirit, middle distillate feedstock). After considering the magnitude of the source in relation to the national totals, the uncertainty associated with emissions, and the likely forthcoming IPCC reporting requirements in the 2006 Guidelines, emissions of carbon from the following additional sources have been included in the 2004 GHG inventory (2006 NIR) and subsequent NIRs: (1) Petroleum waxes, (2) Carbon emitted during energy recovery - chemical industry, (3) Carbon in products - soaps, shampoos, detergents etc., (4) Carbon in products – pesticides.	UK Greenhouse Gas Inventory, 1990 to 2006, April 2008, Annex 3, pp. 351-353

3.9 Energy for EU-27

3.9.1 Overview of sector (EU-27)

Figure 3.99: CRF Sector 1 Energy: EU-27 GHG emissions in CO_2 equivalents (Tg) for 1990–2006

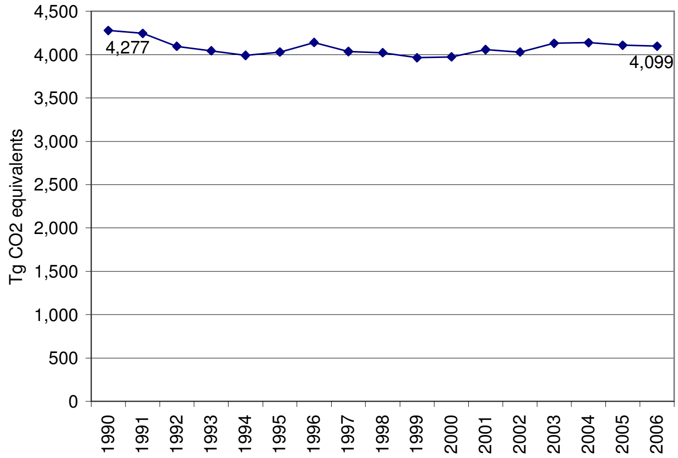
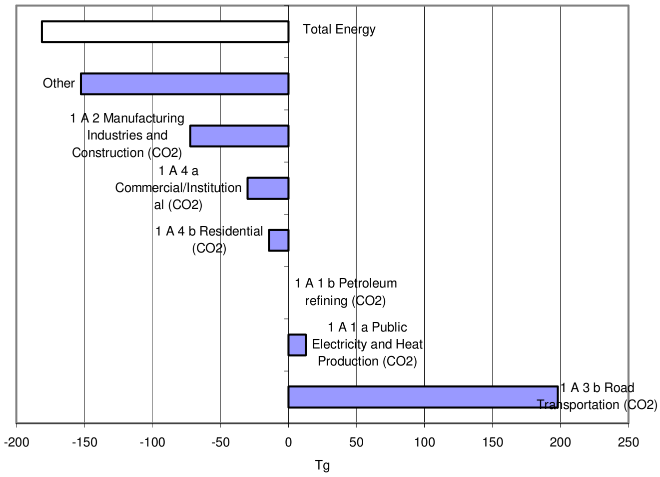
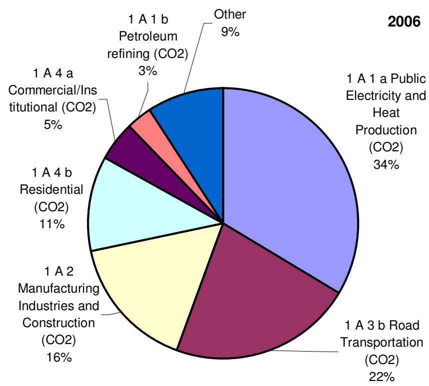


Figure 3.101: CRF Sector 1 Energy: Absolute change of GHG emissions in CO_2 equivalents (Tg) by large key source categories for 1990–2006 and share of largest key source categories in 2006





3.9.2 Source categories (EU-27)

3.9.2.1 Public Electricity and Heat Production (1A1a) (EU-27)

Table 3.110: 1A1a Public Electriciy and Heat Production, liquid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	124,478	75,649	66,888	81.7%	-8,760	-12%	-57,589	-46%			
Bulgaria	9,835	334	149	0.2%	-185	-55%	-9,686	-98%	T2	NS	CS, D
Cyprus	1,664	3,472	3,653	4.5%	182	5%	1,990	120%	T1,T2	NS,PS	D, CS
Czech Republic	819	515	436	0.5%	-79	-15%	-383	-47%	T1	NS	D
Estonia	4,825	540	409	0.5%	-131	-24%	-4,416	-92%	T1,T2	NS,PS	D, CS
Hungary	1,830	391	452	0.6%	61	16%	-1,378	-75%	T2	PS, NS	D
Latvia	3,051	164	96	0.1%	-68	-41%	-2,955	-97%	T1	NS	NS
Lithuania	6,058	668	672	0.8%	3	1%	-5,386	-89%	T2	NS	CS
Malta	738	1,960	1,976	2.4%	16	1%	1,238	168%	T1,T2	NS,PS	D, CS
Poland	5,116	729	697	0.9%	-32	-4%	-4,418	-86%	T2	NS	D
Romania	22,727	7,653	6,407	7.8%	-1,247	-16%	-16,320	-72%	T1	NS	D
Slovakia	1,033	33	26	0.0%	-7	-20%	-1,007	-97%	T1	PS	CS
Slovenia	277	32	43	0.1%	11	33%	-234	-84%	T1	NS	D
EU-27	**182,451**	**92,142**	**81,906**	**100.0%**	**-10,236**	**-11%**	**-100,545**	**-55%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.111: 1A1a Public Electriciy and Heat Production, solid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	750,217	677,459	687,028	68.9%	9,568	1%	-63,189	-8%			
Bulgaria	21,740	24,948	25,369	2.5%	422	2%	3,629	17%	T2	NS	CS, D
Cyprus	NO	NA	NA	-	-	-	-	-	T1,T2	NS,PS	D, CS
Czech Republic	51,658	52,496	52,264	5.2%	-232	0%	606	1%	T1	NS	CS
Estonia	21,045	9,731	9,064	0.9%	-666	-7%	-11,980	-57%	T1,T2	NS,PS	D, CS
Hungary	12,725	9,209	8,758	0.9%	-451	-5%	-3,967	-31%	T3	PS, NS	CS,PS
Latvia	355	19	12	0.0%	-7	-37%	-344	-97%	T1	NS	NS
Lithuania	185	41	42	0.0%	1	4%	-143	-77%	T2	NS	CS
Malta	611	NA	NA	-	-	-	-611	-100%	T1,T2	NS,PS	D, CS
Poland	214,586	164,837	172,612	17.3%	7,774	5%	-41,974	-20%	T2	NS	CS/D
Romania	36,266	26,717	30,501	3.1%	3,785	14%	-5,765	-16%	T1	NS	D
Slovakia	11,542	6,115	5,815	0.6%	-300	-5%	-5,727	-50%	T1	PS	CS
Slovenia	5,600	6,059	6,050	0.6%	-9	0%	450	8%	T1	PS	PS
EU-27	**1,126,532**	**977,630**	**997,515**	**100.0%**	**19,885**	**2%**	**-129,016**	**-11%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.112: 1A1a Electricity and heat production, solid fuels: N_2O emissions of EU-27

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	6,521	5,981	6,077	80.0%	96	2%	-445	-7%			
Bulgaria	230	245	248	3.3%	4	1%	18	8%	T2	NS	CS, D
Cyprus	NO	NA	NA	-	-	-	-	-	T1,T2	0.0	D, CS
Czech Republic	229	236	235	3.1%	-1	0%	5	2%	T1	NS	D
Estonia	2	2	2	0.0%	0	14%	0	1%	T1,T2	0.0	D, CS
Hungary	59	41	38	0.5%	-3	-8%	-21	-36%	T1	PS, NS	D
Latvia	3	0	0	0.0%	0	-40%	-3	-97%	T1	NS	D
Lithuania	2	0	0	0.0%	0	4%	-1	-75%	T2	NS	CS
Malta	3	NA	NA	-	-	-	-3	-100%	T1,T2	0.0	D, CS
Poland	982	770	809	-	-	-	-173.0	-18%	T2	NS	D
Romania	142	117	134	1.8%	17	14%	-8	-6%	T1	NS	D
Slovakia	52	27	26	0.3%	-1	-3%	-26	-50%	T1	PS	D
Slovenia	24	25	26	0.3%	1	2%	2	10%	T1	PS	D
EU-27	**8,250**	**7,443**	**7,595**	**100.0%**	**152**	**2%**	**-655**	**-8%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.113 1A1a Electricity and heat production, gaseous fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	60,436	231,184	232,813	86.5%	1,630	1%	172,378	285%			
Bulgaria	6,364	1,980	1,906	0.7%	-74	-4%	-4,457	-70%	T2	NS	CS, D
Cyprus	NO	NA	NA	-	-	-	-	-	T1,T2	NS,PS	D, CS
Czech Republic	1,541	1,845	1,802	0.7%	-43	-2%	261	17%	T1	NS	D
Estonia	2,544	1,875	1,973	0.7%	98	5%	-571	-22%	T1,T2	NS,PS	D, CS
Hungary	5,825	7,313	8,266	3.1%	953	13%	2,441	42%	T3	PS, NS	D
Latvia	2,691	1,813	1,911	0.7%	98	5%	-780	-	T1	NS	NS
Lithuania	5,982	3,220	3,033	1.1%	-187	-6%	-2,948	-49%	T2	NS	CS/C
Malta	NA	NA	NA	-	-	-	-	-	T1,T2	NS,PS	D, CS
Poland	1,208	3,184	3,065	1.1%	-119	-4%	1,857	154%	T2	NS	D
Romania	38,778	11,900	11,880	4.4%	-19	0%	-26,898	-69%	T1	NS	D
Slovakia	2,089	2,565	2,345	0.9%	-219	-9%	256	-	T1	PS	CS
Slovenia	112	263	247	0.1%	-15	-6%	135	121%	T1	NS	CS
EU-27	**127,569**	**267,141**	**269,243**	**100.0%**	**2,102**	**1%**	**141,673**	**111%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.114: 1A1a Public Electriciy and Heat Production, other fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	13,946	27,918	31,611	99.8%	3,694	13%	17,666	127%			
Bulgaria	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Cyprus	NO	NA	NA	-	-	-	-	-	NO	NO	NO
Czech Republic	NO	NO	NO	-	-	-	-	-	T1	NS	D
Estonia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Hungary	NO	NO	NO	-	-	-	-	-	---	---	---
Latvia	NO	NO	NO	-	-	-	-	-	T1	NS	NS
Lithuania	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Malta	NA	NA	NA	-	-	-	-	-	NO	NO	NO
Poland	NA	NA	NA	-	-	-	-	-	T2	NS	D
Romania	NE	NE	NE	-	-	-	-	-	T1	NS	D
Slovakia	30	47	49	0.2%	2	4%	19	64%	T1a	AS	D
Slovenia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
EU-27	**13,976**	**27,965**	**31,660**	**100.0%**	**3,695**	**13%**	**17,685**	**127%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

3.9.2.2 Petroleum Refining (1A1b) (EU-27)

Table 3.115 1A1b Petroleum Refining, liquid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	98,607	114,077	108,729	92.4%	-5,348	-5%	10,121	10%			
Bulgaria	286	NO	NO	-	-	-	-286	-100%	T2	NS	CS, D
Cyprus	73	NO	NO	-	-	-	-73	-100%	NO	NO	NO
Czech Republic	923	990	676	0.6%	-314	-32%	-247	-27%	T1	NS	D
Estonia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Hungary	928	975	982	0.8%	7	1%	54	6%	T1	NS	D
Latvia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Lithuania	1,580	1,913	1,624	1.4%	-289	-15%	43	3%	T2	NS	CS/C
Malta	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Poland	1,378	4,014	4,732	4.0%	718	18%	3,354	243%	T2	NS	D
Romania	IE	IE	IE	-	-	-	-	-	NA	IE1	NA
Slovakia	507	1,021	947	0.8%	-74	-7%	440	87%	T1	PS	CS
Slovenia	43	1	1	0.0%	-1	-54%	-42	-99%	T1	NS	D
EU-27	**104,327**	**122,992**	**117,690**	**100.0%**	**-5,301**	**-4%**	**13,364**	**13%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.116 1A1b Petroleum Refining, solid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	3,581	651	703	45.5%	52	8%	-2,878	-80%			
Bulgaria	NO	NO	NO	-	-	-	-	-	T2	NS	CS, D
Cyprus	NO	NO	NO	-	-	-	-	-	T1, T2	0.0	CS
Czech Republic	NO	NO	NO	-	-	-	-	-	T1	NS	CS
Estonia	369	645	657	42.5%	12	2%	287	78%	T1, T2	0.0	CS
Hungary	NO	NO	NO	-	-	-	-	-	---	---	---
Latvia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Lithuania	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Malta	NO	NO	NO	-	-	-	-	-	T1, T2	0.0	CS
Poland	736	40	32	2.1%	-8	-20%	-704	-96%	T2	NS	CS/D
Romania	IE	IE	IE	-	-	-	-	-	NA	IE1	NA
Slovakia	NO	216	155	10.0%	-61	-28%	155	-	T1	PS	CS
Slovenia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
EU-27	**4,686**	**1,552**	**1,546**	**100.0%**	**-6**	**0%**	**-3,140**	**-67%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.117 1A1b Petroleum Refining, gaseous fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	3,846	9,557	9,308	78.5%	-249	-3%	5,462	142%			
Bulgaria	69	49	51	0.4%	2	4%	-19	-27%	T2	NS	CS, D
Cyprus	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Czech Republic	324	276	265	2.2%	-11	-4%	-59	-18%	T1	NS	D
Estonia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Hungary	689	429	482	4.1%	54	13%	-207	-30%	T1	NS	D
Latvia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Lithuania	NO	2	0.3	0.002%	-1	-82%	-	-	T2	NS	CS
Malta	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Poland	93	1,286	1,383	11.7%	97	8%	1,290	1383%	T2	NS	D
Romania	IE	IE	IE	-	-	-	-	-	NA	IE1	NA
Slovakia	755	350	358	3.0%	8	-	-398	-	T1	PS	CS
Slovenia	126	NO	8	0.1%	8	-	-119	-94%	T1	NS	CS
EU-27	**5,905**	**11,949**	**11,855**	100.0%	-93	-1%	5,951	-			

Abbreviations explained in the Chapter 'Units and abbreviations'.

3.9.2.3 Manufacture of Solid Fuels and Other Energy Industries (1A1c) (EU-27)

Table 3.118 1A1c Manufacture of Solid Fuels and Other Energy Industries, gaseous fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	16,708	22,294	20,400	84.7%	-1,894	-8%	3,692	22%			
Bulgaria	71	656	698	2.9%	41	6%	626	878%	T2	NS	CS, D
Cyprus	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Czech Republic	NO	NO	NO	-	-	-	-	-	T1	NS	D
Estonia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Hungary	IE	IE	3	0.0%	3	-	3	-	T1	NS	D
Latvia	45	49	52	0.2%	4	7%	7	15%	T1	NS	NS
Lithuania	NO	6	5	0.02%	-0.4	-7%	5	-	T2	NS	CS
Malta	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Poland	691	1,044	1,482	6.2%	438	42%	791	115%	T2	NS	D
Romania	IE	IE	IE	-	-	-	-	-	NA	IE1	NA
Slovakia	NO	1,480	1,456	6.0%	-24	-2%	1,456	-	T1	PS	CS
Slovenia	42	NO	NO	-	0	-	-42	-100%	NO	NO	NO
EU-27	**17,557**	**25,529**	**24,097**	**100.0%**	**-1,433**	**-6%**	**6,540**	**37%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.119 1A1c Manufacture of Solid Fuels and Other Energy Industries, solid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	72,520	30,402	30,831	86.3%	428	1%	-41,689	-57%			
Bulgaria	382	178	161	0.4%	-18	-10%	-221	-58%	T2	NS	CS, D
Cyprus	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Czech Republic	2,393	1,118	1,153	3.2%	35	3%	-1,240	-52%	T1	NS	CS
Estonia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Hungary	IE	IE	155	0.4%	155	-	155	-	T1	NS	D
Latvia	164	5	1	0.0%	-3	-77%	-163	-99%	T1	NS	NS
Lithuania	35	19	24	0.1%	5	27%	-11	-32%	T2	NS	CS
Malta	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Poland	4,060	4,718	3,394	9.5%	-1,324	-28%	-666	-16%	T2	NS	CS/D
Romania	IE	IE	IE	-	-	-	-	-	NA	IE1	NA
Slovakia	10	NO	NO	-	0	-	-10	-100%	NO	NO	NO
Slovenia	36	NO	NO	-	-	-	-36	-100%	NO	NO	NO
EU-27	**79,600**	**36,440**	**35,718**	**100.0%**	**-722**	**-2%**	**-43,883**	**-55%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

3.9.2.4 Iron and Steel (1A2a) (EU-27)

Table 3.120 1A2a Iron and Steel, liquid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	7,315	4,139	4,314	81.1%	175	4%	-3,001	-41%			
Bulgaria	22	2	0.3	0.01%	-2	-84%	-22	-99%	T2	NS	CS, D
Cyprus	NO	NO	NO	-	-	-	-	-	T1,T2	0.0	D, CS
Czech Republic	IE	831	907	17.0%	77	9%	907	-	T1	NS	D
Estonia	NO	NO	0.1	0.001%	0.1	-	0.1	-	T1,T2	0.0	D, CS
Hungary	803	5	8	0.1%	3	62%	-795	-99%	T2	PS, NS	D
Latvia	154	48	64	1.2%	16	34%	-90	-58%	T1	NS	NS
Lithuania	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Malta	IE	IE	IE	-	-	-	-	-	T1,T2	0.0	D, CS
Poland	855	6	9	0.2%	3	49%	-846	-99%	T2	NS	D
Romania	IE	IE	IE	-	-	-	-	-	NA	IE2	NA
Slovakia	164	1	1	0.0%	0	17%	-163	-99%	T1	PS	CS
Slovenia	54	7	18	0.3%	11	155%	-36	-67%	T1	NS	D
EU-27	**9,367**	**5,040**	**5,323**	**100.0%**	**283**	**6%**	**-4,044**	**-43%**			

Table 3.121 1A2a Iron and Steel, solid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	93,631	75,745	72,343	82.3%	-3,402	-4%	-21,288	-23%			
Bulgaria	2,378	2,210	2,039	2.3%	-171	-8%	-339	-14%	T2	NS	CS, D
Cyprus	NO	NO	NO	-	-	-	-	-	T1	0.0	D
Czech Republic	IE	1,251	1,176	1.3%	-74	-6%	1,176	-	T1	NS	CS
Estonia	3	1	1	0.0%	0	-11%	-2	-58%	T1	0.0	D
Hungary	3,327	2,229	2,346	2.7%	117	5%	-981	-29%	T2	PS, NS	D
Latvia	NO	NO	NO	-	-	-	-	-	T1	NS	NS
Lithuania	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Malta	IE	NA	NA	-	-	-	-	-	T1	0.0	D
Poland	11,493	6,111	7,583	8.6%	1,472	24%	-3,910	-34%	T2	NS	CS/D
Romania	IE	IE	IE	-	-	-	-	-	NA	IE2	NA
Slovakia	2,447	2,195	2,357	2.7%	161	7%	-90	-4%	T1	PS	CS
Slovenia	57	24	35	0.0%	11	44%	-21	-38%	T1	NS	D
EU-27	**113,336**	**89,767**	**87,881**	**100.0%**	**-1,886**	**-2%**	**-25,455**	**-22%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.122 1A2a Iron and Steel, gaseous fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	16,337	20,821	21,095	71.3%	274	1%	4,758	29%			
Bulgaria	1,049	605	622	2.1%	17	3%	-426	-41%	T2	NS	CS, D
Cyprus	NO	NO	NO	-	-	-	-	-	T1	0.0	D
Czech Republic	IE	804	869	2.9%	65	8%	869	-	T1	NS	D
Estonia	NO	1	1	0.0%	0	1%	1	-	T1	0.0	D
Hungary	1,448	615	546	1.8%	-69	-11%	-901	-62%	T2	PS, NS	D
Latvia	239	231	228	0.8%	-2	-1%	-10	-4%	T1	NS	NS
Lithuania	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Malta	IE	IE	IE	-	-	-	-	-	T1	0.0	D
Poland	2,894	1,116	1,138	3.8%	22	2%	-1,755	-61%	T2	NS	D
Romania	IE	IE	IE	-	-	-	-	-	NA	IE2	NA
Slovakia	6,526	4,212	4,898	16.6%	687	16%	-1,628	-25%	T1	PS	CS
Slovenia	308	176	172	0.6%	-4	-3%	-137	-44%	T1	NS	CS
EU-27	**28,800**	**28,580**	**29,571**	**100.0%**	**990**	**3%**	**771**	**3%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

3.9.2.5 Non Ferrous Metals (1A2b) (EU-27)

Table 3.123 1A2b Non ferrous Metals, solid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	4,131	1,647	1,507	50.4%	-140	-9%	-2,625	-64%			
Bulgaria	223	140	146	4.9%	6	4%	-78	-35%	T2	NS	CS, D
Cyprus	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Czech Republic	IE	1	IE	-	-1	-100%	-	-	T1	NS	CS
Estonia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Hungary	397	459	468	15.7%	9	2%	71	18%	T2	NS	CS,D
Latvia	NO	NO	NO	-	-	-	-	-	T1	NS	NS
Lithuania	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Malta	IE	NA	NA	-	-	-	-	-	NO	NO	NO
Poland	727	722	773	25.9%	51	7%	46	6%	T2	NS	CS/D
Romania	IE	IE	IE	-	-	-	-	-	NA	IE2	NA
Slovakia	798	68	94	3.1%	25	37%	-704	-88%	T1	PS	CS
Slovenia	152	NO	NO	-	0	-	-152	-100%	NO	NO	NO
EU-27	**6,429**	**3,038**	**2,987**	**100.0%**	**-51**	**-2%**	**-3,442**	**-54%**			

Table 3.124 1A2b Non ferrous Metals, gaseous fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	2,411	4,220	4,297	76.3%	78	2%	1,886	78%			
Bulgaria	24	37	39	0.7%	2	6%	16	66%	T2	NS	CS, D
Cyprus	NO	NO	NO	-	-	-	-	-	T1	0.0	D
Czech Republic	IE	172	180	3.2%	8	4%	180	-	T1	NS	D
Estonia	NO	1	1	0.0%	0	-6%	1	-	T1	0.0	D
Hungary	1,645	584	591	10.5%	7	1%	-1,054	-64%	T2	NS	D
Latvia	NO	11	11	0.2%	0	0%	11	-	T1	NS	NS
Lithuania	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Malta	NO	NA	NA	-	-	-	-	-	T1	0.0	D
Poland	257	361	384	6.8%	23	6%	128	50%	T2	NS	D
Romania	IE	IE	IE	-	-	-	-	-	NA	IE2	NA
Slovakia	435	83	79	1.4%	-4	-5%	-356	-82%	T1	PS	CS
Slovenia	163	44	47	0.8%	3	7%	-116	-71%	T1	NS	CS
EU-27	**4,934**	**5,513**	**5,629**	**100.0%**	**116**	**2%**	**696**	**14%**			

3.9.2.6 Chemicals (1A2c) (EU-27)

Table 3.125 1A2c Chemicals, liquid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	30,793	22,144	22,392	78.6%	248	1%	-8,401	-27%			
Bulgaria	458	483	472	1.7%	-11	-2%	14	3%	T2	NS	CS, D
Cyprus	11	6	6	0.0%	0	8%	-4	-41%	T1	0.0	D
Czech Republic	IE	277	1,186	4.2%	910	329%	1,186	-	T1	NS	D
Estonia	13	5	6	0.0%	1	11%	-7	-54%	T1	0.0	D
Hungary	812	1,442	1,248	4.4%	-194	-13%	436	54%	T2	NS	D
Latvia	277	NO	NO	-	-	-	-277	-100%	T1	NS	NS
Lithuania	72	1	2	0.0%	2	337%	-70	-97%	T2	NS	CS
Malta	IE	NA	NA	-	-	-	-	-	T1	0.0	D
Poland	306	1,981	2,093	7.3%	112	6%	1,787	584%	T2	NS	D
Romania	IE	IE	IE	-	-	-	-	-	NA	IE2	NA
Slovakia	1,363	1,085	1,049	3.7%	-37	-3%	-314	-23%	T1	PS	CS
Slovenia	31	40	40	0.1%	-1	-2%	9	27%	T1	NS	D
EU-27	**34,135**	**27,464**	**28,494**	**100.0%**	**1,030**	**4%**	**-5,641**	**-17%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.126 1A2c Chemicals, solid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	8,114	4,744	4,549	23.5%	-195	-4%	-3,566	-44%			
Bulgaria	436	486	616	3.2%	130	27%	179	41%	T2	NS	CS, D
Cyprus	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Czech Republic	IE	7,188	9,938	51.4%	2,750	38%	9,938	-	T1	NS	CS
Estonia	7	NO	NO	-	-	-	-7	-100%	NO	NO	NO
Hungary	61	12	NO	-	-12	-100%	-61	-100%	---	---	---
Latvia	NO	NO	NO	-	-	-	-	-	T1	NS	NS
Lithuania	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Malta	IE	NA	NA	-	-	-	-	-	NO	NO	NO
Poland	3,350	3,980	3,972	20.5%	-8	0%	621	19%	T2	NS	CS/D
Romania	IE	IE	IE	-	-	-	-	-	NA	IE2	NA
Slovakia	1,584	291	278	1.4%	-13	-4%	-1,305	-82%	T1	PS	CS
Slovenia	1	NO	NO	-	-	-	-1	-100%	NO	NO	NO
EU-27	**13,554**	**16,701**	**19,352**	**100.0%**	**2,651**	**16%**	**5,798**	**43%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.127 1A2c Chemicals, gaseous fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	28,051	32,993	30,792	88.7%	-2,202	-7%	2,740	10%			
Bulgaria	2,593	1,285	1,178	3.4%	-108	-8%	-1,415	-55%	T2	NS	CS, D
Cyprus	NO	NO	NO	-	-	-	-	-	T1	0.0	D
Czech Republic	IE	632	720	2.1%	88	14%	720	-	T1	NS	D
Estonia	60	1	1	0.0%	0	24%	-58	-98%	T1	0.0	D
Hungary	1,379	1,866	1,046	3.0%	-820	-44%	-333	-24%	T2	NS	D
Latvia	24	25	27	0.1%	2	8%	3	12%	T1	NS	NS
Lithuania	341	115	195	0.6%	80	69%	-147	-43%	T2	NS	CS
Malta	NO	NA	NA	-	-	-	-	-	T1	0.0	D
Poland	295	452	511	1.5%	59	13%	216	73%	T2	NS	D
Romania	IE	IE	IE	-	-	-	-	-	NA	IE2	NA
Slovakia	1,753	89	128	0.4%	39	44%	-1,625	-93%	T1	PS	CS
Slovenia	175	125	124	0.4%	-1	-1%	-51	-29%	T1	NS	CS
EU-27	**34,671**	**37,583**	**34,722**	**100.0%**	**-2,862**	**-8%**	**50**	**0%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.128 1A2c Chemicals, other fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	3,393	7,019	6,824	100.0%	-196	-3%	3,430	101%			
Bulgaria	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Cyprus	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Czech Republic	NO	NO	NO	-	-	-	-	-	T1	NS	D
Estonia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Hungary	NO	NO	NO	-	-	-	-	-	---	---	---
Latvia	NO	NO	NO	-	-	-	-	-	T1	NS	NS
Lithuania	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Malta	NO	NA	NA	-	-	-	-	-	NO	NO	NO
Poland	NA	NA	NA	-	-	-	-	-	T2	NS	D
Romania	IE	IE	IE	-	-	-	-	-	NA	IE2	NA
Slovakia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Slovenia	1	NO	NO	-	-	-	-1	-100%	NO	NO	NO
EU-27	**3,394**	**7,019**	**6,824**	**100.0%**	**-196**	**-3%**	**3,430**	**101%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

3.9.2.7 Pulp, Paper and Print (1A2d) (EU-27)

Table 3.129 1A2d Pulp, Paper and Print, liquid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	9,641	5,879	5,778	92.7%	-101	-2%	-3,863	-40%			
Bulgaria	59	100	64	1.0%	-35	-35%	6	10%	T2	NS	CS, D
Cyprus	23	4	5	0.1%	1	14%	-18	-78%	T1	0.0	D
Czech Republic	IE	185	140	2.2%	-45	-24%	140	-	T1	NS	D
Estonia	NO	1	1	0.01%	0	-1%	1	-	T1	0.0	D
Hungary	86	29	20	-	-10	-33%	-67	-77%	T2	NS	D
Latvia	16	NO	NO	-	-	-	-16	-100%	T1	NS	NS
Lithuania	69	1	1	0.01%	0	8%	-68	-99%	T2	NS	CS
Malta	IE	NA	NA	-	-	-	-	-	T1	0.0	D
Poland	104	150	158	2.5%	8	5%	54	52%	T2	NS	D
Romania	IE	IE	IE	-	-	-	-	-	NA	IE2	NA
Slovakia	985	23	26	0.4%	3	12%	-959	-97%	T1	PS	CS
Slovenia	97	102	44	0.7%	-58	-57%	-53	-55%	T1	NS	D
EU-27	**11,079**	**6,474**	**6,236**	**100.0%**	**-238**	**-4%**	**-4,843**	**-44%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.130 1A2d Pulp, Paper and Print, solid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006	
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
EU-15	3,536	1,447	1,450	42.3%	3	0%	-2,086	-59%
Bulgaria	3	0	0	0.0%	0	-11%	-2	-96%
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	IE	653	320	9.3%	-333	-51%	320	-
Estonia	NO	NO	NO	-	-	-	-	-
Hungary	24	0.2	0.3	0.01%	0	36%	-24	-99%
Latvia	3	2	2	0.1%	0	0%	0	-8%
Lithuania	NO	NO	NO	-	-	-	0	-
Malta	IE	NA	NA	-	-	-	-	-
Poland	173	1,286	1,086	31.7%	-200	-16%	913	528%
Romania	IE	IE	IE	-	-	-	-	-
Slovakia	1,142	399	397	11.6%	-2	0%	-744	-65%
Slovenia	173	180	170	5.0%	-9	-5%	-3	-2%
EU-27	**5,053**	**3,968**	**3,426**	**100.0%**	**-541**	**-14%**	**-1,627**	**-32%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.131 1A2d Pulp, Paper and Print, gaseous fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	10,640	18,522	18,526	93.9%	4	0%	7,886	74%			
Bulgaria	NO	121	128	0.6%	7	6%	128	-	T2	NS	CS, D
Cyprus	NO	NO	NO	-	-	-	-	-	T1	0.0	D
Czech Republic	IE	229	240	1.2%	11	5%	240	-	T1	NS	D
Estonia	NO	3	5	0.0%	2	55%	5	-	T1	0.0	D
Hungary	51	202	189	1.0%	-14	-7%	138	270%	T2	NS	D
Latvia	152	11	13	0.1%	2	16%	-139	-91%	T1	NS	NS
Lithuania	193	4	2	0.0%	-1	-	-190	-	T2	NS	CS
Malta	NO	NA	NA	-	-	-	-	-	T1	0.0	D
Poland	6	128	162	0.8%	34	27%	156	2775%	T2	NS	D
Romania	IE	IE	IE	-	-	-	-	-	NA	IE2	NA
Slovakia	152	223	209	1.1%	-14	-6%	57	-	T1	PS	CS
Slovenia	109	286	257	1.3%	-29	-10%	148	135%	T1	NS	CS
EU-27	**11,302**	**19,729**	**19,731**	**100.0%**	**2**	**0%**	**8,429**	**75%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

3.9.2.8 Food Processing, Beverages and Tobacco (1A2e) (EU-27)

Table 3.132 1A2e Food Processing, Beverages and Tobacco, liquid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	15,288	10,662	10,272	85.7%	-390	-4%	-5,015	-33%			
Bulgaria	180	150	201	1.7%	50	33%	21	12%	T2	NS	CS, D
Cyprus	174	41	43	0.4%	1	3%	-131	-76%	T1	NS	D
Czech Republic	IE	737	488	4.1%	-249	-34%	488	-	T1	NS	D
Estonia	439	6	3	0.0%	-3	-46%	-436	-99%	T1	NS	D
Hungary	817	123	73	0.6%	-49	-40%	-744	-91%	T2	NS	D
Latvia	798	73	76	0.6%	3	4%	-722	-91%	T1	NS	NS
Lithuania	241	55	53	0.4%	-2	-3%	-189	-78%	T2	NS	CS
Malta	IE	NA	NA	-	-	-	-	-	T1	NS	D
Poland	228	725	624	5.2%	-101	-14%	396	174%	T2	NS	D
Romania	IE	IE	IE	-	-	-	-	-	NA	IE2	NA
Slovakia	359	46	45	0.4%	-1	-2%	-314	-88%	T1	PS	CS
Slovenia	144	96	112	0.9%	17	18%	-32	-22%	T1	NS	D
EU-27	**18,667**	**12,713**	**11,990**	**100.0%**	**-723**	**-6%**	**-6,677**	**-36%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.133 1A2e Food Processing, Beverages and Tobacco, solid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	5,186	1,749	2,169	36.6%	420	24%	-3,017	-58%			
Bulgaria	36	87	94	1.6%	7	8%	58	161%	T2	NS	CS, D
Cyprus	NO	NO	NO	-	-	-	-	-	T1	0.0	D
Czech Republic	IE	1,120	642	10.8%	-478	-43%	642	-	T1	NS	CS
Estonia	5	NO	0.2	0.003%	0.2	-	-4	-96%	T1	0.0	D
Hungary	194	24	15	0.3%	-9	-37%	-178	-92%	T2	NS	CS
Latvia	98	12	10	0.2%	-2	-20%	-88	-90%	T1	NS	NS
Lithuania	33	12	10	0.2%	-2	-	-23	-69%	T2	NS	CS
Malta	IE	NA	NA	-	-	-	-	-	T1	0.0	D
Poland	3,374	3,490	2,942	49.7%	-548	-	-432	-13%	T2	NS	CS/D
Romania	IE	IE	IE	-	-	-	-	-	NA	IE2	NA
Slovakia	312	32	32	0.5%	0	-	-279	-90%	T1	PS	CS
Slovenia	9	4	4	0.1%	0	3%	-5	-57%	T1	NS	D
EU-27	**9,247**	**6,530**	**5,919**	**100.0%**	**-611**	**-9%**	**-3,328**	**-36%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.134 1A2e Food Processing, Beverages and Tobacco, gaseous fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	12,732	23,133	22,842	85.3%	-291	-1%	10,111	79%			
Bulgaria	12	184	204	0.8%	19	10%	192	1665%	T2	NS	CS, D
Cyprus	NO	NO	NO	-	-	-	-	-	T1	0.0	D
Czech Republic	IE	1,149	1,170	4.4%	21	2%	1,170	-	T1	NS	D
Estonia	15	7	6	0.0%	-1	-11%	-9	-59%	T1	0.0	D
Hungary	804	678	697	2.6%	19	3%	-107	-13%	T2	NS	D
Latvia	177	176	181	0.7%	5	3%	4	2%	T1	NS	NS
Lithuania	484	210	220	0.8%	10	5%	-264	-55%	T2	NS	CS
Malta	NO	NA	NA	-	-	-	-	-	T1	0.0	D
Poland	110	974	1,030	3.8%	55	6%	920	836%	T2	NS	D
Romania	IE	IE	IE	-	-	-	-	-	NA	IE2	NA
Slovakia	470	361	347	1.3%	-13	-4%	-123	-26%	T1	PS	CS
Slovenia	65	74	86	0.3%	13	17%	21	32%	T1	NS	CS
EU-27	**14,868**	**26,946**	**26,783**	**100.0%**	**-163**	**-1%**	**11,916**	**80%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

3.9.2.9 Other (1A2f) (EU-27)

Table 3.135 1A2f Other, liquid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	126,193	113,064	115,383	89.3%	2,319	2%	-10,810	-9%			
Bulgaria	1,238	2,069	2,110	1.6%	41	2%	872	70%	T2	NS	CS, D
Cyprus	490	730	722	0.6%	-8	-1%	232	47%	T1,T2	NS	D, CS
Czech Republic	9,110	2,857	2,372	1.8%	-485	-17%	-6,738	-74%	T1	NS	D
Estonia	324	152	121	0.1%	-31	-20%	-203	-63%	T1,T2	NS	D, CS
Hungary	636	115	114	0.1%	-1	0%	-522	-82%	T1	NS	D
Latvia	945	147	172	0.1%	25	17%	-773	-82%	T1	NS	NS
Lithuania	3,515	231	228	0.2%	-3	-1%	-3,287	-94%	T2	NS	CS/C
Malta	NA	NA	NA	-	-	-	-	-	T1,T2	NS	D, CS
Poland	2,194	3,481	2,207	1.7%	-1,274	-37%	13	1%	T2	NS	D
Romania	8,958	4,958	4,960	3.8%	1	0%	-3,998	-45%	T1	NS	D
Slovakia	1,286	108	176	0.1%	68	63%	-1,110	-86%	T1	PS	CS
Slovenia	696	510	613	0.5%	102	20%	-84	-12%	T1	NS	D
EU-27	**155,584**	**128,423**	**129,178**	**100.0%**	**755**	**1%**	**-26,406**	**-17%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.136 1A2f Other, solid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	120,311	37,107	37,864	68.0%	756	2%	-82,448	-69%			
Bulgaria	11,201	1,472	1,115	2.0%	-357	-24%	-10,086	-90%	T2	NS	CS, D
Cyprus	73	0	0	0.0%	0	-	-73	-100%	T1,T2	NS	D, CS
Czech Republic	31,522	4,294	3,099	5.6%	-1,195	-28%	-28,423	-90%	T1	NS	CS
Estonia	793	273	287	0.5%	14	5%	-506	-64%	T1,T2	NS	D, CS
Hungary	550	242	20	0.0%	-222	-92%	-531	-96%	T1	NS	D
Latvia	41	73	114	0.2%	41	57%	73	178%	T1	NS	NS
Lithuania	156	364	527	0.9%	163	45%	371	239%	T2	NS	CS
Malta	NA	NA	NA	-	-	-	-	-	T1,T2	NS	D, CS
Poland	13,752	5,894	5,617	10.1%	-278	-5%	-8,135	-59%	T2	NS	CS/D
Romania	6,552	5,937	6,043	10.9%	106	2%	-508	-8%	T1	NS	D
Slovakia	2,897	944	829	1.5%	-115	-12%	-2,068	-71%	T1	PS	CS
Slovenia	199	156	158	0.3%	2	1%	-41	-21%	T1	NS	D
EU-27	**188,046**	**56,756**	**55,672**	**100.0%**	**-1,085**	**-2%**	**-132,374**	**-70%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.137 1A2f Other, gaseous fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	105,041	144,157	143,221	87.0%	-936	-1%	38,180	36%			
Bulgaria	1,793	849	1,097	0.7%	248	29%	-696	-39%	T2	NS	CS, D
Cyprus	NO	0	0	0.0%	0	-	-	-	T1	NS	D
Czech Republic	5,984	4,252	4,258	2.6%	6	0%	-1,726	-29%	T1	NS	D
Estonia	101	90	106	0.1%	16	18%	5	5%	T1	NS	D
Hungary	2,072	1,004	584	0.4%	-420	-42%	-1,488	-72%	T1	NS	D
Latvia	850	302	278	0.2%	-24	-8%	-572	-67%	T1	NS	NS
Lithuania	1,093	362	327	0.2%	-35	-10%	-766	-70%	T2	NS	CS
Malta	NA	NA	NA	-	-	-	-	-	T1	NS	D
Poland	2,245	3,477	3,390	2.1%	-87	-2%	1,145	51%	T2	NS	D
Romania	16,449	9,783	8,300	5.0%	-1,483	-15%	-8,149	-50%	T1	NS	D
Slovakia	1,613	2,009	2,378	1.4%	370	18%	765	-	T1	PS	CS
Slovenia	530	583	619	0.4%	36	6%	90	17%	T1	NS	CS
EU-27	**137,770**	**166,867**	**164,558**	**100.0%**	**-2,309**	**-1%**	**26,788**	**19%**			

3.9.2.10 Civil Aviation (1A3a) (EU-27)

Table 3.138 1A3a Civil Aviation, jet kerosine: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	16,056	24,778	25,020	99.1%	242	1%	8,964	56%			
Bulgaria	314	118	121	0.5%	3	2%	-193	-61%	T1	NS	D
Cyprus	NO	NO	NO	-	-	-	-	-	T1	0.0	D
Czech Republic	82	7	10	0.04%	3.3	50%	-73	-88%	T1	NS	D
Estonia	12	2	9	0.04%	8	454%	-3	-24%	T1	0.0	D
Hungary	NO	NO	NO	-	-	-	-	-	---	---	---
Latvia	0	2	2	0.01%	0.1	5%	2	3820%	T1	Q	D
Lithuania	NE	1	1	0.005%	0.3	33%	1	-	T2	NS	CS
Malta	NA	NA	NA	-	-	-	-	-	T1	0.0	D
Poland	30	49	65	0.3%	16	33%	35	117%	T1	NS	D
Romania	25	14	12	0.05%	-3	-18%	-13	-52%	T1	AS	D
Slovakia	7	10	11	0.04%	1	12%	4	60%	T2	AS	D
Slovenia	NO	NO	NO	-	-	-	-	-	T1	NS	D
EU-27	**16,526**	**24,981**	**25,252**	100.0%	271	1%	8,726	53%			

Abbreviations explained in the Chapter 'Units and abbreviations'.

3.9.2.11 Road Transportation (1A3b) (EU-27)

Table 3.139 1A3b Road Transport, diesel oil: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	265,613	484,359	499,709	89.1%	15,349	3%	234,095	88%			
Bulgaria	3,124	4,308	4,504	0.8%	196	5%	1,381	44%	T2	NS	CS, D
Cyprus	442	1,072	1,025	0.2%	-47	-4%	583	132%	T1	NS	D
Czech Republic	2,817	10,059	10,550	1.9%	491	5%	7,733	275%	T1	NS	D
Estonia	675	1,084	1,174	0.2%	90	8%	499	74%	T1	NS	D
Hungary	2,485	6,701	7,321	1.3%	620	9%	4,836	195%	T1	NS	CS
Latvia	615	1,647	1,870	0.3%	223	14%	1,255	204%	COPERT III	NS	C
Lithuania	2,166	2,174	2,393	0.4%	219	10%	227	10%	T2	NS	CS
Malta	150	279	268	0.0%	-11	-4%	118	79%	T1	NS	D
Poland	11,161	16,966	18,189	3.2%	1,224	7%	7,029	63%	T2	Q	CS
Romania	3,388	6,674	7,534	1.3%	860	13%	4,146	122%	T1	NS	D
Slovakia	3,108	3,746	3,579	0.6%	-167	-4%	471	15%	M	AS	D
Slovenia	900	2,271	2,550	0.5%	279	12%	1,649	183%	COPERT 3	NS	C
EU-27	**296,645**	**541,342**	**560,666**	**100.0%**	**19,324**	**3.6%**	**264,022**	**89%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.140 1A3b Road Transport, gasoline: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	362,612	301,342	288,155	88.2%	-13,188	-4%	-74,457	-21%			
Bulgaria	4,462	1,726	1,920	0.6%	194	11%	-2,542	-57%	T2	NS	CS, D
Cyprus	515	951	1,006	0.3%	55	6%	491	95%	T1	NS	D
Czech Republic	3,179	6,422	6,287	1.9%	-135	-2%	3,108	98%	T1	NS	D
Estonia	1,462	850	925	0.3%	75	9%	-537	-37%	T1	NS	D
Hungary	4,985	4,810	4,672	1.4%	-138	-3%	-314	-6%	T1	NS	CS
Latvia	1,660	1,010	1,122	0.3%	112	11%	-538	-32%	COPERT III	NS	CS
Lithuania	3,054	1,075	1,144	0.4%	70	6%	-1,910	-63%	T2	NS	CS
Malta	183	226	229	0.1%	2	1%	45	25%	T1	NS	D
Poland	10,130	12,095	12,831	3.9%	735	6%	2,701	27%	T2	Q	CS
Romania	3,073	4,595	4,290	1.3%	-305	-7%	1,217	40%	T1	NS	D
Slovakia	1,393	2,228	1,992	0.6%	-236	-11%	599	43%	M	AS	D
Slovenia	1,711	2,077	2,017	0.6%	-59	-3%	306	18%	COPERT 3	NS	C
EU-27	**398,419**	**339,408**	**326,589**	**100.0%**	**-12,819**	**-3.8%**	**-71,830**	**-18%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.141 1A3b Road Transport, LPG: Member CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	7,314	5,462	5,258	41.1%	-204	-4%	-2,056	-28%			
Bulgaria	0	1,144	1,195	9.3%	51	4%	1,195	2102803%	T2	NS	CS, D
Cyprus	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Czech Republic	NO	210	216	1.7%	6	3%	216	-	T1	NS	D
Estonia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Hungary	NA	85	72	0.6%	-13	-	72	-	T1	NS	D
Latvia	38	71	77	0.6%	6	8%	38	100%	COPERT III	NS	C
Lithuania	60	624	638	5.0%	14	2%	578	966%	T2	NS	CS
Malta	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Poland	NO	5,111	5,206	40.7%	94	2%	5,206	-	T2	Q	CS
Romania	NA	103	48	0.4%	-56	-54%	48	-	T1	NS	D
Slovakia	NO	110	91	0.7%	-19	-17%	91	-	D	AS	D
Slovenia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
EU-27	**7,412**	**12,919**	**12,799**	**100.0%**	**-120**	**-1%**	**5,387**	**73%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.142 1A3b Road Transport, diesel oil: N_2O emissions of EU-27

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	3,096	7,865	8,273	90.5%	409	5%	5,178	167%			
Bulgaria	24	34	35	0.4%	2	5%	11	44%	T2	NS	CS, D
Cyprus	9	23	22	0.2%	-1	-4%	12	134%	T1	NS	D
Czech Republic	36	201	211	2.3%	10	5%	175	490%	T2	NS	CS
Estonia	2	3	3	0.0%	0	8%	1	75%	T1	NS	D
Hungary	63	111	122	1.3%	10	9%	59	93%	T2	NS	D
Latvia	10	23	32	0.3%	9	37%	22	216%	COPERT III	NS	C
Lithuania	36	36	40	0.4%	4	10%	4	10%	T2	NS	CS
Malta	0	1	1	0.0%	0	-4%	0	80%	T1	NS	D
Poland	151	231	249	2.7%	18	8%	98	65%	T2	Q	D
Romania	9	17	19	0.2%	2	13%	11	122%	T1	NS	D
Slovakia	61	74	69	0.8%	-5	-7%	8	13%	M	AS	D
Slovenia	20	63	72	0.8%	9	15%	52	252%	COPERT 3	NS	C
EU-27	**3,517**	**8,681**	**9,147**	**100.0%**	**466**	**5%**	**5,629**	**160%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.143 1A3b Road Transport, gasoline: N_2O emissions of EU-27

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	2,559	9,258	9,093	83.5%	-165	-2%	6,534	255%			
Bulgaria	23	8	9	0.1%	1	11%	-13	-58%	T2	NS	CS, D
Cyprus	3	19	20	0.2%	1	6%	17	549%	T1	NS	D
Czech Republic	35	442	433	4.0%	-9	-2%	398	1137%	T2	NS	CS
Estonia	4	2	3	0.0%	0	9%	-1	-37%	T1	NS	D
Hungary	338	308	261	2.4%	-46	-15%	-77	-23%	T2	NS	D
Latvia	6	28	34	0.3%	7	24%	29	495%	COPERT III	NS	C
Lithuania	26	9	10	0.1%	1	6%	-16	-63%	T2	NS	CS
Malta	0	1	1	0.0%	0	1%	0	25%	T1	NS	D
Poland	75	781	829	7.6%	48	6%	754	1007%	T2	Q	D
Romania	8	12	12	0.1%	-1	-7%	3	40%	T1	NS	D
Slovakia	11	98	90	0.8%	-8	-8%	79	753%	M	AS	D
Slovenia	13	93	94	0.9%	1	1%	81	604%	COPERT 3	NS	C
EU-27	**3,101**	**11,059**	**10,888**	**100.0%**	**-171**	**-2%**	**7,788**	**251%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

3.9.2.12 Railways (1A3c) (EU-27)

Table 3.144 1A3c Railways, liquid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	7,917	5,876	5,837	75.0%	-39	-1%	-2,080	-26%			
Bulgaria	334	94	93	1.2%	-1	-1%	-241	-72%	T2	NS	CS, D
Cyprus	NO	NO	NO	-	-	-	-	-	T1	NS	D
Czech Republic	647	270	258	3.3%	-12	-5%	-389	-60%	T1	NS	D
Estonia	143	124	136	1.7%	12	10%	-7	-5%	T1	NS	D
Hungary	513	182	185	2.4%	3	1%	-328	-64%	T1	NS	D
Latvia	526	255	224	2.9%	-31	-12%	-302	-57%	T1	NS	D
Lithuania	355	232	221	2.8%	-11	-5%	-134	-38%	T2	NS	CS
Malta	NO	NA	NA	-	-	-	-	-	T1	NS	D
Poland	1,758	501	460	5.9%	-41	-8%	-1,298	-74%	T1	NS	D
Romania	904	219	223	2.9%	4	2%	-680	-75%	T1	NS	D
Slovakia	377	107	113	1.5%	7	6%	-264	-70%	T1	AS	D
Slovenia	64	38	37	0.5%	0	0%	-27	-42%	T1	NS	D
EU-27	**13,537**	**7,898**	**7,788**	**100.0%**	**-110**	**-1%**	**-5,749**	**-42%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

3.9.2.13 Navigation (1A3d) (EU-27)

Table 3.145 1A3d Navigation, residual oil: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	5,723	7,575	8,122	99.9%	547	7%	2,399	42%			
Bulgaria	NO	NO	NO	-	-	-	-	-	NA	NA	NA
Cyprus	NE	NO	NO	-	-	-	-	-	T1	0.0	D
Czech Republic	NO	NO	NO	-	-	-	-	-	0.0	0.0	0.0
Estonia	473	NO	NO	-	-	-	-473	-100%	T1	0.0	D
Hungary	2	NO	NO	-	-	-	-	-	---	---	---
Latvia	NO	NO	NO	-	-	-	-	-	T1	Q	D
Lithuania	NO	0.3	1	0.01%	1	250%	1	-	T2	NS	CS
Malta	NA	NA	NA	-	-	-	-	-	T1	0.0	D
Poland	58	3	3	0.04%	0	13%	-55	-94%	T1	NS	D
Romania	146	2	1	0.01%	-1	-31%	-144	-99%	T1	NS	D
Slovakia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Slovenia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
EU-27	**6,400**	**7,580**	**8,127**	**100.0%**	**547**	**7%**	**1,727**	**27%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.146 1A3d Navigation, gas/diesel oil: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	12,228	12,331	13,503	98.6%	1,172	10%	1,275	10%	#NV	#NV	#NV
Bulgaria	58	NO	NO	-	-	-	-58	-100%	NA	NA	NA
Cyprus	NE	NO	NO	-	-	-	-	-	T1	0.0	D
Czech Republic	56	16	19	0.1%	3	20%	-37	-67%	T1	NS	D
Estonia	106	25	34	0.2%	9	36%	-72	-68%	T1	0.0	D
Hungary	28	3	4	0.0%	1	36%	-24	-87%	T1	NS	D
Latvia	16	42	44	0.3%	1	3%	28	177%	T1	Q	D
Lithuania	16	17	18	0.1%	2	9%	3	17%	T2	NS	CS
Malta	8	18	20	0.1%	2	11%	11	136%	T1	0.0	D
Poland	144	8	10	0.1%	3	38%	-134	-93%	T1	NS	D
Romania	39	44	38	0.3%	-6	-13%	-1	-3%	T1	NS	D
Slovakia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Slovenia	IE	IE	IE	-	-	-	-	-	IE	IE	IE
EU-27	**12,699**	**12,503**	**13,690**	**100.0%**	**1,187**	**9%**	**991**	**8%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

3.9.2.14 Other (1A3e) (EU-27)

Table 3.147 1A3e Other: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006	
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
EU-15	6,584	8,840	8,351	82.7%	-489	-6%	1,767	27%
Bulgaria	2,569	724	788	7.8%	64	9%	-1,781	-69%
Cyprus	0	NA	NA	-	-	-	-	-
Czech Republic	494	166	158	1.6%	-8	-5%	-336	-68%
Estonia	451	130	135	1.3%	4	3%	-317	-70%
Hungary	NO	NO	NO	-	-	-	-	-
Latvia	NO	NO	NO	-	-	-	-	-
Lithuania	NO	NO	NO	-	-	-	-	-
Malta	NA	NA	NA	-	-	-	-	-
Poland	1,299	615	607	6.0%	-8	-1%	-692	-53%
Romania	7	49	54	0.5%	5	11%	47	650%
Slovakia	7	2	2	0.0%	0	0%	-5	-73%
Slovenia	NO	NO	NO	-	-	-	-	-
EU-27	**11,412**	**10,526**	**10,095**	**100.0%**	**-431**	**-4%**	**-1,318**	**-12%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

3.9.2.15 Commercial/Institutional (1A4a) (EU-27)

Table 3.148 1A4a Commercial/Institutional, liquid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	73,987	58,453	56,944	94.1%	-1,508	-3%	-17,042	-23%			
Bulgaria	102	95	205	0.3%	110	116%	103	102%	T2	NS	CS, D
Cyprus	182	340	343	0.6%	3	1%	160	88%	T1,T2	NS	D, CS
Czech Republic	1,786	132	124	0.2%	-8	-6%	-1,662	-93%	T1	NS	D
Estonia	62	60	41	0.1%	-19	-31%	-21	-34%	T1,T2	NS	D, CS
Hungary	1,296	122	103	0.2%	-19	-16%	-1,194	-92%	T1	NS	D
Latvia	1,131	139	183	0.3%	44	32%	-948	-84%	T1	NS	NS
Lithuania	1,174	23	17	0.0%	-7	-28%	-1,157	-99%	T2	NS	CS
Malta	56	40	36	0.1%	-4	-11%	-19	-35%	T1,T2	NS	D, CS
Poland	NO	1,361	1,030	1.7%	-330	-24%	1,030	-	T2	NS	D
Romania	926	1,205	877	1.4%	-328	-27%	-49	-5%	T1	NS	D
Slovakia	384	24	25	0.0%	1	3%	-359	-94%	T1	PS	CS
Slovenia	267	650	597	1.0%	-53	-8%	330	124%	T1	NS	D
EU-27	**81,353**	**62,644**	**60,525**	**100.0%**	**-2,120**	**-3%**	**-20,828**	**-26%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.149 1A4a Commercial/Institutional, solid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	27,666	1,748	1,710	27.2%	-38	-2%	-25,956	-94%			
Bulgaria	31	32	31	0.5%	-1	-3%	0	-1%	T2	NS	CS, D
Cyprus	NO	NO	NO	-	-	-	-	-	T1,T2	NS	D, CS
Czech Republic	6,274	977	1,002	15.9%	25	3%	-5,272	-84%	T1	NS	CS
Estonia	6	7	1	0.0%	-6	-84%	-5	-83%	T1,T2	NS	D, CS
Hungary	650	11	19	0.3%	9	83%	-631	-97%	T1	NS	D
Latvia	1,440	99	106	1.7%	7	7%	-1,335	-93%	T1	NS	NS
Lithuania	1,186	222	299	4.8%	77	35%	-887	-75%	T2	NS	CS
Malta	NA	NA	NA	-	-	-	-	-	T1,T2	NS	D, CS
Poland	11,635	2,669	3,049	48.5%	380	14%	-8,586	-74%	T2	NS	CS/D
Romania	400	3	15	0.2%	13	505%	-385	-96%	T1	NS	D
Slovakia	1,729	74	60	1.0%	-14	-18%	-1,669	-97%	T1	PS	CS
Slovenia	200	NO	NO	-	0	-	-200	-100%	NO	NO	NO
EU-27	**51,218**	**5,840**	**6,292**	**100.0%**	**452**	**8%**	**-44,926**	**-88%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.150 1A4a Commercial/Institutional, gaseous fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	59,133	100,712	98,593	85.5%	-2,119	-2%	39,460	67%			
Bulgaria	39	98	147	0.1%	49	51%	108	274%	T2	NS	CS, D
Cyprus	NO	NO	NO	-	-	-	-	-	T1	NS	D
Czech Republic	1,428	3,070	3,057	2.6%	-13	0%	1,629	114%	T1	NS	D
Estonia	19	30	34	0.0%	4	12%	15	80%	T1	NS	D
Hungary	1,928	5,554	5,048	4.4%	-506	-9%	3,121	162%	T1	NS	D
Latvia	283	265	279	0.2%	14	5%	-4	-1%	T1	NS	NS
Lithuania	730	121	128	0.1%	8	6%	-602	-82%	T2	NS	CS/C
Malta	7	11	12	0.0%	1	9%	5	71%	T1	NS	D
Poland	770	3,920	3,513	3.0%	-407	-10%	2,743	356%	T2	NS	D
Romania	313	1,838	3,768	3.3%	1,930	105%	3,455	1104%	T1	NS	D
Slovakia	1,215	845	758	0.7%	-87	-10%	-457	-	T1	PS	CS
Slovenia	29	60	32	0.0%	-28	-46%	4	12%	T1	NS	CS
EU-27	**65,894**	**116,523**	**115,370**	**100.0%**	**-1,153**	**-1%**	**49,477**	**75%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

3.9.2.16 Residential (1A4b) (EU-27)

Table 3.151 1A4b Residential, liquid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	169,708	158,438	153,407	96.4%	-5,031	-3%	-16,301	-10%			
Bulgaria	1,577	70	74	0.0%	4	6%	-1,503	-95%	T2	NS	CS, D
Cyprus	202	343	349	0.2%	6	2%	147	73%	T1,T2	NS	D, CS
Czech Republic	490	75	70	0.0%	-5	-7%	-420	-86%	T1	NS	D
Estonia	547	26	29	0.0%	3	12%	-518	-95%	T1,T2	NS	D, CS
Hungary	3,423	418	430	0.3%	13	3%	-2,993	-87%	T1	NS	D
Latvia	330	101	104	0.1%	3	3%	-226	-68%	T1	NS	NS
Lithuania	396	174	152	0.1%	-22	-13%	-245	-62%	T2	NS	CS
Malta	3	1	0	0.0%	0	-36%	-2	-86%	T1,T2	NS	D, CS
Poland	106	2,975	2,223	1.4%	-752	-25%	2,117	1992%	T2	NS	D
Romania	867	1,160	1,211	0.8%	52	4%	345	40%	T1	NS	D
Slovakia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Slovenia	434	1,258	1,125	0.7%	-133	-11%	691	159%	T1	NS	D
EU-27	**178,083**	**165,039**	**159,175**	**100.0%**	**-5,864**	**-4%**	**-18,908**	**-11%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.152 1A4b Residential, solid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	74,552	11,244	10,495	27.5%	-749	-7%	-64,057	-86%			
Bulgaria	3,209	1,138	1,164	3.1%	26	2%	-2,045	-64%	T2	NS	CS, D
Cyprus	NO	NO	NO	-	-	-	-	-	T1,T2	NS	D, CS
Czech Republic	17,373	1,641	1,735	4.6%	94	6%	-15,638	-90%	T1	NS	CS
Estonia	700	95	75	0.2%	-20	-21%	-625	-89%	T1,T2	NS	D, CS
Hungary	7,981	944	956	2.5%	12	1%	-7,025	-88%	T1	NS	D
Latvia	632	87	75	0.2%	-12	-14%	-557	-88%	T1	NS	NS
Lithuania	1,458	160	206	0.5%	46	29%	-1,252	-86%	T2	NS	CS
Malta	NA	NA	NA	-	-	-	-	-	T1,T2	NS	D, CS
Poland	26,227	19,669	22,791	59.8%	3,122	16%	-3,436	-13%	T2	NS	CS/D
Romania	2,040	51	39	0.1%	-12	-23%	-2,000	-98%	T1	NS	D
Slovakia	5,949	507	578	1.5%	71	14%	-5,371	-90%	T1	AS	CS
Slovenia	338	7	NO	-	-7	-100%	-338	-100%	NO	NO	NO
EU-27	**140,457**	**35,544**	**38,114**	**100.0%**	**2,570**	**7%**	**-102,343**	**-73%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.153 1A4b Residential, gaseous fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	161,882	248,698	239,413	88.4%	-9,284	-4%	77,532	48%			
Bulgaria	NO	33	57	0.0%	24	74%	57	-	T2	NS	CS, D
Cyprus	NO	NO	NO	-	-	-	-	-	T1	NS	D
Czech Republic	2,746	5,405	5,316	2.0%	-89	-2%	2,570	94%	T1	NS	D
Estonia	118	104	106	0.0%	2	2%	-12	-10%	T1	NS	D
Hungary	3,937	9,181	8,516	3.1%	-664	-7%	4,580	116%	T1	NS	D
Latvia	223	234	241	0.1%	7	3%	18	8%	T1	NS	NS
Lithuania	526	320	334	0.1%	13	4%	-192	-37%	T2	NS	CS
Malta	32	54	41	0.0%	-13	-24%	9	29%	T1	NS	D
Poland	6,821	7,542	7,741	2.9%	200	3%	920	13%	T2	NS	D
Romania	2,785	5,974	6,014	2.2%	40	1%	3,229	116%	T1	NS	D
Slovakia	1,586	3,279	2,975	1.1%	-304	-9%	1,389	-	T1	AS	CS
Slovenia	25	227	219	0.1%	-8	-4%	194	775%	T1	NS	CS
EU-27	**180,681**	**281,051**	**270,974**	**100.0%**	**-10,077**	**-4%**	**90,293**	**50%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.154 1A4b Residential, biomass: CH_4 emissions of EU-27

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006	
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
EU-15	6,099	4,787	4,613	65.6%	-173	-4%	-1,486	-24%
Bulgaria	18	111	117	1.7%	7	6%	99	555%
Cyprus	1	0	0	0.0%	0	17%	-1	-98%
Czech Republic	37	213	213	3.0%	0	0%	176	475%
Estonia	34	78	76	1.1%	-1	-2%	43	127%
Hungary	73	199	240	3.4%	41	20%	167	230%
Latvia	126	203	197	2.8%	-7	-3%	70	56%
Lithuania	76	152	152	2.2%	0	0%	76	101%
Malta	NA	NA	NA	-	-	-	-	-
Poland	216	634	658	9.4%	24	4%	442	204%
Romania	139	721	678	9.6%	-43	-6%	539	386%
Slovakia	NO	NO	NO	-	-	-	-	-
Slovenia	86	96	86	1.2%	-10	-10%	0	0%
EU-27	**6,905**	**7,193**	**7,030**	**100.0%**	**-163**	**-2%**	**125**	**2%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

3.9.2.17 Agriculture/Forestry/Fisheries (1A4c) (EU-27)

Table 3.155 1A4c Agriculture/Forestry/Fisheries, liquid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	56,783	51,515	51,259	84.7%	-256	0%	-5,524	-10%			
Bulgaria	245	152	117	0.2%	-35	-23%	-127	-52%	T2	NS	CS, D
Cyprus	218	83	95	0.2%	12	14%	-123	-56%	T1,T2	NS	D, CS
Czech Republic	342	75	67	0.1%	-8	-10%	-275	-80%	T1	NS	D
Estonia	47	71	50	0.1%	-21	-30%	3	6%	T1,T2	NS	D, CS
Hungary	2,134	745	819	1.4%	73	10%	-1,315	-62%	T1	NS	D
Latvia	695	324	336	0.6%	13	4%	-358	-52%	T1	NS	NS
Lithuania	1,188	131	130	0.2%	-1	-1%	-1,058	-89%	T2	NS	CS
Malta	NE	NA	NA	-	-	-	-	-	T1,T2	NS	D, CS
Poland	3,593	7,913	6,939	11.5%	-975	-12%	3,346	93%	T2	NS	D
Romania	3,558	357	448	0.7%	91	25%	-3,111	-87%	T1	NS	D
Slovakia	3	13	15	0.0%	3	20%	12	402%	T1	PS	CS
Slovenia	330	229	231	0.4%	1	1%	-100	-30%	T1	NS	D
EU-27	**69,136**	**61,609**	**60,506**	**100.0%**	**-1,103**	**-2%**	**-8,630**	**-12%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.156 1A4c Agriculture/Forestry/Fisheries, solid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	4,066	752	764	14.5%	12	2%	-3,303	-81%			
Bulgaria	177	21	27	0.5%	6	30%	-150	-85%	T2	NS	CS, D
Cyprus	NO	NO	NO	-	-	-	-	-	T1,T2	NS	D, CS
Czech Republic	1,493	67	81	1.5%	14	21%	-1,412	-95%	T1	NS	CS
Estonia	16	1	0	0.0%	0	-78%	-16	-99%	T1,T2	NS	D, CS
Hungary	212	19	12	0.2%	-7	-36%	-200	-94%	T1	NS	D
Latvia	103	5	5	0.1%	0	0%	-98	-95%	T1	NS	NS
Lithuania	148	4	6	0.1%	1	35%	-142	-96%	T2	NS	CS
Malta	NE	NA	NA	-	-	-	-	-	T1,T2	NS	D, CS
Poland	2,846	3,708	4,366	82.9%	658	18%	1,520	53%	T2	NS	CS/D
Romania	69	1	1	0.03%	0	3%	-67	-98%	T1	NS	D
Slovakia	1	10	5	0.1%	-6	-55%	3	234%	T1	PS	CS
Slovenia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
EU-27	**9,132**	**4,588**	**5,266**	**100.0%**	**679**	**15%**	**-3,865**	**-42%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.157 1A4c Agriculture/Forestry/Fisheries, gaseous fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	9,723	10,471	10,514	90.8%	43	0%	791	8%			
Bulgaria	0	62	75	0.6%	13	21%	75	35895%	T2	NS	CS, D
Cyprus	NO	NO	NO	-	-	-	-	-	T1	NS	D
Czech Republic	415	159	160	1.4%	1	1%	-255	-61%	T1	NS	D
Estonia	4	1	0	0.0%	-1	-83%	-4	-95%	T1	NS	D
Hungary	627	555	453	3.9%	-102	-18%	-174	-28%	T1	NS	D
Latvia	792	47	45	0.4%	-2	-4%	-747	-94%	T1	NS	NS
Lithuania	168	68	90	0.8%	22	33%	-78	-46%	T2	NS	CS/C
Malta	NE	NA	NA	-	-	-	-	-	T1	NS	D
Poland	25	61	83	0.7%	23	37%	58	232%	T2	NS	D
Romania	73	86	70	0.6%	-16	-18%	-3	-4%	T1	NS	D
Slovakia	41	172	90	0.8%	-82	-48%	49	-	T1	PS	CS
Slovenia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
EU-27	**11,867**	**11,681**	**11,580**	**100.0%**	**-101**	**-1%**	**-288**	**-2%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

3.9.2.18 Stationary (1A5a) (EU-27)

Table 3.158 1A5a Stationary, solid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	4,667	15	13	57.7%	-2	-15%	-4,654	-100%			
Bulgaria	37	NO	NO	-	-	-	-37	-100%	NO	NO	NO
Cyprus	0	0	0	-	-	-	-	-	NO	NO	NO
Czech Republic	NO	NO	NO	-	-	-	-	-	NA	NA	NA
Estonia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Hungary	NO	NO	NO	-	-	-	-	-	---	---	---
Latvia	NA	NA	NA	-	-	-	-	-	NO	NO	NO
Lithuania	NE,NO	NE,NO	NE,NO	-	-	-	-	-	NO	NO	NO
Malta	NA	NA	NA	-	-	-	-	-	NO	NO	NO
Poland	IE	IE	IE	-	-	-	-	-	IE	IE	IE
Romania	NE	NE	NE	-	-	-	-	-	NA	NA4	NA
Slovakia	198	11	10	42.3%	-1	-13%	-188	-95%	T1	PS	CS
Slovenia	NA	NA	NA	-	-	-	-	-	NO	NO	NO
EU-27	**4,902**	**26**	**23**	**100.0%**	**-4**	**-14%**	**-4,879**	**-100%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

3.9.2.19 Mobile (1A5b) (EU-27)

Table 3.159 1A5b Mobile, liquid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	13,679	6,223	5,714	84.3%	-509	-8%	-7,965	-58%			
Bulgaria	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Cyprus	0	0	0	-	-	-	-	-	NA	NA	NA
Czech Republic	1,601	1,097	1,053	15.5%	-44	-4%	-548	-34%	T1	NS	D
Estonia	NA	NA	NA	-	-	-	-	-	NA	NA	NA
Hungary	NO	NO	NO	-	-	-	-	-	---	---	---
Latvia	NA	NA	3	0.0%	3	-	3	-	NO	NO	NO
Lithuania	NE,NO	12	12	0.2%	0	-3%	12	-	NO	NO	NO
Malta	NA	NA	NA	-	-	-	-	-	NA	NA	NA
Poland	NO	NO	NO	-	-	-	-	-	IE	IE	IE
Romania	NA	NA	NA	-	-	-	-	-	NA	NA4	NA
Slovakia	NA	NA	NA	-	-	-	-	-	NO	NO	NO
Slovenia	NA	NA	NA	-	-	-	-	-	NO	NO	NO
EU-27	**15,279**	**7,332**	**6,781**	**100.0%**	**-550**	**-8%**	**-8,498**	**-56%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

3.9.2.20 Fugitive emissions from Solid Fuels (1B1) (EU-27)

Table 3.160 1B1a Coal Mining: CH_4 emissions of EU-27

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	44,285	12,174	10,893	36.7%	-1,281	-11%	-33,392	-75%			
Bulgaria	1,592	1,107	1,187	4.0%	80	7%	-405	-25%	T1	NS	D
Cyprus	0	NO	NO	-	-	-	-	-	T1,T2	PS	CS
Czech Republic	7,600	4,650	4,960	16.7%	309	7%	-2,640	-35%	T2,T1	NS	CS, D
Estonia	408	258	262	0.9%	4	2%	-146	-36%	T1,T2	PS	CS
Hungary	659	22	23	0.1%	1	5%	-636	-97%	D,T2	NS,PS	CS
Latvia	NO	NO	NO	-	-	-	-	-	NE	NE	NE
Lithuania	NO	NO	NO	-	-	-	-	-	T2	NS	CS
Malta	NA	NA	NA	-	-	-	-	-	T1,T2	PS	CS
Poland	14,717	9,570	9,193	31.0%	-377	-4%	-5,524	-38%	CS	NS	CS
Romania	3,661	2,493	2,598	8.8%	105	4%	-1,063	-29%	NA	NA4	NA
Slovakia	571	340	308	1.0%	-32	-9%	-263	-46%	T2	PS	CS
Slovenia	303	256	254	0.9%	-1	0%	-48	-16%	CS	NS	CS
EU-27	**73,796**	**30,870**	**29,679**	**100.0%**	**-1,190**	**-4%**	**-44,117**	**-60%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

3.9.2.21 Fugitive emissions from oil and natural gas (1B2) (EU-27)

Table 3.161 1B2a Fugitive CO_2 emissions from oil: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	9,590	9,685	9,915	97.6%	230	2%	325	3%			
Bulgaria	NE,NO	NE,NO	NE,NO	-	-	-	-	-	NE	NE	NE
Cyprus	0	NA,NE	NA,NE	-	-	-	-	-	NO	NO	NO
Czech Republic	IE,NE,NO	IE,NE,NO	IE,NE,NO	-	-	-	-	-	NA	NA	NA
Estonia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Hungary	IE,NO	IE,NO	IE,NO	-	-	-	-	-	---	---	---
Latvia	NE,NO	NE,NO	NE,NO	-	-	-	-	-	NE	NE	NE
Lithuania	0.1	0.1	0.1	0.001%	0	2%	0	148%	T2	NS	D
Malta	NA,NE	NA,NE	NA,NE	-	-	-	-	-	NO	NO	NO
Poland	42	225	245	2.4%	20	9%	203	481%	T1	NS	CS/D
Romania	NE,NO	NE,NO	NE,NO	-	-	-	-	-	NA	NO	NA5
Slovakia	0.0012	0.0007	0.0007	0.0%	0	2%	0	-37%	T1	AS	CS
Slovenia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
EU-27	**9,632**	**9,910**	**10,160**	**100.0%**	**249**	**3%**	**528**	**5%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.162 1B2b Fugitive CH_4 emissions from natural gas: CH_4 emissions of EU-27

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	26,295	21,528	20,791	55.1%	-736	-3%	-5,504	-21%			
Bulgaria	606	601	577	1.5%	-24	-4%	-28	-5%	T1	NS	D
Cyprus	0	NA	NA	-	-	-	-	-	T1	NS	D
Czech Republic	878	666	682	1.8%	15	2%	-196	-22%	T2	NS	CS
Estonia	787	513	519	1.4%	6	1%	-268	-34%	T1	NS	D
Hungary	917	1,484	1,493	4.0%	9	1%	576	63%	D	NS, PS	OTH
Latvia	236	135	97	0.3%	-38	-28%	-139	-59%	PS	PS	PS
Lithuania	IE,NE,NO	IE,NE,NO	IE,NE,NO	-	-	-	-	-	T2	NS	CS
Malta	NA,NE	NA,NE	NA,NE	-	-	-	-	-	T1	NS	D
Poland	3,076	4,258	4,298	11.4%	40	1%	1,222	40%	T1	NS	CS
Romania	19,027	8,669	8,609	22.8%	-60	-1%	-10,418	-55%	NA	NA4	NA
Slovakia	448	606	612	1.6%	6	1%	164	-	T1	AS	CS
Slovenia	57	33	32	0.1%	-1	-4%	-26	-45%	T2	NS, AS	CS, D
EU-27	**52,328**	**38,494**	**37,712**	**100.0%**	**-782**	**-2%**	**-14,616**	**-28%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.163 1B2c Fugitive CO_2 emissions from venting and flaring: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	6,441	6,419	5,733	98.4%	-686	-11%	-707	-11%			
Bulgaria	NE	NE	NE	-	-	-	-	-	NE	NE	NE
Cyprus	0	NA	NA	-	-	-	-	-	NA	NA	NA
Czech Republic	NE	NE	NE	-	-	-	-	-	NA	NA	NA
Estonia	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA	NA
Hungary	173	85	80	1.4%	-5	-5%	-92	-53%	D	NS,PS	D
Latvia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Lithuania	1	18	15	0.3%	-3	-16%	14	1434%	T2	NS	D
Malta	NA	NA	NA	-	-	-	-	-	NA	NA	NA
Poland	NE	NE	NE	-	-	-	-	-	NE	NE	NE
Romania	NE	NE	NE	-	-	-	-	-	NA	NA	NA5
Slovakia	0	0	0	0.0%	0	4%	0	-3%	T1	AS	CS
Slovenia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
EU-27	**6,614**	**6,522**	**5,829**	**100.0%**	**-693**	**-11%**	**-786**	**-12%**			

3.9.3 Reference approach (new Member States)

Table 3.164 Comparison between Eurostat and national reference approach for CO_2 from fuel combustion for the new MS (CRF 1.A) ([27])

EU-27

1990	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	25,486,580	1,646,669	25,466,058	1,654,411	-0.1%	0.5%
Solid fossil fuels	18,862,328	1,790,072	18,916,381	1,804,240	0.3%	0.8%
Gaseous fossil fuels	12,347,269	677,543	12,392,775	670,486	0.4%	-1.0%
Total	**56,696,177**	**4,114,284**	**56,775,214**	**4,129,137**	**0.1%**	**0.4%**
2005	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	26,478,516	1,682,439	26,739,183	1,683,580	1.0%	0.1%
Solid fossil fuels	13,340,165	1,264,535	13,275,516	1,256,165	-0.5%	-0.7%
Gaseous fossil fuels	18,679,409	1,030,954	18,591,334	1,025,679	-0.5%	-0.5%
Total	**58,498,090**	**3,977,928**	**58,606,033**	**3,965,424**	**0.2%**	**-0.3%**
2006	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	26,245,645	1,671,290	26,457,530	1,666,803	0.8%	-0.3%
Solid fossil fuels	13,579,417	1,286,376	13,408,080	1,271,998	-1.3%	-1.1%
Gaseous fossil fuels	18,333,726	1,012,606	18,335,315	1,012,092	0.0%	-0.1%
Total	**58,158,788**	**3,970,273**	**58,200,925**	**3,950,893**	**0.1%**	**-0.5%**

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	389,668	26,736	396,034	28,320	1.6%	5.9%
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	**979,949**	**73,974**	**1,010,589**	**80,960**	**3.1%**	**9.4%**
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	200,366	12,929	206,141	13,227	2.9%	2.3%
Solid fossil fuels	288,783	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	**606,550**	**47,025**	**615,986**	**49,966**	**1.6%**	**6.3%**
2006	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	207,184	13,272	208,655	13,286	0.7%	0.1%
Solid fossil fuels	291,648	28,267	297,369	31,208	2.0%	10.4%
Gaseous fossil fuels	121,442	6,468	121,930	6,494	0.4%	0.4%
Total	**620,274**	**48,008**	**627,953**	**50,988**	**1.2%**	**6.2%**

([27]) Minus means that Member State-based estimates are lower than the Eurostat-based estimates.

Cyprus

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	50,326	3,605	56,297	4,014	11.9%	11.3%
Solid fossil fuels	2,521	234	787	73	-68.8%	-68.8%
Gaseous fossil fuels	0	0	0	0	-	-
Total	**52,846**	**3,839**	**57,084**	**4,087**	**8.0%**	**6.5%**
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	99,712	7,240	92,631	6,821	-7.1%	-5.8%
Solid fossil fuels	1,488	138	937	89	-37.0%	-35.7%
Gaseous fossil fuels	0	0	NA	NA	-	-
Total	**101,200**	**7,378**	**93,569**	**6,909**	**-7.5%**	**-6.4%**
2006	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	105,507	7,684	93,789	6,911	-11.1%	-10.1%
Solid fossil fuels	1,546	143	996	94	-35.5%	-34.2%
Gaseous fossil fuels	0	0	NA	NA	-	-
Total	**107,052**	**7,827**	**94,785**	**7,006**	**-11.5%**	**-10.5%**

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	361,923	22,067	347,586	22,950	-4.0%	4.0%
Solid fossil fuels	1,316,155	127,157	1,326,753	125,748	0.8%	-1.1%
Gaseous fossil fuels	219,711	12,264	224,667	12,541	2.3%	2.3%
Total	**1,897,788**	**161,488**	**1,899,006**	**161,238**	**0.1%**	**-0.2%**
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	396,115	22,920	378,490	25,223	-4.4%	10.0%
Solid fossil fuels	840,928	81,817	841,566	80,412	0.1%	-1.7%
Gaseous fossil fuels	322,528	18,003	321,420	17,942	-0.3%	-0.3%
Total	**1,559,570**	**122,740**	**1,541,476**	**123,577**	**-1.2%**	**0.7%**
2006	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	398,189	23,006	392,905	25,889	-1.3%	12.5%
Solid fossil fuels	866,598	84,231	852,591	81,489	-1.6%	-3.3%
Gaseous fossil fuels	317,190	17,705	324,040	18,179	2.2%	2.7%
Total	**1,581,977**	**124,943**	**1,569,536**	**125,556**	**-0.8%**	**0.5%**

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	118,877	8,618	124,874	9,205	5.0%	6.8%
Solid fossil fuels	249,841	24,789	256,011	24,645	2.5%	-0.6%
Gaseous fossil fuels	51,175	2,857	51,175	2,857	0.0%	0.0%
Total	**419,893**	**36,263**	**432,060**	**36,706**	**2.9%**	**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	44,798	3,117	28,086	1,976	-37.3%	-36.6%
Solid fossil fuels	133,381	13,231	133,438	12,753	0.0%	-3.6%
Gaseous fossil fuels	33,481	1,735	33,481	1,869	0.0%	7.7%
Total	**211,661**	**18,082**	**195,005**	**16,598**	**-7.9%**	**-8.2%**
2006	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	44,825	3,072	27,695	1,938	-38.2%	-36.9%
Solid fossil fuels	127,031	12,607	127,362	12,226	0.3%	-3.0%
Gaseous fossil fuels	33,836	1,756	33,895	1,892	0.2%	7.8%
Total	**205,692**	**17,435**	**188,952**	**16,056**	**-8.1%**	**-7.9%**

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	360,620	23,347	337,089	21,191	-6.5%	-9.2%
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	**983,327**	**68,012**	**977,810**	**68,092**	**-0.6%**	**0.1%**

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	297,312	16,350	287,707	16,394	-3.2%	0.3%
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	**932,817**	**56,830**	**923,779**	**57,721**	**-1.0%**	**1.6%**

2006	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	312,504	17,128	303,157	17,199	-3.0%	0.4%
Solid fossil fuels	132,014	12,633	131,328	13,233	-0.5%	4.7%
Gaseous fossil fuels	479,672	26,514	480,835	26,579	0.2%	0.2%
Total	**924,190**	**56,275**	**915,320**	**57,011**	**-1.0%**	**1.3%**

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	142,869	10,333	144,090	10,371	0.9%	0.4%
Solid fossil fuels	29,783	2,802	30,385	2,836	2.0%	1.2%
Gaseous fossil fuels	99,653	5,563	99,517	5,555	-0.1%	-0.1%
Total	**272,304**	**18,697**	**273,992**	**18,762**	**0.6%**	**0.3%**

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	55,011	3,671	59,561	4,041	8.3%	10.1%
Solid fossil fuels	3,426	321	3,414	312	-0.3%	-2.9%
Gaseous fossil fuels	56,852	3,173	56,764	3,169	-0.2%	-0.2%
Total	**115,289**	**7,165**	**119,739**	**7,522**	**3.9%**	**5.0%**

2006	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	58,912	3,960	64,548	4,344	9.6%	9.7%
Solid fossil fuels	3,650	341	3,640	332	-0.3%	-2.9%
Gaseous fossil fuels	58,892	3,287	58,611	3,272	-0.5%	-0.5%
Total	**121,454**	**7,589**	**126,799**	**7,947**	**4.4%**	**4.7%**

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	283,218	20,133	285,387	20,316	0.8%	0.9%
Solid fossil fuels	33,357	3,100	33,633	3,125	0.8%	0.8%
Gaseous fossil fuels	195,855	10,436	195,855	9,429	0.0%	-9.7%
Total	**512,431**	**33,669**	**514,875**	**32,870**	**0.5%**	**-2.4%**

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	113,204	7,886	110,342	7,771	-2.5%	-1.5%
Solid fossil fuels	8,437	796	8,672	806	2.8%	1.3%
Gaseous fossil fuels	103,685	5,340	103,692	4,432	0.0%	-17.0%
Total	**225,326**	**14,022**	**222,706**	**13,009**	**-1.2%**	**-7.2%**

2006	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	110,962	7,653	143,962	10,133	29.7%	32.4%
Solid fossil fuels	11,526	1,084	11,844	1,102	2.8%	1.7%
Gaseous fossil fuels	102,747	5,274	102,749	4,066	0.0%	-22.9%
Total	**225,235**	**14,011**	**258,555**	**15,301**	**14.8%**	**9.2%**

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	555,008	34,420	548,490	31,397	-1.2%	-8.8%
Solid fossil fuels	3,149,097	294,201	3,157,074	307,211	0.3%	4.4%
Gaseous fossil fuels	374,206	19,406	374,206	19,315	0.0%	-0.5%
Total	**4,078,311**	**348,027**	**4,079,770**	**357,923**	**0.0%**	**2.8%**

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	912,488	58,891	911,641	52,687	-0.1%	-10.5%
Solid fossil fuels	2,283,568	213,255	2,329,496	225,701	2.0%	5.8%
Gaseous fossil fuels	512,234	27,037	512,234	27,028	0.0%	0.0%
Total	**3,708,290**	**299,183**	**3,753,371**	**305,416**	**1.2%**	**2.1%**

2006	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	969,982	60,232	911,641	52,687	-6.0%	-12.5%
Solid fossil fuels	2,378,178	221,737	2,329,496	225,701	-2.0%	1.8%
Gaseous fossil fuels	518,052	27,428	512,234	27,028	-1.1%	-1.5%
Total	**3,866,211**	**309,398**	**3,753,371**	**305,416**	**-2.9%**	**-1.3%**

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	798,810	56,178	789,057	57,221	-1.2%	1.9%
Solid fossil fuels	517,881	50,228	489,771	46,875	-5.4%	-6.7%
Gaseous fossil fuels	1,207,409	67,397	1,200,116	64,261	-0.6%	-4.7%
Total	**2,524,100**	**173,803**	**2,478,944**	**168,358**	**-1.8%**	**-3.1%**

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	399,362	26,006	383,664	27,841	-3.9%	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	**1,351,464**	**93,765**	**1,326,328**	**94,246**	**-1.9%**	**0.5%**

2006	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	418,863	27,063	404,090	29,220	-3.5%	8.0%
Solid fossil fuels	398,485	39,021	397,952	38,475	-0.1%	-1.4%
Gaseous fossil fuels	611,594	33,579	607,024	33,318	-0.7%	-0.8%
Total	**1,428,943**	**99,663**	**1,409,065**	**101,013**	**-1.4%**	**1.4%**

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	177,826	9,419	196,758	10,596	10.6%	12.5%
Solid fossil fuels	325,896	31,390	343,341	33,418	5.4%	6.5%
Gaseous fossil fuels	213,023	11,891	223,810	12,363	5.1%	4.0%
Total	**716,745**	**52,701**	**763,909**	**56,377**	**6.6%**	**7.0%**

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	139,931	7,955	139,445	7,420	-0.3%	-6.7%
Solid fossil fuels	179,547	16,936	178,393	16,938	-0.6%	0.0%
Gaseous fossil fuels	247,919	13,541	247,163	13,288	-0.3%	-1.9%
Total	**567,397**	**38,433**	**565,002**	**37,645**	**-0.4%**	**-2.1%**

2006	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	136,945	7,623	138,457	7,280	1.1%	-4.5%
Solid fossil fuels	188,877	17,876	185,134	17,592	-2.0%	-1.6%
Gaseous fossil fuels	225,161	12,321	225,610	12,166	0.2%	-1.3%
Total	**550,982**	**37,819**	**549,201**	**37,038**	**-0.3%**	**-2.1%**

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	72,312	5,181	72,559	5,342	0.3%	3.1%
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	**173,083**	**13,674**	**171,231**	**13,851**	**-1.1%**	**1.3%**

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	106,029	7,315	101,836	7,481	-4.0%	2.3%
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	**209,374**	**15,710**	**202,718**	**15,634**	**-3.2%**	**-0.5%**

2006	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	110,266	7,558	104,417	7,483	-5.3%	-1.0%
Solid fossil fuels	65,468	6,428	63,900	6,396	-2.4%	-0.5%
Gaseous fossil fuels	37,650	2,014	37,656	1,810	0.0%	-10.1%
Total	**213,383**	**16,001**	**205,974**	**15,689**	**-3.5%**	**-2.0%**

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 (EU-15)

CRF Sector 2 Industrial Processes is the third largest sector contributing 8 % to total EU-15 GHG emissions in 2006. The most important GHGs from this sector are CO_2 (5 % of total GHG emissions), HFCs (1.4 %) and N_2O (0.9 %). The emissions from this sector decreased by 12 % from 373 Tg in 1990 to 328 Tg in 2006 (Figure 4.1). In 2006, the emissions decreased by 1.2 % compared to 2005. 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 2 Foam blowing: (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 1990–2006 in CO_2 equivalents (Tg)**

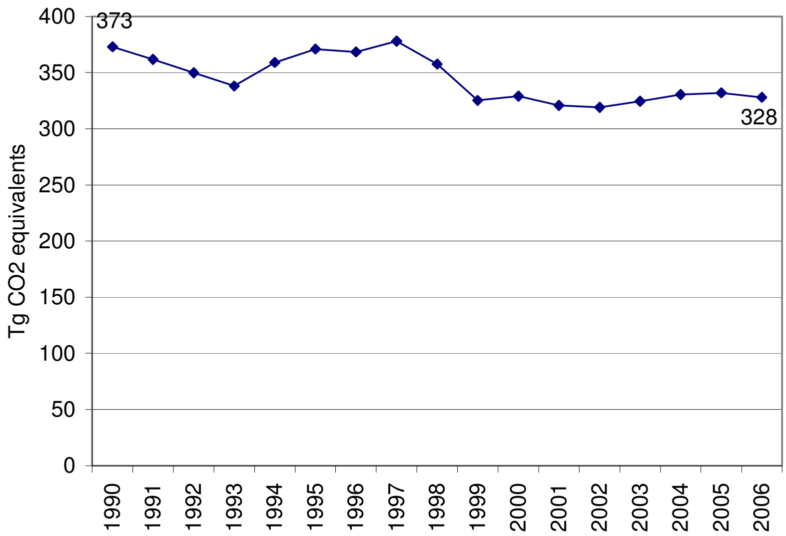
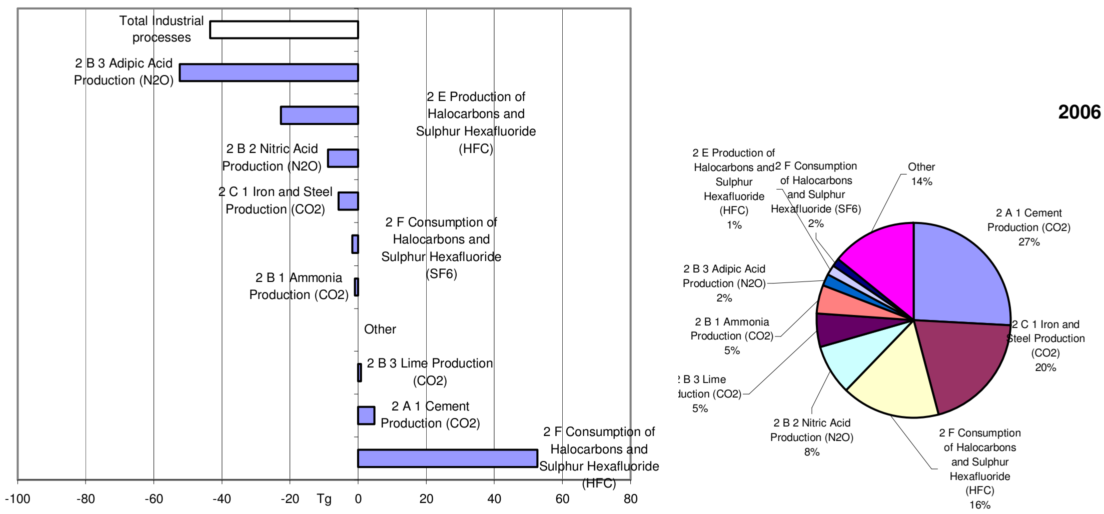


Figure 4.2 shows that large emission reductions occurred in adipic acid production (N_2O) mainly due to reduction measures in Germany, France, the UK and Italy, and in production of halocarbons and SF_6 (HFCs). Large HFC emission increases can be observed from consumption of halocarbons and SF_6. Figure 4.2 ahows that the three largest key sources account for about 62 % 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 1990–2006 in CO_2 equivalents (Tg) and share of largest key source categories in 2006**



4.2 Source categories (EU-15)

4.2.1 Mineral products (CRF Source Category 2A) (EU-15)

The source category 2A Mineral Products includes three key 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 2006. CO_2 emission from Mineral Products increased by 7.5 %. The relative decrease was largest in Luxembourg, the relative growth was largest in Ireland. Spain had largest emission increases in absolute terms and Germany largest absolute emission reductions in the period 1990-2006.

Table 4.1 2A Mineral Products: Member States'total GHG and CO_2 emissions

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2006 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO_2 emissions in 2006 (Gg)
Austria	3,269	3,294	3,269	3,294
Belgium	5,342	5,748	5,342	5,748
Denmark	1,073	1,609	1,073	1,609
Finland	1,308	1,254	1,308	1,254
France	15,066	13,076	15,066	13,076
Germany	22,567	20,028	22,567	20,028
Greece	6,454	7,200	6,454	7,200
Ireland	1,103	2,539	1,103	2,539
Italy	21,100	24,048	21,100	24,048
Luxembourg	611	493	611	493
Netherlands	967	1,173	967	1,173
Portugal	3,385	4,364	3,384	4,362
Spain	15,669	22,705	15,669	22,705
Sweden	1,919	2,275	1,919	2,275
United Kingdom	10,143	8,440	10,119	8,423
EU-15	**109,977**	**118,247**	**109,952**	**118,227**

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 2006. In 2006, CO_2 emissions from Cement Production were 6 % above 1990 levels in the EU-15.

Spain and Italy are the largest emitters accounting for 41 % of EU-15 emissions, followed by Germany (16 %). Germany, France and the United Kingdom had large reductions in absolute terms between 1990 and 2006, whereas especially Spain but also Ireland and Italy had large increases. Relative emisssion growth compared to 1990 was highest in Ireland (166 %) and Denmark (58 %). 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

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006	
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	2,033	1,797	1,954	2.3%	157	9%	-79	-4%
Belgium	2,824	2,934	3,116	3.7%	182	6%	292	10%
Denmark	882	1,456	1,395	1.6%	-61	-4%	513	58%
Finland	786	542	571	0.7%	29	5%	-215	-27%
France	10,948	8,970	9,165	10.7%	196	2%	-1,783	-16%
Germany	15,146	12,921	13,208	15.5%	288	2%	-1,938	-13%
Greece	5,778	6,649	6,461	7.6%	-188	-3%	683	12%
Ireland	884	2,357	2,348	2.8%	-9	0%	1,464	166%
Italy	16,084	17,886	17,933	21.0%	47	0%	1,849	11%
Luxembourg	557	435	431	0.5%	-4	-1%	-126	-23%
Netherlands	416	421	400	0.5%	-21	-5%	-16	-4%
Portugal	3,107	3,616	3,602	4.2%	-14	0%	495	16%
Spain	12,534	17,141	17,395	20.4%	254	1%	4,860	39%
Sweden	1,272	1,341	1,470	1.7%	129	10%	198	16%
United Kingdom	7,295	5,941	5,893	6.9%	-48	-1%	-1,402	-19%
EU-15	**80,547**	**84,406**	**85,342**	**100.0%**	**936**	**1%**	**4,795**	**6%**

Table 4.3 shows information on methods applied, activity data, emission factors for CO_2 emissions from 2A1 Cement Production for 1990 and 2006. 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 0.51 for Portugal to 0.55 for Austria, Ireland and the UK; most MS use country-specific and plant-specific emission factors. The EU-15 IEF (excluding Denmark) is 0.54 t CO_2/t of clinker produced. The table also suggests that 89 % 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

Member State	Method applied	Activity data	Emission factor	1990				2006			
				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	3653	0.53	1954
Belgium	T3	PS	PS	Clinker production	5292	0.53	2824	Clinker production	5752	0.54	3116
Denmark	CS/T2	PS	PS	Cement production	1620	0.54	882	Cement production	2842	0.49	1395
Finland	T2	PS	CS	Clinker production	1470	0.53	786	Clinker production	1147	0.50	571
France	C	AS	PS	Clinker production	20854	0.53	10948	Clinker production	17731	0.52	9165
Germany	CS	PS	CS	Clinker production	28577	0.53	15146	Clinker production	24921	0.53	13208
Greece	T3	PS	PS	Clinker production	10645	0.54	5778	Clinker production	12305	0.53	6461
Ireland	T2	PS	PS	Clinker production	1610	0.55	884	Clinker production	4400	0.53	2348
Italy	T2	NS	CS, PS	Clinker production	29786	0.54	16084	Clinker production	33210	0.54	17933
Luxembourg	T2	PS	CS PS	Clinker production	1048	0.53	557	Clinker production	826	0.52	431
Netherlands	CS	NS	PS	Clinker production	770	0.54	416	Clinker production	785	0.51	400
Portugal	T2	PS	D	Clinker production	6128	0.51	3107	Clinker production	7105	0.51	3602
Spain	T2	AS	CS	Clinker production	23212	0.54	12534	Clinker production	32212	0.54	17395
Sweden	T2	PS	PS	Clinker production	2348	0.54	1272	Clinker production	2660	0.55	1470
UK	T2	NS	CS	Clinker production	13199	0.55	7295	Clinker production	10802	0.55	5893
EU15				**EU15 w/o DK (99%)**	**148,632**	**0.54**	**79,664**	**EU15 w/o DK (98%)**	**157,510**	**0.53**	**83,946**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.4 summarizes the methodological information provided by EU-15 Member States in their national inventory reports for cement production. A number of Member States use data collected from plants under the EU Emission trading Scheme.

Table 4.4 2A1 Cement Production: Summary of methodological information provided by Member States

Member State	Methodology comment
Austria	Emissions were estimated using a country specific method similar to the IPCC Tier 2 methodology. AD (clinker production) as well as emission were taken from studies from the Austrian cement production industry covering the years 1988 to 2003. The determination of the emission data took place by inspection of every single plant, recording and evaluation of plant specific records and also plant specific measurements and analysis carried out by independent scientific institutes. AD for 2004 to 2006 were reported directly by the Association of the Austrian Cement Industry. For 2005 and 2006 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 2008].
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 2008]
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 . 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. From the year 2006 the CO2 emission compiled for the EU-ETS is used in the inventory . [NIR 2008]
Finland	The amount of clinker produced annually is used as AD. The data for years 1990- 2006 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 years 2005 and 2006 are 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 2008]
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 2 plants produce a special type of cement with a specific higher EF. [NIR2008]
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 2008]
Greece	Methodology based on AD and parameters for emission calcualtions collected from industry using the Tier 3 methodology. Detailed plant specific data is available for all years except 2004. Information reported by operators under the EU ETS is used for the years 2005 and 2006. [NIR2008]
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 and 2006. 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 process emission factors in 2006 ranged from 0.528 t CO2/ t clinker to 0.537 t CO2/ t clinker with a weighted average of 0.534 t CO2/t for all clinker production. [NIR 2008]
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 under EPER and the EU ETS [NIR2008].
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 2008]
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. Data for 2005 and 2006 was extrapolated using the trend of the previous zears.. 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 2008]
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. [NIR2008]
Sweden	Emissions have been estimated based on ETS data as well as direct information from the company based on clinker production. A cement kiln dust (CKD) correction factor is used. For CO2 estimates for 1990-2004, the cement company uses the GHG protocol made on initiative by the WRI for the WBCSD. Since 2005, data on clinker production has been acquired through the ETS. Emissions have been calculated using ETS activity data together with EFs from the GHG protocol by WRI. [NIR2008]
UK	The methodology used for estimating CO2 emissions from calcination is to use data provided by the British Cement Association (2007), which in turn is based on data generated by UK cement clinker producers for the purposes of reporting to the EU Emission Trading Scheme. The data are available for 2005 and 2006 only, and so the value for 2005 has been applied to earlier years as well. Previously, estimates had been based on the IPCC Tier 2 approach (IPCC, 2000), yielding an emission factor of 137.6 t C/kt clinker. The revised emission factors are about 10% higher than this figure and the reasons for this disparity are that the previous emission factor (i) slightly underestimated the CaO content of clinker produced; and (ii) failed to take account of CO2 emitted from dolomite (i.e. the method assumed a zero MgO content, which was not correct).

Table 4.5 summarizes the recommendations from the review of the initial reports 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 UNFCCC review of the initial report in relation to CO_2 emissions and responses in 2008 inventory submissions

Member State	Review findings and responses related to 2A1 Cement Production	
	Comment UNFCCC report of the review of the initial report	Status in 2007 submission
Austria	No recommendation for improvement of this source category in Initial Review Report.	No follow-up necessary
Belgium	The information provided in the NIR is not sufficient for expert review. Belgium is recommended to report the cement kiln dust factors and the amount of non-carbonate sources in a way consistent with the tier 2 method. As there is a lack of plant-specific data, the cement operators in Belgium recommended the use of 2002 plant-specific EFs to estimate CO2 emissions from 1990 to 2001, but the reason for this was not given in the NIR. Belgium is recommended to check the consistency of the selected EFs for 1990 to 2001 with all other years of the time series.	Not resolved
Denmark	The ERT concludes that the estimates based on cement production are adequate. To improve transparency, the ERT recommends that Denmark provide additional information on how the emissions are derived, including background data and assumptions, in the NIR.	2006 finding on the applicability of the methodology resolved. Transparency still needs to be addressed.
Finland	not addressed	No follow-up necessary
France	In the period 1990-2004, CO2 emissions from cement production decreased by 17.7 per cent due to a decrease in production. The EF was kept constant during the period (0.525 t CO2/t clinker). This emissions factor (EF) is higher than the IPCC default (0.51 t CO2/t clinker). France explained in the OMINEA report that clinker in France contains about 2 per cent of magnesium oxide (MgO), which increases the EF. The ERT recommends that France expand this explanation by providing reasons why France's clinker differs from the clinker as assumed in the Revised 1996 IPCC Guidelines.	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	The NIR reports high countryspecific calcium oxide (CaO) content in clinker of 64 to 67 per cent, which is higher than the IPCC default value of 65 per cent, and a subsequent EF of 0.53 t CO2/t cement over the entire time series, also cited to be used in the European Union (EU) emission trading scheme (ETS). The ERT recommends that Germany continue monitoring average values of the CaO content of clinker so that an estimate can be developed periodically, for example every five years, to reflect changes in the industry, rather than rely on the same factor throughout the entire time series.	CaO content of clinker is monitored under the EU ETS.
Greece	The ERT recommends that Greece includes an explanation of the AD shift 1994 to 1995 in the NIR of its future submissions.The ERT encourages Greece to further improve the transparency of its reporting by including an explanation in the NIR of how the calcium oxide (CaO) and magnesium oxide (MgO) contents are arrived at each year.	The AD shift in 1995 is due to one plant which shift ownership. The new owner used the full capacity of the existing plant.
Ireland	Emissions from cement production are estimated using information recently acquired from the four cement plants in connection with the EU ETS. From 2003, CO2 emissions have been verified by using this information. In its 2006 submission, Ireland has updated all estimates using data on process CO2 emissions disclosed by the cement plants for the years 1990-2004, coupled with AD for the years 2003-2004. The ERT recommends Ireland to review and clarify this methodology in its next inventory submission.	More detailed information on the methods and parameters used are provided in the NIR.
Italy	No recommendation for improvement of this source category in Initial Review Report.	No follow-up necessary
Luxembourg	Emissions have been estimated using the CORINAIR simple methodology, which corresponds to IPCC tier 1. As this is a key category, a tier 2 methodology should be used. During the in-country visit new calculations for 1990 and 2004 based on a tier 2 method were presented to the ERT. The revised estimation method should be transparently described in Luxembourg's next NIR.	2008 NIR not yet available
Netherlands	ERT recommends that the Party describe the measurements undertaken and the methodology applied to estimate emissions. The technology process should be described and the fuels used in the kiln or material added as combustible should be reported.	Detailed explanation of all issues raised by ERT in 2008 NIR.
Portugal	The ERT recommends the Party to develop a country-specific lime (CaO) content in clinker and to verify the information that all CKD is in fact recycled to the process in the plants.	Efforts are underway to develop a country specific emission factor. Industry experts confirmed that alls CKD is recycled in Portuguese plants.
Spain	To improve transparency, the ERT suggests that Spain report in the NIR the QA/QC activities developed for the sector. The ERT also suggests that Spain provide in the NIR a more detailed explanation of the trends. The ERT noted that it would be useful for Spain to use the ETS data in a systematic way.	Additional explanation in NIR provided. ETS data not used.
Sweden	Following the recommendation of the ERT, Sweden has agreed to collect or estimate data on the lime (CaO) content of clinker, and to provide this information in its future submissions.	Information included in 2008 NIR.
UK	A 25.2 per cent decrease in the emissions between 1990 and 1992 was linked to a significant downturn in construction activity. The ERT recommends the United Kingdom to include this explanation in its future NIRs.	Information included in 2008 NIR.

CO_2 emissions from 2A2 Lime Production account for 0.4 % of total GHG emissions in 2006.

Between 1990 and 2006, CO_2 emissions from this source increased by 5 % in the EU-15 (Table 4.6). Germany was responsible for 30 % of the emissions from this source. The decreases in Germany (-10%) but also in the UK (-42%) were offset by emissison increases in other EU-15 Member States between 1990 and 2006.

Table 4.6 2A2 Lime Production: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006	
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	396	579	586	3.2%	7	1%	189	48%
Belgium	2,097	2,018	2,139	11.8%	122	6%	42	2%
Denmark	116	63	69	0.4%	6	9%	-46	-40%
Finland	383	455	503	2.8%	48	10%	121	32%
France	2,545	2,330	2,489	13.8%	159	7%	-56	-2%
Germany	6,135	5,415	5,502	30.4%	87	2%	-633	-10%
Greece	367	372	409	2.3%	37	10%	42	11%
Ireland	214	183	180	1.0%	-3	-2%	-34	-16%
Italy	2,042	2,670	2,795	15.4%	125	5%	753	37%
Luxembourg	NO	NO	NO	-	-	-	-	-
Netherlands	NE	NE	NE	-	-	-	-	-
Portugal	178	458	478	2.6%	21	5%	301	169%
Spain	1,123	1,594	1,627	9.0%	33	2%	504	45%
Sweden	498	607	629	3.5%	22	4%	131	26%
United Kingdom	1,192	793	688	3.8%	-105	-13%	-503	-42%
EU-15	**17,285**	**17,539**	**18,096**	**100.0%**	**558**	**3%**	**811**	**5%**

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 2006. The table shows that most MS use lime production as activity data for calculating CO_2 emissions. The EU-15 IEF (excluding Belgium, Denmark and the UK) is 0.76 t CO_2/t of lime produced. The implied emission factors per tonne of lime produced vary between 0.66 for Portugal and 0.87 for Sweden. The table also suggests that 25% if the emissions are estimated using higher tier methodologies.

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

Member State	Method applied	Activity data	Emission factor	1990 Activity data Description	1990 Activity data (kt)	1990 Implied emission factor (t/t)	1990 CO_2 emissions (Gg)	2006 Activity data Description	2006 Activity data (kt)	2006 Implied emission factor (t/t)	2006 CO_2 emissions (Gg)
Austria	CS	PS	CS	Lime Production	513	0.77	396	Lime Production	781	0.75	586
Belgium	T3	PS	PS	Lime and dolomite production	2661	0.79	2097	Lime and dolomite production	2759	0.78	2139
Denmark	D	NS	D	Production of Lime and Bricks	156	0.74	116	Production of Lime and Bricks	92	0.75	69
Finland	T2	PS	CS	Lime Production	519	0.74	383	Lime Production	679	0.74	503
France	C	AS	PS	Lime Production	3319	0.77	2545	Lime Production	3309	0.75	2489
Germany	D	NS	D	Lime Production	7719	0.79	6135	Lime Production	6934	0.79	5502
Greece	T3	PS	PS	Lime Production	492	0.75	367	Lime Production	548	0.75	409
Ireland	T2	PS	PS	Lime Production	255	0.84	214	Lime Production	231	0.78	180
Italy	D	NS	CS,PS	Lime Production	2583	0.79	2042	Lime Production	3496	0.80	2795
Portugal	D	NS,PS	D	Lime Production	268	0.66	178	Lime Production	639	0.75	478
Spain	D	AS, PS	D, PS	Lime Production	1475	0.76	1123	Lime Production	2187	0.74	1627
Sweden	D	PS	D, CS	Lime Production	880	0.87	498	Lime Production	1138	0.85	629
UK	T2	NS	D	Limestone consumption	2708	0.44	1192	Limestone consumption	1565	0.44	688
EU15				**EU15 w/o BE, DK and UK (92%)**	**20,685**	**0.77**	**15,978**	**EU15 w/o DK and UK (96%)**	**22,701**	**0.76**	**17,339**

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, Greece, Ireland 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. Since 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 2008]
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 2008]
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 2008]
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. Since the year 2005 the AD was received from the Energy Market Authority which grants the emission permits to companies for the EU Emission Trading Scheme. 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. [NIR 2008]
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.[NIR2008 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. [NIR2008]
Greece	Lime and hydrated lime production were estimated taking into consideration both information collected during the formulation of the NAP for the period 2005 – 2007, and data provided by the NSSG However, plant specific information covers the period 2000 – 2003 and presents significant differences compared to NSSG data. In order to improve consistency, total production is estimated by applying the production trend and ratio between lime and hydrated lime production calculated according to NSSG data to the plant specific information collected. Lime production in 2004 is kept constant at 2004 levels due to lack of data. Plant specific data is available for 2005 and 2006 due to the EU ETS [NIR 2008]
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 CORINAIR default value for CO2 emissions from lime production (0.75 t CO2/t lime) was used consistently to estimate process emissions from this source using the Tier 1 method for all inventory years up to 2003.For later years data from the EU ETS have been used. They indicate implied EFs in the range 0.75 to 0.88 t CO2/t lime produced. [NIR 2008]
Italy	AD obtained from national statistics. EF have been estimated on the basis of detailed information supplied by plants in the framework of the European emission trading scheme and checked with the industrial association [NIR2008]
Luxembourg	NO
Netherlands	Lime production are not estimated since production was negligible in the early 1990s and has stopped later,
Portugal	Higher tier methodology considereing different types of lime and using default EF. Production data from national statistics until 2000, linear trend extrapolation for 2001-2006. AD for lime production in iron and steel industry only available for period 1991-1994, extrapolation based on energy consumption in steel industry for the years until 2001 when lime production in the iron and steel industry ceased. [NIR 2008]
Spain	Higher tier methodology considereing different types of lime and using EF obtained from national association [NIR2008]
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. [NIR2008]
UK	Estimation of lime production is based on limestone and dolomite consumption data from British Geological Survey. 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 2008]

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 UNFCCC review of the initial report in relation to CO_2 emissions and responses in 2008 inventory submissions

Member State	Review findings and responses related to 2A2 Lime Production	
	Comment UNFCCC report of the review of the initial report	Status in 2007 submission
Austria	not addressed	No follow-up necessary
Belgium	No recommendation for improvement of this source category in Initial Review Report.	No follow-up necessary
Denmark	The ERT recommends that Denmark report only CO2 emissions from lime production in this category. The ERT also recommends that Denmark report emissions from yellow bricks in category other (mineral products (2.A.7)) and provide relevant information in the CRF and NIR.	Emissions from lime and yellow brick production are reported separately in the 2008 NIR.
Finland	not addressed	No follow-up necessary
France	Reported emissions in this category do not include emissions by auto-producers (producers of lime for use on-site). During the in-country visit France explained that all lime produced in paper mills and the sugar industry is produced from CO2 generated by biomass combustion, and that the iron and steel industry does not produce lime on-site. The ERT recommends that France continue to investigate the external input of limestone for calcination in these and other industries.	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	No recommendation for improvement of this source category in Initial Review Report.	No follow-up necessary
Greece	Greece reports in its NIR that emissions from hydraulic lime production are not included in the estimate of CO2 emissions from lime production but are estimated to increase emissions by about 3 percent. The ERT recommends Greece to include CO2 emissions from hydraulic lime production in its future inventories. The ERT also recommends that Greece carry out a check of data quality for this category.	Emissions from the production of hydraulic lime have not been estimated, because the available data do not allow for a reliable estimation. Emissions for 2005 have been recalculated using EU ETS data. The difference between previous and recalculated estimate is 1.98%.
Ireland	The ERT encourages Ireland to enhance the transparency of this information in the NIR by including information on data sources, the assumptions made to estimate AD, and explanations of the trend. The ERT encourages Ireland to provide in the NIR a justification as to why captive lime production is not included in the lime production estimates.	Not yet addressed
Italy	No recommendation for improvement of this source category in Initial Review Report.	No follow-up necessary
Luxembourg	not addressed	No follow-up necessary
Netherlands	The Party should give more information about this subcategory for the years when lime production existed in order to improve both completeness and transparency. For the years when lime production did not occur, the notation key "not occurring" ("NO") should be used in the CRF tables instead of "NE".	Not yet addressed
Portugal	not addressed	No follow-up necessary
Spain	not addressed	No follow-up necessary
Sweden	The ERT recommends Sweden to follow the IPCC good practice guidance and also provide transparent information on the estimation of the CO2 removals.	Detailed explanations on methodologies and assumptions provided in 2008 NIR. All issues raised by ERT concerning transparency, methodologies and IEF addressed.
UK	not addressed	No follow-up necessary

CO_2 emissions from 2A3 Limestone and Dolomite Use account for 0.2 % of total GHG emissions in 2006. Between 1990 and 2006, CO_2 emissions from this source increased by 31 % in the EU-15 and by 5% from 2005 to 2006 (Table 4.10). Italy was responsible for 31 % and Spain for 30% of the emissions from this source. Emissions from this source category increased in all MS between 1990 and 2006 with the largest absolute growth in Spain.

Table 4.10 2A3 Limestone and Dolomite Use: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006	
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	222	291	296	3.6%	5	2%	74	33%
Belgium	421	490	493	5.9%	3	1%	72	17%
Denmark	18	61	74	0.9%	13	22%	56	307%
Finland	88	132	151	1.8%	19	15%	63	72%
France	IE	IE	IE	-	-	-	-	-
Germany	IE	IE	IE	-	-	-	-	-
Greece	286	303	315	3.8%	12	4%	30	10%
Ireland	0	4	3	0.0%	-2	-38%	3	2401%
Italy	2,375	2,548	2,529	30.5%	-20	-1%	154	6%
Luxembourg	IE	IE	IE	-	-	-	-	-
Netherlands	276	293	299	3.6%	6	2%	22	8%
Portugal	33	91	94	1.1%	3	3%	61	182%
Spain	1,220	2,293	2,473	29.8%	180	8%	1,253	103%
Sweden	109	137	141	1.7%	4	3%	32	29%
United Kingdom	1,285	1,282	1,435	17.3%	153	12%	149	12%
EU-15	**6,335**	**7,924**	**8,302**	**100.0%**	**378**	**5%**	**1,967**	**31%**

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).
Luxembourg reports emissions in the source category 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 2006. The table shows that almost all MS use limestone and dolomite consumption as activity data for calculating CO_2 emissions. The EU-15 IEF excluding Belgium and Denmark is 0.44 t CO_2/t of lime produced. The implied emission factors per tonne of lime produced vary between 0.42 for the Netherlands and 0.47 for Sweden. The very low value for Denmark (0.04) reflects different processes where limestone and dolomite are employed and not comparable to other countries; Activity data in Sweden is incomplete and the implied emission factor therefore not correct. 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

Member State	Method applied	Activity data	Emission factor	1990 Activity data		1990 Implied emission factor (t/t)	1990 CO_2 emissions (Gg)	2006 Activity data		2006 Implied emission factor (t/t)	2006 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	683	0.43	296
Belgium	T3	PS	C/CS	Limestone and Dolomite Use			421	Limestone and Dolomite Use			493
Denmark	T1/T2	NS	D	Limestone and Dolomite Use	506	0.04	18	Limestone and Dolomite Use	653	0.11	74
Finland	T1	PS	D	Limestone and Dolomite Use	206	0.43	88	Limestone and Dolomite Use	352	0.43	151
France				Limestone and Dolomite Use	IE	IE	IE	Limestone and Dolomite Use	IE	IE	IE
Germany	NA	NA	NA	Limestone and Dolomite Use	IE	IE	IE	Limestone and Dolomite Use	IE	IE	IE
Greece	T3	PS	PS	Limestone Consumption	649	0.44	286	Limestone Consumption	679	0.46	315
Ireland	T2	PS	PS	Limestone Consumption	0.2	0.44	0.1	Limestone Consumption	6	0.44	3
Italy	D	NS	D, CS,PS	Carbonates input to brick, tiles, ceramic production	5397	0.44	2375	Carbonates input to brick, tiles, ceramic production	5747	0.44	2529
Netherlands	CS	NS	D	Limestone and Dolomite Use	733	0.38	276	Limestone and Dolomite Use	857	0.35	299
Portugal	D	NS	D	Limestone consumption	74	0.45	33	Limestone consumption	205	0.46	94
Spain	D	PS, AS	D	Limestone and Dolomite Use	2758	0.44	1220	Limestone and Dolomite Use	5618	0.44	2473
Sweden	D	PS	D	Limestone and Dolomite Use	234	0.47	109	Limestone and Dolomite Use	307	0.46	141
UK	T2	NS,AS	D,CS	Limestone and Dolomite Use	3044	0.42	1285	Limestone and Dolomite Use	2753	0.52	1435
EU15				**EU15 w/o BE and DK (93%)**	**13,599**	**0.43**	**5,895**	**EU15 w/o BE and DK (93%)**	**17,206**	**0.45**	**7,735**

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, Greece, 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. Since 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, iron and steel and chemical industry. AD for limestone used for desulphurization were taken from a national report on desulphurization technologies in Austria. For 2005 and 2006 additional information due to emissions reported under the ETS was included. [NIR 2008]
Belgium	CO2 emissions in the "limestone and dolomite use" category cover the production of glass and ceramics. Emissions from limestone and dolomite use in the iron and steel industry are reported under 2C. Emissions are estimated using plant specific AD and EF, partially based on EU ETS data. CO2-emissions due to the use of limestone in pollution control are negligible and not estimated. [NIR 2008]
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 2008]
Finland	The consumption of limestone and dolomite has been used as AD when calculating emissions from lime stone and dolomite use. AD since 2005 is collected directly from individual companies and the EU ETS data. 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 2008]
France	Limestone consumption reported under the respective sectors. [NIR 2008]
Germany	Limestone consumption is reported in the sectors that use limestone and in 2A7 Other. [NIR 2008]
Greece	Estimate inludes limestone use in steel, aluminium and ceramics production. AD and EF from operators under EU ETS. [NIR 2008]
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 2008]
Italy	CaCO3 and limestone/dolomite use from plants under EU ETS, EF from bricks and ceramics industry and EU ETS. [NIR 2008]
Luxembourg	Limestone consumption reported under 2C. [NIR 2007]
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 2008]
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. Recent years extrapolated. [NIR 2008]
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 2008]
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 2008]
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 and the Iron & Steel Statistics Bureau, respectively and gypsum produced in FGD plant is available from the British Geological Survey. 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. [NIR 2008]

Table 4.13 summarizes the recommendations from UNFCCC review of the initial report in relation to

the category 2A3 Limestone and Dolimite Use. The overview shows that most findings were addressed and resolved.

Table 4.13 2A3 Limestone and Dolomite Use: Findings of the UNFCCC review of the initial report in relation to CO_2 emissions and responses in 2008 inventory submissions

Member State	Review findings and responses related to 2A3 Limestone and Dolomite Use	
	Comment UNFCCC report of the review of the initial report	**Status in 2007 submission**
Austria	not addressed	No follow-up necessary
Belgium	not addressed	No follow-up necessary
Denmark	No recommendation for improvement of this source category in Initial Review Report.	No follow-up necessary
Finland	The Party indicates in the NIR that some plants may exist and that emissions from some of these plants are not included in the national total. For the sake of completeness of reporting, the ERT recommends that Finland collect the AD and estimate the associated emissions for the next inventory submission.	Emissions included in 2008 inventory.
France	The completeness of the coverage of limestone calcination in the emission estimates should be further investigated by France. Notation keys are sometimes used incorrectly and explanations associated with the "IE" notation key are not provided.	Not yet addressed
Germany	No recommendation for improvement of this source category in Initial Review Report.	No follow-up necessary
Greece	not addressed	No follow-up necessary
Ireland	In order to improve the time-series consistency of the emission estimates and comparability with other Parties' inventories, the ERT recommends Ireland to reallocate bricks and ceramics production data to the subcategory other under mineral products (2.A.7). The ERT encourages Ireland to provide more information in the NIR on the methodology applied, the assumptions made for estimating AD and the data sources used.	Use of clays in bricks and ceramics production reallocated to 2A7. Information on AD and methodologies improved in NIR.
Italy	not addressed	No follow-up necessary
Luxembourg	not addressed	No follow-up necessary
Netherlands	not addressed	No follow-up necessary
Portugal	not addressed	No follow-up necessary
Spain	No recommendation for improvement of this source category in Initial Review Report.	No follow-up necessary
Sweden	The ERT recommends that Sweden follow the Revised 1996 IPCC Guidelines and account for all CO2 emissions from limestone use in category 2.A.3.	Not addressed
UK	not addressed	No follow-up necessary

Table 4.14 provides an overview about the emission sources reported in the category 2A7 Other Mineral Products in 2006 as well as total emissions in this category. The most frequent source reported under Other Mineral Products is glass production (12 Member States), followed by bricks and tiles production. Some Member States include emissions from brick and tile production and glass production under 2A3 Limestone and Dolimite Use. Germany is the largest contributor to this category with 29 %, followed by France (20 %).

Table 4.14 2A7 Other Mineral Products: Emission sources reported for the year 2006

Member State	2.A.7 Other Mineral Products	CO_2 emissions [Gg]	Share in EU-15 total
Austria	Sinter, bricks and tiles (decarbonizing)	442	10%
Belgium	Glass Production, Ceramics, other	0	0%
Denmark	Glass Production, Yellow bricks. Expanded clay	69	2%
Finland	Glass production	20.74	0.5%
France	Glass Production, Brick and Tile Production	907	20%
Germany	Glass Production, Ceramics, Brick and Tile Production	1318	29%
Greece	Glass Production	15	0.3%
Ireland	Bricks and Tiles (decarbonizing)	7	0.2%
Italy	Glass production	543	12%
Luxembourg	Glass production	62	1%
Netherlands	Glass production	293	6%
Portugal	Glass Production	176	4%
Spain	Glass production, Magnesia production, Porous Tiles, Potassium Carbonate, Ferrum Carbonate, Coal (reduction agent in glass industry), Non-porous Tiles, Barium Carbonate, Lithium Carbonate	479	11%
Sweden	Light expanded clay aggregate, Glass and mineral wool production	6	0.1%
UK	Fletton Brick Production	200	4%
EU-15 Total		**4,537**	**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 2005 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 2005 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2005		Main explanations
	Gg	Percent	Gg	Percent	
Austria	0,0	0,0	0,0	0,0	
Belgium	7,5	0,1	-9,6	-0,2	
Denmark	1,0	0,1	0,0	0,0	
Finland	-0,8	-0,1	7,1	0,6	
France	147,2	1,0	-313,0	-2,4	Révision méthodologique sur toute la présiode
Germany	0,0	0,0	259,5	1,3	Correction of one glass specific EF; new disaggregation: ceramics for non-GHG and Bricks for CO_2
Greece	0,0	0,0	-87,7	-1,2	Update of AD
Ireland	-2,3	-0,2	-2,1	-0,1	
Italy	0,0	0,0	14,6	0,1	Update of AD
Luxembourg	20,0	3,4	-3,0	-0,6	
Netherlands	-33,7	-3,4	30,1	2,6	Revised emission factor for glass production
Portugal	0,0	0,0	-40,8	-0,9	Update of timeseries
Spain	0,0	0,0	1,9	0,0	
Sweden	-0,1	0,0	0,4	0,0	
UK	635,9	6,7	592,4	7,6	Revision to emission factor for cement production based on data from industry; Revision to activity data for lime production
EU-15	**774,7**	**0,7**	**449,8**	**0,4**	

4.2.2 Chemical industry (CRF Source Category 2B) (EU-15)

Chemical industry includes the following key categories: CO_2 from 2B1 Ammonia Production, N_2O from 2B2 Nitric Acid Production and from 2B3 Adipic Acid Production and CO_2 and N_2O from 2B5 Other Chemical Industry.

Source category 2B1 Ammonia Production covers CO_2 emissions that occur during the production of ammonia, a chemical used as a feedstock for the production of several chemicals. In most instances, anhydrous ammonia is produced by catalytic steam reforming of natural gas (mostly CH_4) or other fossil fuels. CO_2 at plants using this process is released primarily during regeneration of the CO_2 scrubbing solution, with additional but relatively minor emissions resulting from condensate stripping. Source category 2B2 Nitric Acid Production accounts for N_2O emitted as a by-product of the high temperature catalytic oxidation of ammonia (NH_3) in the production of nitric acid. Adipic Acid Production (2B3) also emits N_2O as a by-product when a cyclohexanone/cyclohexanol mixture is oxidized by nitric acid.

Table 4.16 summarises information on Member States' emissions from chemical industry in 1990 and 2006 for total GHG, CO_2 and N_2O. Between 1990 and 2006, CO_2 emission from 2B Chemical Industry increased by 13 %. The absolute increase was largest in Germany, Portugal and Belgium, the absolute reductions were largest in France and Italy. Between 1990 and 2006, N_2O emission from 2B Chemical Industry decreased by 64 %. The absolute decreases were largest in UK and France, emissions increased only in 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 2006 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO_2 emissions in 2006 (Gg)	N_2O emissions in 1990 (Gg CO2 equivalents)	N_2O emissions in 2006 (Gg CO2 equivalents)
Austria	1,512	899	585	599	912	280
Belgium	4,579	5,210	645	2,644	3,934	2,566
Denmark	1,044	2	1	2	1,043	NA,NO
Finland	1,790	1,594	130	149	1,656	1,438
France	27,678	7,306	3,252	1,337	24,423	5,970
Germany	35,599	26,849	11,823	15,298	23,776	11,550
Greece	713	634	IE,NA,NE,NO	IE,NA,NE,NO	713	634
Ireland	2,025	NO	989	NO	1,035	NO
Italy	8,914	3,961	2,186	1,308	6,676	2,647
Luxembourg	NO	NO	NO	NO	NO	NO
Netherlands	11,052	10,236	3,702	3,718	7,096	6,259
Portugal	1,209	2,665	634	2,034	567	620
Spain	3,757	2,306	832	697	2,884	1,555
Sweden	901	515	69	48	832	466
United Kingdom	27,662	5,831	2,885	3,430	24,641	2,364
EU-15	**128,436**	**68,010**	**27,732**	**31,264**	**100,189**	**36,348**

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 2005 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 2005 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2005		Main explanations
	Gg	Percent	Gg	Percent	
Austria	0,0	0,0	0,0	0,0	
Belgium	-273,3	-29,8	780,9	34,8	In the 2007 submission the emissions reported under 2B5 were temporary figures in the Flemish region.
Denmark	0,0	0,0	0,0	0,0	
Finland	0,0	0,0	0,1	0,1	
France	-285,5	-8,1	-288,0	-12,1	Prise en compte du cas spécifique d'un site de production consommant directement de l'hydrogène comme matière première sans passer par le gaz naturel
Germany	0,0	0,0	-28,6	-0,2	
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	-280,8	-8,9	-277,0	-8,5	Emission factor for energy recovery from waste solvents revised based on data from industry
EU-15	**-839,6**	**-2,9**	**187,3**	**0,6**	

Table 4.18 provides information on the contribution of Member States to EC recalculations in N_2O from 2B Chemical Industry for 1990 and 2005 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 2005 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2005		Main explanations
	Gg	Percent	Gg	Percent	
Austria	0,0	0,0	0,0	0,0	
Belgium	0,0	0,0	0,2	0,0	
Denmark	0,0	0,0	0,0	0,0	
Finland	0,0	0,0	56,6	3,6	Correction made in one nitric acid plant.
France	280,4	1,2	483,5	7,7	Mise à jour de données pour quelques sites basée sur les déclarations GEREP
Germany	0,0	0,0	-297,1	-2,0	In further researches it was found out, that because of reduction meseaures there are since 1992 no emissions of N2O.
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	-473,6	-6,3	0,0	0,0	Reported constant N2O emissions have been replaced by a revised time series, based on: a production-index series over the period 1990-2004 received from the company
Portugal	0,0	0,0	0,0	0,0	
Spain	0,0	0,0	297,8	19,1	The amount of nitric acid produced has been revised following the new available information at a production plant
Sweden	0,0	0,0	0,0	0,0	
UK	0,0	0,0	0,0	0,0	
EU-15	**-193,2**	**-0,2**	**541,1**	**1,2**	

CO_2 emissions from 2B1 Ammonia Production account for 0.4 % of total EU-15 GHG emissions in 2006. Between 1990 and 2006, CO_2 emissions from this source decreased by 6 % (Table 4.19). Germany, the Netherlands and Portugal are responsible for 63% of these emissions in the EU-15. France, Ireland and Italy had large reductions in absolute terms between 1990 and 2006. The reasons for this were a change to low emitting technology in France and production decreases in the other two countries. 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 1990	2005	2006	Share in EU15 emissions in 2006	Change 2005-2006 (Gg CO_2 equivalents)	(%)	Change 1990-2006 (Gg CO_2 equivalents)	(%)
Austria	517	503	542	3.4%	39	8%	25	5%
Belgium	420	1,330	1,290	8.0%	-40	-3%	870	207%
Denmark	NO	NO	NO	-	-	-	-	-
Finland	44	NO	NO	-	-	-	-44	-100%
France	3,066	2,068	1,312	8.2%	-756	-37%	-1,754	-57%
Germany	4,596	5,253	5,138	32.0%	-116	-2%	541	12%
Greece	IE	IE	IE	-	-	-	-	-
Ireland	989	NO	NO	-	-	-	-989	-100%
Italy	1,710	705	657	4.1%	-49	-7%	-1,053	-62%
Luxembourg	NO	NO	NO	-	-	-	-	-
Netherlands	3,096	3,105	3,071	19.1%	-34	-1%	-25	-1%
Portugal	569	1,809	1,903	11.9%	94	5%	1,334	234%
Spain	709	612	582	3.6%	-31	-5%	-127	-18%
Sweden	NO	NO	NO	-	-	-	-	-
United Kingdom	1,322	1,120	1,560	9.7%	441	39%	239	18%
EU-15	**17,038**	**16,507**	**16,055**	**100.0%**	**-453**	**-3%**	**-983**	**-6%**

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 2006. The table shows that most MS report Ammonia Production as activity data. The implied emission factors per tonne of ammonia produced vary for 2006 between 1.08 for Austria and 3.56 for Ireland. The EU-15 IEF (excluding Greece, Netherlands, Portugal and the UK) is 1.46 t CO_2/t of ammonia produced. The increase of the IEF from 1990 to 2006 is mainly due to an increase of the IEF in Belgium. The table also suggests about 60 % of EU-15 emissions are estimated with higher Tier methods. Germany as the highest emitter in this source category is using a default EF based on a recommendation by the ERT; the German energy balance does not differentiate between energy and non-energy use of natural gas in ammonia production.

Table 4.20 2B1 Ammonia Production: Information on methods applied, activity data, emission factors for CO_2 emissions

Member State	Method applied	Activity data	Emission factor	1990 Activity data Description	1990 Activity data (kt)	1990 Implied emission factor (t/t)	1990 CO_2 emissions (Gg)	2006 Activity data Description	2006 Activity data (kt)	2006 Implied emission factor (t/t)	2006 CO_2 emissions (Gg)
Austria	CS	NS,PS	CS	Ammonia Production	461	1.12	517	Ammonia Production	502.29	1.08	541.76
Belgium	T3	PS	D/PS	Ammonia Production	360	1.17	420	Ammonia Production	362	3.56	1290
Finland	T1	PS	D	Ammonia Production	28	1.55	44	Ammonia Production	NO	NO	NO
France	C	AS	PS	Ammonia Production	1928	1.59	3066	Ammonia Production	761	1.72	1312
Germany	D	NS	D	Ammonia Production	2532	1.82	4596	Ammonia Production	2831	1.82	5138
Greece				Ammonia Production	313	IE	IE	Ammonia Production	201	IE	IE
Ireland	T1	NS	CS	Ammonia Production	430	2.30	989	Ammonia Production	NO	NO	NO
Italy	D	NS,PS	C, PS	Ammonia Production	1455	1.18	1710	Ammonia Production	559	1.17	657
Netherlands	T1b	NS	CS	Ammonia Production	C	C	3096	Ammonia Production	C	C	3071
Portugal	D,T2	NS,PS	CS,PS	Ammonia Production	C	C	569	Ammonia Production	C	C	1903
Spain	D	PS	PS	Ammonia Production	573	1.24	709	Ammonia Production	488	1.19	582
UK	T2,T3	PS	CS	Natural gas consumption PJ net	45	29.59	1322	Natural gas consumption PJ net	38	40.97	1560
EU15				**EU15 w/o GR, NL, PT and UK (71%)**	**7723**	**1.39**	**10730**	**EU15 w/o GR, NL, PT and UK (59%)**	**5466**	**1.46**	**7960**

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. [NIR2008]
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.[NIR2008]
Denmark	Not occuring
Finland	The annual ammonia production figures have been obtained from the production plant. The CO2 emissions have been calculated with the mean value of two IPCC default emission factors (1.55 tonne CO2/tonne ammonia produced). [NIR 2008]
France	Emission data obtained directly from plants, CS EF calculated on this basis. [NIR2008]
Germany	Emissions are estimated from ammonia production data from national statistics and the IPCC default EF. [NIR 2008]
Greece	Emissions are included in the energy sector to avoid double-counting [NIR 2008]
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 2002-2006 the average emission factors result from PS data from EPER [NIR 2008]
Luxembourg	Not occuring
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 2008]
Portugal	Emissions are estimated using feedstock (Vaccum Residual Fuel Oil) consumption data from national statistics and an EF based on the VRF carbon content. [NIR2008]
Spain	Production data and country-specific EF from some plants and IPCC default factors and production statistics for the other plants.[NIR 2008].
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 2008]
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. [NIR2008]

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 report of the review of the initial report	**Status in 2008 submission**
Austria	Austria estimates CO2 and CH4 emissions from ammonia production. During the in-country review, Austria indicated that it assumes that all carbon in the natural gas feedstock is fully converted to CO2. Given the assumption of full conversion to CO2, the ERT concluded that CH4 emissions from ammonia production are already accounted for in the CO2 estimate. Furthermore, the ERT recommended that Austria investigate any possible double counting of CO2 emissions between ammonia and urea production.	The double counting was corrected in this submission and CO2 emissions have been recalculated for the whole time-series.
Belgium	Belgium is recommended to include information and emissions data (by region) on the allocation of process and energy emissions in its next inventory submission. The Party is encouraged to allocate process emissions to the industrial processes sector and energy emissions to the energy sector.	Methodological description was revised.
Finland	No recommendation for improvement of this source category in Initial Review Report.	No follow-up necessary
France	No recommendation for improvement of this source category in Initial Review Report.	Methodological description was added.
Germany	The ERT recognizes that Germany is making efforts to have plant-specific data available in future. The ERT recommends that this approach be followed.	Germany intends to collect plant specific data in the future.
Greece	not addressed	No follow-up necessary
Ireland	not addressed	No follow-up necessary
Italy	The ERT recommends that Italy also verify emission data published in the EPER registry based on the amounts of natural gas used as production input in ammonia plants.	Emissions from ammonia production have been checked with the relevant process operators and with data reported to the national EPER registry.
Luxembourg	not adressed	No follow-up necessary
Netherlands	not addressed	No follow-up necessary
Portugal	The second-largest CO2 source belongs to a single ammonia production plant and has an EF that is not comparable with those of other Parties because an uncommon feedstock, namely vacuum residual fuel oil (VRF), is used to produce hydrogen for the process. VRF has higher carbon content (86 per cent) than ordinary natural gas. To improve transparency, the ERT recommends that Portugal provide this clarification in its future NIRs.	Methodological description was revised.
Spain	not adressed	No follow-up necessary
Sweden	not adressed	No follow-up necessary
UK	not adressed	No follow-up necessary

Abbreviations explained in the Chapter 'Units and abbreviations'.

CO_2 emissions from 2B5 Other account for 0.4 % of total EU-15 GHG emissions in 2006. Between 1990 and 2006, CO_2 emissions from this source increased by 52 % (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 2006	Change 2005-2006		Change 1990-2006	
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	31	18	27	0.2%	9	46%	-4	-13%
Belgium	224	1,692	1,354	9.0%	-338	-20%	1,130	504%
Denmark	1	3	2	0.0%	-1	-28%	1	172%
Finland	86	125	149	1.0%	24	19%	63	73%
France	27	29	25	0.2%	-4	-15%	-3	-9%
Germany	6,783	9,599	10,143	67.6%	544	6%	3,360	50%
Greece	NA,NE,NO	NA,NE,NO	NA,NE,NO	-	-	-	-	-
Ireland	NO	NO	NO	-	-	-	0	-100%
Italy	475	610	650	4.3%	40	6%	175	37%
Luxembourg	NO	NO	NO	-	-	-	-	-
Netherlands	606	640	646	4.0%	6	1%	41	7%
Portugal	65	127	131	0.8%	5	4%	66	101%
Spain	NE	NE	NE	-	-	-	-	-
Sweden	NA	NA	NA	-	-	-	-	-
United Kingdom	1,563	1,856	1,869	12.5%	13	1%	306	20%
EU-15	**9,861**	**14,699**	**14,996**	**100.0%**	**297**	**2%**	**5,135**	**52%**

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 0.7 % of total EU-15 GHG emissions in 2006. Between 1990 and 2006, N_2O emissions from this source decreased by 24% (Table 4.24). Germany accounts for 30% of EU-15 emissions from this source, followed by the Netherlands (20%) and France (13%). Nearly all Member States had reductions from this source between 1990 and 2006. France had the greatest reductions in absolute terms, due to a decrease in production and a decrease of the IEF. Production decreased or stopped in Ireland, Spain and the UK as well. The largest growth was in Germany; despite this emissions decreased in Germany by 23% from 2005 to 2006 due to a production decrease after a strong production increase in 2005.

Table 4.24 2B2 Nitric acid production: Member States' contributions to N_2O emissions

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006	
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	912	274	280	1.0%	6	2%	-632	-69%
Belgium	3,562	3,066	2,082	7.5%	-984	-32%	-1,480	-42%
Denmark	1,043	NO	NO	-	-	-	-1,043	-100%
Finland	1,656	1,625	1,438	5.2%	-187	-12%	-218	-13%
France	6,570	4,267	3,676	13.2%	-591	-14%	-2,894	-44%
Germany	4,673	11,061	8,479	30.5%	-2,583	-23%	3,805	81%
Greece	713	634	634	2.3%	0	0%	-79	-11%
Ireland	1,035	NO	NO	-	-	-	-1,035	-100%
Italy	2,086	1,688	1,225	4.4%	-462	-27%	-861	-41%
Luxembourg	NO	NO	NO	-	-	-	-	-
Netherlands	6,330	5,659	5,597	20.1%	-62	-1%	-733	-12%
Portugal	567	612	619	2.2%	7	1%	53	9%
Spain	2,884	1,860	1,555	5.6%	-305	-16%	-1,329	-46%
Sweden	814	440	457	1.6%	17	4%	-357	-44%
United Kingdom	3,904	2,020	1,759	6.3%	-261	-13%	-2,145	-55%
EU-15	**36,749**	**33,206**	**27,802**	**100.0%**	**-5,404**	**-16%**	**-8,947**	**-24%**

Table 4.25 shows information on methods applied, activity data, emission factors for N_2O emissions from 2B2 Nitric Acid Production for 1990 to 2006. The table shows that 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 2006 between 0.0016 for Austria and 0.0135 for Belgium. The EU-15 IEF (excluding Netherlands and Portugal) is 0.0077 t N_2O/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 the closure of older plants in some MS. The table also

suggests that about 45 % of EU-15 emissions are estimated with higher tier methods for 2006. Germany as the country with the highest emissions from this source category estimates that the EF applied has an uncertainty of 50% as it does not take plant technology and abatement measures into account; Germany has initiated the necessary work to move to tier 3 in the future.

Table 4.25 2B2 Nitric Acid Production: Information on methods applied, activity data, emission factors for N_2O emissions

				1990				2006			
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)		
Austria	CS	PS	PS	Nitric Acid Production	530	0.0056	2.9	Nitric Acid Production	580	0.0016	0.9
Belgium	T3	PS	PS	Nitric Acid Production	1436	0.0080	11.5	Nitric Acid Production	1873	0.0036	6.7
Denmark	NO	NO	NO	Nitric Acid Production	450	0.0075	3.4	Nitric Acid Production	NO	NO	NO
Finland	T2	PS	PS	Nitric acid production medium pressure plants	549	0.0097	5.3	Nitric acid production medium pressure plants	599	0.0077	4.6
France	C	AS	PS	Nitric Acid Production	3200	0.0066	21.2	Nitric Acid Production	2367	0.0050	11.9
Germany	CS	NS	CS	Nitric Acid Production	2741	0.0055	15.1	Nitric Acid Production	4973	0.0055	27.4
Greece	D	PS	D	Nitric Acid Production	511	0.0045	2.3	Nitric Acid Production	454	0.0045	2.0
Ireland	T1	PS	PS	Nitric Acid Production	339	0.0099	3.3	Nitric Acid Production	NO	NO	NO
Italy	D	PS	D, PS	Nitric Acid Production	1037	0.0065	6.7	Nitric Acid Production	526	0.0075	4.0
Netherlands	T2	NS	PS	Nitric Acid Production	C	C	20.4	Nitric Acid Production	C	C	18.1
Portugal	D	NS,PS	C,OTH	Nitric Acid Production	C	C	1.8	Nitric Acid Production	C	C	2.0
Spain	D	PS, AS	CS	Nitric Acid Production	1329	0.0070	9.3	Nitric Acid Production	717	0.0070	5.0
Sweden	T2	PS	PS	Nitric Acid Production	374	0.0070	2.6	Nitric Acid Production	272	0.0054	1.5
UK	T2,T3	PS	CS	Nitric Acid Production	2408	0.0052	12.6	Nitric Acid Production	1468	0.0039	5.7
EU15				**EU15 w/o NL and PT (81%)**	**14,904**	**0.0065**	**96**	**EU15 w/o NL and PT (78%)**	**13,829**	**0.0050**	**70**

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 2008]
Belgium	Emissions are estimated in Flanders using an emission factor of 8 kg N2O/ton HNO3 from CITEPA. 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 43 kg/t in 2006. 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. [NIR 2008]
Denmark	The N2O emission from the production of nitric acid/fertiliser is based on measurement for 2002. For the previous years, the N2O emission has been estimated from annual production statistics from the company and an emission factor of 7.5 kg N2O/tonne nitric acid, based on the 2002 emission measured. The production of nitric acid ceased in the middle of 2004. [NIR 2008]
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 2008]
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 2008]
Greece	Estimates are based on activity data from industry and average IPCC default EF; 2005 data was held constant for 2006. No N2O abatement technologies are used [NIR 2008]
Ireland	Nitric acid production was closed in 2002
Italy	Emissions are calculated based on data from EPER, national statistics and plant-specific EF. IPCC default EF for low and medium pressure plants that are now closed [NIR 2008].
Luxembourg	Not occuring
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 2008]
Portugal	Estimates are calculated from nitric acid production data (national statistics and extrapolations for recent years) and PS EF. Plant-specific EFs are monitored at one of the three plants. No N2O abatement technology is used in Portugal. [NIR 2008]
Spain	Production data and EF obtained from national business association. AD disaggregated per plant and type of manufacturing process. CS EF form industrial association is used compiled from plant-specific data. [NIR 2008]
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 2008]
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 2008]

Table 4.27 summarizes the recommendations from the UNFCCC review of the initial report 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 report of the review of the initial report	Status in 2007 submission
Austria	No recommendation for improvement of this source category in Initial Review Report.	No follow-up necessary
Belgium	Belgium is recommended to report in the NIR the nitric acid plant technology to allow comparison with IPCC good practice guidance EFs. The ERT also recommends that Belgium document variations in AD, the N2O EF and production data across the regions; discuss the assumption that selective catalytic reactors reduce N2O emissions; and document the N2O destruction factor of the catalyst used in the Flemish region.	Only partially addressed in 2008 NIR
Denmark	No recommendation for improvement of this source category in Initial Review Report.	No follow-up necessary
Finland	All nitric acid plants in Finland are medium pressure plants and the EFs used are high compared to the IPCC default range (6.0–7.5 kg/t). In order to enhance transparency, the ERT recommends that Finland explore the reasons for the high EFs and document its findings in the next submission.	Only partially addressed in 2008 NIR
France	The ERT recommends that France include a more detailed explanation of the decrease in emissions in the NIR.	Not yet addressed
Germany	The ERT recommends that Germany pursue the use of plant-specific EFs, which the ERT believes will improve the inventory.	Germany initiated the process of moving to tier 3 (plant specific data)
Greece	The ERT therefore recommends that Greece in its future submissions follow the IPCC good practice guidance and continue to collect plant-specific emissions data. The ERT also recommends that this development be appropriately documented in the NIR. In particular, it recommends that Greece in its future submissions follow the IPCC good practice guidance by implementing tier 2 quality control checks when undertaking recalculations.	Provided that nitric acid production is a key category, plant-specific and destruction data availability will be investigated according to the IPCC good practice guidance. These data will possibly clarify the existence of the abrupt shift in the activity data trend.
Ireland	not addressed	No follow-up necessary
Italy	not addressed	No follow-up necessary
Luxembourg	not adressed	No follow-up necessary
Netherlands	As the AD are confidential, the ERT suggests that the Party explain qualitatively the increase of emissions during 1993 and 2004 and improve the transparency of the NIR by reporting in greater detail the plant-specific methodology used to estimate these emissions. The Party has carried out recalculations since its previous inventory submissions but this information is not reported in the NIR or in the protocol. The ERT recommends the Party to report in its next submission that this error has been corrected and recalculations carried out, and to report on the plants which stopped production in 1999 and 2000, which could be responsible for the fluctuations in emissions.	Not yet addressed
Portugal	No recommendation for improvement of this source category in Initial Review Report.	No follow-up necessary
Spain	Spain is encouraged to collect information from the plants to verify the average EF for this key category.	EF from association was confirmed by main manufacturer.
Sweden	not addressed	No follow-up necessary
UK	The ERT recommends the Party tries to reduce the uncertainty in this category by reviewing the assumptions used and investigating if other industrial data could be used as the basis for more accurate estimates of emissions.	Detailed explanation of methodologies and assumptions in NIR

N_2O emissions from 2B3 Adipic Acid Production account for 0.2 % of total EU-15 GHG emissions in 2006. Between 1990 and 2006, N_2O emissions from this source decreased by 89 % (Table 4.28). Only France, Germany, Italy and the UK produce adipic acid and all four countries were able to decrease emissions from this source category significantly due to the retrofitting of installations with abatement technologies. Italy was the last country were abatement measures were only installed since the last inventory leading to a 77% reduction of emissions between 2005 and 2006.

Table 4.28 2B3 Adipic Acid Production: Member States' contributions to N_2O emissions

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006	
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	NO	NO	NO	-	-	-	-	-
Belgium	0	0	0	-	-	-	-	-
Denmark	NO	NO	NO	-	-	-	-	-
Finland	NO	NO	NO	-	-	-	-	-
France	14,806	1,520	1,538	23.4%	18	1%	-13,268	-90%
Germany	18,805	3,276	3,004	45.7%	-272	-8%	-15,801	-84%
Greece	NO	NO	NO	-	-	-	-	-
Ireland	NO	NO	NO	-	-	-	-	-
Italy	4,579	6,073	1,421	21.6%	-4,652	-77%	-3,158	-69%
Luxembourg	NO	NO	NO	-	-	-	-	-
Netherlands	NO	NO	NO	-	-	-	-	-
Portugal	NO	NO	NO	-	-	-	-	-
Spain	NA	NA	NA	-	-	-	-	-
Sweden	NO	NO	NO	-	-	-	-	-
United Kingdom	20,737	776	605	9.2%	-171	-22%	-20,132	-97%
EU-15	**58,927**	**11,645**	**6,568**	**100.0%**	**-5,077**	**-44%**	**-52,359**	**-89%**

Table 4.29 shows information on methods applied, activity data, emission factors for N_2O emissions from 2B3 Adipic Acid Production for 1990 to 2006. The table shows that in 2006 adipic acid was produced in four MS only. All four use adipic acid production as activity data but the information is confidential in France, Germany and the UK. The implied emission factors per tonne of adipic acid produced is only provided by Italy with 0.3 t/t for 1990 and 0.05 t/t for 2005. 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

				1990				2006			
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	5.0
Germany	CS	0	D, PS	Adipic acid production	C	C	60.7	Adipic acid production	C	C	9.7
Italy	D	PS	PS	Adipic acid production	49	0.30	14.8	Adipic acid production	84	0.05	4.6
UK	T2,T3	PS	CS	Adipic acid production	C	C	66.9	Adipic acid production	C	C	2.0
EU15				**EU15**			**190**	**EU15**			**21**

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

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 2008]
Germany	Estimates are based on detailed plant-specific data since mid-90ies; before that emissions are calculated using nitric acid production and the IPCC default value [NIR 2008]
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. [NIR 2008 and additional explanation]
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 2008]

Table 4.31 summarizes the recommendations from the UNFCCC review of the initial report in relation to the category 2B3 Adipic Acid Production. The ERTs specifically noted in two cased that the underlying confidential data was checked and the emission calculations approved. One small issue was raised in Germany and addressed in the 2008 inventory submission.

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 report of the review of the initial report	**Status in 2007 submission**
France	The ERT was given access to the underlying confidential data, which satisfied the ERT that this trend has been estimated in the appropriate way.	No follow-up necessary
Germany	The NIR states that production data for adipic acid are confidential. However, AD in the CRF tables are reported as NE instead of confidential. The ERT recommends that Germany use the appropriate notation key for the AD.	Correct notation keys used in 2008
Italy	No recommendation for improvement of this source category in Initial Review Report.	No follow-up necessary
UK	The ERT was given access to the underlying confidential data, which satisfied the ERT that this trend has been estimated in the appropriate way.	No follow-up necessary

N_2O emissions from 2B5 Other account for 0.05 % of total EU-15 GHG emissions in 2006. Between 1990 and 2006, N_2O emissions from this source decreased by 56 % (Table 4.32). Belgium, the Netherlands and France are responsible for 96 % of these emissions in the EU-15. Emission decreases in France had the most influence on the reductions in the EU-15.

Table 4.32 2B5 Other: Member States' contributions to N_2O emissions

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006	
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Belgium	372	344	484	24.5%	140	41%	112	30%
Denmark	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Finland	NO	NO	NO	-	-	-	-	-
France	3,047	940	755	38.2%	-185	-20%	-2,292	-75%
Germany	298	68	68	3.4%	0	0%	-231	-77%
Greece	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Ireland	NO	NO	NO	-	-	-	-	-
Italy	11	NA,NO	NA,NO	-	-	-	-11	-100%
Luxembourg	NO	NO	NO	-	-	-	-	-
Netherlands	766	705	662	33.5%	-43	-6%	-104	-14%
Portugal	0	0	0	0.0%	0	4%	0	126%
Spain	NE	NE	NE	-	-	-	-	-
Sweden	18	9	9	0.5%	0	0%	-9	-49%
United Kingdom	NO	NO	NO	-	-	-	-	-
EU-15	**4,513**	**2,066**	**1,979**	**100.0%**	**-88**	**-4%**	**-2,535**	**-56%**

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 2006. The largest contributor to emissions is Germany with 61 %. CO_2 Emissions in Germany are dominated by the production of carbon black and methanol as well as catalytic burning and conversion loss. Country specific emission factors are based on a study from 2006 and activity data on national statistics. In the UK CO_2 emissions are due to carbon from non energy use of products. In Belgium non energy use of fuels in the chemical industry, flaring as well as the production of ethylene oxide, acrylic acid from propene, cyclohexanone from cyclo-hexane and production of paraxylene/meta-xylene are reported in this source category.

Table 4.33 2B5 Other: Overview of sources reported under this source category for 2006

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	27.0	0.8	NA,NO	44.0	0.3%
Belgium	Caprolactam Production, Other chemical production	1,353.9	0.0	1.6	1,838.4	10.6%
Denmark	Catalysts/Fertilizers, Pesticides and Sulphuric acid	2.2	NA,NO	NA,NO	2.2	0.0%
Finland	Ethylene, Hydrogen, chemicals production	149.2	0.3	NO	155.8	0.9%
France	Glyoxylic acid production, Anhydrid Phtalic Production, Other chemical production	24.5	0.0	2.4	779.9	4.5%
Germany	Carbon black, Methanol, Caprolactam, N2O for Medical Using, Catalytic Burning, Conversion loss, N-Dodecandiacid	10,143.2	0.0	0.2	10,211.4	58.8%
Greece	Organic chemicals production	NA,NE,NO	0.0	NA,NO	0.7	0.0%
Ireland		NO	NO	NO	-	-
Italy	Carbon black, Ethylene, Titanium Dioxide Production, Propylene	649.8	0.3	NA,NO	656.6	3.8%
Luxembourg		NO	NO	NO	-	-
Netherlands	Carbon black, Ethylene, Styrene, Methanol, Graphite, Caprolactam, Other chemical industry, Carbon electrodes, Ethene oxide production	646.3	11.6	2.1	1,553.4	9.0%
Portugal	Carbon black, Ethylene, Ammonium sulphate, Monomer and polymer production, Production of explosives	131.1	0.6	0.0	142.9	0.8%
Spain	Carbon black, Ethylene, Styrene	NE	2.4	NE	49.8	0.3%
Sweden	Pharmaceutical industry, Other inorganic chemical production, Other organic chemical production, Base chemicals for plastic industry	NA	0.0	0.0	9.9	0.1%
UK	Ethylene, Chemical Industry (All), Carbon from NEU products	1,869.2	1.8	NO	1,907.1	11.0%
EU-15 Total		**14,996**	**18**	**6**	**17,352**	**100.0%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

4.2.3 Metal production (CRF Source Category 2C) (EU-15)

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 2006, CO_2 emission from 2C Metal Production decreased by 8 %. The relative decrease was largest in Luxembourg, the relative growth was largest in Austria. 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 2006 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO2 emissions in 2006 (Gg)	PFC emissions in 1990 (Gg CO2 equivalents)	PFC emissions in 2006 (Gg CO2 equivalents)	SF_6 emissions in 1990 (Gg CO2 equivalents)	SF_6 emissions in 2006 (Gg CO2 equivalents)
Austria	5,029	5,106	3,725	5,106	1,050	NO	253	NO
Belgium	1,946	1,676	1,946	1,620	NO	NO	-	-
Denmark	60	0	28	NA,NO	NO	NO	31	NO
Finland	1,867	2,473	1,862	2,464	NO	NO	NO	C,NO
France	7,527	4,708	3,685	3,805	3,032	586	809	315
Germany	52,449	48,362	49,767	45,568	2,489	188	189	2,604
Greece	740	601	482	531	258	71	NA,NE	NA,NE,NO
Ireland	NO	NO	NO	NO	NO	NO	NO	NO
Italy	5,713	2,384	3,983	2,110	1,673	154	NA,NO	61
Luxembourg	985	170	985	170	NA,NO	NA,NO	NA,NO	NA,NO
Netherlands	5,155	1,886	2,909	1,824	2,246	62	NO	NO
Portugal	16	15	16	15	NE	NO	NE	NO
Spain	4,417	4,097	3,511	3,949	883	134	NA,NE	NA,NE
Sweden	2,813	2,409	2,413	2,088	377	244	24	77
United Kingdom	4,096	2,463	2,309	2,134	1,333	123	426	184
EU-15	**92,812**	**76,352**	**77,621**	**71,383**	**13,341**	**1,563**	**1,732**	**3,241**

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 2005 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 2005 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2005		Main explanations
	Gg	Percent	Gg	Percent	
Austria	0	0	2	0	
Belgium	0	0	0	0	
Denmark	0	0	0	0	
Finland	3	-	2	-	
France	-953	-21	423	11	Mise à jour des consommations et des FE selon la méthodologie validée lors du dernier GCIIE
Germany	0	0	-46	0	2C2: updated plant specific data
Greece	0	0	-297	-35	The recalculation is due to the acquisition of plant specific activity data, permitting the application of Tier 3 calculation method.
Ireland	0	0	0	0	
Italy	0	0	312	19	Update of AD
Luxembourg	23	2	-126	-51	No information provided
Netherlands	0	0	0	0	
Portugal	0	2	0	0	
Spain	666	23	122	3	1990, 2005: Emissions from flaring in iron & steel industry (that were previously included in category 6C of waste sector) have been reallocated, following the UNFCCC Secretariat ERT's requirements, to category 2C1 of industrial processes; 2005: Revision of the baked anodes characteristics (contents of sulphur, ash and impurities) in the primary aluminium industry (prebaked anode process) following the new available information provided by one production plant
Sweden	0	0	-15	-1	
UK	0	0	3	0	
EU-15	**-261**	**0**	**381**	**1**	

Table 4.36 provides information on the contribution of Member States to EC recalculations in PFC from 2C3 Aluminium production for 1990 and 2005 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 2005 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2005		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	0,0	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	0,0	0,0	
Netherlands	0,0	0,0	0,8	1,0	
Portugal	NE	NE	NE	0,0	
Spain	0,0	0,0	0,0	0,0	
Sweden	-63,2	-14,4	-37,8	-12,9	The calculation of PFC emissions from primary aluminium production is now in complete agreement with the Tier 2 calculation method described in IPCC Good Practice Guidance
UK	0,0	0,0	-99,9	-64,6	Emission factor revision
EU-15	**-63,2**	**-0,5**	**-136,8**	**-7,0**	

CO_2 emissions from 2C1 Iron and Steel Production account for 2% of total EU-15 GHG emissions in 2006. Between 1990 and 2006, CO_2 emissions from this source decreased by 8 % (Table 4.37). Germany is responsible for 68% of these emissions in the EU-15. Germany had the largest decreases in absolute terms between 1990 and 2006 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 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	3,546	4,995	5,089	7.7%	95	2%	1,544	44%	T2	NS,PS	CS,D
Belgium	1,946	1,535	1,620	2.5%	85	6%	-326	-17%	D/T3	PS	PS
Denmark	28	16	NA,NO	-	-16	-100%	-28	-100%	T1	NS	D
Finland	1,861	2,396	2,464	3.7%	68	3%	602	32%	CS	PS	PS
France	3,151	3,590	3,054	4.6%	-536	-15%	-97	-3%	C	AS/ NS	CS
Germany	48,326	42,574	44,859	67.9%	2,285	5%	-3,467	-7%	T2	0.0	CS
Greece	203	222	222	0.3%	0	0%	19	9%	T3	PS	PS
Ireland	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Italy	3,124	1,533	1,680	2.5%	146	10%	-1,445	-46%	D	NS	C, CS, PS
Luxembourg	985	119	170	0.3%	51	43%	-814	-83%	CS T2	NS PS	CS
Netherlands	2,514	1,208	1,410	2.1%	202	17%	-1,104	-44%	T2	NS	CS
Portugal	13	12	13	0.0%	0	3%	-1	-5%	T2	PS	PS
Spain	2,491	2,298	2,353	3.6%	55	2%	-138	-6%	T2	PS, AS	PS, CS
Sweden	1,813	1,963	1,573	2.4%	-390	-20%	-240	-13%	CS, T1	PS	CS, PS
United Kingdom	1,859	1,879	1,568	2.4%	-311	-17%	-291	-16%	T3	NS,AS	CS
EU-15	**71,861**	**64,341**	**66,075**	**100.0%**	**1,735**	**3%**	**-5,786**	**-8%**			

Table 4.38 shows information on activity data, emission factors for CO_2 emissions from 2C1 Iron and Steel Production for 1990 and 2006. 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

Member State	1990 Activity data: Description	1990 Activity data: (kt)	1990 Implied emission factor (t/t)	1990 CO2 emissions (Gg)	2006 Activity data: Description	2006 Activity data: (kt)	2006 Implied emission factor (t/t)	2006 CO2 emissions (Gg)
Austria	**Iron and steel production**		**0.26**	**3546**	**Iron and steel production**		**0.31**	**5089**
	Steel Production [kt]	4291	0.11	484	Steel Production [kt]	7127	0.11	778
	Iron Production [kt]	3444	0.88	3043	Iron Production [kt]	5565	0.77	4263
	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			20	Other			49
Belgium	**Iron and steel production**		**0.06**	**1946**	**Iron and steel production**		**0.06**	**1620**
	Steel	7621	0.13	1019	Steel	6897	0.10	686
	Pig Iron	9415	0.06	546	Pig Iron	7514	0.09	682
	Sinter	13735	0.03	381	Sinter	11170	0.02	242
	Coke	1512			Coke	1260		
	Other				Other			9
Denmark	**Iron and steel production**		**0.05**	**28**	**Iron and steel production**		**NA,NO**	**NA,NO**
	Steel	614	0.05	28	Steel	NO	NO	NO
	Pig Iron	NO	NO	NO	Pig Iron	NO	NO	NO
	Sinter	NO	NO	NO	Sinter	NO	NO	NO
	Coke	NO	NO	NO	Coke	NO	NO	NO
	Other			NA	Other			NA
Finland	**Iron and steel production**		**0.56**	**1861**	**Iron and steel production**		**0.42**	**2464**
	Produced steel	2861	0.65	1858	Produced steel	5054	0.49	2459
	Pig Iron	IE	IE	IE	Pig Iron	IE	IE	IE
	Sinter	IE	IE	IE	Sinter	IE	IE	IE
	Produced coke	487	0.001	1	Produced coke	870	0.001	1
	Other			3	Other			3
France	**Iron and steel production**		**0.10**	**3151**	**Iron and steel production**		**0.09**	**3054**
	Steel: kt Production	19073	0.09	1639	Steel: kt Production	20085	0.07	1476
	Pig Iron: kt Production	14088	0.09	1210	Pig Iron: kt Production	13013	0.10	1262
	Sinter: kt Production	IE	IE	IE	Sinter: kt Production	IE	IE	IE
	Coke: kt Production	IE	IE	IE	Coke: kt Production	IE	IE	IE
	Other			302	Other			316
	2.C.1.5.1 Rolling mills, blast furnace charging	16848	0.02	302	2.C.1.5.1 Rolling mills, blast furnace charging	18740	0.02	316
Germany	**Iron and steel production**		**0.46**	**48326**	**Iron and steel production**		**0.42**	**44859**
	Steel	43939	1.10	48326	Steel	47224	0.95	44859
	Pig Iron	32263	IE	IE	Pig Iron	30360	IE	IE
	Sinter	29869	IE	IE	Sinter	28180	IE	IE
	Coke	NE	NE	NE	Coke	NE	NE	NE
	Other			NO	Other			NO
Greece	**Iron and steel production**		**0.20**	**203**	**Iron and steel production**		**0.24**	**222**
	steel production in EAF	999	0.20	203	steel production in EAF	917	0.24	222
	Pig Iron	NO	NO	NO	Pig Iron	NO	NO	NO
	Sinter	NO	NO	NO	Sinter	NO	NO	NO
	Coke	NO	NO	NO	Coke	NO	NO	NO
	Other			NO	Other			NO

	1990				2006			
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**		**NO**	**NO**	**Iron and steel production**		**NO**	**NO**
	Steel	NO	NO	NO	Steel	NO	NO	NO
	Pig Iron	NO	NO	NO	Pig Iron	NO	NO	NO
	Sinter	NO	NO	NO	Sinter	NO	NO	NO
	Coke	NO	NO	NO	Coke	NO	NO	NO
	Other			NO	Other			NO
Italy	**Iron and steel production**		**0.05**	**3124**	**Iron and steel production**		**0.03**	**1680**
	Steel: Production	25467	0.05	1346	Steel: Production	31624	0.02	691
	Pig Iron: Production	11852	0.15	1778	Pig Iron: Production	11492	0.09	988
	Sinter: Production	13577	NA	NA	Sinter: Production	10231	NA	NA
	Coke: Production	6356	NA	NA	Coke: Production	4688	NA	NA
	Other			NA	Other			NA
Luxembourg	**Iron and steel production**		**0.09**	**985**	**Iron and steel production**		**0.06**	**170**
	steel production	3560	0.11	404	steel production	2802	0.06	170
	pig iron production	2645	0.08	200	pig iron production	NO	NO	NO
	sinter production	4804	0.08	380	sinter production	NO	NO	NO
	coke production in non-integrated plants	NO	NO	NO	coke production in non-integrated plants	NO	NO	NO
	Other			NA	Other			NA
Netherlands	**Iron and steel production**		**0.49**	**2514**	**Iron and steel production**		**0.22**	**1410**
	Crude steel production	5162	0.01	43	Crude steel production	6355	0.01	53
	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			2471	Other			1357
	Carbon input	2298	0.97	2223	Carbon input	NE	NE	1061
	Limestone equiv. use	595	0.42	249	Limestone equiv. use	NE	NE	296
Portugal	**Iron and steel production**		**0.02**	**13**	**Iron and steel production**		**11.66**	**13**
	Steel	316	0.04	12	Steel	1	11.66	13
	Pig Iron	IE	IE	IE	Pig Iron	IE	IE	IE
	Sinter	IE	IE	IE	Sinter	IE	IE	IE
	Coke	230	0.01	2	Coke	IE	NO	NO
	Other			NO	Other			NO
Spain	**Iron and steel production**		**0.09**	**2491**	**Iron and steel production**		**0.08**	**2353**
	Steel production	13163	0.08	1041	Steel production	18332	0.07	1277
	Pig iron production	5588	0.04	246	Pig iron production	3578	0.15	533
	Sinter production	7126	0.08	538	Sinter production	5272	0.08	439
	Coke production	3211	IE	IE	Coke production	2840	IE	IE
	Other			666	Other			103
Sweden	**Iron and steel production**		**0.40**	**1813**	**Iron and steel production**		**0.28**	**1573**
	Production of secondary steel	1743	0.08	147	Production of secondary steel	1881	0.10	186
	Production of primary iron	2845	0.59	1667	Production of primary iron	3711	0.37	1387
	Sinter	IE	IE	IE	Sinter	IE	IE	IE
	Coke	IE	IE	IE	Coke	IE	IE	IE
	Other			NA	Other			NA
UK	**Iron and steel production**		**0.08**	**1859**	**Iron and steel production**		**0.09**	**1568**
	Steel production (EAF) (kt)	4546	0.01	37	Steel production (EAF) (kt)	2727	0.01	20
	Pig iron production (BF) (kt)	12463	IE	IE	Pig iron production (BF) (kt)	10696	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)	4473	IE	IE
	Other			1822	Other			1548
	Blast furnace gas flared (PJ)	7	275.67	1805	Blast furnace gas flared (PJ)	6	270.43	1536
	Steel Production (OC)	13169	0.00	17	Steel Production (OC)	11203	0.00	12

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 2006	Share 2C1
	1A2a	2C1	Combined		
	2006	2006	2006		
Austria	6,450	5,089	11,539	7.0%	44%
Belgium	9,315	1,620	10,935	6.7%	15%
Denmark	511	NA,NO	511	0.3%	0%
Finland	3,790	2,464	6,254	3.8%	39%
France	16,015	3,054	19,069	11.6%	16%
Germany	11,664	44,859	56,523	34.5%	79%
Greece	175	222	397	0.2%	56%
Ireland	2	NO	2	0.0%	NA
Italy	16,671	1,680	18,351	11.2%	9%
Luxembourg	310	170	480	0.3%	35%
Netherlands	4,601	1,410	6,011	3.7%	23%
Portugal	213	13	225	0.1%	6%
Spain	7,993	2,353	10,346	6.3%	23%
Sweden	1,218	1,573	2,791	1.7%	56%
United Kingdom	18,893	1,568	20,461	12.5%	8%
EU-15	**97,821**	**66,075**	**163,896**	**100.0%**	**40%**

It is obvious, that the ratio 2C1 / (1A2a + 2C1) entitled as "Share 2C1" differs significantly for individual Member States. Therefore, boundary between 1A2a and 2C1 is not uniformly interpreted in individual Member States. The seven Member States that are significant CO_2 emitters from iron and steel production (accounting together for 90% of EU-15) allocate emissions in the following ways:

Germany: About 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.

France: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.

United Kingdom: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 2006

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. For 2005 and 2006 verified CO_2 emissions, reported under the EU ETS, were taken for the inventory. These data cover CO_2 emissions from pig iron and basic oxygen furnace steel. Process specific emissions are calculated by the Umweltbundesamt according to the IPCC good practice guidance; these emissions are subtracted from total CO_2 emissions reported by the company. The remaining emissions are reported in the energy sector as emissions due to combustion in category 1 A 2 a Iron and Steel. CO_2 emissions from pig iron production were calculated following closely the IPCC GPG guidelines Tier 2 approach, applying the default emission factor of table 3.6 of the IPCC GPG. CO_2 emissions from steel production (which corresponds to steel production at the two integrated sites operating basic oxygen furnaces) were calculated following the IPCC GPG guidelines Tier 2 approach. CO_2 emissions from electric steel production were estimated using a country specific methodology. For 2005 and 2006 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 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. 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

Member states	Description of methods
	plant-specific, because all plants are different from each other. The main common feature for all plants is, that fuel-based emissions for each installation are calculated in ILMARI system from the use of fuels, excluding coke and heavy bottom oil used in blast furnaces, and subtracted from total CO_2 emissions (described below). Fuel-based emissions are allocated to CRF 1A 2a and CRF1A 1c (coke ovens) The rest of emissions are allocated to process emissions in CRF 2C 1 (and CRF 2.A 1 in the case of lime kilns). Total CO_2 emissions for each installation (coke oven, sinter plant, blast furnace, lime kiln, steel converter, rolling mills, power plants/boilers) in each plant are mostly taken from VAHTI database. These emissions are basically calculated by plant operators using carbon inputs (fuel inputs and reducing materials) and they are reported by installations separately. From 2005 on, all four iron and steel plants in Finland report to the ETS. From 2007 submission, the 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	Country specific based on carbon mass balance approach Data sources: Annual pollutant emission reports; French Iron Association.
Germany	In keeping with the difficulties of differentiating between process-related and energy-related emissions in oxygen steel production, the following actions are taken: 1. All of the CO_2 emissions resulting from use of reducing agents and fuels are calculated, 2. Process-related CO_2 emissions are determined from the carbon requirements for the ideal blast-furnace process and from limestone inputs in pig iron production, and CO_2 emissions are determined from electrode consumption in electric steel production. 3. Then, the determined emissions are aggregated and allocated to the total processrelated and energy-related CO_2 emissions from iron and steel production (2.C.1 and 1.A.2.a). This approach rules out the possibility of any double-counting, and it simplifies the process of summing up all carbon inputs and outputs. For determination of total CO_2 emissions from inputs of reducing agents and fuel, pig-iron and oxygen-steel production are considered in one step. CO_2 emissions from reducing agents are determined in keeping with Tier 2 of the IPCC GPG (2000). CO_2 emissions from limestone use are determined in accordance with Tier 1. CO_2 emissions from electrode consumption in electric steel production are calculated from quantities of produced electric steel, via a standard factor for electrode consumption (1.3 kg C per tonne of electric steel), and via a stoichiometric factor (3.667 t CO/t C).
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. For 2005-2006 facility specific CO_2 emissions data have been collected from verified reports of the installations under the EU ETS (Tier 3 methodology, 2006 IPCC Guidelines). For the previous years (1990-2004) 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).
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 and the European emission trading scheme, and supplied by industry (FEDERACCIAI, several years) 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 2006 it reduced to 0.086 t CO_2/t pig iron production. 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. Implied emission factors for steel reduced from 0.053 to 0.022 t CO_2/t steel production, from 1990 to 2006, due to the use of lime instead of of limestone and dolomite in the basic oxygen furnaces. 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.
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. [NIR 2007]
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. Emissions factors for production process where set mostly from CORINAIR/EMEP also with contributions from IPCC96 and US-EPA AP42. The CO_2 emission factors for

Member states	Description of methods
	Electric Arc Furnace, and that were used for each one of the two iron and steel plants that are included in the European Union Emission Trading Scheme (EU-ETS), were determined from consumption of carbon bearing materials in these units: limestone, calcium carbide and coke for years 2002 and 2003. It was assumed that the same carbon content exists in both scrap and final steel produced in EAF furnaces and consequently no additional emissions are estimated apart from carbon in additives.
Spain	La estimación de las emisiones de CO_2 en los procesos de fabricación de sínter, arrabio y acero se ha realizado utilizando el método de nivel 2 de IPCC según el cual se rastrea el carbono a través del proceso de producción, evitándose de esta manera la contabilidad por partida doble de las emisiones. La elección de este método ha sido posible debido a que se ha podido disponer de balances de masa de carbono en las materias de entrada y salida correspondientes para cada uno de los procesos encuadrados dentro de esta categoría, tal y como se describe más adelante en este mismo apartado, con distinción entre las tecnologías utilizadas en la fabricación de acero (acerías eléctricas vs acerías de oxígeno básico), dadas las diferencias sustanciales en cuanto a la tecnología y las materias primas utilizadas. En cuanto a las antorchas, la estimación de las emisiones de CO_2 se basa en el contenido de carbono de cada gas incinerado y en los factores de oxidación, tal y como se detalla más adelante en este mismo epígrafe.
Sweden	Generally emissions from combustion of conventional fuels such as residual fuel oil etc. are reported in CRF 1A2a and fuels acting as reducing agents are reported in CRF 2C1. Steel: The emissions include secondary steel plants using reducing agents such as coke, coal and electrodes in 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. From 2005, the equivalent data are acquired from the ETS, environmental reports and through contacts with the companies. The Good Practice Guidance method Tier 1 has been used for six of the plants. The Tier 1 method include plant-specific activity data only on carbon-containing input materials since data on outgoing carbon in produced steel and residual products is not available. For these plants, plant specific emission factors for CO_2 were used for all years to get as accurate emission estimates as possible. For the three remaining plants (two from 2004 and onwards), activity data on reducing agents and emissions are not available for all years. Instead plant specific methods are applied, where activity data on steel production has been used to estimate the emissions for 1990-1997 for two plants and for 1990-2006 for the third plant. 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 Corus (2005). Carbon emissions from flaring of blast furnace gas (BFG) and basic oxygen furnace gas (BOFG) are calculated using emission factors which are calculated as part of the carbon balance used to estimate emissions from CRF category 1A2a. The figure for 2005 was 73.8 g C/PJ. Emissions from electric arc furnaces are 2.2 kt C/Mt steel in 1990, falling to 2 kt C/Mt steel in 2000 and constant thereafter (Briggs, 2005).

Source: NIR 2008 unless stated otherwise

Table 4.41 summarizes the recommendations from the UNFCCC review of the initial report in relation to the category 2C1 Iron and Steel Production. The overview shows that some implementations could be implemented.

Table 4.41 2C1 Iron and Steel Production : Findings of the UNFCCC review of the initial report in relation to CO_2 emissions and responses in 2008 inventory submissions

Member State	Review findings and responses related to 2.C.1 Iron and Steel Production	
	Comment UNFCCC report of the review of the initial report	Status in 2008 submission
Austria	No recommendation for improvement for this source category in the report of the review of the initial report.	No follow-up necessary
Belgium	The ERT recommends that Belgium provide a clear description of the tier 2 method in the NIR, and include information on each parameter used to estimate emissions; the number of plants producing iron and steel and a description of their processes; the mass of reducing agent in pig iron production and mass of carbon in the ore, pig iron and steel; and the EFs for reducing agents and electric arc furnaces. The NIR indicated that one sinter plant reported CO2 emissions in 2003. The emissions were not reported in the 2006 NIR because of a lack of data for other years. The ERT recommends that Belgium report a complete time series of emissions from all sinter operations.	Not resolved; no detailed description of Tier 2 is provided. Resolved; emissions from sinter are included for the whole time-series.
Denmark	No recommendation for improvement for this source category in the report of the review of the initial report.	No follow-up necessary
Finland	No recommendation for improvement for this source category in the report of the review of the initial report.	No follow-up necessary
France	No recommendation for improvement for this source category in the report of the review of the initial report.	No follow-up necessary
Germany	The ERT commends Germany for separating energy and process emissions in the use of reducing agents in blast furnaces, in accordance with the IPCC good practice guidance, as recommended in previous review reports. The ERT recommends Germany, if possible, to provide a more concise description of the emission estimation methodology in the NIR rather than split it between the body of the report and the annex. In its response to the draft review report, Germany stated that it has completely revised its documentation in order to deliver a comprehensive description of the methods applied in its 2008 NIR.	Resolved; a comprehensive description of methodology is provided, including a table defining the allocation of CO2 emissions to energy and process for all sub-categories.
Greece	No recommendation for improvement for this source category in the report of the review of the initial report.	No follow-up necessary
Ireland	Ireland is encouraged to use the notation keys consistently across the time series (CO2 emissions for iron and steel are reported as “NE”, “NO” or “0.00” in the period 1990–2003).	Resolved; NO is used consistently for the whole time-series
Italy	No recommendation for improvement for this source category in the report of the review of the initial report.	No follow-up necessary
Luxembourg	In the revised estimates provided to the ERT a tier 2 method based on a detailed carbon balance available for 2004 has already been applied. Information on the carbon content in input material (scrap, electrodes, anthracite and carbon) and carbon remaining in steel products was used in the calculation. Based on the 2004 calculations, an EF for EAF steel production is derived and used for earlier years. The revised methodologies for estimating emissions from BOF and EAF steel production are in line with the IPCC good practice guidance and should be transparently reported in Luxembourgs next NIR.	To be checked; no NIR provided by 20 May.
Netherlands	No recommendation for improvement for this source category in the report of the review of the initial report.	No follow-up necessary
Portugal	No recommendation for improvement for this source category in the report of the review of the initial report.	No follow-up necessary
Spain	The Party is encouraged to report clearly in the NIR on this allocation in order to give assurance that there is no omission or double counting between the industrial processes, energy and waste sectors.	Resolved; a detailed methodological description is provided.
Sweden	Sweden uses a country-specific method to estimate and allocate the CO2 emissions from primary (pig) iron production. Sweden calculates these CO2 emissions based on the total amount of blast furnace gas consumed. In addition it accounts for these emissions in the (sub)sectors where the blast furnace gas is combusted, including in some (sub)categories in the energy sector. The ERT suggests that Sweden adopt the approach set out in the IPCC good practice guidance, which would facilitate future reviews and comparison between Parties.	Not resolved; In its NIR Sweden states that necessary data for adopting the IPCC approach is not available.
UK	No recommendation for improvement for this source category in the report of the review of the initial 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 0.04 % of total EU-15 GHG emissions in 2006. Between 1990 and 2006, PFC emissions from this source decreased by 88 %. France, Germany and Sweden are responsible for 65 % of these emissions in the EU-15. All Member States reduced their emissions from this source between 1990 and 2006. France, the Netherlands and Germany had the largest

decreases in absolute terms. The decreasing trend of PFC emissions from this key source between 1990 and 2006 is due to production stop (AT, 90-92) or decline (DE, ES) and due to process improvements (FR, DE, ES, NL). The peak in 2002 is due to technologigal changes and not well optimized operations (NL, FR).

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 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	1,050	NO	NO	-	-	-	-1,050	-100%	T3b	NS	PS
Belgium	NO	NO	NO	-	-	-	-	-	NA	NA	NA
Denmark	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Finland	NO	NO	NO	-	-	-	-	-	NO	NO	NO
France	3,032	699	586	37.5%	-113	-16%	-2,445	-81%	C	NS	PS
Germany	2,489	338	188	12.0%	-149	-44%	-2,301	-92%	T3	0.0	CS
Greece	258	72	71	4.5%	-1	-2%	-187	-73%	T3	PS	PS
Ireland	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Italy	1,673	181	154	9.9%	-26	-15%	-1,519	-91%	T1, T2	PS	PS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Netherlands	2,246	88	62	4.0%	-26	-29%	-2,184	-97%	T2	PS	PS
Portugal	NE	NO	NO	-	-	-	-	-	NA	NA	NA
Spain	883	143	134	8.6%	-9	-6%	-749	-85%	T2	PS	PS
Sweden	377	255	244	15.6%	-12	-5%	-133	-35%	T2	PS	CS
United Kingdom	1,333	55	123	7.9%	69	125%	-1,210	-91%	T2,T3	NS	PS
EU-15	**13,341**	**1,831**	**1,563**	**100.0%**	**-268**	**-15%**	**-11,778**	**-88%**			

Table 4.43 shows information on activity data and emission factors for PFC emissions from 2C Metal Production for 1990 to 2006. The table shows that in 2006 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 2006 between 0.03 kg/t for the Netherlands and 0.36 kg/t for Sweden. The EU-15 IEF (excluding Greece and the UK) is 0.10 kg/t. The implied emission factors for C_2F_6 per tonne of aluminium produced vary for 2006 between 0.003 kg/t for 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 2006 all reported emissions are estimated using higher tier methods (based on plant specific data). For 1990 Italy used a T1 approach to estimate emissions. The EU-15 IEFs generally decrease due to reduced durations and frequencies of the anode effects.

Table 4.43 2C Metal Production: Information on methods applied, activity data, emission factors for PFC emissions

Member State	Method applied	Activity data	Emission factor	Gas	1990				2005			
					Activity data		Implied emission factor (kg/t)	Emissions (t)	Activity data		Implied emission factor (kg/t)	Emissions (t)
					Description	(t)			Description	(t)		
Austria	T3b	NS	PS	CF_4	Aluminium production	88	1.56	137	Aluminium production	NO	NO	NO
				C_2F_6	Aluminium production	88	0.19	17	Aluminium production	NO	NO	NO
France	C	NS	PS	CF_4	Aluminium production	326	1.13	369	Aluminium production	443	0.18	79
				C_2F_6	Aluminium production	326	0.21	69	Aluminium production	443	0.05	20
Germany	T3	0	CS	CF_4	Aluminium production	740	0.45	336	Aluminium production	646	0.07	45
				C_2F_6	Aluminium production	740	0.05	34	Aluminium production	646	0.01	5
Greece	T3	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	232	0.86	198	Aluminium production	196	0.12	24
				C_2F_6	Aluminium production	232	0.18	42	Aluminium production	196	0.02	3
Netherlands	T2	PS	PS	CF_4	Aluminium production	272	1.02	277	Aluminium production	334	0.03	11
				C_2F_6	Aluminium production	272	0.18	48	Aluminium production	334	0.01	2
Spain	T2	PS	PS	CF_4	Aluminium production	355	0.34	122	Aluminium production	397	0.05	20
				C_2F_6	Aluminium production	355	0.03	10	Aluminium production	397	0.00	1
Sweden	T2	PS	CS	CF_4	Aluminium production	96	0.56	54	Aluminium production	103	0.36	37
				C_2F_6	Aluminium production	96	0.03	3	Aluminium production	103	0.02	2
UK	T2,T3	NS	PS	$CF_4 + C_2F_6$	Aluminium production	290	IE	IE	Aluminium production	370	IE	IE
					Aluminium production	290	NE	NE	Aluminium production	370	IE	IE
EU-15				**CF_4**	**EU-15 w/o GR,UK (98%)**	**2110**	**707.66**	**1493**	**EU-15 w/o GR,UK (96%)**	**2118**	**102.23**	**216**
				C_2F_6	**EU-15 w/o GR,UK (98%)**	**2110**	**105.44**	**222**	**EU-15 w/o GR,UK (97%)**	**2118**	**15.24**	**32**

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	Deux types de technologies sont employées sur les sites, la plus ancienne, dénommée SWPB correspondant à une alimentation mécanisée sur les côtés des cuves, et la plus récente, dénommée PFPB correspondant à une alimentation ponctuelle automatique au centre de la cuve. Emission declarations from plants are used.
Germany	The production figures for the year 2006 were taken from the monitoring report by the aluminium industry for the year 2006. 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 2006 were calculated by multiplying the total anode effects by the specific CF_4 emissions per anode effect determined in 2006. 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.
Greece	PFC emissions estimates are based on measurements data made by the aluminium industry according to the PESHINEY methodology (Tier 3b methodology, IPCC 2000).
Ireland	NO
Italy	For the estimation of PFC emissions from aluminium production, both IPCC Tier 1 and Tier 2 methods are used. These emissions, specifically CF4 and C2F6, have been calculated on the basis of information provided by national statistics (ENIRISORSE, several years; ASSOMET, several years) and the national primary aluminium producer, with reference to the document drawn up by the 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. From the year 2000, the more accurate Tier 2 method has been followed, based on default technology specific slope and overvoltage coefficients. Regarding the Tier 1 methodology, the emission factors for CF4 and C2F6 were provided, whereas for the Tier 2 site-specific values and, where they were not available, default coefficients were provided (ALCOA, 2004).
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 1990-2006. 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	Tier 2: Activity data used for the PFC emission calculations, anode effects in min/oven day and production statistics, were provided by the company, and specified for the Prebaked and Söderberg processes.
United Kingdom	The estimates were based on actual emissions data provided by the aluminium-smelting sector. There are two main aluminium smelting operators in the UK. One operator uses a Tier 2 methodology Smelter-specific relationship between emissions and operating parameters based on default technology-based slope and over-voltage coefficients, using the default factors for the CWPB (Centre Worked Prebaked) plant. 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 2008 unless stated otherwise

Table 4.45 summarizes the recommendations from the UNFCCC review of the initial report in relation to the category 2C3 Aluminium Production. The overview shows that few recommendations were made, and some could be implemented.

Table 4.45 2C3 Aluminium Production: Findings of the UNFCCC review of the initial report in relation to PFC emissions and responses in 2008 inventory submissions

Member State	Review findings and responses related to 2.C.3 Aluminium Production	
	Comment UNFCCC report of the review of the initial report	Status in 2008 submission
Austria	Although this is not transparently documented in the NIR, the ERT learned during the review that these country-specific parameters were compared to, and determined to be consistent with, international statistics. The ERT encourages Austria to include this QA/QC documentation in its future inventory submissions.	Resolved; information is included
Belgium	No recommendation for improvement for this source category in the report of the review of the initial report.	No follow-up necessary
Denmark	No recommendation for improvement for this source category in the report of the review of the initial report.	No follow-up necessary
Finland	No recommendation for improvement for this source category in the report of the review of the initial report.	No follow-up necessary
France	No recommendation for improvement for this source category in the report of the review of the initial report.	No follow-up necessary
Germany	No recommendation for improvement for this source category in the report of the review of the initial report.	No follow-up necessary
Greece	No recommendation for improvement for this source category in the report of the review of the initial report.	No follow-up necessary
Ireland	No recommendation for improvement for this source category in the report of the review of the initial report.	No follow-up necessary
Italy	No recommendation for improvement for this source category in the report of the review of the initial report.	No follow-up necessary
Luxembourg	No recommendation for improvement for this source category in the report of the review of the initial report.	No follow-up necessary
Netherlands	Emissions from all aluminium production plants have been recalculated in the 2006 submission based on new measurements which were made prior to a technology switch – made in 1998 for the smallest company and in 2002/2003 for the largest company – from side worked prebaked (SWPB) to centre worked prebaked (CWPB) in the two plants of the Netherlands. PFC emissions increased during the period 1996–1997 and no explanation is provided in the NIR. The ERT recommends the Party to give more information about the increase of emissions during these years bearing in mind the decreasing trend between 1990 and 1995.	Not resolved; no further explanation is provided in the NIR.
Portugal	No recommendation for improvement for this source category in the report of the review of the initial report.	No follow-up necessary
Spain	No recommendation for improvement for this source category in the report of the review of the initial report.	No follow-up necessary
Sweden	The methodology used to estimate PFC emissions from this sector deviates from the IPCC good practice guidance in that different slope coefficients for the anode effects are used, resulting in a potential overestimation of PFC emission levels in the base year. Following the recommendation of the ERT, Sweden re-estimated and revised the estimated PFC emissions from aluminium production, on the basis of the IPCC good practice guidance methodology. The revised estimation method should be reported transparently in Sweden's next NIR.	Resolved; the revised estimation method is reported in the NIR
UK	No recommendation for improvement for this source category in the report of the review of the initial report.	No follow-up necessary

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	The emission of SF_6 has been decreasing in recent years due to the fact that activities under Magnesium Foundry no longer exist
Finland	Direct reporting method, Tier 1a. Tier 1b is not applicable to this category because all SF_6 used is imported in bulk. Emissions from this source are not reported separately due to confidentiality (Included in 2 F).
France	Les émissions de SF_6 sont déterminées par bilan matière à partir de l'estimation des consommations annuelles et de certaines informations communiquées par les industriels. Les quantités consommées sont considérées totalement relarguées à l'atmosphère.
Germany	Aluminium production: All of the SF_6 used in Germany to purify molten aluminium is emitted completely upon

Member states	Description of methods
	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). Es konnte eine gute Übereinstimmung festgestellt werden, so dass in Zukunft nur noch die Befragung über den Gasehandel erfolgen wird.
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, several years). The plant started its activity in September 1995.
Luxembourg	NO
Netherlands	NO
Portugal	NO
Spain	NA/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.

Table 4.47 provides an overview of all sources reported under 2C5 Other Metal Production by EU-15 Member States for the year 2006. Three Member States report emissions from silicium or non-ferrous metals: the largest contributor to emissions is Spain with 59 %.

Table 4.47 2C5 Other: Overview of sources reported under this source category for 2006

Member State	2.C.5 Other Metal Production	CO_2 emissions [Gg]	CH_4 emissions [Gg]	N_2O emissions [Gg]	Total emissions [Gg CO2 equivalents]	Share in EU-15 Total
Austria	NA	NA	NA	NA	-	0.0%
Belgium	-	-	-	-	-	0.0%
Denmark	NO	NO	NO	NO	-	0.0%
Finland	Non-ferrous metals	0.2	NO	NO	0.2	0.1%
France	NA	NA	NA	NA	-	0.0%
Germany	NO	NO	NO	NO	-	0.0%
Greece	NO	NO	NO	NA	-	0.0%
Ireland	NO	NO	NO	NO	-	-
Italy	NA	NA	NA	NA	-	0.0%
Luxembourg	NA	NA	NA	NA	-	-
Netherlands	NO	NO	NO	NO	-	0.0%
Portugal	NO	NO	NO	NO	-	0.0%
Spain	Silicium production	217.7	NE	NE	218	58.7%
Sweden	Non-ferrous metals	152.8	NE,NO	NA,NO	153	41.2%
UK	NO	NO	NO	NO	-	0.0%
EU-15 Total		**371**	**0**	**0**	**371**	**100.0%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

4.2.4 Production of halocarbons and SF_6 (CRF Source Category 2E) (EU-15)

Table 4.48 summarise information by Member State on emission trends for the key source HFCs from 2E Production of Halocarbons and SF_6.

Table 4.48 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 2006 (Gg CO_2 equivalents)	HFC emissions in 1990 (Gg CO_2 equivalents)	HFC emissions in 2006 (Gg CO_2 equivalents)
Austria	NA, NO	NA,NO	NA	NA
Belgium	3,993	152	0	NA
Denmark	0	0	NO	NA,NO
Finland	0	0	NA,NO	NA,NO
France	4,691	1,394	3,635	638
Germany	4,409	291	4,329	291
Greece	935	2,290	935	2,290
Ireland	NA, NO	NA, NO	NA,NO	NA,NO
Italy	605	21	351	21
Luxembourg	0	0	NA,NO	NA,NO
Netherlands	4,432	329	4,432	329
Portugal	NE, NO	NE, NO	NE,NO	NA,NO
Spain	2,403	863	2,403	863
Sweden	0	0	NO	NA,NO
United Kingdom	11,385	393	11,374	303
EU-15	**32,852**	**5,734**	**27,459**	**4,736**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.49 provides information on the contribution of Member States to EC recalculations in HFC from 2E Production of Halocarbons for 1990 and 2005 and main explanations for the largest recalculaltions in absolute terms.

Table 4.49 2E Production of Halocarbons and SF_6: Contribution of MS to EC recalculations in HFC for 1990 and 2005 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2005		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	0,0	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	0,0	0,0	
Netherlands	0,0	0,0	-0,7	-0,3	
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**	**-0,7**	**0,0**	

HFC emissions from 2E1 By-Product Emissions account for 0.1 % of total EU-15 GHG emissions in 2006. Between 1990 and 2006, HFC emissions from this source decreased by 81 %. Greece is responsible for 59 % of these emissions in the EU-15. Greece was the only Member State with emission increases from this source between 1990 and 2006 (Table 4.50).

Table 4.50 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 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	NA	NA	NA	-	-	-	-	-	NO	NO	NO
Belgium	NO	NO	NA,NO	-	-	-	-	-	T3	PS	PS
Denmark	NO	NA,NO	NA,NO	-	-	-	-	-	NO	NO	NO
Finland	NA,NO	NO	NA,NO	-	-	-	-	-	NO	NO	NO
France	1,663	474	519	13.3%	45	10%	-1,144	-69%	C	PS	PS
Germany	C,NA,NO	C,NA,NO	C,NA,NO	-	-	-	-	-	0.0	0.0	PS
Greece	935	2,551	2,290	58.5%	-260	-10%	1,355	145%	T1	AS	D
Ireland	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NO	NO	NO
Italy	351	4	5	0.1%	0	9%	-346	-99%	CS	PS	PS
Luxembourg	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NO	NA
Netherlands	4,432	196	281	7.2%	85	43%	-4,151	-94%	T2	C/PS	C/PS
Portugal	NE,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA	NA
Spain	2,403	334	517	13.2%	183	55%	-1,887	-79%	T1, T2	PS	D, PS
Sweden	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA	NA
United Kingdom	11,374	341	303	7.7%	-38	-11%	-11,071	-97%	T3	Q,PS	PS
EU-15	**21,158**	**3,899**	**3,914**	**100.0%**	**15**	**0%**	**-17,244**	**-81%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.51 shows information on methods used for HFC emissions from 2E1 By-Product Emissions for 1990 tand 2006. For 2E1 By-Product Emissions it is not possible to give an average IEF for the EU-15 because for most countries activity data is confidential. Except for Greece, all reported emissions are estimated with higher Tier methods.

Table 4.51 2E1 By-Product Emissions: Description of national methods used for estimating HFC emissions and abatements applied

Member States	**Description of methods**
Austria	NO
Belgium	NO
Denmark	NO
Finland	NO
France	Il existe un site en France, producteur de HCFC-22, émetteur de HFC-23. Les émissions ont été réduites de façon importante depuis 1992 après l'introduction d'un incinérateur. Les émissions sont déterminées à partir d'une approche bottum-up à partir des données communiquées directement par les sites industriels conformément aux déclarations faites aux DRIRE (arrêté du 24 décembre 2002 modifié).

Member States	Description of methods
Germany	Since 1995 emissions have been calculated (via mass balance) on the basis of the amount of H-CFC-22 produced, of annual measurements of HFC-23 concentrations in the facility's waste gas, of amounts of HFC-23 sold and of the amounts of HFC-23 delivered to the cracking facility; for the 1995 report year, emissions reduction measures (cracking facility) have been taken into account, as of the middle of the year, for the first production facility. Since produced quantities of H-CFC are not reported, no emission factor can be determined and compared with the IPCC standard emission factor. The producer reports only emissions of HFC-23. These are reported in aggregated form, together with emissions from the CRF sub - source category 2.E.2, since they are confidential. In 1995, in Frankfurt, a CFCcracking plant went into operation that cracks, at high temperature, excess HFC-23 produced during production of H-CFC-22 and that recovers hydrofluoric acid; i.e. no significant emissions are produced. HFC-23 produced at the second German production facility is captured in large amounts at the production system itself; the substance is then sold as a refrigerant or – following further distillative purification – as an etching gas for the semiconductor industry.
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. For 2006 production data were not available, so the emissions have been estimated by means of extrapolation.
Ireland	NO
Italy	For source category ”By-product emissions”, the IPCC Tier 2 method is used, based on plant-level data communicated by the national producer (Solvay, several years). Also for source category “Fugitive emissions”, emission estimates are based on plant- level data communicated by the national producer (Solvay, several years).
Luxembourg	NO
Netherlands	*Production of HCFC-22*(2E1): To comply with the IPCC Good Practice Guidance (IPCC, 2001) an IPCC Tier 2 method is used to estimate emission of this source category. HFC-23 emissions are calculated using both (measured) data on the mass flow of HFC23 produced in the process and a destruction factor to estimate the reduction of this HFC 23 flow by the thermal afterburner.
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. Two of the three manufacturers were members of the UK greenhouse gas Emissions Trading Schemes. All three now report their emissions to the Environment Agency’s Pollution Inventory and these reported emissions have been used to calculate total emissions in later years. As a requirement of participation in the scheme, their reported emissions are verified annually via external and independent auditors. There is a significant decrease in HFC emissions in 1998/1999. This step-change in emissions is due to the installation of thermal oxider pollution abatement equipment at one of the UK manufacturing sites. Fugitive HFC emissions from both an HCFC22 plant and HFC manufacturing plant (run by the same operator) are treated using the same thermal oxidiser unit. Emissions also decrease in 2004, reflecting the installation of a thermal oxider at the second of the UK’s HCFC22 manufacturing sites. This was installed in late 2003, and became fully operational in 2004.

Source: NIR 2008 unless stated otherwise

Table 4.52 summarizes the recommendations from the UNFCCC review of the initial report in relation to the category 2E Production of Halocarbons. The overview shows that some recommendations could be implemented.

Table 4.52 2E Production of Halocarbons and SF_6: Findings of the UNFCCC review of the initial report and responses in 2008 inventory submissions

Member State	Review findings and responses related to 2.E. Production of halocarbons and SF6	
	Comment UNFCCC report of the review of the initial report	Status in 2008 submission
Austria	No recommendation for improvement for this source category in the report of the review of the initial report.	No follow-up necessary
Belgium	Belgium reported that an external audit of the emission inventory was conducted in July 2005 and improvements in emission measurements and mass balance models were subsequently implemented. The ERT recommends that Belgium report the outcomes of the audit in the NIR, particularly in the context of applied or planned improvements and recalculations and impacts on time series consistency.	Resolved; the findings of the audit are summarized in the NIR.
Denmark	No recommendation for improvement for this source category in the report of the review of the initial report.	No follow-up necessary
Finland	No recommendation for improvement for this source category in the report of the review of the initial report.	No follow-up necessary
France	France reported a 100 per cent reduction of PFC emissions since 2003. The ERT recommends that France further investigate whether fugitive emissions of PFCs occur in the industry.	Not resolved; still fugitive PFC emissions are reported only until 2002 and the NIR does not mention any activities of further investigations wether fugitive emissions of PFC occur.
Germany	No recommendation for improvement for this source category in the report of the review of the initial report.	No follow-up necessary
Greece	No recommendation for improvement for this source category in the report of the review of the initial report.	No follow-up necessary
Ireland	No recommendation for improvement for this source category in the report of the review of the initial report.	No follow-up necessary
Italy	No recommendation for improvement for this source category in the report of the review of the initial report.	No follow-up necessary
Luxembourg	No recommendation for improvement for this source category in the report of the review of the initial report.	No follow-up necessary
Netherlands	The ERT recommends that in its future submissions the Netherlands specify the year of installation of the afterburner in order to clearly identify the reason for the reduction in emissions between 1998 and 1999.	Resolved; an explanation is provided in the NIR.
Portugal	No recommendation for improvement for this source category in the report of the review of the initial report.	No follow-up necessary
Spain	No recommendation for improvement for this source category in the report of the review of the initial report.	No follow-up necessary
Sweden	No recommendation for improvement for this source category in the report of the review of the initial report.	No follow-up necessary
UK	No recommendation for improvement for this source category in the report of the review of the initial report.	No follow-up necessary

4.2.5 Consumption of halocarbons and SF_6 (CRF Source Category 2F) (EU-15)

Table 4.53 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 4.53 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 2006 (Gg CO_2 equivalents)	HFC emissions in 1990 (Gg CO_2 equivalents)	HFC emissions in 2006 (Gg CO_2 equivalents)	SF_6 emissions in 1990 (Gg CO_2 equivalents)	SF_6 emissions in 2006 (Gg CO_2 equivalents)
Austria	301	1,474	23	858	249	480
Belgium	542	1,670	439	1,595	103	75
Denmark	13	887	NA,NE,NO	835	13	36
Finland	94	804	0	748	94	40
France	1,441	13,976	23	12,745	1,076	754
Germany	4,511	12,220	40	9,523	4,333	2,303
Greece	3	2,362	NE,NO	2,358	3	4
Ireland	36	723	1	506	35	69
Italy	213	6,368	NO	5,911	213	329
Luxembourg	17	91	14	87	3	4
Netherlands	236	1,640	NO	1,231	217	215
Portugal	0	866	NE,NO	851	NE	15
Spain	67	5,123	NA,NO	4,686	67	324
Sweden	87	859	4	823	84	34
United Kingdom	664	9,671	2	8,894	604	695
EU-15	**8,226**	**58,734**	**544**	**51,651**	**7,096**	**5,376**

Abbreviations explained in the Chapter 'Units and abbreviations'.

HFC emissions from 2F Consumption of Halocarbons and SF_6 account for 1.3 % of total EU-15 GHG emissions in 2006. HFC emissions in 2006 were 98 times higher than in 1990. The main reason for this is the phase-out of ozone-depleting substances such as chlorofluorocarbons under the Montreal Protocol and the replacement of these substances with HFCs (mainly in refrigeration, air conditioning, foam production and as aerosol propellants). France, Germany, UK and Italy had the most significant absolute increases from this source between 1990 and 2006.

SF_6 emissions from 2F Consumption of Halocarbons and SF_6 account for 0.1 % of total EU-15 GHG emissions in 2006. Between 1990 and 2006, SF_6 emissions from this source decreased by 24 %. Germany, France and UK are responsible for 70 % of total EU-15 emissions from this source. In absolute terms, Germany had also the most significant decreases from this source between 1990 and 2006.

Table 4.54 provides information on the contribution of Member States to EC recalculations in HFC from 2F Consumption of Halocarbons for 1990 and 2005 and main explanations for the largest recalculations in absolute terms.

Table 4.54 2F Consumption of halocarbons: Contribution of MS to EC recalculations in HFC for 1990 and 2005 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2005		Main explanations
	Gg	Percent	Gg	Percent	
Austria	0,0	0,0	-3,9	-0,4	
Belgium	4,7	1,1	40,4	2,8	Emissions from car air conditioning, polyurethane, refrigeration and air conditioning “installations”, have been re-estimated; The disposal emissions have been added. Some minor mistakes or inconsistencies have been removed.
Denmark	0,0	0,0	0,0	0,0	
Finland	0,0	0,0	0,0	0,0	
France	0,0	0,0	1.445,7	14,0	Mise à jour des données communiquées par l'EMP
Germany	0,0	0,0	-1,7	0,0	
Greece	0,0	0,0	-1.330,6	-39,6	Error in data input
Ireland	0,0	-	4,0	0,9	
Italy	0,0	0,0	0,0	0,0	
Luxembourg	0,6	4,3	-0,1	-0,1	
Netherlands	0,0	0,0	-0,2	0,0	
Portugal	NE	0,0	394,6	101,0	Changes in Importers data; change in Fire Extinguishers Activity Data; change in Commercial Refrigeration Methods; change in Commercial Refrigeration Emission Factors; change in Commercial Refrigeration and Industrial Stationary Air Conditioning Activity Data
Spain	0,0	0,0	-4,8	-0,1	
Sweden	0,0	0,0	18,4	2,4	
UK	0,0	-0,4	2,7	0,0	
EU-15	**5,3**	**1,0**	**564,6**	**1,2**	

Table 4.55 provides information on the contribution of Member States to EC recalculations in SF_6 from 2F Consumption of Halocarbons for 1990 and 2005 and main explanations for the largest recalculations in absolute terms.

Table 4.55 2F Consumption of halocarbons and SF_6: Contribution of MS to EC recalculations in SF_6 for 1990 and 2005 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2005		Main explanations
	Gg	Percent	Gg	Percent	
Austria	0,0	0,0	-0,3	-0,1	
Belgium	-0,1	-0,1	40,8	94,8	The SF6 emissions from double glazing have been revised, in particular to include one more manufacturer.
Denmark	0,0	0,0	0,0	0,0	
Finland	0,0	0,0	0,0	0,0	
France	22,2	2,1	27,3	3,4	Suppression des émissions affectées aux DOMCOM, réaffectées à la métropole
Germany	-143,5	-3,2	-216,9	-8,8	The emissions of SF6 are recalculated because of wrong calculations of the emissions in the last submission; The confidental emissions of sport shoes and AWACS maintenance are reallocated because of confidentiality reasons together with SF6 emissions of 2.E at 2.G;the potential emissions of SF6 of the last submission were because of technical problems too low.
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	-87,4	-25,9	The method to estimate SF6 emission from Electrical equipment (2F8) has been changed. From this submission on the country-specific method is equivalent to the IPCC Tier 3 method.
Portugal	-2,9	-100,0	3,5	34,3	Change in Electric Equipment (Method, EF, AD)
Spain	0,0	0,0	0,0	0,0	
Sweden	0,0	0,0	0,1	0,3	
UK	0,0	0,0	0,6	0,1	
EU-15	**-124,3**	**-1,7**	**-232,2**	**-4,1**	

Table 4.56 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 74 % of HFC emissions in this source category; 2F4 Aerosols/Metered Dose Inhalers and 2F2 Foam Blowing account for 15 % and 5 % respectively.

Table 4.56 2F Consumption of Halocarbons and SF_6: Member States' sub-categories of HFC emissions for 2006 (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	**858**	642	153	29	27	2	NO	5	NO	NA,NO
Belgium	**1,595**	1,301	107	12	176	NO	NE	NO	0	NA
Denmark	**835**	691	127	NO	16	NO	NO	NO	NO	1
Finland	**748**	659	9	C,NO	77	NO	NO	C,NA,NE,NO	NO	1
France	**12,745**	8,408	536	117	3,379	288	NO	17	NO	NA,NO
Germany	**9,523**	8,158	731	7	601	C,NO	NO	24	NO	2
Greece	**2,358**	2,357	NE	NE	0	NE	NO	NE	0	NA
Ireland	**506**	361	24	16	103	NO	NO	3	NO	NA,NO
Italy	**5,911**	5,322	247	98	237	NO	NO	7	NO	NA,NO
Luxembourg	**87**	77	6	NE	4	NE	NE	NE	NA	NA,NO
Netherlands	**1,231**	1,085	NO	NO	NO	NO	NO	NO	NO	145
Portugal	**851**	800	38	6	7	NO	NO	NO	NO	NA,NO
Spain	**4,686**	2,904	116	1,539	128	NO	NO	NO	NO	NA
Sweden	**823**	719	74	6	24	NE	NO	NO	NA	NA,NO
UK	**8,894**	4,987	619	305	2,764	58	NA	IE	IE	163
EU-15	**51,651**	**38,472**	**2,788**	**2,133**	**7,543**	**348**	**0**	**55**	**0**	**312**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.57 and 4.58 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 4.57 2F1 Refrigeration and Air conditioning: Member States' contributions to HFC emissions and information on method applied, activity data and emission factor

Member State	HFC (Gg CO_2 equivalents)			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	2	591	642	1.7%	51	9%	640	36388%	CS	Q	CS
Belgium	79	1,224	1,301	3.4%	77	6%	1,223	1556%	T2	Q/AS	CS/PS
Denmark	NA,NE	651	691	1.8%	41	6%	691	-	M/CS	CS	M/CS
Finland	0	777	659	1.7%	-118	-15%	659	5232556%	T2	Q	D
France	NO	7,772	8,408	21.9%	637	8%	8,408	-	M	Q	CS/ D
Germany	NO	7,491	8,158	21.2%	667	9%	8,158	-	T2a	0.0	D, CS
Greece	NE,NO	2,029	2,357	6.1%	328	16%	2,357	-	T2	AS	D
Ireland	IE,NO	297	361	0.9%	64	22%	361	-	T1, T3	NS	CS
Italy	NO	4,686	5,322	13.8%	637	14%	5,322	-	T2a, CS	AS, PS	CS, PS
Luxembourg	6	72	77	0.2%	5	6%	71	1131%	CS	Q	CS
Netherlands	NO	958	1,085	2.8%	127	13%	1,085	-	T2	CS	CS
Portugal	NE,NO	715	800	2.1%	85	12%	800	-	T2	NS,PS	D,CS
Spain	NO	2,590	2,904	7.5%	314	12%	2,904	-	C	AS, Q	C
Sweden	3	673	719	1.9%	45	7%	716	28143%	T2, CS	PS,NS	D, CS
UK	IE,NO	5,068	4,987	13.0%	-82	-2%	4,987	-	T3	Q,AS	CS
EU-15	**89**	**35,594**	**38,472**	**100.0%**	**2,878**	**8%**	**38,383**	**43059%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

In 2006, HFC emissions from 2F1 were more than 400 times higher than in 1990. France, Germany, Italy and UK are responsible for 67 % of total EU-15 emissions from this source. Between 2005 and 2006 EU-15 emissions increased by 8 %. The only countries in which emissions decreased between these years were FI and UK.

Table 4.58 2F4 Aerosols/ Metered Dose Inhalers: Member States' contributions to HFC emissions and information on method applied, activity data and emission factor

Member State	HFC (Gg CO_2 equivalents)			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	19	44	27	0.4%	-17	-39%	8	41%	CS	Q	D
Belgium	35	158	176	2.3%	18	11%	140	398%	T1	RS/NS	PS
Denmark	NA,NE	9	16	0.2%	7	84%	16	-	M/CS	CS	M/CS
Finland	NA,NO	77	77	1.0%	1	1%	77	-	T2	Q	D
France	NE,NO	3,083	3,379	44.8%	296	10%	3,379	-	C/ T2	AS	CS
Germany	NO	613	601	8.0%	-11	-2%	601	-	CS/T2a	0.0	D, CS
Greece	NE	NE	NE	-	-	-	-	-	0.0	0.0	0.0
Ireland	0	101	103	1.4%	2	2%	103	1598654%	T1, T2	NS	CS
Italy	NO	240	237	3.1%	-3	-1%	237	-	T2	AS	CS
Luxembourg	0	4	4	0.1%	0	0%	4	41340%	CS	Q	CS
Netherlands	NO	NO	NO	-	-	-	-	-	T2	CS	CS
Portugal	NE,NO	7	7	0.1%	0	0%	7	-	RA	NS	CS
Spain	NO	158	128	1.7%	-30	-19%	128	-	C	AS, Q	C
Sweden	1	29	24	0.3%	-5	-18%	23	1739%	T2, CS	PS,NS	D, CS
UK	2	2,746	2,764	36.6%	17	1%	2,762	166075%	T3	AS	CS
EU-15	**57**	**7,268**	**7,543**	**100.0%**	**275**	**4%**	**7,486**	**13113%**			

In 2006, 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 2005 and 2006 EU-15 emissions increased by 4 %. In Spain, Austria, Germany, Sweden and Italy emissions decreased between these years (Table 4.58).

Table 4.59 provide descriptions on methods used for estimating HFC, PFC and SF_6 emissions from 2F Consumption of Halocarbons and SF_6.

Table 4.59 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 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).

Member States	Description of methods
	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 (including transport refrigeration) and air conditioning (including mobile air conditioning) equipment and of metered dose inhalers 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.
Ireland	Emission calculation based on special studies by sub-contractors
Italy	Methodology used is IPCC Tier 2a, except for SF_6 emissions from electrical equipment (2F7), where it is IPCC Tier 3b. The IPCC Tier 1a method has been used to calculate potential emissions, using production, import, export and destruction data provided by the national producer. As regard PFC potential emissions, since no production occurs in Italy, export has been reasonably assumed negligible, whereas import correspond to consumption of PFCs by semiconductor manufactures, that use these substances.
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. [NIR2007]
Netherlands	To comply with the IPCC Good Practice Guidance (IPCC, 2001) IPCC Tier 2 methods are used to estimate emissions of the sub-sources Stationary refrigeration, Mobile airconditioning, Aerosols, Foams and Semiconductor manufacturing. The country-specific method for the source Electrical equipment is equivalent to the IPCC Tier 3 method and the country-specific methods for the sources Sound-proof windows and Electron microscopes are equivalent to IPCC Tier 2 methods.
Portugal	For those sources with sufficient available data, actual emissions where estimated with a Tier 2 (advanced or actual method) approach which is considered Good Practice in accordance with GPG. As a general rule, bottom-

Member States	Description of methods
	up methodologies were used, and thus overall methodology should be classified as Tier 2a. This approach departs from the knowledge of the number of equipments using Fluorinated compounds and estimates emissions to atmosphere from charge (amount of chemical used in the equipment), service life, emission rate during the various periods of the equipment life and possible recovery of emissions.
Spain	No general description, see sub-category specific descriptions
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	No general description, see sub-category specific descriptions

Source: NIR 2008 unless stated otherwise

Table 4.60 provide descriptions on methods used for estimating HFC emissions from 2F1 Refrigeration and Air-Conditioning Equipment.

Table 4.60 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, emissions have been estimated separately for the following source categories: industrial and commercial installations, household refrigerators, air conditioning of private cars, air conditioning of buses and coaches, and refrigerated transport. An annual inquiry is made on the consumption of the major F-gas containing product manufacturers, among which the 4 car manufacturers. These data are used for calculating the potential emissions as well as the assembly emissions. Industrial and commercial "installations" represent all on-site assembled systems for industrial & commercial refrigeration as well as stationary air-conditioning applications, which is the largest single source of F-gas emissions. The consumption and emission of refrigerants are modelled on the basis of an annual inquiry among refrigerant distributors on their national supply by refrigerant mixture, as well as on assumptions on average loss rates, from which the estimated supply for refilling vehicles is subtracted. No distinction is made between industrial refrigeration, commercial refrigeration and air conditioning installations, as it is not possible to disaggregate the consumption data between these sub-sectors, because of the presence of intermediary wholesalers, and the fact that no inventory of installations is available. The refrigerant consumption and emissions of the transportation sector are estimated by modelling the evolution of the vehicle stock, on the basis of the number of new vehicle registrations and of the percentage of new vehicles equipped with air conditioning., by category of vehicles (cars, buses and coaches). The emissions from refrigerated transport are calculated on the basis of the annual number of new registrations of refrigerated trucks and trailers by gross / net weight categories, the average quantity of refrigerant (by type of refrigerant) contained in each vehicle (by vehicle category) and emission factors taken from the literature.
Denmark	See General description of national methods used for estimating emissions from Consumption of halocarbons and SF_6. In case of commercial refrigerants and Mobile Air Condition (MAC), national emission factors are defined and used.
Finland	Refrigeration and air conditioning (CRF 2.F.1) Top-down Tier 2, Tier 1a, Tier 1b The Tier 2 top-down method is used for all sources in this category, both stationary and mobile. Data are not collected for separate subcategories because such statistics are either not available or the preparation of such statistics would entail a very high reporting burden on companies. There is also some evidence that simpler questionnaires lead to better response activity. HFC-23 emissions from this source are not reported separately due to confidentiality.
France	IPCC Tier 2. Les émissions de HFC sont déterminées à l'aide du modèle « RIEP » développé par l'Ecole des Mines de Paris qui utilise une méthode de rang 2 du GIEC avancée.
Germany	IPCC Tier 2a. This category is divided into the sub-categories of domestic refrigeration, commercial refrigeration, transport refrigeration, industrial refrigeration, stationary air-conditioning systems and room air-conditioners, and mobile air-conditioning systems. For calculation of HFC emissions from the sub-categories of refrigeration and stationary airconditioning systems, individual data are collected, or refrigerant models used. Any refrigerant models used are described in connection with the relevant method. The emission factors used are the result of surveys of experts. The emission factors for waste disposal are the standard values from the IPCC Guidelines of 1996. For some sub - source categories, disposal emissions occurred for the first time in 2003. [NIR 2007]
Greece	Refrigeration and air-conditioning: F-gases emissions are estimated according to the Tier 2a methodology described in the IPCC Good Practice Guidance. It is a bottom-up approach based on detailed equipment data and emission factors representing various types of leakage per equipment category. It should be noted that the application of the Tier 1

Member States	Description of methods
	methodology (calculation of potential emissions based on imports, exports and domestic consumption of each gas) and Tier 2b is not possible, as the available information is not reported in the way required by these methodologies. Total emissions are calculated as the sum of assembly emissions, operation emissions that include annual leakage from equipment stock in use as well as servicing emissions and disposal emissions that include the amount of refrigerant released from scrapped systems.
Ireland	In terms of stationary refrigeration data on the quantities of industrial gases supplied to the refrigeration sector is obtained from chemical suppliers and manufacturers of refrigeration units. Sales data is provided for a range of HFCs and blends corresponding to the individual HFC species. A bottom-up approach is not feasible for estimating actual emissions from stationary refrigeration and air conditioning in Ireland due to the lack of data available on equipment types and HFC sales data into equipment sub-categories. Therefore emissions are estimated using a top-down approach based on reported sales data and information on market shares, which are applied to calculate estimates of total HFC sales into the Irish stationary refrigeration and air-conditioning sectors. Emissions of HFCs from sub-category 2.IIA.F.1.6 Mobile Air-Conditioning are estimated using a Tier 3b bottom-up analysis which utilises national vehicle fleet statistics from the Department of the Environment, Heritage and Local Government and assumed rates of airconditioning unit penetration in the national vehicle fleet. The methodology used takes account of vehicle lifetime, the percentage of vehicles having HFC in their air-conditioning systems, average charge per unit, product manufacturing emissions, effective lifetime leakage rates (incorporating emissions from normal operating losses and accidental releases arising from collision damage) and decommissioning losses.
Italy	Refrigeration and air-conditioning: IPCC Tier 2a Basic data and have been supplied by industry: specifically, for the mobile air conditioning equipment the national motor company and the agent's union of foreign motor-cars vehicles have provided the yearly consumptions; for the other air conditioning equipment the producer supply detailed table of consumption data by gas. Losses rates have been checked with industry and they are distinguished by domestic equipment, small and large commercial equipment, industrial chillers, mobile air conditioning equipment. Refrigeration activities, such as commercial, transport, industrial and other stationary, are all reported under domestic refrigeration because no detailed information is available to split consumptions and emissions in the different sectors. Anyway appropriate losses rates have been applied for each gas taking in account the equipment where refrigerants are generally used. Therefore implied product life factors, especially for HFC 134a, result from the weighted average of different losses rates, from 0.7% for domestic refrigeration to 10% for large chillers.
Luxembourg	See General description of national methods used for estimating emissions from Consumption of halocarbons and SF_6. [NIR 2007]
Netherlands	See General description of national methods used for estimating emissions from Consumption of halocarbons and SF_6.
Portugal	CFC, HCFC and F-Gases emissions from operation and disposal of Domestic Refrigeration Equipments, Commercial Refrigeration (non domestic Refrigeration Equipments), transport refrigeration equipments, Stationary and Industrial Air conditioning equipments and Mobile Air Conditioning were estimated using the bottom-up approach (Tier 2a or actual method) as proposed in chapter 3.7.4 of the GPG. The stock of domestic refrigeration equipments was estimated from the number of households and from the percentage of households with refrigeration equipments, available for years 1990, 1995 and 2000, according to an unpublished report from INE. A survey to Hotels, Hostels and Camping Parks was conducted with the support of "Turismo de Portugal, ip" and "AHP – Associação da Hotelaria de Portugal", in order to obtain real data concerning the number and dimension of non-domestic refrigeration equipments. Data pertaining to other commerce and services activities was estimated with the technical support of APIRAC, Importers and DGE (Enterprise and Industry General Directorate). Calculations for Hypermarkets were made separately. Estimates for Road Transportation and Railways were made separately. The number of light vehicles with MAC was estimated from the total number of light vehicles sold each year, using the same information used to establish the time series of car sales and fleet in chapter 1A3, and the percentage of new cars sold with MAC at each year was estimated according to data provided by manufacturers.
Spain	En cuanto a la refrigeración y el aire acondicionado se ha contado con información suministrada para algunos años por las asociaciones empresariales del frío y climatización y, por lo que respecta a su uso en la industria de automoción, con información obtenida vía cuestionario a las plantas de fabricación de automóviles. En el primer caso, es decir para los equipos estacionarios de refrigeración y climatización, el equipo de trabajo del inventario ha extendido las tasas de variación interanual para completar los últimos años de la serie al no haberse podido disponer de otra información en esta edición del inventario. Los factores de emisión son por lo que respecta a la producción nacional de automóviles datos derivados de la información de cuestionarios a las plantas fabricantes, y para los demás sub-sectores se han tomado de las guías de IPCC. La metodología de estimación de las emisiones se ha basado en la expuesta en la Sección 2.17.4.2 del Manual de Referencia 1996 IPCC y en las secciones 3.7.4 y 3.7.5 de la Guía de Buenas Prácticas 2000 IPCC. Según estas referencias las emisiones se pueden originar en las fases de montaje, funcionamiento y retirada de los equipos. A cada una de estas fases corresponde un algoritmo de cálculo de las emisiones. La emisión total será la suma de las emisiones generadas en cada una de las tres fases.
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).

Member States	Description of methods
United Kingdom	The calculation methodology within the model is considered to provide a relatively conservative approach to the estimation of emissions. The bank of fluid is estimated by considering the consumption of fluid in each sector, together with corrections for imports, exports, disposal and emissions. Once the size of the bank in a given year is known, the emission can be estimated by application of a suitable emission factor. Emissions are also estimated from the production stage of the equipment and during disposal. The methodology corresponds to the IPCC Tier 2 -'bottom-up'- approach. Data are available on the speciation of the fluids used in these applications; hence estimates were made of the global warming potential of each fluid category. Emissions from the domestic refrigeration sector were estimated based on a bottom-up approach using UK stock estimates of refrigerators, fridge-freezers, chest-freezers and upright freezers from the UK Market Transformation Programme (MTP, 2002). For the commercial 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). A full list of emission factors and assumptions used for the domestic and commercial refrigeration sub-sectors is provided in AEAT (2004). Emissions of HFCs from mobile air conditioning systems were also derived based on a bottom-up analysis using UK vehicle statistics obtained from the UK Society of Motor Manufacturers and Traders, and emission factors determined in consultation with a range of stakeholders. A full account of the assumptions and data used to derive emission estimates for the MAC sub-sector is in AEAT (2004).

Source: NIR 2008 unless stated otherwise

Table 4.61 provides an overview of all sources reported under 2F9 Other by EU-15 Member States for the year 2006. The largest contributor to emissions is Germany with 42 %. CO_2 Most Member States report emissions from double glaze windows in this source category.

Table 4.61 2F9 Other: Overview of sources reported under this source category for 2006

Member State	2.F.9 Other	HFC emissions [Gg CO_2 equivalents]	PFC emissions [Gg CO_2 equivalents]	SF_6 emissions [Gg]	Total emissions [Gg CO_2 equivalents]	Share in EU-15 Total
Austria	Double glaze windows, Research and other use	NA,NO	NA,NO	0.0115	274.0	7.6%
Belgium	Double glaze windows	NA	NA	0.0027	64.2	1.8%
Denmark	Double glaze windows, Laboratories, Fibre optics	0.9	3.4	0.0010	27.4	0.8%
Finland	Grouped confidential data	1.4	1.1	0.0012	32.2	0.9%
France	Shoes application, Closed application, Open application	NA,NO	188.4	NO	188.4	5.2%
Germany	Car Tyres, Shoes, Trace gas, Double glaze windows, Coating, AWACS maintenance	1.8	C,NA,NO	0.0634	1,517.6	41.8%
Greece	NA	NA	NA	NA	-	0.0%
Ireland	Medical Applications, Tracer in Leak Detection, Double glaze windows, Sporting goods	NA,NO	NA,NO	0.0005	13.0	0.4%
Italy	NA,NO	NA,NO	NA,NO	NO	-	0.0%
Luxembourg	Noise reduction windows	NA,NO	NA,NO	0.0001	2.9	892.3
Netherlands	No specific allocation due to confidentiality of data	145.3	194.5	0.0090	554.9	15.3%
Portugal	NA,NO	NA,NO	NA,NO	NO	-	0.0%
Spain	NA	NA	NA	NA	-	0.0%
Sweden	Shoes, Double glaze windows	NA,NO	NA,NE,NO	0.0005	11.9	0.3%
UK	Semiconductors, Electrical and production of trainers, One Component Foams, OT and CD F Gas Emissions	162.5	82.8	0.0291	940.0	25.9%
EU-15 Total		**312**	**470**	**0.1190**	**3,626**	**100.0%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.62 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. 62 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 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	127	82	274	9.6%	192	236%	147	117%	CS	Q	CS
Belgium	84	73	64	2.3%	-9	-12%	-19	-23%	NA	NA	NA
Denmark	12	9	23	0.8%	14	149%	11	93%	M/CS	CS	M/CS
Finland	8	16	30	1.0%	14	89%	22	278%	T1	Q	D
France	118	NO	NO	-	-	-	-118	-	0.0	0.0	0.0
Germany	3,211	1,425	1,516	53.3%	91	6%	-1,695	-53%	NA	¾	NA
Greece	0	0	NA	-	-	-	-	-	0.0	0.0	0.0
Ireland	13	7	13	0.5%	6	88%	0	-3%	NO	NO	NO
Italy	NO	NO	NO	-	-	-	-	-	D	AS	PS
Luxembourg	2	3	3	0.1%	0	2%	1	23%	CS	Q	CS
Netherlands	217	250	215	7.6%	-35	-14%	-2	-1%	CS,T2	PS	D,PS
Portugal	NE	NO	NO	-	-	-	-	-	NA	NA	NA
Spain	NA	NA	NA	-	-	-	-	-	NA	NA	NA
Sweden	2	14	12	0.4%	-2	-17%	9	382%	CS	PS	CS, D, PS
United Kingdom	604	856	695	24.4%	-161	-19%	91	15%	T2	PS, AS	CS
EU-15	**4,398**	**2,734**	**2,844**	**100.0%**	**110**	**4%**	**-1,554**	**-35%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.63 provide descriptions on methods used for estimating SF_6 emissions from 2F Consumption of Halocarbons and SF_6.

Table 4.63 2F Consumption of halocarbons and SF_6: Description of national methods used for estimating SF_6 emissions

Member States	Description of methods
Austria	<u>Semiconductors:</u> All consumption data and data about actual emissions from semiconductor manufacture are based on direct information from industry. Because of the confidentiality claimed for consumption data in this industry emissions are reported in the CRF only for the sum of HFC and PFC. Emissions are calculated according to the formula presented below: *Emissions = Consumption*(1-emission control technology) * efficiency factor * uptime* Typical ranges of these parameters are: for emission control technology 0.01 – 0.95, for efficiency factor 0.75-0.95, and for uptime 0.9. The emission control technology applied is high temperature combustion and elution of HF with typical efficiencies of 65-95% for latest years.. <u>Electrical Equipment:</u> Information on SF_6 stocks in electrical equipment in 2003-2006 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. <u>Noise insulating windows:</u> 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. Emissions at disposal became relevant in 2006, because the average life time is estimated to be 25 years and the first SF_6 filled windows were introduced in Austria in 1980. They are calculated by assuming that the remaining quantity of SF_6 in windows produced in 1980 is emitted this year. <u>Tyres:</u> 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. <u>Shoes</u>: 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. <u>Research:</u> 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 originating from the production and the stock of soundproof double-glazing are calculated from the SF_6 consumption data, which have been obtained from the main manufacturers. The emission rate of glazing from the bank is assumed to be 1% /year, as previously. The emission from production of acoustic double glazing is assumed to be 33% of the SF_6 consumption. The disposal emissions are based on an assumed unique lifetime of 25 years. SF_6 emissons from the electricity sector are based on stock and emission factor data obtained from the SYNERGRID association.
Denmark	See also General description of national methods used for estimating emissions from Consumption of halocarbons and SF_6.
Finland	<u>Electrical equipment (CRF 2.F. 8)</u> 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). <u>Running shoes (CRF 2.F. 9)</u> 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.

Member States	Description of methods
France	IPCC Tier 2. Fabrication de semi-conducteurs (2F7) : Les émissions de PFC, HFC-23 et SF_6 sont calculées selon la méthode de rang 2c du GIEC à partir des consommations de gaz déclarées par les sites. Equipements électriques (2F8) : La méthode de calcul distingue les émissions à la charge des équipements à l'usine selon les quantités déclarées par les industriels à leur syndicat et les émissions du parc installé estimées par EDF qui distingue les fuites à l'usage, la maintenance et la fin de vie.
Germany	Semiconductor manufacture: In keeping with a standardised calculation formula (Tier 2c approach), the emissions data are calculated for each production site, from annual consumption, aggregated and then reported by the German Electrical and Electronic Manufacturers Association (Zentralverband Elektrotechnik- und Elektroindustrie eV. - ZVEI, electronic components and systems) to the Federal Environmental Agency. The basic data for calculation, the 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 calculated. Electrical equipment: The emissions data is based primarily on a mass balance and not on the calculation using EF and AR. Ongoing emissions from products in service include the amount of SF_6 in service, as accumulated since 1970 via annual additions of switching systems; they are given as the average for year n. The final amount of SF_6 in all electrical equipment for a given year n changes annually by the balance of new additions and removals. Some removals (high voltage) have been registered since 1997; systematic removals of products from entire years cannot be expected before 2010, in light of the products' estimated 40-year service lifetime. Noise insulating windows: Emissions are calculated in keeping with with equations 3.24 – 3.26 of IPCC-GPG (2000) on the basis of new domestic consumption, average annual stocks and remaining stocks 25 years ago. Tyres and Shoes: The emissions are calculated using equation 3.23 of IPCC-GPG (2000). [NIR 2007]
Greece	Electrical equipment The available information is not sufficient in order to apply the methodologies suggested by the IPCC Good Practice Guidance. CS: In the context of the present inventory emissions are estimated on the basis of information provided by PPC regarding losses in the transmission and in the distribution system. The data provided cover the period 1995 – 2004. Emissions estimates from the transmission system and for the years 2003 and 2004 are the results of measurements performed by PPC.
Ireland	Semiconductor manufacture: There are two main semiconductor manufacturers in Ireland, both of which provide data on the annual use and estimated emissions of HFCs, PFCs and SF_6 in their plants over the full time series 1990-2006. Electrical equipment: The Electricity Supply Board (ESB) is the owner of both the high and low voltage distribution systems and the owner and operator of the medium and lower voltage distribution systems in Ireland. The company has supplied an estimate of SF_6 emissions from their equipment using a Tier 1 approach based on an analysis of opening and closing stocks of SF_6. Other Emission Sources (2.F.9): This category includes emissions of SF_6 from minor uses within Ireland including emissions from double glazed windows, medical applications, sporting goods and as a gas-air tracer in leak detection.
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, several years). Additional data on SF_6 used in high voltage gasinsulated transmission lines have been supplied by the main energy distribution companies
Luxembourg	See also General description of national methods used for estimating emissions from Consumption of halocarbons and SF_6. [NIR 2007]
Netherlands	See General description of national methods used for estimating emissions from Consumption of halocarbons and SF_6.
Portugal	SF_6 emissions from electrical equipment: different estimates methodologies for electricity distribution at: (a) Very High Voltage (>110 kV): a methodology based on "Correspondent States Principle" was used (b) distribution at Low (≤1 kV), Medium (>1 kV and ≤45 kV) and High Voltage (>45 kV and ≤110 kV): estimated with a tier T3b, based on data provided by "EDP Distribuição", excluding the details in life-cycle and using a country-specific emission factor. Separate estimates were made for Gas Circuit Breakers; Outdoor Gas Insulated Switchgears; Gas Insulated Switchgears; High and Medium Voltage Sectioning Posts;
Spain	Tier 2. Category 2F8 includes the SF_6 emissions from electrical equipment. In the case of Spain, this is the only source generating emissions of this gas. De una forma general, las emisiones se pueden generar en cada uno de los siguientes puntos del ciclo de vida de los equipos eléctricos que incorporan SF_6 como aislante: 1) En la fase de fabricación del equipo (lo que incluye las operaciones de prueba y la carga de los equipos). 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	Semiconductor manufacture: Information concerning the annually used amounts of various fluorinated

Member States	Description of methods
	substances has been provided by the company, and as far as possible been compared to information from the Products register at the Swedish Chemicals Inspectorate. Emissions are calculated by using the IPCC Good practice Guidance Tier 1 method. Electrical equipment: The SF_6 emissions from production have decreased in later years due to measures taken at the production facility. These estimates, obtained from industry, are of medium to high quality, with better quality in later years. Emissions from installed amounts of SF_6 for insulation purposes in operating systems have previously contributed less to the actual annual emissions. In 2001-2002, a questionnaire was sent out to power companies from the trade association 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 showed an installed accumulated amount of approximately 80 Mg and an annual leakage rate of 0.6% (equals the amount replaced from the questionnaire) and these were used as input data in the inventory. For later years, data on replaced amounts of SF_6 in operating systems results in a calculated annual leakage rate of 0.5% (Swedenergy and power distribution companies). For jogging shoes, a more or less rough estimate has been made. It has not been possible to obtain any national data, so a Norwegian estimate was scaled to the Swedish population. According to the results from a study performed in early 2004 a phasing out of SF_6 and replacement with PFC-218 was started in 2003. Manufacturers of windows have provided data on the amount of SF_6 used in the manufacture of barrier gas windows. The manufacturers have also provided estimates of the share of SF_6 emitted in production. These estimates vary considerably between manufacturers, from 5-50%. Calculating a weighted average of the emission factor at production results in a national figure in the order of 30%, which is in line with the point estimate of 33% given in the IPCC Good Practice Guidance.
United Kingdom	Emissions of SF_6 from semiconductor manufacturing and from electrical equipment are combined with emissions from training shoes in source category 2F8b for reasons of commercial confidentiality. SF_6 emission from electrical transmission and distribution were based on industry data from BEAMA (for equipment manufacturers) and the Electricity Association (for electricity transmission and distribution), who provided emission estimates based on Tier 3b, but only for recent years. Tier 3a estimates were available for the electricity distribution and transmission industry for 1995. In order to estimate a historical time series and projections, these emission estimates together with fluid bank estimates provided by the utilities were extrapolated using the March study methodology (March, 1999). This involved estimating leakage factors based on the collected data and using the March model to estimate the time series. Emissions prior to 1995 used the March SF_6 consumption data to extrapolate backwards to 1990 from the 1995 estimates. Emissions of PFC and SF_6 emissions from electronics are based on data supplied by UK MEAC – the UK Microelectronics Environmental Advisory Committee. UK MEAC gave total PFC consumption for the UK electronics sector based on purchases of PFCs as reported by individual companies. Emissions were then calculated using the IPCC Tier 1 methodology, which subtracts the amount of gas left in the shipping container (10%), the amount converted to other products (between 20% and 80% depending on the gas) and the amount removed by abatement (currently assumed to be zero). Emissions for previous years were extrapolated backwards assuming an annual 15% growth in the production of semiconductors in the UK up until 1999.

Source: NIR 2008 unless stated otherwise

Table 4.64 summarizes the recommendations from the UNFCCC review of the initial report in relation to the category 2F Consumption of Halocarbons. The overview shows that some recommendations have been implemented.

Table 4.64 2F Consumption of halocarbons and SF_6: Findings of the UNFCCC review of the initial report and responses in 2008 inventory submissions

Member State	Review findings and responses related to 2.F. Consumption of halocarbons and SF6	
	Comment UNFCCC report of the review of the initial report	Status in 2008 submission
Austria	No recommendation for improvement for this source category in the report of the review of the initial report.	No follow-up necessary
Belgium	The ERT encourages Belgium to report both the potential emissions and ratio of potential to actual emissions for F-gases.	potential emissions and the ratio of potential to actual emissions are reported; potential emissions are reported as negative numbers, which is not comprehensible.
Denmark	Detailed information on EFs is not provided in the NIR. The ERT recommends that Denmark provide more information on the choice of EFs and the specific model approaches.	Not resolved; no detailed information on the choice of EFs and specific model approaches is provided.
Finland	The trend for SF6 emissions from 1990 to 1995 displays considerable year-to-year variation. The ERT recommends that Finland provide this detailed information in the next NIR, explaining the decreasing trend in SF6 emissions from 1990 to 1994 and the sudden increase in 1995, in particular since 1995 is the base year for the F-gases.	Resolved; the trend for SF6 from electrical equipment is explained in the NIR.
France	All categories are reported in the base year, except for the potential emissions of PFCs. Italy informed the ERT during the in-country review that these emissions will be included in its next submission.	No follow-up necessary
Germany	The ERT recommends that Germany complete the recalculation and fully document the changes in its next inventory report, as Germany indicates it will in the NIR.	Partly resolved; Several Recalculations in the sector 2.F are reported in the NIR. In this sector improvements are still planned according to the NIR.
Greece	The ERT recommends that Greece develop estimates for the categories (refrigeration and air conditioning (2.F.1), the subcategories industrial refrigeration, transport refrigeration; foam blowing (2.F.2); fire extinguishers (2.F.3); aerosols and metered dose inhalers (2.F.4); solvents (2.F.5); and semiconductor manufacturing (2.F.7)) in its future inventories; as appropriate, set up a system for the gathering of data; and develop a national application of the methods described in the IPCC good practice guidance.	Not resolved; in the Greek CRF for the year 2006 emissions from 2.F.1 Refrigeration and Air Conditioning Equipment are reported, but Table 2(II).Fs1 does not include emissions from industrial and transport refrigeration. Emissions from all other categories in 2.F are reported NE.
Ireland	The ERT recommends that the documentation on the methods (for stationary refrigeration and air conditioning, international production data for foams, and United Kingdom data for aerosols adjusted for population size) be improved in Ireland's next inventory submission, including the underlying assumptions (from the studies) and explanations of the inter-annual fluctuations.	Partly resolved; a comprehensive description of methods used is provided for each sub-sector. Explanations of inter-annual fluctuations are still missing.
Italy	All categories are reported in the base year, except for the potential emissions of PFCs. Italy informed the ERT during the in-country review that these emissions will be included in its next submission.	Resolved; potential PFC emissions are reported.
Luxembourg	The ERT recommends that Luxembourg use information from the new draft F-gas study and recalculate the emissions for the whole time-series for its next submission. The ERT further recommends that AD and EFs be reported in the relevant background tables of the CRF to improve transparency.	Not resolved; Luxembourg still reports NE in some 2.F sub-sectors and does not report background data in Table2(II).Fs
Netherlands	No recommendation for improvement for this source category in the report of the review of the initial report.	No follow-up necessary
Portugal	No recommendation for improvement for this source category in the report of the review of the initial report.	No follow-up necessary
Spain	Spain is encouraged to continue its efforts to collect reliable data to help in the estimation of potential emissions of fluorinated gases (F-gases) and to improve the use of the notation keys. Information on the consumption of halocarbons and SF6 in semiconductor manufacturing is currently lacking. Spain is encouraged to continue with the improvements it plans, looking for other sources of information for emissions from semiconductor manufacturing involving the other ministries and industry contacts.	Not resolved; potential emissions are not calculated. Not resolved; emissions from semiconductor manufacturing are not reported and the NIR does not include planned improvements with respect to estimate emissions from this sub-source .
Sweden	No recommendation for improvement for this source category in the report of the review of the initial report.	No follow-up necessary
UK	No recommendation for improvement for this source category in the report of the review of the initial report.	No follow-up necessary

4.2.6 Other (CRF Source Category 2G) (EU-15)

Table 4.65 shows that only one Member State reports GHG emissions under 2G5 Other for the year 2006. The Netherlands includes emissions from fireworks and candles, degassing drinkwater from groundwater and process emissions in other economic sectors.

Table 4.65 2G Other: Overview of sources reported under this source category for 2006

Member State	2.G Other	CO_2 emissions [Gg]	CH_4 emissions [Gg]	N_2O emissions [Gg]	Total emissions [Gg CO2 equivalents]	Share in EU-15 Total
Austria	NA	NA	NA	NA	-	0.0%
Belgium	NA,NE	NA,NE	NA	NA	-	0.0%
Denmark	NO	NO	NO	NO	-	0.0%
Finland	NA	NA	NA	NA	-	0.0%
France	NO	NO	NO	NO	-	0.0%
Germany	NO	NO	NO	NO	-	0.0%
Greece	NO	NO	NO	NO	-	0.0%
Ireland	NO	NO	NO	NO	-	-
Italy	NA	NA	NA	NA	-	0.0%
Luxembourg	NA	NA	NA	NA	-	-
Netherlands	Fireworks and candles, Degassing drinkwater from groundwater, Process emissions in other economic sectors	332.2	1.8	0.0	376	100.0%
Portugal	NO	NO	NO	NO	-	0.0%
Spain	NA	NA	NA	NA	-	0.0%
Sweden	NA	NA	NA	NA	-	0.0%
UK	NA	NA	NA	NA	-	0.0%
EU-15 Total		**332**	**2**	**0**	**376**	**100.0%**

Abbreviations explained in the Chapter ‘Units and abbreviations’.

4.2 Methodological issues and uncertainties (EU-15)

The previous section presented for each EU-15 key source in CRF Sector 2 an overview of the Member States’ contributions to the key source in terms of level and trend, information on methodologies, emission factors, completeness and qualitative uncertainty estimates. Detailed information on national methods and circumstances is available in the Member States’ national inventory reports.

Table 4.66 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 CO_2 from 2A6 and the lowest for PFC from 2E. With regard to trend CO_2 from 2A6shows the highest uncertainty estimates, CO_2 from 2D, CH_4 from 2B and 2G the lowest. For a description of the Tier 1 uncertainty analysis carried out for the EU-15 see Chapter 1.7.

Table 4.66 Sector 2 Industrial processes: Uncertainty estimates for the EU-15

Source category	Gas	Emissions 1990	Emissions 2006 [1]	Emission trends 1990-2006	Level uncertainty estimates based on MS uncertainty estimates	Trend uncertainty estimates based on MS uncertainty estimates
2.A.1 Cement production	CO_2	80.547	85.342	6%	3%	9
2.A.2 Lime production	CO_2	17.285	18.096	5%	11%	-1
2.A.3 Limestone and dolomite use	CO_2	6.335	8.302	31%	9%	205
2.A.4 Soda ash production and use	CO_2	1.702	1.934	14%	14%	19
2.A.5 Asphalt roofing	CO_2	0	0	25%	25%	19
2.A.6 Road paving with asphalt	CO_2	27	16	-40%	8661%	35027
2.A.7 Other	CO_2	4.057	4.537	12%	12%	91
2.B Chemical industry	CO_2	27.732	31.264	13%	13%	4
2.C Metal production	CO_2	77.621	71.383	-8%	4%	1
2.D Other Production	CO_2	73	20	-72%	100%	0
2.A Mineral products	CH_4	24	19	-20%	102%	26
2.B Chemical industry	CH_4	515	397	-23%	24%	0
2.C Metal production	CH_4	105	156	49%	37%	16
2.G Other	CH_4	42	38	-11%	51%	0
2.B Chemical industry	N_2O	100.189	36.348	-64%	18%	7
2.C Metal production	N_2O	13	8	-34%	118%	36
2.G Other	N_2O	3	7	121%	71%	85
2.E Production of halocarbons and SF_6	HFC	27.459	4.736	-83%	42%	7
2.F Consumption of halocarbons and SF_6	HFC	544	51.651	9386%	33%	60
2.C Metal production	PFC	13.341	1.563	-88%	6%	4
2.E Production of halocarbons and SF_6	PFC	3.579	873	-76%	0,03%	0,1
2.F Consumption of halocarbons and SF_6	PFC	585	1.707	192%	11%	20
2.C Metal production	SF_6	1.732	3.241	87%	1%	7
2.E Production of halocarbons and SF_6	SF_6	1.815	125	-93%	3%	1
2.F Consumption of halocarbons and SF_6	SF_6	7.096	5.376	-24%	10%	7
Total	**all**	**372.987**	**327.953**	**-12%**	**6%**	**4**

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 (EU-15)

There are two main activities for improving the quality of GHG emissions from industrial processes: (1) Before and during the compilation of the 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 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 (EU-15)

Table 4.67 shows that in the industrial processes sector the largest recalculations in absolute terms were made for CO_2 in 1990 and 2005.

Table 4.67 Sector 2 Industrial processes: Recalculations of total GHG emissions and recalculations of GHG emissions for 1990 and 2005 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	-50.392	-1,6%	-851	-0,2%	-8.415	-2,1%	5	0,0%	617	3,7%	-51	-0,5%
Industrial Processes	-1.429	-0,7%	0	0,1%	-1.127	-1,1%	5	0,0%	617	3,7%	-51	-0,5%
2005												
Total emissions and removals	33.796	1,1%	2.011	0,6%	-11.037	-3,3%	220	0,4%	-35	-0,6%	-70	-0,8%
Industrial Processes	133	0,1%	5	0,8%	-76	-0,2%	-109	-0,2%	-35	-0,6%	-70	-0,8%

Table 4.68 provides an overview of Member States' contributions to EU-15 recalculations. France had the most influence on the CO_2 recalculations in 1990 and 2005. N_2O recalculations in 1990 were mostly influenced by the Netherlands.

Table 4.68 Sector 2 Industrial processes: Contribution of Member States to EU-15 recalculations for 1990 and 2005 by gas (difference between latest submission and previous submission Gg of CO_2 equivalents)

	1990						2005					
	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
Austria	0	0	0	0	0	0	2	0	0	-3	11	1
Belgium	-681	0	0	5	680	0	453	0	0	47	0	33
Denmark	1	0	0	0	0	0	0	0	0	0	0	0
Finland	-12	0	0	0	0	0	-1	0	57	0	0	0
France	-1.760	0	280	0	0	-48	-731	0	484	1.114	0	31
Germany	0	0	0	0	0	0	185	0	-297	-12	0	-63
Greece	0	0	0	0	0	0	-384	0	0	-1.336	0	0
Ireland	-2	0	0	0	0	0	-2	0	0	2	-4	0
Italy	0	0	0	0	0	0	327	0	0	0	0	0
Luxembourg	39	0	0	1	-	0	-133	0	0	32	-	0
Netherlands	-34	0	-1.409	0	0	0	30	0	-618	-4	1	-77
Portugal	0	0	0	0	0	-3	-41	0	0	349	0	5
Spain	666	0	2	0	0	0	124	2	299	0	0	0
Sweden	0	0	0	0	-63	0	-15	0	0	30	-37	0
UK	355	0	0	0	0	0	318	2	0	3	-5	0
EU-15	**-1.429**	**0**	**-1.127**	**5**	**617**	**-51**	**133**	**5**	**-76**	**220**	**-35**	**-70**

4.5 Industrial processes for EU-27

4.5.1 Overview of sector (EU-27)

Figure 4.3 CRF Sector 2 Industrial Processes: EU-27 GHG emissions for 1990–2006 in CO_2 equivalents (Tg)

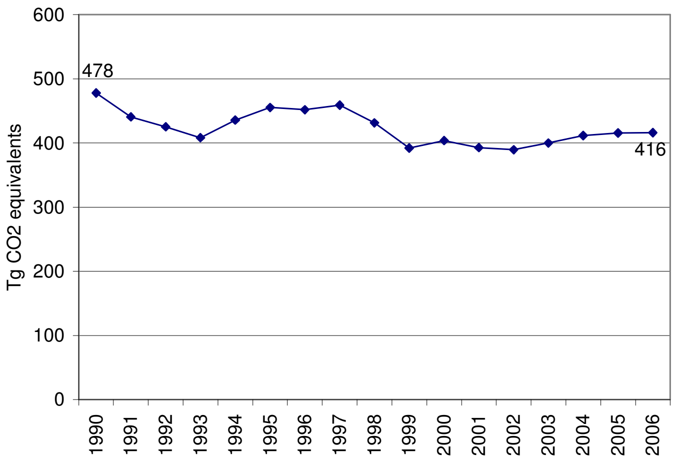
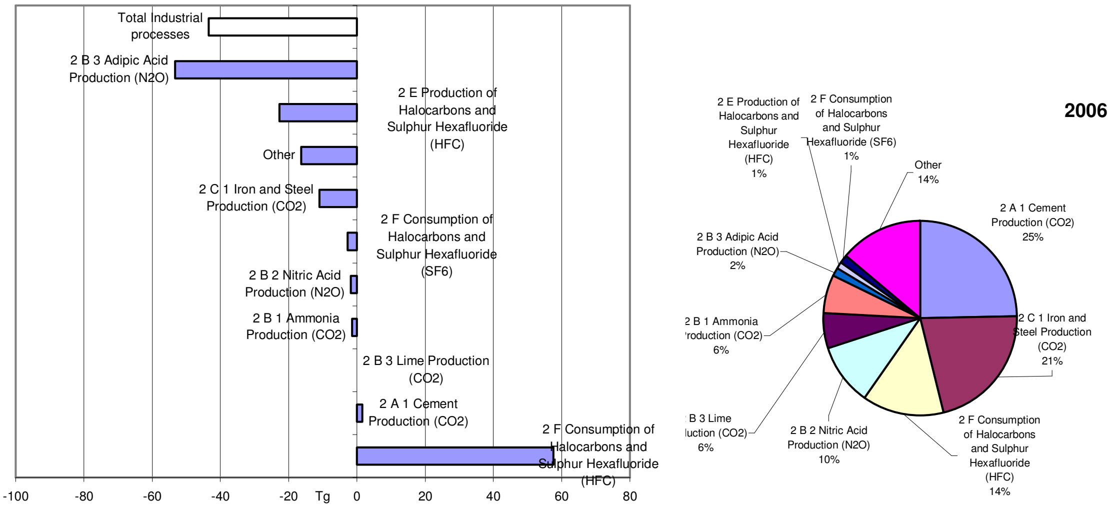


Figure 4.4 **CRF Sector 2 Industrial processes: Absolute change of GHG emissions by large key source categories 1990–2006 in CO_2 equivalents (Tg) and share of largest key source categories in 2006**



4.5.2 Source categories (EU-27)

4.1.1.1 Mineral products (CRF Source Category 2A) (EU-27)

Table 4.62 **2A1 Cement production: CO_2 emissions of EU-27**

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	80,547	84,406	85,342	82.7%	936	1%	4,795	6%			
Bulgaria	2,070	1,552	1,488	1.4%	-63	-4%	-582	-28%	T2	NS	D
Cyprus	565	822	821	0.8%	-1	0%	256	45%	CS	PS	CS
Czech Republic	2,489	1,625	1,748	1.7%	123	8%	-741	-30%	T2	NS	CS
Estonia	483	373	414	0.4%	41	11%	-69	-14%	CS	PS	CS
Hungary	1,673	1,199	1,295	1.3%	97	8%	-377	-23%	D,T2,T3	PS	PS
Latvia	366	120	133	0.1%	13	11%	-233	-64%	T2	PS	PS
Lithuania	1,571	363	424	0.4%	61	17%	-1,147	-73%	T2	NS	PS
Malta	NO	NO	NO	-	-	-	-	-	CS	PS	CS
Poland	5,453	5,057	5,984	5.8%	927	18%	530	10%	T1	NS	CS
Romania	4,416	3,154	3,631	3.5%	478	15%	-784	-18%	T2, CS1	AS, Q, NS	D, PS
Slovakia	1,438	1,234	1,364	1.3%	130	11%	-74	-5%	T1a	AS	CS
Slovenia	482	498	523	0.5%	25	5%	41	8%	T2	PS	PS
EU-27	**101,552**	**100,402**	**103,168**	**100.0%**	**2,766**	**3%**	**1,616**	**2%**			

Table 4.63 2A2 Lime Production: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	17,285	17,539	18,096	73.8%	558	3%	811	5%			
Bulgaria	1,222	996	1,038	4.2%	42	4%	-184	-15%	T2	NS	D
Cyprus	6	13	13	0.1%	0	0%	7	126%	T1	PS	CS
Czech Republic	869	496	493	2.0%	-3	-1%	-376	-43%	D	NS	CS
Estonia	145	29	31	0.1%	2	7%	-114	-79%	T1	PS	CS
Hungary	653	323	304	1.2%	-19	-6%	-349	-53%	D, T2	PS	D
Latvia	121	2	1	0.0%	-1	-29%	-120	-99%	T2	PS	PS
Lithuania	212	29	48	0.2%	19	64%	-165	-77%	T1	NS	D
Malta	NE	NO	NO	-	-	-	-	-	T1	PS	CS
Poland	2,512	1,373	1,520	6.2%	147	11%	-992	-40%	T1	NS	D
Romania	3,080	1,982	1,975	8.1%	-7	0%	-1,105	-36%	D3	NS	D
Slovakia	770	786	854	3.5%	68	9%	84	11%	T1a	AS	CS
Slovenia	206	121	134	0.5%	13	11%	-72	-35%	T2	PS	PS
EU-27	**27,082**	**23,689**	**24,508**	**100.0%**	**819**	**3%**	**-2,575**	**-10%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.64 2A3 Limestone and Dolomite Use: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	6,335	7,924	8,302	68.7%	378	5%	1,967	31%			
Bulgaria	482	314	329	2.7%	16	5%	-152	-32%	0.0	0.0	0.0
Cyprus	NE	NA	NA	-	-	-	-	-	NO	NO	NO
Czech Republic	678	1,055	1,069	8.9%	14	1%	392	58%	CS	NS	CS
Estonia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Hungary	202	332	321	2.7%	-12	-4%	118	58%	D, T2	PS	D
Latvia	0	42	31	0.3%	-11	-25%	31	8766%	T2	PS	PS
Lithuania	NE	NE	NE	-	-	-	-	-	NA	NE	NA
Malta	NE	NE	NE	-	-	-	-	-	NO	NO	NO
Poland	IE	569	618	5.1%	49	9%	618	-	PS/IE	PS/IE	PS/IE
Romania	1,221	931	946	7.8%	15	2%	-276	-23%	D	Q, PS2	D
Slovakia	302	471	455	3.8%	-16	-3%	153	51%	T1	AS	CS
Slovenia	2	5	6	0.0%	1	12%	4	146%	T1	PS	D
EU-27	**9,223**	**11,643**	**12,077**	**100.0%**	**433**	**4%**	**2,854**	**31%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

4.1.1.2 Chemical industry (CRF Source Category 2B) (EU-27)

Table 4.65 2B1 Ammonia Production: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	17,038	16,507	16,055	61.5%	-453	-3%	-983	-6%			
Bulgaria	1,620	597	467	1.8%	-129	-22%	-1,153	-71%	T1	NS	D
Cyprus	NO	NA	NA	-	-	-	-	-	T1a, T1b	PS	CS
Czech Republic	807	609	581	2.2%	-28	-5%	-226	-28%	T1	NS	CS
Estonia	317	144	135	0.5%	-9	-6%	-182	-58%	T1a, T1b	PS	CS
Hungary	1,416	822	773	3.0%	-49	-6%	-642	-45%	T3	PS	D, PS
Latvia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Lithuania	1,190	1,154	1,129	4.3%	-26	-2%	-61	-5%	T2	PS	PS
Malta	NO	NO	NO	-	-	-	-	-	T1a, T1b	PS	CS
Poland	2,811	4,448	4,230	16.2%	-218	-5%	1,419	50%	T2	NS	CS
Romania	3,267	2,417	2,370	9.1%	-47	-2%	-897	-27%	T1b	NS	D
Slovakia	356	422	351	1.3%	-71	-17%	-5	-2%	T2	PS	PS
Slovenia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
EU-27	**28,822**	**27,120**	**26,091**	**100.0%**	**-1,029**	**-4%**	**-2,731**	**-9%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.66 2B5 Other: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006	
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
EU-15	9,861	14,699	14,996	100.0%	297	2%	5,135	52%
Bulgaria	NO	NO	NO	-	-	-	-	-
Cyprus	0	0	0	-	-	-	-	-
Czech Republic	IE,NE	IE,NE	IE,NE	-	-	-	-	-
Estonia	NA	NA	NA	-	-	-	-	-
Hungary	NO	NO	NO	-	-	-	-	-
Latvia	NO	NO	NO	-	-	-	-	-
Lithuania	NO	NO	NO	-	-	-	-	-
Malta	NO	NO	NO	-	-	-	-	-
Poland	0	0	0	-	-	-	-	-
Romania	NE	NE	NA,NE	-	-	-	-	-
Slovakia	NO	NO	NO	-	-	-	-	-
Slovenia	NA,NO	NA,NO	NA,NO	-	-	-	-	-
EU-27	**9,861**	**14,700**	**14,997**	**100.0%**	**297**	**2%**	**5,135**	**52%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.67 2B2 Nitric acid production: N_2O emissions of EU-27

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	36,749	33,206	27,802	66.3%	-5,404	-16%	-8,947	-24%			
Bulgaria	2,255	992	900	2.1%	-92	-9%	-1,356	-60%	D	NS	D
Cyprus	NO	NA	NA	-	-	-	-	-	NO	NO	NO
Czech Republic	1,127	1,009	915	2.2%	-94	-9%	-212	-19%	T2	NS, PS	PS
Estonia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Hungary	3,214	1,941	1,629	3.9%	-312	-16%	-1,585	-49%	T3	PS	PS,D
Latvia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Lithuania	771	2,187	2,193	5.2%	6	0%	1,421	184%	T1	PS	D
Malta	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Poland	3,163	4,451	4,414	10.5%	-37	-1%	1,251	40%	T1	NS	CS
Romania	4,402	3,174	2,507	6.0%	-667	-21%	-1,895	-43%	D	Q , PS	D5
Slovakia	1,149	1,281	1,565	3.7%	284	22%	416	36%	T2	PS	PS
Slovenia	NO	0.003	NO	-	-0.003	-100%	-	-	NO	NO	NO
EU-27	**52,831**	**48,241**	**41,925**	**100.0%**	**-6,317**	**-13%**	**-10,906**	**-21%**			

Table 4.68 2B3 Adipic Acid Production: N_2O emissions of EU-27

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU27 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)	(%)			
EU-15	58,927	11,645	6,568	100.0%	-5,077	-44%	-52,359	-89%			
Bulgaria	NO	NO	NO	-	-	-	-	-	0.0	0.0	0.0
Cyprus	NO	NA	NA	-	-	-	-	-	NO	NO	NO
Czech Republic	NO	NO	NO	-	-	-	-	-	NA	NA	NA
Estonia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Hungary	NO	NO	NO	-	-	-	-	-	---	---	---
Latvia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Malta	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Poland	372	NO	NO	-	-	-	-372	-100%	NO	NO	NO
Romania	574	NA	NA	-	-	-	-574	-100%	NA	NA	NA
Slovakia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Slovenia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
EU-27	**59,872**	**11,645**	**6,568**	**100.0%**	**-5,077**	**-44%**	**-53,305**	**-89%**			

Table 4.69 2B5 Other: N_2O emissions of EU-27

Member State	N2O emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2005	Change 2004-2005		Change 1990-2005	
	1990	2004	2005		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
EU-15	4,513	2,066	1,979	85.7%	-88	-4%	-2,535	-56%
Bulgaria	NO	NO	NO	-	-	-	-	-
Cyprus	0	0	0	-	-	-	-	-
Czech Republic	84	84	94	4.1%	11	13%	11	13%
Estonia	NA	NA	NA	-	-	-	-	-
Hungary	NO	NO	NO	-	-	-	-	-
Latvia	NO	NO	NO	-	-	-	-	-
Lithuania	NO	NO	NO	-	-	-	-	-
Malta	NO	NO	NO	-	-	-	-	-
Poland	143	235	235	10.2%	0	0%	92	64%
Romania	NE	NE	NA,NE	-	-	-	-	-
Slovakia	NO	NO	NO	-	-	-	-	-
Slovenia	NA,NO	NA,NO	NA,NO	-	-	-	-	-
EU-27	**4,740**	**2,385**	**2,308**	**100.0%**	**-77**	**-3%**	**-2,432**	**-51%**

4.1.1.3 Metal production (CRF Source Category 2C) (EU-27)

Table 4.70 2C1 Iron and Steel Production: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	71,861	64,341	66,075	74.1%	1,735	3%	-5,786	-8%			
Bulgaria	1,793	1,376	1,548	1.7%	172	12%	-245	-14%	D	NS	C, D
Cyprus	0	NA	NA	-	-	-	-	-	NA	NA	NA
Czech Republic	12,533	7,318	8,425	9.5%	1,107	15%	-4,107	-33%	T1	NS	D
Estonia	NA	NA	NA	-	-	-	-	-	NA	NA	NA
Hungary	380	254	270	0.3%	16	6%	-111	-29%	CS	IS	D
Latvia	13	12	13	0.0%	0	2%	0	-2%	T2	PS	PS
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Malta	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA	NA
Poland	7,624	2,896	4,096	4.6%	1,200	41%	-3,528	-46%	T1/T2/T3/CS	NS/ /Q /PS	CS/PS
Romania	10,291	6,805	8,129	9.1%	1,323	19%	-2,163	-21%	T2	PS, Q	D,CS
Slovakia	420	506	564	0.6%	58	11%	143	34%	T1	PS	CS
Slovenia	30	30	29	0.0%	-2	-6%	-1	-3%	T2	PS	PS
EU-27	**104,945**	**83,539**	**89,148**	**100.0%**	**5,609**	**7%**	**-15,797**	**-15%**			

Table 4.71 2C3 Aluminium Production: PFC emissions of EU-27

Member State	PFC emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	13,341	1,831	1,563	60.6%	-268	-15%	-11,778	-88%			
Bulgaria	NA,NE,NO	NA,NO	NA,NO	-	-	-	-	-	NO	NO	NO
Cyprus	0	NA	NA	-	-	-	-	-	NO	NO	NO
Czech Republic	NO	NO	NO	-	-	-	-	-	NA	NA	NA
Estonia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Hungary	271	208	NO	-	-208	-100%	-271	-100%	D, T2	PS	D, PS
Latvia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Lithuania	NO	NO	NO	-	-	-	-	-	0.0	0.0	0.0
Malta	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Poland	NE	243	253	9.8%	11	4%	253	-	T1	NS	D
Romania	2,116	570	610	23.7%	40	7%	-1,506	-71%	T1	PS, Q	D7
Slovakia	271	20	36	1.4%	16	79%	-236	-87%	T1	PS	D
Slovenia	257	124	116	4.5%	-8	-6%	-142	-55%	T3	PS	PS

4.1.1.4 Production of halocarbons and SF_6 (CRF Source Category 2E) (EU-27)

Table 4.72 2E1 By-Product Emissions: HFC emissions of EU-27

Member State	HFC (Gg CO_2 equivalents)			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	21,158	3,899	3,914	100.0%	15	0%	-17,244	-81%			
Bulgaria	NO	NA,NO	NA,NO	-	-	-	-	-	NE	NE	NE
Cyprus	0	NA	NA	-	-	-	-	-	NA	NA	NA
Czech Republic	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA	NA
Estonia	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA	NA
Hungary	NA,NO	NA,NO	NA,NO	-	-	-	-	-	---	---	---
Latvia	NO	NA,NO	NA,NO	-	-	-	-	-	NO	NO	NO
Lithuania	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NO	NA
Malta	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA	NA
Poland	NE	NA,NE,NO	NA,NE,NO	-	-	-	-	-	NO	NO	NO
Romania	NA	NA	NA	-	-	-	-	-	NA	NA	NA
Slovakia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Slovenia	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NO	NO	NO
EU-27	**21,158**	**3,899**	**3,914**	**100.0%**	**15**	**0%**	**-17,244**	**-81%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

4.1.1.5 Consumption of halocarbons and SF_6 (CRF Source Category 2F) (EU-27)

Table 4.73 2F1 Refrigeration and Air conditioning: HFC emissions of EU-27

Member State	HFC (Gg CO_2 equivalents)			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	89	35,594	38,472	90.1%	2,878	8%	38,383	43059%			
Bulgaria	NE	NE	NE	-	-	-	-	-	NE	NE	NE
Cyprus	0	136	53	0.1%	-83	-61%	53	-	CS	Q	CS
Czech Republic	NO	528	805	1.9%	277	52%	805	-	T2	Q	D
Estonia	NO	8	28	0.1%	20	259%	28	-	CS	Q	CS
Hungary	NO	506	595	1.4%	88	17%	595	-	CS	Q	CS
Latvia	IE,NA,NE	18	34	0.1%	16	90%	34	-	CS	NS	CS
Lithuania	NA	19	113	0.3%	94	497%	113	-	T2	NS	CS
Malta	NE,NO	51	76	0.2%	25	48%	76	-	CS	Q	CS
Poland	NE	2,370	2,196	5.1%	-175	-7%	2,196	-	T1	Q	D
Romania	NE	4	5	0.0%	2	42%	5	-	T2	PS, Q	D
Slovakia	NO	169	196	0.5%	27	16%	196	-	D	AS	CS
Slovenia	NO	95	111	0.3%	16	17%	111	-	T2	NS, PS, Q	D
EU-27	**89**	**39,499**	**42,685**	**100.0%**	**3,186**	**8%**	**42,596**	**47786%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.74 2F4 Aerosols/Meterd Dose Inhalers: HFC emissions of EU-27

Member State	HFC (Gg CO_2 equivalents)			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	57	7,268	7,543	95.0%	275	4%	7,486	13113%			
Bulgaria	NE,NO	NE,NO	NE,NO	-	-	-	-	-	NE	NE	NE
Cyprus	0	NA	NA	#WERT!	-	-	#WERT!	-	CS	Q	CS
Czech Republic	NO	33	42	0.5%	9	26%	42	-	D	Q	D
Estonia	NO	NE	4	0.05%	4	-	4	-	CS	Q	CS
Hungary	NO	7	6	0.1%	-1	-15%	6	-	D, T1	PS	CS
Latvia	NE,NO	1	1	0.01%	0.2	21%	1	-	CS	Q	CS
Lithuania	NA	NE	NE	-	-	-	-	-	NA	NE	NA
Malta	NE	NE	NE	-	-	-	-	-	CS	Q	CS
Poland	0	346	346	4.4%	-1	0%	346	-	T1	Q	D
Romania	NE	NE	NE	-	-	-	-	-	NA	NE	NA
Slovakia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Slovenia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
EU-27	**57**	**7,655**	**7,941**	**100.0%**	**286**	**4%**	**7,884**	**13810%**			

Table 4. 75 2F9 Other: SF_6 emissions of EU-27

Member State	SF_6 emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	4,398	2,734	2,844	96.8%	110	4%	-1,554	-35%			
Bulgaria	NE	NE	NE	-	-	-	-	-	0.0	0.0	0.0
Cyprus	0	NA	NA	-	-	-	-	-	CS	Q	CS,D
Czech Republic	NO	33	12	0.4%	-22	-65%	12	-	T2	Q	D
Estonia	NO	NE,NO	0.03	-	-	-	0.03	-	CS	Q	CS,D
Hungary	NO	50	83	2.8%	32	64%	83	-	---	---	---
Latvia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Lithuania	NA	NO	NO	-	-	-	-	-	0.0	0.0	0.0
Malta	NA	NA	NA	-	-	-	-	-	CS	Q	CS,D
Poland	NO	NA,NO	NA,NO	-	-	-	-	-	T1	Q	D
Romania	NE	NE	NE	-	-	-	-	-	NA	NE	NA
Slovakia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Slovenia	NA	NA	NA	-	-	-	-	-	T2	AS	PS
EU-27	**4,398**	**2,818**	**2,939**	**100.0%**	**121**	**4%**	**-1,459**	**-33%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

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 (EU-15)

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 20 % from 10.2 Tg in 1990 to 8.1 Tg in 2006 (Figure 5.1 and Table 5.1).

As it is shown in Table 5.1 and Figure 5.2, in the period 1990 to 2006 an emission reduction in this sector could be archieved by

- Germany (915 Gg CO_2eq; -44 %),
- France (564 Gg CO_2eq; -30 %),
- the Netherlands (325 Gg CO_2eq; -60 %),
- Italy (246 Gg CO_2eq; -10 %)
- Austria, Finland, Denmark, Sweden, Greece, Ireland, and Luxembourg (together 261 Gg CO_2eq; -13 %)

The Member States with the highest increase in emission in this sector are Portugal with 119 Gg CO_2eq (54 %) and Spain with (125 Gg CO_2eq; 9 %).

Figure 5.1 Sector 3 Solvent and Other Product Use: EU-15 GHG emissions for 1990–2006 in CO_2 equivalents (Tg)

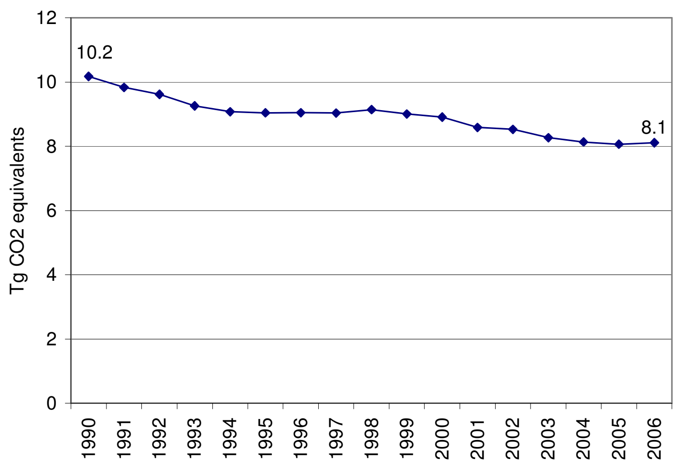
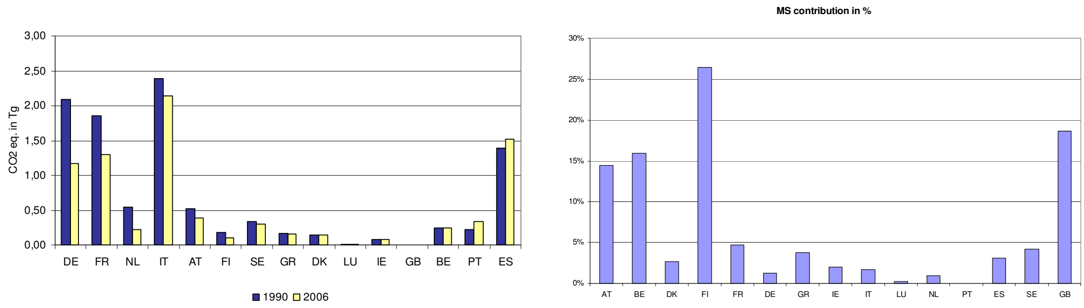


Figure 5.2 Sector 3 Solvent and Other Product Use: GHG emissions of EU-15 MS for 1990 and 2006 as well as Member States' contributions to GHG emissions for 2006 in percentage



In 2006, the emissions decreased by 0.6 % compared to 2005 (Table 5.1). In this period the highest emission reduction in absolute terms was achieved by France (-52 Gg CO_2eq; -4 %).

The Member States with the highest emission increases in this sector is Denmark (38 Gg CO_2eq; 38 %) and Portugal (14 Gg CO_2eq; 4 %). In the Member States Greece, Irland, and Luxembourg, 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 EU 15 GHG emissions in this sector and Germany and France are jointly responsible for 30 % of the total EU 15 GHG 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 2006	Change 2005-2006		Change 1990-2006	
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	515	399	385	4.7%	-14	-3%	-130	-25%
Belgium	246	250	249	3.1%	-1	0%	3	1%
Denmark	148	101	139	1.7%	38	38%	-9	-6%
Finland	178	105	100	1.2%	-5	-5%	-78	-44%
France	1,857	1,345	1,293	15.9%	-52	-4%	-564	-30%
Germany	2,089	1,174	1,174	14.5%	0	0%	-915	-44%
Greece	170	156	160	2.0%	4	2%	-10	-6%
Ireland	81	76	80	1.0%	4	5%	-1	-1%
Italy	2,394	2,144	2,148	26.5%	4	0%	-246	-10%
Luxembourg	18	15	15	0.2%	0.3	2%	-3	-18%
Netherlands	541	221	216	2.7%	-5	-2%	-325	-60%
Portugal	220	325	339	4.2%	14	4%	119	54%
Spain	1,388	1,514	1,513	18.6%	-1	0%	125	9%
Sweden	332	312	303	3.7%	-8	-3%	-29	-9%
United Kingdom	0	0	0	0.0%	0	-	0	-
EU-15	**10,178**	**8,067**	**8,115**	**100.0%**	**48**	**0.6%**	**-2,063**	**-20%**

This sector does not contain a key source.

In the Sector 3 Solvent and Other Product Use in addition to CO_2 emission NMVOC and N_2O emission are identified. The most important GHG from Solvent and Other Product Use is CO_2. In 2006 the CO_2 emissions have a share of 0.15 % of the 'Total EU 15 CO_2 Emissions and Removals' and a share of 0.12 % of the 'Total EU 15 GHG emissions' (Table 5.2). In 2006 the N_2O emissions have a share of 0.99 % of the 'Total EU 15 N_2O emissions' and a share of 0.07 % of the 'Total EU 15 GHG emissions' (Table 5.3).

Table. 5.2 Sector 3 Solvent and Other Product Use: EU-15 CO_2 emissions as well as their share

	Unit	1990	2006
CO_2 emission in Solvent and Other Product Use	[Gg]	5,986	5,043
Total EU-15 GHG emission in 'Solvent and Other Product Use'	[Gg CO_2 eq]	10,178	8,115
Share of CO_2 emission in Total EU-15 GHG in 'Solvent and Other Product Use'		*59%*	*62%*
Total EU-15 CO_2 Emissions and Removals	[Gg]	3,352,984	3,465,788
Share of CO_2 emission from 'Solvent and Other Product Use' in Total EU-15 CO_2 Emissions and Removals		*0.18%*	*0.15%*
Total EU-15 GHG Emissions and Removals	[Gg CO_2 eq]	4,243,802	4,151,363
Share of CO_2 emission from 'Solvent and Other Product Use' in Total EU-15 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

	Unit	1990	2006
N_2O emission in Solvent and Other Product Use	[Gg]	13.5	9.9
Total EU-15 GHG emission in Solvent and Other Product Use	[Gg CO_2 eq]	10,178	8,115
Share of N_2O emission in Total EU-15 GHG in 'Solvent and Other Product Use'		*41%*	*38%*
Total EU-15 N_2O Emissions and Removals	[Gg]	1,291	1,003
Share of N_2O emission from 'Solvent and Other Product Use' in Total EU-15 N_2O Emissions and Removals		*1.05%*	*0.99%*
Total EU-15 GHG Emissions and Removals	[Gg CO_2 eq]	4,243,802	4,151,363
Share of N_2O emission from 'Solvent and Other Product Use' in Total EU-15 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

	Unit	1990	2006
GHG emission in 'Solvent and Other Product Use'	[Gg CO_2 eq]	10,178	8,115
Total EU-15 GHG Emissions and Removals	[Gg CO_2 eq]	4,243,802	4,151,363
Share of GHG emission from 'Solvent and Other Product Use' in Total EU-15 GHG Emissions and Removals		*0.24%*	*0.20%*

5.2 Methodological issues and uncertainties (EU-15)

This sector does not contain any key source. An overview information on methodologies used by the Member States is given in Table. 5.5. For estimation the emission in this sector the methodologies used by the Member States are very different and based on:

- Methodology provided by IPPC Guidelines and CORINAIR Guidebook;
- Bottom up and top down approach / consumption-based emissions estimating;
- Chemical approach
- mass balance for single substances or groups of substances
- plant specific surveys / expert judgment.

Furthermore a couple of Member States changed their methodology in the last four 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 2008)

GHG & pollutant: CO_2, NMVOC, N_2O ***GHG Key Category:*** CO_2 ***Completness:*** yes ***Uncertainties:*** CO_2: 11 %, N_2O: 20 %

Time series consistency: *yes* ***Sectorspecific QA/QC and verification:*** provided ***Recalulation:*** yes ***Planned improvements:*** no

Methodology (CO_2 emissions):

CO_2 emissions from solvent use were calculated from NMVOC emissions of this sector. As a first step the quantity of solvents used and the solvent emissions were calculated. To determine the quantity of solvents used in Austria in the various applications, a bottom up and a top down approach were combined. The top down approach provided total quantities of solvents used in Austria. The share of the solvents used for the different applications and the solvent emission factors have been calculated on the basis of the bottom up approach. By linking the results of bottom up and top down approach, quantities of solvents annually used and solvent emissions for the different applications were obtained. Emission estimates only based on the top down approach 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.

Activity:

The top-down approach is based on (A) import-export statistics, (B) production statistics on solvents in Austria, (C) survey on non-solvent-applications in companies, (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'.

Emission factor:

For every category of application and waste gas treatment an emission factor was estimated to calculate solvent emissions in the year 2000. In a second step a survey in 1800 households was made for estimating the domestic solvent use. Also, solvent use in the context of moonlighting besides commercial work and do-it-yourself was calculated.

Methodology, Activity & Emission factor (N_2O Emissions):

N_2O Emissions in CRF 3: 3 D 1 Use of N_2O for anaesthesia and 3 D 3 Use of N_2O in aerosol cans: A specific methodology for these activities has not been prepared yet. 100 % of N_2O used for anaesthesia/ aerosol cans is released into atmosphere, which means that activity data = emission (1.00 Mg N_2O / Mg product use)

Belgium (NIR BE 2008)

GHG & pollutant: NMVOC, N_2O ***GHG Key Category:*** no ***Completness:*** yes ***Uncertainties:*** high

Time series consistency: *yes* ***Sectorspecific QA/QC and verification:*** not provided ***Recalulation:*** no ***Planned improvements:*** yes

Methodology (CO_2 emissions):

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 of solvent and other product use in their region.

The emissions of NMVOC in Flanders are estimated by using the results of a study started by the University of Gent in 1998 and continued by the Flemish Environment Agency (VMM). In Wallonia, the calculation is based on a methodology established by Econotec.

In the Brussels region, the emissions are calculated by using the results of research projects.

Because of the less importance of these emissions in the greenhouse gas story, only a general view of how these emissions are calculated in Belgium is given below. Broadly speaking, emissions of NMVOC are estimated in Belgium as follows :

- All emissions of category 3A (NMVOC emissions for Paint Application…) as well as some of category 3.D (other domestic use, wood coating, wood conservation, recovery of solvents, treatment of rubber, coating of synthetic material and paper) are estimated based on production figures that are given by the specific industry or professional federations. The emission factors used are mainly the solvent content of the product.
- The remaining emissions of categories 3C (production of paints, inks and glues) and 3D (storage and handling of products and assembly of automobiles, extraction of oil seeds, textile coating and printing industry) are estimated based on information gathered in the industrial databases mainly originating from the yearly reporting obligations of the industrial companies.
- There is no estimation carried out in Belgium of the CO_2 equivalents calculated out of the emissions of NMVOC of the solvent consumption because of the unreliability of this factors proposed in literature.

Methodology, Activity & Emission factor (N_2O Emissions):

The emission calculation for the emission of N_2O from anaesthesia (3D) is based on the number of hospital beds in Belgium and the average consumption of anaesthetics per bed. The emission factor is 10,3 kg N_2O/bed/year. This factor was determined by inquiries carried out in 1995 by an independent consultant agency Econotec. It has been assumed that all of the nitrous oxide used for anaesthetics will eventually be released to the atmosphere. The number of beds used for the emissions calculations was obtained from the DGASS (General Directorate for Health and Social Action).

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions

Denmark (NIR DK 2008)

GHG & pollutant: CO_2, NMVOC, N_2O ***GHG Key Category:*** no ***Completness:*** yes ***Uncertainties:*** 165%

Time series consistency: yes ***Sectorspecific QA/QC and verification:*** yes ***Recalulation:*** yes ***Planned improvements:*** yes

Methodology (CO_2 emissions):

The method is based on a chemical approach, and this implies that the SNAP category system is not directly applicable. Instead emissions will be related to specific chemicals, products, industrial sectors and households and to the CRF sectors mentioned.

The emissions of Non-Methane Volatile Organic Compounds (NMVOC) from industrial use and production processes and household use in Denmark have been assessed. Until 2002 the NMVOC inventory in Denmark was based on questionnaires and interviews with different in-dustries, regarding emissions from specific activities, such as lacquering, painting impregnation etc. However, this approach implies large uncer-tainties due to the diverse nature of many solvent-using processes. For example, it is inaccurate to use emission factors derived from one print-work in an analogue printwork, since the type and combination of inks may vary considerably. Furthermore the employment of abatement techniques will result in loss of validity of estimated emission factors.

A new approach has been introduced, focusing on single chemicals in-stead of activities. 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

Eq. (1) Use = production + import – export – destruction/disposal – hold up

Eq. (2) 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 sub-stances, and the total amount of emitted chemical is obtained by sum-ming 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 (I) Definition of chemicals to be included, (II) Quantification of use amounts from Eq. (1) and (III) Quantification of emission factors for each chemical

In principle all chemicals that can be classified as NMVOC must be included in the analysis, which implies that it is essential to have an explicit definition of NMVOC. The definition of NMVOC is, however, not consistent; In the EMEP-guidelines for calculation and reporting of emissions, NMVOC is defined as ”all hydrocarbons and hydrocarbons where hydrogen atoms are partly or fully replaced by other atoms, e.g. S, N, O, halogens, which are volatile under ambient air conditions, excluding CO, CO_2, CH_4, CFCs and halons”. The amount of chemicals that fulfil these criteria is large and a list of 650 single chemicals and a few chemical groups described in ”National Atmospheric Emission Inventory”, cf. Annex 3.F, is used. It is probable that the major part will be insignificant in a mass balance, but it is not correct to exclude any chemicals before a more detailed investigation has been made. It is important to be aware that some chemicals are comprised in products and will not be found as separate chemicals in databases, e.g. di-ethylhexyl–phthalate (DEHP), which is the predominant softener in PVC. In order to include these chemicals the product use must be found and the amount of chemicals in the product must be estimated. It is important to distinguish the amount of chemicals that enters the mass balance as pure chemical and the amount that is associated to a product, in order not to overestimate the use.

Activity:

Production, import and export figures are extracted from Statistics Denmark, from which a list of 427 single chemicals, a few groups and products is generated. For each of these a use amount in tonnes pr. year (from 1995 to 2006) is calculated. It is found that 44 different NMVOCs comprise over 95 % of the total use, and it is these 44 chemicals that are investigated further.

In the Nordic SPIN database (Substances in Preparations in Nordic Countries) information for industrial use categories and products specified for individual chemicals, according to the NACE coding system is available. This information is used to distribute the use amounts of individual chemicals to specific products and activities. The product amounts are then distributed to the CRF sectors 3A – 3D.

Emission factor:

Emission factors, cf. Eq. (2), are obtained from regulators or the industry and can be provided on a site by site basis or as a single total for whole sectors. Emission factors can be related to production processes and to use. In production processes the emissions of solvents typically are low and in use it is often the case that the entire fraction of chemical in the product will be emitted to the atmosphere. Each chemical will therefore be associated with two emission factors, one for production processes and one for use.

Methodology, Activity & Emission factor (N_2O Emissions):

This year’s solvent use emission inventory includes N_2O emissions for the first time. Five companies sell N_2O in Denmark and only one company produces N_2O. N_2O is primarily used in anaesthesia by dentists, veterinarians and in hospitals and in minor use as propellant in spray cans and in the production of electronics. Due to confidentiality no data on produced amount are available and thus the emissions related to N_2O production are unknown. An emission factor of 1 is assumed for all uses, which equals the sold amount to the emitted amount.

Finland (NIR FI 2008)

GHG & pollutant: CO_2, NMVOC, N_2O ***GHG Key Category:*** no ***Completness:*** yes ***Uncertainty:***NMVOC:-27%-+29%, N_2O:-34%-+39%.

Time series consistency: *yes* ***Sectorspecific QA/QC and verification:*** yes ***Recalulation:*** no ***Planned improvements:*** no

Methodology (CO_2 emissions):

Indirect CO_2 emissions from solvents and other product use have been calculated from NMVOC emissions for the time series 1990-2006. Indirect CO_2 emissions were calculated using the equation below. It was assumed that the average carbon content is 60% by mass for all categories under the sector of solvents and other products use. Indirect CO_2 emissions from NMVOC emissions for oil and natural gas, asphalt roofing and road paving with asphalt, chemical industry and metal production sectors were calculated using average carbon content 85 %. Used fossil carbon content fraction of NMVOC are based on limited published national analyses of speciation profile.

$Emissions_{CO2} = Emissions_{NMVOC}$ * Percent carbon in NMVOCs by mass * 44 /12

CRF 3.A: NMVOC emissions are based on the emissions calculated by the Association of 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. In 2007 regarding 2006 emissions questionnaires were send to 10 companies. The data from questionnaires was checked for example to avoid double counting with VAHTI database. These questionnaires have been sent for six inventories, starting from summer 2002 when the emissions of 2001 were collected. Before that the amount of emissions of non-members was estimated as 15% of the emissions of members.

CRF 3.B: NMVOC emissions are based on import statistics of pure chlorinated solvents, amount of products containing chlorinated organic solvents and amounts of solvent waste processed in the hazardous waste treatment plant.

CRF 3.C: The emissions are foremost from the emission data of the Regional Environment Centres. VAHTI database. Questionnaires are also sent to companies in the textile, plastic and paint industry in which they report either the amount of used solvent or the emissions of their production processes. In 2007 regarding 2006 emissions questionnaires were send totally to 111 companies. In textile industry the response rate was 83%, in plastic industry 73% and in paint industry 75%. The data from questionnaires was checked for example to avoid double counting with VAHTI database.
CRF 3.D: 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 the VAHTI database, activity data from the Finnish Environment Institute.s Chemical Division database and emission calculation of the Finnish Cosmetics, Toiletry and Detergents Association. In 2007 regarding 2006 emissions questionnaires were send totally to 141 companies. In oil mills the response rate was 75% but in printing industry just 50%. The data from questionnaires was checked for example to avoid double counting with VAHTI database. Indirect CO_2 emissions from this category have been calculated using the equation given in Section 5.2.2.
Activity data
CRF 3.A: Activity data for use of paint are collected with a questionnaire sent to paint manufacturing companies which are not members of the Association of Finnish Paint Industry.
CRF 3.B: The amount of imported chlorinated solvents is from ULTIKA, import statistics of Finland. The amount of products containing chlorinated chemicals is based on expert estimation following the information of the publication of VTT (Arnold, 1998). The amount of solvent waste is from the VAHTI database.
CRF 3.C: Activity data of the use of solvents are collected from those companies which are not obligated to report NMVOC emissions from their production processes to the Regional Environment Centres' VAHTI database.
CRF 3 C: Activity data as the amount of creosote sold for NMVOCs from the preservation of wood are from the Finnish Environment Institute.s Chemical Division (Kotiranta, 2007). Activity data for NMVOC emissions from pesticide use are from the Finnish Food Safety Authority (EVIRA, 2007).
Emission factor:
For calculating NMVOC emissions from Paint application the solvent content of produced or imported paints is used as the emission factor. For calculating NMVOC emissions from degreasing and dry cleaning the emission factor of 0.7 kg/kg imported solvent is used. The emission factor is an expert estimation by VTT Technical Research Centre of Finland (Arnold, 1998). For calculating NMVOC emissions from Chemical products, manufacture and processing the solvent content information collected from the survey is used as the emission factor.
CRF 3.D: Emission factors for use of pesticides (80 kg/t) and preservation of wood (100 kg/t) are country-specific based on expert estimation at the Finnish Environment Institute.s Chemical Division. The emission factors used on results of questionnaires are mostly the solvent content of the chemicals used.
Methodology (N_2O Emissions):
The N_2O emissions are calculated by Statistics Finland. The Tier 2 calculation method is consistent with the IPCC Guidelines. In the estimation of the N_2O emissions sales data are obtained from the companies delivering N_2O for medical use and other applications in Finland. For the years 1990 to 1999 the emissions have been assumed constant based on activity data obtained for the years 1990 and 1998. Since 2000 annual and more precise data have been received from the companies.
Emission factor
The emission estimation is based on the assumption that all used N_2O is emitted to the atmosphere in the same year it is produced or imported to Finland. A very small part of emissions is estimated due to non-response.
Activity
For the estimation of N_2O emissions production or importation data are obtained from companies for the years 1990, 1998 and all years starting from 2000. In 2006 one company reported that they have continued to export and that has been also taken into account in the calculations.

France (NIR FR 2008)

GHG & pollutant: NMVOC, N_2O ***GHG Key Category:*** no ***Completness:*** yes ***Uncertainty:*** 3A: 54%, 3D: 102%
Time series consistency: yes ***Sectorspecific QA/QC and verification:*** not provided ***Recalulation:*** yes ***Planned improvements:*** yes
Methodology (CO_2 emissions):
Cette catégorie regroupe l'ensemble des activités consommatrices de solvants que sont l'application de peinture (dans l'industrie, le bâtiment, à usage domestique, …), le dégraissage des métaux et le nettoyage à sec. Ces activités sont des sources importantes de COVNM qui selon les règles de notification des émissions, sont convertis en émissions de CO_2 en considérant leur oxydation ultime.
The activities (*Paint application, Degreasing and dry cleaning, Chemical products, manufacture and processing, Other)* of this category are important sources of NMVOC emissions. 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.
Methodology, Activity & Emission factor (N_2O Emissions):
Le N_2O est également, du fait de son usage comme gaz analgésique, émis par ce secteur.
The emission calculation for the emission of N_2O from anaesthesia (3D) is based on the number of population and the use of N_20 from anaesthesia in Europe.

Germany (NIR DE 2008)

GHG & pollutant: NMVOC, N_2O ***GHG Key Category:*** no ***Completness:*** yes ***Uncertainty:*** NMVOC:-16%-+24%, N_2O:-40%-+8%.
Time series consistency: *yes* ***Sectorspecific QA/QC and verification:*** provided ***Recalulation:*** no ***Planned improvements:*** yes
Methodology (CO_2 emissions):
NMVOC emissions are calculated in keeping with a product-consumption-oriented approach. In this approach, the NMVOC input quantities allocated to these source categories, via solvents or solvent-containing products, are determined and then the relevant NMVOC emissions (for each source category) are calculated from those quantities via specific 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 categories (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 product-group level with the help of production and foreign-trade statistics. Where possible, the so-determined domestic-consumption quantities are then further verified via cross-checking with industry statistics. The values used for the average VOC concentrations of the input substances, and the emission factors used, are based on experts' assessments (expert opinions and industry dialog) relative to the various source categories and source-category areas.

Activity data & Emission factor

Not all of the necessary basic statistical data required for calculation of NMVOC emissions for the most current relevant year in 2003 and 2004 are available; as a result, the data determined for the previous year are used as a basis for a forecast for the current report. The forecast for NMVOC emissions from solvent use for the relevant most current year is calculated on the basis of specific activity trends. As soon as the relevant basic statistical data are available for the relevant most current year, in their final form, the inventory data for NMVOC emissions from solvent use will be recalculated. Since 1990, so the data, NMVOC emissions from use of solvents and solvent-containing products have decreased by nearly 38 %. The main emissions reductions have been achieved in the years since 1999. This successful reduction has occurred especially as a result of regulatory provisions such as the 31st Ordinance on the execution of the Federal Immissions Control Act (Ordinance on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain facilities – 31. BImSchV), the 2^{nd} such ordinance (Ordinance on the limitation of emissions of highly volatile halogenated organic compounds – 2. BImSchV) and the TA Luft. The German "Blauer Engel" ("Blue Angel") environmental quality seal, which is used to certify a range of products, including lowsolvent paints, lacquers and glues, has also played an important role in this development. While product sales increased in some areas – even over periods of several years – thereby adding to emissions, the above-described measures offset this trend. These successes, which have occurred especially in recent years, are reflected in the updated emissions calculations – which, thanks to methods optimisation, now feature greater differentiation of
VOC concentrations and emission factors.

Methodology, Activity & Emission factor (N_2O Emissions):

N_2O in medical application: In medicine, nitrous oxide, which has analgesic properties, is used for narcotic purposes. It is the oldest narcotic in use, and it is among those with the fewest side-effects. In medical applications, nitrous oxide is mixed with pure oxygen, to produce an active gas mixture consisting of 70% nitrous oxide and 30 % oxygen. In modern anaesthesia, the effects of nitrous oxide are enhanced through addition of other narcotics.

N_2O use in the food industry: In the food industry, nitrous oxide is used as an additive known as "E 942". Foods sold in pressurised containers are extracted from such containers with the help of propellants. As it exits such a container, a food takes on either a foamy or a creamy consistency, depending on what type of food it is.

N_2O in technical applications: A wide range of different chemicals and gases is used in semiconductor production. Argon, ultra-pure oxygen, hydrogen, ultra-pure helium and nitrogen account for the lion's share of the gases used. Special process gases, such as dinitrogen monoxide, ammonia and hexafluorethane, are used only in relatively small amounts, and the amounts involved have remained nearly constant over the past few years (AMD Saxony LLC&Co. KG, Dresden, Umweltbericht (environmental report) 2002/2003).

With regard to development of N_2O-emissions time series for product use, to date only N_2O emissions from medical applications have actually been determined. At the same time, this approach is justified, since this sector is the main source of N_2O emissions in the area of product use, accounting for 90 % of such emissions (SCHÖN et al., 1993, page 82). The remaining 10 % can be broken down into technical applications (less than 10 %39) and foodtechnology applications (less than 5 %40) . From this information, the pertinent share for the food-technology industry is estimated at 3 %, and thus the corresponding share for the "technical applications" area is estimated at 7 %, the difference between the total remaining share (10 %) and the 3 % for foods. "Other" applications is a combination of food-technology applications and technical applications. The N_2O-applications distribution in 2001 is 90 % for medical applications and 10 % for other applications. In the time-series trend, a constant N_2O-emissions level is assumed in the "other" area, since no detailed figures on trends in this sector are available. In product use (medical and other applications), the input nitrous oxide escapes into the air directly and completely. As a result, the emission factor for this sector is 1 t/t, for all years in question.

N_2O formation in detonation of explosives with ammonium nitrate According to the Federal Office for Material Research and Testing (BAM), levels of explosives use in Germany remained constant from 1990 to 2005. The N_2O-emissions amount estimated above represents only the theoretically maximum emittable amount. No information is available as to distribution, i.e. as to the number of detonations that would be required to emit this maximum amount of N_2O. For this reason, it is also assumed here that detonations are carried out primarily as "controlled" detonations, and that thus the maximum N_2O-emissions levels are seldom attained. No figures are available to permit determination of the amounts of N_2O emissions actually emitted upon detonations. The above figure (68 g N_2O per kg AN) is a theoretical one, and it could be far off the actual value. When a 5 % emissions rate is assumed, the N_2O amount is 3.4 g. This figure is of the same order as the maximum emissions rate (2 g) given by BENNDORF (1999, p 4), a figure that corresponds to about 3 % of the above-determined theoretical maximum N_2O emissions level. For a "worst-case scenario", the time-series trend in this project is calculated using the higher value (3.4 g). To determine the relevant emission factors in kg/t, the explosives amounts involved are used. Together with the above-presented time-series trend for N_2O emissions, the time-series trend for the pertinent emission factors can also be obtained.

Greece (NIR GR 2008)

GHG & pollutant: CO_2, NMVOC ***GHG Key Category:*** no ***Completness:*** no ***Uncertainty:*** no
Time series consistency: yes ***Sectorspecific QA/QC and verification:*** not provided ***Recalulation:*** no ***Planned improvements:*** yes

Methodology (NMVOC, CO_2 emissions):

The calculation of NMVOC emissions requires a very detailed analysis of the use of solvents and other products containing volatile organic compounds. There are two basic approaches for the estimation of emissions from Solvent and Other Product Use, which depend on the availability of data on the activities producing emissions and the emission factors.

- Production-based. In cases that solvent or coating use is associated with centralised industrial production activities (e.g. automobile and ship production), it is generally possible to develop NMVOC emission factors based on unit of product output. Next, annual emissions are estimated on the basis of production data.
- 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%.
Paint application: Data availability concerning the use of products containing solvents for "Vehicle manufacture and Vehicle refinishing" is limited and as a result the respective emissions are not estimated. Emissions from "Domestic use and construction" are estimated on the basis of population figures and default emission factors from CORINAIR (0.5 kg / capita).
Metal Degreasing and Dry Cleaning: Emission estimates are given only for the dry cleaning sector. These estimates are based on population figures and default emission factors from CORINAIR (0.25 kg /capita) that is applicable to all types of dry cleaning equipment.
Other Use of Solvents and Related Activities: The emission factors used for some of the activities defined in CORINAIR and for which it was possible to obtain the corresponding activity data from the National Statistical Service of Greece, are: (a) Production and processing of PVC: 40 kg / t of product produced or processed. (b) Production of pharmaceutical products: 14 g /capita. (c) Ink production: 30 kg / t of product. (d) Glue production, applied emission factor: 20 kg /t of product (e) For the wood preservation: 24 kg / t of wood preserved (f) For fat edible and non edible oil extraction: 14 kg NMVOC/ t of seed processed (g) For domestic solvent use (except paint application): 2.6 kg NMVOC/capita/year
In the case of printing industry, the estimation of emissions was based on the consumption of ink. Printing ink is mostly used for the publishing of newspapers, books and various leaflets. According to the estimations of one publishing organisation, the amount of ink used for the printing of a daily newspaper is approximately 3.7 g of ink. The quantity of ink used for printing books etc. Was calculated by subtracting the total quantity used for the newspapers from the total ink consumed. The emission factor applied (260 kg / t ink) is the average of emission factors for newspaper printing (54 kg /t ink) and for books and other leaflets printing (132-800 kg / t ink).

Ireland (NIR IE 2008)

GHG & pollutant: CO_2, NMVOC ***GHG Key Category:*** no ***Completness:*** ***##*** ***Uncertainty:*** CO_2: 30 %
Time series consistency:yes ***Sectorspecific QA/QC and verification:*** not provided ***Recalulation:yes*** ***Planned improvements:*** no
Methodology (CO_2 emissions):
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.
Activity data
The activity data used for computing estimates of CO_2 emissions in Solvent and Other Product Use are the mass emissions of NMVOC computed for the relevant source categories (3.A Paint Application, 3.B Degreasing and Dry Cleaning, 3.C Chemical Products and 3.D Other Solvent Uses). The Irish data used for this purpose are the VOC emissions compiled according to the CORINAIR methodology for reporting to UNECE under the Convention on Long Range Transboundary Air Pollution (CLRTAP) (UNECE, 1999). As part of the work on recalculations for the 2002 submission, Ireland produced a revised and consistent timeseries of such NMVOC emissions estimates based on the results of detailed analysis and investigations for 1998 (Finn et al, 2001). The CO_2 emissions are derived by assuming that 85 percent of the mass emissions of NMVOC in the four categories is converted to CO_2.
Emission factor
UK emission factors together with Irish statistics for number of vehicles, persons and households were used in the absence of any other data.

Italy (NIR IT 2008)

GHG & pollutant: CO_2, NMVOC, N_2O ***GHG Key Category:*** yes ***Completness:*** *yes*
Uncertainty: CO_2: AD 30%, EF 50%; N_2O: AD 50%, EF 10%
Time series consistency:yes ***Sectorspecific QA/QC and verification:*** provided ***Recalulation:*** yes ***Planned improvements:*** yes
Methodology, Activity data & Emission factor (CO_2 emissions):
Emissions of NMVOC from solvent use have been estimated according to the CORINAIR methodology with a bottom- up approach, applying both national and international emission factors (Vetrella, 1994; EMEP/CORINAIR, 2005). All the activities in the Selected 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 (Professione Verniciatore del Legno, several years; FIAT, several years), solvent use in dry cleaning (ENEA/USLRMA, 1995), solvent use in textile finishing and in the tanning industries (TECHNE, 1998; Regione Toscana, 2001; Regione Campania, 2005; GIADA 2006). Basic information from industry on percentage reduction of solvent content in paints and other products has been applied to EMEP/CORINAIR emission factors in order to evaluate the reduction in emissions during the considered period.
Emissions from domestic solvent use have been calculated using a detailed methodology, based on VOC content per type of consumer product. As regards household and car care products, information on VOC content and activity data has been supplied by the Sectoral Association of the Italian Federation of the Chemical Industry (Assocasa, several years) and by the Italian Association of Aerosol Producers (AIA, several years).
As regards cosmetics and toiletries, basic data have been supplied by the Italian Association of Aerosol Producers too (AIA, several years) and by national statistics (ISTAT, several years); emission factors time series have been reconstructed on the basis of the information provided by the European Commission (EC, 2002). The conversion of NMVOC emissions into CO_2 emissions has been carried out considering specific factors calculated on the basis of molecular weights and suggested by the European Environmental Agency for the CORINAIR project (EEA, 1997), except for emissions from the 3C sub-sector to avoid doublecounting.
Methodology, Activity data & Emission factor (N_2O emissions):
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 2005 (Assogastecnici, several years). For previous years, data have been estimated by the number of surgical beds published by national statistics (ISTAT, several years). Moreover, the Italian Association of Aerosol Producers (AIA, several years) has provided data on the annual production of aerosol cans. It is assumed that all N_2O used will eventually be released to the atmosphere, therefore the emission factor for anaesthesia is 1 Mg N_2O/Mg product use, while the emission factor used for aerosol cans is 0.025 Mg N_2O/Mg product use, because the N_2O content in aerosol cans is assumed to be 2.5% on average (Co.Da.P., 2005). 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.

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions

Luxembourg (NIR LU 2007)

GHG & pollutant: CO_2, NMVOC, N_2O ***GHG Key Category:*** no ***Completness: yes*** ***Uncertainty:*** *no*
Time series consistency: yes ***Sectorspecific QA/QC and verification:*** not provided ***Recalulation:*** no ***Planned improvements:*** yes
Methodology, Activity data & Emission factor (CO_2 emissions):

The total amount of NMVOC emissions from solvents and other product use has been taken as a basis to calculate resulting CO_2 emissions. The following VOC emission estimates from this source categroy were done for 1990. Part of these data are based on estimations of various solvent application activities in Luxembourg as they were at the beginning of the 1990ies. In some sub-sectors, no statistical data on consumption of solvent containing products were available. Therefore part of the estimations are based on typical consumption estimates of products containing solvents for the neighbour countries of Luxembourg and/or for Europe. An update of these estimations of VOC emissions from solvents could lead to an improvement of the emission data.

Netherlands (NIR NL 2008)

GHG & pollutant: CO_2, NMVOC, N_2O ***GHG Key Category:*** no ***Completness: yes*** ***Uncertainty:*** CO_2: 27 %, N_2O: 50%
Time series consistency: yes ***Sectorspecific QA/QC and verification:*** not provided ***Recalulation:*** yes ***Planned improvements:*** no
Methodology (CO_2 emissions):

Country-specific carbon contents of the NMVOC emissions from 3A 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).

Activity data: Consumption data and NMVOC contents of products are mainly provided by trade associations, such as the VVVF (for paints), the NCV (for cosmetics) and the NVZ (for detergents). The consumption of almost all solvent-containing products has increased since 1990. However, the general NMVOC content of products (especially paints) has decreased over the past years, resulting in a steady decline in NMVOC emissions since 1990 (see section 2.4). Due to the increased sales of hairspray and deodorant sprays NMVOC emissions have increased slightly in recent years. It is assumed that the NMVOC contents of these products have remained stable.

Emission factors: It is assumed that all 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). The carbon contents of NMVOC emissions are documented in the monitoring protocol on the website www.greenhousegases.nl.

Methodology (N_2O emissions):

Country-specific methodologies are used for the N_2O sources in Sector 3. Since the emissions in this source category are from non-key sources for N_2O, the present methodology complies with the IPCC Good Practice Guidance (IPCC, 2001).

Activity data: The major hospital supplier of N_2O for 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. Domestic sales of cream in aerosol cans have shown a strong increase since 2000. In 2005 sales increased 7%, in 2006 15%. The increase is reflected in the increased emissions in these years.

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 (based on data provided by one producer), and is assumed to be constant over time.

Portugal (NIR PT 2008)

GHG & pollutant: CO_2, NMVOC, N_2O ***GHG Key Category:*** 3A, 3D ***Completness:*** yes ***Uncertainty:*** 3A: 262% 3D: 408%
Time series consistency: yes ***Sectorspecific QA/QC and verification:*** not provided ***Recalulation:*** no ***Planned improvements:*** yes
Methodology, Activity data & Emission factor (CO_2 emissions):

NMVOC emissions estimates must be converted in CO_2 emissions whenever the carbon that is present in organic compounds has fossil fue origin (originated from feed-stocks from petroleum, coal or natural gas), and being assumed that NMVOC compounds are fully oxidized in air to carbon dioxide contributing thence to the atmospheric pool. Therefore, in general terms in except for the cases where a specific methodology is presented, emission of ultimate CO_2 were calculated assuming that 85 percent of the mass emissions of NMVOC is carbon and it is converted to carbon dioxide in the atmosphere. All solvents are assumed to have fossil origin and hence all ultimate CO_2 emissions are included in the inventory as CO_2e. With $U_{CO2} = 44/12 * NMVOC * 0.85$, where U_{CO2} - Ultimate CO_2 (ton/yr); NMVOC - Global emissions of NMVOC (ton/yr).

Paint Application (CRF 3A): *Methodology:* NMVOC emissions from use of coating materials are estimated in a simple manner using the following formulation: $Emi_{NMVOC(a,p,y)} = \sum_a \sum_p [EF_{(p)} * Coating_{CONS(a,p,y)}] * 10^{-3}$ Where $Emi_{NMVOC(y)}$ – NMVOC emissions resulting from use/application of coating substances during year y; $Coating_{CONS(a,p,y)}$ – Use of coating substance p in economic activity a during year y; $EF_{(p)}$ – NMVOV emission factor (solvent content) resulting from application of substance p.

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: $Total_{Cons(y,p)} = Production_{(y,p)} + Imports_{(y,p)} – Exports_{(y,p)}$

Where: $Total_{Cons(y)}$ - Consumed paint and varnish of type p in year y; $Production_{(y,p)}$ - National Produced paint and varnish of type p in year y; $Imports_{(y,p)}$ - Imported paint and varnish of type p in year y; $Exports_{(y,p)}$ - Exported paint and varnish of type p in year y.

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. Thus, total consumption of paints was calculated from 1990 and 2000. Values for 2001 to 2006 were forecasted by APA 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. 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.

Degreasing and dry cleaning (CRF 3B) - *Methodology:* Assuming that all solvents consumed during degreasing and dry-cleaning evaporate, NMVOC emission will be equal to the amount of solvents used. If it is considered that annual consumption of solvents in an economic activity is used to replenish the quantity of solvent that was lost, then annual NMVOC emissions may be estimated from the annual consumption of solvent. This methodology overcomes the need of being aware of the portion of solvent that is recovered. In the case of the dry-cleaning activity it was assumed that either the solvent is lost directly to atmosphere, or if it is conveyed to water or retained in clothes, but it will eventually reach atmosphere by evaporation. For the dry cleaning sector other methodologies, based on quantities of washed cloths, are recommended by several sources (USEPA, 1981; EMEP/CORINAIR). However, in Portugal there is no sufficient information to use this other approach.

Activity data: Statistical information concerning total solvent use, from the National Statistics Institute (INE), was used to estimate VOC emissions. Consumption of solvents was based on consumption of volatile organic materials in the metal and plastic industries, from IAIT statistical survey. There is no available statistical information concerning consumption of solvents and other materials in dry-cleaning activity, because this activity is not included under IAIT and IAPI industrial surveys. Therefore, it was assumed that all PER 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. The full time series is forecasted for the years after 2002.

Chemical products, manufacture and processing (CRF 3C): *Methodology:* Emissions were estimated by the use of emission factors that are multiplied by the quantity of material produced: $Emi_{NMVOC} = EF * Activity_{Rate} * 10^{-3}$ Where Emi_{NMVOC} - annual emission of NMVOC; $Activity_{Rate}$ - Indicator of activity in the production process. Quantity of product produced per year as a general rule for this emission source.

Processing of polymers to produce plastic materials involve organic compounds emission to atmosphere resulting from leakage of some monomers still present in the polymer mass, some polymer decomposing, evaporation of additives - such as phthalic anhydride - but mostly from solvents used in the production process. Synthetic fibber production emits non-methane volatile organic compounds that result from solvent use, for example to dissolve the polymer prior to extrusion. Emissions from foam blowing result from the application of hydrocarbons as blowing agents which are used as CFC substitutes.

Activity data: Information about activity data for this sector is scarce and limited to year 1990, from INE. However, because some polymers and fibbers are produced in a restricted number of industrial units, confidentiality constraints avoid their publication in NIR.

Emission factors applied to polymer processing and fibber production were set from AP42 (US-EPA), and from CORINAIR/EMEP.

Rubber Processing - Methodology: Assuming that all solvents consumed during rubber processing evaporate, NMVOC emission will be equal to the amount of solvents used. This procedure could be used to estimate emissions for years 1990 and 1991. However, because statistical data on solvent consumption in this sector is not available beyond year 1992, NMVOC emissions had to be estimated from quantity of rubber processed according to: $Emi_{NMVOC(y)} = Solvent\ (y) = \sum_p [S_{Fac(p)} * Proc_{RUBBER(p,y)}] * 10^{-3}$ Where: $Emi_{NMVOC(y)}$ – NMVOC total emissions from rubber processing; Solvent (y) – Total solvent use in rubber processing; $S_{Fac(p)}$ – Quantity of solvent used to produce product p; $Prod_{RUBBER(p,y)}$ – Production of rubber product p in year y.

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. From the several materials that were consumed in this activity only Benzene and Gasoline were considered solvents and prone to evaporation.

Activity data: Production data of rubber artefacts, including tires and tire reconstruction, was available from the IAIT and IAPI industrial surveys from INE.

Paints Manufacturing: *Activity data:* Production of paints and varnish as described in Paint Application.

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.

Inks Manufacturing: *Activity data:* Statistical data of annual production of inks in Portugal is available from IAIT and IAPI industrial surveys (INE), for years 1990 through 2000. Linear forecast values were considered for subsequent years. Use of pigments in ink production was also available from INE's database.

Emission factor: 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).

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 is reported in chapter 5.5.

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.

Other use of solvents and related activities (CRF 3D) - In this sector are included emission calculations for different activities, such as: 1) printing; 2) edible and non edible oil extraction; 3) use of glue and adhesives; 4) preservation of wood; 5) other solvents use; 6) use of perfume; 7) use of waxes and polishing products; 8) use of soaps and detergents.

Printing - *Methodology:* With $Emi_{NMVOC(a,p,y)} = \sum_p \sum_t \sum_i [EF_{(i)} * INK_{CONS(p.i,t,y)}] * 10^{-3}$. Where $Emi_{NMVOC(y)}$ – NMVOC emissions resulting from printing activities during year y; $Ink_{CONS(p,i,t,y)}$ – Use of ink i for printing product p using technology t during year y; $EF_{(p)}$ – EF (solvent content) of ink i.

Emission factor: 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.

Activity data: Consumption of inks in printing industry according to printing product is available from IAPI industrial survey, for years 1995 to 2000, from the INE's statistical database. Original data allows that total consumption of inks – but not its type – be divided by printing products. Data printing activities in other economic activities – metallic industry, plastic industry, ceramic and - is also included. Some assumptions were made concerning what technology was used for each press product, i.e.: a) newspapers are printed using web letterpress or web offset lithography, according to national sales of ink; b) books printing uses lithography; c) Magazines and other publications use rotogravure; d) Packages and metallic, plastic and other artefacts use flexography; e) serigraphy technology is used in textile processes. For years in the period from 1990 to 1994, consumption of inks had to be estimated from national production and external trade and according to: $Total_{Cons(y)} = Production_{(y)} + Imports_{(y)} – Exports_{(y)}$ Where: $Total_{Cons(y)}$ - Total consumption of inks in year y; $Production_{(y,p)}$ - National Produced inks in year y; $Imports_{(y,p)}$ - Imported inks in year y; $Exports_{(y,p)}$ - Exported quantity of inks in year y. Because external trade classifies inks in a single class, the more detailed desegregation of inks, available for production of inks, could not be used, and only total ink consumption could be assessed. The same proportion of technologies/products in 1995 was used to separate total inks consumption for the years between 1990 and 1994.

Edible and non edible oil extraction - *Methodology:* 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; $MakeUp_{Solvents(y)}$ - annual consumption of solvent in edible and non-edible oil industry, to replenish looses.

Ultimate CO_2 emissions are calculated assuming that 85.71 percent of the mass emissions of NMVOC is carbon and is converted to carbon

dioxide in the atmosphere. All solvents are assumed to have fossil origin and hence all ultimate CO_2 emissions are included in the inventory. U_{CO2} = 44/12 * NMVOC * 0.8571 Where: U_{CO2} - Ultimate CO_2 (ton/yr); NMVOC - Global emissions of NMVOC.
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 because solvent consumption is not available from IAPI survey. Because in IAPI survey (1992-2000) it was not possible to distinguish production of edible oils from production of non-edible soils, it was decided just to use a global EF.
Activity data: Oil production data was available from INE's industrial surveys: IAIT for 1990 and 1991 and IAPI thereafter until 2000. Production data for 2001-2006 was forecasted by APA from previous years. All annual values are reported in Table 5.23, together with olive oil production, although that product does not cause NMVOC emissions.
Glues and adhesives - Methodology: NMVOC = $Cons_{Nat}$ x FE_{Nat} + Imp x FE_{imp} Where: NMVOC = Global emissions of NMVOC (ton); $Cons_{Nat}$ = Consumption of Glues and Adhesives produced in Portugal (ton); FE_{Nat} = Emission factor for Glues and Adhesives produced in Portugal; 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: $Cons_{Nat}$ = Consumed Glues and Adhesives produced in Portugal (ton); $Prod_{Nat}$ = National Produced Glues and Adhesives (ton); Exp = Exported Glues and Adhesives (ton)
Emission factor: 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.
For non-natural imported glues and adhesives the CORINAIR90 Default Emission Factor was used: 600 kg/ton. It is considered that natural based glue does not contribute to NMVOC emission.
Wood Preservation - Methodology: $Emi_{NMVOC\ (y)}$ = Consumption(y) * $FE_{Consumption}$ where: $Emi_{NMVOC(y)}$ - Emissions of NMVOC associated to consumption of wood preservation products (ton); Consumption(y) - Consumption of wood preservation products (ton); $FE_{Consumption}$ - Emission factor associated to the consumption of wood preservation products.
Emission factor: CORINAIR90 Emission Factor Handbook proposes three emission factors for VOC emission from wood preservation, depending on the type of product used. The emission factor is 100 kg/ton of product applied for creosote; 900 kg/ton for solvent based products and 0 for water based products. The available data do not discriminate the share of the several types of preservation products, therefore, it was assumed that the main product used in Portugal is creosote.
Perfumes and Cosmetics Use - *Methodology:* Perfumes, personal hygiene and cosmetic products. Lipsticks, brilliantine, beauty creams and milks, depilatories, deodorants, hair sprays, sun lotions, tanner products, shampoos, tooth-cleaning, hair coloration and nail varnishes, among others, were considered in perfume, personal hygiene or cosmetic product. Emissions are estimated from: NMVOC = Use * $FE_{Prod+use}$ where: NMVOC - Emissions of NMVOC associated to the production and use of perfumes (ton); use - Use of perfumes (ton); $FE_{Prod+use}$ - Emission factor associated to the production and use of perfumes (ton)
Emission factor: 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 perfumes, personal hygiene and cosmetic products manufactured. With $FE_{Prod+use}$ = Solvents / National Production where: $FE_{Prod+use}$ = Emissions of NMVOC associated to consumption of perfume and cosmetics use (ton); Solvents = Solvent content of perfumes (ton); National Production = National production values of perfumes (ton)
Waxes and polishing products / Soaps and Detergents: The Methodology is similar to the one that was used for Perfume Use.
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.
Methodology: Emissions are therefore estimated from: NMVOC = TotalConsumption – $Cons_{NONEMI}$ Where NMVOC – Emission; TotalConsumption – Total consumption of biological solvent in all activities; $Cons_{NONEMI}$ – Consumption of biological solvents in activities where solvents are not emitted to atmosphere. For rosin derivatives total consumption is obtained from industrial production corrected from imports and exports: TotalConsumption = IndustrialProduction + Imports – Exports. Because these two compounds have a biological origin NMVOC emissions are not added to ultimate carbon dioxide emissions accounting.

- **Other uses of synthetic solvents from fossil fuels -** Methodology: NMVOC = Produced Solvents where: NMVOC = Emissions of NMVOC (ton); Consumed Solvents = quantity of produced solvents(ton). The calculation of Global CO_2 emissions is made according to: U_{CO2} = 44/12 * NMVOC * 0.85 where: U_{CO2} - Ultimate CO_2 (ton/yr); NMVOC - Global emissions of NMVOC (ton/yr).

Spain (NIR ES 2008)

GHG & pollutant: CO_2, NMVOC, N_2O ***GHG Key Category:*** no ***Completness:*** yes ***Uncertainty:***CO_2: 25 %
Time series consistency:yes ***Sectorspecific QA/QC and verification:*** not provided ***Recalulation:*** yes ***Planned improvements:*** yes
Methodology, Activity data & Emission factor (CO_2 emissions):
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.
Methodology, Activity data & Emission factor (N_2O emissions):
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.

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions

Sweden (NIR SE 2008)

GHG & pollutant: CO_2, NMVOC, N_2O ***GHG Key Category:*** no ***Completness:*** yes ***Uncertainty:***CO_2 25 %
Time series consistency:yes ***Sectorspecific QA/QC and verification:*** provided ***Recalulation:*** yes ***Planned improvements:*** no

Methodology, Activity data & Emission factor (CO_2 emissions):

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.
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.
Emission of CO_2 has been calculated with the following equation: $\text{emission}_{CO2} = C_{quantity}*\text{emission factor}*44/12$
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).

Methodology, Activity data & Emission factor (N_2O emissions):

There are two companies in Sweden selling N_2O in gas cylinders. Information on sold amounts was obtained from one of the companies (1990 - 1991) and from the Products register at the Swedish Chemicals Inspectorate (1992 - 2005). The time series of use of N_2O in Sweden are reported in "Other use of N_2O" (3D4) since no background data is available to separate between the source categories "Use of N_2O for Anaesthesia" (3D1) and "N_2O from Aerosol cans" (3D3). Consequently CRF codes 3D1 and 3D3 are both reported as IE. Activity data for the latest year, 2006, is not yet official and hence Sweden has chosen to report data from 2005 also for 2006. Data for 2006 will be updated in the next submission.

United Kingdom (NIR GB 2008)

GHG & pollutant: CO_2, NMVOC ***GHG Key Category:*** no ***Completness:*** yes ***Uncertainty:***##
Time series consistency:yes ***Sectorspecific QA/QC and verification:*** not provided ***Recalulation:*** yes ***Planned improvements:*** yes

Methodology, Activity data & Emission factor (CO_2 emissions):

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. 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 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 (EU-15)

There are no sector-specific QA/QC procedures for this sector.

5.4 Sector-specific recalculations (EU-15)

Table 5.6 shows that in the solvent sector only minor recalculations were made (in particular in absolute terms) for CO_2 and N_2O.

Table 5.6 Sector 3 Solvent and Other Product Use: Recalculations of total GHG emissions and recalculations of GHG emission for 1990 and 2005 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	-50.392	-1,6%	-851	-0,2%	-8.415	-2,1%	5	0,0%	617	3,7%	-51	-0,5%
Solvent and other product use	3	0,0%	0	0,0%	9	0,2%	NO	NO	NO	NO	NO	NO
2005												
Total emissions and removals	33.796	1,1%	2.011	0,6%	-11.037	-3,3%	220	0,4%	-35	-0,6%	-70	-0,8%
Solvent and other product use	8	0,2%	0	0,0%	40	1,4%	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. Luxembourg contributed most to recalculations for N_2O emissions in 1990; in 2005 it was Italy with the the most influence on recalculations in the sector Solvents.

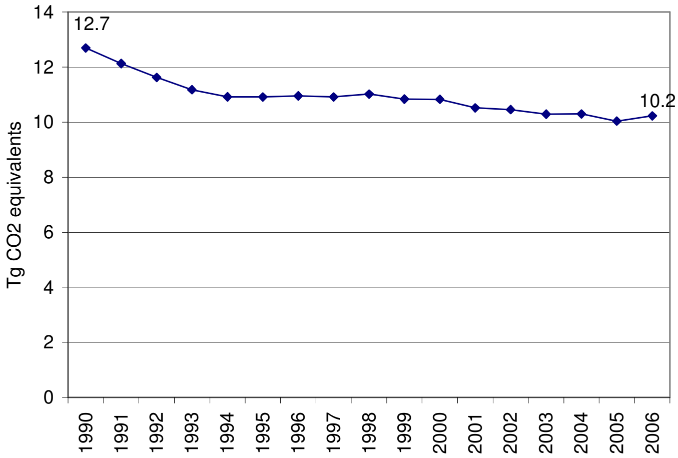
Table 5.7 Sector 3 Solvent and Other Product Use: Contribution of Member States to EU-15 recalculations for 1990 and 2005 by gas (difference between latest submission and previous submission Gg of CO_2 equivalents)

	1990						2005					
	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	13	0	0	NO	NO	NO
Belgium	NE	0	0	NO	NO	NO	NE	0	0	NO	NO	NO
Denmark	6	0	0	NO	NO	NO	-13	0	14	NO	NO	NO
Finland	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
France	0	0	0	NO	NO	NO	4	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	2	0	0	NO	NO	NO
Italy	0	0	0	NO	NO	NO	11	0	30	NO	NO	NO
Luxembourg	0	0	9	NO	NO	NO	0	0	6	NO	NO	NO
Netherlands	0	0	0	NO	NO	NO	-8	0	0	NO	NO	NO
Portugal	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
Spain	-4	0	0	NO	NO	NO	-4	0	0	NO	NO	NO
Sweden	0	0	0	NO	NO	NO	2	0	-10	NO	NO	NO
UK	NE	0	0	NO	NO	NO	NE	0	0	NO	NO	NO
EU-15	**3**	**0**	**9**	**NO**	**NO**	**NO**	**8**	**0**	**40**	**NO**	**NO**	**NO**

Abbreviations explained in the Chapter 'Units and abbreviations'.

5.5 Solvent and other product use for EU-27

Figure 5.3 Sector 3 Solvent and Other Product Use: EU-27 GHG emissions for 1990–2006 in CO_2 equivalents (Tg)



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 state28.

The links between the richness of the natural environment and farming practices are complex. While many valuable habitats in Europe are maintained by extensive farming, and a wide range of wild species rely on this for their survival, agricultural practices can also have an adverse impact on natural resources. Pollution of soil, water and air, fragmentation of habitats and loss of wildlife can be the result of inappropriate agricultural practices and land use.

Agriculture in Europe is determined by the Common Agricultural Policy (CAP) of the European Union. The CAP dates from 1957, and its foundations are entrenched in the Treaty of Rome. Initially, the emphasis of the CAP was to increase agricultural productivity, partly for food security reasons, but also to ensure that the EU had a viable agricultural sector and that consumers had a stable supply of affordable food (Gay et al., 2005). With the MacSharry reform of 1992 several steps were taken by the EU to shift CAP subsidies away from price and market support towards direct support for farmers. This was further pursued with the Agenda 2000 reform, as signified by the shift in focus towards the maintenance and enhancement of the rural environment and the growing recognition of agriculture as a multifunctional activity. In environmental terms, the focus is on

(i) less-favoured areas and areas with environmental restrictions, and

(ii) on agricultural production methods designed to protect the environment and to maintain the countryside.

However price support and income payments, together with milk quotas, remained the dominant support measures. The 2003 CAP reform made further progress in the direction initiated by the Agenda 2000 reform, by aiming to make European agriculture more market oriented and giving a stronger focus to environmental protection. With the CAP reform, cross-compliance became an obligatory element of the CAP. Cross-compliance establishes a link between the granting of income support to the farmers and the compliance by the beneficiary with specified requirements of public interest (Oenema, 2008). These are given in

(i) "Statutory management requirements" (SMR, (Annex III of Regulation (EC) No 1782/2003) which are set in 19 community legislative acts on environment, food safety, animal health and welfare, as well as

(ii) the obligation to maintaining land in good agricultural and environmental conditions (GAECs) and maintaining permanent pasture at level at 1.5.2004. Definitions of GAEC are specified at national or regional level and should warrant appropriate soil protection, ensure a minimum level of maintenance of soil organic matter and soil structure and avoid the deterioration of habitats.

The *Nitrates Directive* (Council Directive 91/676/EEC) is the SMR with the largest impact on greenhouse gas emissions from agriculture. The directive aims at reducing and preventing water pollution caused by nitrates from agricultural sources with the goal that nitrate concentrations in groundwater will not exceed 50 mg NO3 L^{-1} and listing codes of good practice (Annex II A) to be implemented by the farmers on a voluntary basis. Nitrate vulnerable zones must be designated on the basis of monitoring results which indicate that the groundwater and surface waters in these zones are

[28] http://europa.eu.int/comm/agriculture/envir/index_en.htm

or could be affected by nitrate pollution from agriculture. The action program must contain mandatory measures relating to: (i) periods when application of animal manure and fertilizers is prohibited; (ii) capacity of and facilities for storage of animal manure; and (iii) limits to the amounts of animal manure and fertilizers applied to land.
However, greater compliance to standards and requirements for animal welfare and the housing of animals may contribute to increasing emissions (so-called pollution swapping).

Beside the environmentally-targeted directives, also the so-called first pillar of the CAP (dealing with market support in contrast to pillar two covering rural development measures) had a strong impact on the greenhouse gas emissions from agriculture in Europe, namely through the milk quota system, which lead to a strong reduction of animal numbers in the dairy sector to compensate for the increasing animal performance during the last decades.

Other important policies affecting greenhouse gas emissions from agriculture, particularly by addressing the abatement of air pollution through the control of NO_x and NH_3 emissions include, under others,

- the 1999 *Gothenburg Protocol* under the *Convention on Long Range Transboundary Air Pollution (CLRTAP)* to 'Abate Acidification, Eutrophication and Ground-level Ozone', which entered into force on 22 June 2006;
- the National Emission Ceilings Directive (NEC - Directive 2001/81/EC), which sets upper limits for each Member State for the total emissions in 2010 of the four pollutants responsible for acidification, eutrophication and ground-level ozone pollution;
- the *Integrated Pollution Prevention and Control* (IPPC) Directive, which was established in 1996 (http://ec.europa.eu/environment/ippc/index.htm), and aims at minimizing pollution from point sources, i. e., intensive animal production facilities (pig and poultry farms, with > 2000 fattening pigs; >750 sows; or > 40,000 head of poultry). These are required under the directive to apply control techniques for preventing NH_3 emissions according to Best Available Technology (BAT).

6.1 Overview over the sector

CRF Sector 4 'Agriculture' contributes 9 % to total EU-15 GHG emissions, making it the second largest sector after 'Energy'. The most important GHGs from '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 384 Tg in 2006 (Figure 6.1). In 2006, the emissions decreased by 0.6 % compared to 2005. 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 shows that the three largest key sources account for about 70% of agricultural GHG emissions of the EU-15.

Figure 6.1 EU-15 GHG emissions for 1990–2004 from CRF Sector 4: 'Agriculture' in CO_2 equivalents (Tg) and share of largest key source categories in 2004

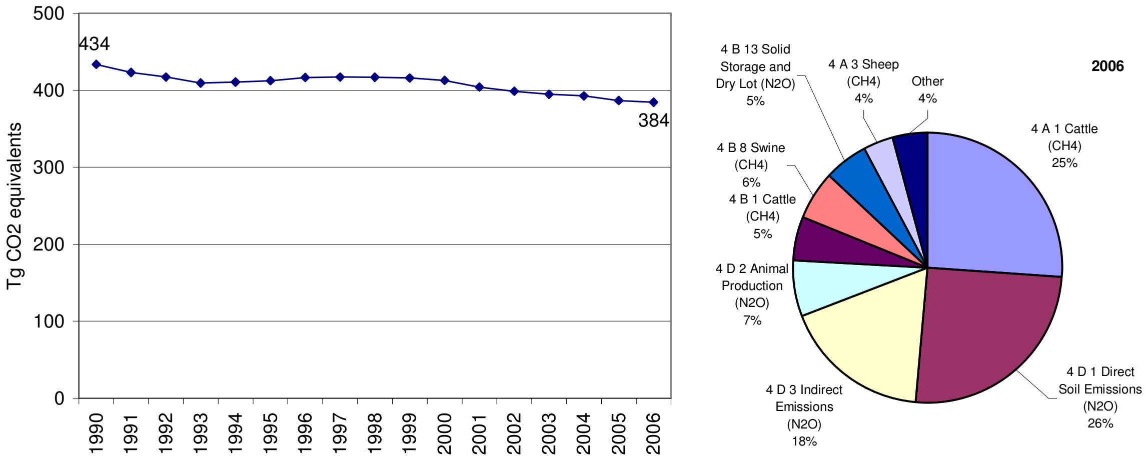
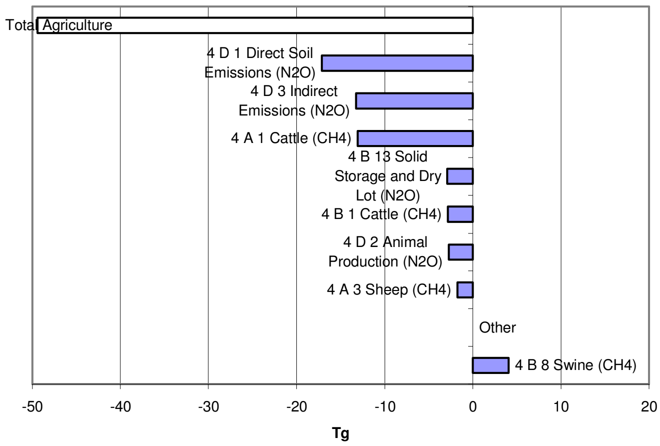


Figure 6.2 shows that large reductions occurred in the largest key sources CH_4 from 4.A.1: 'Cattle' and N_2O from 4.D.1: 'Direct soil emissions'. The main reasons for this are declining cattle numbers and decreasing use of fertiliser and manure in most Member States.

Figure 6.2 Absolute change of GHG emissions by large key source categories 1990–2006 in CO_2 equivalents (Tg) in CRF Sector 4: 'Agriculture'



6.2 Source Categories

6.2.1 Enteric fermentation (CRF Source Category 4A) (EU-15)

Table 6.1 shows total GHG and CH_4 emissions by Member State from 4A Enteric Fermentation. Between 1990 and 2006, CH_4 emission from 4A Enteric fermentation decreased by 11 %. 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 2006 (Gg CO_2 equivalents)	CH_4 emissions in 1990 (Gg CO_2 equivalents)	CH_4 emissions in 2006 (Gg CO_2 equivalents)
Austria	3,762	3,210	3,762	3,210
Belgium	4,068	3,529	4,068	3,529
Denmark	3,259	2,602	3,259	2,602
Finland	1,918	1,563	1,918	1,563
France	30,653	27,705	30,653	27,705
Germany	24,083	18,342	24,083	18,342
Greece	2,866	2,832	2,866	2,832
Ireland	9,494	9,151	9,494	9,151
Italy	12,179	10,629	12,179	10,629
Luxembourg	271	238	271	238
Netherlands	7,526	6,310	7,526	6,310
Portugal	2,622	3,044	2,622	3,044
Spain	11,780	13,383	11,780	13,383
Sweden	3,058	2,793	3,058	2,793
United Kingdom	18,421	16,160	18,421	16,160
EU-15	**135,958**	**121,492**	**135,958**	**121,492**

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 2006. Between 1990 and 2006, CH_4 emissions from enteric fermentation from cattle declined by 12 % in the EU-15 (Table 6.2). In 2006, the emissions were 1 % lower compared to 2005. The main driving force of CH_4 emissions from enteric fermentation is the number of cattle, which was 15 % below 1990 levels in 2006. The Member States with most emissions from this source were France and Germany (42 %). All Member States except Spain and Portugal reduced CH_4 emissions from enteric fermentation of cattle between 1990 and 2006.

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 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	3,561	3,017	3,009	3.0%	-7	0%	-551	-15%	T2	NS	CS, D
Belgium	3,813	3,317	3,284	3.3%	-33	-1%	-528	-14%	T1/T2	NS	D/CS
Denmark	2,950	2,256	2,183	2.2%	-72	-3%	-767	-26%	T2	NS	CS
Finland	999	795	768	0.8%	-27	-3%	-231	-23%	T2	NS	CS
France	28,162	25,490	25,540	25.6%	50	0%	-2,622	-9%	C	NS	CS
Germany	22,639	16,951	16,951	17.0%	0	0%	-5,688	-25%	C/ D/ T1/ T2	NS	CS, D
Greece	866	826	841	0.8%	16	2%	-25	-3%	T1	NS	D
Ireland	8,422	8,340	8,338	8.3%	-1	0%	-84	-1%	T2	NS	CS
Italy	10,040	8,665	8,366	8.4%	-299	-3%	-1,675	-17%	T2	NS	CS
Luxembourg	267	234	232	0.2%	-2	-1%	-35	-13%	T2	NS	CS
Netherlands	6,769	5,677	5,641	5.6%	-36	-1%	-1,128	-17%	T2	NS	CS
Portugal	1,814	2,150	2,117	2.1%	-34	-2%	302	17%	T2	NS	CS
Spain	6,473	8,188	8,067	8.1%	-121	-1%	1,593	25%	T2, CS	NS	D, CS
Sweden	2,698	2,445	2,439	2.4%	-6	0%	-259	-10%	CS	NS	CS
United Kingdom	13,484	11,975	12,095	12.1%	120	1%	-1,390	-10%	T2	NS	CS,D
EU-15	**112,958**	**100,324**	**99,871**	**100.0%**	**-454**	**0%**	**-13,087**	**-12%**			

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 2006, CH_4 emissions from enteric fermentation of sheep declined by 11 % in the EU-15 (Table 6.3). In 2006, the emissions were 0.3 % higher compared to 2005. The main driving force of CH_4 emissions from enteric fermentation is the number of sheep, which was 14 % below 1990 levels in 2006. The Member States with most emissions from this source were Spain and the United Kingdom (54 %). Eight Member States reduced CH_4 emissions from enteric fermentation of sheep.

Table 6.3: 4A3 Sheep: Member States' contributions to CH_4 emissions and information on method applied, activity data and emission factor

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	52	55	52	0.4%	-2	-4%	0	1%	T1	0.0	D
Belgium	33	26	26	0.2%	0	0%	-7	-21%	T1/T2	NS	D/CS
Denmark	33	34	37	0.3%	3	8%	4	11%	T2	NS	CS
Finland	15	15	21	0.1%	5	33%	6	39%	T2	NS	CS
France	1,922	1,532	1,499	10.5%	-33	-2%	-422	-22%	C	NS	D
Germany	556	444	444	3.1%	0	0%	-112	-20%	C/ D/ T1/ T2	NS	CS, D
Greece	1,350	1,371	1,365	9.6%	-6	0%	15	1%	T2	NS	CS
Ireland	1,032	813	762	5.4%	-50	-6%	-270	-26%	T1	NS	D
Italy	1,468	1,336	1,382	9.7%	46	3%	-86	-6%	T1	NS	D, CS
Luxembourg	1	2	2	0.0%	0	-6%	0	32%	T1	NS	D
Netherlands	286	229	231	1.6%	2	1%	-55	-19%	T1	NS	CS
Portugal	560	686	714	5.0%	28	4%	154	28%	T2	NS	CS
Spain	4,258	4,089	4,060	28.5%	-30	-1%	-198	-5%	T2, CS	NS	D, CS
Sweden	68	79	85	0.6%	6	7%	17	25%	T1	NS	D
United Kingdom	4,354	3,469	3,541	24.9%	71	2%	-813	-19%	T2	NS	CS,D
EU-15	**15,988**	**14,181**	**14,222**	**100.0%**	**41**	**0%**	**-1,767**	**-11%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

6.2.2 Manure management (CRF Source Category 4B) (EU-15)

Table 6.4 shows total GHG, CH_4 and N_2O emissions by Member State from 4B Manure Management. Between 1990 and 2006, CH_4 emission from 4B Manure Management increased by 3 %, whereas N_2O emission from 4B Manure Management decreased by 11 %.

Table 6.4: 4B Manure Management: Member States' contributions to total GHG emissions, CH_4 and N_2O emissions

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2006 (Gg CO_2 equivalents)	CH_4 emissions in 1990 (Gg CO_2 equivalents)	CH_4 emissions in 2006 (Gg CO_2 equivalents)	N_2O emissions in 1990 (Gg CO2 equivalents)	N_2O emissions in 2006 (Gg CO2 equivalents)
Austria	2,065	1,750	1,060	875	1,005	875
Belgium	3,134	2,757	2,174	1,924	960	834
Denmark	1,436	1,561	751	1,042	684	519
Finland	895	794	230	281	665	512
France	20,547	19,749	13,708	13,746	6,839	6,003
Germany	9,974	7,990	5,881	4,954	4,093	3,036
Greece	798	779	497	488	301	290
Ireland	2,726	2,633	2,328	2,234	397	399
Italy	7,383	6,650	3,462	3,029	3,921	3,621
Luxembourg	126	125	86	104	41	21
Netherlands	3,778	3,310	2,965	2,458	813	852
Portugal	1,751	1,759	1,176	1,169	575	590
Spain	8,695	12,736	6,231	9,738	2,465	2,998
Sweden	1,098	981	354	470	743	511
United Kingdom	4,643	3,937	2,923	2,536	1,720	1,401
EU-15	**69,048**	**67,511**	**43,827**	**45,050**	**25,222**	**22,461**

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 2006, CH_4 emissions from this source decreased by 12 % (Table 6.5). Germany and France are responsible for 56 % of the total EU-15 emissions from this source. All Member States except Finland, Luxembourg, Portugal and Sweden had reductions between 1990 and 2006. In absolute terms, France and Germany had the most significant decreases from this source.

Table 6.5: 4B1 Cattle: Member States' contributions to CH_4 emissions and information on method applied, activity data and emission factor

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	587	458	455	2.3%	-3	-1%	-132	-23%	T1	0.0	D
Belgium	851	721	712	3.6%	-9	-1%	-139	-16%	CS/M	NS/RS	CS
Denmark	282	261	251	1.3%	-10	-4%	-31	-11%	T2	NS	CS
Finland	66	89	89	0.4%	0	0%	23	35%	T2	NS	CS
France	8,743	7,988	8,022	40.3%	34	0%	-721	-8%	C/ T1	NS	D/ CS
Germany	4,035	3,160	3,160	15.9%	0	0%	-875	-22%	D/ T1/ T2	0.0	CS/ D
Greece	202	193	196	1.0%	4	2%	-6	-3%	T1	NS	D
Ireland	1,867	1,673	1,663	8.4%	-10	-1%	-204	-11%	T2	NS	CS
Italy	1,636	1,243	1,164	5.8%	-79	-6%	-473	-29%	T2	NS	CS
Luxembourg	53	68	68	0.3%	1	1%	15	28%	T2	NS	CS
Netherlands	1,571	1,448	1,453	7.3%	5	0%	-119	-8%	T2	NS	CS
Portugal	47	70	70	0.4%	0	0%	23	50%	T2	NS	CS
Spain	473	445	440	2.2%	-5	-1%	-33	-7%	T2, CS	NS	D, CS
Sweden	218	312	310	1.6%	-2	-1%	92	42%	T2	NS	CS
United Kingdom	2,114	1,841	1,855	9.3%	13	1%	-259	-12%	T2	NS	CS,D
EU-15	**22,746**	**19,969**	**19,907**	**100.0%**	**-63**	**0%**	**-2,840**	**-12%**			

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 2006. Between 1990 and 2006, CH_4 emissions from this source increased by 22% (Table 6.6). France and Spain are responsible for 62 % of the total EU-15 emissions from this source. In absolute terms, Spain had the most significant increases from this source.

Table 6.6: 4B8 Swine: Member States' contributions to CH_4 emissions and information on method applied, activity data and emission factor

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	448	397	395	1.8%	-2	0%	-53	-12%	T1	0.0	CS, D
Belgium	1,245	1,144	1,137	5.1%	-7	-1%	-107	-9%	CS/M	NS/RS	CS
Denmark	448	720	747	3.4%	27	4%	299	67%	T2	NS	CS
Finland	81	104	108	0.5%	4	4%	27	34%	T2	NS	CS
France	4,209	5,057	5,034	22.7%	-23	0%	825	20%	C/ T1	NS	D/ CS
Germany	1,621	1,546	1,546	7.0%	0	0%	-75	-5%	D/ T1/ T2	0.0	CS/ D
Greece	146	138	139	0.6%	1	1%	-7	-5%	T1	NS	D
Ireland	328	439	431	1.9%	-8	-2%	104	32%	T1	NS	D
Italy	1,432	1,454	1,423	6.4%	-31	-2%	-9	-1%	T2	NS	CS
Luxembourg	31	37	34	0.2%	-2	-7%	4	12%	T1	NS	D
Netherlands	1,140	932	927	4.2%	-5	-1%	-213	-19%	T2	NS	CS
Portugal	1,087	1,035	1,044	4.7%	9	1%	-43	-4%	T2	NS	CS
Spain	5,329	7,899	8,783	39.6%	884	11%	3,454	65%	T2, CS	NS	D, CS
Sweden	99	128	121	0.5%	-7	-6%	21	21%	T2	NS	CS
United Kingdom	476	296	311	1.4%	15	5%	-165	-35%	T2	NS	CS,D
EU-15	**18,119**	**21,325**	**22,180**	**100.0%**	**855**	**4%**	**4,062**	**22%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

N_2O emissions from 4B13 Solid Storage and Dry Lot account for 0.5 % of total EU-15 GHG emissions in 2006. Between 1990 and 2006, N_2O emissions from this source decreased by 12 % (Table 6.7). Italy, France and Spain are responsible for 58 % 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.

Table 6.7: 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 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	965	840	838	4.1%	-2	0%	-127	-13%	T1	NS	D
Belgium	892	787	769	3.8%	-17	-2%	-123	-14%	T1	NS/RS	D
Denmark	590	481	447	2.2%	-34	-7%	-143	-24%	CS	NS	D
Finland	652	491	492	2.4%	1	0%	-160	-25%	D	NS	D
France	6,605	5,803	5,770	28.1%	-33	-1%	-835	-13%	C/ T1	NS	D/ CS
Germany	3,642	2,649	2,649	12.9%	0	0%	-993	-27%	CS/ T1	NS	D
Greece	282	285	270	1.3%	-15	-5%	-12	-4%	D	NS	D
Ireland	341	344	343	1.7%	-1	0%	2	0%	T1	NS	D
Italy	3,728	3,267	3,170	15.5%	-97	-3%	-557	-15%	T2	NS	D, CS
Luxembourg	39	19	18	0.1%	-1	-5%	-21	-53%	T1	EJ	D
Netherlands	603	717	704	3.4%	-14	-2%	101	17%	T2	NS	D
Portugal	560	575	575	2.8%	0	0%	15	3%	D	NS	D
Spain	2,387	2,917	2,880	14.0%	-37	-1%	493	21%	D, CS	NS	D
Sweden	663	381	379	1.9%	-1	0%	-283	-43%	T2	NS	CS
United Kingdom	1,468	1,178	1,200	5.9%	22	2%	-268	-18%	T2	NS	CS,D
EU-15	**23,416**	**20,733**	**20,505**	**100.0%**	**-228**	**-1%**	**-2,911**	**-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 2006. Between 1990 and 2006, N_2O emissions from this source increased by 104 % (Table 6.8). Italy is responsible for 49 % of the total EU-15 emissions from this source and had the most significant increases from this source in absolute terms.

Table 6.8: 4B14 Other: Member States' contributions to N_2O emissions

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006	
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	17	16	16	2.7%	0	0%	-1	-4%
Belgium	3	10	9	1.5%	-1	-6%	6	184%
Denmark	NO	NO	NO	-	-	-	-	-
Finland	NE	NE	NE	-	-	-	-	-
France	NA	NA	NA	-	-	-	-	-
Germany	NO	NO	NO	-	-	-	-	-
Greece	13	15	14	2.3%	-1	-5%	1	9%
Ireland	NO	NO	NO	-	-	-	-	-
Italy	NO	302	295	49.4%	-6	-2%	295	-
Luxembourg	0.02	0.30	0.29	0.05%	0	-2%	0	1130%
Netherlands	NO	NO	NO	-	-	-	-	-
Portugal	NO	NO	NO	-	-	-	-	-
Spain	NO	NO	NO	-	-	-	-	-
Sweden	65	110	109	18.3%	-1	-1%	44	67%
United Kingdom	195	158	153	25.7%	-5	-3%	-42	-21%
EU-15	**293**	**611**	**597**	**100.0%**	**-14**	**-2%**	**304**	**104%**

Abbreviations explained in the Chapter 'Units and abbreviations'.
Emissions of Finland were not estimated due to lack of data.

6.2.3 Agricultural soils (CRF Source Category 4D) (EU-15)

N_2O emissions from this source category account for 5 % of total GHG emissions. Table 6.9 shows total GHG and N_2O emissions by Member State for N_2O from 4D Agricultural Soils. N_2O emissions from this source decreased by 15 % between 1990 and 2006. All EU-15 Member States decreased emissions except Spain.

Table 6.9: 4D Agricultural Soils: Member States' contributions to total GHG and N_2O emissions

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2006 (Gg CO_2 equivalents)	N_2O emissions in 1990 (Gg CO_2 equivalents)	N_2O emissions in 2006 (Gg CO_2 equivalents)
Austria	3,340	2,928	3,333	2,920
Belgium	4,549	3,896	4,546	3,893
Denmark	8,349	5,442	8,349	5,442
Finland	4,301	3,208	4,301	3,208
France	55,881	47,283	55,881	47,283
Germany	43,628	37,211	44,300	37,845
Greece	9,749	7,902	9,749	7,902
Ireland	7,009	6,664	7,009	6,664
Italy	19,437	17,880	19,437	17,880
Luxembourg	379	331	379	331
Netherlands	10,794	8,563	10,794	8,563
Portugal	3,437	3,235	3,437	3,235
Spain	19,090	19,423	19,090	19,423
Sweden	5,251	4,729	5,251	4,729
United Kingdom	30,412	23,956	30,412	23,956
EU-15	**225,606**	**192,651**	**226,267**	**193,272**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 6.10 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 2006. Direct N_2O emissions from agricultural soils occur from the application of mineral nitrogen fertilisers and organic nitrogen from animal manure. Between 1990 and 2006, emissions declined by 15 % 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 21 % and 7 % below 1990 levels in 2006, respectively. N_2O emissions from agricultural land can be decreased by overall efficiency improvements of nitrogen uptake by crops, which should lead to lower fertiliser consumption on agricultural land. The decrease of fertiliser use is partly due to the effects of the 1992 reform of the common agricultural policy and the resulting shift from production-based support mechanisms to direct area payments in arable production. This has tended to lead to an optimisation and overall reduction in fertiliser use. In addition, reduction in fertiliser use is also due to directives such as the nitrate directive and to the extensification measures included in the agro-environment programmes (EC, 2001).

Table 6.10: 4D1 Direct soil emissions: Member States' contributions to N_2O emissions and information on method applied, activity data and emission factor

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	1,805	1,562	1,610	1.6%	48	3%	-195	-11%	T1	NS	D
Belgium	2,367	2,197	2,174	2.2%	-23	-1%	-194	-8%	T1	NS/RS	D
Denmark	4,222	2,986	2,860	2.9%	-126	-4%	-1,362	-32%	D/CS	NS	D/CS
Finland	3,370	2,486	2,460	2.5%	-27	-1%	-910	-27%	D	NS	CS, D
France	26,595	23,037	22,093	22.5%	-944	-4%	-4,502	-17%	C/ T1	NS	D/ CS
Germany	27,711	23,816	23,816	24.3%	0	0%	-3,896	-14%	C/ D/ T1/ T2	0.0	C, D
Greece	2,760	1,725	1,699	1.7%	-26	-2%	-1,061	-38%	T1a,T1b	NS	D
Ireland	2,862	2,699	2,591	2.6%	-108	-4%	-271	-9%	T1a, T1b	NS	D
Italy	9,590	9,010	8,856	9.0%	-153	-2%	-734	-8%	D	NS	D, CS
Luxembourg	179	159	162	0.2%	3	2%	-17	-9%	T1a T1b	EJ NS	D
Netherlands	4,600	4,799	4,801	4.9%	2	0%	201	4%	T1b, T2	NS	CS
Portugal	1,449	1,074	1,231	1.3%	156	15%	-218	-15%	T1a	NS	D
Spain	10,106	9,518	9,804	10.0%	286	3%	-302	-3%	T1a, T1b, CS	NS	D
Sweden	3,191	2,918	2,901	3.0%	-17	-1%	-291	-9%	CS, T1a, T1b	NS	CS, D
United Kingdom	14,474	12,078	11,076	11.3%	-1,002	-8%	-3,398	-23%	T1a, T1b	NS	D
EU-15	**115,281**	**100,064**	**98,134**	**100.0%**	**-1,930**	**-1.9%**	**-17,147**	**-15%**			

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 2006. Between 1990 and 2006, N_2O emissions from this source decreased by 10 % (Table 6.11). 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 6.11: 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 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	218	219	217	0.8%	-2	-1%	-1	-1%	T1	NS	D
Belgium	936	803	791	3.1%	-12	-2%	-145	-15%	T1	NS/RS	D
Denmark	312	282	279	1.1%	-3	-1%	-33	-11%	D/CS	NS	D
Finland	165	149	149	0.6%	0	0%	-15	-9%	D	NS	D
France	8,539	7,384	7,373	28.7%	-11	0%	-1,166	-14%	C/ T1	NS	D/ CS
Germany	1,682	1,397	1,397	5.4%	0	0%	-286	-17%	C/ D/ T1/ T2	0.0	C, D
Greece	3,383	3,421	3,387	13.2%	-34	-1%	4	0%	D	NS	D
Ireland	2,802	2,821	2,783	10.8%	-38	-1%	-19	-1%	T1a	NS	D
Italy	1,736	1,518	1,556	6.1%	38	3%	-180	-10%	D	NS	D, CS
Luxembourg	59	54	53	0.2%	-1	-1%	-5	-9%	T1	EJ	D
Netherlands	1,307	651	611	2.4%	-40	-6%	-696	-53%	T1b	NS	CS
Portugal	662	745	758	3.0%	13	2%	97	15%	T1a	NS	D
Spain	1,366	1,583	1,560	6.1%	-23	-1%	194	14%	T1a, T1b, CS	NS	D
Sweden	286	319	320	1.2%	1	0%	34	12%	T2	NS	CS
United Kingdom	4,973	4,338	4,437	17.3%	99	2%	-536	-11%	NO	NO	NO
EU-15	**28,427**	**25,683**	**25,670**	**100.0%**	**-13**	**0%**	**-2,757**	**-10%**			

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 2006. Between 1990 and 2006, N_2O emissions from this source decreased by 12 % (Table 6.12). France, Germany and the UK are responsible for 56 % of the total EU-15 emissions from this source; they had large absolute reductions between 1990 and 2006.

Table 6.12: 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 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	1,310	1,087	1,092	1.6%	5	0%	-218	-17%	T1	NS	D
Belgium	1,242	918	928	1.4%	10	1%	-314	-25%	T2	NS/RS	D
Denmark	3,787	2,361	2,218	3.3%	-143	-6%	-1,569	-41%	D/CS	NS	D
Finland	758	597	598	0.9%	1	0%	-159	-21%	D	NS	D
France	20,401	18,109	17,587	25.9%	-522	-3%	-2,814	-14%	C/ T1	NS	D/ CS
Germany	14,906	12,463	12,463	18.3%	0	0%	-2,443	-16%	C/ D/ T1/ T2	0.0	C, D
Greece	3,606	2,829	2,816	4.1%	-13	0%	-789	-22%	T1a	NS	D
Ireland	1,345	1,308	1,289	1.9%	-19	-1%	-55	-4%	T1b	NS	D
Italy	8,111	7,505	7,468	11.0%	-37	0%	-643	-8%	D	NS	D, CS
Luxembourg	141	118	116	0.2%	-2	-1%	-25	-18%	T1a	EJ NS	D
Netherlands	4,863	3,157	3,146	4.6%	-12	0%	-1,717	-35%	T1, T3	NS	D
Portugal	1,324	1,126	1,244	1.8%	118	11%	-80	-6%	T1a	NS	D
Spain	7,515	7,580	7,836	11.5%	255	3%	320	4%	T1a, T1b, CS	NS	D
Sweden	1,142	935	922	1.4%	-13	-1%	-220	-19%	CS, T1	NS	D
United Kingdom	10,797	8,622	8,270	12.2%	-352	-4%	-2,527	-23%	NO	NO	NO
EU-15	**81,247**	**68,716**	**67,993**	**100.0%**	**-723**	**-1%**	**-13,254**	**-16%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

6.3 Methodological issues and uncertainty

All Member States consider their greenhouse gas inventories in the agricultural sector for complete for those categories that are reported to occur in the countries. For categories 4.A, 4.B (both methane and nitrous oxide) and 4.D (nitrous oxide) emissions in all relevant sub-categories are considered (CRF Tables 7s2). CH_4 emissions from rice fields are reported for France, Greece, Italy, Portugal and Spain.

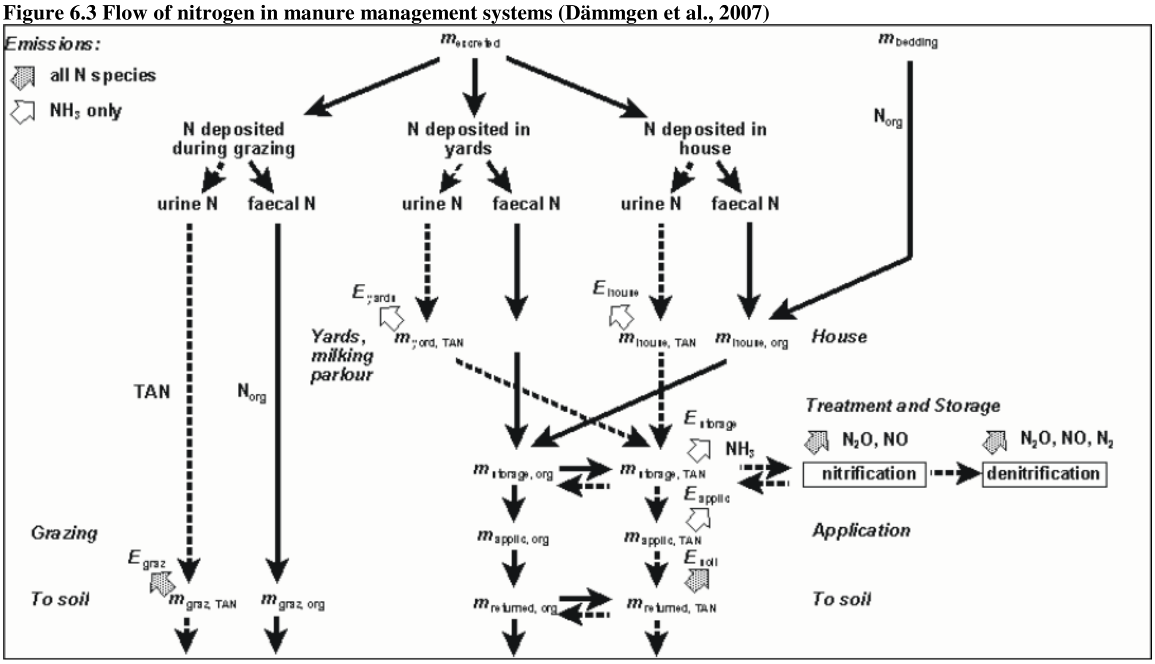
Many countries recognise that in the agriculture sector the emissions from the different categories are inherently linked and are best estimated in a comprehensive model that covers not only greenhouse gases (CH_4 and N_2O) in a consistent manner, but also ammonia. Estimations of ammonia emissions are required for reporting under the Convention on Long-Range Transboundary Air Pollution and are needed to estimate indirect N_2O emissions. Hence, some countries have developed comprehensive models covering consistently different source categories and different gases.

- Germany: GAS-EM (GASeous Emissions) calculates consistently the emissions from the agriucltural sector (Dämmgen et al., 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 4.A)

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 48% of emissions in category 4.A., Greece) are reported by Greece, Italy, Portugal, Spain and the UK. Emissions accounting for more than 5% of the emissions in this category are further reported by for the sub-category "Goats" (Greece, 20%) and for the sub-category "Swine" (Denkmark, 12%).
An overview of the CH_4 emissions, animal population and the corresponding implied emission factors for CH_4 emissions from enteric fermentation for the most important categories cattle and sheep (key source at EC-level) and also goats and swine are given in Table 6.13. Data are given for 2006 as the last inventory year and the base year 1990. The table shows that there is a general trend of decreasing animal numbers which are partly compensated by higher emissions per head due to intensification of livestock production in Europe.

Table 6.13: Total CH_4 emissions in category 4A and implied Emission Factor at EU-15 level for the years 1990 and 2006

1990[1)]	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine
CH_4 emissions [Gg CH_4]	2518	2861	761	65	154
Animal population [1000 heads]	26245	63952	114501	12682	112532
Implied EF (kg CH_4/head/yr)	96	45	6.6	5.1	1.4

2006	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine
CH_4 emissions [Gg CH_4]	2042	2714	677	61	166
Animal population [1000 heads]	18369	58046	98091	11804	119074
Implied EF (kg CH_4/head/yr)	111	47	6.9	5.2	1.4

2006 value in percent of 1990	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine
CH4 emissions [Gg CH4]	81%	95%	89%	93%	107%
Animal population [1000 heads]	70%	91%	86%	93%	106%
Implied EF (kg CH4/head/yr)	116%	104%	104%	100%	102%

Information source: CRF for 1990 and 2006, submitted in 2008

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 6.14. In addition to the methodology applied by the Member States for calculating CH_4 emissions, the table indicates also the total emissions in the category "enteric fermentation", the contribution of the animal types considered (dairy and non-dairy cattle and sheep) to the total emissions, and whether the emissions from the animal class are belonging to the key source categories in the different Member States.

The table indicates also the Tier level of the source category and of the emission estimates for the animal types considered. For this purpose we compare the implied emission factor for dairy cattle, non-dairy cattle and sheep with the IPCC default values for Western Europe of 100 kg CH_4 head^{-1} year^{-1}, 48 kg CH_4 head^{-1} year^{-1} and 8 kg CH_4 head^{-1} year^{-1}, respectively. 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 (for a detailed description of the estimation of the Tier level see section 6.4.1). A value of 56 kg CH_4 head^{-1} year^{-1} was also used by Austria and Portugal for non-dairy cattle, however, according to the national inventory reports of these countries they were derived on the basis of a Tier 2 calculation. We can thus observe that for cattle, almost all emissions are calculated with the help of country-specific data (99% have been estimated using the Tier 2 methodology), while for sheep still 26% of the emissions are estimated with a Tier 1 approach. The Tier levels for goats, swine, and reindeer are included in Table 6.77**.**

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.

On EU-15 level, 97% of the CH_4 emissions in category 4.A have been estimated with a Tier 2 approach. Overall, a Tier level between 1.4 and 2.0 can be derived for the source category 'enteric fermenation' with a Tier level of Tier 1.9 for EU-15. This estimate includes also the Tier level for goat (Tier 1.1), swine (Tier 1.3) and reindeer (estimated by Finland and Sweden with national emission factors). The thus aggregated Tier level of Tier 1.92 accounts for 98% of the emissions in category 4A and has been complemented with 'other emissions' assuming that these are estimated with a Tier 1 approach.

Table 6.14: Total emissions, contribution of the main sub-categories to CH_4 emissions in category 4A, methodology applied and key source assessment by Member States for the sub-categories dairy cattle, non-dairy cattle and sheep.

Member State	Total		Dairy Cattle		Non-dairy cattle		Cattle	Sheep	
	Gg CO_2-eq	b	a	b	a	b	c	a	b
Austria	3,210	Tier 1.9	40%	Tier 2.0	54%	Tier 2.0	y	2%	Tier 1.0
Belgium	3,529	Tier 1.9	36%	Tier 2.0	57%	Tier 2.0	y	1%	Tier 1.0
Denmark	2,602	Tier 2.0	56%	Tier 2.0	28%	Tier 2.0	y	1%	Tier 2.0
Finland	1,563	Tier 2.0	49%	Tier 2.0	48%	Tier 2.0	y	1%	Tier 1.0
France	27,705	Tier 1.9	31%	Tier 2.0	61%	Tier 2.0	y	5%	Tier 1.0
Germany	18,342	Tier 2.0	55%	Tier 2.0	37%	Tier 2.0	y	2%	Tier 1.0
Greece	2,832	Tier 1.5	13%	Tier 1.0	17%	Tier 1.0	y	48%	Tier 2.0
Ireland	9,151	Tier 2.0	28%	Tier 2.0	63%	Tier 2.0	y	8%	Tier 2.0
Italy	10,629	Tier 1.8	41%	Tier 2.0	38%	Tier 2.0	y	13%	Tier 1.0
Luxembourg	238	Tier 2.0	43%	Tier 2.0	54%	Tier 2.0	y	1%	Tier 1.0
Netherlands	6,310	Tier 1.9	61%	Tier 2.0	28%	Tier 2.0	y	4%	Tier 1.0
Portugal	3,044	Tier 2.0	27%	Tier 2.0	43%	Tier 2.0	y	23%	Tier 2.0
Spain	13,383	Tier 1.9	15%	Tier 2.0	46%	Tier 2.0	y	30%	Tier 2.0
Sweden	2,793	Tier 1.9	38%	Tier 2.0	49%	Tier 2.0	y	3%	Tier 1.0
United Kingdom	16,160	Tier 2.0	28%	Tier 2.0	47%	Tier 2.0	y	22%	Tier 2.0
EU-15	**121,492**	**Tier 1.92**	**35%**	**Tier 2.0**	**47%**	**Tier 2.0**	**y**	**12%**	**Tier 1.7**
EU-15: Tier 1	3%		1%		0%			26%	
EU-15: Tier 2	97%		99%		100%			74%	

a Contribution to CH_4 emissions from enteric fermentation

b Tier 1: default methodology; Tier 2: country-specific methodology

c Source category is key in the Member State's inventory (y/n). nr: not reported. Assessment for total cattle.

Details on the applied methodologies for the estimation of CH_4 emissions from enteric fermentation are given in Table 6.15.

Table 6.15: Methodology used by Member States for calculating CH_4 emissions in category 4A

Member State	Methodology
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	Because CH_4-emissions from enteric fermentation are a key source category for cattle a Tier 2 approach is required in both regions, Flanders and Wallonia. CH_4 emissions from enteric fermentation from the other, non key source, animal categories (sheep, goats, swine, horses and mules and asses) are estimated using the Tier 1 methodology.
Denmark	The emissions from the agricultural sector are calculated in a comprehensive agricultural model complex called DIEMA (Danish Integrated Emission Model for Agriculture) (Mikkelsen, 2006; Mikkelsen and Gyldenkærne 2006). The category Non-Dairy Cattle includes Calves, Heifer, Bulls and Suckler Cows and the implied emission factor is a weighted average of these different subcategories. Data given for Non-Dairy Cattle covers data for heifer older than ½ year. The category Swine includes the subcategories Sows, Piglets and Slaughtering Pigs. The feed intake for sows and piglets has increased while the feed intake for slaughtering pigs has decreased as a result of improved fodder efficacy.
Finland	Tier 1 for Horses, Swine and Goats. Tier 2 method for Cattle, since emissions from cattle (key source in Finnish inventory). 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. Cattles are not used for work in Finland.
France	Emissions from Dairy Cattle are calculated using an equation developed at INRA (Tier 2+). Tier 1 other animal types.
Germany	Dairy cattle are differentiated by productivity and feed composition at the "Kreise" level. Tier 2 for dairy and non-dairy cattle and swine.
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. In the approach outlined by O'Mara (2006), the daily energy requirement of cows in each region is calculated by month or part thereof based on maintenance requirements, milk yield and composition, requirements for foetal growth and gain or loss of bodyweight (INRA, 1989). Given data for liveweight and liveweight gain, energy requirements of animals were estimated during the winter housing periods and grazing seasons of the animal's lifetime using the INRAtion computer programme, version 3.0. This programme is devised by the French research organisation INRA, and is based on the net energy system for Cattle. Other animals: Tier 1 Methodology, EFs IPCC default.
Italy	The Tier 2 IPCC GPG approach has been followed for Dairy, Non-Dairy and Buffalo. Country-specific emission factor suggested by the Research Centre on Animal Production for rabbits have been use. A Tier 1 approach, with IPCC default emission factors, has been used to estimate methane emissions from swine, sheep, goats, horses, mules and asses.
Luxembourg	IPCC Tier I method has been applied to all animal types except cattle, where the Tier II method has been applied.
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 2006 are given in Table 6.16. The characterization of the livestock population across the background tables 4.A, 4.B(a), and 4.B(b) is done in a consistent way by all Member States and will therefore be discussed only here. Luxembourg and Netherlands have chosen to use the option B for the classification of cattle. In order to allow the calculation of an EC implied emission factor for the categories listed under option A, these numbers were "converted" using the following rule: Mature Dairy Cattle → Dairy Cattle; Mature Non-dairy Cattle + Young Cattle → Non-dairy cattle.

Other animal types with population data reported in Table4.A are deer (Austria and United Kingdom), reindeer (Finland and Sweden), fur farming (Denmark, Finland) and rabbits (Italy, Portugal), and other poultry (Spain).

Some information on the source of the animal numbers for the different Member States is given in Table 6.17.

Table 6.16: Animal population [1000 heads] in 2006

Member State 2006	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine	Poultry
Austria	527	1,475	312	53	3,139	13,027
Belgium	524	2,139	154	28	6,295	32,751
Denmark	550	984	102	13	13,361	17,249
Finland[1)]	309	640	117	7	1,436	10,239
France	3,883	15,684	8,924	1,304	11,491	247,834
Germany	4,236	8,799	2,643	170	24,481	120,562
Greece	219	399	8,790	5,421	949	31,565
Ireland	1,101	5,091	6,279	7	1,632	15,775
Italy	1,821	4,296	8,227	955	9,281	177,535
Luxembourg[2)]	77	290	10	2	84	81
Netherlands[2)]	2,839	4,651	1,376	310	11,356	94,704
Portugal	323	1,106	3,454	474	2,327	39,120
Spain	963	5,351	22,474	2,957	26,628	172,998
Sweden	388	1,204	506	6	1,681	17,060
United Kingdom	527	1,475	312	53	3,139	13,027
EU-15	19,827	60,517	98,091	11,804	119,074	1,158,295

Information source: CRF for 1990 and 2006, submitted in 2008

[1)] Finland reports non-dairy cattle under "other" in the following categories: bulls, cows, heifers, and calves. [2)] For Luxembourg and the Netherlands the numbers for cattle have been calculated using the figure given under option B.

Table 6.17: Information on the source of animal population data

Member State	Activity Data
Austria	The Austrian official statistics (Statistic Austria, 2006) provides national data of annual livestock numbers on a very detailed level. In 1998-2002 swine numbers were fluctuating due to a high elasticity to market prices. The animal numbers of Young Swine were not taken into account because the emission factors for Breeding Sows already includes nursery and growing pigs (Schechtner 1991). Information about the extent of organic farming in Austria was provided in the Austrian INVEKOS database (Kirner and Schneeberger, 1999). From 2004 onwards INVEKOS data of organic cattle population as reported in the so called 'Green Reports' of the ministery of agriculture (BMLFUW 2007) was used.
Belgium	The National Institute of Statistics (NIS) publishes land-use and the livestock figures yearly (NIS, 2006 http://www.statbel.fgov.be/downloads/cah2006m_fr.xls). All agricultural businesses have to fill in a form each year about the situation at 1 may of that year and sent it to the NIS. 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. In 2006 Wallonia has 55% of the land used for agriculture, but 67% of agricultural businesses are situated in Flanders.
Denmark	Livestock production is primarily based on the agricultural census from Statistics Denmark. The emission from slaughter pigs and poultry is based on slaughter data. Approximate numbers of horses, goats and sheep on small farms are added to the number in the Agricultural Statistics, in agreement with the Danish Agricultural Advisory Centre (DAAC), as Statistics Denmark does not include farms less than 5 hectares. , manure type in different stable types, nitrogen content in manure, etc. The Danish Institute of Agricultural Sciences (FAS) delivers Danish standards related to feed consumption.
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.
France	Agricultural statistics are issued by the ministry of agriculture (SCEES/AGRESTE). Activity data is a one year average. Heifers are included in Other Cattle, but heifers more than 2 years old (40% of the total heifer livestock) are considered as Dairy cattle.
Germany	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. Calculation methods and elaboration of activity data are detailed in Daemmgen et al. (2007).
Greece	Data on animal population, agricultural production and cultivated areas used for the emissions calculation were provided by the NSSG. 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

Member State	Activity Data
	year. Milk yield derives from data of the annual Agricultural Statistics.
Ireland	Because of the importance of agriculture in the country, Ireland has very extensive and up-to-date statistical data on all aspects of the sector, compiled and published by the Central Statistics Office. The Irish cattle herd is now characterised by 11 principal animal categories for which annual census data are published by CSO. The number of Cows in each category given by CSO statistics was allocated to the regions using CMMS reports published by the Department of Agriculture and Food (DAF, 2007). The most important parameter is liveweight gain as it directly affects the energy requirement and thus feed intake. There is little statistical information on the liveweight gain of the different types of Cattle in the Irish Cattle herd, but the weight of carcasses of all slaughtered cattle is recorded by the Department of Agriculture and Food.
Italy	Livestock data are collected from the National Institute of Statistics (ISTAT) and are based on specific national surveys, such as the 'milk production' and the 'farm structure and production' surveys, and from a general agricultural census carried out every 10 years. 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”.
Luxembourg	The activity data are the livestock data reported in the national statistics.
Netherlands	Activity data for the animal population are based on the annual agricultural survey performed by Statistics Netherlands (CBS). Data can be found on the website www.cbs.nl and in background documents (Van der Hoek and Van Schijndel, 2006; Van Schijndel and Van der Sluis, 2008). For cattle three categories are distinguished: Dairy cattle: adult female cows (for milk production); Non-dairy cattle: adult cows (for meat production); Young cattle showing a mix of different age categories (for breeding and meat production).
Portugal	Activity data are 3-years average except for last year. Annual livestock numbers were available from the statistical databases of the National Statistics Institute (INE) for Cattle, Swine, Sheep, Goats, Horses, Mules and Donkeys, dissagregated per region, age and sex. The number of Rabbits, Hens, Broilers, Turkeys, Ducks, Geese and Guinea-fowl, is only available for 1999 – from the national agriculture census that is done every ten years.
Sweden	The Farm Register provides the main basis for agricultural statistics in Sweden. The Register is administered by the Swedish Board of Agriculture and Statistics Sweden and provides annual information on the total number of animals of different categories on Swedish farms. The information on livestock refers to the situation prevailing in mid-June of that year and thus is considered to be equivalent to a one-year average. Mink and foxes are minor contributors to greenhouse gas emissions and are not included in the inventory due to a lack of well-founded emission factors. The number of slaughter chickens (mean number of chickens kept during the year) is provided by the Swedish Poultry Meat Association.
United Kingdom	The animal population data are collected in an annual census (Defra). Dairy Cattle - changed animal weights with data from Steve Walton, Defra stats. Pre-1995 is corrected home killed slaughter weights (UK livestock Slaughter Statistics, Defra, SERAD, WAG and DARDNI and their predecessors, 1995 and onwards are weights from the over 30 months scheme (courtesy of Rural Payments Agency). In using the animal population data, it is

Member State	Activity Data
	assumed that the reported numbers of animals are alive for that whole year. The exception is the treatment of sheep where it is normal practice to slaughter lambs and other non-breeding sheep after 6 to 9 months. Hence it is assumed that breeding sheep are alive the whole year but that lambs and other non-breeding sheep are only alive 6 months of a given year (based on Smith and Frost, 2000).

Emission Factors and other parameters

Considerable variation is found in the IEF for dairy and non-dairy cattle with values between 81 kg CH_4 head^{-1} yr^{-1} (Greece) and 131 kg CH_4 head^{-1} yr^{-1} (Sweden) for dairy cattle, and 35 kg CH_4 head^{-1} yr^{-1} (Denmark) and 56 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 6.18. For EU-15, the implied emission factor in 2006 was 111 kg CH_4 head^{-1} yr^{-1}.

More detailed information on the development of the emission factors for category 4A is given in

Member State	Implied EF (kg CH_4/head/yr) [1)]						CH_4 conversion (%) [1)]				
2006	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	117	44	8.2	8.7	1.5		6.0	6.0			
Denmark	126	35	17.2	13.2	1.1		5.9	5.9	6.0	5.0	0.6
Finland[1)]	118	46	8.4	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	110	54	5.8	5.0	0.5		6.0	6.0	7.0	NE	NE
Italy	113	45	8.0	5.0	1.5		6.0	4.4	NA	NA	NA
Luxembourg[2)]	127	42	8.0	5.0	1.5		6.0	6.0	6.0	5.0	0.6
Netherlands[2)]	129	37	8.0	5.0	1.5		NE	NE	NE	NE	NE
Portugal	119	56	9.8	8.4	1.4		6.0	5.9	6.0	5.0	0.6
Spain[3)]	97	54	8.6	5.0	1.5		5.5	5.3	6.6	NA	NA
Sweden	131	54	8.0	5.0	1.5		6.7	7.0	6.0	5.0	0.6
United Kingdom	103	43	4.9	5.0	1.5		6.0	6.0	NE	NE	NE
EU-15	111	47.3	6.9	5.2	1.4		6.0	5.6	6.3	5.0	0.6

Information source: CRF for 1990 and 2006, submitted in 2008. 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 6.19.

The following outliers can be identified:

- *Implied Emission Factor for Dairy cattle, Netherlands*

  The slightly lower Dutch IEF compared to the default IPCC IEF for adult dairy cattle at a comparable milk production rate (at a milk production rate of 6700 kg per cow per year) can be explained by the higher feed digestibility in the Netherlands.

- *Implied Emission Factor for Non-dairy cattle, Denmark.*

Non-Dairy Cattle" includes calves, heifers, bulls and suckler cows and the implied emission factor is a weighted average of these different subcategories. 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.

- *Implied Emission Factor for Non-dairy cattle, Germany*

  The low IEF is due to large share of cattle with low EF. The level of IEF seems to be comparable to that given by a number of other countries (comparison based on 2007 submissions, including Option B). Further, the low IEF is consistent with a low animal weight for non-dairy cattle in Germany.

- *Implied Emission Factor for Sheep and goat, Denmark*

  The emissions from sheep include lamb and thus explain the high IEF value. The same situation exists for goats, which include kids. This is due to the availability of data. The Danish normative data from the Faculty of Agricultural Sciences operate with sheep including lamb as a standard and do not distinguish between sheep and lamb.

Table 6.18: Implied Emission factors for CH_4 emissions from enteric fermentation and CH_4 conversion factors used in Member State's inventory

Member State	Implied EF (kg CH_4/head/yr) [1]						CH_4 conversion (%) [1]				
2006	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	117	44	8.2	8.7	1.5		6.0	6.0			
Denmark	126	35	17.2	13.2	1.1		5.9	5.9	6.0	5.0	0.6
Finland[1]	118	46	8.4	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	110	54	5.8	5.0	0.5		6.0	6.0	7.0	NE	NE
Italy	113	45	8.0	5.0	1.5		6.0	4.4	NA	NA	NA
Luxembourg[2]	127	42	8.0	5.0	1.5		6.0	6.0	6.0	5.0	0.6
Netherlands[2]	129	37	8.0	5.0	1.5		NE	NE	NE	NE	NE
Portugal	119	56	9.8	8.4	1.4		6.0	5.9	6.0	5.0	0.6
Spain[3]	97	54	8.6	5.0	1.5		5.5	5.3	6.6	NA	NA
Sweden	131	54	8.0	5.0	1.5		6.7	7.0	6.0	5.0	0.6
United Kingdom	103	43	4.9	5.0	1.5		6.0	6.0	NE	NE	NE
EU-15	111	47.3	6.9	5.2	1.4		6.0	5.6	6.3	5.0	0.6

Information source: CRF for 1990 and 2006, submitted in 2008. 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 6.19: Member State's background information for CH_4 emissions in category 4.A. Emission Factor and other parameters

Member State	Emission Factor and other parameters
Austria	Country specific emission factors for cattle calculated from the specific gross energy intake and the methane conversion rate (IPCC for "all other cattle" because there are few if any feedlot cattle with a high-energy diet). Austrian 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, Gruber and Poetsch, 2006). For suckler cows, a constant average milk yield of 3 000 kg was applied.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 average animal weight and weight gain originate in Flanders from the Department Agriculture and Fishery and in Wallonia from average weights published by the federal finance departement. In Flanders, data for feed digestibility (DE%) originate from a report [http://www.rivm.nl/bibliotheek/rapporten/680125001.html] from the Netherlands, a neighbouring country with comparable feeding situations. In both regions a methane conversion rate (Ym) of 6% is used to calculate the emission factor for each cattle type. The emission factors for all categories with exception for dairy cows stay constant over the entire time series. For dairy cows the emission factor increases with increasing milk production.
Denmark	Feed consumption for all animal categories is based on the Danish normative figures. The estimation of the national values of Ym is based on model "Karoline" developed by FAS based on average feeding plan for 20% of all dairy cows in Denmark obtained from the Danish Agricultural Advisory Centre DAAC (Danfær, A. 2005). New investigations from FAS have shown a change in fodder practice from use of 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. Enteric CH_4 emissions are, in general, lower than the IPCC default values due to the professional way farms are managed in Denmark.
Finland	IPCC gives no default emission factor for reindeer, thus it has been calculated by using national methodology for estimating gross energy intake of reindeer from the basis of their forage. The same equation has been used for sheep also. Emission factors for cattle are updated annually. EF´s for other animal groups will be updated if more national data will become available. Average daily weight gain for cattle was estimated to remain constant.
France	The EF for Dairy Cattle, is depending to the milk production.
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

Member State	Emission Factor and other parameters
	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 2006 herd and then repeated for 1990 and 2005. The study and analysis underlying the new emission factors is available (O'Mara, 2006). Emission factors for the Beef cattle categories were determined by calculating lifetime emissions for the animal and by partitioning between the first, second and third years of the animal's life. The inventory agency continues to use the Tier 1 approach for enteric fermentation for all livestock categories other than cattle.
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.
Luxembourg	The emission factors have been established during the re-evaluation of methane emissions from agriculture in 2006. Revising emission factors for young cattle, which are lower than adult cattle.
Netherlands	The emission factors for three cattle types are calculated annually (e.g. adult dairy, adult non-dairy and young cattle, respectively). Swine, sheep, goat and horses: default.
Portugal	For the emission factor for Rabbit, the default EF for Horse has been downscaled to the average weight of a rabbit according to the scaling equation in IPCC GPG. Default EF for Horses, Mules and Asses, due to the unavailability of a more detailed livestock characterization and specific characterization of national populations.
Sweden	A national methodology based on feed energy requirements expressed as metabolisable energy is used in the Swedish inventory to estimate emission factors for dairy cows, beef cows and other cattle. The calculations for dairy cows were revised some years ago. The emission factors for other cattle groups were also reevaluated, using the same methodology. The initial step in estimating emission factors for cattle according to the Swedish method is enhanced characterisation of feed intake estimates (Tier 2 methodology). The energy requirements for maintenance, growth, lactation and pregnancy are estimated, but expressed as metabolisable energy (MJ/day) instead of as net energy. The metabolisable energy requirement is then recalculated to digestible energy. A lactation period of 305 days and a non-lactating period of 60 days was used (Bertilsson, 2002; Nieminen, 1998). The default values in the IPCC Guidelines are used for the less significant animal groups. Reindeer: according to IPCC GPG (Tier 2) using a Finnish value of gross energy requirements.
United Kingdom	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

Member State	Emission Factor and other parameters
	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). Apart from cattle, lambs and deer, the methane emission factors are IPCC Tier 1 defaults (IPCC, 1997) and do not change from year to year.

Milk productivity is one of the most important factors determining the level of CH_4 emissions from dairy cattle. Several countries have reported milk productivity, which are reproduced in Table 6.20 and Table 6.21 beside information on feed intake, animal weight, and feed digestibility. The data show clearly that a strong intensification of cattle husbandry occurred, with increases in the milk yield ranging from 10% (Greece) to 88% (Spain). This is thus more than the increase in the CH_4 emission factor. The increased production was only partly achieved by increased energy intake (up to a maximum of 34%, 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 13 countries which report a time-dependent milk productivity). Higher feed digestibility reduces the portion of carbon intake that is transformed to methane in ruminants. As the feed intake increase is smaller than the increase in milk productivity (for EU15 the numbers are 19% and 37%, 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 38% than the default value for Western Europe (11.5 kg/day) in 1990, and increased to a level which was 89% above IPCC default in 2006. Even though feed digestibility for dairy cattle was not separately estimated for each year by all countries, the level is 12% to 14% above IPCC default (60%) digestibility.

Table 6.20: Additional background information for calculating CH_4 emissions from enteric fermentation from dairy cattle

Member State	Dairy Cattle				Member State	Dairy Cattle			
2006	Feed Intake[1)]	Animal Weight (kg)	Milk prod.[1)]	Feed Digest. (%)	**1990**	Feed Intake[1)]	Animal Weight (kg)	Milk prod.[1)]	Feed Digest. (%)
Austria	292	700	16	70	Austria	248	700	10	66
Belgium	297	600	17	75	Belgium	251	600	11	75
Denmark	324	575	23	71	Denmark	278	575	17	71
Finland	300	576	21	70	Finland	247	503	16	70
France	NA	NA	34	NA	France	NA	NA	27	NA
Germany	288	590	19	66	Germany	241	539	13	63
Greece	NE	NE	10		Greece	NE	NE	9	
Ireland	239	535	14	NE	Ireland	222	535	11	NE
Italy	288	603	17	65	Italy	236	603	12	65
Luxembourg	322	650	19	66	Luxembourg	268	650	13	66
Netherlands	NE	NE	NE	NE	Netherlands	NE	NE	NE	NE
Portugal	303	NE	17	60	Portugal	241	NE	12	60
Spain	269	648	19	71	Spain	200	642	10	71
Sw eden	339	NE	NE	NE	Sw eden	339	NE	NE	NE
United Kingdom	261	577	18	74	United Kingdom	224	550	14	74
EU-15	282	594	22	68	EU-15	238	571	16	67

Information source: CRF for 1990 and 2006, submitted in 2008. Abbreviations explained in the Chapter 'Units and abbreviations'.

1) Unit for feed intake: MJ/head/yr; unit for Milk productivity: kg/day/head.

Table 6.21: Additional background information for calculating CH_4 emissions from enteric fermentation from non-dairy cattle

Member State 2006	Non-dairy Cattle Feed Intake[1)]	Animal Weight (kg)	Milk prod.[1)]	Feed Digest. (%)
Austria	142	427	NO	72
Belgium	113	393	NA	75
Denmark	105	326	NO	71
Finland	117	NA	NA	70
France	NA	NA	NA	NA
Germany	96	270	NE	72
Greece	NE	NE	NE	NE
Ireland	134	500	14	NE
Italy	137	377	NA	NA
Luxembourg	107	353	NA	64
Netherlands	NE	NE	NE	NE
Portugal	146	425	0	62
Spain	154	471	1	70
Sw eden	181	NE	NE	NE
United Kingdom	189	NE	NE	
EU-15	140	387	7	71

Member State 1990	Non-dairy Cattle Feed Intake[1)]	Animal Weight (kg)	Milk prod.[1)]	Feed Digest. (%)
Austria	123	364	NO	74
Belgium	104	367	NA	75
Denmark	107	325	NO	71
Finland	103	NA	NA	70
France	NA	NA	NA	NA
Germany	93	249	NE	73
Greece	NE	NE	NE	NE
Ireland	132	500	11	NE
Italy	141	376	NA	NA
Luxembourg	104	322	NA	64
Netherlands	NE	NE	NE	NE
Portugal	130	355	2	62
Spain	155	460	1	69
Sw eden	181	NE	NE	NE
United Kingdom	189	NE	NE	
EU-15	133	347	7	72

Information source: CRF for 1990 and 2006, submitted in 2008. Abbreviations explained in the Chapter 'Units and abbreviations'.
1) Unit for feed intake: MJ/head/yr; unit for Milk productivity: kg/day/head.

Trends

Animal population. Regarding animal numbers, some major changes occurred since 1990. In all countries, the numbers of cattle and sheep are considerably reduced, on the average by 30% for dairy cattle and 10% for non-dairy cattle, and by 14% for sheep. An increase in the number of cattle has only been observed in the category of non-dairy cattle in Greece (5%), Sweden (5%), Ireland (10%), Portugal (13%) and Spain (54%). Largest decrease of the number of dairy cattle occurred in Austria (2006 at 58% of the 1990 level). For non-dairy cattle, largest decrease occurred in Denmark (2006 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 2006 increased by 222% respective to the population in 1990; in the Netherlands this figure amounts to 409%. However, due to a decrease of the goat number in other countries with a high population (mainly Spain with 2,957,000 heads in 2006), the goat population at EU15 level was rather stable (2006 at 93% of 1990-level).

The swine population was increasing especially in Denmark (41%), Spain (62%), and Ireland (34%), but this was balance from reductions in other countries. Poultry numbers saw a slight increase of 8% in EU15; only Austria reported CH_4 emissions from enteric fermentation of poultry.

The trend in animal numbers is to a large extend influenced by EU policy such as suckler cow premia, milk quota, but also environmental legislation linked to agricultural policy through cross-compliance and the rural development. Animal development is also determined by epidemies such as the avian flu (reducing e. g. the number of poultry in the Netherlands in 2003), the BSE crisis between 2001 and 2003, to name just the most important.

Implied emission factor. At the aggregated level for EU-15, the implied emission factor for dairy cattle increase from 96.0 kg CH_4 $head^{-1}$ yr^{-1} to 111 kg CH_4 $head^{-1}$ yr^{-1} while at the same time the animal number of dairy cattle decreased by 30%, resulting in a decrease of European CH_4 emissions from enteric fermentation in the category of dairy cattle by Dairy Cattle.

The increase of the implied emission factor of 16% for dairy cattle is due to changes reported in 14 countries, whereas only one country has used a fixed implied emissions factor. For non-dairy cattle, also 14 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 2006 from 47.3 kg CH_4 head^{-1} yr^{-1} to 45.3 kg CH_4 head^{-1} yr^{-1}. It decreased in 5 countries (Denmark, Ireland, Italy, Netherlands, Spain). The maximum decrease was observed in Netherlands by 6%.
For sheep, the implied emission factors changed since 1990 in 7 countries, but stayed close to the 1990-value for EU15. 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.

Figure 6.4 through Figure 6.12 show the trend in the activity data for the key source in the category of enteric fermentation as well as the trend of one important indicator for animal productivity, the average daily gross energy intake for dairy and non-dairy cattle and sheep. The trend of the populations of swine, goat, and poultry are included as well. Table 6.22 gives additional information on the trend in category 4A as reported in the national inventory reports.

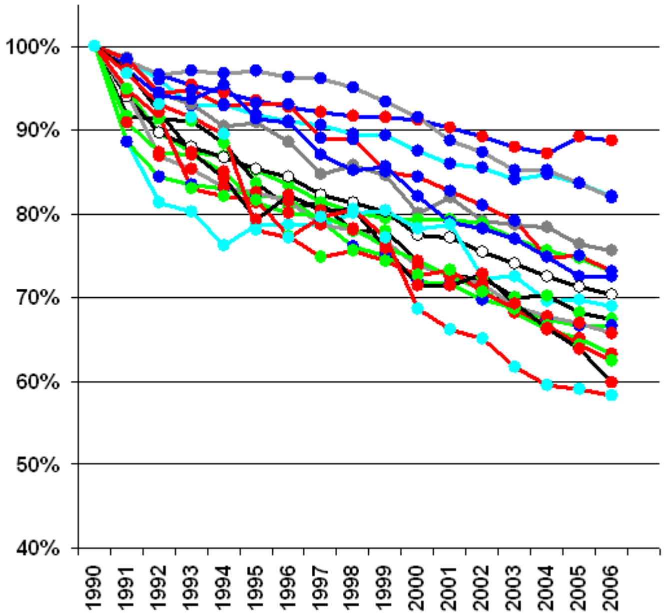
Table 6.22: Member State's background information on the trend for CH_4 emissions in category 4.A.

Member State	Trend in category 4A
Austria	The overall reduction is caused by a decrease in total numbers of animals. However, in the case of dairy cows the reduction of animals is partly counterbalanced by an increase in emissions per animal (because of the increasing milk yield of milk cattle and the connected gross energy intake since 1990). The high increase of mother cattle numbers is responsible for the increase of emissions from non-dairy cattle. Up to the early 1990ies Austrian dairy husbandry was determined by traditional Austrian green feeding and traditional Austrian races. From the mid 1990ies onwards milk production has been intensified: diets with higher energy concentration were fed and the share of high yield breeds (e.g. Holstein Friesian) in dairy farming was increased.
Belgium	In 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.
Denmark	New investigations have shown a change in fodder practice from use of sugar beet to maize (whole cereal). Sugar beet feeding gives a higher methane production rate compared to grass and maize due to the high content of easily convertible sugar. The increase in the IEF for dairy cattle from 1990-2006 is the result of in-creasing feed consumption due to rising milk yields. On average, the milk yield has increased from 6200 litre per cow per year in 1990 to approximately 8500 litre per cow per year in 2006 (Statistics Denmark).
Finland	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. Emissions have decreased by 19% since 1990 especially due to the decreasing number of cattle. The number of dairy cattle, for example, declined from 490,000 in 1990 to 309,400 in 2006. Emissions from other livestock decreased during 1990-2001 but have been increasing slightly since 2002 due to the growing 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 1990-2006 being 0 for dairy cow and suckler cow, 1.1 for bull, 0.7 for heifer and 0.85 kg for calf.

Member State	Trend in category 4A
Ireland	The emission factors for beef cattle indicate an overall weighted average of approximately 40 kg/head, compared to the value of 50 kg/head previously used. Little change is indicated between 1990 and 2006, except in the case of male cattle in the category of animals greater than two years old. This is explained by the earlier finishing time for male beef cattle since the BSE crisis that affected agriculture during the 1990s.
Italy	The decrease in cattle number is tending to drive down livestock emissions, particularly as emissions per head from cattle are 10 times greater than emissions per head of sheep or goat. The interannual decrease of IEF for Non-Dairy Cattle between 2005/2006 (4%) is due to the age distribution of non dairy cattle; in 2006 the number of calves (no emissions) increased and the number of cattle > 2 years decreased.
Netherlands	Between 1990 and 2006 (dairy) cattle, pigs and sheep numbers decreased by 24, 18 and 19% respectively, while poultry numbers remained fairly constant. Goat numbers increased by a factor 5 and horse numbers increased by 83%. Sheep numbers decreased by 20%. 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 2006, 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 2006 the numbers of young (dairy) cattle follow the same trends as those of adult female cattle – namely, a decrease. (Van Schijndel and Van der Sluis, 2008). The increased number of swine in 1997 was a direct result of the outbreak of classical swine fever in that year. In areas where this disease was present, the transportation of pigs, sows and piglets to the slaughterhouse was not allowed, so the animals had to remain on the pig farms for a relatively long period (accumulation of pigs).
Spain	The interannual increase of IEF for Dairy Cattle between 2005 and 2006 (4%) is due to the increase in the milk yield (per individual animal)of the dairy cattle. The numbers of dairy cattle animals decrease whilst the total milk production increased.

Figure 6.4. Trend of activity data (population) for dairy cattle.

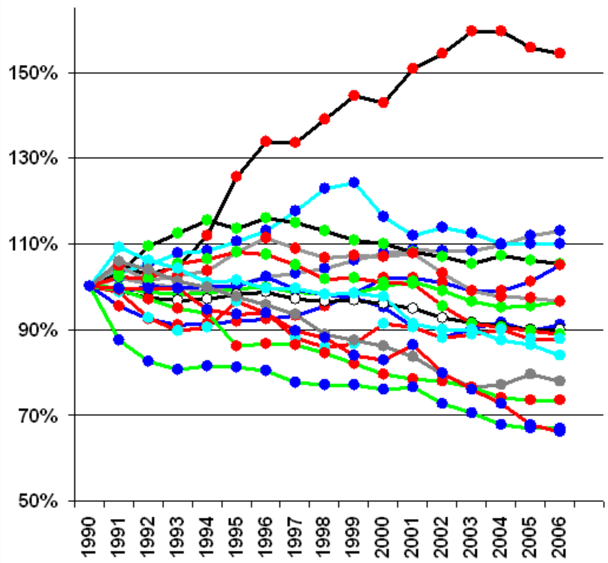
Dairy cattle: Population (1000 head)



	1990	Trend (%) 1990-2006	2006
Greece	246	89%	220
Ireland	1,342	82%	1,122
Portugal	394	82%	330
Netherlands	3,755	76%	2,866
France	5,310	73%	3,964
Denmark	753	73%	564
United Kingdom	2,847	73%	2,065
EU-15	28,182	70%	20,102
Italy	2,642	69%	1,842
Sweden	576	67%	393
Germany	6,355	67%	4,236
Luxembourg	118	66%	79
Finland	490	63%	319
Belgium	839	62%	539
Spain	1,611	60%	1,028
Austria	905	58%	534

Figure 6.5. Trend of activity data (population) for non-dairy cattle.

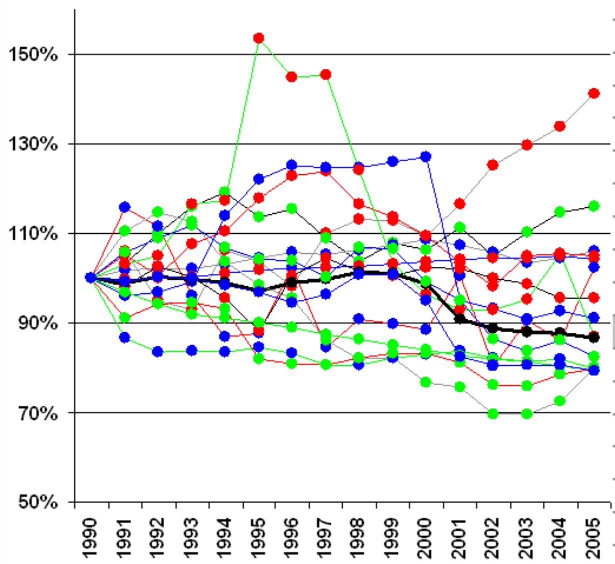
Non-dairy cattle: Population (1000 head)



	1990	Trend (%) 1990-2006	2006
Spain	3,469	154%	5,398
Portugal	978	113%	1,093
Ireland	4,628	110%	5,090
Sweden	1,142	105%	1,212
Greece	380	105%	384
France	16,227	97%	15,487
Luxembourg	186	97%	181
United Kingdom	9,232	91%	8,289
EU-15	67,159	90%	60,467
Belgium	2,410	89%	2,159
Austria	1,679	88%	1,476
Italy	5,110	84%	4,410
Netherlands	3,168	78%	2,517
Finland	870	74%	640
Germany	13,133	67%	8,799
Denmark	1,486	66%	1,006

Figure 6.6. Trend of activity data (population) for sheep

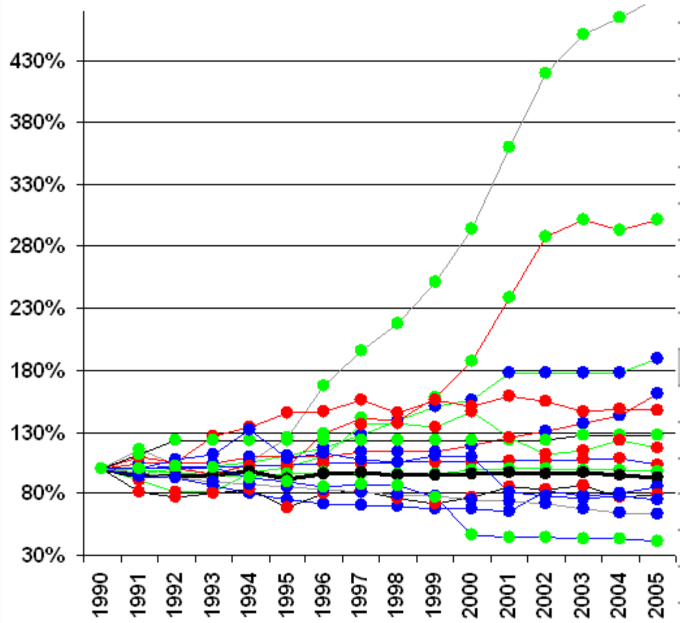
Sheep: Population (1000 head)



	1990	Trend (%) 1990-2006	2006
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	102%	94
Spain	23,822	95%	22,749
Italy	8,739	91%	7,954
Finland	103	87%	90
EU-15	114,501	87%	99,286
Ireland	8,021	82%	6,617
Netherlands	1,702	80%	1,363
Germany	3,310	80%	2,643
Belgium	192	80%	153
France	11,439	80%	9,118
United Kingdom	44,469	79%	35,241

Figure 6.7. Trend of activity data (population) for goats

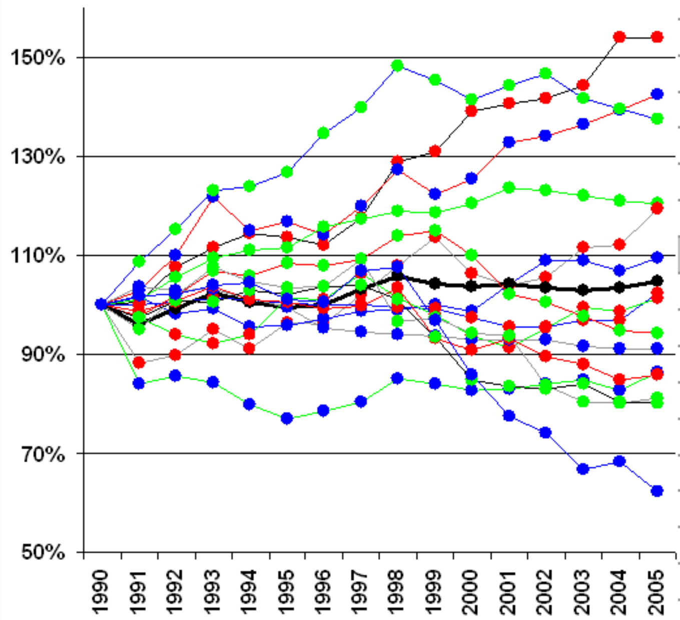
Goats: Population (1000 head)



	1990	Trend (%) 1990-2006	2006
Netherlands	61	481%	292
Belgium	9	301%	26
Germany	90	189%	170
Denmark	8	161%	14
Austria	37	148%	55
Sweden	4	128%	6
Finland	6	117%	7
Greece	5,339	103%	5,509
France	1,329	98%	1,304
EU-15	12,682	93%	11,812
United Kingdom	113	85%	96
Spain	3,663	79%	2,905
Italy	1,259	75%	946
Portugal	745	63%	473
Ireland	17	42%	7
Luxembourg			

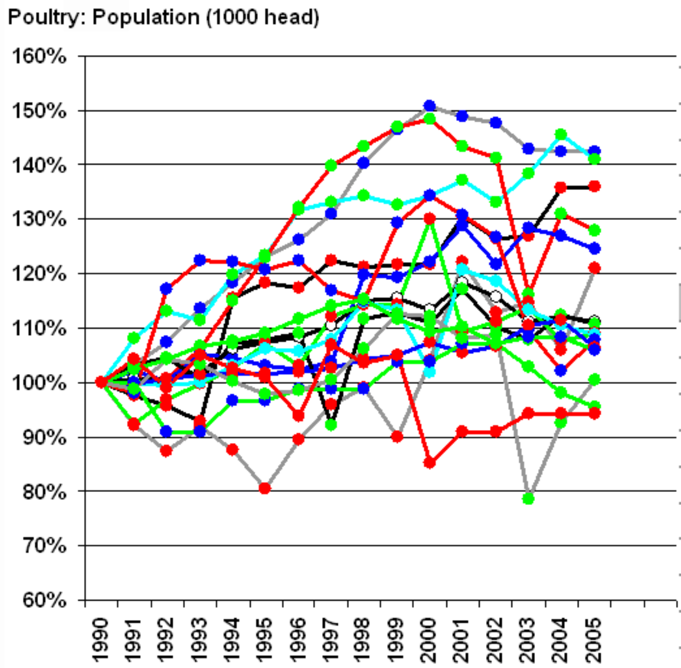
Figure 6.8. Trend of activity data (population) for swine

Swine: Population (1000 head)



	1990	Trend (%) 1990-2006	2006
Spain	16,393	154%	25,244
Denmark	9,497	143%	13,534
Ireland	1,221	138%	1,679
France	9,587	120%	11,542
Luxembourg	75	119%	90
Italy	8,407	109%	9,200
EU-15	112,532	105%	117,808
Greece	994	102%	1,017
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 6.9. Trend of activity data (population) for poultry



	1990	Trend (%) 1990-2006	2006
Portugal	27,511	142%	39,167
Ireland	11,413	141%	16,095
Spain	127,224	136%	172,998
Belgium	27,166	128%	34,715
United Kingdom	136,805	124%	170,233
Luxembourg	69	121%	83
EU-15	1,067,596	111%	1,185,813
Sweden	15,490	111%	17,154
Finland	9,662	109%	10,538
Italy	173,342	109%	188,595
Denmark	16,249	108%	17,530
Greece	28,747	106%	30,587
Germany	113,879	106%	120,562
Netherlands	95,561	100%	95,936
France	270,658	96%	258,592
Austria	13,821	94%	13,027

Figure 6.10. Trend of activity data (gross energy intake) for non-dairy cattle.

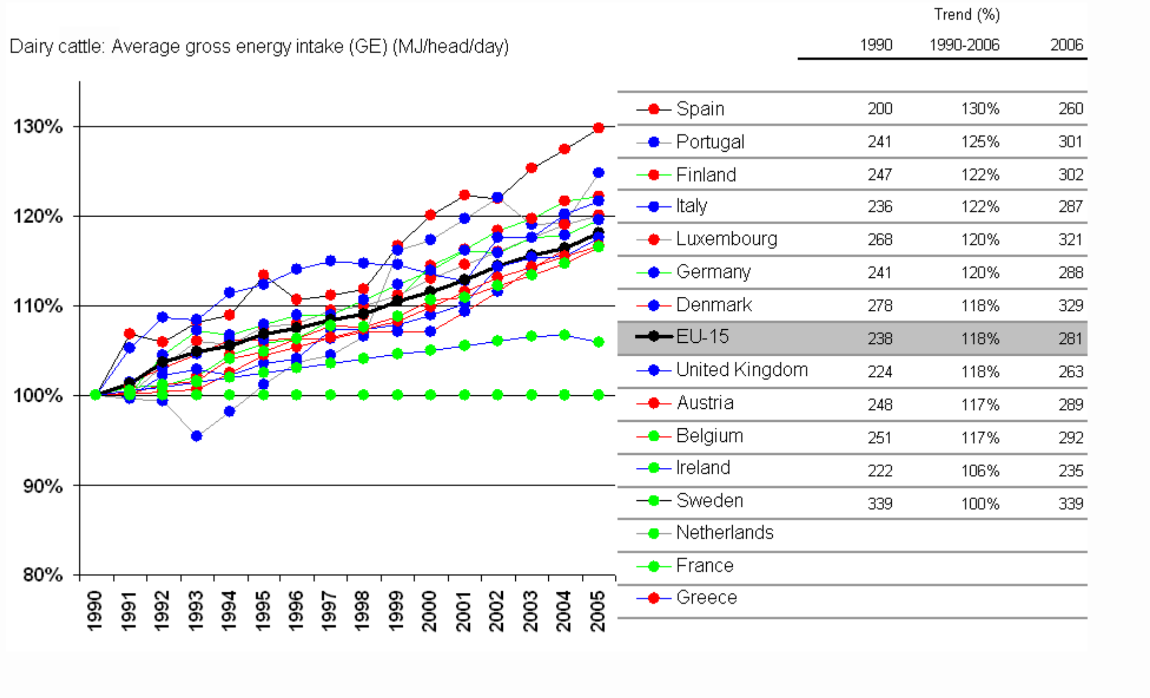


Figure 6.11. Trend of activity data (gross energy intake) for non-dairy cattle.

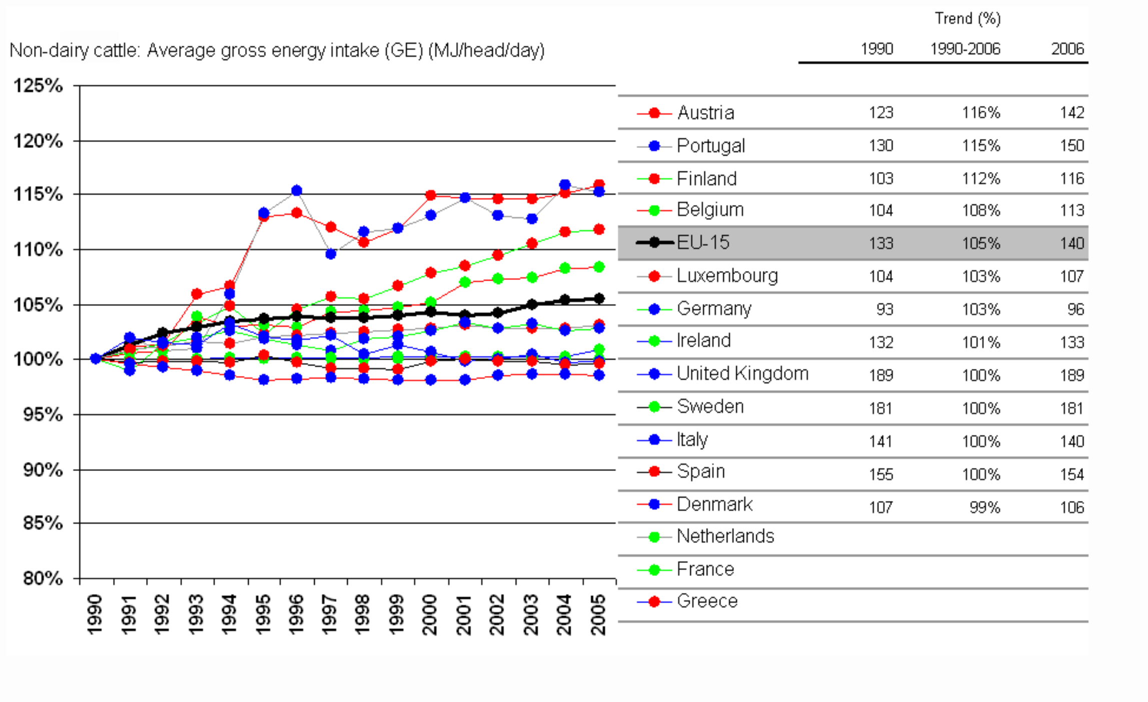
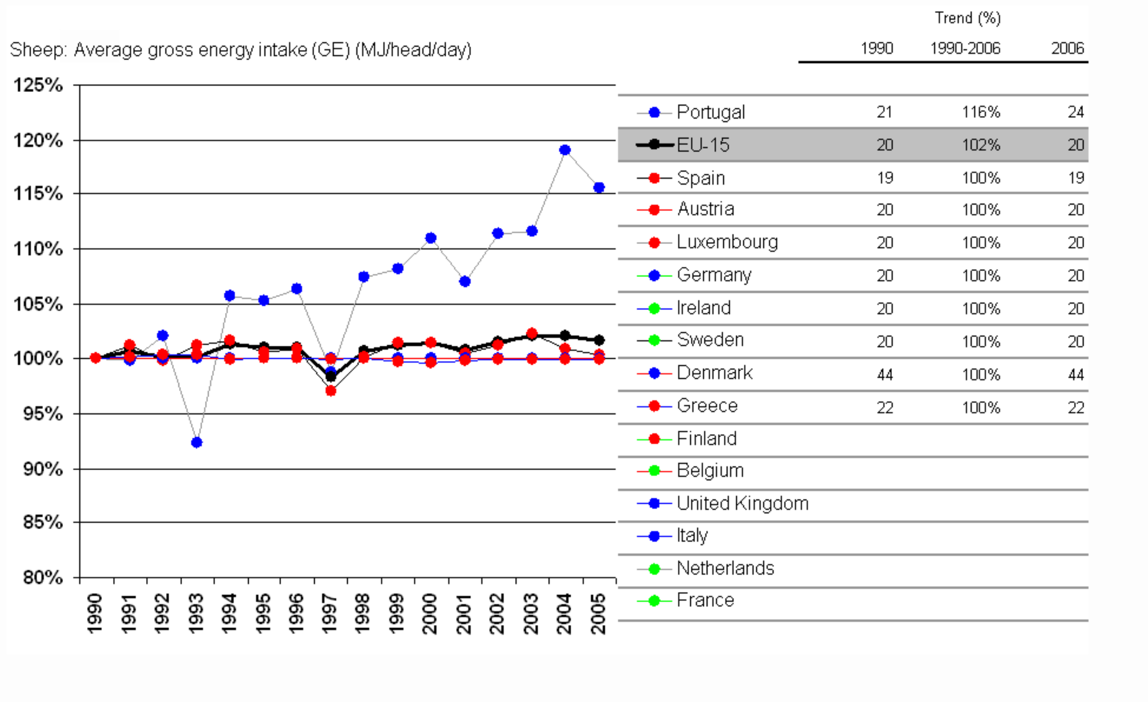


Figure 6.12. Trend of activity data (gross energy intake) for sheep



Uncertainty and time series consistency

CH_4 emissions from enteric fermentation belong to the source categories in agriculture, which are less uncertain. Animal numbers are assumed to be correct with a maximum uncertainty of 10% (with the exception of Portugal), and also the emission factor, which is calculated to a large extent with the Tier 2 methodology, is estimated to be known with a precision better than 20% for most countries, with 40% being the highest uncertainty estimate (Belgium and France) for cattle and 50% (Portugal) for other animal types. One exception is the high uncertainty assigned to some animal types (mules and asses, poultry and rabbit) in Portugal. The absence of statistic numbers for poultry, the need to estimate a time-series based on surrogate drivers, and the prevalence of dispersed animals in small farms, naturally causes higher uncertainty values for these animals. Finally, animals that are usually not considered as meat, such as equines, are less controlled and numbers tend to be known with less rigour.

The contribution of enteric fermentation to the overall inventory uncertainty is generally 1% or less, only France, Sweden and Ireland report a contribution of 4.1%, 2.6%, and 1.5% to the total inventory uncertainty, respectively.

An overview of the uncertainty estimates for activity data and emission factors are given in Table 6.38 and Table 6.39. An overview of uncertainty estimates for agriculture at country and EU15 levels will be given in 6.4. Note that some countries (Finland, Germany) are using Tier 2 methodology for combining uncertainty estimates in agriculture at a much finer level of disaggregation and thus do not report AD and EF uncertainty estimates separately. Instead, due the combined uncertainty estimate is reported also in the cells for the EF uncertainty and the AD uncertainty is set to zero.

Table 6.23: Relative uncertainty estimates for activity data in category 4A (data from 2007 submission)

Member State 2006	Total	Cattle	Dairy Cattle	Non-Dairy Cattle	Buffalo	Sheep	Goats	Camels and Llamas	Horses	Mules and Asses	Sw ine	Poultry	Other
Austria		10.0											
Belgium	5.0												
Denmark	10.0												
Finland	0.0												
France	5.1												
Germany			0.0	0.0	0.0								
Greece	5.0												
Ireland			1.0	1.0									1.0
Italy	20.0												
Luxembourg	10.0												
Netherlands		5.0									5.0		5.0
Portugal			6.1	6.5		19.1	19.1		71.2	271.8	11.0		770.6
Spain	3.1												
Sw eden	5.0												
United Kingdom	10.0												

Table 6.24: Relative uncertainty estimates for implied emission factors in category 4A (data from 2007 submission)

Member State 2006	Total	Cattle	Dairy Cattle	Non-Dairy Cattle	Buffalo	Sheep	Goats	Camels and Llamas	Horses	Mules and Asses	Sw ine	Poultry	Other
Austria		20.0											
Belgium	40.0												
Denmark	8.0												
Finland	32.1												
France	68.8												
Germany			10.0	6.2	5.4								
Greece	30.0												
Ireland			15.0	15.0									30.0
Italy	20.0												
Luxembourg	36.1												
Netherlands		15.0									50.0		30.0
Portugal			20.0	20.0		20.0	20.0		50.0	50.0	20.0		20.0
Spain	11.0												
Sw eden	25.0												
United Kingdom	20.0												

The following issues related to time-serires consistency are identified:

- *Sweden, AD general*

  The time series in the agricultural sector in Sweden are calculated consistently but the data needed are not always available for every year covered by the inventory. In cases where statistics are not produced annually, interpolation and extrapolation are necessary tools for the imputation of estimates. Methane from enteric fermentation may be a bit more certain with an error of about 30 %.

- *United Kingdom, AD general*

  In the United Kingdom, the time-series consistency of these activity data is very good due to the continuity in data provided.

- *Austria, mineral fertilizer application*

  The FAO agricultural data base provides worldwide harmonized data (FAO AGR. STATISTICAL SYSTEM 2001). In the case of Austria, these data come from the national statistical system (Statistik Austria). However, there are inconsistencies between these two data sets.

- *Denmark, animal population of sheep, goats and horse*

  Agricultural Statistics, in agreement with the Danish Agricultural Advisory Centre (DAAC), as Statistics Denmark does not include farms less than 5 hectares. Statistics Denmark is the source for the database kept by FAO (Food and Agriculture Organization of the United Nations). This explains why the number of sheep, goats and horses in FAO and the Danish emission inventory disagree. The largest difference is found for horses.

- *Germany, buffalo population*

  Buffalo have been kept in Germany since 1996. In 1990, their population was zero. They are therefore not reported for the whole time series.

- *Luxembourg, goat population*

  Goats numbers in Luxembourg are not reported for the whole time series. The exact number of Luxembourg's goats was not recorded with precision before the year 2000. Numbers of goats are only available regularly, and with enough confidence, since 2000 onwards. In 1997, the first year goat population was reported, the goat population of Luxembourg corresponded to 0.003% of the goat population in EU-15. In 1990, the goat population of Luxembourg is assumed to be negligible.

- *Germany, animal population*

  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).

6.3.2 Manure Management CH_4 (CRF source category 4.B(a))

Source category description

Table 6.25 shows that at the European level, swine and cattle contribute more or less equally to CH_4 emissions from manure management (44% and 49% 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 27% and 17%, 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 11% and 4.2% of total CH_4 from manure management, respectively. Greece has also the highest contribution of poultry to CH_4 emissions from manure management with 16%.

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 6.25: Total CH_4 emissions in category 4B(a) and implied Emission Factor at EU-15 level for the years 1990 and 2006

	Dairy Cattle	Non-dairy cattle	Swine
	1990		
Total Emissions of CH_4 [Gg CH_4]	450	633	863
Total Population [1000 heads]	26245	63952	112532
Implied Emission Factor [kg CH_4 / head / year]	17.2	10.0	7.7

	Dairy Cattle	Non-dairy cattle	Swine
	2006		
Total Emissions of CH_4 [Gg CH_4]	372	576	1056
Total Population [1000 heads]	18369	58046	119074
Implied Emission Factor [kg CH_4 / head / year]	20.3	10.0	8.9

	Dairy Cattle	Non-dairy cattle	Swine
	2006 value in percent of 1990		
Total Emissions of CH_4 [Gg CH_4]	83%	91%	122%
Total Population [1000 heads]	70%	91%	106%
Implied Emission Factor [kg CH_4 / head / year]	118%	100%	116%

Source of information: CRF Table4s1 and 4.B(a) for 1990 and 2006, submitted in 2008

Dairy cattle includes Mature Dairy cattle, Non-dairy cattle includes Mature Non-Dairy Cattle and Young Cattle

Methodological Issues

Methods

CH_4 emissions from manure management are a key source category for cattle and swine at EU-15 level. This is true also for many Member States. Table 6.26 shows the total emissions in category 4.B(a), how this is composed and the methodology used for calculating the emissions for cattle and swine by Member States. Also, it is reports whether the source category is a key source category for the Member States.

The method for calculation of CH_4 emissions from manure management implies the need to estimate for each animal category the excretion of volatile organic solids (VS) and a maximum methane producing capacity (B_0); furthermore, for each animal category and manure management system, a methane conversion factor must be determined, which is dependent on the climate region. Each country must determine the fractions of the manure managed in 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 6.26, we report also the Tier that has been used by the Member States to estimate CH_4 emissions from manure management according to the approach described in section 4.56.4.1 (see Table 6.78 through Table 6.81).In the case of CH_4 emissions from manure management, a Tier 2 approach was assigned according to the "median-rule" with the weighting factors 0.75, 0.13, and 0.13 for VS, B_0, or MCF, respectively. For the methane conversion factor, we calculated the default value by using the allocation to the different climate regions reported by the countries and multiplying with the respective IPCC value. For the Netherlands, no background data are given, so the level of the method could not be calculated. However, according to the NIR of the Netherlands, a country-specific Tier 2 method has been applied.

Overall, the quality of the emission estimates in category 4B(a) range between Tier 1.1 and Tier 2.0 with a Tier level for EU-15 of Tier 1.6 (corresponding to 64% of the emissions being calculated with country-specific data). This relatively low quality for this source category is due to the fact that countries with a high number of animals have intermediate quality (Tier 1.5, e.g. because no country-specific estimation of VS has been done).

Some additional information on the methodological approaches for some Member States is given in Table 6.27.

Table 6.26: Total emissions and contribution of the main sub-categories to CH_4 emissions in category 4B(a), methodology applied and key source assessment by Member States for the sub-categories dairy cattle, non-dairy cattle and swine.

	Total		Dairy Cattle		Non-dairy cattle		Cattle	Swine	
	Gg CO_2-eq	b	a	b	a	b	c	a	b
Austria	875	Tier 1.8	26%	Tier 1.8	26%	Tier 1.8	y	45%	Tier 1.8
Belgium	1,924	Tier 1.7	13%	Tier 1.3	24%	Tier 1.3	y	59%	Tier 1.9
Denmark	1,042	Tier 1.9	21%	Tier 1.9	3%	Tier 1.9	y	72%	Tier 1.9
Finland	281	Tier 1.6	32%	Tier 1.9	12%	Tier 1.9	y	38%	Tier 1.2
France	13,746	Tier 1.2	11%	Tier 1.2	47%	Tier 1.2	y	37%	Tier 1.2
Germany	4,954	Tier 2.0	34%	Tier 2.0	30%	Tier 2.0	y	31%	Tier 2.0
Greece	488	Tier 1.1	18%	Tier 1.2	22%	Tier 1.2	y	29%	Tier 1.2
Ireland	2,234	Tier 1.6	21%	Tier 1.8	53%	Tier 1.8	y	19%	Tier 1.2
Italy	3,029	Tier 1.9	17%	Tier 2.0	21%	Tier 2.0	y	47%	Tier 2.0
Luxembourg	104	Tier 1.8	38%	Tier 1.8	28%	Tier 1.8	y	33%	Tier 1.8
Netherlands	2,458	Tier 2.0	47%	Tier 2.0	13%	Tier 2.0	y	38%	Tier 2.0
Portugal	1,169	Tier 1.9	3%	Tier 1.9	3%	Tier 1.8	y	89%	Tier 1.9
Spain	9,738	Tier 1.8	3%	Tier 1.8	1%	Tier 1.8	y	90%	Tier 1.8
Sweden	470	Tier 1.9	32%	Tier 1.9	34%	Tier 1.9	y	26%	Tier 1.9
United Kingdom	2,536	Tier 1.7	43%	Tier 1.8	30%	Tier 2.0	y	12%	Tier 1.2
EU-15	**45,050**	**Tier 1.6**	**17%**	**Tier 1.8**	**27%**	**Tier 1.5**	**y**	**49%**	**Tier 1.7**
EU-15: Tier 1	36%		25%		51%			32%	
EU-15: Tier 2	64%		75%		49%			68%	

a Contribution to CH_4 emissions from manure management
b Tier 1: default methodology; Tier 2: country-specific methodology
c Source category is key in the Member State's inventory (y/n)

Table 6.27: Member State's background information for the calculation of CH_4 emissions in category 4.B(a)

Member State	Methods
Austria	Cattle and swine: Tier 2 (key sources); Sheep, Goats, Horses and Other Soliped, Chicken, Other Poultry and Other animals: Tier 1.
Belgium	Tier 2 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. A study performed by the Flemish Institute for Technological Research (Vito), indicates that CH_4 emissions during manure processing are negligible.
Denmark	The emissions from the agricultural sector are calculated in a comprehensive agricultural model complex called DIEMA (Danish Integrated Emission Model for Agriculture, Mikkelsen, 2006). The 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 2006, approximately 8% (0.96 M tonnes of cattle slurry and 1.18 M tonnes of pig slurry) were treated in biogas plants (DEA 2007). 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).

Member State	Methods
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+.
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	Tier 1
Ireland	The analysis of the feeding regime for cattle (O' Mara, 2006) included a full evaluation of the organic matter content of the feeds applicable to the 11 categories that characterise the national herd, which facilitates the estimation of their respective levels of organic matter excretion.
Italy	Methane emission factors for manure management have been calculated for cattle, buffalo and swine with the IPCC Tier 2 approach.
Luxembourg	Tier II method for all animal types.
Netherlands	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. Detailed descriptions of the methods can be found on the website www.greenhousegases.nl.
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 6.28 and Table 6.29 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 2006 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 2006). The trend for non-dairy cattle goes into the other direction in Sweden with a decreasing portion of manure managed in liquid systems (in 1990 and in 2006) and increasing use of solid storage systems.

Table 6.28: Member State's Allocation of Animal Waste Management Systems over liquid systems, solid storage and dry lot, and pasture range and paddock in 2006

Member State	Dairy Cattle - Allocation of AWMS (%)				Non-Dairy Cattle - Allocation of AWMS (%)				Swine - Allocation of AWMS (%)			
2006	Liquid system[1]	Daily Spread	Solid storage and dry lot	Pasture range paddock	Liquid system[1]	Daily Spread	Solid storage and dry lot	Pasture range paddock	Liquid system[1]	Daily Spread	Solid storage and dry lot	Pasture range paddock
Austria	19%	NO	70%	11%	24%	NO	66%	10%	72%	NO	29%	NO
Belgium	31%		31%	39%	31%		31%	39%	100%			
Denmark	75%	NO	10%	15%	24%	NO	39%	38%	92%	NO	7%	1%
Finland	48%	NO	26%	26%	NO	NO	NO	NO	61%	NO	39%	NA
France	11%	NO	42%	47%	37%	NO	23%	40%	83%	NO	17%	NO
Germany	65%	NO	20%	15%	54%	NO	33%	14%	86%	NO	14%	
Greece		2%	90%	8%		3%	62%	33%	90%		10%	
Ireland	41%	NO	3%	57%	23%	NO	11%	65%	100%	NO	NO	NO
Italy	38%	NO	57%	5%	57%	NO	41%	2%	100%	NO	NA	NA
Luxembourg	38%	NO	12%	45%	29%	NO	16%	50%	90%	NO	5%	NO
Netherlands	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Portugal	47%	NO	23%	30%	NO	NO	20%	80%	93%	NO	2%	4%
Spain	8%	13%	30%	50%	8%	13%	30%	50%	93%	NO	NO	7%
Sweden	52%	NO	24%	24%	15%	NO	23%	42%	71%	NO	22%	NO
United Kingdom	31%	14%	10%	46%	6%	23%	21%	50%	31%	6%	55%	7%
EU15	37%	2%	30%	31%	30%	5%	27%	38%	87%	0%	10%	2%

Source of information: CRF 4.B(a) for 2006, submitted in 2008. Abbreviations explained in the Chapter 'Units and abbreviations'.

1) Anaerobic lagoon + Liquid system. Missing fraction belong to the category 'Other'

Table 6.29: Member State's Allocation of Animal Waste Management Systems over liquid systems, solid storage and dry lot, and pasture range and paddock in 1990

Member State	Dairy Cattle - Allocation of AWMS (%)				Non-Dairy Cattle - Allocation of AWMS (%)				Swine - Allocation of AWMS (%)			
1990	Liquid system[1]	Daily Spread	Solid storage and dry lot	Pasture range paddock	Liquid system[1]	Daily Spread	Solid storage and dry lot	Pasture range paddock	Liquid system[1]	Daily Spread	Solid storage and dry lot	Pasture range paddock
Austria	19%	NO	70%	11%	25%	NO	66%	9%	71%	NO	29%	NO
Belgium	31%		31%	39%	31%		31%	39%	100%			
Denmark	70%	NO	15%	15%	37%	NO	36%	28%	89%	NO	11%	NO
Finland	22%	NO	50%	28%	NO	NO	NO	NO	45%	NO	55%	NA
France	11%	NO	42%	47%	36%	NO	23%	40%	83%	NO	17%	0%
Germany	51%	NO	29%	20%	57%	NO	32%	10%	84%	NO	16%	
Greece		2%	90%	8%		3%	62%	33%	90%		10%	
Ireland	41%	NO	3%	57%	23%	NO	11%	65%	100%	NO	NO	NO
Italy	38%	NO	57%	5%	58%	NO	40%	2%	100%	NO	NA	NA
Luxembourg	23%	NO	32%	45%	19%	NO	31%	50%	90%	NO	5%	NO
Netherlands	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Portugal	35%	NO	35%	30%	NO	NO	28%	72%	95%	NO	3%	2%
Spain	15%	25%	60%		NO		31%	69%	95%	NO	NO	5%
Sweden	23%	NO	54%	22%	18%	NO	33%	39%	44%	NO	52%	NO
United Kingdom	31%	14%	10%	46%	6%	23%	21%	50%	31%	6%	55%	7%
EU15	32%	3%	36%	28%	33%	4%	28%	35%	83%	0%	15%	1%

Source of information: CRF 4.B(a) for 1990, submitted in 2008
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 6.17 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 6.30.

.

Table 6.30: Member State's background information on the allocation to animal waste management systems used for the calculation of CH_4 and N_2O emissions in category 4.B(a)

Member State	Activity data
Austria	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	From 2006, all farmers have to report which stable type they are using to the Danish Plant Directorate. These information are now included in the inventory and are in overall consonant with the expert judgement from DAAC. At present, there exist no official statistics concerning the distribution of animals according to stable type. The distribution is, therefore, based on an expert judgement from the Danish Agricultural Advisory Centre (DAAC). Approximately 90-95% of Danish farmers are members of DAAC and DAAC regularly collects statistical data from the farmers on different issues, as well as making recommendations with regard to farm buildings.
Finland	Distribution over animal systems (slurry, solid storate, pasture) is country-specific from literature (MKL, 1993; Seppänen and Matinlassi, 1998) and expert judgement. Anaerobic lagoons and daily spread not used in Finland.
France	AWMS distribution national on the basis of a survey carried out in 1994.
Ireland	The allocation to animal waste management system is based on the farm facilities survey. The same values are used for all years. The bulk of animal wastes in housing are managed in liquid storage systems. New information obtained from a national farm facilities survey (Hyde et al., in prep).
Luxembourg	
Netherlands	Specified data on manure management are based on statistical information on management systems; these data are documented in Van Schijndel and Van der Sluis, 2008.
Portugal	Livestock numbers per animal type were available at Concelho level from two detailed agriculture surveys: RGA89 and RGA99. Livestock numbers in each Concelho area were allocated to each climate region, for year 1999, according to the land are percentage, and always assuming an homogeneous distribution of animals in the Concelho territorial area. Number of animals were summed at each Administrative Region (Região). Livestock population in each climate region and by Região was estimated annually from total livestock population in Região and considering the

Member State	Activity data
	constant share and, finally, the total national livestock population for each region was calculated.
Sweden	Information on waste management systems is collected from the survveys publishes in the biannual statistical report on the use of fertilisers and animal manure in agriculture (Statistics Sweden, MI 30-series). Three manure management systems are considered apart form grazing animals: liquid systems (including semi-liquid manure), solid storage and deep litter (sometimes categorised as "other" in the national inventory). National estimates of stable periods are collected from the statistical report on use of fertilisers and animal manure in agriculture (Statistics Sweden, MI 30-series). This information has been available biannually since 1997. Before 1997, the data are extrapolated to 1990. Since dairy cows are often stabled at night, the data on stable periods for this animal category is combined with an assumption that 38% of its manure was produced in the stable during the grazing period (caclulated according to the STANK model, Swedish Board of Agriculture, 2005)
United Kingdom	The distribution to AWMS was revised in 2000 for cattle and poultry. Data on 'no significant storage capacity' of farmyard manure were allocated. This could have a large effect on emissions because it amounted to around 50% of manure and the 'Daily spread (DS)' category has an emission factor of zero, compared to 0.02 for the 'Solid storage and dry lot (SSD)' category. There was a revision (in 2002) of the allocation of manure to the different management systems based on new data.

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 6.31. 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 5, 5, and 8 for sheep, goats and swine, respectively. The highest IEF for dairy cattle is used by Netherlands with 38.3 kg CH_4/head/year and the smallest by Portugal with 4.8 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.

The following outliers can be identified:

- *Implied Emission Factor for Dairy cattle, Portugal*

  Part of dairy cattle is managed in "Fossas" (Pits)", which corresponds best to the IPCC class "Pit storage below animal confinments". The storage time is very short, less than one month. Therefore, Portugal set the MCF to zero. In 2006 guidelines the MCF is revised to 3 per cent, but no clear distinction is made between pits and liquid/slurry system. A more detailed assessment would require a country-specific study.

- *Implied Emission Factor for Non-dairy cattle, Denmark.*

  Non-Dairy Cattle" includes calves, heifers, bulls and suckler cows and the implied emission factor is a weighted average of these different subcategories. 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.

- *Implied Emission Factor for Non-dairy cattle, France*

  The IEF is calculated with the default values of the IPCC. First, for the MCF indicator, the climate region is "temperate" in the metropolitan territory and "warm" in DOM and COM, high values of "MCF" are used for France. Then the part of non dairy cattle relating to liquid management must be higher than in other countries because this AWMS has a bigger impact.

- *Implied Emission Factor for Non-dairy cattle, Spain*

  Spain uses a Tier 2 approach. Gross energy is calculted using tier 2 methodology of enteric fermentation whilst percentages of manure management systems are taken from national references. The dominant systems for non-dairy cattle are solid storage and pasture, both of which have very a low MCF at 10ºC.

- *Implied Emission Factor for Non-dairy cattle, Portugal*

  In Portugal non dairy cattle are usually kept in range (mother cows) or in solid storage systems (steers and feedlots). According to agriculture experts the use of liquid systems has no expression.

Table 6.31: Implied Emission factors for CH_4 emissions from manure management used in Member State's inventory 2006

Member State	Implied EF (kg CH_4/head/yr)				
2006	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Sw ine
Austria	20.4	7.4	0.19	0.12	6.0
Belgium	22.7	10.3	0.58	0.59	8.6
Denmark	18.6	1.7	0.32	0.26	2.7
Finland[1)]	13.7	2.6	0.19	0.12	3.6
France	18.3	19.8	0.28	0.18	20.9
Germany	18.9	8.0	0.19	0.12	3.0
Greece	19.0	13.0	0.28	0.18	7.0
Ireland	20.7	11.1	0.15	0.12	12.6
Italy	13.8	7.0	0.22	0.15	7.3
Luxembourg	48.8	9.5	0.19	0.12	19.5
Netherlands	38.3	6.3	0.18	0.34	3.9
Portugal	4.8	1.6	0.31	0.26	21.4
Spain	15.2	1.2	0.23	0.16	15.7
Sw eden	18.7	6.3	0.19	0.12	3.4
United Kingdom	25.2	4.3	0.12	0.12	3.0
EU-15	20.3	10.0	0.19	0.18	8.9

Source of information: CRF 4.B(a) for 2006, submitted in 2008 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. 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 6.32) and methane conversion factor used (
Table 6.33). Most of Europe falls into the cool climate region with average annual temperatures below

15°C. Accordingly, most countries are allocating 100% of the animal population to the cool climate region, with Italy and Portugal allocating a part of the population into the temperate region (for dairy cattle for example 8% and 57%, respectively) and only Greece allocating 100% of the animals to the temperate climate region. France assumes 0.1% of the dairy cattle and 0.9% of the non-dairy cattle in the warm climate region, which is due to the extra-territorial regions; the remaining manure is allocated to the temperate climate region. The distribution of the animals over the climate regions is somewhat different for different animal types; in Portugal, for example, the portion of animals living in the temperate region increases from dairy cattle over non-dairy cattle to swine.

For the categories dairy cattle, non-dairy cattle and swine, only in few cases is the allocation of animal population to climate regions reported to be dynamic. However, in Portugal, for example, a general shift of livestock production to warmer climate regions has been observed increasing the percentage of manure managed in the temperate region by 5%, 18%, 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 6.34); the amount of volatile organic solid excreted per animal (Table 6.35) and year varies across the countries on the basis of the animal characterization with a ratio of highest to lowest average VS excretion rate between 2.2 (dairy cattle) and 2 (swine).

Table 6.32: Member State's allocation of dairy cattle, non-dairy cattle and swine to the climate regions "cool", "temperate" and "warm" in 2006

Member State	Dairy Cattle - Allocation by climate region[1]			Non-Dairy Cattle - Allocation by climate region[1]			Swine - Allocation by climate region[1]		
2006	Cool (%)	Temperate (%)	Warm (%)	Cool (%)	Temperate (%)	Warm (%)	Cool (%)	Temperate (%)	Warm (%)
Austria	100%	NO	NO	100%	NO	NO	100%	NO	NO
Belgium	100%			100%			100%		
Denmark	100%	NO	NO	100%	NO	NO	100%	NO	NO
Finland	100%	NA	NA	NO	NO	NO	100%	NA	NA
France	NO	100%	0.1%	NO	99%	0.9%	NO	99%	1.0%
Germany	100%	NO	NO	100%	NO	NO	100%	NO	NO
Greece		100%			100%			100%	
Ireland	100%	NO	NO	100%	NO	NO	100%	NO	NO
Italy	92%	8%	NO	87%	13%	NO	97%	3%	NO
Luxembourg	100%	NA	NA	100%	NA	NA	100%	NA	NA
Netherlands	NO	NO	NO	NO	NO	NO	NO	NO	NO
Portugal	43%	57%	NO	25%	75%	NO	20%	80%	NO
Spain	83%	17%	NO	60%	40%	NO	48%	52%	NO
Sweden	100%	NO	NO	100%	NO	NO	100%	NO	NO
United Kingdom[1]	100%			100%			100%		
EU-15	73%	27%	0%	64%	35%	0%	74%	26%	0%

Source of information: CRF 4.B(a) for 2006, submitted in 2008. Abbreviations explained in the Chapter 'Units and abbreviations'.

[1] The portion lacking for 100% are reported as daily spread (only UK) and 'other'.

Table 6.33: Member State's Methane Conversion Factor used for dairy cattle, non-dairy cattle and swine for the different animal waste management systems in 2006

Member State	Dairy Cattle - Methane Conversion Factor (%) [1)]				Non-dairy Cattle - Methane Conversion Factor (%) [1)]				Swine - Methane Conversion Factor (%) [1)]			
2006	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	90%	39%	1.00%	1.00%	90%	39%	1.00%	1.00%	90%	39%	1.00%	1.00%
Belgium		20%	10.00%	1.00%		20%	10.00%	1.00%		20%		
Denmark	NO	10%	1.00%	1.00%	NO	10%	1.00%	1.00%	NO	10%	1.00%	1.00%
Finland	NA	1%	1.00%	1.00%	NO	1%	1.00%	1.00%	NO	1%	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%	1.00%	1.00%
Greece												
Ireland	NA	39%	1.00%	1.00%	NA	39%	1.00%	1.00%	NA	39%	NA	NA
Italy	NO	16%	3.00%	1.25%	NO	16%	3.00%	1.25%	NO	26%	NA	NA
Luxembourg	NA	39%	1.00%	1.00%	NA	39%	1.00%	1.00%	NA	39%	1.00%	NA
Netherlands	NA	NA	NA	NA	NA	NA	NA	NA	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%	1.92%	1.49%	90%	43%	1.96%	1.48%	57%	42%	1.49%	1.50%

Source of information: CRF 4.B(a) for 2006, submitted in 2008. 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 6.34: Member State's methane producing potential for emissions from manure management for the main animal types in 2006

Member State	CH4 producing potential (Bo) (CH4 m^3/kg VS)				
2006	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine
Austria	0.24	0.17	0.19	0.17	0.45
Belgium			0.19	0.17	0.45
Denmark	0.24	0.17	0.19	0.17	0.45
Finland	0.24	0.17	0.19	0.17	0.45
France	0.24	0.17	0.19	0.17	0.45
Germany	0.20	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	0.14	0.13	0.19	0.17	0.46
Luxembourg	0.24	0.17	0.19	0.17	0.45
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	0.19	0.19	0.17	0.46

Source of information: CRF 4.B(a) for 2006, submitted in 2008. Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 6.35: Member State's volatile solid excretion from managed manure for the main animal types in 2006

Member State	VS excretion (kg dm/head/day)				
2006	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Sw ine
Austria	4.2	1.9	0.4	0.3	0.4
Belgium	NE	NE	0.5	0.5	0.5
Denmark	4.8	1.4	0.7	0.7	0.4
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	2.9	1.3	0.4	0.3	0.5
Italy	6.4	2.8	0.4	0.3	0.3
Luxembourg	5.5	1.9	0.4	0.3	0.5
Netherlands	NE	NE	NE	NE	NE
Portugal	6.0	2.8	0.5	0.5	0.5
Spain	3.8	2.4	NA	NA	0.4
Sw eden	5.3	1.5	0.4	0.3	0.3
United Kingdom	3.4	2.7	NE	NE	NE
EU-15*	4.6	2.2	0.4	0.3	0.4

Source of information: CRF 4.B(a) for 2006, submitted in 2008. Abbreviations explained in the Chapter 'Units and abbreviations'. * Values have been divided by 365 to convert from year to day. $ Values have been multiplied by 365 (non-dairy cattle)

Some additional background information on the factors and parameters used by the Member States is given in Table 6.36.

Table 6.36: Member State's background information on the emission factors and other parameters used for the calculation of CH_4 emissions in category 4.B(a)

Member State	Emission Factors and other parameters
Austria	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 an average milk yield of 3 000 kg was applied. As no major changes in diets of Non-Dairy Cattle occurred, methane emissions from manure management of Non-Dairy Cattle are calculated with a constant gross energy intake and thus constant VS excretion rate for the whole time series.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.

Member State	Emission Factors and other parameters
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. Old-style tethering systems with solid manure have been replaced by loose housing with slurry-based systems. The MCF for liquid manure is ten times higher than that for solid manure. For non-dairy cattle, the opposite development has taken place. An increasing proportion of bull-calves are raised in stables with deep litter, where the MCF is lower than for liquid manure.
Finland	Cattle: National values for digestible energy (DE %), fraction of animal´s manure managed annually in each manure management system (MS), average milk production and animal weight. For Reindeer it is assumed that all manure is deposited on pastures and for fur animals it is assumed that all manure is managed as solid. For fur animals, VSi value is based on expert judgement being 0.17 kg/head/day.
France	IPCC EFs, only some specific national conditions were considered.
Germany	According to the calculation at district level, IEF are varying with time and space due to differences in AWMS distribution and climate.
Greece	The choice of emission factors follows the same criteria as for the case of enteric fermentation.
Ireland	The emission factors for manure management are derived using the quantified organic matter excretion as volatile solids (VS), a BO (the methane production potential of animal waste) value of 0.24 m3 CH_4/kg VS, the allocation to animal waste management system based on the farm facilities survey and the corresponding values of MCF (methane conversion factor) given for the cool climate zone.
Italy	Cattle. 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. Then, a simplified methodology for estimating national time series for emission factors has 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

Member State	Emission Factors and other parameters
	emission data from experimental research 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 for all three manure management systems for every animal category on a Tier 2 level. These calculations are based on country-specific data on manure characteristics: organic matter (OM) and maximum methane-producing potential (B_0), manure management system conditions (storage temperature and period) for liquid manure systems, which determine the methane conversion factor (MCF). Country-specific data on manure characteristics (volatile solids and maximum methane producing potential). Country-specific data on manure management system conditions (storage temperature and period) are also taken into account for liquid manure systems. For the other manure systems (solid manure and manure produced in the meadow), IPCC default values for the methane conversion factor are used. The Netherlands uses a MCF of 1.5% for all animal categories; for manure production in the meadow, it uses the IPCC default MCF value.
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 usually have a surface cover.
United Kingdom	The emission factors for Lambs are assumed to be 40% of that for adult Sheep (Sneath, 1997). Apart from cattle, lambs and deer, calculations use IPCC Tier 1 defaults (IPCC, 1997) and do not change from year to year.

Trends

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 replaced for poultry by solid manure systems which explain the decreasing emissions for poultry.

Figure 6.13 through Figure 6.23 show the trend of the development of animal productivity in terms of volatile solid excretion for dairy and non-dairy cattle and swine, and the IEF for CH_4 emissions from manure management. These figures show how the different development of the animal sectors in the various countries affects the average characteristics at EU level. Spain is the country with the largest increase in the Swine population and also the country which estimates the highest estimated volatile solid excretion rate. Thus the trend observed at EU-15 level (steepest increase in volatile solid excretion) can entirely be explained by a shift of the weight towards Spanish conditions.

Table 6.22 gives additional information on the trend in category 4B(a) as reported in the national inventory reports.

Table 6.37: Member State's background information on the trend for CH_4 emissions in category 4.A.

Member State	Trend in category 4B(a)
Austria	Emissions of Cattle dominate the trend. From 1990 to 2005 CH_4 emissions from Manure Management decreased by 16.9% to 42.0 Gg. This is mainly due a decrease of the livestock categories cattle and swine.
Denmark	The emission from manure management has increased due to a change towards greater use of slurry-based stable systems, which have a higher emission factor than systems with solid manure. For pigs, there has been a similar development as for dairy cattle with a move from solid manure to slurry-based systems. Updated stable type data for 2006 shows fewer animals on slurry systems than previous estimated by the expert judgement from the Danish Agricultural Advisory Centre.
Finland	Methane emissions from manure management have been fluctuating during 1990-2006 but overall there is an increase of 22% in the emissions in 2006 compared with 1990. This is due to an increase in the number of animals kept in a slurry-based system.The fluctuationsunderlying the general increase in emissions from 1990-2006 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.
Germany	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.

Member State	Trend in category 4B(a)
Ireland	A decrease of the IEF for non-dairy catte between 2005 and 2006 (by 5%) is explained by the strong increase of recovery of biogas from the animal waste storage for energy purposes in 2006.
Netherlands	Between 1990 and 2006, the emission of CH_4 from Manure management decreased by 17%. Emissions from cattle, swine and poultry decreased by 8%, 19% and 75%, respectively, during this period. From 2005 to 2006, the emission of CH_4 from Manure management slightly decreased. The decreased CH_4 emission from swine between 1990 and 2006 largely results from the decrease in their animal numbers. For adult non-dairy cattle and young cattle to a great extent this is also the case. For adult dairy cattle the decrease in CH_4 emission is much lower than the decrease in animal numbers as a consequence of a higher IEF. For poultry the large decrease in CH_4 emissions between 1990 and 2006 can only be explained by the rather small decrease in animal numbers in combination with a higher IEF.
Spain	The interannual increase of CH_4 emissions for Swine 2005/2006 by 11% is due to several factors: a) an increse of 5% in the numbers of animals that superimposes to an increase in the per animal weight, and b) to an increase of the annual average temperatures (based on annual meteorological - not climatic - data for temperature).

Figure 6.13. Trend of volatile solid excretion for dairy cattle

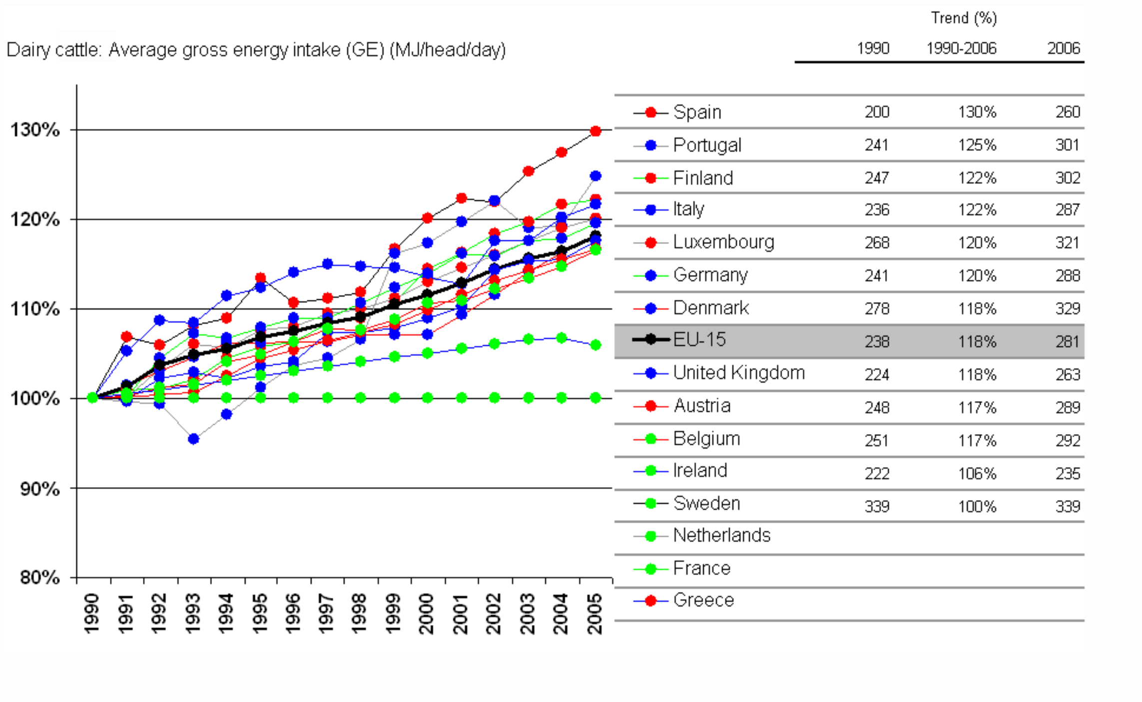


Figure 6.14. Trend of volatile solid excretion for non-dairy cattle

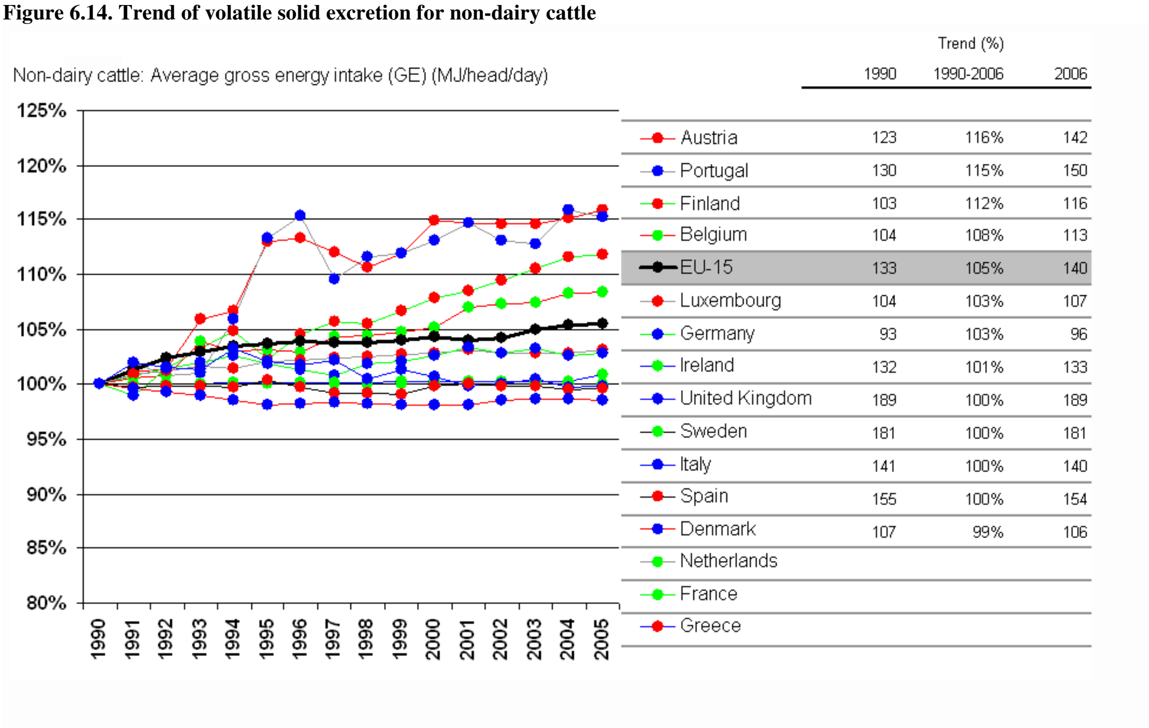


Figure 6.15. Trend of volatile solid excretion for sheep

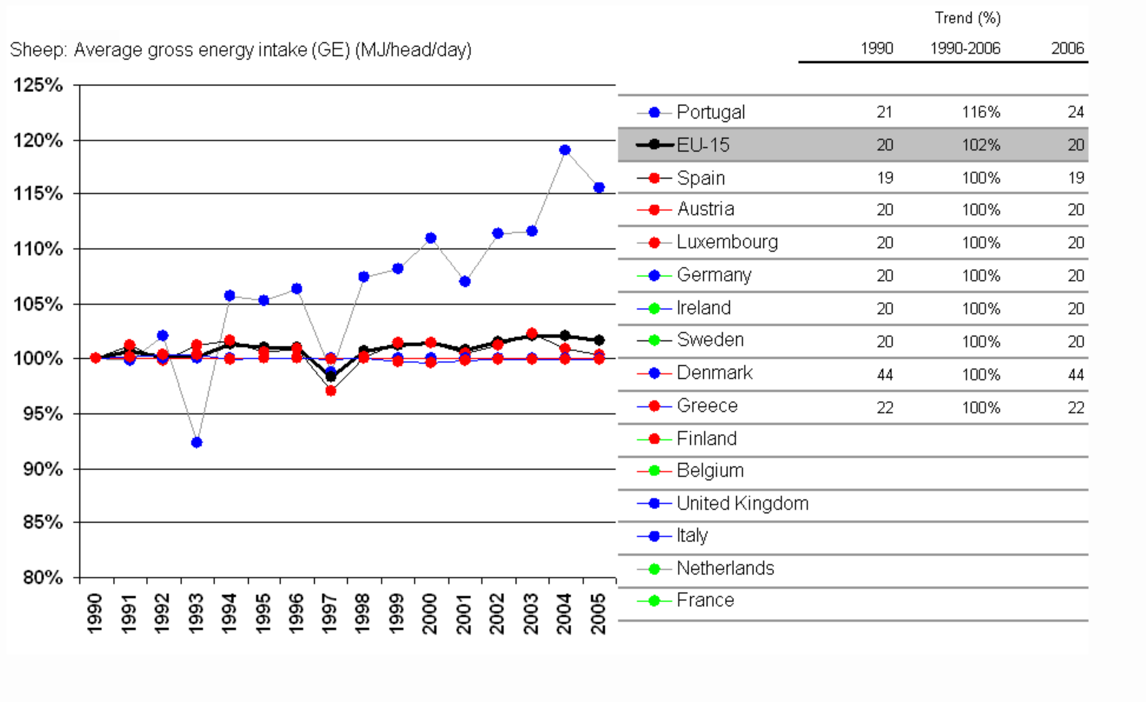


Figure 6.16. Trend of IEF for CH_4 emissions from category 4B(a) for dairy cattle

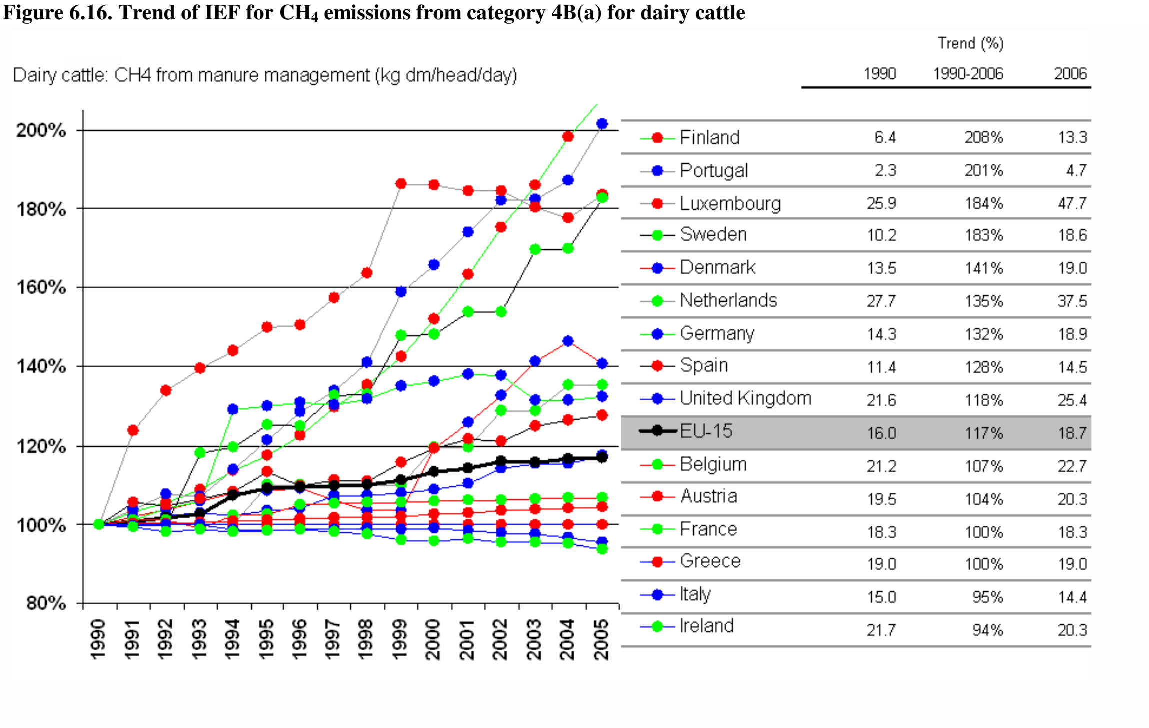


Figure 6.17. Trend of IEF for CH_4 emissions from category 4B(a) for dairy cattle

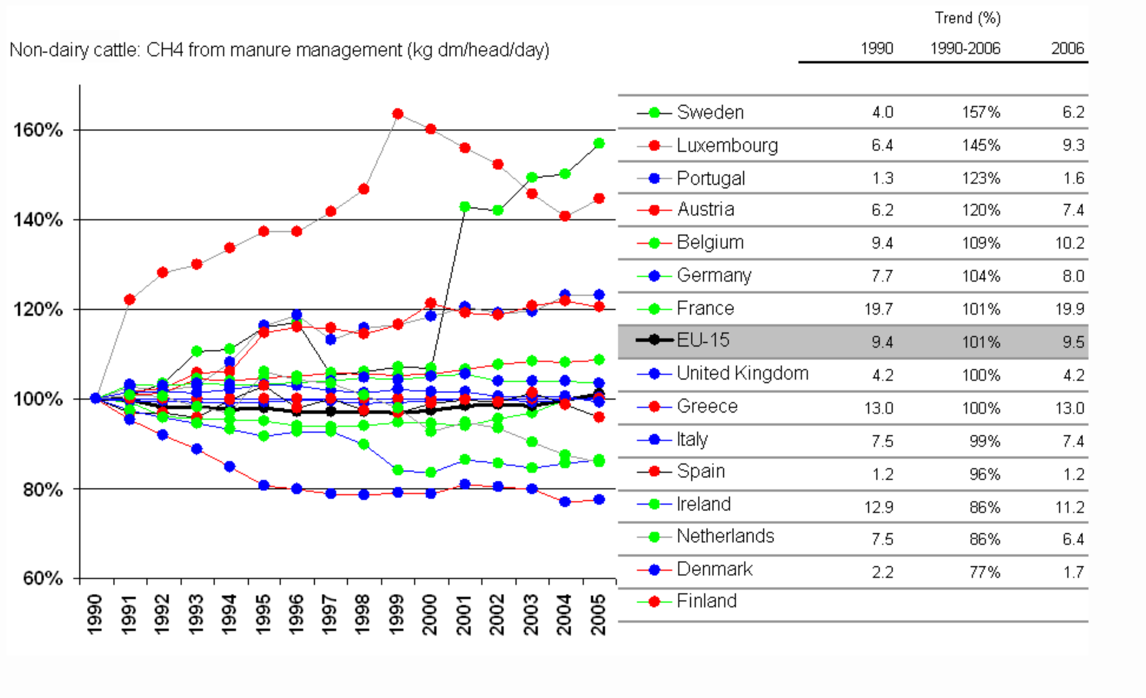
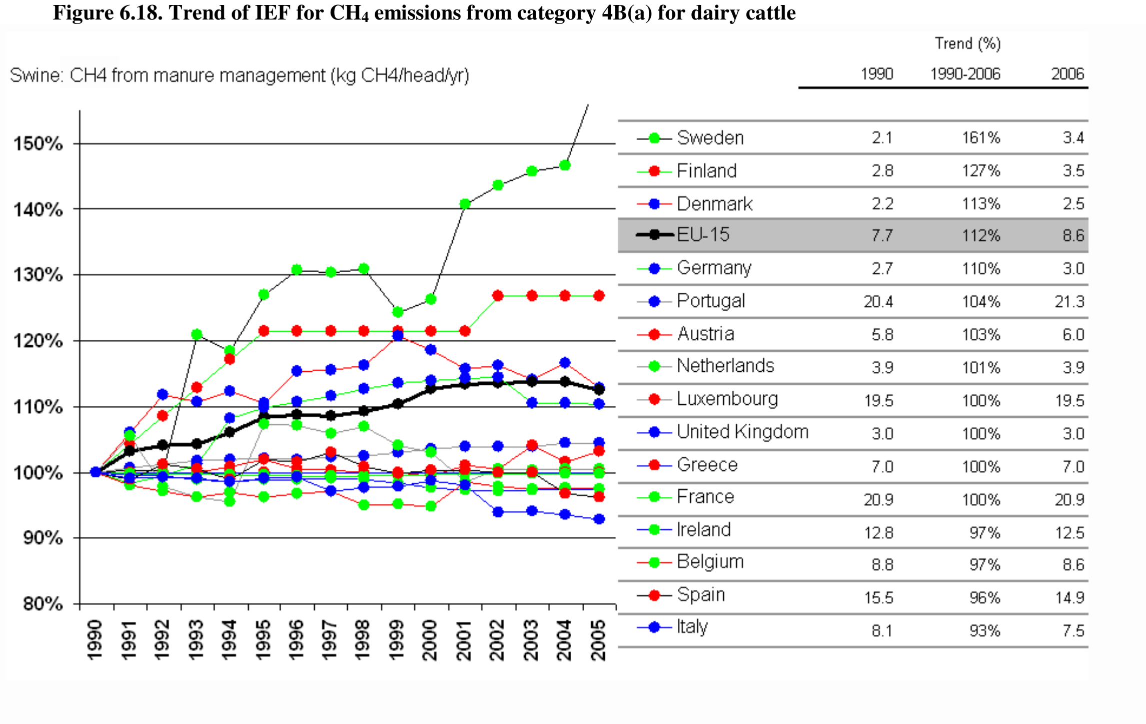


Figure 6.18. Trend of IEF for CH_4 emissions from category 4B(a) for dairy cattle



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 several animal types.

The uncertainty estimate for the emission factors is higher and ranges between 11% (Spain) and 100%.

An overview of the uncertainty estimates for activity data and emission factors are given in Table 6.38 and Table 6.39. An overview of uncertainty estimates for agriculture at country and EU15 levels will be given in 6.4

Table 6.38: Relative uncertainty estimates for activity data in category 4B(a) (data from 2007 submission)

Member State 2006	Total	Cattle	Dairy Cattle	Non-Dairy Cattle	Buffalo	Sheep	Goats	Camels and Llamas	Horses	Mules and Asses	Swine	Poultry	Other
Austria		10.0									10.0		
Belgium	10.0												
Denmark	10.0												
Finland	0.0												
France	2.5												
Germany			0.0	0.0	0.0						0.0		
Greece	5.0												
Ireland			1.0	1.0									1.0
Italy	20.0												
Luxembourg													
Netherlands		10.0							10.0		10.0	10.0	
Portugal			6.1	6.5		19.1	19.1		71.2	271.8	11.0	41.1	770.6
Spain	2.0												
Sweden	20.0												
United Kingdom	10.0												

Table 6.39: Relative uncertainty estimates for implied emission factors in category 4B(a) (data from 2007 submission)

Member State 2006	Total	Cattle	Dairy Cattle	Non-Dairy Cattle	Buffalo	Sheep	Goats	Camels and Llamas	Horses	Mules and Asses	Swine	Poultry	Other
Austria		70.0									70.0		
Belgium	40.0												
Denmark	100.0												
Finland	15.9												
France	83.4												
Germany			20.0	15.0	14.8						16.5		
Greece	50.0												
Ireland			15.0	15.0									30.0
Italy	100.0												
Luxembourg													
Netherlands		100.0							100.0		100.0	100.0	
Portugal			60.6	46.8		59.3	58.4		61.0	61.0	91.0	66.0	66.0
Spain	11.0												
Sweden	50.0												
United Kingdom	30.0												

6.3.3 Manure Management N_2O (CRF source category 4.B(b))

Source category description

Generally, GHG emissions (in CO_2-equivalents) 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 3.0, ranging from 0.8 (Finland) to 8.4 (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 6.40.
Table 6.40 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 2006 with decrease by 100% increase of the IEF for solid systems.

Table 6.40: Total N_2O emissions in category 4B(b) and implied Emission Factor at EU-15 level for the years 1990 and 2006

	Anaerobic lagoon	Liquid systems	Solid storage and dry lots
	1990		
Total Emissions of N_2O [Gg N_2O-N]	0	5	76
Total Nitrogen excreted [Gg N]	16	3107	2513
Implied Emission Factor [kg N_2O-N / kg N]	0.10%	0.10%	1.89%

	Anaerobic lagoon	Liquid systems	Solid storage and dry lots
	2006		
Total Emissions of N_2O [Gg N_2O-N]	0	4	66
Total Nitrogen excreted [Gg N]	16	2833	2205
Implied Emission Factor [kg N_2O-N / kg N]	0.00%	0.00%	0.00%

	Anaerobic lagoon	Liquid systems	Solid storage and dry lots
	2006 value in percent of 1990		
Total Emissions of N2O [Gg N2O-N]	99%	90%	88%
Total Nitrogen excreted [Gg N]	99%	91%	88%
Implied Emission Factor [kg N2O-N / kg N]	0%	0%	0%

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 6.41 shows the total emissions in category 4B(b), how this is composed and the methodology used for calculating the emissions for cattle and swine by Member States. The table shows also that 'solid storage' is a key category for all Member States. Activity Data are the excretion of nitrogen per animal and the distribution over the manure management systems. This is done by most Member States at a higher disaggregation level than categories that are reported in the CRF. The emission factor of N_2O per nitrogen managed in a certain manure management system is usually IPCC default.
The quality of the emission estimates are calculated from the Nex factor for the each manure management system (assigning Tier 1 or Tier 2 when comparing to IPCC default), combined with the MEAN-rule (see section 0, Table 6.82 through Table 6.85) and then further combined with the Tier level of the emission factor for the manure storage system by using the MEDIAN rule with weighting factors for Nex and the IEF being 2/3 and 1/3.
As most countries use country-specific nitrogen excretion rates for most animals but use default emission factors, the Tier level of Tier 1.7 is assigned. The combined uncertainty of both solid, liquid, and other systems (3% of total emissions, for which a Tier 1 was assumed) range between Tier 1.4 and Tier 2.0. Nitrogen excretion is reported by animal type and not by manure management system in the CRF tables. To assign nevertheless a Tier level for the nitrogen excretion by manure management system, the allocation of animal waste to manure management systems from the calculation of CH_4 emissions from manure management is used. Netherland does not report nitrogen excretion rates and

no allocation of animal waste to manure management systems, however, according to the national inventory report, a Tier 2 approach can be assumed for the Nex values.
For EU-15, the overall Tier level is Tier 1.7 (64% of emissions estimated using country-specific information). This value is somewhat lower for solid systems (Tier 1.6) than for liquid systems (Tier 1.7). A compilation of national methodologies for the estimation of nitrogen excretion can be found in Table 6.47; most data are based on country-specific information. This is important if we assess the uncertainty of the EU15 emission estimate: given that nitrogen excretion is largely controlling N_2O emissions from manure management, the error of the estimates of the different countries can be assumed to be largely independent one from another. Only two countries are relying on IPCC default values, i.e. Greece using values reported for the Mediterranean region and France (for dairy cattle) using the value for Western Europe.
Additional background information on the methodology, if available, is summarised in Table 6.42.

Table 6.41: Total emissions and contribution of the main sub-categories to N_2O emissions in category 4B(b), methodology applied (EF) and key source assessment by Member States for the sub-categories solid storage and liquid systems

	Total		Solid Storage			Liquid Systems	
	Gg CO_2-eq	b	a	b	c	a	b
Austria	875	Tier 1.7	96%	Tier 1.7	y	2%	Tier 1.7
Belgium	834	Tier 1.8	92%	Tier 2.0	y	7%	Tier 1.7
Denmark	519	Tier 1.9	86%	Tier 1.7	y	14%	Tier 1.9
Finland	512	Tier 1.4	96%	Tier 1.1	y	4%	Tier 1.4
France	6,003	Tier 1.5	96%	Tier 1.4	y	4%	Tier 1.5
Germany	3,036	Tier 1.8	87%	Tier 2.0	y	13%	Tier 1.7
Greece	290	Tier 1.7	93%	Tier 1.0	y	2%	Tier 1.7
Ireland	399	Tier 1.7	86%	Tier 1.7	y	14%	Tier 1.7
Italy	3,621	Tier 1.7	88%	Tier 1.6	y	4%	Tier 1.7
Luxembourg	21	Tier 2.0	88%	Tier 2.0	y	10%	Tier 2.0
Netherlands	852	Tier 1.7	83%	Tier 1.7	y	17%	Tier 1.7
Portugal	590	Tier 1.7	97%	Tier 1.7	y	1%	Tier 1.7
Spain	2,998	Tier 1.7	96%	Tier 1.7	y	4%	Tier 1.7
Sw eden	511	Tier 1.8	74%	Tier 2.0	y	4%	Tier 1.7
United Kingdom	1,401	Tier 1.7	86%	Tier 1.7	y	3%	Tier 1.7
EU-15	**22,461**	**Tier 1.7**	**91%**	**Tier 1.7**	**y**	**6%**	**Tier 1.7**
EU-15: Tier 1	36%		36%			30%	
EU-15: Tier 2	64%		64%			70%	

a Contribution to N_2O emissions from manure management; b Quality level (between Tier 1 and Tier 2); c Source category is key in the Member State's inventory (y/n); nr: not reported

Table 6.42: Member State's background information on the methodology for estimating N_2O emissions in category 4.B(b)

Member State and reference	Methods
Austria	For the estimation of N_2O emissions from manure management systems only a Tier 1 approach is available. Manure management from Solid storage and dry lot is the key source.
Denmark	Emissions from manure management are calculated in with the model DIEMA (Danish Integrated Emission Model for Agriculture, Mikkelsen et al., 2006). 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	Activity data are collected in compliance with a Tier 2 method. The method used is fully in compliance with the IPCC Good Practice Guidance (IPCC, 2001), which is required for this key source. N_2O emissions from manure produced in the meadow during grazing are not taken into account in the source category manure management. In accordance with the IPCC guidelines, this source is included in the source category agricultural soils. The total amount of nitrogen excreted from animals is no longer adjusted for N from NH3 volatilization during manure management, which makes the estimate consistent with the IPCC Good Practice Guidance.Tier II method for all animal types.
Sweden	The methodology for estimating N_2O from manure management is in accordance with the

Member State and reference	Methods
	IPCC Guidelines Tier 2 methodology; it is based on emission factors from the IPCC Guidelines in combination with national activity data.
United Kingdom	It is assumed that 20% of the total N emitted by livestock volatilises as NOx and NH3 and does not contribute to N_2O emissions. This is because in the absence of a more detailed split of NH3 losses at the different stages of the manure handling process it has been assumed that NH3 loss occurs prior to major N_2O losses. Emission estimates are made with 20% smaller Nex factors than those reported in the CRF. The methodology for estimating N_2O from manure management is in accordance with the IPCC Guidelines Tier 2 methodology; it is based on emission factors from the IPCC Guidelines in combination with national activity data.

Activity Data

In EU-15, a total of 8,175 Gg N was managed in manure management systems or excreted on pasture range and paddock in 2006. 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 10%. The largest decrease of nitrogen managed occurred for the solid storage and dry lot systems, which in 2006 was less than in 1990. The decrease of nitrogen was particularly pronounced in the Netherlands, where total nitrogen decreased by 7%. 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 2006 is given in Table 6.43. Background information on the allocation to manure management systems is given in Table 6.30. Nitrogen excretion data per head will be discussed below.

Table 6.43: 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 2006

Member State 2006	Anaerobic lagoon	Liquid systems	Daily Spread	Solid storage and dry lot	Other	Pasture range paddock	Total
Austria		42		86	7	22	157
Belgium		111	2	82	4	86	285
Denmark		182		47		31	259
Finland		42		50		22	114
France		477		593		764	1,834
Germany		827		366		148	1,342
Greece		14	1	28	6	348	396
Ireland		114		35		286	435
Italy		319		325	30	160	834
Luxembourg		4		2	1	5	12
Netherlands		302		72		87	461
Portugal	16	15		59		78	167
Spain		244	18	296		328	885
Sw eden		46		41	11	43	140
United Kingdor		97	115	123	65	455	855
EU-15	16	2,833	136	2,205	123	2,862	8,175

Information source: CRF Table 4.B(b) for 2006, submitted in 2008. 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 6.44.

Table 6.44: Implied Emission factors for N_2O emissions from manure management used in Member State's inventory 2006

Member State	Implied EF (kg N_2O-N / kg N)			
2006	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	NO	0.10%	2.0%	0.1%
Netherlands	NO	0.10%	2.0%	NO
Portugal	0.10%	0.10%	2.0%	NO
Spain	NO	0.10%	2.0%	NO
Sw eden	NO	0.10%	1.9%	2.0%
United Kingdom	NO	0.10%	2.0%	0.5%
EU-15				

Information source: CRF Table 4.B(b) for 2006, submitted in 2008
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 6.45 for EU15-countries and the main animal types. The table shows a range by a factor of up to 5 between the highest and the lowest value used is found. For example, for dairy cattle, we have a range from about 70 kg N head^{-1} y^{-1} for Spain and Greece and 134 kg N head^{-1} y^{-1} for Denmark. Vary large ranges are found for non-dairy cattle with values between 39 (Denmark) 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 6.46. Additional background information on the calculation of nitrogen excretion rates are summarised in Table 6.47.

Table 6.45: Total Nitrogen excretion by AWMS [Gg N] for dairy and non-dairy cattle, sheep, swine, and poultry in 2006

Member State 2006	Dairy	Non-Dairy	Sheep	Swine	Poultry
Austria	95.6	46.0	13.1	14.3	0.5
Belgium	113.0	60.1	7.4	11.7	0.5
Denmark	133.5	38.6	17.0	8.6	0.6
Finland	119.1	46.7	9.1	18.6	0.8
France	100.0	57.3	18.3	16.4	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	5.9	8.6	0.3
Italy	116.0	48.7	16.2	11.7	0.5
Luxembourg	102.0	47.2	17.0	11.5	0.6
Netherlands	NA	NA	NA	NA	NA
Portugal	87.6	47.8	8.0	7.9	0.7
Spain	67.5	52.3	5.1	9.4	0.7
Sweden	125.3	185.0	13.0	46.8	1.2
United Kingdom	112.0	49.8	5.5	11.4	0.6
EU-15	107.4	49.4	7.7	11.3	0.6

Information source: CRF Table 4.B(b) for 2006, submitted in 2008
Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 6.46: Member State's background information on the emission factor for calculation of N_2O emissions in category 4.B(b)

Member State	Emission Factors
Denmark	IEF for "Solid Storage and dry lot" is a weighted value: 0.005 for poultry manure without bedding and 0.02. Other manure default. Effects from biogas-treated slurry are included in the N_2O emissions.
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 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 6.47: Member State's background information for the development of nitrogen excretion rates used in the calculation of N_2O emissions in category 4.B(b)

Member State	Nitrogen excretion rates
Austria	N-excretion data are calculated following the guidelines of the European Commissions according to the requirements of the European Nitrate Directive based on feed rations which are estimated on the basis of field studies on representative grassland and dairy farm areas for cattle and take into consideration the daily gain of weight, nitrogen and energy uptake, efficiency, etc. Similar level of detail for pigs. (Gruber & Poetsch, 2005; Poetsch et al., 2005; Steinwidder & Guggenberger, 2003).
Belgium	N_2O emissions from manure storage are based on N excretion data estimated through local production factors. In Wallonia, emissions are calculated using the model developed by (Siterem, 2001) also used for CH_4 and NH3 emissions. It includes emissions from animal husbandry, excreta deposited in buildings and collected as liuid slurry or solid manure, and application of mineral fertilizer and manure nitrogen to land. Such factors were first determined for the implementation of the CE Nitrates Directive 91/676 on http://www.nitrawal.be/pdf/arretenitrates_mb2.pdf, but were representing the nitrogen after deduction of the atmospheric losses, so new factors were calculated on this basis for the purposes of estimating atmospheric emissions. For Flanders, nitrogen excretion factors are from the Manure Bank of the Flamish Land Agency (www.vlm.be) and are based on the regional situation.
Denmark	N-excretion (kg N/head/yr) is weighted values from the following categorisation: Non-dairy cattle: Calves, Bulls, Heifers and Suckling Cattle, Sheeps, Goats, Swine: Piglets, Slaugthering pigs, Fur animals, Poultry: Broilers, Hens, Ducks, etc. The variations in N-excretion in the time-series reflect changes in feed intake, fodder efficiency and allocation of subcategories. The Danish N-excretion levels are generally lower than IPCC default values. This is due to the highly skilled, professional and trained farmers in Denmark, with access to a highly competent advisory system.
Finland	Annual N excretion per animal for cattle, sheep, swine, horses, poultry and fur animals has been calculated by animal nutrition experts of MTT Agrifood Research Finland (Nousiainen, J. pers.comm.). Values for annual N excretion (Nex) are based on calculations on N intake-N retention for typical animal species in typical forage system. Annual nitrogen excretion per animal and in the case when animals are kept less than one year in farms (swine, poultry), replacement of animals with new ones has been taken account in the calculations. For reindeer, values for goats have been used. N-excretion for Fur animals is average of two sub-categories: Minks and Fitches and Fox and Racoon.
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. Swine and hens: N-excretion is calculated on the basis of productivity (number of births or weight

Member State	Nitrogen excretion rates
	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.
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)
Luxembourg	The nitrogen excretion per AWMS cannot be calculated since the nitrogen excretion per head of animal is not yet estimated for Luxembourg. The default factors suggested for Western Europe in the IPCC Guidelines have to be further investigated to decide whether or not they might be applied to Luxembourg's situation as regards manure management of animals.
Netherlands	Standard factors for manure production and manure N-excretion per animal per animal category and per manure management system are calculated by Netherlands Statistics and decided on by WUM (Working group for Uniform calculations on Manure- and minerals) annually, based on specific data such as milk yield. More specified data on manure management are based on statistical information on management systems and is documented (Van der Hoek, 2006). http://www.greenhousegases.nl/documents/4B_N$_2$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

Member State	Nitrogen excretion rates
	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

The decreases in N_2O emissions of 11% (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 18% 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 0.4%, 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.

Figure 6.19 through Figure 6.25 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.
The category “other“ animal waste management systems for Italy is reported for the years 1995 onwards only in the Italian inventory. This nitrogen excretion refers to poultry manure that is undergoing a drying-process. This system has been widely used from 1995 (CRPA, 2000).
Nitrogen excretion for buffalo is reported for Italy and Greece only While Greece uses a constant excretion factor of 50 kg N $head^{-1}$ $year^{-1}$, the N excretion of buffalo varies significantly in Italy with values between 92 and 107 kg N $head^{-1}$ $year^{-1}$. The N-excretion values result from the weighted average of cow buffalo and other buffaloes and the variability is due to the interannual variation of the proportion of the two livestock number as published by the National Institute of statistics. Cow buffaloes have a higher N excretion, comparable with dairy cows, because they are prevalently breeded for milk production (mozzarelle di bufala).

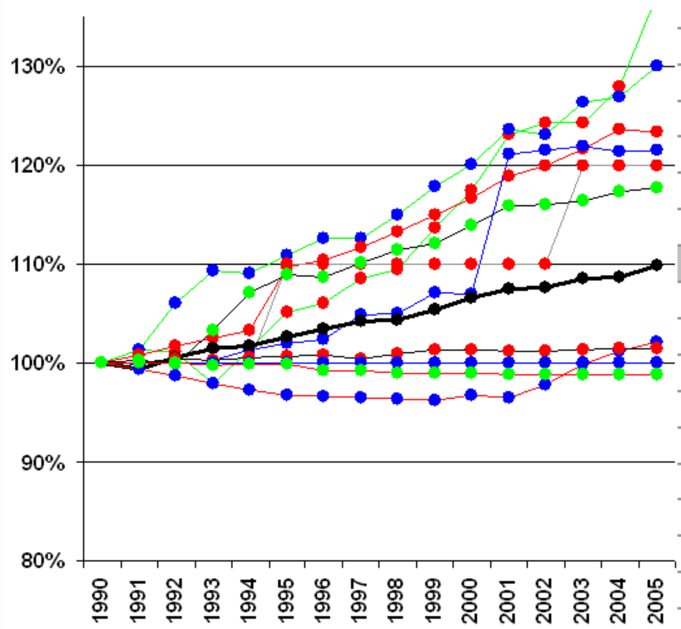
Table 6.48 gives additional information on the trend in category 4B(b) as reported in the national inventory reports.

Table 6.48: Member State's background information on the trend for CH_4 emissions in category 4B(b).

Member State	Trend in category 4B(b)
Austria	Emissions of Cattle dominate the trend. From 1990 to 2005 the N_2O emissions from Manure Management decreased by 12.8% to 2.8 Gg. The reduction of diary cows is partly counterbalanced by an increase in emissions per animal (because of the increasing gross energy intake, milk production and N excretion of diary cattle since 1990).
Denmark	The total amount of nitrogen in manure has decreased by 11% from 1990 to 2006, despite the increasing production of pigs and poultry. This reduction is particularly due to an improvement in fodder efficiency, especially for slaughter pigs.
Finland	Nitrous oxide emissions from manure management have decreased by 15% over the time period 1990-2006. The fluctuation in the emissions is related to both changes in animal numbers, which is largely dependent on agricultural policy, as well as changes in the distribution of manure management systems used. Slurry-based systems increase methane emissions per animal tenfold compared to the solid storage or pasture.
Netherlands	The emissions of N_2O from Manure management increased 5% between 1990 and 2006, from 2.6 to 2.7 Gg N_2O in 2006 (Table 6.1). The relatively large decrease in N_2O emissions of solid manure in 2003 is a direct result of the decrease in poultry animal manure. This decrease was due to the reduction in the number of poultry animals that followed the avian flu epidemic. In 2004 and 2005, N_2O emissions increased once again following the recovery of poultry animal numbers, while in 2006 the emission decreased as a consequence of lower poultry numbers. The slightly increased N_2O emissions from Manure management between 1990 and 2006 are explained by an increase in a higher IEF partly counteracted by a decrease in N excretion in the stable.
Sweden	The N_2O emissions have decreased since 1990, mainly because of a change from solid manure management to slurry management in dairy and pork production. Due to more intense Swine production, the values for Sows and Pigs for meat production were updated in 2001.

Figure 6.19. Trend of nitrogen excretion rates for dairy cattle

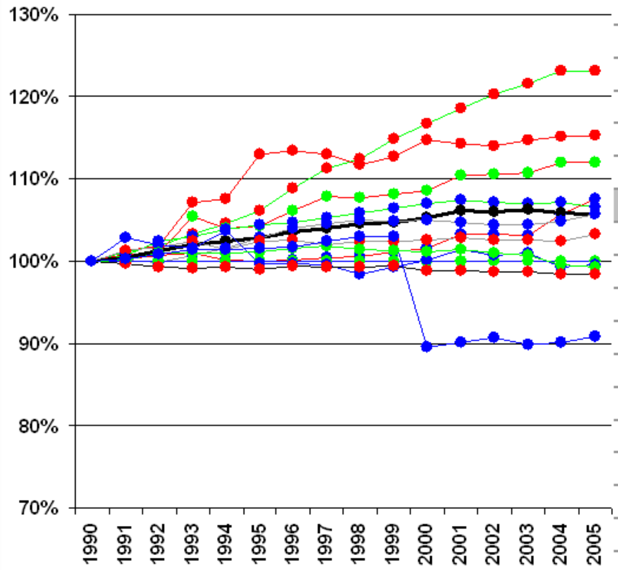
Dairy cattle: Nitrogen excretion (kg N/head/yr)



	1990	Trend (%) 1990-2006	2006
Finland	84.6	137%	116.1
Germany	90.5	130%	117.6
Austria	76.6	123%	94.5
United Kingdom	92.3	121%	112.1
Luxembourg	85.0	120%	102.0
Sweden	104.9	118%	123.5
EU-15	81.6	110%	89.7
Denmark	129.5	102%	132.2
Spain	66.6	101%	67.5
Greece	70.0	100%	70.0
Ireland	85.0	100%	85.0
Portugal	87.6	100%	87.6
France	100.0	100%	100.0
Italy	116.0	100%	116.0
Belgium	114.5	99%	113.1
Netherlands			

Figure 6.20. Trend of nitrogen excretion rates for non-dairy cattle:

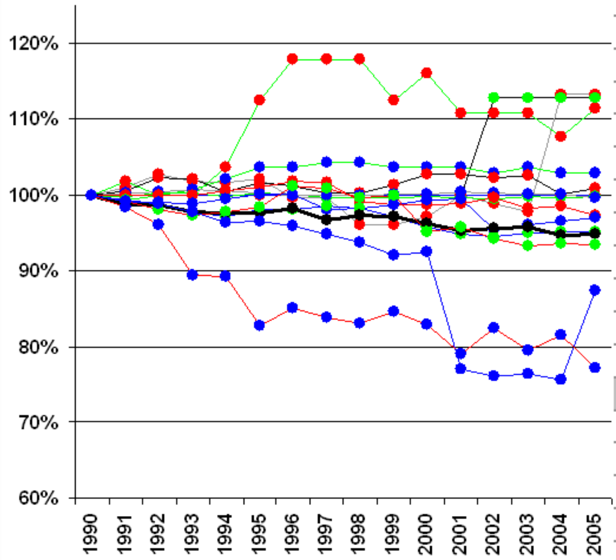
Non-dairy cattle: Nitrogen excretion (kg N/head/yr)



	1990	Trend (%) 1990-2006	2006
Finland	37.1	123%	45.7
Austria	40.0	115%	46.1
Belgium	53.7	112%	60.1
Denmark	36.6	108%	39.4
Germany	40.3	107%	42.9
EU-15	43.1	106%	45.6
Portugal	45.0	106%	47.5
Luxembourg	45.8	103%	47.3
Sweden	185.0	100%	185.0
Greece	50.0	100%	50.0
Ireland	65.0	100%	65.0
Italy	50.0	100%	49.8
France	57.9	99%	57.4
Spain	53.1	98%	52.3
United Kingdom	53.8	91%	48.9
Netherlands			

Figure 6.21. Trend of nitrogen excretion rates for swine

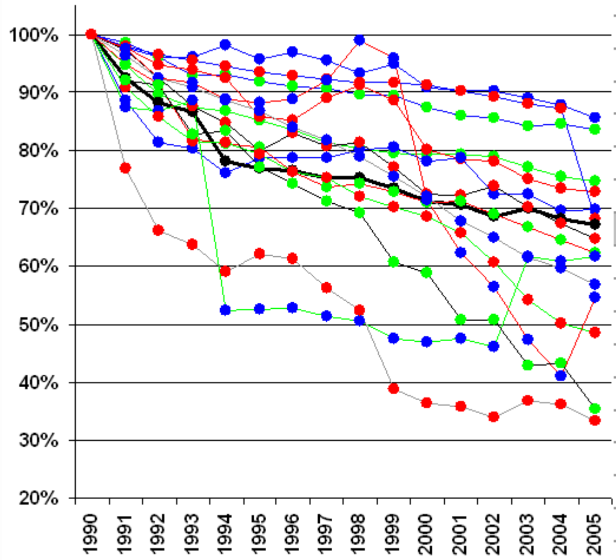
Swine: Nitrogen excretion (kg N/head/yr)



	1990	Trend (%) 1990-2006	2006
Luxembourg	10.2	113%	11.5
Sweden	41.5	113%	46.8
Finland	16.8	111%	18.7
Germany	14.0	103%	14.4
Spain	9.1	101%	9.2
Greece	16.0	100%	16.0
France	16.4	100%	16.4
Portugal	8.0	100%	8.0
Austria	14.6	97%	14.2
Italy	12.0	97%	11.7
Ireland	8.8	95%	8.4
EU-15	11.9	95%	11.3
Belgium	12.5	93%	11.7
United Kingdom	13.3	87%	11.6
Denmark	11.6	77%	9.0
Netherlands			

Figure 6.22. Trend of N managed in solid storage and dry lot, dairy cattle

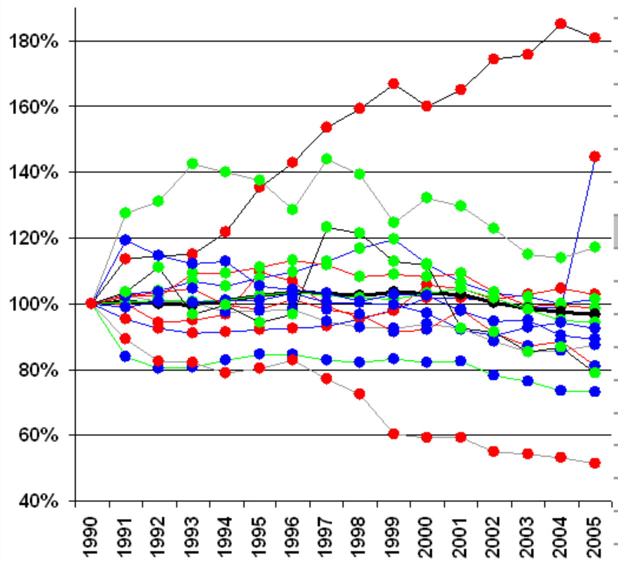
Dairy cattle: Nitrogen managed in solid storage systems (Gg N/yr)



	1990	Trend (%) 1990-2006	2006
United Kingdom	24.5	86%	21.0
Ireland	3.1	84%	2.6
France	225.1	75%	168.1
Austria	48.8	73%	35.6
Italy	174.9	70%	121.9
Greece	15.5	68%	10.6
EU-15	827.1	67%	555.6
Spain	64.3	65%	41.7
Belgium	27.0	62%	16.8
Germany	163.7	62%	100.9
Portugal	12.1	57%	6.9
Denmark	14.6	55%	8.0
Finland	20.9	48%	10.1
Sweden	32.4	35%	11.5
Luxembourg	1.6	33%	0.5
Netherlands			

Figure 6.23. Trend of N managed in solid storage and dry lot, non-dairy cattle

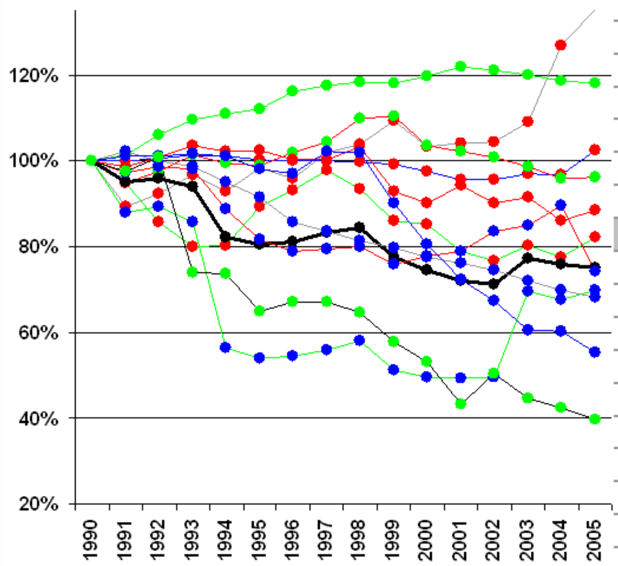
Non-Dairy cattle: Nitrogen managed in solid storage systems (Gg N/yr)



	1990	Trend (%) 1990-2006	2006
Spain	57.7	181%	104.3
Greece	11.8	145%	17.0
Netherlands	5.1	117%	5.9
Austria	43.0	103%	44.2
Ireland	23.2	101%	23.5
Belgium	47.9	99%	47.3
EU-15	828.9	97%	802.7
France	275.0	94%	259.4
United Kingdom	78.4	93%	72.6
Italy	101.8	89%	91.0
Portugal	12.9	88%	11.3
Denmark	19.5	81%	15.8
Sweden	15.4	79%	12.1
Germany	142.3	73%	104.2
Luxembourg	2.3	51%	1.2
Finland			

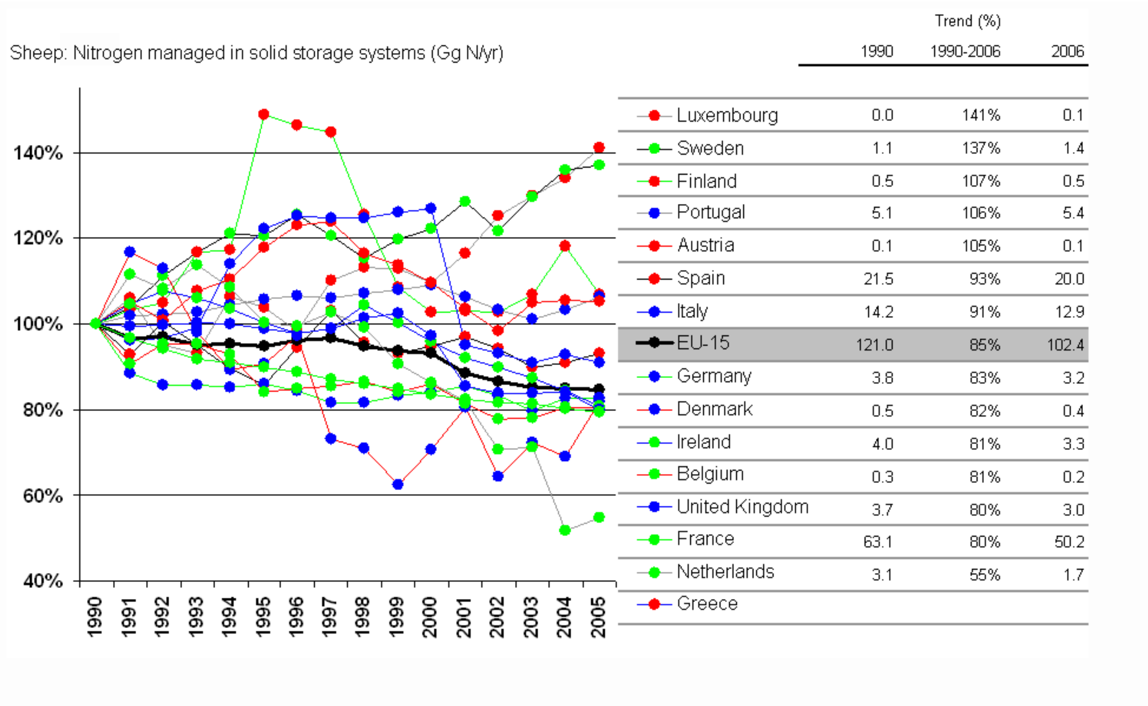
Figure 6.24. Trend of N managed in solid storage and dry lot, swine

Swine: Nitrogen managed in solid storage systems (Gg N/yr)



	1990	Trend (%) 1990-2006	2006
Luxembourg	0.0	135%	0.1
France	27.1	118%	32.1
Greece	1.6	102%	1.6
Belgium	6.4	96%	6.2
Austria	7.1	88%	6.3
Finland	12.8	82%	10.5
EU-15	193.6	75%	145.0
Denmark	12.0	74%	8.9
Germany	73.4	70%	51.4
Portugal	0.6	68%	0.4
United Kingdom	43.9	55%	24.3
Sweden	8.6	40%	3.4
Spain			
Netherlands			
Ireland			
Italy			

Figure 6.25. Trend of N managed in solid storage and dry lot, sheep



Uncertainty and time series consistency

Activity data used for the estimation of N_2O emissions from manure management are generally analog to those used for the estimation of CH_4 emissions, and consequently also the uncertainty estimates are similar. The uncertainty of the emission factor is much higher than the uncertainty of the activity data, and only Germany has estimated an uncertainty lower than 50%. Generally an uncertainty of 100% is assumed, the United Kingdom assume high uncertainty with 414%.

Nevertheless, N_2O emissions from manure management are representing only a small fraction in most inventories, so that the contribution to the overall uncertainty remains in most cases small, i. e. 0.5% of total emissions or less. Only Austria and Finland report a higher contribution of N_2O emissions from manure management to the overall uncertainty with 1.2% and 0.9% of total emissions, respectively.

An overview of the uncertainty estimates for activity data and emission factors are given in Table 6.49. An overview of uncertainty estimates for agriculture at country and EU15 levels will be given in 6.4

Table 6.49: Relative uncertainty estimates for activity data and implied emission factors in category 4B(b) (data from 2007 submission)

Member State 2006	AD	IEF
Austria	10.0	100.0
Belgium	10.0	90.0
Denmark	10.0	100.0
Finland	0.0	82.0
France	1.1	93.7
Germany		21.9
Greece	50.0	100.0
Ireland	11.2	200.0
Italy	20.0	100.0
Luxembourg		
Netherlands	10.0	100.0
Portugal		100.0
Spain	0.7	100.0
Sw eden	20.0	50.0
United Kingdom	1.0	414.0

6.3.4 Rice Cultivation

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 21 g m^{-2} in 2003 for continuous flooded rice fields, which represents an increase in the implied emission factor by 18% since 1990 (see Table 6.50), which can be explained by the higher contribution of Portugal with an implied EF of 67.6 g CH_4 m^{-2} in 2006 compared to 31.9 g CH_4 m^{-2} in 1990. Note that the implied emission factors for intermittently flooded field are stemming from the Italian inventory only. In ItalyHere it is smaller than the emissions from continuously flooded fields. At the EU-15 level and with the given choices of emission factors by the different countries, however, the average emission from continuous flooded fields appears to be only half of those from single-aerated rice fields.

Table 6.50: Total CH_4 emissions, area harvested and implied Emission Factor for category 4C at EU-15 level for 2006

	Continuously Flooded	Intermittently flooded: single aeration	Intermittently flooded: multiple aeration
	1990		
Total Emissions of CH4 [Gg CH4]	29.7	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]	18	27	35

	Continuously Flooded	Intermittently flooded: single aeration	Intermittently flooded: multiple aeration
	2006		
Total Emissions of CH4 [Gg CH4]	40.4	11.1	58.8
Total Area harvested [10^9 m^2 y^{-1}]	1.89	0.47	1.82
Implied Emission Factor [g CH4 / m^2]	21	24	32

	Continuously Flooded	Intermittently flooded: single aeration	Intermittently flooded: multiple aeration
	2006 value in percent of 1990		
Total Emissions of CH4 [Gg CH4]	136%	1823%	80%
Total Area harvested [10^9 m^2 y^{-1}]	115%	2088%	85%
Implied Emission Factor [g CH4 / m^2]	118%	87%	93%

Methodological Issues

Methods

A summary of the methodologies used for the calculation of CH_4 emissions from rice cultivation is given in Table 6.51. More detailed data are given in the section on the emission factors.

Table 6.51: Additional information in the methodology used for the calculation of CH_4 emissions in category 4.C in 2006

Member State	Method
France	Default EF, non key source, IPCC methodology. Statistic from the Ministry of Agriculture.
Greece	In order to estimate methane emissions from rice cultivation, the default methodology suggested by the IPCC Good Practice Guidance was followed. The cultivated areas provided by the NSSG and the default emission factor (20 g CH_4 / m^2) were used for the emissions calculation. Rice cultivated in Greece is grown in continuously flooded fields without the use of organic amendments and one cropping period is considered annually.
Italy	According to specific characteristics of rice cultivation in Italy, methane emissions from rice cultivation are estimated only for an irrigated regime, other categories suggested by IPCC (rainfed, deep water and “other”) are not present. Methane emission factor has been adjusted with the following parameters: daily integrated emission factor for continuously flooded fields without organic fertilisers, scaling factor to account for the differences in water regime in the rice growing season (SFw), scaling factor to account for the differences in water regime in the preseason status (SFp) and scaling factor which varies for both types and amount of amendment applied (SFo) (Yan et al., 2005). Futher, the following national cirumstances are considered: cultivation period of rice (days) and annual harvested area under specific condictions. In Italy, rice is sown from mid-April to the end of May and harvested from mid-September to the end of October; the only practised system is the controlled flooding system, with variations in water regimes (Tossato and Regis, 2002; Mannini, 2004; Confalonieri and bocchi, 2005; Regione Emilia Romagna ,2005) In Italy, three types of rice cultivation are distinguished: Wet-seeded "classic" cultivation, Wet-seeded "red rice control" cultivation and dry-seeded with delayed flooding. The wet-seeded cultivation methods fall into the IPCC category of 'multiple aeration' while the dry-seeded cultivation method is intermittently aerated one once. A detailed description of the management is given in the national inventory report.
Portugal	Methane emissions from rice production were estimated following the GPG, but simplified 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 2285 km^2 of rice cultivation, followed by Spain with an area of 1192 km^2 (2006 data). The other three countries have rice producing areas around 200 km^2, as shown in Table 6.52 for the rice cultivation practices continuously flooded, intermittently flooded with single aeration, and intermittently flooded with multiple aerations.

Table 6.52: Harvested Area Rice in the Member States in 2006 and 1990

Member State 2006	Harvested area in 2005 [10^9 m^2]		
	Continuously Flooded	Intermittently flooded: single aeration	Intermittently flooded: multiple aeration
France	0.22	NO	NO
Greece	0.22	NO	NO
Italy	NO	0.47	1.82
Portugal	0.25	NO	NO
Spain	1.19	NO	NO
EU-15	1.89	0.47	1.82

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 2006 and 1990, submitted in 2008
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 6.53. France and Greece are using IPCC default emission factors presented in the IPCC *Good Practice Guidance*. This value is the arithmetic mean of the seasonally integrated emission factors presented in Table 4-13 of the IPCC *Guidelines*. In this Table, a value from Schuetz et al (1989) is also presented (36 g m^{-2}, range 17-54 g m^{-2}, representing a seasonally averaged emission factor). In Italy, a daily integrated emission factor for continuously flooded fields without organic fertiliser (Schuetz et al., 1989; Leip et al., 2002) have been adjusted to account for differences for three different cultivation types (see Table 6.51) 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 2006 are the above-mentioned value of 36 g m^{-2} measured by Schuetz et al. (1989).

Table 6.53: Implied Emission factors for CH_4 emissions from rice cultivation used in Member State's inventory

Member State 2006	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	23.70	32.33
Portugal	67.6	NO	NO
Spain	12.00	NO	NO
EU-15	21.35	23.70	32.33

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	NE	NE
Italy	NO	27.14	34.60
Netherlands	NO	NO	NO
Portugal	31.9	NO	NO
Spain	12.00	NO	NO
EU-15	18.06	27.14	34.60

Information source: CRF Table 4.C for 2006 and 1990, submitted in 2008
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 6% 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 36%. The trend was opposite in France with peaks in rice production during 1993-1995 and in 2006 the level was about 7% lower than in 1990. Finally, Portugal saw a decline in rice production, amounting to 25% since 1990.

Figure 6.26. Trend of continuous flooded rice cultivation – area harvested

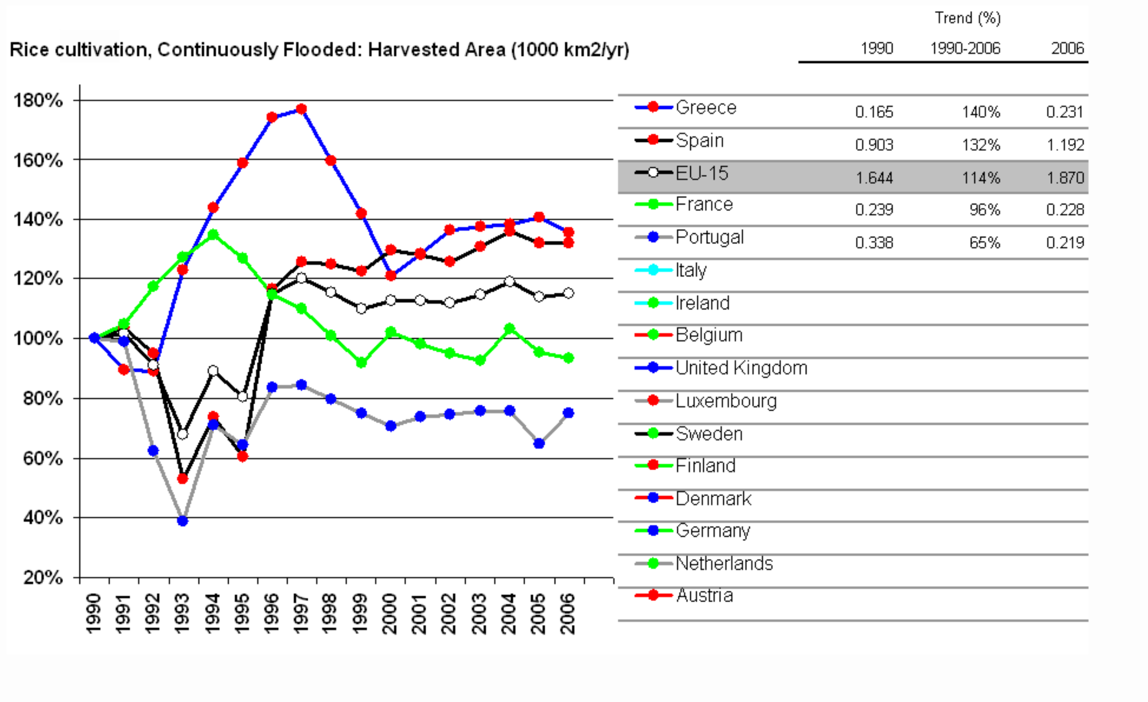


Figure 6.27. Trend of intermittently flooded (single aeration) rice cultivation – area harvested

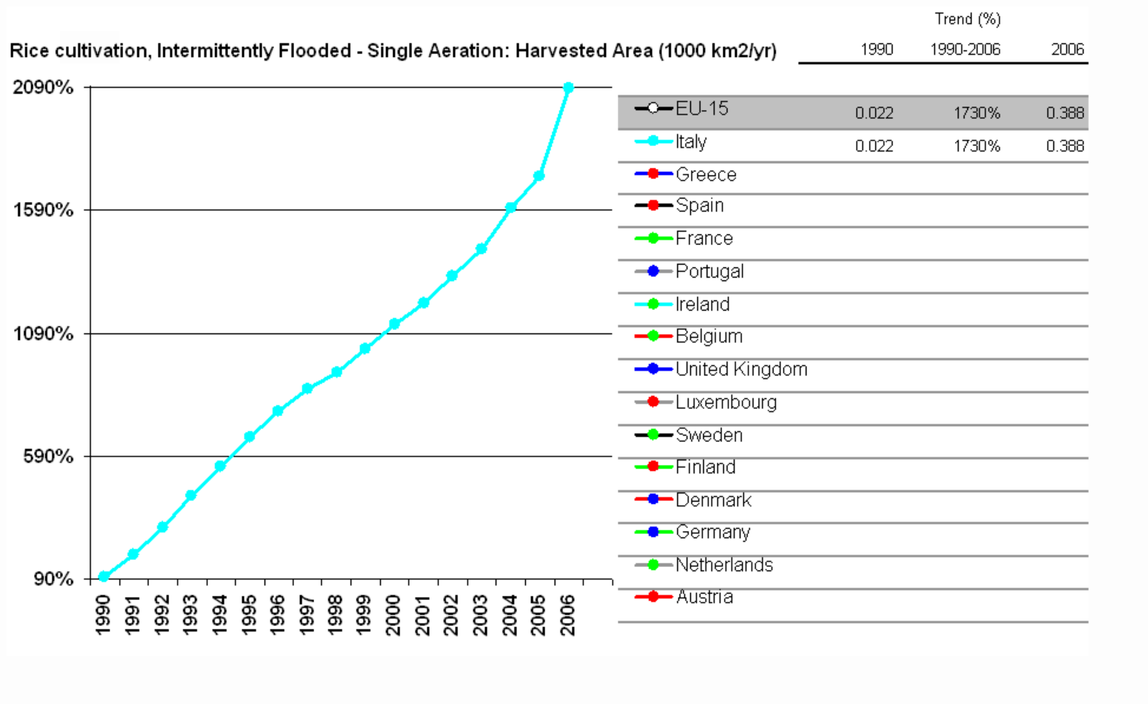


Figure 6.28. Trend of intermittently flooded (multiple aeration) rice cultivation – area harvested

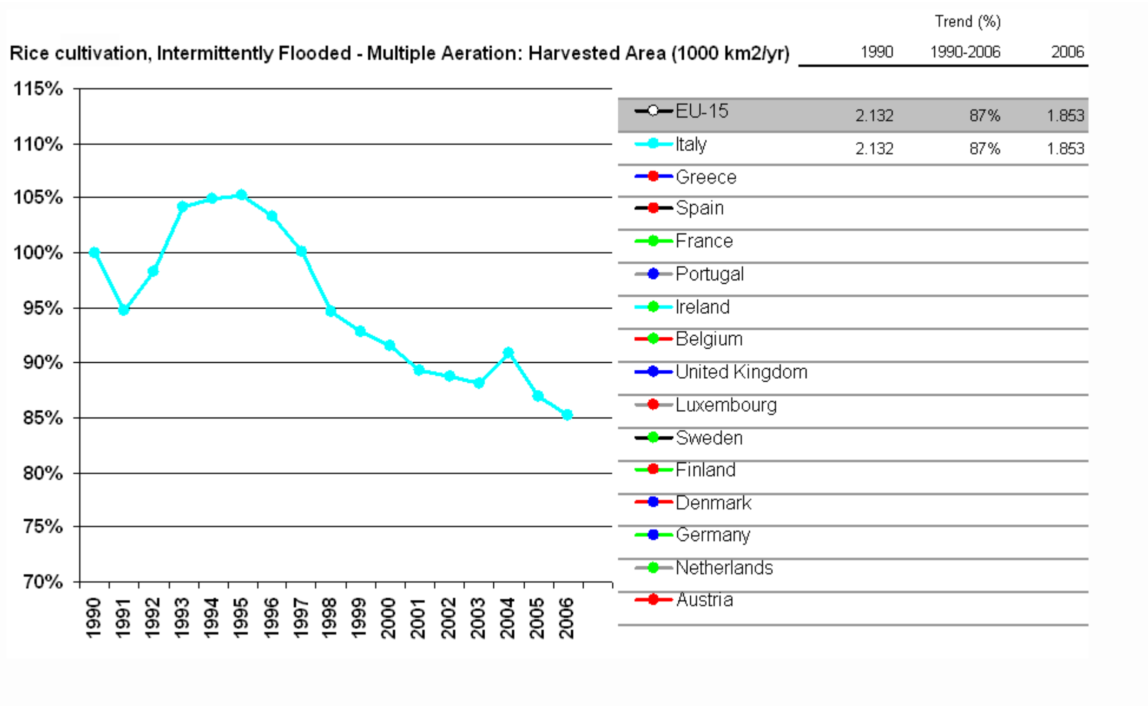


Figure 6.29. Trend of continuous flooded rice cultivation – implied emission factor

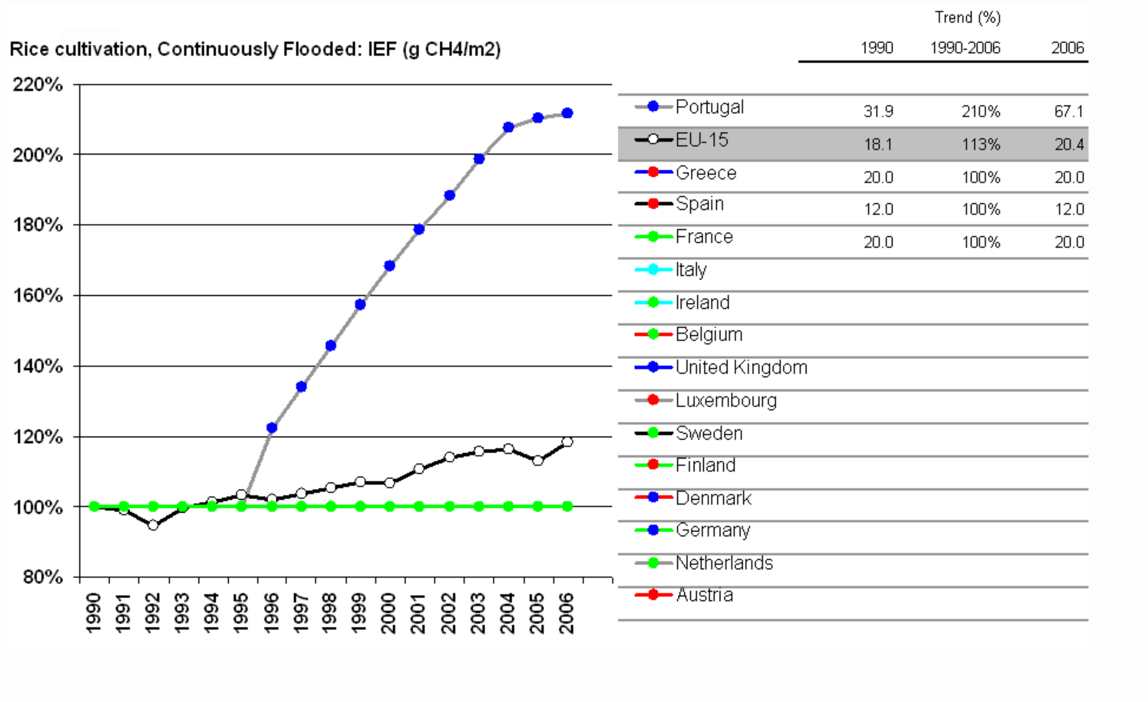


Figure 6.30. Trend of intermittently flooded (single aeration) rice cultivation – implied emission factor

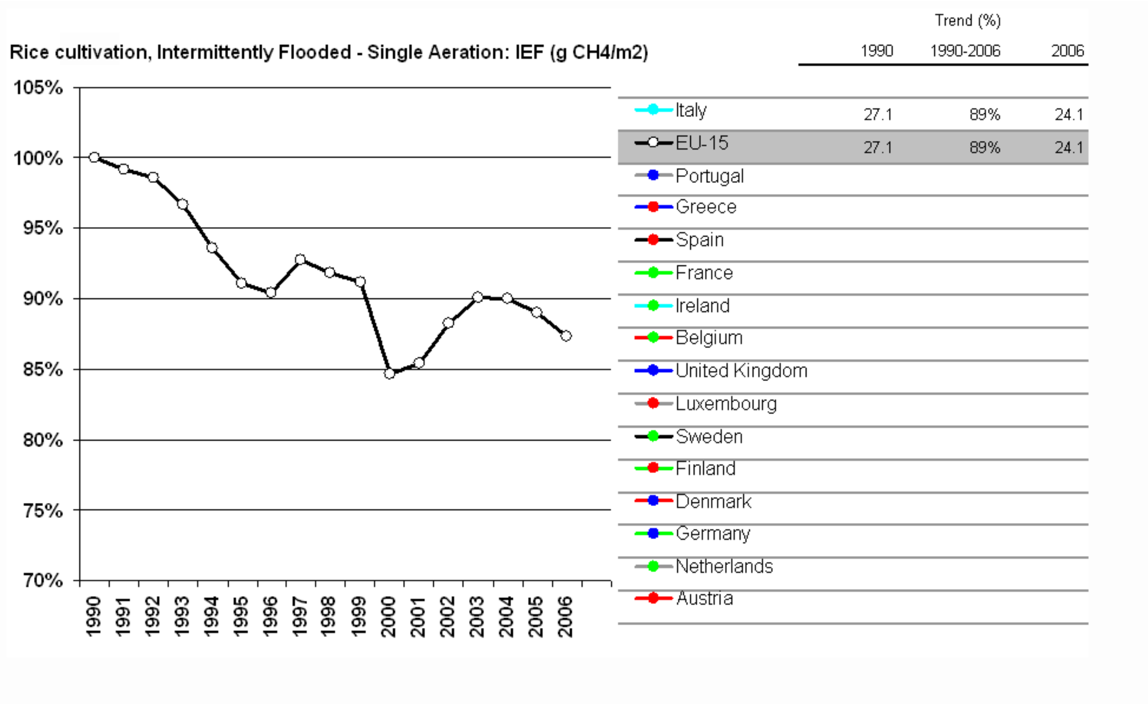
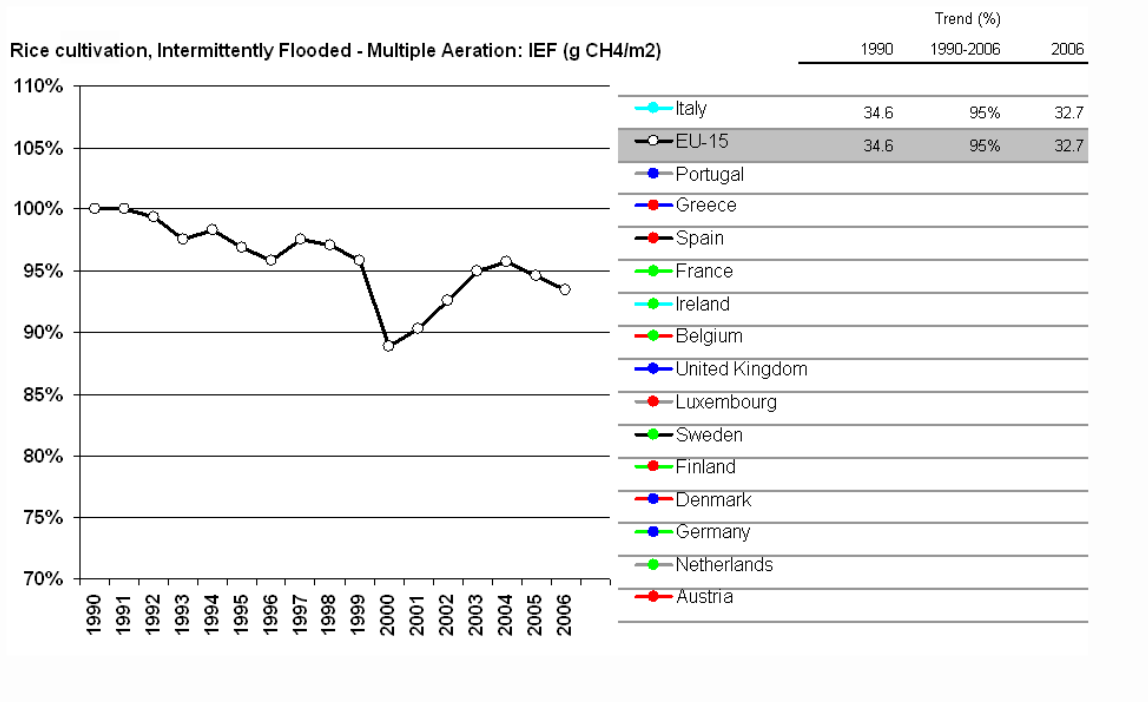


Figure 6.31. Trend of intermittently flooded (multiple aeration) rice cultivation – implied emission factor



Uncertainty and time series consistency

Uncertainty estimates for CH_4 emissions from rice cultivation are reported by three countries (Greece, Italy, and Portugal). The area used for the cultivation of rice is generally well known, only Portugal reports an uncertainty of 37.2%. The uncertainty of the implied emission factor is 40%, Italy uses a national methodology and estimates an uncertainty of 20%. An overview of the estimates is given in Table 6.54. .

Table 6.54: Relative uncertainty estimates for activity data and implied emission factors in category 4C (data from 2007 submission)

Member State 2006	AD	IEF
Greece	2.0	40.0
Italy	3.0	20.0
Portugal	37.2	40.0

6.3.5 Agricultural Soils - N_2O (Source category 4.D)

Source category description

For EU-15, emissions from all sub-categories in the category 4.D have decreased since 1990 (see Table 6.55). This was most significant for direct emissions from the application of synthetic fertiliser (-21%), followed by indirect emissions from leaching and run-off (-16%) and volatilisation of NH_3+NO_x (-17%). 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 3%.

At the aggregated EU-15 level, the implied emission factor for N_2O emissions from the application of manure increased by 4%, caused by a doubling of the implied emission factor for this source in the Netherlands during 1990 to 2006. 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 21% for synthetic fertilizer application, 7% for application of manure, 4% of the area of histosols cultivated and 9% of nitrogen excreted by grazing animals. This translated to a reduction of volatilized and re-deposited nitrogen by 17% and of the amount of nitrogen leached by 12%.

Table 6.55: Total N_2O emissions, Total Nitrogen input into agricultural soils and implied Emission Factor for category 4D at EU-15 level in 2006 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	90	27	92	48	215
Total Nitrogen input [Gg N]	10295	4606	22794	3092	3024	6120
Implied Emission Factor [kg N_2O-N / kg N]	1.22%	1.24%	7.5	1.89%	1.00%	2.23%

2006	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]	155	87	26	83	40	180
Total Nitrogen input [Gg N]	8135	4269	21820	2820	2506	5371
Implied Emission Factor [kg N_2O-N / kg N]	1.21%	1.29%	7.5	1.87%	1.00%	2.13%

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	79%	97%	95%	90%	83%	84%
Total Nitrogen input	79%	93%	96%	91%	83%	88%
Implied Emission Factor	100%	104%	100%	99%	100%	96%

Source of information: Tables 4.D for 1990 and 2006, submitted in 2008

1) Histosols unit AD: km^2; Unit for IEF: kg N_2O-N/ha

Methodological Issues

Methods

Due to the large uncertainty associated with the emission factors in this category and the lack of well-established alternatives, most Member States rely on the IPCC default emission factors (see below). For other parameters used in the calculation of N_2O emissions from agricultural soils, however, many Member States use country-specific methodologies, linking the N_2O inventory with the CORINAIR NH_3 inventory or using simulation models. A more specific discussion of emission factors and parameters used is presented below.

Table 6.56 gives an overview of the total N_2O emissions in category 4D and the contribution of the main sub-categories. For direct N_2O emissions from the application of fertilizer and from emissions from animal production activity data are multiplied with the emission factor, which is for most countries the IPCC default factor. Thus, the vast majority of the emissions are calculated with the Tier 1 approach for the emission from synthetic fertilizer. However, emissions depend also the fraction of nitrogen that volatilises is subtracted from the applied nitrogen for the calculation of N_2O emissions and – for manure applied – also from the method that is used to estimate nitrogen excretion, which has already been discussed above. Additionally, nitrogen in crop residues and nitrogen fixed by biological nitrogen fixation might be estimated using country-specific data.

For each single sub-category we calculated a 'Tier-level' scoring between 1 and 2 according to the methodology described in0 (Table 6.86 through Table 6.89).

- The Tier level for direct N_2O emissions is calculated from the Tier level for emissions from mineral fertilizer input, manure application, crop residues and N-fixing crops on the basis of the MEAN rule. The Tier level for the estimation of N_2O emissions from mineral fertilizer is done by comparing the IEF with the IPCC default value. For emissions from manure applications, the Tier level of the nitrogen excretion rates estimated for N_2O emissions from manure management are combined with the Tier level of the IEF using the MEDIAN rule. The Tier level for N_2O emissions from crop residues and N-fixing crops are combined from the qulity level of the emission factor used and the Tier level of the N-input, which is done by expert judgement on the basis of the information contained in the national inventory reports (see Table 6.64 and Table 6.65). A “Tier 2” level has been assigned only if country-specific data have been used; the use of Tier 1b with default IPCC parameters counted as Tier 1 level. An analogue approach is followed to determine the Tier level for N_2O emissions from the cultivation of histosols.

- The Tier level of N_2O emissions from grazing animals is derived from the quality of N excretion factors, the implied emission factor, and a factor based on the information given in the national inventory report on the fraction of manure deposited to grazing land. The share of nitrogen that is deposited on pasture/range and paddock was only considered to be “Tier 2” if the estimate is based on a more is based on a more elaborate approach than purely the length of the grazing season.

- The Tier level for indirect N_2O emissions is a combination of the Tier levels for N_2O emissions from volatilised NH_3+NO_x and from leached/run-off nitrogen. In either case the Tier level is derived from the emission factor used and the respective fraction of nitrogen with weighing factors being 1/3 and 2/3. In the case of N-volatilization the Tier level of the amount of nitrogen is derived from both voliatilization of mineral nitrogen and manure nitrogen (MEAN rule), whereby the quality of the latter is obtained from $Frac_{GASM}$ and nitrogen excretion factors (equal weights) using the MEDIAN rule.

As a result, we estimate that a minimum of 47% of the emissions reported in category 4D are estimated with country-specific information. Highest quality was obtained for emissions from volatilised nitrogen (59%), which reflects the direct impact of the calculation of N-excretion rates and the fact that several countries link this calculation to the NH_3 inventory, where fertilizer-specific volatilisation fractions are given.
A summary of the main methodological issues, as presented in the respective national greenhouse gas inventory reports, is given in Table 6.57. Note however, that most information will be summarized in specific tables on the emission factors and parameters used.

Table 6.56: Total emissions and contribution of the main sub-categories to N_2O emissions in category 4D, methodology and key source assessment by Member States for the sub-categories direct emissions, animal production and indirect emissions for the year 2006.

	Total		Direct			Animal Production			Indirect			Volatilization		Leaching	
Member State	Gg CO_2-eq	b	a	b	c	a	b	c	a	b	c	a	b	a	b
Austria	2,920	Tier 1.3	55%	Tier 1.3	y	7%	Tier 1.4	y	37%	Tier 1.2	y	6%	Tier 1.6	31%	Tier 1.1
Belgium	3,893	Tier 1.4	56%	Tier 1.2	y	20%	Tier 1.4	y	24%	Tier 2.0	y	6%	Tier 2.0	18%	Tier 2.0
Denmark	5,442	Tier 1.4	53%	Tier 1.3	y	5%	Tier 1.4	y	41%	Tier 1.6	y	6%	Tier 1.4	34%	Tier 1.6
Finland	3,208	Tier 1.2	77%	Tier 1.1	y	5%	Tier 1.0	y	19%	Tier 1.6	y	6%	Tier 1.6	13%	Tier 1.6
France	47,283	Tier 1.3	47%	Tier 1.1	y	16%	Tier 1.3	y	37%	Tier 1.6	y	6%	Tier 1.6	31%	Tier 1.6
Germany	37,845	Tier 1.8	63%	Tier 1.9	y	4%	Tier 1.7	y	33%	Tier 1.7	y	6%	Tier 2.0	26%	Tier 1.6
Greece	7,902	Tier 1.1	22%	Tier 1.1	y	43%	Tier 1.1	y	36%	Tier 1.1	y	6%	Tier 1.0	29%	Tier 1.1
Ireland	6,664	Tier 1.3	39%	Tier 1.1	y	42%	Tier 1.4	y	19%	Tier 1.6	y	6%	Tier 1.6	13%	Tier 1.6
Italy	17,880	Tier 1.2	50%	Tier 1.1	y	9%	Tier 1.7	y	42%	Tier 1.2	y	9%	Tier 1.6	33%	Tier 1.1
Luxembourg	331	Tier 1.2	49%	Tier 1.1	y	16%	Tier 1.4	y	35%	Tier 1.2	y	6%	Tier 1.0	29%	Tier 1.2
Netherlands	8,563	Tier 1.9	56%	Tier 1.9	y	7%	Tier 1.7	y	37%	Tier 2.0	y	6%	Tier 2.0	31%	Tier 2.0
Portugal	3,235	Tier 1.4	38%	Tier 1.1	y	23%	Tier 1.4	y	38%	Tier 1.6	y	6%	Tier 1.6	32%	Tier 1.6
Spain	19,423	Tier 1.7	50%	Tier 1.8	y	8%	Tier 1.7	y	40%	Tier 1.6	y	5%	Tier 1.6	35%	Tier 1.6
Sweden	4,729	Tier 1.9	61%	Tier 1.9	y	7%	Tier 2.0	y	19%	Tier 1.7	y	4%	Tier 2.0	16%	Tier 1.6
United Kingdom	23,956	Tier 1.3	46%	Tier 1.1	y	19%	Tier 1.4	y	35%	Tier 1.5	y	7%	Tier 1.0	28%	Tier 1.6
EU-15	**193,272**	**Tier 1.4**	**51%**	**Tier 1.4**	**y**	**13%**	**Tier 1.4**	**y**	**35%**	**Tier 1.6**	**y**	**6%**	**Tier 1.6**	**29%**	**Tier 1.5**
EU-15: Tier 1	53%		58%			59%			45%			41%		46%	
EU-15: Tier 2	47%		42%			41%			55%			59%		54%	

a Contribution to N2O emissions from agricultural soils
b Tier 1: default methodology; Tier 2: country-specific methodology
c Source category is key in the Member State's inventory (y/n)

Table 6.57: Member State's background information for the calculation of N_2O emissions in category 4.D

Member State	Methods
Austria	The IPCC Tier 1a and – where applicable – Tier 1b with Austria specific consideration of nitrogen losses (NH3-N, NOx-N, N_2O-N).
Denmark	The IPCC Tier 1a methodology is used to calculate the N_2O emission. Emissions of N_2O are closely related to the nitrogen balance (DIEMA). Indirect emissions from atmospheric deposition includes all emission sources of ammonia, i. e., livestock manure, use of synthetic fertilizer, crops, ammonia-treated straw used as feed, and sewage sludge and sludge from industrial production applied to agricultural soils.
Finland	The calculation methodology has been developed towards a mass-flow approach in order to avoid double-counting. The N lost as NH3 and NOx ($Frac_{GASF}$, $Frac_{GASM}$) 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).

Member State	Methods
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.
Italy	Direct and indirect nitrous oxide emissions from agricultural soils are key sources at level and trend assessment, both with the Tier 1 and Tier 2 (animal production) approaches.
Luxembourg	Nitrous oxide emissions from agricultural soils are estimated by using emission factors in relation with the mass of fertilizers used. For fallows (cultures without fertilizer use) an area-based emission factor is used in relation with the respective agricultural surface areas.
Netherlands	The IPCC Tier 1b/2 methodology is used to estimate direct N_2O emissions for two soil types (organic and inorganic soils) and to estimate direct N_2O emissions from animal production. The IPCC Tier 1 method is used to estimate indirect N_2O emissions. For emissions from crop residues and N-fixing crops, only crops from arable farming and horticulture in the full soil (not in tubs) are included. All relevant documents concerning methodology, emission factors and activity data are published on www.greenhousegases.nl. The LEI (Dutch agricultural economic institute) performs these calculations based on the methodology described in Van der Hoek et al. (2007). Ammonia emissions are published by CBS/Statline (website www.cbs.nl). About 80–85% of the manure N collected in the stable and in storage is applied to soils. A small portion of the manure N (approximately 1–4%) is exported; while approximately 13-15% is emitted as ammonia during storage.
Portugal	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 NOx are estimated according to the IPCC (1997) methodology but with corrections to avoid double counting N. The sources of ammonia and NOx considered are synthetic fertiliser application and animal manures applied as fertiliser. The method used corrects for the N content of manures used as fuel but no longer for the N lost in the direct emission of N_2O from animal manures as previously.

Activity Data

For the estimation of N_2O emissions from N-fixing crops and crop residues, most Member States use the amount of N input (in Gg N) as activity data in the CRF table; but some countries give the emission factor in kilogram of nitrogen emitted per kg of dry crop production (N-fixing crop or other crops, respectively). Therefore, the data given in Table 6.58 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 6.59.

Table 6.58: Member State's activity data to calculate direct and indirect N_2O emissions in category 4D

Member States	Synthetic Fertilizer (Gg N)	Animal Wastes appl. (Gg N)	N-fixing crops (Gg N)	Crop residue (Gg N)	Cultiv. of Histosols (km^2)	Animal Production (Gg N)	Atmosph. Deposition (Gg N)	Nitrogen Leaching and run-off (Gg N)
2006	Direct						Indirect	
Austria	98	103	23	39	NO	22	36	75
Belgium[1)]	151	151	2	52	25	81	47	58
Denmark	187	175	35	54	823	29	72	153
Finland	147	62	0.7	27	2,672	15	39	34
France	1,985	848	314	463	NO	757	584	1,214
Germany	1,778	1,019	91	316	12,995	143	495	306
Greece	209	38	1	27	67	348	103	190
Ireland	337	78	1	11	NO	286	88	71
Italy	713	432	175	128	90	156	321	485
Luxembourg	13	5	3	5	NO	5	4	8
Netherlands	277	282	5	30	2,230	76	97	220
Portugal	120	57	2	23	NO	78	43	85
Spain	941	557	185	92	NO	328	217	1,862
Sweden	160	65	30	53	2,526	41	36	61
United Kingdom	1,019	397	33	345	392	455	325	549
EU-15	8,135	4,269	926	1,823	21,820	2,820	2,506	5,371

Source of information: Tables 4.D for 2006, submitted in 2008. 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 6.59: Member State's background information on the activity data used for the calculation of N_2O emissions in category 4.D

Member State	Activity data
Austria	Mineral Fertilizer application detailed data about the use of different kind of fertilizers are available until 1994, because until then, a fertilizer tax („Düngemittelabgabe") had been collected. Data about the total synthetic fertilizer consumption are available for amounts (but not for fertilizer types) from the statistical office (Statistic Austria, 2005) and from an agricultural marketing association (Agrarmarkt Austria, AMA). The yearly numbers of the legume cropping areas were taken from official statistics (BMLFUW 2007). Harvest data were taken from (BMLFUW) and the datapool of (Bundesanstat fuer Agrarwirtschaft). Agriculturally applied Sewage sludge data were taken from Water Quality Report, 2000 (Philippitsch, 2001), For 2001 to 2005 data from the National Austrian Waste Water Database operated by the Umweltbundesamt was used (data query 2006).
Denmark	The amount of nitrogen (N) applied on soil by use of synthetic fertiliser is estimated from sale estimates by the Danish Plant Directorate, which is source to the FAO database. Data for crop yield is based on Statistics Denmark. For nitrogen content in the plants the data is taken from Danish feed stuff tables (Danish Agricultural Advisory Centre).
Finland	The amount of synthetic fertilisers sold annually has been received from the annual agricultural statistics of the Ministry of the Agriculture and Forestry. The amount of sewage sludge applied annually has been received from the VAHTI database of Finland's environmental administration. Area of cultivated organic soils are from MTT Agrifood Research Finland. Crop yields of cultivated

Member State	Activity data
	plants have been received from agricultural statistics.
France	National statistics of fertilizer consumption are from UNIFA. Crop production statistics are obtained from the Ministry of agriculture (SCEES/ AGRESTE). For animal production, the difference between table 4.D and table 4B(b) is due to the oversea territories that are accounted separately in table 4D.
Greece	The data regarding the annual quantities of synthetic fertilizers consumed in the country derive from FAO. The data for the last two years result from extrapolation based on the trend of the last five years. Data on agricultural crop production used for the calculation of emissions was obtained from the annual national statistics of the NSSG.
Ireland	The annual statistics on nitrogen fertilizer use (Nfert) are obtained from the Department of Agriculture and Food.
Luxembourg	AD from national statistical data (Statistical Yearbook, tables C.2100 and C.2104) and ASTA (Administration des Services Techniques de l'Agriculture)
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. Estimated standard yields for different crops are published annually by the Swedish Board of Agriculture/Statistics Sweden and are a function of crop yields estimated by surveys conducted over the last 15 years.
United Kingdom	Annual consumption of synthetic fertilizer is estimated based on crop areas (Defra, 2006a) and fertilizer application rates (BSFP, 2006). Crop production data are taken from Defra (2006a, 2006b).

Emission Factors and other parameters

Table 6.60 and Table 6.61 give an overview of the emission factors and other parameters used for the calculation of N_2O emissions from agricultural soil in 2006. 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 6.63 for direct N_2O emissions from fertilizer application, Table 6.64 and Table 6.65 for N_2O emissions from N-fixing crops and crop residues, Table 6.66 for the N_2O emissions from animal production and Table 6.67 for N_2O emissions from cultivated histosols.

Furthermore, background information on the development of national parameters is given in Table 6.68 for $Frac_{GASF}$, Table 6.69 for $Frac_{GASM}$, and Table 6.70 for $Frac_{LEACH}$.

Most Member States use the IPCC default emission factors for the calculation of N_2O emissions from the application of mineral and organic fertiliser. A differentiation between organic and inorganic fertiliser has been made by the Netherlands and Sweden. The Swedish EF 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 6.62. Additional background information on the emission factors used is given in Table 6.63.

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%, 1.7% and 1.6%, respectively.

Table 6.60: Implied Emission Factors for the category 4D - N_2O emissions from agricultural soils in 2006 (data for Italy and Spain for 2003)

Member States	Synthetic Fertilizer	Animal Wastes appl.	N-fixing crops	Crop residue	Cultiv. of Histosols	Animal Production	Atmosph. Deposition	Nitrogen Leaching and run-off
2006	Direct						Indirect	
Austria	1.25%	1.25%	1.25%	1.25%	NO	2.0%	1.00%	2.50%
Belgium	1.25%	1.25%	1.25%	1.25%	8.0	2.0%	1.00%	2.50%
Denmark	1.25%	1.25%	1.25%	1.25%	2.9	2.0%	1.00%	2.50%
Finland	1.25%	1.25%	1.25%	1.25%	7.8	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%	6.72%
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	2.1%	1.00%	2.50%
Luxembourg	1.25%	1.25%	1.25%	1.25%	NO	2.0%	1.00%	2.50%
Netherlands	1.02%	2.00%	1.00%	1.00%	4.7	1.7%	1.00%	2.50%
Portugal	1.25%	1.25%	1.25%	1.25%	NO	2.0%	1.00%	2.50%
Spain	1.17%	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%	1.29%	1.25%	1.20%	7.5	1.9%	1.00%	2.13%

Source of information: Tables 4.D for 2006, submitted in 2008. Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 6.61: Relevant parameters for the calculation of N_2O emissions from agricultural soils in 2006 (data for Italy and Spain for 2003)

Member States	FracBURN	FracFUEL	FracGASF	FracGASM	FracGRAZ	FracLEACH	FracNCRBF	FracNCRO	FracR
Austria	0.26%		3.4%	21%	14%	30%	2.6%	0.9%	34%
Belgium			4.3%	20%	22%	7%	3.0%	1.5%	45%
Denmark	NO	NO	2.3%	20%	12%	33%	NE	NE	23%
Finland	NA	NA	0.6%	33%	20%	15%	4.2%	1.0%	45%
France	NA	NO	10.0%	20%	42%	30%	3.0%	NA	NA
Germany	NO	NO	4.2%	30%	11%	30%	NE	NE	NE
Greece	10%		10.0%	20%	89%	30%	1.4%	0.5%	55%
Ireland	NO	NO	1.6%	19%	66%	10%	NO	NO	NO
Italy	10%		9.2%	29%	19%	30%	3.0%	1.5%	45%
Luxembourg	NO	NO	10.0%	20%	44%	30%	3.0%	1.5%	45%
Netherlands	NO	NO	NE	NE	NE	NE	NE	NE	NE
Portugal	5.3%	NO	5.7%	21%	46%	32%	2.3%	1.3%	72%
Spain	17.1%	NO	6.4%	34%	37%	30%	2.3%	0.6%	NA
Sweden			1.2%	32%	32%	23%	2.0%		20%
United Kingdom			10.0%	20%	52%	30%	3.0%	1.5%	45%
EU-15[1)]	NA	NA	5.6%	24%	36%	26%	2.7%	1.2%	43%

Source of information: Tables 4.D for 2006, submitted in 2008. Abbreviations explained in the Chapter 'Units and abbreviations'.
[1)] Arithmetic average over the MS that reported.

Direct emissions from application of fertiliser.

Table 6.62: N_2O emission factors for agricultural soils used in Netherlands' inventory (from the NL protocol for direct N_2O emissions; www.greenhousegases.nl)

Supply source	EF (kg N_2O–N per kg N supply) Mineral soil	Organic soil	Reference
Using fertiliser			
- ammonia-retaining (no nitrate)	0.005	0.01	2
- other types of fertiliser	0.01	0.02	1
Using animal manure			
- above-ground usage	0.01	0.02	1
- low-emission use	0.02	0.02	1
Grazing agricultural pets			
- faeces	0.01	0.01	1
- urine	0.02	0.02	1
Nitrogen fixation	0.01		1
Remaining crop residues	0.01		2
Agricultural use of histosols		0.02	2

references: 1= Kroeze, 1994; 2= Van der Hoek et al., 2005

Table 6.63: Member State's background information for the calculation of N_2O emissions from the application of fertilizer in category 4.D

Member State	Direct emissions from fertilizer applicatoin
Finland	Current area estimate is based on the results of soil analysis. The emission factors for organic soils on grass and other crops are based on national data (Monni et al. 2007). The amount of nitrogen applied to soils has been corrected with a fraction of nitrogen volatilised as NH3 and NOx ($Frac_{GASF}$ 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) soil emissions by manure application to soil a 80% increase of the IEF occurs in the period 1990–2006 which is caused by a ammonia policy driven shift from the surface spreading of manure to the incorporation of manure into the soil. 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.The IPCC default emission factors.
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

Member State	Direct emissions from fertilizer applicatoin
	value is implemented in the inventory since a Swedish/Finnish research group concluded that not enough data exists to generate different emission factors for different management and soil types (Klemedsson et al., 1999).

Table 6.64: Member State's background information for the calculation of N_2O emissions from crop residues in category 4.D

Member State	Direct emissions from crop residues
Austria	Country-specific data for average crop residues/crop products ratio, dry matter fraction, N in crop residues (Goetz, 1998) and fraction of crop residues 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; N-content in crop residues calcualted using the protein content in dry matter, and dividing by the factor 6.25.
Netherlands	A fixed countryspecific value in kg N per hectare is used for the nitrogen content of the above-ground crop residues (Velthof and Kuikman, 2000). Country-specific values for removal of crop residues show that during the period 1990-2003, only grains and corn were removed (90%) from the fields (Van der Hoek et al., 2005).
Sweden	N-content in crop residues from cereals is 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	Production data of crops are taken from Defra (2006a, 2006b). Field burning has ceased to be legal in the UK since 1993, and none is assume to occur after this date. For years prior to 1993, field-burning data were taken from the annual MAFF Straw Disposal Survey (MAFF, 1995).

Table 6.65: Member State's background information for the calculation of N_2O emissions from N-fixing crops in category 4.D

Member State	Direct emissions from N-fixing crops
Austria	Values for biological fixation for peas, soja beans adn horse/field beans (120 kg N/ha) and clover-hey (160 kg N/ha) are country-specific (Goetz, 1998); these values are constant over the time series.
Denmark	The estimates for the amount of fixed nitrogen in crops are estimated by Danish Institute of Agricultural Science (Swedish Board of Agriculture, 2005) from literature (Kristensen, 2003; Høgh-Jensen et al, 1998; Kyllingsbæk, 2000). Emissions from clover-grass are included (not mentionen in IPCC). Area with grass and clover covered approx.17% of the total agricultural area and represent thus a significant part of N-fixing crops emissions.
Finland	Vegetables grown in the open have been included into the emission estimate of crop residues for the first time in 2005 submission. Vegetable yields have been received from literature (Yearbook of Farm Statistics, 2006). Values for the residue/product fraction, dry matter content and nitrogen fraction are IPCC with amendments where appropriate values were missing (turnip rape/rape; sugar beet; clover seed) or where more values based on expert judgement were used (N-fraction for peas of 3.5%; DM and residue/product fraction from sugar beet used for vegetables).
Germany	Die durch Leguminosen fixierten N-Mengen werden aus den Anbauflächen (DÄMMGEN et al., 2007) und nationalen Mittelwerten der flächenspezifischen N-Fixierung berechnet.
Italy	Country-specific methodology considering also legume forage. Nitrogen fixed per hectare is taken from Erdamn, 1959 in Giardini (1983).
Netherlands	Country-specific value for nitrogen fixation per hectare (Mineralen Boekhouding, 1993) (Lucerne: 422 kg N per hectare; Green peas (harvested dry) and field peas, marrowfat peas en grey peas, brown beans, peas (harvested green): 164 kg N per hectare; Field beans: 325 kg N per hectare; Stem beans (harvested green), scarlet runner-/salad-/common beans: 75 kg N per hectare; Broad beans: 164 kg N per hectare.
Sweden	To estimate nitrogen fixation from the atmosphere, a model according to Høgh-Jensen has been used since submission 2006 The model covers fixation from root and stubble as well as trensmission to other plants. It has been adapted to Swedish conditions (Frankow-Lindberg, 2005). According to the model, the amount of fixed nitrogen is estimated as a part of the total amount of N in the plant's biomass, which varies depending on th ekind of leguminous plant, the age of the pasture, the number of harvests and, to some extent, the amount of fertiliser applied.
United Kingdom	The total nitrous oxide emission reported also includes a contribution from improved grass calculated using a fixation rate of 4 kg N/ha/year (Lord, 1997). Crop production data are taken from

Member State	Direct emissions from N-fixing crops
	Defra (2006a, 2006b).

Table 6.66: Member State's background information for the calculation of N_2O emissions from animal production in category 4.D

Member State	Grazing animals
Austria	During the summer months, 14.1% of Austrian Dairy cows and Suckling cows are on alpine pastures 24 hours a day. 43.6 % are on pasture for 4 hours a day and 42.3 % stay in the housing for the whole year (Konrad, 1995).
Belgium	The nitrogen from grazing is estimated, taking into account the number of days in pasture and the nitrogen excreted by each animal category. Available nitrogen is the difference between the manure nitrogen content and the manure nitrogen volatilisation in NH3 and NO form. In Wallonia and Flanders no animal manure is burned.
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 NH3 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.

Member State	Grazing animals
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. Due to lack of data concerning reindeer, the nitrogen production by sheep is also applied to reindeer.
United Kingdom	The fraction of livestock N excreted and deposited onto soil during grazing is a country specific value of 0.52, much larger than the IPCC recommended value (0.23), based on country specific data.

Direct emissions from the cultivation of histosols.

N_2O emissions from the cultivation of histosols reported as not occurring in Austria, France, and Spain, and as not estimated in Portugal. Also, no emissions from the cultivation of histosols are reported by Ireland, because tillage farming in Ireland is concentrated in the south-east of the country while the bulk of organic soils occur in the middle and western part of the country. Consequently, nitrogen inputs due to the cultivation of organic soils have been taken as negligible.

The cultivation of histosols represents the biggest share of emissions from agricultural soils in Finland (32%), 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 (7%). The emission factor proposed in the IPCC GPG of 8 kg N_2O-N per hectare and year (IPCC, 2000) is used in most countries. Netherlands uses 4.7 kg N_2O-N ha^{-1}; national emission factors are further used in Denmark (2.9 kg N_2O-N ha^{-1}) and Finland (7.8 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 (3.3 Gg N_2O) and Sweden (3.2 Gg N_2O).

Table 6.67: Member State's background information for the calculation of N_2O emissions from the cultivation of histosols in category 4.D

Member State	Histosols
Belgium	The area histosols is calculated on the basis of an intersection between the CORINE Land Cover Geodataset from 1990 and the Belgian 'Soilassociationmap'. The area is held constant for the entire time series.
Denmark	National IEF for histosols. N_2O emissions from histosols are based on the area with organic soils multiplied with a national emission factor for C, the C:N relationship for the organic matter in the histosols and an emission factor of 1.25 of the total amount of released N. 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.

Member State	Histosols
Finland	The area of cultivated organic soils has been received from MTT Agrifood Research Finland and has been updated for the 2006 submission on the basis of (Myllys, 2004; Kähäri, 1987). The area of cultivated organic soils is poorly known in Finland. Current area estimate is based on the results of soil analysis. The emission factors for organic soils on grass and other crops are based on national data (Monni et al. 2007). The emission factors were calculated on the basis of published results on annual fluxes measured with flux chambers on five different peat fields.
Germany	Estimation of the are of cultivated histosols on the basis of an overlay of a land-use map and a soil map (Daemmgen et al., 2006).
Greece	Estimation of ?2? emissions from the organic soils (0.084 kt) was based on the cultivated area (6.7 kha, constant for the entire period examined) and the updated default emission factor suggested in the IPCC Good Practice Guidance for mid-latitude organic soils.
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 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 Spain uses a smaller emission factor for N_2O from nitrogen leached or run-off (0.75%).

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.

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 10%, with 4 countries using the default value of 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 20.5% to 34%) with 4 countries using the default $Frac_{GASM}$ of 20% and the lowest volatilization fraction used being 19%. 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 7% to 33% with 8 countries using the default FracLEACH of 30% and countries using a smaller value. They are in some cases based on a nitrogen-leaching model (e.g., Denmark, Sweden) and in some cases based on national studies (e.g., Finland, Ireland).

Table 6.68: Member State's background information on the fraction of NH3 and NOx volatilized from applied mineral fertilizer, FracGASF for the calculation of N_2O emissions in category 4.D

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 NH3 and NO volatilisation).
Denmark	The Danish value for the $Frac_{GASF}$ is an average of national estimates of NH3 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 NH3-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 NH3 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). NH3 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 NH3 inventory for agriculture and it is assumed that nitrogen lost as NOX is negligible in comparison to NH3.

Member State	$Frac_{GASF}$
Netherlands	Indirect N_2O emissions resulting from atmospheric deposition are estimated using country-specific data on ammonia emissions. The extent of the NOx 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 NOx 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 NH3 and NOx were estimated using a time variable and country-specific fraction $Frac_{GASF}$, which varies between 0.053 and 0.062 kg NH3-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 6.69: Member State's background information on the fraction of NH3 and NOx volatilized from applied manure, FracGASM for the calculation of N_2O emissions in category 4.D

Member State	$Frac_{GASM}$
Austria	The amount of manure left for spreading was calculated within source category 4B (Amon et al., 2002). With regard to a coprehensive treatment of the nitrogen budget, the emission inventory of N_2O is linked with the Austrian inventory of NH3. 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, NH3-N losses from housing, NH3-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 NH3-N and NOx-N occurring during manure application are subtracted (detailed methodology CORINAIR/EMEP 1999). A conservative emission factor for NOx-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 2006 from 0.26 to 0.20. This is a result of an active strategy to improve the utilization of the nitrogen in manure. It is assumed that 1.9% of the N-input from sewage sludge or industrial sludge applied to soil volatilises as ammonia. An ammonia emission factor of 7% is used for all animal categories based on investigations from the Netherlands and the United Kingdom (Jarvis et al. 1989a, Jarvis et al., 1989b

Member State	$Frac_{GASM}$
	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 NH3 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 fractions $Frac_{GASF}$ and $Frac_{GASM}1$ are estimated at 0.016 and 0.486, respectively in 2006 from the NH3 inventory.
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 6.70: Member State's background information on the fraction of nitrogen input leached or run-off, FracLEACH for the calculation of N_2O emissions in category 4.D

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 and it is used for 2006, as it was for previous years.
Netherlands	Default $Frac_{GASM}$. Any manure that is exported to other countries is not included in the calculation. The nitrogen in exported manure is determined annually by CBS. The sewage sludge supply source is not included in the calculation of indirect N_2O emissions from agricultural soil. Indirect N_2O emissions resulting from leaching and run-off N emissions are estimated using country-specific data on total N-input into soil (estimated at a Tier 2 level). IPCC default values are used for the fraction of N-input to soil that leaches from the soil and ends up partly as N_2O emissions from groundwater and

Member State	FracLEACH
	surface water (Fracleach) and for the N_2O emission factors.
Sweden	The national estimates of nitrogen leaching are calculated from the SOILNDB model , which is a part of the SOIL/SOILN model (Johnsson, 1990; Swedish EPA, 2002). The simulation model SOIL/SOILN was developed during the 1980s in order to describe nitrogen processes in agricultural soils. Since then the model has been developed and tested on data from controlled leaching experiments, and these tests show that the model estimates leachign from soils with good precision (Swedish EPA, 2002b). By using national data on crops, yields, soil, use of fertilizer/manure and spreading time, the leaching is estimated for 22 regions. These regions are based on similarities in agricultural production. For calculating nitrogen leaching in the inventory, the average N leaching per hectare, calculated by the SOILNDB model, is multiplied by the total Swedish area of agricultural soil. To estimate the implied FracLEACH,the leached nitrogen, according to the national model, is divided by the sum of nitrogen in fertilisers and anim
United Kingdom	Indirect emissions of N_2O from leaching and runoff are estimated according the IPCC methodology but with corrections for N_2O emissions to avoid double counting N. The sources of nitrogen considered, are synthetic fertiliser application and animal manures applied as fertiliser.

N_2O emissions from other sources.

Seven countries report emissions of N_2O from the application of sewage sludge, according to the IPCC GPG. The emission factors used are in six cases the IPCC default factor for direct N_2O emissions, one Member States used a different value. An overview of the emissions from sewage sludge and the specified other 'other' sources in category 4D is given in Table 6.71.

Table 6.71: Member State's emissions from "other" sources in category 4D

Member States 2005	Description	Value kg N/yr (1990)	IEF kg N_2O-N / kg N (1990)	EMISSIONS N_2O (Gg) (1990)	Value kg N/yr (2006)	IEF kg N_2O-N / kg N (2006)	EMISSIONS N_2O (Gg) (2006)
Belgium	Sludge Spreading	75,274	0.0125	0.0015	75,681	0.0125	0.0015
Denmark	Industrial w aste used as fertilizer	1,528,720	0.0125	0.0300	11,000,000	0.0125	0.2161
Denmark	Use of sew age sludge as fertilizers	3,056,917	0.0125	0.0600	2,812,753	0.0125	0.0553
Belgium	Municipal sew age sludge applied to fields	1,494,440	0.0125	0.0294	95,857	0.0125	0.0019
France	Other non-specified	NA	NA	1.1185	NA	NA	0.7421
Germany	Sew age sludge on agriculture landfields	NE	NE	NE	27,818,612	0.0125	0.5464
Netherlands	Sludge application on land	5,000,000	0.0100	0.0786	1,200,000	0.0100	0.0189
Portugal	Other non-specified	340,375	0.0125	0.0067	340,375	0.0125	0.0067
Spain	Domestic Wastew ater Sludge	8,321,004	0.0125	0.1630	27,621,660	0.0125	0.5409
Spain	Municipal Solid Wastes Compost	8,506,498	0.0125	0.1666	9,171,539	0.0125	0.1796
Sw eden	Cultivation of mineral soils	2,592,000	0.5000	2.0366	2,408,000	0.5000	1.8919
United Kingdom	Improved Grassland	27,689,300	0.0125	0.5439	28,414,124	0.0125	0.5581

Trends

Consistent with the decrease of animal numbers in Europe and the decrease of nitrogen in manure (see above), also the input of nitrogen to agricultural soils decreased considerably in the time between 1990 and 2006, as shown in Table 6.58. The input of manure decreased by 7%, and the input of mineral fertilizer decreased even more, by 21%. Accordingly, also the amount of nitrogen volatilized or leached decreased by 17% and 12%, respectively.

Figure 6.32 through Figure 6.45 show the trend of direct N_2O emissions from the source categories mineral and organic fertilizer application and indirect emissions from atmospheric deposition and nitrogen leaching and run-off.
In several countries the fraction of mineral fertilizer that volatilises as NH_3 or NO_x is showing considerable fluctuation (see for example Sweden and Ireland). This is a direct consequence of the varying composition of the types of mineral fertilizer used and the NH_3 emission factors taken from the more detailed ammonia-inventory.
The fraction of livestock N excretion that volitilises as NH_3 or NO_x is reported to be more stable. A descreasing trend can be observed for Denmark and Belgium.

Table 6.48 gives additional information on the trend in category 4D as reported in the national inventory reports.

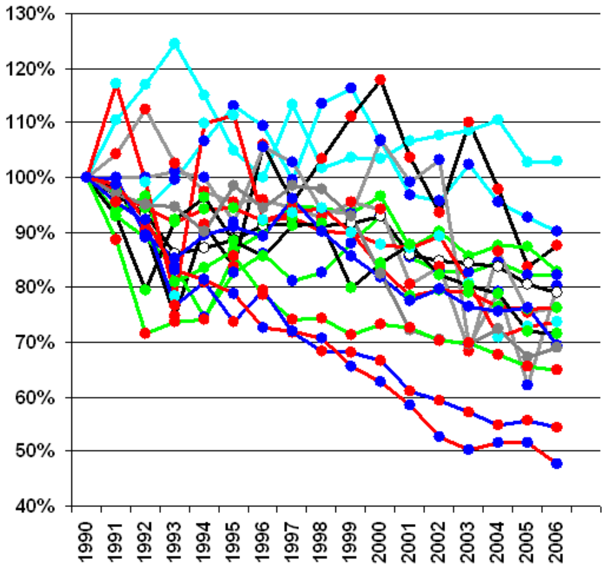
Table 6.72: Member State's background information on the trend for CH_4 emissions in category 4D.

Member State	Trend in category 4B(b)
Austria	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.
Denmark	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 1990-2006 has decreased by 24%. 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. As a result of increasing requirements for improved use of nitrogen in livestock manure and reduce the nitrogen loss to the environment, the consumption of nitrogen in synthetic fertiliser has more than halved from 1990 to 2006 .
Finland	The emissions have decreased by 25%, from 13.9 Gg in 1990 to 10.4 Gg in 2006. The main reasons causing this reduction are the reduction in animal numbers, which affects the amount of nitrogen excreted annually to soils, the fall in the amount of synthetic fertilisers sold annually and the decrease in the area of cultivated organic soils. Some parameters, such as the annual crop yields affecting the amount of crop residues produced, cause the fluctuation in the time series but this fluctuation does not have much effect on the overall N_2O emissions trend.

Member State	Trend in category 4B(b)
Netherlands	Total N_2O emissions from Agricultural soils decreased by 21% between 1990 and 2006. Direct emissions increased by 4%, while indirect emissions and emissions from animal manure produced in the meadow decreased 36 and 52 %, respectively. This decrease is caused by a relatively high decrease in N-input to soil (from manure and chemical fertilizer application and animal production in the meadow) partly counteracted by the increased IEF in this period that resulted from a shift from the surface spreading of manure to the incorporation of manure into soil as a result of ammonia policy driving a shift from surface spreading of manure to the incorporation of manure into the soil. The decrease in indirect N_2O emissions is fully explained by the decrease in N lost by atmospheric deposition and by leaching and run-off. The decrease in N_2O emissions from animal manure produced in the meadow is also entirely reflected in the decrease in N-input to soil by this source.The 4% increase in direct N_2O emissions can mainly be explained by the 32% decrease in the direct N-input to soil by manure and chemical fertilizer application in combination with a 53% increase of the IEF.
Portugal	Time series shows an abrupt decrease until 1992 and thereafter a lighter reduction: total synthetic nitrogen fertilizer use in 2003 is 22% less than in 1990. Nitrogen in fertilizers is the first source of nitrogen to soils in Portugal just above nitrogen in animal manure applied to soil. Interannual changes of emissions (2002/2003 16%, 2003/2004 6%, 2004/2005 8%, 2005/2006 11%, fluctuation from 2003) can be explained from variations of emissions from N applied as synthetic fertilizers. During this period a severe drought occured which caused reduction in the sales and use of fertilizers.
Sweden	Estimated standard yields for different crops are published annually by SJV/Statistics Sweden and are a function of crop yields estimated by surveys conducted over the last 15 years. By using standard yields instead of actual yields in the calculations, the time series becomes more regular.
United Kingdom	Direct N_2O emissions from soil are decreasing of N_2O emissions in 2006 by 8%, due to a decrease in inorganic fertiliser by 9%

Figure 6.32. Trend of N_2O emissions for mineral fertilizer – N-input

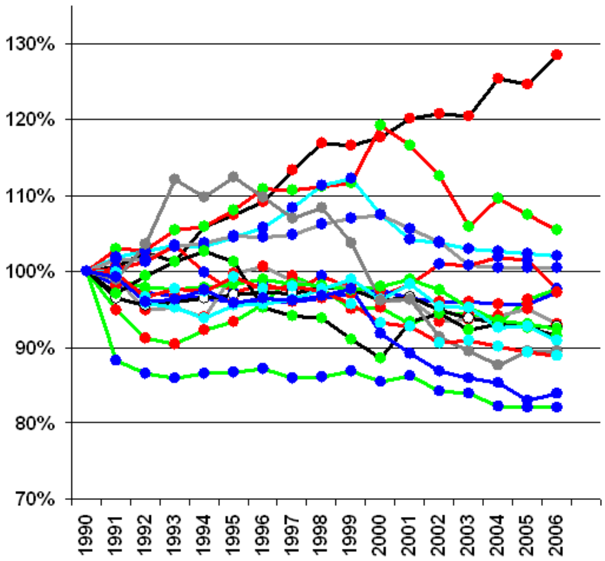
Direct emissions, mineral fertilizer application: Nitrogen input (Gg N/yr)



	1990	Trend (%) 1990-2006	2006
Italy	691.7	103%	710.9
Ireland	373.7	90%	346.6
Spain	1,074.2	88%	898.9
France	2,394.0	83%	2,091.4
Germany	2,163.6	82%	1,778.4
Portugal	149.9	80%	93.2
EU-15	10,295.0	79%	8,294.5
Luxembourg	17.0	76%	12.8
Belgium	197.8	76%	150.5
Austria	133.3	74%	97.0
Sweden	224.5	71%	161.5
United Kingdom	1,470.6	69%	1,119.3
Netherlands	401.1	69%	269.4
Finland	227.1	65%	148.7
Greece	384.8	54%	214.2
Denmark	391.7	48%	201.7

Figure 6.33. Trend of N_2O emissions for organic fertilizer – N-input

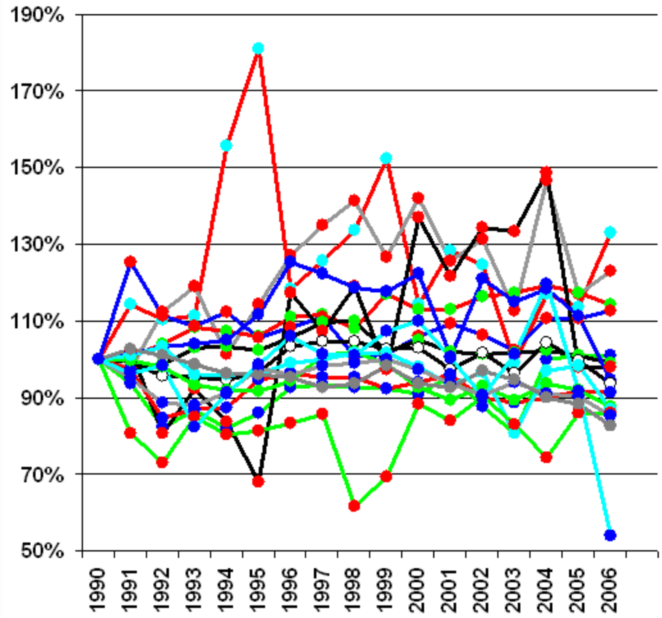
Direct emissions, manure application: Nitrogen input (Gg N/yr)



	1990	Trend (%) 1990-2006	2006
Spain	433.5	128%	540.6
Belgium	143.4	105%	154.1
Ireland	76.2	102%	78.0
Portugal	56.4	101%	56.7
Finland	63.0	98%	60.6
Denmark	178.9	98%	181.5
Greece	39.5	97%	37.8
Luxembourg	5.8	93%	5.5
EU-15	4,606.1	93%	4,273.2
France	918.0	92%	853.9
Sweden	71.2	92%	65.9
Italy	475.3	91%	441.1
Netherlands	314.9	90%	281.8
Austria	115.8	89%	103.5
United Kingdom	472.9	84%	392.7
Germany	1,241.3	82%	1,019.3

Figure 6.34. Trend of N_2O emissions from crop residues – N-input

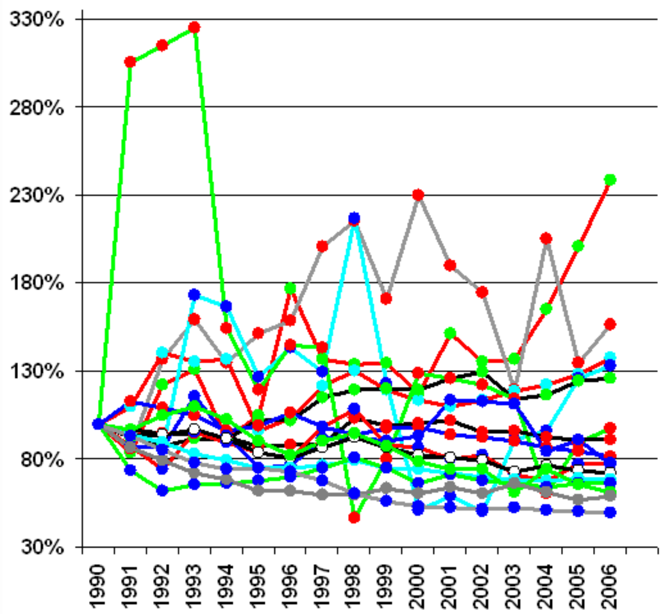
Crop residues: Nitrogen input (Gg N/yr)



	1990	Trend (%) 1990-2006	2006
Austria	29.2	133%	33.1
Luxembourg	4.2	123%	4.9
Belgium	45.1	114%	52.9
Greece	23.6	113%	26.1
Germany	312.8	101%	316.3
Sweden	53.4	99%	53.9
Spain	93.4	98%	91.5
United Kingdom	365.2	95%	407.0
EU-15	1,775.0	94%	1,771.7
Denmark	59.3	91%	54.4
France	527.8	88%	485.6
Italy	147.5	87%	145.2
Finland	30.9	86%	26.6
Portugal	26.6	85%	24.0
Netherlands	36.4	83%	32.1
Ireland	19.7	54%	18.0

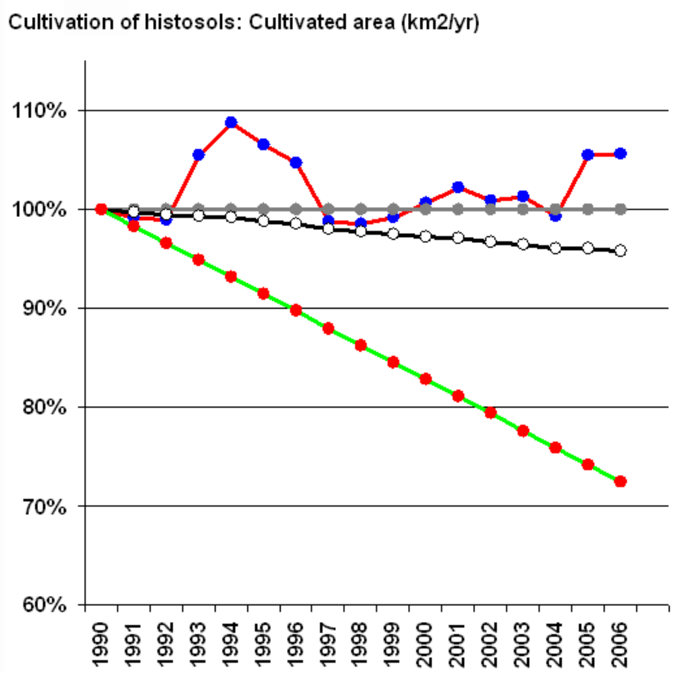
Figure 6.35. Trend of N_2O emissions from N-fixing crops – N-input

N-fixing crops: Nitrogen input (Gg N/yr)



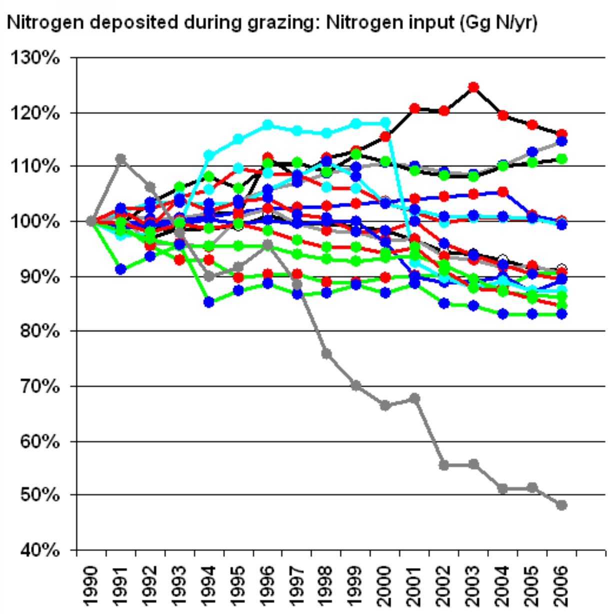
	1990	Trend (%) 1990-2006	2006
Belgium	0.8	238%	1.5
Luxembourg	2.0	157%	2.7
Austria	16.8	137%	21.6
Ireland	0.5	133%	0.6
Sweden	23.6	126%	29.3
Finland	0.7	97%	0.6
Spain	203.1	91%	184.7
Greece	1.1	81%	1.0
Denmark	44.3	78%	34.1
United Kingdom	43.2	77%	39.3
EU-15	1,252.9	72%	924.6
Italy	254.7	69%	176.6
Germany	136.9	66%	90.6
France	512.4	61%	334.9
Netherlands	7.8	59%	4.5
Portugal	5.0	49%	2.5

Figure 6.36. Trend of N_2O emissions from cultivated histosols – Cultivated area



	1990	Trend (%) 1990-2006	2006
Denmark	780	106%	822
Belgium	25	100%	25
Greece	67	100%	67
Germany	12,995	100%	12,995
Sweden	2,526	100%	2,526
United Kingdom	392	100%	392
Italy	90	100%	90
Netherlands	2,230	100%	2,230
EU-15	22,794	96%	21,882
Finland	3,689	72%	2,736
Austria			
Luxembourg			
Spain			
France			
Portugal			
Ireland			

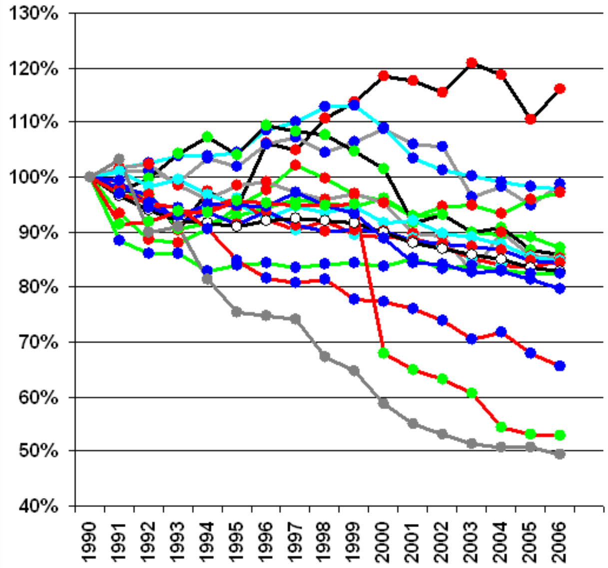
Figure 6.37. Trend of N_2O emissions from pasture, range, and paddock – N-input



	1990	Trend (%) 1990-2006	2006
Spain	282.9	116%	332.7
Portugal	67.9	115%	76.5
Sweden	36.9	111%	40.9
Greece	347.3	100%	351.1
Austria	22.4	99%	22.5
Ireland	287.6	99%	289.6
EU-15	3,091.6	91%	2,828.6
Luxembourg	6.0	91%	5.5
Finland	16.9	91%	15.3
Denmark	32.1	89%	29.0
United Kingdom	510.4	89%	445.2
Italy	178.2	87%	155.8
France	876.4	86%	757.9
Belgium	96.0	85%	82.4
Germany	172.7	83%	143.4
Netherlands	157.8	48%	81.0

Figure 6.38. Trend of N_2O emissions for atmospheric deposition – N-input

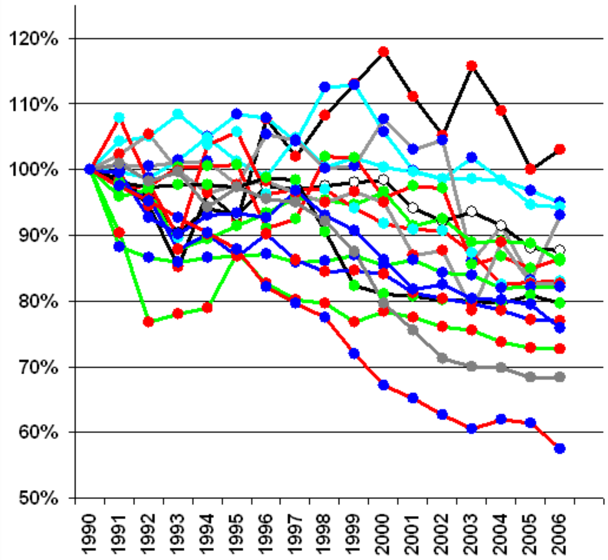
Nitrogen volatilised as NH3+NOx: Nitrogen input (Gg N/yr)



	1990	Trend (%) 1990-2006	2006
Spain	187.2	116%	206.9
Portugal	43.4	99%	41.2
Ireland	90.2	98%	88.6
Finland	39.9	97%	38.3
France	670.8	87%	597.4
Sweden	42.0	86%	36.4
Luxembourg	4.6	85%	4.0
Italy	378.5	85%	323.1
Austria	42.5	85%	35.6
Greece	122.1	84%	103.5
EU-15	3,023.7	83%	2,522.7
Germany	600.7	82%	494.5
United Kingdom	408.0	80%	332.4
Denmark	109.3	65%	74.3
Belgium	88.6	53%	47.0
Netherlands	195.9	49%	99.5

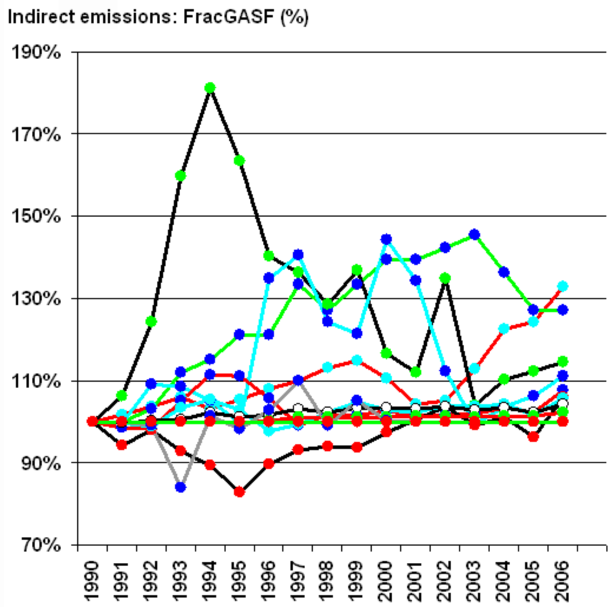
Figure 6.39. Trend of N_2O emissions for nitrogen leaching and run-off – N-input

Nitrogen leached/run-off: Nitrogen input (Gg N/yr)



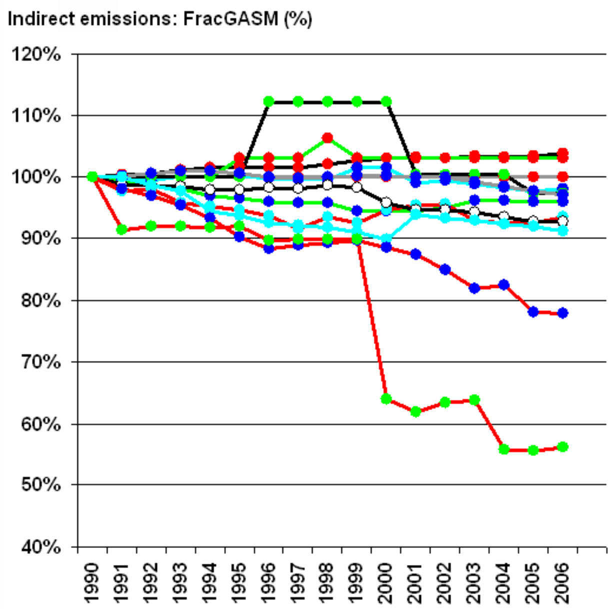
	1990	Trend (%) 1990-2006	2006
Spain	1,807.5	103%	1,806.1
Ireland	74.3	95%	72.0
Italy	514.6	94%	487.0
Portugal	91.4	93%	76.0
EU-15	6,120.5	88%	5,384.2
Belgium	66.6	86%	56.6
France	1,411.7	86%	1,252.1
Austria	90.5	83%	75.0
Luxembourg	9.8	83%	8.1
Germany	372.4	82%	306.0
Sweden	76.8	80%	62.2
Greece	247.2	77%	190.9
United Kingdom	723.3	76%	575.0
Finland	46.3	73%	33.7
Netherlands	320.9	68%	219.4
Denmark	267.2	57%	164.2

Figure 6.40. Trend of FracGASF



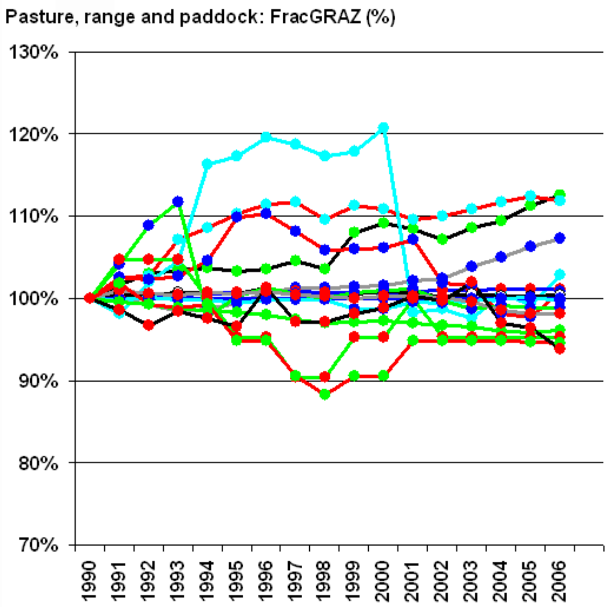
	1990	Trend (%) 1990-2006	2006
Austria	0.03	133%	0.03
Germany	0.03	127%	0.04
Sweden	0.01	115%	0.01
Ireland	0.01	111%	0.02
Denmark	0.02	108%	0.02
Spain	0.06	106%	0.06
Italy	0.09	106%	0.09
EU-15	0.05	104%	0.06
Belgium	0.04	102%	0.04
Greece	0.10	100%	0.10
Portugal	0.06	100%	0.06
France	0.10	100%	0.10
United Kingdom	0.10	100%	0.10
Luxembourg	0.10	100%	0.10
Finland	0.01	100%	0.01
Netherlands			

Figure 6.41. Trend of FracGASM



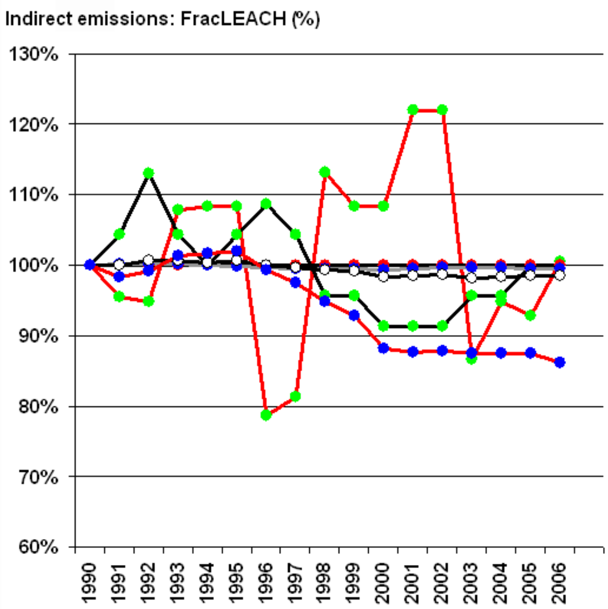
	1990	Trend (%) 1990-2006	2006
Spain	0.33	104%	0.34
Finland	0.32	103%	0.33
Greece	0.20	100%	0.20
France	0.20	100%	0.20
United Kingdom	0.20	100%	0.20
Luxembourg	0.20	100%	0.20
Ireland	0.19	98%	0.19
Sweden	0.33	97%	0.32
Portugal	0.22	97%	0.21
Germany	0.32	96%	0.30
Austria	0.22	93%	0.21
EU-15	0.26	93%	0.24
Italy	0.32	91%	0.29
Denmark	0.26	78%	0.21
Belgium	0.36	56%	0.20
Netherlands			

Figure 6.42. Trend of FracGRAZ



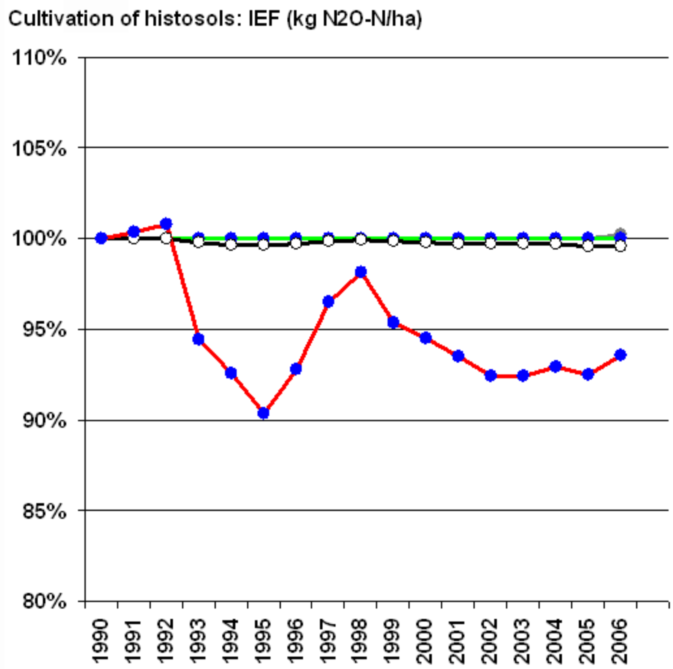
	1990	Trend (%) 1990-2006	2006
Sweden	0.28	113%	0.31
Austria	0.13	112%	0.14
Portugal	0.43	107%	0.46
Italy	0.19	103%	0.18
Greece	0.88	101%	0.89
Denmark	0.12	101%	0.12
EU-15	0.36	100%	0.36
United Kingdom	0.52	100%	0.52
Ireland	0.66	100%	0.66
Germany	0.11	99%	0.11
Luxembourg	0.45	98%	0.44
France	0.43	96%	0.42
Finland	0.21	95%	0.20
Belgium	0.23	95%	0.22
Spain	0.39	94%	0.38
Netherlands			

Figure 6.43. Trend of FracLEACH



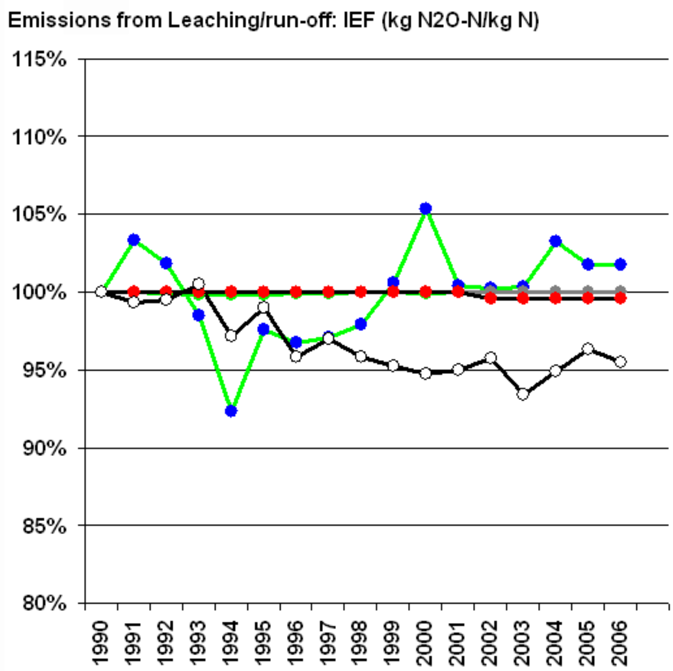
	1990	Trend (%) 1990-2006	2006
Belgium	0.07	100%	0.07
Sweden	0.23	100%	0.23
Austria	0.30	100%	0.30
Italy	0.30	100%	0.30
Greece	0.30	100%	0.30
United Kingdom	0.30	100%	0.30
Ireland	0.10	100%	0.10
Germany	0.30	100%	0.30
Luxembourg	0.30	100%	0.30
France	0.30	100%	0.30
Finland	0.15	100%	0.15
Spain	0.30	100%	0.30
Portugal	0.32	100%	0.32
EU-15	0.26	99%	0.26
Denmark	0.38	86%	0.34
Netherlands			

Figure 6.44. Trend of direct emissions from the cultivation of histosols - IEF



	1990	Trend (%) 1990-2006	2006
Netherlands	4.70000	100%	4.70000
Finland	7.84999	100%	7.85000
Greece	8.00000	100%	8.00000
Italy	8.00000	100%	8.00000
Belgium	8.00000	100%	8.00000
Sweden	8.00000	100%	8.00000
United Kingdom	8.00000	100%	8.00000
Germany	8.02382	100%	8.02382
EU-15	7.49767	100%	7.46518
Denmark	3.06678	94%	2.83689
France			
Ireland			
Austria			
Luxembourg			
Portugal			
Spain			

Figure 6.45. Trend of indirect emissions from leaching/run-off - IEF



	1990	Trend (%) 1990-2006	2006
Germany	0.06604	102%	0.06721
France	0.02490	100%	0.02490
Belgium	0.02500	100%	0.02500
Ireland	0.02500	100%	0.02500
United Kingdom	0.02500	100%	0.02500
Austria	0.02500	100%	0.02500
Portugal	0.02500	100%	0.02500
Greece	0.02500	100%	0.02500
Italy	0.02500	100%	0.02500
Luxembourg	0.02500	100%	0.02500
Denmark	0.02500	100%	0.02500
Finland	0.02500	100%	0.02500
Sweden	0.02500	100%	0.02500
Netherlands	0.02500	100%	0.02500
Spain	0.00750	100%	0.00747
EU-15	0.02231	96%	0.02150

Uncertainty and time series consistency

As described above, N_2O emissions from agricultural soils belong to the most uncertain source categories of national GHG inventories. For direct N_2O emissions, the highest uncertainty is attributed to the emission factor, which ranges up to 400% Greece relative uncertainty (expressed in 2•standard_deviation) and even 500% for each sub-category in Portugal. For indirect emissions, both the activity data and the emission factors are considered equally uncertain, which stems from the fact that a most uncertain parameter, the fraction of nitrogen leached, must be applied to determine the activity data. Thus, uncertainties of indirect N_2O emissions are estimated as up to more than 200% (Finland, Netherland, Portugal).

This large spread of the uncertainty estimates does generally not reflect real differences in the uncertainties, but rather differences in the interpretation of the available data:

In the United Kingdom, the uncertainty assumed for agricultural soils uses a lognormal distribution since the range of possible values is so high. Here it is assumed that the 97.5 percentile is greater by a factor of 100 than the 2.5 percentile based on advice from the Land Management Improvement Division of DEFRA (per. comm.).

The estimate of Portugal is based on the Good Practice Guidance that presents a possible variation from one-fifth to 5 times the default emission factor of 1.25 per cent. From that range an uncertainty of 500 per cent was assumed in uncertainty analysis.

An overview of the uncertainty estimates for activity data and emission factors are given in Table 6.73**.** and Table 6.74. An overview of uncertainty estimates for agriculture at country and EU15 levels will be given in section 6.4

Table 6.73: Relative uncertainty estimates for activity data in category 4A (data from 2007 submission)

Member State 2006	Total	Direct	Animal Production	Indirect
Austria		5.0	5.0	5.0
Belgium	30.0			
Denmark	7.4			
Finland		0.0	0.0	0.0
France	8.7			
Germany		0.0	0.0	0.0
Greece		20.0	50.0	20.0
Ireland		11.2	11.2	11.2
Italy		20.0	20.0	20.0
Luxembourg		5.0	5.0	20.6
Netherlands		10.0	10.0	50.0
Portugal[1,2]		31.9	39.0	78.2
Spain		2.2		1.7
Sweden				
United Kingdom	1.0			

1) Portugal, direct N2O emissions. Mineral fertilizer: 17%; Manure application: 107%; Crop residues: 25%; N-fixation: 25%

2) Portugal, indirect N2O emissions. Mineral fertilizer: 82%; Manure application: 118%; Crop residues: 63%; N-fixation: 63%

Table 6.74: Relative uncertainty estimates for implied emission factors in category 4A (data from 2007 submission)

Member State 2006	Total	Direct	Animal Production	Indirect
Austria		150.0	150.0	150.0
Belgium	250.0			
Denmark	22.9			
Finland		70.8	70.8	248.3
France	52.4			
Germany		409.6	30.0	736.1
Greece		400.0	100.0	50.0
Ireland		100.0	100.0	50.0
Italy		100.0	100.0	100.0
Luxembourg		300.0	500.0	300.0
Netherlands		60.0	100.0	200.0
Portugal[1,2]			500.0	
Spain		400.0		50.0
Sweden				
United Kingdom	424.0			

1) Portugal, Mineral fertilizer: 500%; Manure application: 500%; Crop residues: 510%; N-fixation: 510%

2) Portugal, Mineral fertilizer: 100%; Manure application: 100%; Crop residues: 100%; N-fixation: 100%

The following issue related to time-series consistency has been identified:

- *Sweden. $Frac_{GASM}$.*

  An inconsistent time series is used by Sweden, which report a higher $Frac_{GASM}$ for the years 1996-2000 due to changes in the methodology. Sweden did not yet have the possibility to carry out a revision of the older data.

6.3.6 Agricultural Soils – CH_4

Only a few countries report CH_4 fluxes from agricultural soils. Table 6.75 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 6.76. 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 6.75: CH_4 Emission from agricultural soils in 2006

Member States	D. Agricultural Soils	1. Direct Soil Emissions	2. Animal Production	3. Indirect Emissions	4. Other
Austria	0.41	0.41		NA	
Belgium	0.16				
Denmark	NE,NO	NE		NE	
Finland	NE	NE		NE	
France	NA	NA		NA	
Germany	-30.18	IE		NO	
Greece	NE,NO	NE		NE	
Ireland	NE,NO	NE		NO	
Italy	NA	NA		NA	
Luxembourg	NA,NE	NE		NE	
Netherlands	NE,NO	NO		NO	
Portugal	NE,NO	NE		NE	
Spain	NE	NE		NE	
Sweden	NO	NO		NO	
United Kingdom	NA,NE	NA		NE	
EU-15	-29.60	0.41	NO	NO	NO

Source of information: Tables 4.D for 2006, submitted in 2008
Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 6.76: Methodologies used to calculate CH_4 Emission from agricultural soils in 2006

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 quality assurance and quality control

6.4.1 Determination of the quality level

The IPCC methodology estimates emissions Es from a certain source category s as

$$E_s = IEF_s \cdot AD_s \quad (1$$

where ADs are the activity data for the source category s and IEFs is the implied emission factor for this category. There are three levels for estimating the emissions, called Tier 1, Tier 2, and Tier 3, moving from the use of default values over the inclusion of national information to the application of modeling tools. In order to define an EU-wide Tier level per source category and sector, two criteria must be met:

1. For each source category and Member State a Tier level must be assigned.
2. To assess the Tier level of aggregated emissions derived at different quality, the Tier levels must be measured on an interval scale, allowing 'intermediate' Tier levels.

To do so, we developed standard procedures for each source category. These are based on the following principles:

i. However, the flow of nutrients in agriculture implies that the emission in one category can serve as activity level in another, for example, nitrogen excretion can be regarded as an emission of nitrogen in livestock production systems. According to the IPCC the amount of nitrogen excreted is an activity data for estimating N_2O emissions from manure management. Thus, in contrast to the IPCC definitions, we define as activity data only this information that must be obtained using statistical surveys (e.g., population data, distribution of animal manure systems etc.) and regard everything else as parameters (emission factors and other factors).
ii. A Tier level is assessed for each parameter by comparing the IPCC default value with the value used by the countries. If the default IPCC value is used, the Tier level is set to Tier 1 and otherwise the Tier level is set to Tier 2. Caution must be taken if country-specific data are identical to the default values.
iii. An appropriate estimation of the basic activity data (animal numbers, mineral fertilizer consumption, allocation of manure to the manure management systems) is regarded as basic requirement for the estimation of the source strength and is not considered in the calculation of the overall Tier level. Note however, that

Tier levels are aggregated applying different aggregation rules.

1. The MEDIAN-rule should be applied where the Tier level of a product of different parameters Pi is to be evaluated. For example the emission factor for CH_4 emissions from manure management is calculated from the CH_4 production potential, the methane conversion factor, and the volatile solid excretion. The aggregation of the Tier level of these parameters to estimate the level of quality of the emission factor should follow the following principles. (i) If parameters with very different quality are multiplied, the higher quality should get more weight; (ii) if parameters with different uncertainty are multiplied, it should be good practice to estimate the parameter which is associated with the higher uncertainty at a higher Tier level. Thus, the aggregation rule should reward if efforts have been made to improve uncertain parameters. However, with the lack of a comprehensive set of relative uncertainty estimates for the individual parameters, in the following equation an arbitrary weighting factors $w_{p,j}$ has been introduced, based on expert judgment.

$$Q_{\prod_i P_i} = 3 - \prod_i \left[\left(3 - Q_{P_i}\right)^{\frac{w_{p,i}}{\sum_j \{w_{p,j}\}}} \right] \qquad (2)$$

with i and j indicating the individual parameters to be multiplied. The term (3-Q_i) assures that a higher weight is given to the parameter estimated with the higher Tier.

In some cases, when there is clear domination of one multiplicative parameter, the median rule simplified and the Tier level of the product is approximated with that Tier level. This simplified rule has been applied to estimate the Tier level of CH_4 emissions from enteric fermentation, which is in many cases based or validated with direct measurements.

2. The MEAN-rule if an emission estimate is calculated as the sum of two or more sub-categories. In this case, the Tier levels of the individual estimates are aggregated using an emission-weighted average. E.g., the Tier level of indirect N_2O emissions from agriculture Q4D3 is calculated from the Tier levels calculated for indirect emissions through volatilization of nitrogen gases Q4D3a and leaching/run-off of nitrate Q4Db according to:

$$Q_{A+B} = \frac{Q_A \cdot E_A + Q_B \cdot E_B}{E_{A+B}} \qquad (3)$$

It must be noted, however, that a higher Tier-level does not automatically mean that also the emission estimate is more accurate. The relationship holds however, if (i) inherent links between processes are reflected in the methodology; (ii) parameters are based on statistically representative sample of measurements or carefully with experimental data validated models.

CH_4 emissions from enteric fermentation

The Tier level for CH_4 emissions from enteric fermentation is determined by comparison the Implied Emission Factor with the IPCC default emission factors. The Tier level for cattle, sheep, goats, swine, and reindeer is shown in Table 6.77**.**

Table 6.77: Range of contribution of category 4D to overall GHG uncertainty. Minimum and maximum values since 2005 submission

	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Sw ine	Reindeer
Austria[1)]	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0	
Belgium	Tier 2.0	Tier 2.0	Tier 1.0	Tier 2.0	Tier 1.0	
Denmark	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	
Finland	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 2.0
France	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0	
Germany	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	
Greece	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0	Tier 1.0	
Ireland	Tier 2.0	Tier 2.0	Tier 2.0	Tier 1.0	Tier 2.0	
Italy	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0	
Luxembourg	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0	
Netherlands	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0	
Portugal[1)]	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	
Spain	Tier 2.0	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	
Sw eden	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 2.0
United Kingdom	Tier 2.0	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	
EU-15	**Tier 2.0**	**Tier 2.0**	**Tier 1.7**	**Tier 1.1**	**Tier 1.3**	

1) Non-dairy cattle for Austria and Portugal: IEF equals default IPCC EF, how ever Tier 2 has been used according to the national inventory reports.

CH_4 emissions from manure management

The determination of the Tier level for the estimation of CH_4 emissions from manure management is done in four steps

1. "Default" CH_4 conversion factors for each manure management system are calculated on the basis of the allocation of manure to the different AWMS

2. The results are compared with the used MCF and a Tier 2 level assigned if the two numbers differs (see Table 6.78).

Table 6.78: Tier level of MCF for CH_4 emissions from manure management

MCF	Dairy	Non-dairy	Sheep	Goats	Sw ine	Poultry
Austria	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Belgium	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Denmark	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Finland	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
France	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Germany	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Greece	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Ireland	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Italy	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Luxembourg [1)]	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Netherlands [2)]	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Portugal	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Spain	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Sw eden	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
United Kingdom	Tier 1.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
EU-15	**Tier 1.6**	**Tier 1.8**	**Tier 1.0**	**Tier 1.0**	**Tier 1.5**	**Tier 1.0**

Sheep and goats get Tier 1 for MCF!

3. The data used for B_0 and VS are compared with IPCC default values.

Table 6.79: Tier level of B_0 for CH_4 emissions from manure management

B0	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Sw ine	Poultry
Austria	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Belgium	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Denmark	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Finland	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
France	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Germany	Tier 2.0	Tier 2.0	Tier 2.0	Tier 1.0	Tier 2.0	Tier 2.0
Greece	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Ireland	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Italy	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Luxembourg	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Netherlands [2)]	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Portugal	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Spain	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Sw eden	Tier 1.0	Tier 1.0	Tier 2.0	Tier 2.0	Tier 1.0	Tier 2.0
United Kingdom	Tier 1.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
EU-15	**Tier 1.3**	**Tier 1.3**	**Tier 1.0**	**Tier 1.0**	**Tier 1.1**	**Tier 1.1**

Table 6.80: Tier level of VS for CH_4 emissions from manure management

VS	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Sw ine	Poultry
Austria	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Belgium	Tier 1.0	Tier 1.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0
Denmark	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0
Finland	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 2.0
France	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Germany	Tier 2.0	Tier 2.0	Tier 1.0	Tier 2.0	Tier 2.0	Tier 2.0
Greece	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Ireland	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0
Italy	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Luxembourg	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 1.0
Netherlands [2)]	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Portugal	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0
Spain	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Sw eden	Tier 2.0	Tier 2.0	Tier 1.0	Tier 2.0	Tier 2.0	Tier 2.0
United Kingdom	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
EU-15	**Tier 1.6**	**Tier 1.4**	**Tier 1.1**	**Tier 1.1**	**Tier 1.7**	**Tier 1.2**

4. The final Tier level is obtained using the MEDIAN rule from the Tier levels of MCF, B_0, and VS, using the following weigths: w_{MCF}=0.13; wB_0=0.13; w_{VS}=0.75. The highest weight is given to the Volatile solid excretion factor because it can and should be based on the detailed characterization of the animal performance.

Table 6.81: Tier level of the IEFs for CH_4 emissions from manure management

	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Sw ine	Poultry
Austria	Tier 1.8	Tier 1.8	Tier 1.0	Tier 1.0	Tier 1.8	Tier 1.0
Belgium	Tier 1.3	Tier 1.3	Tier 1.8	Tier 1.8	Tier 1.9	Tier 1.8
Denmark	Tier 1.9	Tier 1.9	Tier 1.8	Tier 1.8	Tier 1.9	Tier 1.8
Finland	Tier 1.9	Tier 1.9	Tier 1.0	Tier 1.0	Tier 1.2	Tier 1.8
France	Tier 1.2	Tier 1.2	Tier 1.0	Tier 1.0	Tier 1.2	Tier 1.0
Germany	Tier 2.0	Tier 2.0	Tier 1.2	Tier 1.8	Tier 2.0	Tier 1.9
Greece	Tier 1.2	Tier 1.2	Tier 1.0	Tier 1.0	Tier 1.2	Tier 1.0
Ireland	Tier 1.8	Tier 1.8	Tier 1.8	Tier 1.8	Tier 1.2	Tier 1.0
Italy	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Luxembourg	Tier 1.8	Tier 1.8	Tier 1.8	Tier 1.8	Tier 1.8	Tier 1.0
Netherlands [1)]	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0
Portugal	Tier 1.9	Tier 1.8	Tier 1.8	Tier 1.8	Tier 1.9	Tier 1.8
Spain	Tier 1.8	Tier 1.8	Tier 1.0	Tier 1.0	Tier 1.8	Tier 1.0
Sw eden	Tier 1.9	Tier 1.9	Tier 1.2	Tier 1.9	Tier 1.9	Tier 1.9
United Kingdom	Tier 1.8	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.2	Tier 1.0
EU-15	**Tier 1.8**	**Tier 1.5**	**Tier 1.1**	**Tier 1.1**	**Tier 1.7**	**Tier 1.2**

[1)] Netherlands does not give background data in Table 4B(a), how ever according to the national inventory report a Tier 2 methodology is used.

N_2O emissions from manure management

The determination of the Tier level of the estimate of N_2O emissions from manure management is done in four steps

i. The comparison of the N-excretion rates used with the IPCC default valuees (see Table 6.82)

ii. The determination of the Tier level of manure allocated to the manure management systems based on the Tier level of the N-excretion rate by animal type and the allocation of manure-nitrogen to the manure management systems reported in Table 4B(b) (see Table 6.83)

iii. The comparison of the N_2O emission factor used with the IPCC default values (see Table 6.84)

iv. The calculation of the overall Tier level on the basis of the MEDIAN rule by using the Tier level of the IEF (with a weight of 0.33) and the Tier level of the allocated manure nitrogen to the manure management systems (with a weight of 0.67).

Table 6.82: Tier level of the N-excretion rates for N_2O emissions from manure management

	Dairy	Non-Dairy	Sheep	Swine	Poultry	Buffalo	Goats	Horses	Mules and Asses
Austria	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0		Tier 2.0	Tier 2.0	
Belgium	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0		Tier 2.0	Tier 2.0	
Denmark	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0		Tier 2.0	Tier 2.0	
Finland	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0		Tier 2.0	Tier 2.0	
France	Tier 1.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 1.0		Tier 1.0	Tier 1.0	Tier 1.0
Germany	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	
Greece	Tier 1.0	Tier 1.0	Tier 2.0	Tier 2.0	Tier 1.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0
Ireland	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0		Tier 2.0	Tier 2.0	Tier 2.0
Italy	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0
Luxembourg	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 1.0		Tier 2.0	Tier 2.0	Tier 2.0
Netherlands [1)]	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0
Portugal	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0		Tier 2.0	Tier 2.0	Tier 2.0
Spain	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0		Tier 2.0	Tier 1.0	Tier 1.0
Sweden	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0		Tier 2.0	Tier 2.0	
United Kingdom	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0		Tier 2.0	Tier 2.0	
EU-15	**Tier 2.0**	**Tier 2.0**	**Tier 2.0**	**Tier 2.0**	**Tier 2.0**	**Tier 2.0**	**Tier 2.0**	**Tier 2.0**	**Tier 2.0**

[1)] Netherlands does not give N-excretion data in Table 4B(b), however according to the national inventory report a Tier 2 methodology is used.

Table 6.83: Tier level of the allocation of manure-nitrogen to the manure management systems for N_2O emissions from manure management

Member State	Liquid system[1)]	Daily Spread	Solid storage and dry lot	Pasture range paddock	Other
Austria	Tier 2.0		Tier 2.0	Tier 2.0	Tier 2.0
Belgium	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0
Denmark	Tier 1.9		Tier 2.0	Tier 2.0	
Finland	Tier 1.6		Tier 1.1	Tier 1.0	
France	Tier 1.7		Tier 1.6	Tier 1.7	
Germany	Tier 2.0		Tier 2.0	Tier 2.0	
Greece	Tier 2.0	Tier 1.0	Tier 1.1	Tier 1.3	Tier 1.0
Ireland	Tier 2.0		Tier 2.0	Tier 2.0	
Italy	Tier 2.0		Tier 1.9	Tier 2.0	Tier 2.0
Luxembourg	Tier 2.0		Tier 1.9	Tier 2.0	Tier 2.0
Netherlands	Tier 2.0		Tier 2.0	Tier 2.0	
Portugal	Tier 2.0		Tier 1.9	Tier 2.0	
Spain	Tier 2.0	Tier 1.9	Tier 1.9	Tier 2.0	
Sweden	Tier 2.0		Tier 2.0	Tier 1.9	Tier 2.0
United Kingdom	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0
EU15	**Tier 2.0**	**Tier 2.0**	**Tier 1.9**	Tier 2.0	**Tier 2.0**

[1)] including anaerobic lagoon

Table 6.84: Tier level of the IEFs for N_2O emissions from manure management

	Liquid system[1)]	Solid storage and dry lot	Other
Austria	Tier 1	Tier 1	Tier 1
Belgium	Tier 1	Tier 2	Tier 1
Denmark	Tier 2	Tier 1	NO
Finland	Tier 1	Tier 1	NE
France	Tier 1	Tier 1	NA
Germany	Tier 1	Tier 2	NO
Greece	Tier 1	Tier 1	Tier 1
Ireland	Tier 1	Tier 1	NO
Italy	Tier 1	Tier 1	Tier 1
Luxembourg			Tier 1
Netherlands	Tier 1	Tier 1	NO
Portugal	Tier 1	Tier 1	NO
Spain	Tier 1	Tier 1	NO
Sweden	Tier 1	Tier 2	Tier 1
United Kingdom	Tier 1	Tier 1	Tier 1
EU15	**Tier 1.0**	**Tier 1.3**	**Tier 1.0**

Table 6.85: Tier level of the estimation of N_2O emissions from manure management

	Liquid system[1)]	Solid storage and dry lot	Other	Total
Austria	Tier 1.7	Tier 1.7	Tier 1.7	Tier 1.7
Belgium	Tier 1.7	Tier 2.0	Tier 1.7	Tier 1.8
Denmark	Tier 1.9	Tier 1.7	NO	Tier 1.9
Finland	Tier 1.4	Tier 1.1	NE	Tier 1.4
France	Tier 1.5	Tier 1.4	NA	Tier 1.5
Germany	Tier 1.7	Tier 2.0	NO	Tier 1.8
Greece	Tier 1.7	Tier 1.0	Tier 1.0	Tier 1.7
Ireland	Tier 1.7	Tier 1.7	NO	Tier 1.7
Italy	Tier 1.7	Tier 1.6	Tier 1.7	Tier 1.7
Luxembourg	Tier 2.0	Tier 2.0	Tier 1.7	Tier 2.0
Netherlands	Tier 1.7	Tier 1.7	NO	Tier 1.7
Portugal	Tier 1.7	Tier 1.7	NO	Tier 1.7
Spain	Tier 1.7	Tier 1.7	NO	Tier 1.7
Sw eden	Tier 1.7	Tier 2.0	Tier 1.7	Tier 1.8
United Kingdom	Tier 1.7	Tier 1.7	Tier 1.7	Tier 1.7
EU15	**Tier 1.7**	**Tier 1.6**	**Tier 1.7**	**Tier 1.7**

[1)] including anaerobic lagoon

CH_4 emissions from rice cultivation

No combination of information is required.

N_2O emissions from agricultural soils

The determination of the Tier level of N_2O emissions from agricultural soils is done in four steps:

1. The comparison of the used emission factors (for direct N_2O emissions induced by the application of synthetic fertilizer, animal wastes, nitrogen from crop residues and N-fixing crops and by the cultivation of histosols; for N_2O emissions from manure deposited by grazing animals; for indirect N_2O emissions induced by volatilization of NH_3+NO_x from synthetic fertilizer and from applied manure, and induced by leaching/run-off of nitrogen from the fields) with the respective IPCC default values.

2. With the exception of direct N_2O emissions induced by the application of mineral fertilizer, a Tier level has been considered for the nitrogen input data.

   (a) For the application of animal waste the Tier levels of N allocation to liquid systems (incl. anaerobi lagoons), solid storage and dry lot, and other systems has been combined using the MEAN rule.

   (b) For N-fixing crop, crop residues and cultivated area of histosols, the Tier level has been estimated from the information reported in the national inventory reports

   (c) For nitrogen deposited by grazing animals, the Tier level calculated under category 4B(b) for pasture, range, and paddock is used.

3. The Tier level of the N_2O emission estimate is calculated on the basis of the above-obtained information:

(a) Application of synthetic fertilizer the Tier level of the emission factor is used

(b) Direct emissions from other nitrogen sources using the MEDIAN rule with equal weights for the Tier level of the nitrogen input and the emission factor

(c) N_2O emissions from grazing animals using the MEDIAN rule for N-input, $Frac_{GRAZ}$, and the emission factor using equal weights. The Tier level for $Frac_{Graz}$ has been determined on the basis of the information given in the national inventory reports

(d) N_2O emissions from volalised nitrogen using the MEDIAN rule for the amount of volatilised nitrogen, which is calculated from the Tier levels for volatilised synthetic fertilizer and manure nitrogen using the MEAN rule, and the emission factor using equal weights. The Tier level for volatilised synthetic fertilizer is obtained by comparing $Frac_{GASF}$ with the IPCC default value. The Tier level for volatilised manure nitrogen is obtained using the MEDIAN rule on the basis of $Frac_{GASM}$ (comparing with the IPCC default value) and the Tier level of applied nitrogen manure using equal weights.

(e) N_2O emissions from leached/run-off nitrogen using the MEDIAN rule for N-input, FracLEACH and the emission factor giving higher weight to FracLEACH and the emission factor (0.43 each) than to the N-input (0.14)

Table 6.86: Tier level of the estimation of direct N_2O emissions from agricultural soils

Member States	Synthetic fertilizer	Animal Wastes appl.			N-fixing crops			Crop Residues			Cultivation of Histosols		
	N2O emis.	N input	EF	N2O emissions	N input	EF	N2O emissions	N input	EF	N2O emissions	N input	EF	N2O emissions
Austria	Tier 1.0	Tier 1.7	Tier 1.0	Tier 1.4	Tier 2.0	Tier 1.0	Tier 1.6	Tier 2.0	Tier 1.0	Tier 1.6	Tier 1.0	Tier 1.0	Tier 1.0
Belgium	Tier 1.0	Tier 1.8	Tier 1.0	Tier 1.4	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Denmark	Tier 1.0	Tier 1.9	Tier 1.0	Tier 1.5	Tier 2.0	Tier 1.0	Tier 1.6	Tier 2.0	Tier 1.0	Tier 1.6	Tier 1.0	Tier 1.0	Tier 1.0
Finland	Tier 1.0	Tier 1.4	Tier 1.0	Tier 1.2	Tier 2.0	Tier 1.0	Tier 1.6	Tier 2.0	Tier 1.0	Tier 1.6	Tier 1.0	Tier 1.0	Tier 1.0
France	Tier 1.0	Tier 1.5	Tier 1.0	Tier 1.3	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Germany	Tier 2.0	Tier 1.8	Tier 2.0	Tier 1.9	Tier 2.0	Tier 1.0	Tier 1.6	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.6
Greece	Tier 1.0	Tier 1.7	Tier 1.0	Tier 1.4	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Ireland	Tier 1.0	Tier 1.7	Tier 1.0	Tier 1.4	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Italy	Tier 1.0	Tier 1.7	Tier 1.0	Tier 1.4	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.6
Luxembourg	Tier 1.0	Tier 2.0	Tier 1.0	Tier 1.6	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Netherlands	Tier 2.0	Tier 1.7	Tier 2.0	Tier 1.9	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 1.0	Tier 2.0	Tier 1.6
Portugal	Tier 1.0	Tier 1.7	Tier 1.0	Tier 1.4	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Spain	Tier 2.0	Tier 1.7	Tier 2.0	Tier 1.9	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.6
Sweden	Tier 2.0	Tier 1.8	Tier 2.0	Tier 1.9	Tier 2.0	Tier 1.0	Tier 1.6	Tier 2.0	Tier 1.0	Tier 1.6	Tier 2.0	Tier 2.0	Tier 2.0
United Kingdom	Tier 1.0	Tier 1.7	Tier 1.0	Tier 1.4	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
EU-15	**Tier 1.4**			**Tier 1.6**			**Tier 1.1**			**Tier 1.2**			**Tier 1.5**

Table 6.87: Tier level of the estimation of N_2O emissions from pasture, range and paddock

Member States	Animal Production			
	N-input	FracGRAZ	EF	N2O emissions
Austria	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.4
Belgium	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.4
Denmark	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.4
Finland	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
France	Tier 1.7	Tier 1.0	Tier 1.0	Tier 1.3
Germany	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.7
Greece	Tier 1.3	Tier 1.0	Tier 1.0	Tier 1.1
Ireland	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.4
Italy	Tier 2.0	Tier 1.0	Tier 2.0	Tier 1.7
Luxembourg	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.4
Netherlands	Tier 2.0	Tier 1.0	Tier 2.0	Tier 1.7
Portugal	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.4
Spain	Tier 2.0	Tier 1.0	Tier 2.0	Tier 1.7
Sweden	Tier 1.9	Tier 2.0	Tier 2.0	Tier 2.0
United Kingdom	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.4
EU-15				**Tier 1.4**

Table 6.88: Tier level of the estimation of indirect N_2O emissions from nitrogen volatilised from agricultural soils

Member States	$Frac_{GASF}$	Manure application	$Frac_{GASM}$	Volatilized Manure	Volatili-zation	Emission Factor	N2O emissions from volatilised nitrogen
Austria	Tier 2.0	Tier 1.7	Tier 2.0	Tier 1.9	Tier 2.0	Tier 1.0	Tier 1.6
Belgium	Tier 2.0	Tier 1.8	Tier 1.0	Tier 1.4	Tier 1.7	Tier 1.0	Tier 1.4
Denmark	Tier 2.0	Tier 1.9	Tier 1.0	Tier 1.5	Tier 1.8	Tier 1.0	Tier 1.4
Finland	Tier 2.0	Tier 1.4	Tier 2.0	Tier 1.7	Tier 2.0	Tier 1.0	Tier 1.6
France	Tier 1.0	Tier 1.5	Tier 1.0	Tier 1.3	Tier 1.0	Tier 2.0	Tier 1.6
Germany	Tier 2.0	Tier 1.8	Tier 2.0	Tier 1.9	Tier 2.0	Tier 2.0	Tier 2.0
Greece	Tier 1.0	Tier 1.7	Tier 1.0	Tier 1.4	Tier 1.0	Tier 1.0	Tier 1.0
Ireland	Tier 2.0	Tier 1.7	Tier 2.0	Tier 1.9	Tier 2.0	Tier 1.0	Tier 1.6
Italy	Tier 2.0	Tier 1.7	Tier 2.0	Tier 1.9	Tier 2.0	Tier 1.0	Tier 1.6
Luxembourg	Tier 1.0	Tier 2.0	Tier 1.0	Tier 1.6	Tier 1.0	Tier 1.0	Tier 1.0
Netherlands	NE	Tier 1.7	NE	NE	NE	Tier 1.0	Tier 1.0
Portugal	Tier 2.0	Tier 1.7	Tier 2.0	Tier 1.9	Tier 2.0	Tier 1.0	Tier 1.6
Spain	Tier 2.0	Tier 1.7	Tier 2.0	Tier 1.9	Tier 2.0	Tier 1.0	Tier 1.6
Sweden	Tier 2.0	Tier 1.8	Tier 2.0	Tier 1.9	Tier 2.0	Tier 2.0	Tier 2.0
United Kingdom	Tier 1.0	Tier 1.7	Tier 1.0	Tier 1.4	Tier 1.0	Tier 1.0	Tier 1.0
EU-15							**Tier 1.5**

Table 6.89: **Tier level of the estimation of indirect N_2O emissions from nitrogen leached/run-off from agricultural soils**

Member States	N input	$Frac_{LEACH}$	Emission factor
Austria	Tier 1.7	Tier 1.0	Tier 1.0
Belgium	Tier 1.8	Tier 2.0	Tier 1.0
Denmark	Tier 1.9	Tier 2.0	Tier 1.0
Finland	Tier 1.4	Tier 2.0	Tier 1.0
France	Tier 1.5	Tier 1.0	Tier 2.0
Germany	Tier 1.8	Tier 1.0	Tier 2.0
Greece	Tier 1.7	Tier 1.0	Tier 1.0
Ireland	Tier 1.7	Tier 2.0	Tier 1.0
Italy	Tier 1.7	Tier 1.0	Tier 1.0
Luxembourg	Tier 2.0	Tier 1.0	Tier 1.0
Netherlands	Tier 1.7	NE	Tier 1.0
Portugal	Tier 1.7	Tier 2.0	Tier 1.0
Spain	Tier 1.7	Tier 1.0	Tier 2.0
Sw eden	Tier 1.8	Tier 2.0	Tier 1.0
United Kingdom	Tier 1.7	Tier 1.0	Tier 2.0
EU-15			

Uncertainty

Quantitative estimates of the contribution of agriculture to the overall uncertainty of the national GHG inventories are reported in Table 6.95. These data are calculated from the information on the uncertainty of activity data and implied emission factors (see sections above and Table 6.91 through Table 6.93 summarizing all categories in agriculture) and the emissions data. For several countries, N_2O emissions from agricultural soils are by far dominating the uncertainty of national inventory. The uncertainty estimate for this source category ranges from 1.9% of total national GHG emissions (excl. LULUCF, Denmark) to 15.6% of total national GHG emissions (United Kingdom). Overall, the estimate for the uncertainty range is relatively stable since the last years.

Table 6.90: **Range of contribution of category 4D to overall GHG uncertainty. Minimum and maximum values since 2005 submission**

	Minimum uncertainty	Maximum uncertainty
2005	0.7% (Austria)	20.9% (France)
2006	1.5% (Austria)	17.6% (France)
2007	1.9% (Denmark)	19.9% (France)
2008	1.7% (Denmark)	20.1% (France)

The contribution of the whole agricultural sector to the overall uncertainty is very similar to the contribution of agricultural soils (2.6% to 15.7%), highlighting again the dominance of this category.
Some countries allocate the biggest contribution to the direct emissions and others to the indirect emissions of N_2O. For example, the uncertainty of direct N_2O emissions is estimated in the Greece inventory of being ±400% (5.3% of the national total) versus ±54% (1.2% of the national total) of the indirect emissions. On the other hands, the Netherlands estimate an uncertainty of ±61% and ±206% for direct and indirect N_2O emissions agricultural soils, respectively (corresponding to 1.4% and 3.1% of the national total uncertainty, respectively).
CH_4 emissions from enteric fermentation are less uncertain (0.1% to 4.1% of total national GHG

emissions) and manure management contributes with less than 2.4% 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 6.95. The corresponding uncertainties for activity data and emission factors are given in Table 6.91 and Table 6.92, and the combined uncertainty (Tier 1 approach) is given in Table 6.93. The data for the combined uncertainty are "gap-filled" at the category-level, if required, to allow a meaningful comparison of the uncertainty estimates at EU-level, using information reported at the level below the categories.
A table summarizing background information on the uncertainty estimates is given in Table 6.94.
It is interesting to note that combined relative uncertainty of agriculture in some cases is higher than the overall uncertainty of the greenhouse gas inventory (for example in Austria and Spain). This is due to the fact that the combined uncertainty is calculated neglecting any other contribution to the uncertainty. As uncertainties are assumed to be uncorrelated between the different sectors, the consideration of more sectors can thus lead to the partial compensation of the individual uncertainties.
Some countries have carried out also a Monte Carlo uncertainty assessment. In most cases, both the input data and also the results do not deviate much from the Tier 1 analysis. Main differences between both methods are (i) the possibility to assess emission sources where the distribution of the uncertainty is non-normal and (ii) the consideration of correlation between source categories, which tends to reduce the compensation effect.

Table 6.91: Member States's uncertainty estimates for Activity Data used in the agriculture sector

Member State	Enteric ferment. (4A)	Manure Managem. (4B)		Agricultural soils (4D)			
				total	direct	animal prod.	indirect
	CH_4	CH_4	N_2O	N_2O	N_2O	N_2O	N_2O
Austria	*(1)	*(6)	10	0	5	5	5
Belgium	5	10	10	30			
Denmark	10	10	10	7			
Finland	0	0	0	0	0	0	0
France	5	3	1	9			
Germany	*(2)	*(7)	0	0	0	0	0
Greece	5	5	50	0	20	50	20
Ireland	*(3)	*(8)	11	0	11	11	11
Italy	20	20	20	0	20	20	20
Luxembourg					5	5	
Netherlands	*(4)	*(9)	10	0	10	10	50
Portugal	*(5)	*(10)	0	0	32	39	78
Spain	3	2	1	0	2		2
Sweden	5	20	20	0			
United Kingdom	10	10	1	1			

*(1)- Cattle: 10%
*(2)- Dairy and non-dairy cattle, sheep and horses: 0.0001%; swine: 0%
*(3)- Dairy and non-dairy cattle and other animals: 1%
*(4)- Cattle, swine and other animals: 5%
*(5)- Dairy and non-dairy cattle: 6%; Sheep: 19%; goats: 19%; horses: 71%; mules and asses: 272%; poultry: 11%; other animals: 771%
*(6)- Cattle and swine: 10%
*(7)- Dairy and non-dairy cattle, sheep, horses, swine and poultry: 0.0001%
*(8)- Dairy and non-dairy cattle and other animals: 1%
*(9)- Cattle, swine, poultry and other animals: 10%
*(10)- Dairy and non-dairy cattle: 6%; Sheep: 19%; goats: 19%; horses: 71%; mules and asses: 272%; poultry: 11%
*(11)- Portugal, direct N2O emissions. Mineral fertilizer: 17%; Manure application: 107%; Crop residues: 25%; N-fixation: 25%
*(12)- Portugal, indirect N2O emissions. Mineral fertilizer: 82%; Manure application: 118%; Crop residues: 63%; N-fixation: 63%

Table 6.92: Member States's uncertainty estimates for Emission Factors used in the agriculture sector

Member State	Enteric ferment. (4A)	Manure Managem. (4B)		Agricultural soils (4D)			
				total	direct	animal prod.	indirect
	CH_4	CH_4	N_2O	N_2O	N_2O	N_2O	N_2O
Austria	*(1)	*(6)	100		150	150	150
Belgium	40	40	90	250			
Denmark	8	100	100	23			
Finland	32	16	82		71	71	248
France	69	83	94	52			
Germany	*(2)	*(7)	22		410	30	736
Greece	30	50	100		400	100	50
Ireland	*(3)	*(8)	200		100	100	50
Italy	20	100	100		100	100	100
Luxembourg					300	500	
Netherlands	*(4)	*(9)	100		60	100	200
Portugal	*(5)	*(10)	100		*(11)	500	*(12)
Spain	11	11	100		400		50
Sw eden	25	50	50				
United Kingdom	20	30	414	424			

*(1)- Cattle: 20%
*(2)- Dairy and non-dairy cattle, sheep and horses: 10.0000000083301%; swine: 0%
*(3)- Dairy and non-dairy cattle and other animals: 15%
*(4)- Cattle: 15%; swine: 50%;other animals: 30%
*(5)- Dairy and non-dairy cattle: 20%; Sheep: 20%; goats: 20%; horses: 50%; mules and asses: 50%; poultry: 20%; other animals: 20%
*(6)- Cattle and swine: 70%
*(7)- Dairy and non-dairy cattle, sheep, horses, swine and poultry: 20%
*(8)- Dairy and non-dairy cattle: 15%; other animals: 30%
*(9)- Cattle, swine, poultry and other animals: 100%
*(10)- Dairy and non-dairy cattle: 61%; Sheep: 59%; goats: 58%; horses: 61%; mules and asses: 61%; poultry: 91%
*(11)- Mineral fertilizer: 500%; Manure application: 500%; Crop residues: 510%; N-fixation: 510%
*(12)- Mineral fertilizer: 100%; Manure application: 100%; Crop residues: 100%; N-fixation: 100%

Table 6.93: Member States's uncertainty estimates for agriculture (combined uncertainty calculated from the given uncertainty of AD and EF)

Member State	Enteric ferment. (4A)	Manure Managem. (4B)		Agricultural soils (4D)			
				total	direct	animal prod.	indirect
	CH_4	CH_4	N_2O	N_2O	N_2O	N_2O	N_2O
Austria	22	50	100	101	150	150	150
Belgium	40	41	91	252			
Denmark	13	100	100	24			
Finland	32	16	82	71	71	71	248
France	69	83	94	53			
Germany	6	12	22	355	410	30	736
Greece	30	50	112	100	400	112	54
Ireland	11	11	200	58	101	101	51
Italy	28	102	102	67	102	102	102
Luxembourg					300	500	
Netherlands	15	71	100	83	61	100	206
Portugal	14	82	100	231	505	502	127
Spain	11	11	100	223	400		50
Sw eden	25	54	54	0			
United Kingdom	22	32	414	424			

Table 6.94: Member State's background information on the uncertainty estimates in the sector of agriculture

Member State	Uncertainties
Austria	Since the first detailed uncertainty analysis (Winiwarter and Rypdal, 2001) the Austrian inventory compilers have spent considerale deffort t also obtain uncertainties from individual contributors to the inventory.
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.
Denmark	The combined effect of low uncertainty in actual animal numbers, feed ocnsumption and excretion rates gives a very low uncertainty in the activity data. The major uncertainty, therefore, relates to the emission factors.
Finland	Uncertainty is quantified with a Tier 2 approach (KASPER model , developed by VTT Technical Research Centre of Finland). In agriculture, an uncertainty estimate was given for each calculation parameter of the calculation model at a detailed level. The most significant sources contributing to the total uncertainty in Finland are CO_2 emissions from peat fuel production and N_2O emissions from agricultural soils according to key source analysis (Monni et al., 2004). Agriculture is one of the most uncertain emission categories (representing over 20% of GHG inventory uncertainty in Finland), due to both high natural variability of the emission sources and poor knowledge of the emission-generating processes (Monni et al., 2007)
France	Uncertainty calculation according to Tier 1 methodology. Strongest impact on total uncertainty arises from the category of N_2O emissions from agricultural soils.
Ireland	Tier 1 method. In some of the most important emissions sources in Agriculture (such as enteric fermentation and agricultural soils) and Waste (solid waste disposal, for example) the activity data or emission factors ultimately used are determined by several specific component inputs, which are all subject to varying degrees of uncertainty. The uncertainty estimates used for both activity data and emission factor for these sources have been derived by assigning uncertainties to the key component parameters and combining them at the level of activity data or emission factors, as appropriate, for each activity for input to the Tier 1 uncertainty assessment.
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

Member State	Uncertainties
	correlated or the distributions non-normal, custum corrleations or fuctions have been used (landfill, sewage sludge distributions calculated from a known data series; agricultural soils lognormal distribution with the 97.5%il being 100 times the 2.5%il). Calculations are carried out using the @RISK software.

The uncertainties estimates are combined to the EU-15 level for source categories in the agriculture sector and for the sector as a whole are combined with a Tier 1 approach considering an assumed degree of dependence between each pair of countries. The quantitative assessment of the quality-levels outlined above helps to derive a reasonable estimate for the correlation coefficient ρ_{XY} between two countries X and Y. To this purpose, the quality levels Q_X and Q_Y are transformed with the following equation:

$$\rho_{X,Y} = \sqrt{(2 - Q_X)\cdot(2 - Q_Y)} \qquad (4)$$

Equation (4) leads to the situation of no correlation $(\rho_{X,Y} = 0)$ for two countries with a Tier 2 approach and full correlation $(\rho_{X,Y} = 1)$ if both countries used a Tier 1 approach. A correlation coefficient can be calculated for any intermediate situation. This information is further processed within the standard IPCC Tier 1 method for both level and trend uncertainty.

Table 6.95: Member States's uncertainty estimates for agriculture expressed in percent of total GHG emissions. The table shows three "scenarios" for the uncertainty at EU-15 level, i.e., (i) with the correlation between MS uncertainty estimates as quantified with equation (4); (ii) under the assumption of no correlation and (iii) under the assumption of full correlation between the uncertainty estimates of MS. Scenario (i) is considered to be the most realistic case, and scenarios (ii) and (iii) are giving the range of uncertainty at EU-15 level.

Member State	Total agriculture	Enteric ferment. (4A)	Manure Managem. (4B)		Agricultural soils (4D)			
					total	direct	animal prod.	indirect
		CH_4	CH_4	N_2O	N_2O	N_2O	N_2O	N_2O
	uncertainties expressed as % of total GHG emissions							
Austria	4.4	1.0	0.6	1.2	4.0	3.3	0.4	2.2
Belgium	7.3	1.0	0.6	0.6	7.2			
Denmark	2.6	0.5	1.5	0.8	1.9			
Finland	5.1	1.1	0.1	0.9	4.9	3.7	0.2	3.2
France	7.2	4.1	2.4	1.2	5.3			
Germany	13.6	0.1	0.1	0.1	13.9	10.1	0.0	9.5
Greece	6.2	0.7	0.2	0.3	6.1	5.3	2.9	1.2
Ireland	5.9	1.5	0.4	1.2	5.6	3.8	4.0	1.0
Italy	2.9	0.7	0.7	0.8	2.6	2.0	0.3	1.7
Luxembourg	3.9			0.2			2.0	2.7
Netherlands	3.6	0.5	0.8	0.4	3.4	1.4	0.3	3.1
Portugal	9.7	0.6	1.2	0.8	9.6	8.0	4.9	2.0
Spain	10.9	0.4	0.3	0.7	10.8	9.8		1.0
Sweden	6.5	2.6	0.9	1.0				
United Kingdom	15.7	0.6	0.1	0.9	15.6			
EU15	**5.6**	**0.6**	**0.4**	**0.4**	**6.0**			
EU15 no corr	**4.7**	**0.5**	**0.3**	**0.2**	**4.7**			
EU15 full corr	**9.5**	**0.9**	**0.6**	**0.6**	**9.5**			

Uncertainties calculated from information contained in NIR on uncertainty of activity data and emission factors, and emission data, using the Tier 1 approach.

6.4.2 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 include (i) more transparent overview tables on methodological issues; (ii) better presentation of trend development; (iii) streamlining information contained in CRF and NIR; (iv) continuous working with Member States in order to improve the inventory and allowing the quantification of all background data; (v) including a summary of workshops.

For the submission in 2007, few improvements have been added, mainly regarding the calculation of the quality of the EC estimate. Several errors that were identified in the background tables of the Member States could be eliminated, such as the inconsistent use of units or implied emission factors. These corrections did not have an impact on the calculated emissions, but made the aggregation of background information difficult and the comparison impossible.

For the current submission, based on recommendations by the Expert Rview Team of the in-country review in 2007, the following improvements were implemented:

Aggregation of animal numbers presented under Option B into Option A (which is used at EU level) is explained

Time series consistencies and trends (including epidemic diseases) are discussed with more details (including issues raised by the ERT, such as the buffalo population in Germany and the goat population in Luxembourg, manure managed in 'other' systems in Italy, or $Frac_{GASM}$ used in Sweden).

Discussion of outliers in a more systematic way with the MS and presenting the results in a more transparent way (this will be continued during the coming years)

Emission sources reported by a few MS only (such as CH_4 emissions from enteric ferementation of poultry, reported by Austria and Luxembourg only) will still lead to a discrepancy between the IEF for EU-15 reported in the CRF-tables and the NIR. This is because our principle to not change the category MS report emissions (with the above-mentioned exception of the shift from Option B to Option A for cattle). In the annex to the NIR a weighted average of the IEF for poultry is calculated instead giving the IEF of those animals for which emissions have been quantified and included into the EU total. This is documented also in the CRF tables in a transparent way.

Continuous work with MS to identify and correct errors. Thus eliminated errors in the current years include

- wrong distribution of manure over climate regions and AWMS (giving 100% per climate region or AWMS rather than 100% total);
- use of the correct unit for AD and IEF for crop residues and N-fixing crops;
- identification of inconsistencies between the product of animal numbers and N-excretion rates on one side and the reported total amount of manure-nitrogen on the other side;
- harmonization of the unit for reporting milk yield;
- rounding and transcription errors in various cells; …

Discussion of mail policies in Europe that important for determining the level of greenhouse gas emissions in Europe (i.e., EU agricultural policy (CAP), nitrate directive, etc.)

The novel approach to calculate uncertainties at the EU level including the assessment of the quality of the emission estimates at MS and EU level has been presented during the in-country-review in 2007. Based on the suggestion of the ERT, this approach has now been implemented and described in the NIR.

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[29]. 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.

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)

---

29 The participants of the workshop welcomed the project carried out in Italy for comparison of methodologies used in Mediterranean countries.

- 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 6.71 shows that in the agriculture sector the largest recalculations were made for N_2O in 1990 and for CH_4 in 2005.

Table 6.71 Sector 4 Agriculture: Recalculations of total GHG emissions and recalculations of GHG emissions for 1990 and 2005 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	-50.392	-1,6%	-851	-0,2%	-8.415	-2,1%	5	0,0%	617	3,7%	-51	-0,5%
Agriculture	0	0,0%	-455	-0,2%	659	0,3%	NO	NO	NO	NO	NO	NO
2005												
Total emissions and removals	33.796	1,1%	2.011	0,6%	-11.037	-3,3%	220	0,4%	-35	-0,6%	-70	-0,8%
Agriculture	0	0,0%	704	0,4%	492	0,4%	NO	NO	NO	NO	NO	NO

NO: not occurring

Table 6.72 provides an overview of Member States´contributions to EU-15 recalculations. Belgium was mainly responsible for recalculations in 1990. In 2005, also France contributed significantly to the EU-15 recalculations.

Table 6.72 Sector 4 Agriculture: Contribution of MS to EC recalculations in CRF sector 4 'Agriculture' for 1990 and 2004 by gas (difference between latest submission and previous submission in Gg of CO_2 equivalents)

	1990						2005					
	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
Austria	0	0	45	NO	NO	NO	0	-13	44	NO	NO	NO
Belgium	0	-999	-293	NO	NO	NO	0	-733	-246	NO	NO	NO
Denmark	0	0	-3	NO	NO	NO	0	40	32	NO	NO	NO
Finland	0	0	0	NO	NO	NO	0	-2	18	NO	NO	NO
France	0	9	0	NO	NO	NO	0	851	170	NO	NO	NO
Germany	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
Greece	0	0	0	NO	NO	NO	0	-94	310	NO	NO	NO
Ireland	0	171	-5	NO	NO	NO	0	180	48	NO	NO	NO
Italy	0	1	0	NO	NO	NO	0	-2	27	NO	NO	NO
Luxembourg	-	83	274	NO	NO	NO	-	110	207	NO	NO	NO
Netherlands	0	-3	121	NO	NO	NO	0	-2	111	NO	NO	NO
Portugal	0	-16	237	NO	NO	NO	0	149	-311	NO	NO	NO
Spain	0	263	72	NO	NO	NO	0	240	-123	NO	NO	NO
Sweden	0	38	0	NO	NO	NO	0	-10	0	NO	NO	NO
UK	0	0	211	NO	NO	NO	0	-8	204	NO	NO	NO
EU-15	**0**	**-455**	**659**	**NO**	**NO**	**NO**	**0**	**704**	**492**	**NO**	**NO**	**NO**

NO: not occurring; IE: included elsewhere

6.5.1 Enteric Fermentation (CRF source category 4.A)

Information on recalculations of emission estimates in category 4A contained in the NIR of some countries are summarized below:

Table 6.96: Member State's background information for recalculations of emissions in category 4.A

Member State	Recalculations
Austria	
Belgium	As a consequence the expert review team did recommend Belgium to set up a Tier 2 methodology for cattle. These recalculations result in a decrease of the emissions for the entire time series during the 2008 submission.
Denmark	The data received from statistics Denmark concerning the livestock production and the cultivated area 2005 is updated
Finland	
Germany	The methane emissions for Horses were recalculated and corrected for the animal numbers of big and small horses. The EFs are place and time variable.
Ireland	As a result of a technical review of the inventory by a member of staff of the Department of Agriculture in 2007, CH_4 estimates from other cattle in the categories less than 1 year, 1-2 years old and greater than two years old were separated into male and female sub-divisions and appropriate emission factors applied.
Italy	
Luxembourg	
Netherlands	
Sweden	CH_4 emission factors for beef cows and reindeer were revised due to recommendations from the ERT during the in-country visit of the Swedish 2006 submission. The previous national emission factor for beef cows, 98 kg CH_4/head and year, was revised to 78 kg CH_4/head and year, based on a new national study. For reindeer, the previous CH_4 emission factor (7.7 kg CH_4/head and year) was based on information from the Finnish GHG inventory180. Finland has now updated the factor to 19.9 kg CH_4/head and year and Sweden was recommended to follow suit.
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%. This is based on the expert opinion of Bruce Cottrill (ADAS), and subsequent acceptance by the research community in the UK.

6.5.2 Manure Management (CRF source category 4.B)

Information on recalculations of emission estimates in category 4B(b) contained in the NIR of some countries are summarized below:

Table 6.97: Member State's background information for recalculations of emissions in category 4.B

Member State	**Recalculations**
Austria	As recommended in the Centralized Review 2004, in the year 2005 Austrian N excretion values were reviewed and recalculated. The revised values consider the typical agricultural practice in Austria. Especially N excretion rates of dairy and suckling cows are higher
Belgium	In the Flemish region a correction has been made after the 2007 submission concerning the allocation to AWMS for slaughter calves (category 4Bb). Before the allocation was identical to those of bovine. This was incorrect because slaughter calves are kept 100% of their lifetime on stable, in a liquid waste management system.
Denmark	Updated normative nitrogen excretion figures in 2003.
Finland	The nitrogen excretion rates of horses and turkeys were updated for the whole time series. The nitrogen excretion of dairy cows were updated for 2004-2005 and that for swine and sheep for 2005. This resulted in changes in the reported emissions of nitrous oxide from manure. Small changes in the methane emissions from poultry manure resulted from a correction in the calculation formula.
Germany	The jung and layers were separated according Tier 2 methodology (HAENEL & DÄMMGEN, 2007a, 2007b).
Ireland	A re-analysis of farm facilities data resulted in revised estimates associated with manure management practices and indirect emissions due to NH3 volatilization.
Italy	
Netherlands	The total amount of nitrogen excreted from animals is no longer adjusted for nitrogen from ammonia volatilization during manure management, which makes the estimate consistent with the IPCC GPG.
Sweden	
United Kingdom	1. 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). Also for this cattle category, the digestibility of the diet has been increased from 65% to 74%, based on expert opinion of Bruce Cottrill (ADAS). 2. The nitrogen excretion (Nex) values assigned to the different livestock types across the timeseries have been substantially revised. This is because the existing country specific Nex level data from the literature was reviewed for the purpose of updating the UK NH_3 emissions inventory.

6.5.3 Rice Cultivation – CH_4 (Source category 4.C)

6.5.4 Agricultural Soils - N_2O (Source category 4.D)

Information on recalculations of emission estimates in category 4D contained in the NIR of some countries are summarized below:

Table 6.98: Member State's background information for recalculations of CH_4 emissions in category 4.D

Member State	Recalculations
Austria	The revision of the share of dairy cattle held in loose (32%) and tied housing systems (68%) within the NH3 inventory resulted in slightly lower direct N_2O emissions from animal manure applied to soils and slightly higher indirect N_2O emissions. The new data on housing system distribution is based on (AMON et al. 2007). N contents of crops were revised, resulting in higher N_2O emissions from 1990 onwards.
Belgium	
Denmark	
Finland	
Germany	
Ireland	
Italy	
Netherlands	Recalculation of indirect N_2O from agricultural soils, Category 4D +2.98 Gg CO_2-eq. in 1990.
Portugal	
Sweden	
United Kingdom	The N excretion factors have been revised according to values provided by Ken Smith and Bruce Cottrill (ADAS). These were corrected for all years 1990-2006. The new values are based on estimation of the total N consumption minus the N content of livestock products, for all the major categories of farm livestock and were developed and published in a DEFRA report (Defra, 2006). These data were incorporated to ensure consistency with the UK NH3 emissions inventory.

6.6 List of references

Austria (NIR 2008, p. 228-277)

Amon B, Amon T & Hopfner-Sixt K (2002) Emission Inventory for the Agricultural Sector in Manure Management. Agricultural, Environmental and Energy Engineering (BOKU - University of Agriculture, Vienna). July 2002.

Bundesanstalt für Agrarwirtschaft (2005) Federal Institute of Agricultural Economics. Download from data pool. http://www.awi.bmlfuw.gv.at/framesets/datapoolframeset.html.

Detzel A, Vogt R & Fehrenbach Hea (2003) Anpassung der deutschen Methodik

Freibauer A & Kaltschmitt M (2001) Biogenic Emissions of Greenhouse Gases Caused by Arable and Animal Agriculture" (FAIR3-CT96-1877) Report Task 3.

Götz B (1998) Stickstoffbilanz der österreichischen Landwirtschaft nach den Vorgaben der OECD. Aktualisierte und erweiterte Fassung. UBA BE-087a. July 1998. Wien: Umweltbundesamt

Gruber L & Pötsch EM (2005) Calculation of nitrogen excretion of dairy cows in Austria. *Die Bodenkultur - Austrian Journal of Agricultural Research* in press.

Gruber L & Steinwidder A (1996) Einfluß der Fütterung auf die Stickstoff- und Phosphorausscheidung landwirtschaftlicher Nutztiere - Modellkalkulationen auf Basis einer Literaturübersicht. *Die Bodenkultur - Austrian Journal of Agricultural Research* 47, 4.

Konrad S (1995) Die Rinder-, Schweine- und Legehennenhaltung in Österreich aus ethologischer Sicht. Wien: WUV Universitätsverlag

Löhr L (1990) Faustzahlen für den Landwirt.

Minonzio G, Grub A & Fuhrer J (1998) Methan - Emissionen der schweizerischen Landwirtschaft. Schriftenreihe Umwelt, 298. Bern: Bundesamt für Umwelt, Wald und Landschaft (BUWAL)

Minonzio G, GRUB A & Fuhrer J (1998) Methan - Emissionen der schweizerischen

Pötsch EM, Gruber L & Steinwidder A (2005) Answers and comments on the additional questions, following the meeting in Bruxelles. Internal statement, HBLFA Raumberg-Gumpenstein.

Scharf S, Schneider M & Zethner G (1997) Zur Situation der Verwertung und Entsorgung des kommunalen Klärschlamms in Österreich. UBA Monographien Band 95. Wien: Umweltbundesamt

Schechtner (1991) Wirtschaftsdünger - Richtige Gewinnung und Anwendung. Sonderausgabe des Förderungsdienst 1991. Wien: BMLF

Steinwidder A & Guggenberger T (2003) Erhebungen zur Futteraufnahme und Nährstoffversorgung von Milchkühen sowie Nährstoffbilanzierung auf Grünlandbetrieben in Österreich. *Die Bodenkultur - Austrian Journal of Agricultural Research* 54, 1, 49-66.

Austria;Germany - EMEP/CORINAIR (2003) Joint EMEP/CORINAIR Emission Inventory Guidebook - 3rd edition October 2002, updated 2003. http://tfeip-secretariat.org/unece.htm.

Winiwarter, W. , and Rypdal, K.: Assessing the uncertainty associated with national greenhouse gas emission inventories: a case study for Austria, Atmos. Environ., 35, 5425-5440, 2001.

Belgium (NIR 2008, p. 86-99)

Pauwelyn J & Depuydt S (1997) Studie der kwantificering van de nutriëntenverliezen per stroombekken naar het oppervlaktewater door landbouwactiviteiten in Vlaanderen: een praktijkgericht onderzoek ter ondersteuning van het milieu- en landbouwbeleid. Instituut voor Scheikundig Onderzoek

SITEREM (2001) Estimation des émissions dans l'air de CH_4, NH3 et N_2O par le secteur agricole en région wallonne. Rapport final demandé par le Ministère de la Région Wallonne. Direction Générale des Ressources Naturelles et de l'Environnement.

VITO VLAAMSE INSTELLING VOOR TECHNOLOGISCH ONDERZOEK = Flemish Institute for Technological Research B, B-2400 MOL (www.emis.vito.be)

Denmark (NIR 2008, p. 226-262)

Børgesen CD & Grant R (2003) Vandmiljøplan II - modelberegning af kvælstofudvaskning på landsplan, 1984 til 2002. Baggrundsnotat til Vandmiljøplan II - slutevaulering (In Danish). Danmarks Jordbrugsforskning og Danmarks Miljøundersøgelser

Bussink DW (1994) Relationship between ammonia volatilisation and nitrogen fertilizer application rate, intake and excretion of herbage nitrogen by cattle on grazed swards. *Fertil. Res.* 38, 111-121.

Djurhuus J & Hansen EM (2003) Notat vedr. tørstof og kvælstof i efterladte planterester for landbrugsjord - af 21. maj 2003 (In Danish). Forskningscenter Foulum, Tjele

Høgh-Jensen H, Loges R, Jensen ES, Jørgensen FV & Vinther FP (1998) Empirisk model til kvantificering af symbiotisk kvælstoffiksering i bælgplanter. In *E. S. KRISTENSEN and J. E. OLESEN (eds.) Kvælstofudvaskning og-balancer i konventionelle og økologiske produktionssystemer* Forskningscenter for Økologisk Jordbrug. p. 69-86.

Illerup JB, Nielsen M, Winther M, Mikkelsen MH, Lyck E, Hoffmann L & Fauser P (2004) Annual Danish Emissions Inventory Report to UNECE. Inventories 1990-2002. National Environmental Research Institute. - Research Notes from NERI 202: 490 pp. (electronic). http://www2.dmu.dk/1_viden/2_Publikationer/3_arbrapporter/rapporter/AR202.pdf.

Jarvis SC, Hatch DJ & Roberts DH (1989) The effects of grassland management on nitrogen losses from grazed swards through ammonia volatilization; the relationship to extral N returns from cattle. *J. Agric. Camp.* 112, 205-216.

Kristensen IS (2003) Indirekte beregning af N-fiksering - draft, not published. Danmarks JordbrugsForskning. (In Danish).

Kyllingsbæk (2000) Kvælstofbalancer og kvælstofoverskud i dansk landbrug 1979-1999. DJF rapport nr. 36/markbrug. Dansk Jordbrugsforskning

Mikkelsen MH, Gyldenkærne S, Poulsen HD, Olesen JE & Sommer SG (2005) Opgørelse og beregningsmetode for landbrugets emissioner af ammoniak og drivhusgasser 1985-2002 (In Danish). DMU arbejdsrapport nr. 204/2005. Danmarks Miljøundersøgelser og Danmarks JordbrugsForskning

Poulsen HD, Børsting CF, Rom HB & Sommer SG (2001) Kvaelstof, fosfor og kalium i husdyrgødning - normtal 2000. DJF rapport No. 36 (in Danish).

Sommer SG & Christensen BT (1992) Ammonia volatilization after in-jection of anhydrous ammonia into arable soils of different moisture levels. *Plant Soil* 142, 143-146.

Sommer SG & Ersbøll AK (1996) Effect of air flow rate, lime amend-ments and chemical soil properties on the volatilization of ammonia from fertilizers applied to sandy soils. *Biol. Fertil. Soils* 21, 53-60.

Sommer SG & Jensen C (1994) Ammonia volatilization from urea and ammoniacal fertilizers surface applied to winter wheat and grassland. *Fertil. Res.* 37, 85-92.

Sommer SG, Hutchings NJ, Andersen JM & Asman WAH (2001) A detail ammonia emission inventory for Denmark. *Atmos. Environ.* 35, 1959-1968.

Denmark;no - Jarvis SC, Hatch DJ & Lockyer DR (1989) Ammonia fluxes from grazed grassland annual losses form cattle production systems and their relation to nitrogen inputs. *Journal of Agricultural Science* 113, 99-108.

Finland (NIR 2008, p. 179-211)

ECETOC (1994) Ammonia emissions to air in Western Europe. Technical Report No. 62. Brussels: European Center for Ecotoxicology and Toxicology of Chemicals (ECETOC)

Grönroos J, Nikander A, Syri S, Rekolainen S & Ekqvist M (1998) Agricultural ammonia emissions in Finland (In Finnish). Finnish Environment 206. Finnish Environment Institute

Hüther, L. (1999) Entwicklung analytischer Methoden und untersuchung von Einflussfactoren auf Ammoniak-, Methan- und Distickskstoffmonoxidemissionen aus Flüssing- und Festmist Landbauforschung Völkenrode, Sonderheft 200.

Kähäri J, Mäntylahti V & Rannikko M (1987) Suomen peltojen viljavuus 1981-1985. Summary: Soil fertility of Finnish cultivated soils in 1981-1985. Viljavuuspalvelu Oy. (In Finnish).

Kyntäjä JP (2005). *Personal Communication.*

Lehtonen A, Mäkipää R, Heikkinen J, SIEVÄNEN R & LISKI J (2004) Biomass expansion factors (BEFs) for Scots pine, Norway spruce and birch according to stand age for boreal forests. *Forest Ecology and Management* 188, 211-224.

McDonald P, Edwards RA & Greenhalg JFD (1988) Animal Nutrition. 4th ed. New York, USA: Longman

MKL (1993) Environmental care programs 1990 B 1992 (In Finnish). Maaseutukeskusten liitto (Rural Advisory Centres)

Monni, S., Syri, S. , and Savolainen, I.: Uncertainties in the Finnish greenhouse gas inventory, Environmental Science & Policy, 7, 87-98, 2004.

Monni, S., Perälä, P. , and Regina, K.: Uncertainty in agricultural CH_4 and N_2O emissions from Finland - possibilities to increase accuracy in emission estimates, Mitigation and Adaptation Strategies for Global Change, in press, 2005.

Monni S, Perälä P & Regina K Uncertainty in agricultural CH_4 and N_2O emissions from possibilities to increase accuracy in emission estimates. Mitigation and adaptation strategies for global change. *in press.*

Mylls M & Sinkkonen M (2004) Viljeltyjen turve- ja multamaiden pinta-ala ja alueellinen jakauma Suomessa. The area and distribution of cultivated organic soils in Finland (In Finnish, abstract and tables in English). *Suo* 55, 3-4, 53-60.

Niskanen R, Keränen S & Pipatti R (1990) Ammonia emissions in the 1980s. In *Kauppi et al. (ed.) Acidification in Finland.* Berlin: Springer-Verlag.

Rekolainen S, Posch M & Turtola E (1993) Mitigation of agricultural water pollution in Finland: an evaluation of management practices. *Water Sci. Tech.* 28, 3-5, 529-538.

Savolainen I, Tähtinen M, Wistbacka M, Pipatti R & Lehtilä A (1996) Economic reduction of acidifying deposition by decreasing emissions in Finland, Estonia and Russia (In Finnish). VTT Research Notes 1744.

Seppänen H & Matinlassi T (1998) Environmental care programs at Finnish farms 1995 B 1997. Maaseutukeskusten liitto (Rural Advisory Centres) (In Finnish).

Seppänen H & Matinlassi T (1998) Environmental care programs at Finnish farms 1995 B 1997 (In Finnish). 43 Maaseutukeskusten liitto (Rural Advisory Centres)

SUOMEN TILASTOLLINEN VUOSIKIRJA (2004) Tilastokeskus (Finnish Statistical Yearbook 2004, Statistics Finland).

France (NIR 2008, p. 99-103)

Germany (NIR 2008, p. 338-375)

Boeckx P & Van Cleemput O (2001) Estimates of N_2O and CH_4 fluxes from agricultural lands in various regions in Europe. Nutr. Cycl. Agroecosyst. 60, 1-3, 35-47.

Dämmgen U, Lüttich M, Döhler H, Eurich-Menden & B. O (2002) GAS-EM - A Procedure to Calculate Gaseous Emissions from Agriculture. *Landbauforschung Völkenrode* 52, 19-42.

Dämmgen U & Lüttich M (2006) The Derivation of Nitrogen Excretions for Dairy Cows from Available Statistical Data. *Landbauforsch. Volk.* special issue 291, 231-243.

Dämmgen U (2006) Statistical Data for Animal Numbers in German Emission Inventories. *Landbauforschung Völkenrode* Special Issue 291, 223-229.

Dämmgen U, (ed.) 2004. Nationaler Inventarbericht 2004 - Berichterstattung unter Klimarahmenkonvention der Vereinten Nationen - Teilbericht für die Quellgruppe Landwirtschaft, Vol. Special Issue 260: Landbauforschung Völkenrode

Dämmgen U, Lüttich M, Haenel H-D, Döhler H, Eurich-Menden B & Osterburg B (2006) Calculations of Emissions from German Agriculture -National Emission Inventory Report (NIR) 2007 for 2005. Part 3: Methods and Data (GAS-EM). *Landbauforschung Völkenrode* Special Issue 304.

Lüttich M, Dämmgen U, Haenel H-D, B. E-M, Döhler H & Osterburg B Calculations of Emissions from German Agriculture – National Inventory Report (NIR) 2006 for the Year 2004. Part 2: Tables Typescript, in print.

Greece (NIR 2006, p. 126-141)

Soil Science Institute of Athens (SSIA) (2001) Tenagi Filippon Soil Study. Athens:

Ireland (NIR 2008, p. 69-81)

CSO (Central Statistics Office) (2003) Livestock Survey. Central Statistics Office, Ireland. http://www.cso.ie/.

European Commission (1991) Council Directive of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources (91/676/EEC). http://europa.eu.int/comm/environment/water/water-nitrates/directiv.html.

Hynds P (1994) A nutrient balance model for typical Irish farming systems. M.Sc Thesis. National Council for Education Awards

Mulligan F & O'Mara F (2002) The Excretion of Nitrogen by Dairy Cows and Beef Cattle. A Review Presented to the Environmental Protection Agency. July 2002.

NEUT (Working Group on Nutrients and Eutrophication under the OSPAR Convention) (1999) Screening Procedure for Irish Coastal Waters with Regard to Eutrophication Status.

O'Mara F (2006) Development of Emission Factors for Enteric Fermentation from the Irish Cattle Herd. LS 5.1.1 Final Report. ohnstown Castle, Wexford, Ireland: Environmental Protection Agency

Italy (NIR 2006, p. 84-117)

CRPA: Biogas e cogenerazione nell'allevamento suino. Manuale pratico, Milano, Italy: ENEL, Direzione studi e ricerche, Centro ricerche ambiente e materiali, 1996.

Cóndor, G. R., Valli, L., De Rosa, G., Di Francia, A. , and De Lauretis, R.: Estimation of the Italian Mediterranean buffalo methane emission factor, submitted, 2006.

CRPA: Progetto MeditAIRaneo: settore Agricoltura. Relazione finale. Technical report on the framework of the MeditAIRaneo project for the Agriculture sector, Reggio Emilia, Italia: CRPA, 2006.

Giardini, L. (1983) Agronomia Generale. Bologna, Italy: Patron.

Husted, S.: An open chamber technique for determination of methane emission from stored livestock manure, Atmos. Environ., 11, 27, 1993.

Husted, S.: Seasonal variation in methane emissions from stored slurry and solid manures, J. Environ. Qual., 23, 585-592, 1994.

Leip, A., Russo, S., Smith, K. A., Conen, F. , and Bidoglio, G.: Rice cultivation by direct drilling and delayed flooding reduces methane emissions, Poster contribution: Third International Symposium on Non-CO_2 Greenhouse Gases (NCGG-3). Scientific understanding, control options and policy aspects. Maastricht, 21-23 January 2002., 2002.

Tani A (2000) Methane emissions from rice paddies: review, assessment and perspectives for Italian lands. Technical Report carried out for APAT.

Portugal - Schütz H, Seiler W & Conrad R (1989) Processes involved in formation and emission of methane in rice paddies. *Biogeochem.* 7, 1, 33-53.

Yan, X., Yagi, K., Akiyama, H. , and Akimoto, H.: Statistical analysis of the major variables controlling methane emission from rice fields, Global Change Biol, 11, 1131-1141, 2005.

Luxembourg (NIR 2005, p. 122-131)

CITEPA (1990): Estimation of emissions from biogenic sources. Paris.

STATEC 1990 – 2006. Annuaires statistiques. Luxembourg.

TÜV Rheinland (1990): Emissionskataster für das Großherzogtum Luxemburg. Köln.

Pulles, T., Marecková, K.; Svetlik, J. & Skákala, J. (1999): TrainerER – Compiling a National Emission Inventory using the CollectER and ReportER software system. Technical Report No 33. European Environment Agency (EEA). Copenhagen.

Netherlands (NIR 2008, p. 149-166)

Bannink A, Dijkstra J, Mills JAN, Kebreab E & France J (2005) Nutritional strategies to reduce enteric methane formation in dairy cows. In T. Kuczynski, et al. (eds.) Emissions from European Agriculture. Wageningen, the Netherlands: Wageningen Academic Publishers.

Bannink A, Kogut J, Dijkstra J, Kebreab E, France J, Van Vuuren AM & Tamminga S (2005) Estimation of the stoichiometry of volatile fatty acid production in the rumen of lactating cows. Journal of Theoretical Biology in press.

Bruggen CV (2006) Dierlijke mest en mineralen 2004. Voorburg: CBS

De Vries W, Kros J, Oenema O & de Klein J (2003) Uncertainties in the fate of nitrogen II: A quantitative assessment of the uncertainties in major nitrogen fluxes in the Netherlands. *Nutr. Cycl. Agroecosyst.* 66, 1, 71-102.

Dijkstra J, Neal HDSC, Beever DE & France J (1992) Simulation of nutrient digestion, absorption and outflow in the rumen: model description. *Journal of Nutrition* 122, 2239-2256.

Kroeze C (1994) Nitrous oxide. Emission inventory and options for control in the Netherlands. RIVM report 773001-004. Bilthoven, the Netherlands:

Kuikman PJ, De Groot WJM, Hendriks RFA, Verhagen J & De Vries F (2003) Stocks of C in soils and emissions of CO_2 from agricultural soils in the Netherlands. Alterra report 561. Wageningen, the Netherlands: Alterra, Wageningen UR

Kuikman PJ, Van den Akker JJH & De Vries F (2005) Emissions of N_2O and CO_2 from organic agricultural soils. Alterra rapport 1035-2. Wageningen, the Netherlands: Alterra, Wageningen UR

Mineralen Boekhouding (1993) Kiezen uit gehalten. Forfaitaire gehalten voor de Mineralenboekhouding 1994. (Mineral Accounting).

Ramírez Ramírez, A., de Keizer, C., van der Sluijs, J. P., 2006: , r., July , and 2006.: Monte Carlo Analysis of Uncertainties in the Netherlands Greenhouse Gas Emission Inventory for 1990 – 2004, Utrecht, The Netherlands: NWS-E-2006-58, Department of Science, Technology and Society, Copernicus Institute for Sustainable Development and Innovation, Utrecht University,

Smink W, Van der Hoek KW, Bannink A & Dijkstra J (2005) Calculation of methane production from enteric fermentation in dairy cows. Utrecht: SenterNovem

Valk H, van Vuuren AM & Beynen AC (2002) Effect of grassland fertilizer on urinary and fecal concentrations of nitrogen and phosphorus in grass-fed dairy cows*) Nitrogen and phosphorus supply of dairy cows*, Vol. Dissertatie RU. Utrecht:

Van der Hoek KW & Van Schijndel MW (2005) Methane and nitrous oxide emissions from animal manure management, including an overview of emissions 1990 - 2003. Background document for the Dutch National Inventory Report. RIVM report 680.125.002. Bilthoven, the Netherlands:

Van der Hoek KW (1994) Berekeningsmethodiek ammoniakemissie in Nederland voor de jaren 1990, 1991 en 1992. RIVM report 773004003. Bilthoven, the Netherlands: RIVM

Van der Hoek KW, van Schijndel MW & Kuikman PJ (2006) Direct and indirect nitrous oxide emissions from agricultural soils, including an overview of emissions 1990 - 2003. Background document for the Dutch National Inventory Report. in preparation. RIVM Report No. 680.125.003. Bilthoven, the Netherlands:

Velthof GL & Kuikman PJ (2000) Beperking van lachgasemissie uit gewasresten. Een systeemanalyse. Alterra report 114.3. Wageningen, the Netherlands: Alterra

Portugal (NIR 2006, p. 328-408)

Seixas J, Gois V, Ferreira F, Diniz R, Moura F, Torres P, Furtado C, Martinho S, Matos P, Fava S, Remédio M & Gonçalves J (2000) Emissão e Controlo de Gases com Efeito de Estufa em Portugal. Ministério do Ambiente e Ordenamento do Território, GASA-DCEA-FCT

Schütz H, Seiler W & Conrad R (1989) Processes involved in formation and emission of methane in rice paddies. *Biogeochem.* 7, 1, 33-53.

Spain (NIR 2008, p. section 6-)

Seiler W, Conrad R, Holzapfel-Pschorn A & Scharffe D (1984) Methane emission from rice paddies. *J. Atm. Chem.* 1, 241-268.

Sweden (NIR 2008, p. 170-197)

Berglund Ö & Berglund K (2005) Kartering av odlade organogena jordar i Sverige med hjälp av digi-tali-serade databaser. Swedish University of Agricultural Sciences. Dept of Soil Sciences. Division of hydrotechnics

Bertilsson J (2002) Methane emissions from enteric fermentation - effects of diet omposition. Plant Production no. 81 October 2002. Danish Institute of Agricultural Sciences

Dustan A (2002) Review of methane and nitrous oxide emission factors for manure management in cold climates. Report 299. Uppsala: JTI - Swedish Institute of Agricultual and Environmental Engineering

Frankow-Lindberg (2005) Bestämning av klöverandel I slåttervall. Uppsala: Swedish University of Agricultural Sciences

Gustafsson, T.: Comparative study of Swedish emission factors for aviation with the IPCC default factors, SMED report 2005, 2005.

Høgh-Jensen H (2004) An empirical model for quantification of symbiotic nitrogen fixation in grass-clover mixtures. *Agric. Syst.* 82.

Johnsson H (1990) Nitrogen and Water Dynamics in Arable Soil. Reports and Dissertations 6 Swedish University for Agricultural Sciences. Department of Soil Sciences

Kasimir-Klemedtsson A (2001) Methodology for estimating the emissions of nitrous oxide from agriculture. Report 5170. Swedish Environmental protection Agency

Klemedtsson L, Kasimir-Klemedtsson Å, Esala M & Kulmala AE (1999) Inventory of N_2O emission from farmed European peatlands. In *A. Freibauer and M. Kaltschmitt (eds.) Approaches to Greenhouse Gas Inventories of Biogenic Sources in Agriculture*. Stuttgart: IER.

Laegreid M & Aastveit AH (2002) Nitrous oxide emissions from field-applied fertilizers. *Danish Institute of Agricultural Sciences Report. Plant Production* 81, 107-121.

Linder, J. (2001) STANK- the official model for input/output accounting on farm level in Sweden*) Element balances as a sustainable tool. Workshop in Uppsala, March 16-17, 2001*, Vol. Report 281 JTI-Swedish Institute of Agricultural and Environmental Engineering.

Mattson L (2005) Halmskörden, hur stor är den? Swedish University of Agricultural Sciences Dept of Soil Sciences, Soil Fertility and Plant Nutrition

Nieminen M, Maijala V & Soveri T (1998) Reindeer feeding. (Poron ruokinta). Finnich Game and Fisheries Research Institute. (In Finnish).

Swedish EPA (2002) Kväveläckage från svensk åkermark. Beräkning av normalutlakning för 1995 och 1999. Report 5248. Swedish EPA

Swedish EPA (2002) TRK Tranport - Retention - Källfördelning. Belastning på havet. Report 5247. Swedish EPA

Swedish EPA/SMED (2005) A review of Swedish crop residue statistics used in the greenhouse gas inventory. SMED report 2005. Swedish EPA/SMED

United Kingdom (NIR 2008, p. 149-158)

ADAS (1995) Personal communication to A Croxford (MAFF). Distribution of animal waste management systems for cattle.

ADAS (1995) Personal communication to A Croxford (MAFF). Linseed burning data.

BSFP (2005) The British Survey of Fertiliser Practice: Fertiliser Use on Farm Crops for Crop Year 2004. BSFP Authority

DEFRA (2004) Basic Horticultural Statistics for the United Kingdom: Calendar and Crop Years 1991/92 - 2001/02. London: The Stationery Office

DEFRA (2005) Agriculture in the UK 2004. London: The Stationery Office

Eggleston, H. S., Salway, A. G., Charles, D., Jones, B. M. R. , and Milne, R.: Treatment of Uncertainties for National Estimates of Greenhouse Gas Emissions, AEA Technology, Report AEAT - 2688, National Environmental Technology Centre, 1998.

Lord (1997).

MAFF (1995) Straw Disposal Survey. MAFF

Sneath RW, Chadwick DR, Phillips VR & Pain BF (1997) A UK Inventory of Methane/Nitrous Oxide Emissions from Farmed Livestock. Contract reports (2) to MAFF, projects WA0604/5, SRI, IGER & ADAS.

Landwirtschaft. Schriftenreihe Umwelt 298. Bern: Bundesamt für Umwelt, Wald und Landschaft (BUWAL)

zur rechnerischen Emissionsermittlung an internationalen Richtlinien. Institut für angewandte Ökologie (IFEU). Institute for Applied Ecology

Other

Gay S.H., Osterburg B., Baldock D., Zdanowicz A. (2005). Recent evolution of the EU Common Agricultural Policy (CAP): state of play and environmental potential. MEACAP report http://www.ieep.org.uk/research/MEACAP/MEACAP_Home.htm

Leip A (2005) The quality of European (EU-15) Greenhouse Gas inventories from agriculture. In *A. v. Amstel (ed.) Non-CO_2 greenhouse gases (NCGG-4)*. Rotterdam: Millpress. p. 231-238.

Leip A, (ed.) 2005. N_2O emissions from agriculture. Report on the expert meeting on "improving the quality for greenhouse gas emission inventories for category 4D", Joint Research Centre, 21-22 October 2004, Ispra., Vol. EUR 21675 p. Luxembourg: Office for Official Publication of the European Communities. Available at: http://carbodat.ei.jrc.it/ccu/Pubblications/N2O.EMISSIONSfromAGRICULTURE.pdf

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.

Oenema, Oena (2008). Nitrogen in current European policies. Background paper for the European Nitrogen Assessment (ENA) chapter 3, Wageningen, 20-21. May, 2008.

6.7 Agriculture for EU-27

6.7.1 Overview of sector (EU-27)

Figure 6.24 Sector 4-Agriculture: EU-27 GHG emissions for 1990–2006 in CO_2 equivalents (Tg)

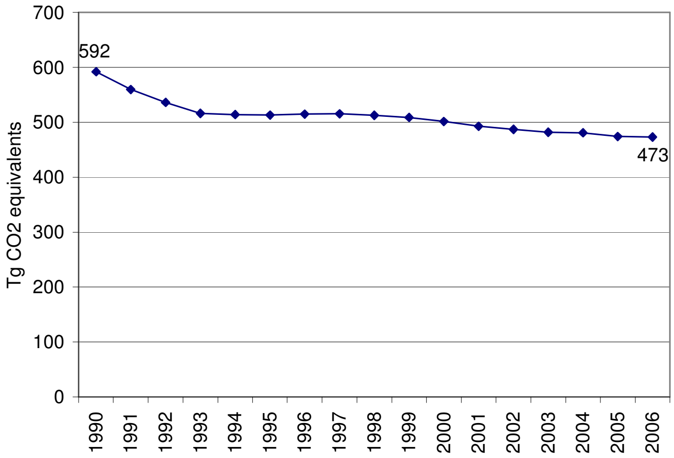
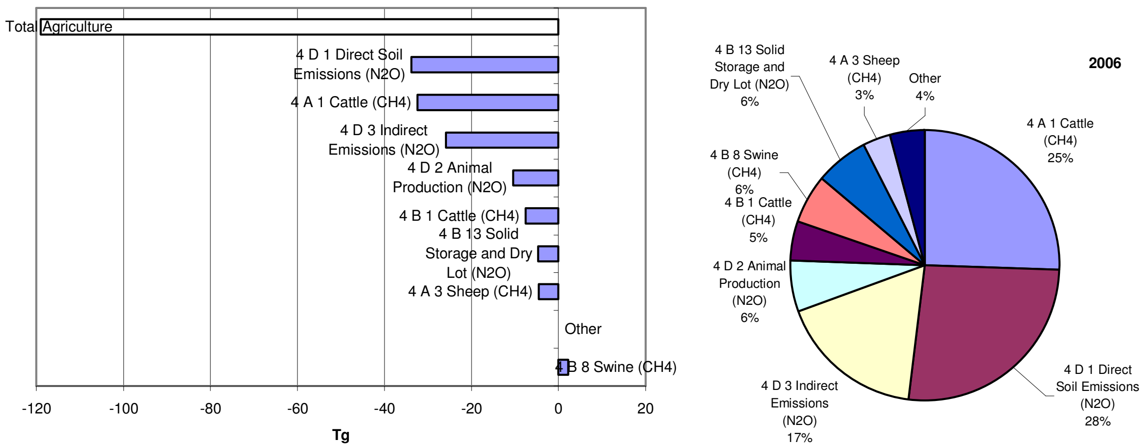


Figure 6.25 Sector 4-Agriculture: Absolute change of GHG emissions by large key source categories 1990–2006 in CO_2 equivalents (Tg) and share of largest key source categories in 2006



6.7.2 Source categories (EU-27)

6.7.2.1 Enteric fermentation (CRF Source Category 4A) (EU-27)

Table 6.80 4A1 Cattle: CH_4 emissions of EU-27

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	112,958	100,324	99,871	83.0%	-454	0%	-13,087	-12%			
Bulgaria	2,098	949	918	0.8%	-30	-3%	-1,180	-56%	T1	NS	D
Cyprus	80	85	83	0.1%	-2	-3%	3	4%	T2	NS	CS, D
Czech Republic	4,632	2,243	2,198	1.8%	-45	-2%	-2,434	-53%	T2	NS	CS
Estonia	1,052	424	416	0.3%	-8	-2%	-636	-60%	T2	NS	CS, D
Hungary	2,238	1,053	1,009	0.8%	-43	-4%	-1,228	-55%	T1	NS	D
Latvia	1,973	550	539	0.4%	-11	-2%	-1,434	-73%	T1	NS	D
Lithuania	3,017	1,187	1,233	1.0%	46	4%	-1,784	-59%	T2	NS	CS
Malta	27	28	28	0.0%	-1	-3%	0	2%	T2	NS	CS, D
Poland	13,910	8,191	8,394	7.0%	203	2%	-5,517	-40%	T2	NS	CS
Romania	8,322	4,166	4,263	3.5%	97	2%	-4,059	-49%	T1	NS	D
Slovakia	1,802	847	831	0.7%	-16	-2%	-971	-54%	T2	NS	CS
Slovenia	700	606	604	0.5%	-2	0%	-96	-14%	T2	NS, AS,Q	CS
EU-27	**152,809**	**120,653**	**120,386**	**100.0%**	**-267**	**0%**	**-32,423**	**-21%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 6.81 4A3 Sheep: CH_4 emissions of EU-27

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	15,988	14,181	14,222	90.3%	41	0%	-1,767	-11%			
Bulgaria	1,350	277	272	1.7%	-5	-2%	-1,078	-80%	T1	NS	D
Cyprus	49	45	46	0.3%	1	1%	-3	-6%	T1	0.0	D
Czech Republic	72	24	25	0.2%	1	6%	-47	-66%	T1	NS	D
Estonia	23	8	11	0.1%	2	26%	-13	-55%	T1	0.0	D
Hungary	329	243	228	1.4%	-15	-6%	-101	-31%	T1	NS	D
Latvia	28	7	7	0.0%	0	-1%	-21	-75%	T1	NS	D
Lithuania	9	5	6	0.0%	1	25%	-3	-35%	T2	NS	CS
Malta	1	2	2	0.0%	0	-15%	1	169%	T1	0.0	D
Poland	700	54	50	0.3%	-4	-8%	-650	-93%	T2	NS	CS
Romania	1,621	799	806	5.1%	7	1%	-814	-50%	T1	NS	D
Slovakia	101	54	56	0.4%	2	4%	-45	-45%	T1	NS	D
Slovenia	3	22	22	0.1%	0	2%	19	549%	T1	NS	D
EU-27	**20,274**	**15,720**	**15,752**	**100.0%**	**31**	**0%**	**-4,522**	**-22%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

6.7.2.2 Manure management (CRF Source Category 4B) (EU-27)

Table 6.82 4B1 Cattle: CH_4 emissions of EU-27

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	22,746	19,969	19,907	87.1%	-63	0%	-2,840	-12%			
Bulgaria	466	212	205	0.9%	-7	-3%	-261	-56%	T1, T2	NS	D, CS
Cyprus	34	37	36	0.2%	-1	-3%	1	3%	T1	0.0	D
Czech Republic	653	272	268	1.2%	-5	-2%	-385	-59%	T1	NS	D
Estonia	78	54	53	0.2%	-1	-1%	-25	-32%	T1	0.0	D
Hungary	159	73	71	0.3%	-2	-3%	-88	-56%	T1	NS	D
Latvia	143	40	39	0.2%	-1	-2%	-104	-73%	T1	NS	D
Lithuania	150	61	63	0.3%	2	3%	-87	-58%	T2	NS	CS
Malta	12	12	12	0.1%	0	-3%	0	0%	T1	0.0	D
Poland	755	880	904	4.0%	25	3%	149	20%	T2	NS/AS	CS
Romania	1,940	974	996	4.4%	23	2%	-944	-49%	T1	NS	D
Slovakia	127	43	41	0.2%	-2	-4%	-86	-67%	T1	NS	D
Slovenia	250	263	261	1.1%	-2	-1%	11	5%	T2	NS, AS, Q	CS
EU-27	**27,514**	**22,890**	**22,856**	**100.0%**	**-34**	**0%**	**-4,658**	**-17%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 6.83 4B8 Swine: CH_4 emissions of EU-27

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	18,119	21,325	22,180	82.3%	855	4%	4,062	22%			
Bulgaria	890	196	204	0.8%	8	4%	-685	-77%	T1, T2	NS	D, CS
Cyprus	58	90	95	0.4%	5	5%	37	63%	T1	0.0	CS, D
Czech Republic	302	181	179	0.7%	-2	-1%	-123	-41%	T1	NS	D
Estonia	99	17	17	0.1%	0	0%	-83	-83%	T1	0.0	CS, D
Hungary	551	253	248	0.9%	-5	-2%	-303	-55%	T1	NS	D
Latvia	118	36	35	0.1%	-1	-3%	-83	-70%	T1	NS	D
Lithuania	231	106	107	0.4%	1	1%	-124	-54%	T2	NS	CS
Malta	13	15	13	0.0%	-3	-18%	0	-3%	T1	0.0	CS, D
Poland	2,208	2,486	2,592	9.6%	106	4%	383	17%	T2	NS/AS	CS
Romania	1,716	973	1,002	3.7%	28	3%	-714	-42%	T1	NS	D
Slovakia	212	93	93	0.3%	0	0%	-119	-56%	T1	NS	D
Slovenia	248	171	184	0.7%	14	8%	-63	-26%	T2	NS, AS, Q	CS
EU-27	**24,764**	**25,943**	**26,949**	**100.0%**	**1,006**	**4%**	**2,185**	**9%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 6.84 4B13 Solid Storage and Dry Lot: N_2O emissions of EU-27

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	23,416	20,733	20,505	66.8%	-228	-1%	-2,911	-12%			
Bulgaria	939	331	328	1.1%	-4	-1%	-611	-65%	D	NS	D
Cyprus	77	0	0	0.0%	0	2%	-77	-100%	T1	NS	D
Czech Republic	502	260	256	0.8%	-4	-1%	-247	-49%	T1	NS	D
Estonia	213	32	32	0.1%	0	-2%	-181	-85%	T1	NS	D
Hungary	2,071	1,090	1,052	3.4%	-38	-4%	-1,019	-49%	T1	NS	D
Latvia	540	156	154	0.5%	-2	-1%	-386	-71%	T1	NS	D/CS
Lithuania	832	299	312	1.0%	12	4%	-520	-63%	T1	NS	D
Malta	0	0	0	0.0%	0	-4%	0	-42%	T1	NS	D
Poland	9,085	5,785	6,016	19.6%	231	4%	-3,069	-34%	T2	NS/AS	CS/D
Romania	2,112	1,438	1,464	4.8%	26	2%	-647	-31%	T1	NS	D
Slovakia	1,076	416	404	1.3%	-12	-3%	-672	-62%	T2	NS	D
Slovenia	244	154	154	0.5%	-1	-1%	-90	-37%	T1	NS, AS, Q	D, CS
EU-27	**41,108**	**30,695**	**30,676**	**100.0%**	**-19**	**0%**	**-10,432**	**-25%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 6.85 4B14 Other: N_2O emissions of EU-27

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006	
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
EU-15	293	611	597	60.7%	-14	-2%	304	104%
Bulgaria	59	28	28	2.9%	0	2%	-31	-52%
Cyprus	0	0	0	-	-	-	-	-
Czech Republic	80	46	46	4.7%	0	1%	-34	-42%
Estonia	123	10	9	1.0%	-1	-9%	-114	-92%
Hungary	9	4	4	0.4%	0	-	-5	-
Latvia	6	2	2	0.2%	0	-2%	-4	-71%
Lithuania	37	19	19	2.0%	0	1%	-18	-48%
Malta	NA	NA	NA	-	-	-	-	-
Poland	NA	NA	NA	-	-	-	-	-
Romania	581	274	278	28.2%	3	1%	-303	-52%
Slovakia	NO	NO	NO	-	-	-	-	-
Slovenia	1	1	1	0.1%	0	4%	-1	-43%
EU-27	**1,190**	**995**	**985**	**100.0%**	**-11**	**-1%**	**-205**	**-17%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

6.7.2.3 Agricultural soils (CRF Source Category 4D) (EU-27)

Table 6.86 4D1 Direct soil emissions: N_2O emissions of EU-27

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	115,281	100,064	98,134	78.3%	-1,930	-2%	-17,147	-15%			
Bulgaria	2,614	1,076	1,039	0.8%	-37	-3%	-1,575	-60%	D	NS	D
Cyprus	112	85	90	0.1%	4	5%	-22	-20%	T1	NS	D
Czech Republic	4,573	2,515	2,452	2.0%	-63	-3%	-2,121	-46%	T1	NS	D
Estonia	926	416	425	0.3%	9	2%	-501	-54%	T1	NS	D
Hungary	4,578	3,230	3,239	2.6%	9	0%	-1,339	-29%	T1b	NS	D
Latvia	1,650	746	774	0.6%	28	4%	-875	-53%	T1,T1a,T2	NS	D/CS
Lithuania	2,724	1,354	1,440	1.1%	86	6%	-1,284	-47%	T1	NS, IS	D
Malta	2	3	2	0.0%	-1	-35%	-1	-23%	T1	NS	D
Poland	13,688	10,075	10,587	8.4%	512	-	-3,101	-	T1/CS	NS	CS
Romania	9,971	5,834	5,522	4.4%	-312	-5%	-4,449	-45%	T1	NS, IS	D
Slovakia	2,414	1,216	1,202	1.0%	-14	-1%	-1,212	-50%	T2	NS	D, CS
Slovenia	411	393	399	0.3%	7	2%	-12	-3%	D, T1, T1b	NS, Q	D, CS
EU-27	**158,945**	**127,009**	**125,306**	**100.0%**	**-1,703**	**-1.3%**	**-33,639**	**-21%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 6.87 4D2 Pasture, Range and Paddock Manure: N_2O emissions of EU-27

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	28,427	25,683	25,670	88.4%	-13	0%	-2,757	-10%			
Bulgaria	1,539	517	520	1.8%	4	1%	-1,018	-66%	D	NS	D
Cyprus	114	38	39	0.1%	1	2%	-74	-65%	T1	NS	D
Czech Republic	706	265	263	0.9%	-2	-1%	-443	-63%	T1	NS	D
Estonia	100	31	32	0.1%	1	3%	-68	-68%	T1	NS	D
Hungary	326	201	193	0.7%	-8	-4%	-133	-41%	T1	NS	D
Latvia	358	102	101	0.3%	-2	-2%	-258	-72%	T1	NS	D
Lithuania	400	172	173	0.6%	1	1%	-227	-57%	T1	NS	D
Malta	NO	NO	NO	-	-	-	-	-	T1	NS	D
Poland	1,500	363	368	1.3%	5	1%	-1,132	-75%	T1	NS	CS/D
Romania	2,871	1,520	1,538	5.3%	19	1%	-1,333	-46%	T1	NS, IS	D
Slovakia	222	94	92	0.3%	-2	-2%	-129	-58%	T2	NS	CS
Slovenia	22	52	53	0.2%	0	1%	31	140%	D	NS, AS, Q	D, CS
EU-27	**36,583**	**29,039**	**29,043**	**100.0%**	**4**	**0%**	**-7,541**	**-21%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 6.88 4D3 Indirect Emissions: N_2O emissions of EU-27

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	81,247	68,716	67,993	82.5%	-723	-1%	-13,254	-16%			
Bulgaria	2,335	875	819	1.0%	-56	-6%	-1,516	-65%	D	NS	D
Cyprus	0	NA	NA	-	-	-	-	-	T1	NS	D
Czech Republic	3,620	1,738	1,764	2.1%	25	1%	-1,856	-51%	T1	NS	D
Estonia	561	179	191	0.2%	11	6%	-370	-66%	T1	NS	D
Hungary	3,298	2,012	2,065	2.5%	54	3%	-1,233	-37%	T1	NS	D
Latvia	1,034	312	318	0.4%	6	2%	-716	-69%	T1	NS	D
Lithuania	1,915	760	849	1.0%	89	12%	-1,066	-56%	T1	NS	D
Malta	NE	NE	NE	-	-	-	-	-	T1	NS	D
Poland	5,988	3,878	4,299	5.2%	420	11%	-1,689	-28%	T1	NS	D
Romania	7,091	3,647	3,490	4.2%	-157	-4%	-3,601	-51%	T1	NS, IS	D
Slovakia	946	379	368	0.4%	-11	-3%	-579	-61%	T2	NS	CS
Slovenia	312	301	308	0.4%	7	2%	-5	-1%	D, T1a	NS, Q	D
EU-27	**108,347**	**82,798**	**82,463**	**100.0%**	**-335**	**0%**	**-25,884**	**-24%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

7 LULUCF (CRF Sector 5)

Complying with revelant provisions, Sector 5 LULUCF (Land Use, Land Use Change and Forestry) of the EC is a compilation of the reports of the Member States. Given that detailed methodological information is provided by the reports by individual Members States, here we focus on some major issues, mainly related to forests – i.e., the main contributor under the LULUCF sector.

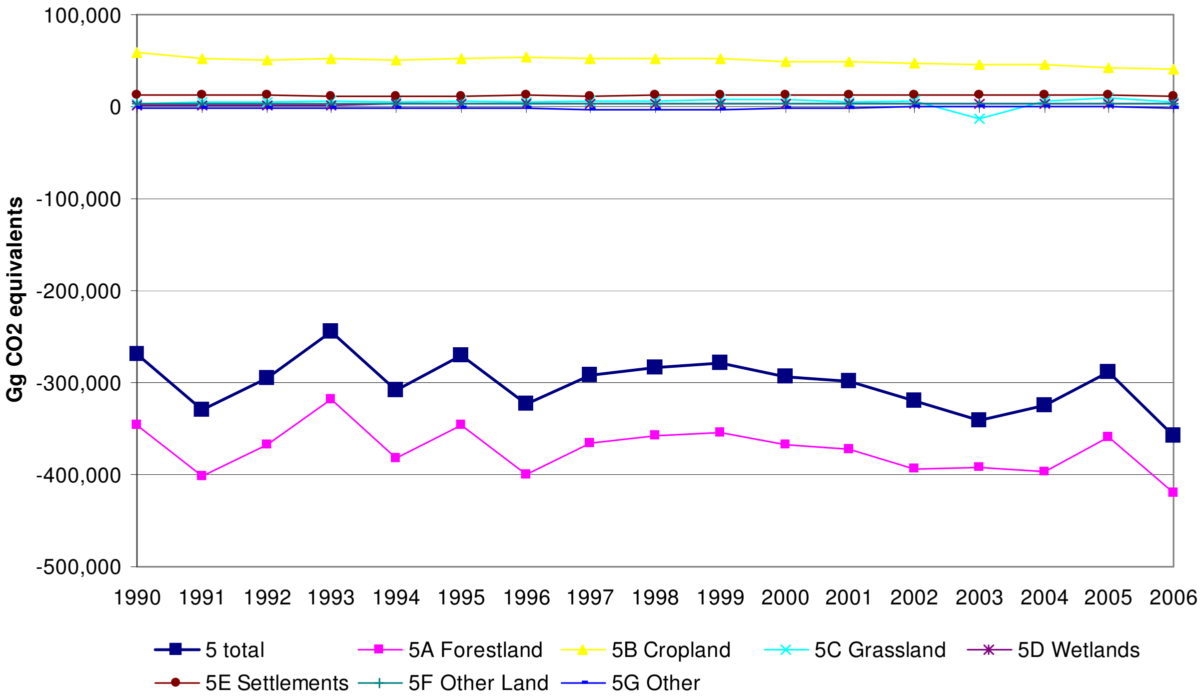
This section starts with an overview on emission and removal trends of the LULUCF sector for the EU-15, followed by general methodological information, a discussion of the key categories and relevant information on uncertainty, QA/QC, improvements and recalculations. Then, the same information is briefly illustrated also for EU-27 (chapter 7.8).

7.1 Overview of sector (EU-15)

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 1990–2006 from CRF in CO_2 equivalents (Gg)**



In 2006, the net sink of CO_2 in the EU-15 was -357,568 Gg (-353,370 Gg in CO_2 equivalents when also non-CO_2 greenhouse gases are included), which represents an increase of about 33% from 1990 (Figure 7.1). This increase is mainly due to the increase in CO_2 removals from forests between 1990 and 2005 (+21%) and, in part, to the decrease in net emissions from cropland (-29%) in the same period. Emissions from grasslands fluctuated across years.

All Member States showed a net sink in LULUCF for 2006, except the Netherlands (Table 7.1). Italy, France, Sweden, Germany, Spain and Finland account for the largest absolute removals. Denmark, Ireland, Portugal and UK turned from net emissions in 1990 to net removals in 2006.

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 2006	Change 2005-2006		Change 1990-2006	
	1990	2005	2006		(Gg CO_2)	(%)	(Gg CO_2)	(%)
Austria	-14,593	-18,388	-18,422	5.2%	-34	0%	-3,829	26%
Belgium	-1,431	-370	-1,061	0.3%	-691	187%	370	-26%
Denmark	552	-633	-1,802	0.5%	-1,169	185%	-2,354	-427%
Finland	-18,487	-31,502	-33,481	9.4%	-1,979	6%	-14,993	81%
France	-43,673	-67,968	-72,326	20.2%	-4,358	6%	-28,654	66%
Germany	-28,616	-36,497	-36,821	10.3%	-323	1%	-8,205	29%
Greece	-3,269	-5,244	-5,217	1.5%	27	-1%	-1,948	60%
Ireland	172	-455	-524	0.1%	-69	15%	-695	-405%
Italy	-79,289	-113,502	-112,361	31.4%	1,141	-1%	-33,072	42%
Luxembourg	-295	-295	-295	0.1%	0	0%	0	0%
Netherlands	2,667	2,581	2,574	-0.7%	-7	0%	-93	-3%
Portugal	1,366	-3,239	-4,263	1.2%	-1,025	32%	-5,629	-412%
Spain	-27,114	-33,246	-33,474	9.4%	-227	1%	-6,360	23%
Sweden	-58,953	22,533	-38,143	10.7%	-60,675	-269%	20,811	-35%
United Kingdom	2,928	-2,037	-1,953	0.5%	83	-4%	-4,882	-167%
EU-15	**-268,035**	**-288,263**	**-357,568**	**100.0%**	**-69,305**	**24%**	**-89,533**	**33%**

Overall, for the EU-15, Sector 5 in 2006 offsets 8.5 % of the total emissions (without LULUCF). Accross Member States, the contribution of LULUCF to total emissions ranges from +1.2 % (The Netherlands) to -57.8% (Sweden) (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	-19.9%	-21.7%	4.7%
Belgium	-0.8%	-2.0%	0.7%
Denmark	-2.6%	-3.9%	0.7%
Finland	-41.7%	-50.9%	9.8%
France	-12.9%	-15.5%	20.1%
Germany	-3.6%	-7.9%	18.9%
Greece	-3.9%	-3.3%	1.1%
Ireland	-0.7%	-1.3%	0.2%
Italy	-19.8%	-16.7%	22.6%
Luxembourg	-2.2%	NE	NE
Netherlands	1.2%	-1.2%	0.6%
Portugal	-5.0%	-6.7%	1.3%
Spain	-7.6%	-7.6%	7.9%
Sweden	-57.8%	-50.8%	8.0%
United Kingdom	-0.3%	-2.3%	3.6%
EU-15	**-8.5%**	**-10.1%**	**100.0%**

Source: 1: Member States' submissions 2007, CRF Table 5, 5A and Summary 2.

The most important subcategory is 5A (Forest Land), which is a net sink of GHG for all Member States. In 2006, the contribution of this Category to total emissions ranges from of -1.2 % (The Netherlands) to -50.9% (Finland) (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 5-10% (Ireland, UK, Denmark and the Netherlands) up to around 60-65% (Finland and Sweden) (Fig. 7.2).

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
5 D 2 Land converted to Wetlands: 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 (EU-15)

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.

Given the predominance of categories Forest Land (5A), Cropland (5B) and Grassland (5C) in both emission levels and reporting frequency, the general information provided below mainly focuses on these categories, as the other categories (Wetlands, Settlements and Other land) are usually less relevant or less data available (especially on emission factors). 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).

7.2.1 Completeness

Table 7.3 illustrates the current coverage of emissions and removals for the various categories and subcategories in 2006. While nearly all the countries reported for the category 5A1 ("forest remaining forest") and most of them for the categories 5A2 ("land converted to forest land") and 5B1 ("cropland remaining cropland"), the other land use categories are reported less frequently because of lack of activity data or the irrelevance of net emission/removals in the category. In general, the land use "remaining" in the same category is better covered than the "conversions" to other land uses.
Some countries did not separate some of the sub-categories (e.g. Finland and Belgium included the category 5A2 in 5A1). Furthermore, UK did not report emissions and removals from category 5A1 (forests in existence since before 1921) because it was conservatively assumed no significant long term changes in biomass stock (see also footnote 2, later).

Table 7.3 Sector 5 LULUCF: Coverage of CO_2 emissions and removals in the various subcategories for the year 2006, as derived from Table 5 of MS's CRF.

Member State	Reporting category											
	Forest land		Cropland		Grassland		Wetland		Settlements		Other land	
	5.A.1. F-F	5.A.2. L-F	5.B.1. C-C	5.B.2. L-C	5.C.1. G-G	5.C.2. L-G	5.D.1. W-W	5.D.2. L-W	5.E.1. S-S	5.E.2. L-S	5.F.1. O-O	5.F.2. L-O
Austria	R	R	E	E	E	R		E		R		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	R	R	E	E	R	E			E		R
Italy	R	R	R	E						E		
Luxembourg												
Netherlands	R	R		R	E	E				R		E
Portugal	R	R	E	E		R		E	E	E		E

Spain	R	R										
Sweden	R	R	E	R	R	R	E		E	E		
United Kingdom		R	E	E	E	R				E		

Legend: R = net Removal; E = net Emission; empty cells = not reported
Dark cells indicate a change in comparison to last year's submission: a subcategory previously reported but not reported anymore (dark empty cell) or a subcategory reported this year for the first time (dark cell with E or R).

Equally important is the distribution of carbon stock changes by pool for the most important subcategories in 2006, and the new reported pools in comparison to the previous submission (Table 7.4). The most frequently reported pool is "Biomass" (B) over all land use categories. It is worth to notice the considerable efforts that MS have done for increasing the reporting of the soil pools. Although from 2008 all the countries used the latest CRF tables - where the organic soil pool was distinguished from the mineral soil pool - few countries were able to report these pools separately.

Table 7.4 Sector 5 LULUCF: Reporting of carbon pools for the most important categories for the year 2006, with highlughted the pools reported for the first time in 2008 (from Tables 5A, 5B and 5C of MS's CRF).

Member State	Reporting category																							
	Forest land								Cropland								Grassland							
	5.A.1. F-F				5.A.2. L-L				5.B.1. C-C				5.B.2. L-C				5.C.1. G-G				5.C.2. L-G			
	Biomass	DOM	Soil MIN	Soil ORG	Biomass	DOM	Soil MIN	Soil ORG	Biomass	DOM	Soil MIN	Soil ORG	Biomass	DOM	Soil MIN	Soil ORG	Biomass	DOM	Soil MIN	Soil ORG	Biomass	DOM	Soil MIN	Soil ORG
Austria	I	I			I		I		D		I		I		D				D		D		I	
Belgium	I		I								D								D					
Denmark	I				I		I		I		I	D								D				
Finland	I	I	I	D							I	D							D	D				
France	I	D	I		I	I	I						D	D	D						D	D	I	
Germany	I				I				D		D		I		D				D		D		I	
Greece	I	D			I				I		I	D												
Ireland	I	I			I	I	D	D			I				D					D	I		I	D
Italy	I	I	I		I	I	I		I			D	I		D									
Luxemb.																								
Netherl.	I	I			I										I				D		D		I	
Portugal	I	D	I		I	D	I		I	D	D		D	D	D						D	D	I	
Spain	I				I																			
Sweden	I	D	I	D	I				I	D	D	D	I				I	D	I		I			
UK					I	I	I	I	I			D	D		D					D	I		I	

Legend: I = net Increase of the C pool (i.e. the pool is a net sink); D = net Decrease of the C pool (i.e. the pool is a net source); Empty cells = the pool was not reported or reported as zero. Dark cells indicate a change in comparison to last year's submission: a pool previously reported but not reported anymore (dark empty cell) or a pool reported this year for the first time (dark cell with D or I).

7.2.2 *Methods used*

The methods used by the Parties to calculate emissions and removals from the LULUCF sector vary among countries and land use categories. Table 7.5 is a summary of the type of methodology and emission factors used by MS in the GHG inventory 2008 in the LULUCF sector. The most developed methods and factors are generally used to assess emission and removals in categories 5A, 5B and 5C and to assess fluxes of CO_2. Only few countries explicitily report the use of Tier 3 methods and usually only for the most significant categories (e.g., Austria, Finland, Ireland, Sweden and United Kingdom).

Table 7.5 Type of methods and emission factor (EF) used by countries to calculate emission and removals of different GHGs in the LULUCF sector. T1, T2, T3: Tier 1, 2, 3; D: default; CS: country specific; NA: not applicable; OTH: other. Source: CRFs 2008

Member State	CO_2		CH_4		N_2O	
	Method	EF	Method	EF	Method	EF
Austria	T1,T3	CS,D	T1	CS,D	T1	CS,D
Belgium			NA	NA	NA	NA
Denmark	CS,T1	CS,D	D	D	CS	CS
Finland	D,T2,T3	CS,D	D,T2	CS,D	D,T1,T2	CS,D
France	CR,CS,T2	CS	CS,T2	CS	CR,T2	CS
Germany	CS,D,T2	CS,D	NA	NA		
Greece	CS,D,T1,T2	CS,D	T1	D	T1	D
Ireland	D,T1,T2,T3	CS,D	D,T1	D	D,T1	D
Italy	T1,T2	CS,D	T1	D	T1	D
Luxembourg	CS	CS	NA	NA	NA	NA
Netherlands	CS,D,T2	CS,D	NA	NA	NA	NA
Portugal	CS,D,T2	CS,D	D	D	D,T2	CS,D
Spain			CS	D	CS	D
Sweden	T1,T3	CS,D	T1	CS,D	CS,T1	CS,D
United Kingdom	CS,D,T3	CS	D	CS	D,T1,T2	CR,CS

7.2.3 *Activity data*

Given the heterogeneity in terms of ecological and socio-economic conditions, there are no unique definitions of different land uses across MS. Data on the area of land use categories, land affected by disturbances and amount of harvest used to estimate GHGs emission and removals come mainly from national statistics, forest inventories and forest management plans (Tab. 7.6). Thematic maps are sometimes used to integrate the information (national maps, Corine Land Cover).

Table 7.6 **Data sources for activity data in NIR 2008. NFI: national forest inventory; NS: national statistics (agricultural and forest statistics, management plans, cadastral data); NM: national maps; CLC: Corine Land Cover.**

Member State	Reporting categories						
	5A				5B	5C	Others
	5.A.1	5.A.2	Harvest	Disturbance			
Austria	NFI	NFI	NFI, NS	NFI	NS	NS	NS
Belgium	NFI		NS		CLC, NS	CLC, NS	
Denmark	NS	NS	NS		NS	NS	NS
Finland	NFI		NS		NS	NFI, NS	NFI, NS
France	NS, NFI		NS	NS	NS	NS	NS
Germany[a]	NFI	NFI		NS	NS, NM, CLC	NS, NM, CLC	NS, NM, CLC
Greece	NFI, NS	NS	NS	NS	NS	NS	NS
Ireland	NFI, NS	NS, CLC	NS	NS	NS	NS, CLC	NS, CLC
Italy	NFI, NS	NS	NS	NS	NS	NS	NS, CLC
Luxembourg							
Netherlands	NFI, NS	NFI, NS	NS		NS	NS	NS
Portugal	NFI, CLC	CLC, NS	NS	NS	CLC	CLC	CLC
Spain	NFI, CLC, NM	NS		NS	CLC	CLC	CLC
Sweden	NFI	NFI	NFI	NFI	NFI	NFI	NFI
United Kingdom	NS	NS	NS	NS	NS	NS	NS

[a] Methods and data sources from NIR 2007

7.2.4 Emission factors

Tab. 7.7 shows more detailed information on the emission factors used by MS to assess emissions and removals in the categories 5A, 5B and 5C in the biomass, soil and dead organic matter pools. For the living biomass pool, the information refers to the biomass expansion factors.

Table 7.7 **Emission factors applied in the GHG inventory 2008. CS: country specific; D: default; OTH: other factors (e.g. selection of factors from similar countries); 0: no changes in the pools reported (Tier 1); n.e.: no explanation reported; empty cells: no information reported/ no reported pool.**

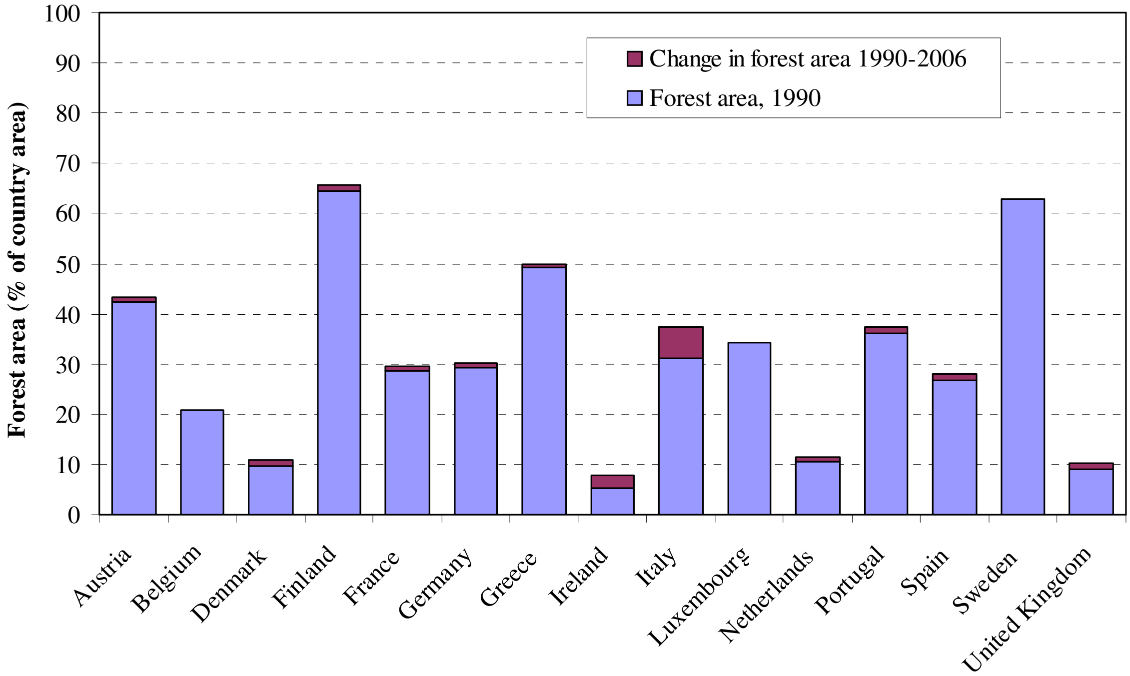
Member State	Reporting category											
	5A1			5A2			5B			5C		
	B	Soil	DOM	B	Soil	DOM	B	soil	DOM	B	soil	DOM
Austria	CS	0	CS, 0	CS	CS		CS, D	CS		CS	CS	
Belgium	OTH, CS	CS	CS, D				0	CS				
Denmark	OTH, CS			OTH	CS		CS	CS, D		CS	CS	
Finland	CS	CS	CS					D, CS			D	
France	CS	0	0	CS	CS, D	CS, D	0, CS	0, CS	0, CS	0, CS	0, CS	0, CS
Germany												
Greece	D	0	D	D		0	CS, D	D	0	0	0	0
Ireland	CS	0	0, D	CS	0	0, D	0, D	0, D		0, D	0, D	
Italy	CS	CS	D, OTH	CS, D	CS	D, OTH	0, D	0, D, CS		0, D	0, D, CS	
Luxembourg												
Netherlands	OTH	CS	CS	OTH	CS	CS	0	0, CS			CS	
Spain	CS, D	0	0	CS, D	0	0						
Sweden	CS	CS	CS	CS	CS	CS		CS			CS	
United Kingdom	CS	CS		CS	CS		CS	CS		CS	CS	

7.3 Forest land (5A) (EU-15)

Forests land is the dominant category in the LULUCF sector. According to the latest CRFs of MS, forests covered 36.0% of the total EU-15 area in 1990 and the 38.8% in 2006 (about 117 and 121 Millions ha, respectively), with large variation between Member States (Fig. 7.2). Although forest area has decreased in a few cases in a few years, the overall trend is an increase of forest area in all Member States (except a small decrease for Belgium), due both to natural forest expansion on abandoned agricultural area and to afforestation. Deforestation is of secondary importance in EU-15.

The current considerable sink of European forest is largely documented, by both forestry institutions and the scientific community. For many centuries, most European forests have been intensively exploited and depleted of carbon. Then, since the middle of the 20th century, growth rates started to increase. Paradoxically, this reversal was first noted during the extensive surveys carried out in the 1980s, when there was concern that Europe's forests were dying. Although it was found evidence of patches of damaged forests, it appeared progressively evident that most of European forests were growing much faster than previously derived yield table estimates (Karjalainen 1999). Overall, in the last 50 years, forests of Europe have increased by 75% their biomass stocks per hectare. Among the likely causes of this increased forest growth - not easily separable among them - the scientific community has suggested: 1) harvesting less than the increment, especially in central and southern Europe, 2) young age structure, i.e. most forests are still recovering from past overexploitation and are still an exponential growth phase, 3) increased fertility of forest soils due to improved silvicultural practices, and 4) fertilizing effects of increased nitrogen deposition (e.g., Magnani et al. 2007) and atmospheric CO_2 concentration, although considerable uncertainties still exist.

Figure 7.2 The percentage of forest land to total land area in the various countries in 1990 and 2006 (from the latest CRF)



7.3.1 Forest Land remaining Forest Land (5A1) (EU-15)

The area of the subcategory 5A1 Forest land remaining Forest land in EU-15 has increased by about 3 % from 1990 to 2006. However, its net removals have increased by about 18 % in the same period (Table 7.8), representing in 2006 about 86 % of the net removals of the whole Forest land category.

Table 7.8 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 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2)	(%)	(Gg CO_2)	(%)			
Austria	-11,511	-16,952	-16,959	4.7%	-8	0%	-5,448	47%	T3 (biomass, dead wood), T1 (soil)	NS	CS (biomass, dead wood), D (soil)
Belgium	-3,205	-2,095	-2,777	0.8%	-682	33%	429	-13%	CS/M	RS/NS	CS
Denmark	-2,831	-1,672	-2,574	0.7%	-902	54%	257	-9%	CS, D	CS	CS
Finland	-23,075	-38,491	-40,865	11.3%	-2,374	6%	-17,790	77%	T2,T3	NS	CS,D
France	-51,116	-62,945	-66,871	18.5%	-3,926	6%	-15,755	31%	CS/T2	NS	CS
Germany	-74,064	-74,064	-74,064	20.4%	0	0%	0	0%	CS/ T2	Q, NS	CS
Greece	-2,043	-4,017	-3,940	1.1%	77	-2%	-1,897	93%	CS,D,T1,T2	NS	CS,D
Ireland	-1,059	-834	-839	0.2%	-5	1%	220	-21%	T1	NS	D
Italy	-45,994	-78,797	-79,926	22.1%	-1,129	1%	-33,932	74%	T2, T3	NS	D, CS
Luxembourg	NE	NE	NE	-	-	-	-	-	NA	NE	NA
Netherlands	-2,505	-2,289	-2,289	0.6%	0	0%	216	-9%	CS	NS	CS
Portugal	526	-4,078	-5,103	1.4%	-1,025	25%	-5,629	-1070%	0.0	0.0	0.0
Spain	-27,114	-33,094	-33,246	9.2%	-152	0%	-6,133	23%	T1, CS, D	NS	D, CS
Sweden	-62,137	15,794	-32,911	9.1%	-48,705	-308%	29,226	-47%	T1, T3	NS	CS
United Kingdom	IE,NO	IE,NO	IE,NO	-	-	-	-	-	IE,NE	IE,NE	IE,NE
EU-15	**-306,127**	**-303,533**	**-362,363**	**100.0%**	**-58,830**	**19%**	**-56,236**	**18%**			

The largest removals in this subcategory across the time series were reported by Italy, Germany, France, Finland, Sweden and Spain. Only Portugal in 2003 and Sweden in 2005 reported a source for 5A, due to exceptional forest fires and wind throws, respectively. The oscillations in removals from Forest Land (see also Fig. 7.1) in the early 1990s largely arise from yr-to-yr variations reported by Sweden for 5A1, due to possible errors in the recalculation methodology30 (NIR Sweden, 2008). For subcategory 5A1, UK assumed no significant long term changes in biomass stock31.

Despite a general tendency of increased forest growth, as explained above, the Implied Emission Factors of net carbon stock change in aboveground biomass vary considerably among MS for category 5A1, ranging from 0.18 tC/ha/yr (Greece) to 1.94 tC/ha/yr (Germany). This may be explained by a series of factors, including:

- The intensity of management: in Nordic countries like Finland and Sweden, where the forest sector is very important for the economy, almost all the growth is harvested and little biomass accumulates. By contrast, in countries like Germany, France and Italy the current wood harvest is considerably less than the increment.
- The intensity and frequency of natural events, e.g. forest fires are typically more frequent in the Mediterranean countries.
- Different biological and ecological potential under the range of climatic zones and historical intensivity of the management.

The forests in this subcategory are very 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. Because of the different ecological and socio-economic conditions in the various countries, and also for historical reasons, it is not possible to develop an harmonized definition from these different definitions.

In almost all countries forest inventories – typically based on repeated measurements on permanent sample plots – provide the main inputs for forest area assessment, while the use satellite remote

[30] See also Section 7.7 for more detailed information on recalculations by Sweden.

[31] 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 7.10).

sensing to this aim is limited. Several countries, however, uses aerial photographs or remote-sensing derived products such as CORINE, at least for gathering ancillary information.
Forest inventories typically provide the basic data also for the calculation of carbon stock changes in the various pools with the stock change method, with the gain-loss method or with a mix of the two. The gain-loss methods are complemented by country-specific statistics on harvest and forest fires and are often based (or at least complemented) by growth models (e.g. UK, Italy, Ireland). As with the forest definitions, the methods for the collection of data in forest inventories differ among Member States in terms of design, spatial intensity, frequency of field survey, and latest information available (Tab. 7.9). However, most countries have made considerable efforts to obtain as recent and accurate information as possible and to include the specific requirements of UNFCCC reporting in the design of new forest inventories.

Table 7.9 Relevant information on the National Forest Inventories (NFI) of Member States

Country	Type of survey	Frequency	Latest survey
Austria	NFI, sample plot – based, 4 x 4 km grid across all of country	5-10 years since 1961	2000-2002
Belgium	NFI, 1.0 km x 0.5 km grid, one for Wallon region, one for Flemish Region	~ 10 years, since 1980	1999 -2000
Denmark	Questionnaire-based Forestry Census, replaced from 2002 by a new sample-based NFI which measures 1/5 of the plots every year and will be completed in 2008.	10 years, since 1881	The two latest censuses carried out in 1990 and 2000.
Finland	NFI, sample-based (systematic cluster sampling) inventory, cover all land use classes with cycles of 8-10 years. Now with cycles of 5 years, different grids 6 x 6 km to 10 x 10km according the region, and cover all country in a year	10 years, since 1921	2004-2008 (10^{th} NFI)
France	NFI, sample based, systematic clusters, 1 x 1 km, cover all the country in a year.	Continuous, since 1962	2004-2006
Germany	Carried out on a random basis with permanent sample points. The sample (cluster) distribution is based on a nationwide 4 km x 4 km quadrangle grid whose resolution may be increased, at Länder request, on a regional basis.	Two NFIs so far (1986-1989; 2001-2002)	2001-2002
Greece	Sample-based	Only one NFI so far.	1992
Ireland	Forest Inventory and Planning System and forest census, increment and harvest statistics.	Since 1958	1995
Italy	Sample-based. The new inventory uses a 3-phase sampling approach. The quantitative measurements are done in the 3^{rd} phase on 7000 points. These points are representative of the forest composition within a region, detected in the previous phases. Data on forest area available per species category.	First in 1985, second on-going.	2003-2008
Luxembourg	Sample-based: simple systematic sampling; points on a 1000x500m grid	Planned every 5-10 years. Only 1 so far.	1998-2000
Netherlands	Sample-based NFI	~ 10 years, since 1940	2001-2002
Portugal	Sampling in geographically located points and not by polygon wall to wall mapping, it represents clearly the geographical distribution of forest species	~ 10 years, since 1965	1999
Spain	Sample-based NFI	Planned every 10 years, since 1964	1997-2007
Sweden	Sample-based since 1983, with an area measured each year.	5-10 years, since 1923	Ongoing
United Kingdom	National Inventory of Woodland and Trees carried out between 1995 and 1999, combined with Forestry censuses data (combined with model fed by yield table data)	Various, NFI since 1924	1999

Furthermore, considerable efforts have been made to improve and transform the information on forest inventory timber volume into carbon stock change. These efforts include, e.g., developing new country-specific biomass functions (e.g. Austria, Finland, Ireland) - that are now used instead of former biomass expansion factors to obtain more accurate biomass estimates - as well intercalibration and harmonization exercises (i.e. via projects). 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 and accurate, thus eliminating or reducing some of the possible bias. An ongoing effort to collect and make available existing factors and biomass functions is demonstrated at the AFOLU web address (see section 7.6)

7.3.2 Land Converted to Forest Land (5A2) (EU-15)

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 20 % from 1990 to 2006. Its net removals have increased by about 45 % in the same period (Table 7.10), accounting for about 14 % of the net removals of the whole Forest land category in 2006. 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 7.10 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 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2)	(%)	(Gg CO_2)	(%)			
Austria	-4,643	-2,802	-2,770	4.8%	32	-1%	1,873	-40%	T2	NS	CS
Belgium	NE,NO	NE,NO	NE,NO	-	-	-	-	-	NA	NA	NA
Denmark	NA,NE,NO	-158	-184	0.3%	-26	16%	-184	-	CS, D	CS	CS
Finland	IE	IE	IE	-	-	-	-	-	NA	NA	NA
France	-10,305	-17,768	-17,875	30.8%	-107	1%	-7,570	73%	CS/T2	NS	CS
Germany	-336	-4,663	-4,986	8.6%	-323	7%	-4,650	1384%	CS/ T2	Q, NS	CS
Greece	IE,NE,NO	-476	-492	0.8%	-16	3%	-492	-	0.0	NS	0.0
Ireland	659	-8	-119	0.2%	-111	1440%	-778	-118%	T1, T3	NS	CS, D
Italy	-13,445	-14,852	-14,958	25.8%	-106	1%	-1,513	11%	T2, T3	NS	D, CS
Luxembourg	NE	NE	NE	-	-	-	-	-	NA	NE	NA
Netherlands	-13	-207	-220	0.4%	-13	6%	-207	1600%	T2	NS	CS
Portugal	-577	-577	-577	1.0%	0	0%	0	0%	0.0	0.0	0.0
Spain	IE,NE,NO	-152	-227	0.4%	-75	50%	-227	-	T1	NS	D, CS
Sweden	867	1,377	-517	0.9%	-1,894	-138%	-1,384	-160%	T3	NS	CS
United Kingdom	-12,156	-15,714	-15,112	26.0%	603	-4%	-2,956	24%	CS,D,T3	RS	CS
EU-15	**-39,947**	**-56,000**	**-58,036**	**100.0%**	**-2,036**	**4%**	**-18,089**	**45%**			

The largest removals in this subcategory were reported by UK and Italy and France. Most MS (except Austria) reported an increase in removals from 1990 to 2006. 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 (EU-15)

7.4.1 Cropland (5B) and Grassland (5C) (EU-15)

Most of the cropland and grassland area reported for the year 2006 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 7.11, 7.12, 7.13 and 7.14 illustrate the main data for the Cropland and Grassland subcategories.

Table 7.11 5B1 Cropland remaining Cropland: Member States' contributions to CO_2 net emissions

Member State	Net CO_2 emissions (Gg)			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2)	(%)	(Gg CO_2)	(%)			
Austria	16	180	161	1.7%	-19	-11%	145	890%	T1	NS	D, CS
Belgium	471	576	575	6.0%	-1	0%	105	22%	CS/M	NS	CS
Denmark	3,287	1,127	888	9.2%	-239	-21%	-2,399	-73%	CS, T1	0.0	CS, T1
Finland	7,416	3,552	3,224	33.5%	-327	-9%	-4,192	-57%	D	NS	CS
France	1,032	1,031	983	10.2%	-48	-5%	-48	-5%	CS/T2	NS	CS
Germany	23,389	21,964	21,964	227.9%	0	0%	-1,425	-6%	CS/ T2	Q, NS	CS
Greece	-1,226	-751	-785	-8.1%	-34	5%	441	-36%	T1,T2	NS	CS,D
Ireland	22	2	-53	-0.6%	-56	-2431%	-75	-347%	T1	NS	D
Italy	-22,162	-19,679	-19,614	-203.5%	65	0%	2,548	-11%	T1	NS	D, CS
Luxembourg	NE	NE	NE	-	-	-	-	-	NA	NE	NA
Netherlands	NA,NE	NA,NE	NA,NE	-	-	-	-	-	NA	NA	NA
Portugal	-164	-164	-164	-1.7%	0	0%	0	0%	0.0	0.0	0.0
Spain	NA,NE,NO	NA,NE,NO	NA,NE,NO	-	-	-	-	-	NE	NS	NE
Sweden	3,865	2,655	1,488	15.4%	-1,166	-44%	-2,376	-61%	T1, T3	NS	CS
United Kingdom	1,788	939	968	10.0%	29	3%	-821	-46%	CS,T3	RS	CS
EU-15	**17,735**	**11,432**	**9,636**	**100.0%**	**-1,796**	**-16%**	**-8,099**	**-46%**			

For category 5B1 Cropland Remaining Cropland most MS reported a relatively small source, except Germany which reported a very significant source from soils and Italy that reported a significant sink due to biomass increase in perennial croplands. Overall, the category registers a significant reduction of total net emissions (46% since 1990 and 16% over 2005-2006), mainly due to the contribution of Denmark, Finland, Sweden and United Kingdom. Cropland emissions/removals are significantly influenced by governamental decisions (i.e state support, programmes), that may substantially contribute on short term to the change of the pattern of GHG emissions/removals associated with this category.

Table 7.12 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 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2)	(%)	(Gg CO_2)	(%)			
Austria	1,548	1,672	1,716	5.4%	44	3%	168	11%	T2	NS	CS
Belgium	NE,NO	NE,NO	NE,NO	-	-	-	-	-	NA	NA	NA
Denmark	NA	NA	NA	-	-	-	-	-	NO	NO	NO
Finland	IE,NE	IE,NE	IE,NE	-	-	-	-	-	NA	NA	NA
France	21,631	12,399	11,828	37.3%	-571	-5%	-9,804	-45%	CS/T2	NS	CS
Germany	3,145	3,043	3,043	9.6%	0	0%	-102	-3%	CS/ T2	Q, NS	CS
Greece	NO	NO	NO	-	-	-	-	-	0.0	0.0	0.0
Ireland	NE,NO	127	127	0.4%	0	0%	127	-	T2	NS	D
Italy	NO	NO	856	2.7%	856	-	856	-	T1	NS	D, CS
Luxembourg	NE	NE	NE	-	-	-	-	-	NA	NE	NA
Netherlands	-36	-36	-36	-0.1%	0	0%	0	0%	0.0	0.0	0.0
Portugal	354	354	354	1.1%	0	0%	0	0%	0.0	0.0	0.0
Spain	NO	NO	NO	-	-	-	-	-	NO	NS	NO
Sweden	-25	143	-497	-1.6%	-640	-449%	-472	1873%	T3	NS	CS
United Kingdom	14,034	14,294	14,312	45.1%	18	0%	278	2%	CS,T3	RS	CS
EU-15	**40,652**	**31,995**	**31,702**	**100.0%**	**-293**	**-1%**	**-8,950**	**-22%**			

Category 5B2 Land Converted to Cropland is an important source at the EU-15 level, although several MS do not report yet under this subcategory. The largest emissions are reported by UK and France. At the EU-15 level, a general decrease is reported since 1990.

Table 7.13 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 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2)	(%)	(Gg CO_2)	(%)			
Austria	39	47	48	0.2%	1	3%	9	24%	T1	NS	D, CS
Belgium	1,303	1,148	1,141	5.2%	-8	-1%	-163	-12%	CS/M	NS	CS
Denmark	93	83	81	0.4%	-2	-2%	-12	-13%	CS, D	CS	CS, D
Finland	-2,468	3,045	3,828	17.5%	783	26%	6,296	-255%	D	NS	D
France	NO	NO	NO	-	-	-	-	-	CS/T2	NS	CS
Germany	18,282	16,670	16,670	76.1%	0	0%	-1,612	-9%	CS/ T2	NS	CS/ D
Greece	NO	NO	NO	-	-	-	-	-	0.0	0.0	0.0
Ireland	620	503	494	2.3%	-9	-2%	-126	-20%	T1	NS	D
Italy	NO	NO	NO	-	-	-	-	-	T1	NS	D, CS
Luxembourg	NE	NE	NE	-	-	-	-	-	NA	NE	NA
Netherlands	4,246	4,246	4,246	19.4%	0	0%	0	0%	0.0	0.0	0.0
Portugal	NE,NO	NE,NO	NE,NO	-	-	-	-	-	0.0	0.0	0.0
Spain	NE,NO	NE,NO	NE,NO	-	-	-	-	-	NE	NS	NE
Sweden	-1,169	1,484	-5,331	-24.3%	-6,815	-459%	-4,162	356%	T1, T3	NS	CS, D
United Kingdom	1,041	718	735	3.4%	17	2%	-307	-29%	CS,T3	RS	CS
EU-15	**21,988**	**27,945**	**21,913**	**100.0%**	**-6,032**	**-22%**	**-76**	**0%**			

Table 7.14 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 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2)	(%)	(Gg CO_2)	(%)			
Austria	-881	-1,128	-1,197	7.1%	-69	6%	-316	36%	T2	NS	CS
Belgium	NE,NO	NE,NO	NE,NO	-	-	-	-	-	NA	NA	NA
Denmark	NA,NO	NA,NO	NA,NO	-	-	-	-	-	CS, D	CS	CS, D
Finland	NE,NO	NE,NO	NE,NO	-	-	-	-	-	NA	NA	NA
France	-9,755	-6,292	-5,992	35.5%	300	-5%	3,764	-39%	CS/T2	NS	CS
Germany	273	-72	-72	0.4%	0	0%	-345	-126%	CS/ T2	NS	CS/ D
Greece	NO	NO	NO	-	-	-	-	-	0.0	0.0	0.0
Ireland	-128	-307	-190	1.1%	117	-38%	-62	48%	T1	NS	D
Italy	-214	-2,692	NO	-	2,692	-100%	214	-100%	T1	NS	D, CS
Luxembourg	NE	NE	NE	-	-	-	-	-	NA	NE	NA
Netherlands	194	194	194	-1.1%	0	0%	0	0%	0.0	0.0	0.0
Portugal	-25	-25	-25	0.1%	0	0%	0	0%	0.0	0.0	0.0
Spain	NE,NO	NE,NO	NE,NO	-	-	-	-	-	NO	NS	NO
Sweden	-158	339	-869	5.2%	-1,208	-357%	-712	452%	T3	NS	CS
United Kingdom	-7,228	-8,625	-8,720	51.7%	-96	1%	-1,492	21%	CS,D,T3	RS	CS
EU-15	**-17,922**	**-18,607**	**-16,872**	**100.0%**	**1,736**	**-9%**	**1,050**	**-6%**			

For most MS, the subcategory 5C1 Grassland Remaining Grassland is a source, with the highest emissions reported by Germany. Finland turned from a net sink to a net source, while Sweden incresed significantly its emissions. By contrast, 5C2 Land Converted to Grassland was a sink in most MS, with the highest removals reported by France and United Kingdom.

7.4.2 Non-CO_2 emissions (EU-15)

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. 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% across MS).

Emissions of CH_4 from wildfires are mainly reported by Mediterranean countries, and at the EU oscillated between 37 and 69 Gg CH_4 between 1990 and 2006.

Significant N_2O emissions from disturbance associated with land-use conversion was reported by France (3.44 Gg N_2O) and Germany (1.36 Gg N_2O) which represent a few percent of the respective agricultural N_2O emissions. Small N_2O emissions are reported from Austria, about 0.5% of the agricultural emissions (0.03 Gg N_2O). With 1.0 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 UK (for the first time this year), Finland and Sweden and report small quantities of nitrogen applied and N_2O emissions (0.004, 0.06 and 0.11 Gg N_2O, respectively), but actually other countries may report these emissions under Sector 4.

Only Ireland and Finland report emissions from drained wetland, which are insignificant.

Many countries report application of lime to agricultural soils with associated carbon emissions ranging from 80 Gg CO_2 (The Netherlands) to 1650 Gg CO_2 (Germany).

7.5 Uncertainties and time-series consistency (EU-15)

7.5.1 Uncertainties

The majority of MS performed some uncertainty assessment for the LULUCF sector. However, given the complexity and difficulty in performing a full uncertainty assessment – highlighted by several MS – in most cases the reported uncertainty did not cover the whole sector. While some MS provide detailed calculations of uncertainty, others only give a total uncertainty value for the entire LULUCF sector. When countries report disaggregated values of uncertainty for the land use categories, the information is sometimes incomplete (e.g. only for activity data or emission factors). Most MS applied the error propagation approach and only very few MS used a Monte Carlo simulation. The difficulty in performing an uncertainty assessment for the LULUCF sector regards both the activity data and the emission factors.

For the activity data, the analysis for the several land-use categories, and the related changes, invariably means that datasets differing in terms of format, spatial resolution, reference years and other attributes need to be combined. It follows that a high degree of uncertainty is associated with the land area activity data in general. Furthermore, given the usually relatively small area of land converted to other lands, some MS underlined the significantly higher uncertainty associated with the emissions/removals of these subcategories (e.g. area of land converted to forest land is not easily estimated with sample-based forest inventories).

Similar or even greater difficulties are reported for the emission factors, mainly due to the fact that a lot of input data are not based on statistical or representative surveys, especially for non-CO_2 gases and soil C, and initiating a statistically-sound new data acquisition is very difficult. In some cases, such as the effect of land use change or specific management activities on soil C, there is little consensus from the available literature. The main challenge is thus to come up with reliable uncertainty estimates, which are ultimately largely based on expert judgment and therefore rather uncertain themselves.

In order to demonstrate the range of current level of uncertainty of the estimates in the EC countries, below are given some examples.

The reported total uncertainty for CO_2 in the LULUCF sector is 28% in Sweden (Tab. 7.15), ~100% in The Netherlands (Tab. 7.16), 16% in Denmark and 58% in France.

Table 7.15 Estimated uncertainties of the emission/removal estimates for the LULUCF sector in Sweden.

Category	2 x Relative Standard Error		
	CO_2	N_2O	CH_4
Living biomass	20	-	-
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 (IV)	50	-	-
Biomass burning, 5 (V)	50	75	75

All	28	89	75

Table 7.16 Estimated uncertainties for activity data, emission factors and the emission/removal estimates for the LULUCF sector in the Netherlands.

Category	*Activity data, %*	*Emission factor, %*	*emission/removal estimates, %*
5A1. Forest Land remaining Forest Land	25	62	67
5A2. Land converted to Forest Land	25	58	63
5B2. Land converted to Cropland	25	50	56
5C1. Grassland remaining Grassland	25	50	56
5C2. Land converted to Grassland	25	61	66
5E2. Land converted to Settlements	25		56
5F2. Land converted to Other Land	25	50	56
5G. Other (liming of soils)	25	1	25
TOTAL	~100		

Typically, "forest land remaining forest land" is the subcategory where the uncertainty parameters are better reported compared to other subcategories. For example, Finland, a country with large forests, estimated uncertainty for the biomass pool by age class, and summed them up; for the total values, the following relative standard errors were estimated: 3.7 % for C-uptake, 4.3 % for C-release, and 16.1 % for the net C- uptake. Similarly, Austria provides very disaggregated estimates for living biomass in 5A1. For this subcategory, the effect of disturbances is also important. To this aim, Portugal included in its uncertainty analysis also the emissions caused by forest fires.

Uncertainty for land use changes is tipically higher, e.g. uncertainties of land changes from and to forests in Austria is considered (based on expert judgement) between 50 and 100%, depending on the other categories from or to which forest land changes. In Greece the uncertainty associated to land use change to forest is 5% for emission factors and 113% for activity data, while in Netherlands is 58% for emission factors and 25% for activity data.

When estimated, also the uncertainties of C stock changes in soil and dead organic matter are high. Portugal, for example, reported uncertainty of 30% and 95% for the dead organic matter and soil pools, respectively. For Finland, Monte Carlo method yielded 92% relative standard error for the carbon stock change in mineral soils in year 2006 and 78% in organic soils.

The heterogeneity of the reporting methods and the incompleteness of the estimates make it rather difficult to assess an uncertainty at the EU level. However, given the relative availability of uncertainty estimates for C stock changes in the living biomass of "forest land remaining forest land", for this pool and subcategory it is possible to compile a synthesis table with the information reported by MS (Tab. 7.17)

Table 7.17 Uncertainty (%) provided by MS in NIR 2008 submission for the net removal of CO_2 in living biomass under category 5A1- Forest remanining forest

Member State	Uncertainty for subcategory 5A1 (%)		
	Detailed uncertainty		Combined uncertainty
	Activity data (AD)	Emission factors (EF)	
Austria	30%		
Belgium			10 %
Denmark	20 %	20 %	28 %
Finland	0 %	37 %	37 %
France	30 %	50 %	58%
Germany	0 %	50 %	50 %
Greece	10 %	79 %	80 %

Ireland	30 %	100 %	104 %
Italy	30 %	54 %	62 %
Luxembourg			
Netherlands	25%	62 %	67%
Portugal	0.7 %	40 %	40 %
Spain			
Sweden			20%
United Kingdom	1 %	23 %	23 %

By gap-filling the missing information of Tab. 7.17 with average EU-15 values, and by using simple error propagation equations, the uncertainty for the C stock changes in the living biomass of subcategory 5.A.1 would be 24% at the EU-15 level.

This preliminary and incomplete estimate will be improved in next submission, by taking into account the effects of correlations (as already done in the Sector 4 – Agriculture) and, hopefully, by using more detailed information from MS on uncertainties of the various pools and categories. Indeed, despite the reported difficulties in estimating uncertainties of the LULUCF sector, MS are doing continuous efforts in this direction and better/more complete estimates are expected and foreseen in the near future by several MS (e.g. United Kingdom, Denmark).

7.5.2 Time series consistency

Time series consistency has been checked for all MS as part of the QA/QC programme of the EC inventory (see Ch. 7.6). Regarding land area, relatively small inconsistencies were found in several MS; as a result, there is a 1% difference between 1990 and 2006 in the sum of the area of all land uses at the EU-15 level. Such problems were generally caused by non-reporting of the area of some categories (e.g. some MS do not use the “Other land” category), by incorrect summing up of areas of land converted to another land use from year to year or by the use of inconsistent methods (e.g. forest inventory and statistics) to assess area of different land uses. Although such inconsistencies are generally very small, MS were strongly encouraged to correct them or at least to acknowledge and discuss the issue in their respective NIRs.

7.6 Category-specific QA/QC and efforts for improving reporting (EU-15)

QA/QC activitities and efforts for improving reporting occurred at both the national and the EC level.

At the national level, most MS have in place a quality management systems, which are part of national GHG estimation systems, that make clear flows of data and information for compilation and reporting, data storage and archiving, detailed institutional coordination and responsabilities, as well as adequate financial alocations. The national systems are designed to be continuously improved, by taking into account new practices and suggestions coming from the review of national reports or by independent assessments (i.e. scientific papers, institutional evaluation). Quality assurance includes peer and public reviews. The purpose of such systems is to ensure adequate levels of transparency, consistency, comparability, completeness, accuracy and timeliness, as requested both by international agrements and EC GHG monitoring directive.

Furthermore, 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 categories and subcategories of LULUCF sector
- use of improved activity data and emission factors
- developments in uncertainty estimation
- improved documentation on methodology
- national and joint research projects.

In addition to national efforts, several activities were carried out by the Joint Research Centre with respect to data quality of the LULUCF sector at the EC level, including:

- Checking of MS inventories for errors and inconsistencies, and interaction with national representatives when relevant. During the checking of the 2008 submission, 140 findings (i.e. possible problems, also based on the latest review of the EC inventory) were communicated to MS, ranging from problems in the use of notations keys, inconsistent land use data, outliers in IEF for all the categories, and various request of clarifications.

- Efforts for improving and harmonizing MS inventories, in close cooperation with the research community. Examples include:

  - 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)

  - Recently, a study under EEC 2152/2003 “Forest Focus regulation on developing harmonized methods for assessing carbon sequestration in European forests” (MASCAREF) has been launched with the purpose to facilitate the development of a monitoring scheme for carbon sequestration in EU forests, in order to i) strengthening and harmonizing the existing national systems to better meet the requirements of international monitoring and reporting of GHG emissions and sinks, and ii) improving the comparability, transparency and accuracy of the GHG inventory reports of the LULUCF sector of Member States, as implemented in the EC Monitoring Mechanism. The efforts undertaken under the task 1 (“LULUCF reporting requirements and realities”) have also been used in the compilation of this chapter.

  - Organization of workshops, e.g. “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) and “Technical meeting on specific forestry issues related to reporting and accounting under the Kyoto Protocol” (Ispra, 27-29 Novemebr 2006, 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)

  - The JRC’s AFOLU DATA web site (http://afoludata.jrc.it/) offer databases (e.g. allometric biomass carbon factors, European forest inventories, yield tables,…), models and other tools to promote transparent, complete, consistent and comparable estimates of greenhouse gas fluxes in the AFOLU sector in Europe. Target users are both greenhouse gas inventory practitioners and scientists.

7.7 Category-specific recalculations (EU-15)

Due to many methodological improvements, revision of activity data (e.g. revision or improvement of land use matrix) and the use of new or improved factors (e.g. biomass expansion factors), as well as reallocation of emissions between sectors and errors corrections, there have been a lot of recalculations (Tables 7.18 - 7.20). In some case, theese recalculations may also be explained by the ongoing efforts by Member States for the improvement of the estimates in the light of the incoming reporting under the Kyoto Protocol.

Table 7.18 shows the extent of recalculations in the LULUCF sector by gas for the EU-15 for 1990 and 2006. Table 7.19 provides an overview of Member States' contributions to EU-15 recalculations for the years 1990 and 2006.

Table 7.18 Sector 5 LULUCF: Recalculations of total GHG emissions and recalculations of net GHG emissions in CRF for 1990 and 2005 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	-50.392	-1,6%	-851	-0,2%	-8.415	-2,1%	5	0,0%	617	3,7%	-51	-0,5%
LULUCF (net)	-45.950	20,7%	816	71,9%	-610	-17,2%	NO	NO	NO	NO	NO	NO
2005												
Total emissions and removals	33.796	1,1%	2.011	0,6%	-11.037	-3,3%	220	0,4%	-35	-0,6%	-70	-0,8%
LULUCF (net)	30.307	-9,5%	945	108,2%	-317	-12,6%	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 2005 by gas (difference between latest submission and previous submission Gg of CO_2 equivalents)

	1990						2005					
	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
Austria	-2.680	0	241	NO	NO	NO	-1.351	0	258	NO	NO	NO
Belgium	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
Denmark	0	0	0	NO	NO	NO	820	0	0	NO	NO	NO
Finland	2.952	-5	0	NO	NO	NO	-538	-2	0	NO	NO	NO
France	-6.038	653	-794	NO	NO	NO	-2.713	712	-453	NO	NO	NO
Germany	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
Greece	-21	0	0	NO	NO	NO	176	4	0	NO	NO	NO
Ireland	51	2	15	NO	NO	NO	202	1	33	NO	NO	NO
Italy	1.363	0	-16	NO	NO	NO	-2.666	0	-129	NO	NO	NO
Luxembourg	0	0	-22	NO	NO	NO	0	0	-22	NO	NO	NO
Netherlands	275	0	0	NO	NO	NO	240	0	0	NO	NO	NO
Portugal	-2.284	0	0	NO	NO	NO	-6.903	1	0	NO	NO	NO
Spain	15.649	171	17	NO	NO	NO	16.431	236	24	NO	NO	NO
Sweden	-55.265	-10	-57	NO	NO	NO	26.589	-8	-30	NO	NO	NO
UK	47	4	7	NO	NO	NO	20	2	2	NO	NO	NO
EU-15	**-45.950**	**816**	**-610**	**NO**	**NO**	**NO**	**30.307**	**945**	**-317**	**NO**	**NO**	**NO**

NO: not occurring

Recalculations for main subcategories for the year 1990 are shown in Table 7.20. The whole effect is a change in both net emissions and removals (22 cases of R+ and 12 cases of R-; 20 cases of E+ and 15 cases of E-), with only very few cases of "no recalculation". In few cases some subcategories have not been reported anymore for 1990 in current submission, while in other cases new subcategories were reported.

Table 7.20 Subcategories where individual MS have recalculated the values submitted last year for the year 1990

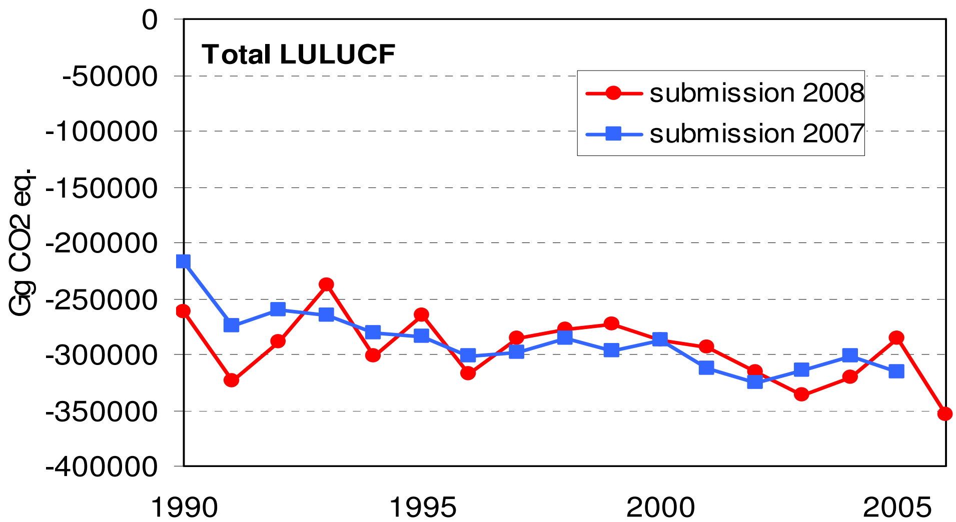
Member State	Reporting category											
	Forest land		Cropland		Grassland		Wetland		Settlements		Other land	
	5.A.1. FL-FL	5.A.2. L-FL	5.B.1. CL-CL	5.B.2. L-CL	5.C.1. GL-GL	5.C.2. L-GL	5.D.1. WL-WL	5.D.2. L-WL	5.E.1. SL-SL	5.E.2. L-SL	5.F.1. OL-OL	5.F.2. L-OL
Austria	R -	R+	E+	E+	E+	R+		E-		R+		E+
Belgium	R+		E+		E-							

Denmark	0		E+		E+		E+					
Finland	R-		E-		R+			0				
France	R+	R+	E	E-		R+		E+		E-		E+
Germany	0	0	0	0	0	0						0
Greece	R-		R+									
Ireland	R-	E+	E-		E+	R+	E+			E-		R+
Italy	R+	R+	R-							E+		
Luxembourg												
Netherlands	R-	R+		R+	0	E+				R-		E+
Portugal	E-	R-	R-	E-		R-		E-	E-	E-		E-
Spain	R+											
Sweden	R+	E+	E-	R+	R-	R+			R+	R+		
United Kingdom		R-	E+	E+	E+	R+				E-		

Legend: 0 = no recalculation; empty cell = not reported
R = net Removal in 1990; E = net Emission in 1990; the "-" signs mean that the current (2008) reclaculeted values for 1990 are smaller (in absolute terms) than the ones submitted last year, whereas the "+" signs mean the opposite. "0" menas no recalculation. Dark cells indicate a change in comparison to 2007 submission: a subcategory previously reported for 1990 but not reported anymore (dark empty cell) or a subcategory reported for 1990 for the first time in current submission (dark cell with R or E).

The quantitative effect of the recalculations over the total emission of LULUCF sector (Figure 7.3) is an increase of net removals, especially in the early 1990s, as well as a higher oscillation. The general trend of increasing sink over time, however, was maintained.

Figure 7.3. LULUCF sector recalculations in 2008 submission compared with previous submission (2007)



Recalculations regarded mainly categories 5A, 5B and 5C (Figure 7.4, 7.5 and 7.6).

In absolute terms, the major recalculations were carried out by Sweden in category 5A1, which led to the higher variability and net removals especially in the early 1990s (see Fig. 7.4). However, according to a communication from Swedish Environmental Protection Agency (2008-05-20, Dnr 125-989-07 Md), these recalculations are affected by an interpolation error, and thus will be soon revised. Significant recalculations, leading to higher removals, occurred for the most recent years also for Spain, Finland and Portugal.

Regarding subcategory 5A2, the recalculated sink is smaller for all 1990-2006 period than in previous submission (Fig. 7.4) mainly due to a decrease in the area under this subcategory reported by Spain.

Figure 7.4. Subcategories 5A1 and 5A2: *difference* between emissions/revomals in 2008 submission compared with previous submission (2007)

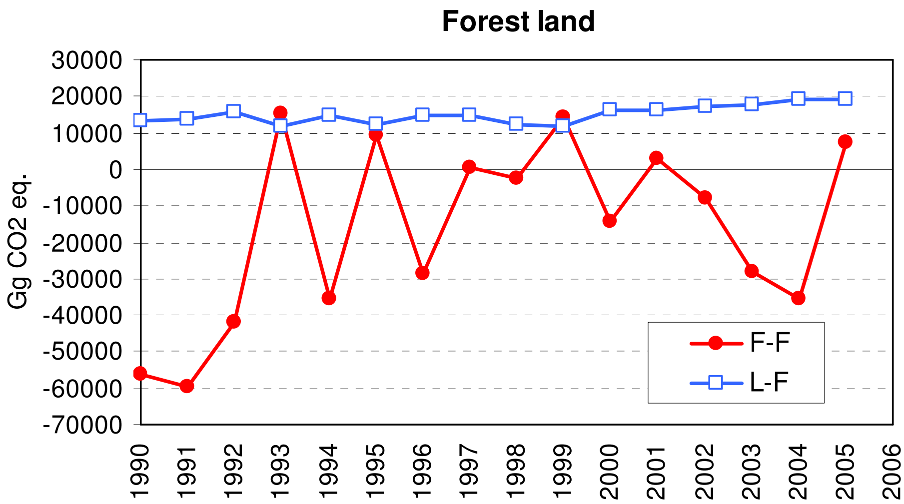
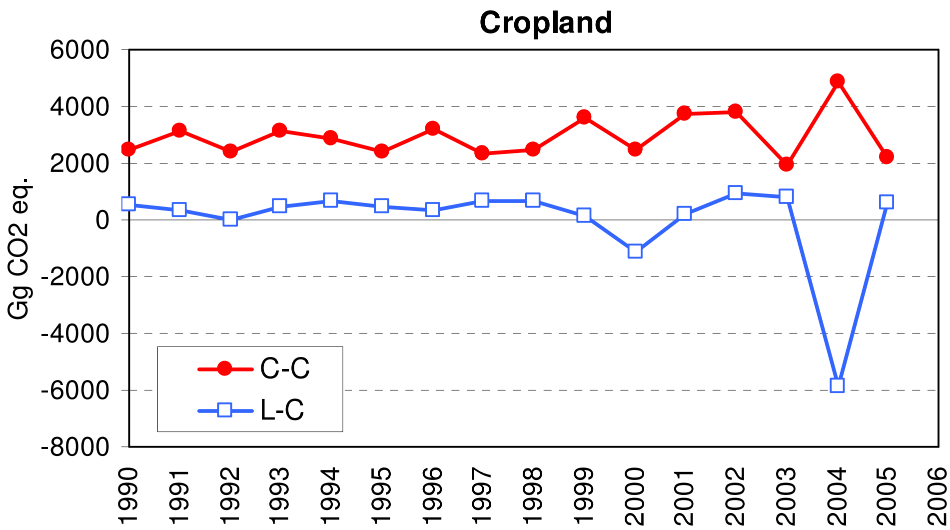
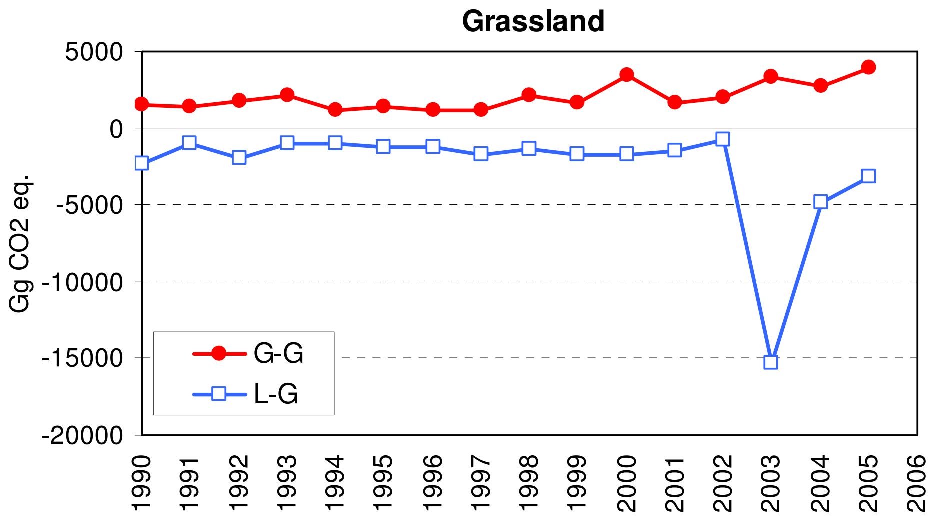


Figure 7.5. Subcategories 5B1 and 5B2: *difference* between emissions/revomals in 2008 submission compared with previous submission (2007)



Recalculations in 5B1 and 5B2 generally resulted in higher emissions than in the previous submission (Fig. 7.5), except for a major change in 2004 under 5B2, due to recalculation from Italy (which reallocated some emissions previously reported under 5A2 in 2004). In case of grasslands (5C), the recalculations resulted in higher emissions in 5C1 “grassland remainig grassland” and lower increased sink in 5C2 “land converted to grasslands”. The peak in removals was due to Italy, which reported a much increased sinks in 2003.

Figure 7.6. Subcategories 5C1 and 5C2: *difference* between emissions/revomals in 2008 submission compared with previous submission (2007)

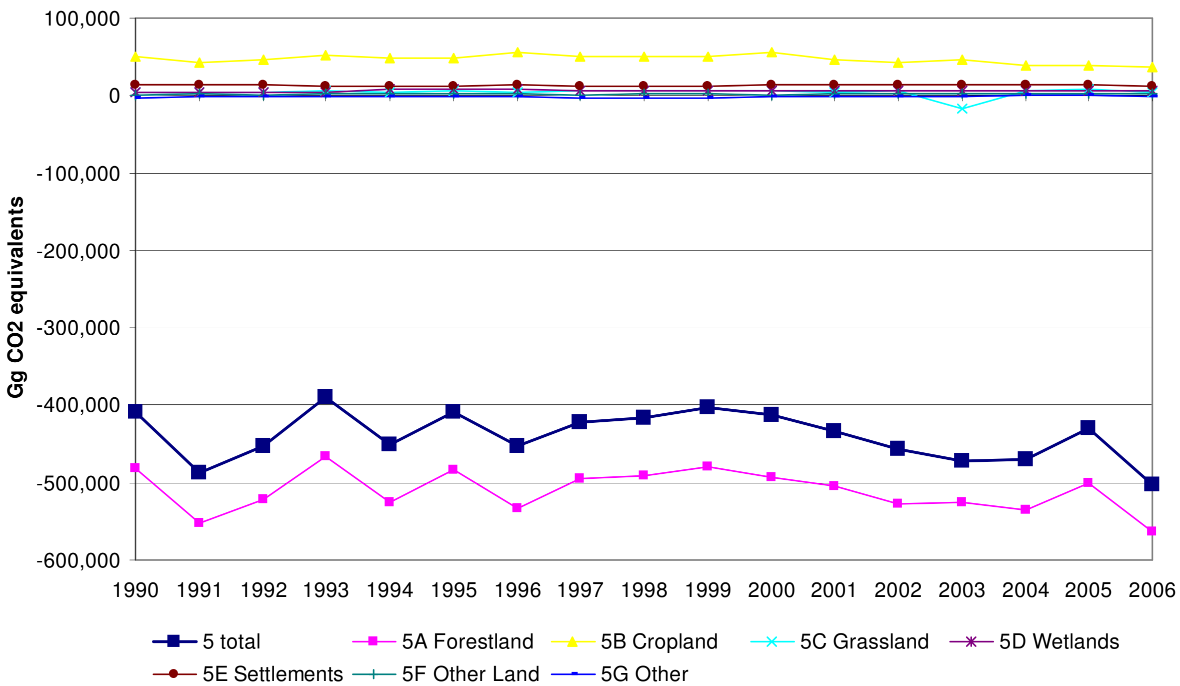


7.8 LULUCF for EU-27

7.8.1 Overview of sector (EU-27)

At the EU-27 level, the LULUCF sector is a net sink of about 500 000 Gg CO_2/year (Figure 7.7), with a similar structure of removals and emissions across categories as in EU-15. Main net removal is by the category 5A (forest land), while main emissions are associated to croplands.

Figure 7.3 Sector 5 LULUCF: EU-27 net GHG emissions (emissions minus removals) for 1990–2006 from CRF in CO_2 equivalents (Gg)



7.8.2 General methodological information (EU-27)

Reporting is rather complete for the category 5A, while the other categories are generally scarcely reported (Table 7.21). For the year 2006, some new MS reported for first time some subcategories, while few countries did not report anymore some subcategories previously reported.

Table 7.21 Sector 5 LULUCF: Coverage of CO_2 emissions and removals in the various subcategories for the year 2006, as derived from Table 5 of new MS's CRF.

Member State	Reporting category											
	Forest land		Cropland		Grassland		Wetland		Settlements		Other land	
	5.A.1. F-F	5.A.2. L-F	5.B.1. C-C	5.B.2. L-C	5.C.1. G-G	5.C.2. L-G	5.D.1. W-W	5.D.2. L-W	5.E.1. S-S	5.E.2. L-S	5.F.1. O-O	5.F.2. L-O
Bulgaria	R		R				E					
Cyprus	R											
Czech Republic	R	R	R	E		R		E		E		
Estonia	R											
Hungary	R	R	R									
Latvia	R	R	E		R							
Lithuania	R	R					E					
Malta	R	R										
Poland	R	R	E		E		E	E	R			
Romania	R											
Slovakia	R	R				R						E
Slovenia	R											

Legend: R = net Removal; E = net Emission; empty cells = not reported
Dark cells indicate a change in comparison to last year's submission: a subcategory previously reported but not reported anymore (dark empty cell) or a subcategory reported this year for the first time (dark cell with E or R).

Regarding the pools covered, forest biomass is almost always reported under 5A1, while all the other pools across all land use categories/subcategories are poorly reported (Table 7.22). Few countries included new pools in current reporting, while few have not reported anymore some pools.

Table 7.22 Sector 5 LULUCF: Reporting of carbon pools for the most important categories for the year 2006, with highlighted the pools reported for the first time in 2008 (from Tables 5A, 5B and 5C of MS's CRF).

Member State	Reporting category																							
	Forest land								Cropland								Grassland							
	5.A.1. F-F				5.A.2. L-L				5.B.1. C-C				5.B.2. L-C				5.C.1. G-G				5.C.2. L-G			
Carbon pools	Biomass	DOM	Soil MIN	Soil ORG	Biomass	DOM	Soil MIN	Soil ORG	Biomass	DOM	Soil MIN	Soil ORG	Biomass	DOM	Soil MIN	Soil ORG	Biomass	DOM	Soil MIN	Soil ORG	Biomass	DOM	Soil MIN	Soil ORG
Bulgaria	I								I															
Cyprus	I																							
Czech Republic	I		I		I		I		I		I		D		D						I		I	
Estonia	I			D																				
Hungary	I				I				I		D													
Latvia	I	I			I				I			D					I			D				
Lithuania	I			D	I																			
Malta		I																						
Poland	I		I		I		I		I		D								D					
Romania	I																							

Slovakia	I					I												0	0			I		
Slovenia	I																							

Legend: I = net Increase (i.e. the pool is a net sink); D = net Decrease (i.e. the pool is a net source); Empty cells = the pool was not reported or reported as zero. Dark cells indicate a change in comparison to last year's submission: a pool previously reported but not reported anymore (dark empty cell) or a pool reported this year for the first time (dark cell with D or I).

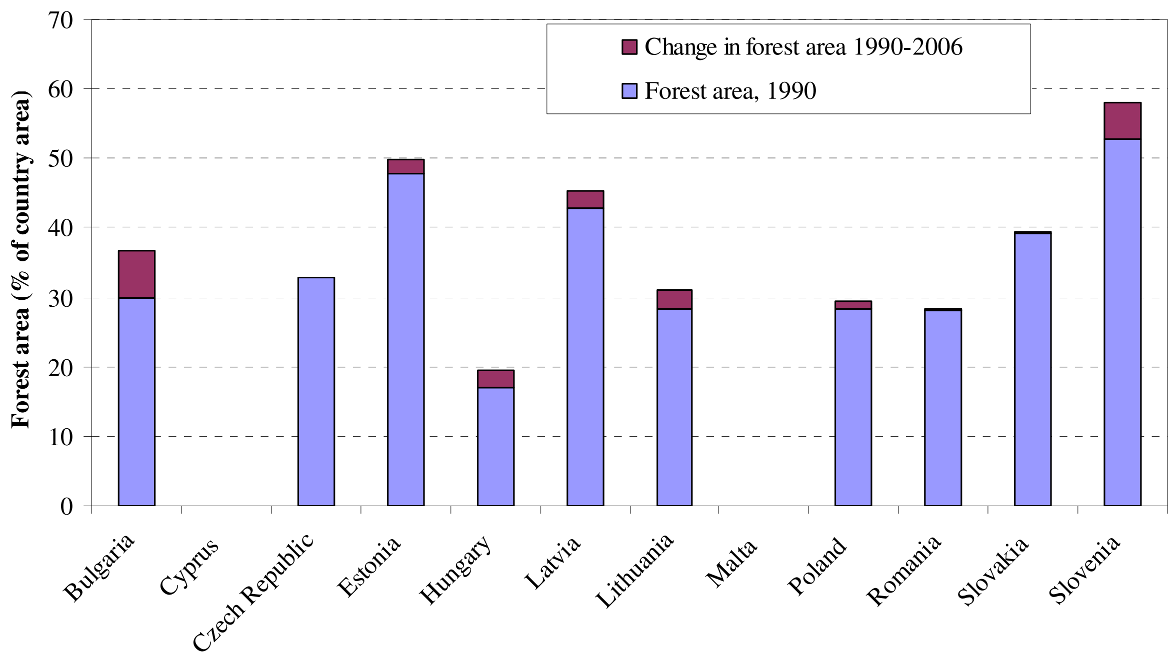
Most of the methodological considerations expressed for EU-15 are also valid for the new MS. To this regards, it should be considered that the availability of a harmonised National Forest Inventories is less frequent in New EU MS, which often utilise other national annual statistics. The lack of a harmonised system is often due to the political changes that those countries had to face in the 90's. On the other hand, the implementation of a NFI system is ongoing is several new Member States (Czech, Latvia, Romania, Slovenia).

Furthermore, given the general shorter experience in reporting GHG emissions/removals, most new MS reported less categories and pools that most of the EU-15 MS. However, in most of the new MS the ongoing efforts are witnessed by more complete reporting (e.e. Czech Republic), by improving the activity data (e.g., the well documented land use matrix change in Czech Republic) and the emission factors (e.g., adjustements of biomass expansion factors by Poland), by changing the estimation methods (e.g., Hungary), by continuos recalculations, by efforts for estimating uncertainties and improving the transparency of the reporting, and by the active participation in European projects aimed at improving the reporting.

6.7.2.4 Forest land (5A1) (EU-27)

According to the latest submissions, EU-27 has a forest area of about 156 Millions ha, 28.6 % more than EU 15's forest land. Since 1990, the new MS have reported on the whole an increase of 23% of forest area as compared to 1990, due especially to Bulgaria, Poland, Hungary, Slovenia and Baltic countries (Figure 7.8).

Figure 7.8 The percentage of forest land to total land area in various new EU MS in 1990 and 2006.



As in EU-15, for the LULUCF sector of the new MS, the category 5A land remaining forest land is the most significant contribution at sector's GHG balance. Subcategory 5A represents a net sink (Table 7.23), of which only some 10-12% is the contribution of 5A2.

Table 7.23 5A1 Forest Land remaining Forest Land: Net CO_2 emissions of EU-27

Member State	Net CO_2 emissions (Gg)			Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006	(Gg CO_2)	(%)	(Gg CO_2)	(%)			
EU-15	-306,127	-303,533	-362,363	-58,830	19%	-56,236	18%			
Bulgaria	-6,157	-6,996	-6,996	0	0%	-839	14%	CS	NS	CS
Cyprus	-22	-165	-166	-1	1%	-144	639%	T1	NS, IS	D
Czech Republic	-4,957	-6,082	-2,997	3,085	-51%	1,959	-40%	T1, T2,	NS, PS,	CS, D
Estonia	-5,379	-4,427	-3,482	944	-21%	1,896	-35%	T1	NS, IS	D
Hungary	-3,942	-5,323	-4,465	858	-16%	-523	13%	T1, T2	NS	D, CS
Latvia	-18,530	-12,574	-16,061	-3,487	28%	2,469	-13%	T1	NS	D
Lithuania	-9,299	-7,705	-7,539	166	-2%	1,760	-19%	T1	NS	CS, D
Malta	-112	-112	-112	0	0%	0	0%	T1	NS, IS	D
Poland	-35,948	-45,995	-50,835	-4,841	11%	-14,887	41%	T1/T2	NS	CS/D
Romania	-35,848	-37,483	-37,497	-14	0%	-1,649	5%	T1, T2	NS	CS, D
Slovakia	-4,454	-187	-2,577	-2,391	1279%	1,877	-42%	T2	PS	PS
Slovenia	-3,186	-5,430	-4,733	697	-13%	-1,547	49%	D,T2	NS, AS, Q	CS,D
EU-27	**-433,962**	**-436,013**	**-499,826**	**-63,813**	**15%**	**-65,864**	**15%**			

Table 7.24 5A2 Land converted to Forest Land: Net CO_2 emissions of EU-27

Member State	Net CO_2 emissions (Gg)			Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006	(Gg CO_2)	(%)	(Gg CO_2)	(%)			
EU-15	-39,947	-56,000	-58,036	-2,036	4%	-18,089	45%			
Bulgaria	-5	NE	NE	-	-	5	-100%	0.0	0.0	0.0
Cyprus	-	NA	NA	-	-	0	-	NA	0.0	NA
Czech Republic	-368	-361	-369	-7	2%	-1	0%	T1, T2	NS, PS	CS, D
Estonia	NE,NO	NE,NO	NE,NO	-	-	-	-	NA	0.0	NA
Hungary	21	-473	-196	277	-59%	-217	-1033%	T2	NS	CS
Latvia	-2,136	-1,566	-1,548	19	-1%	589	-	T1	NS	D
Lithuania	-1,936	-1,781	-563	1,218	-68%	1,373	-71%	T1	NS	CS, D
Malta	NA,NO	NA,NO	NA,NO	-	-	-	-	NA	0.0	NA
Poland	-2,844	-3,232	-3,431	-199	6%	-587	21%	T1/T2	NS	CS/D
Romania	NA,NE	NA,NE	NA,NE	-	-	-	-	NA	NE	NA
Slovakia	IE,NE,NO	-514	-519	-5	1%	-519	-	CS	NS	CS
Slovenia	IE,NE,NO	IE,NE,NO	IE,NE,NO	-	-	-	-	NE	NE	NE
EU-27	**-47,215**	**-63,928**	**-64,662**	**-734**	**1%**	**-17,447**	**37%**			

6.7.2.5 Cropland (5B) and Grassland (5C) (EU-27)

Table 7.25 5B1 Crop Land remaining Crop Land: Net CO_2 emissions of EU-27

Member State	Net CO_2 emissions (Gg)			Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006	(Gg CO_2)	(%)	(Gg CO_2)	(%)			
EU-15	17,735	11,432	9,636	-1,796	-16%	-8,099	-46%			
Bulgaria	-20,790	-11,968	-11,829	139	-1%	8,960	-43%	CS	NS	CS
Cyprus	-	0	0	-	-	-	-	NA	0.0	NA
Czech Republic	1,089	42	50	8	20%	-1,039	-95%	T1	NS	D
Estonia	NE	NE	NE	-	-	-	-	NA	0.0	NA
Hungary	-2,002	-1,491	-1,278	213	-14%	724	-36%	T1	NS	D
Latvia	153	35	64	29	85%	-89	-58%	T1	NS	D
Lithuania	93	NA,NE	NA,NE	-	-	-93	-100%	T1	NS	CS, D
Malta	NE,NO	NE,NO	NE,NO	-	-	-	-	NA	0.0	NA
Poland	10,773	8,522	8,237	-285	-3%	-2,536	-24%	T1	NS	D /CS
Romania	NA,NE	NA,NE	NA,NE	-	-	-	-	NA	NE	NA
Slovakia	3,287	1	1	0	0%	-3,286	-100%	T1	NS	D
Slovenia	NA,NE	NA,NE	NA,NE	-	-	-	-	NE	NE	NE
EU-27	**10,338**	**6,572**	**4,881**	**-1,691**	**-26%**	**-5,457**	**-53%**			

Table 7.26 5B2 Land converted to Crop Land: Net CO_2 emissions of EU-27

Member State	Net CO_2 emissions (Gg)			Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006	(Gg CO_2)	(%)	(Gg CO_2)	(%)			
EU-15	40,652	31,995	31,702	-293	-1%	-8,950	-22%			
Bulgaria	NE	NE	NE	-	-	-	-	0.0	0.0	0.0
Cyprus	-	0	0	-	-	-	-	NA	0.0	NA
Czech Republic	220	98	81	-17	-17%	-139	-63%	T1,T2	NS	CS, D
Estonia	NE	NE	NE	-	-	-	-	NA	0.0	NA
Hungary	IE,NE,NO	IE,NE,NO	IE,NE,NO	-	-	-	-	---	---	---
Latvia	NE	NE	NE	-	-	-	-	T1	NS	D
Lithuania	NA,NE	NA,NE	NA,NE	-	-	-	-	T1	NS	CS, D
Malta	NE,NO	NE,NO	NE,NO	-	-	-	-	NA	0.0	NA
Poland	NE,NO	NE,NO	NE,NO	-	-	-	-	T1	NS	D /CS
Romania	NA,NE	NA,NE	NA,NE	-	-	-	-	NA	NE	NA
Slovakia	NE,NO	NE,NO	NE,NO	-	-	-	-	CS	NS	CS
Slovenia	NE,NO	NE,NO	NE,NO	-	-	-	-	NE	NE	NE
EU-27	**40,872**	**32,093**	**31,783**	**-310**	**-1%**	**-9,088**	**-22%**			

Table 7.27 5C1 Grass Land remaining Grass Land: Net CO_2 emissions of EU-27

Member State	Net CO_2 emissions (Gg)			Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006	(Gg CO_2)	(%)	(Gg CO_2)	(%)			
EU-15	21,988	27,945	21,913	-6,032	-22%	-76	0%			
Bulgaria	NE,NO	NE,NO	NE,NO	-	-	-	-	CS	NS	CS
Cyprus	-	0	0	-	-	-	-	NA	0.0	NA
Czech Republic	52	2	3	0	12%	-49	-95%	NE, T1	NS	D
Estonia	NE	NE	NE	-	-	-	-	NA	0.0	NA
Hungary	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	-	-	-	-	T1	NS	D
Latvia	-195	-387	-307	80	-21%	-113	58%	T1	NS	D
Lithuania	NA,NE	NA,NE	NA,NE	-	-	-	-	T1	NS	CS, D
Malta	NE,NO	NE,NO	NE,NO	-	-	-	-	NA	0.0	NA
Poland	148	132	131	-	-	-	-	T1	NS	D /CS
Romania	NA,NE	NA,NE	NA,NE	-	-	-	-	NA	NE	NA
Slovakia	536	NE,NO	NE,NO	-	-	-536	-100%	T1	NS	D
Slovenia	NE,NO	NE,NO	NE,NO	-	-	-	-	NE	NE	NE
EU-27	**22,530**	**27,692**	**21,739**	**-5,953**	**-21%**	**-791**	**-4%**			

Table 7.28 5C2- Land converted to Grass Land: Net CO_2 emissions of EU-27

Member State	Net CO_2 emissions (Gg)			Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006	(Gg CO_2)	(%)	(Gg CO_2)	(%)			
EU-15	-17,922	-18,607	-16,872	1,736	-9%	1,050	-6%			
Bulgaria	NE,NO	NE,NO	NE,NO	-	-	-	-	0.0	0.0	0.0
Cyprus	-	0	0	-	-	-	-	NA	0.0	NA
Czech Republic	-189	-395	-399	-5	1%	-210	111%	T1, T2	NS	CS, D
Estonia	NE	NE	NE	-	-	-	-	NA	0.0	NA
Hungary	IE,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	-	-	-	-	---	---	---
Latvia	NE	NE	NE	-	-	-	-	T1	NS	D
Lithuania	NA,NE	NA,NE	NA,NE	-	-	-	-	T1	NS	CS, D
Malta	NE,NO	NE,NO	NE,NO	-	-	-	-	NA	0.0	NA
Poland	-71	-137	NE,NO	137	-100%	71	-100%	T1	NS	D /CS
Romania	NA,NE	NA,NE	NA,NE	-	-	-	-	NA	NE	NA
Slovakia	NE,NO	-442	-439	2	0%	-439	-	CS	NS	CS
Slovenia	NE,NO	NE,NO	NE,NO	-	-	-	-	NE	NE	NE
EU-27	**-18,181**	**-19,581**	**-17,710**	**1,871**	**-10%**	**471**	**-3%**			

7.8.3 Recalculations (EU-27)

Table 7.29 Sector 5 LULUCF: Subcategories where individual New Member States have recalculated the values submitted last year for the year 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
Bulgaria	0		R+									
Cyprus	R+											
Czech Republic	R+	R+	R	E		R+		E		E		
Estonia	R+											
Hungary	R+	E+	R+									
Latvia	R+	R-	E-		R+							
Lithuania	R-	R+					E+					
Malta												
Poland	R+	R -	E+		E	R-	E		R+			
Romania	0											
Slovakia	0		0		0						0	
Slovenia	0											

Legend: 0 = no recalculation; empty cell = not reported

R = net Removal in 1990; E = net Emission in 1990; the "-" signs mean that the current (2008) reclaculeted values for 1990 are smaller (in absolute terms) than the ones submitted last year, whereas the "+" signs mean the opposite. Dark cells indicate a change in comparison to 2007 submission: a subcategory previously reported for 1990 but not reported anymore (dark empty cell) or a subcategory reported for 1990 for the first time in current submission (dark cell with R or E).

8 Waste (CRF Sector 6)

This chapter starts with an overview on emission trends in CRF Sector 6 Waste for EU-15 Member States. For each EU-15 key source, overview tables are presented including the Member States contributions to the key source in terms of level and trend, information on methodologies and emission factors. The quantitative uncertainty estimates for this sector and the sector-specific QA/QC activities are summarised in separate sections. This cchapter furthermore includes an overview of recalculations. At the end of the chapter, an overview of the sector for EU-27 is provided.

8.1 Overview of sector (EU-15)

CRF Sector 6 Waste is the fourth largest sector in the EU-15, contributing 2.6 % to total GHG emissions. Total emissions from Waste have been decreasing by 39 % from 175 Tg in 1990 to 107 Tg in 2006 (Figure 8.1). In 2006, emissions decreased by 3.1 % compared to 2005. 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 1990–2006 from CRF in CO_2 equivalents (Tg)

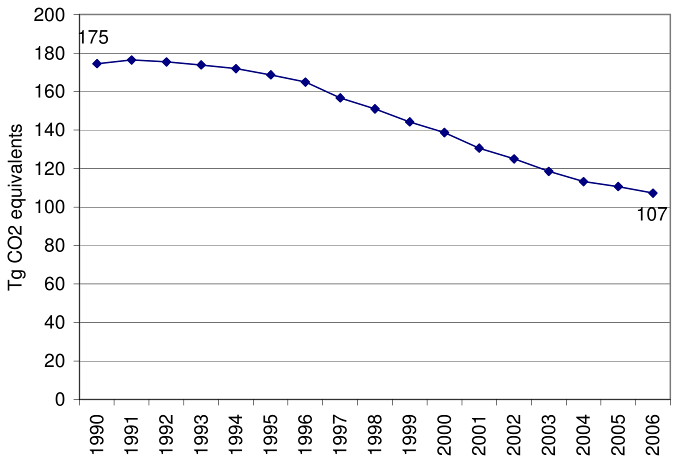
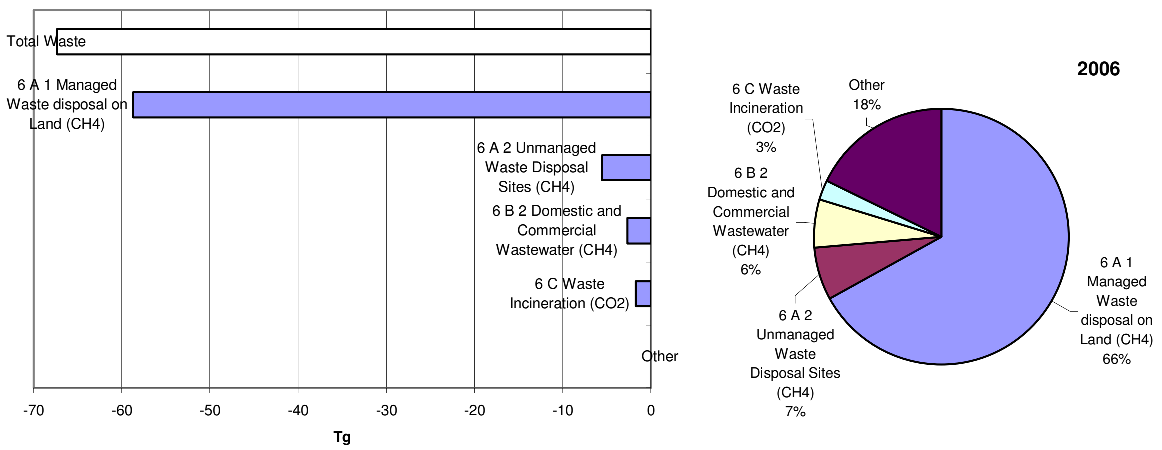


Figure 8.2 shows that CH_4 emissions from 6A1 Managed Waste Disposal on Land had the greatest decrease of all waste-related emissions, but still accounts for 66 % of waste-related GHG emissions in the EU-15 .

Figure 8.2 **Sector 6 Waste: Absolute change of GHG emissions by large key source categories 1990–2006 in CO_2 equivalents (Tg) and share of largest key source categories in 2006**



8.2 Source categories (EU-15)

8.2.1 Solid waste disposal on land (CRF Source Category 6A) (EU-15)

Source category 6A Solid waste disposal on land includes two key sources: CH_4 from 6A1 Managed waste disposal on land and CH_4 from 6A2 Unmanaged waste disposal on land. Methane is produced from anaerobic microbial decomposition of organic matter in solid waste disposal sites. Source category 6A1 Managed waste disposal on land includes CH_4 emission arising from managed solid waste landfills. Methane recovery can also be reflected in this category. Source category 6A2 comprises corresponding CH_4 emissions from unmanaged landfills (without methane recovery).

Table 8.1 provides total greenhouse gas and CH_4 emissions by Member State from 6A Solid Waste Disposal on Land. CH_4 emissions from this category decreased by 44 % between 1990 and 2006 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 2006 (Gg CO_2 equivalents)	CH_4 emissions in 1990 (Gg CO_2 equivalents)	CH_4 emissions in 2006 (Gg CO_2 equivalents)
Austria	3,377	1,760	3,377	1,760
Belgium	2,630	680	2,630	680
Denmark	1,335	1,028	1,335	1,028
Finland	3,639	2,139	3,639	2,139
France	11,113	8,755	11,113	8,755
Germany	35,910	9,618	35,910	9,618
Greece	1,801	2,647	1,801	2,647
Ireland	1,332	1,669	1,332	1,669
Italy	13,298	13,638	13,298	13,638
Luxembourg	43	22	43	22
Netherlands	12,011	5,646	12,011	5,646
Portugal	3,033	4,222	3,033	4,222
Spain	4,417	8,189	4,198	8,175
Sweden	2,874	1,845	2,874	1,845
United Kingdom	49,817	19,456	49,817	19,456
EU-15	**146,628**	**81,316**	**146,410**	**81,303**

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 1.7 % of total EU-15 GHG emissions. Between 1990 and 2006, CH_4 emissions from managed landfills declined by 45 % in the EU-15. In 2006, CH_4 emissions from landfills decreased by 4 % compared to 2005. 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 35 % between 1990 and 2006. 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 2006. 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 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	3,377	1,897	1,760	2.5%	-137	-7%	-1,617	-48%	T2	NS	CS
Belgium	2,630	841	680	0.9%	-160	-19%	-1,949	-74%	CS	PS	CS
Denmark	1,335	1,043	1,028	1.4%	-15	-1%	-307	-23%	T2/CS	NS/PS	CS
Finland	2,235	1,306	1,389	1.9%	83	6%	-846	-38%	T2	NS	D, CS
France	6,278	7,391	6,924	9.7%	-467	-6%	646	10%	CS/ T2	NS	CS
Germany	35,910	10,416	9,618	13.4%	-798	-8%	-26,292	-73%	T2	NS	CS/ D
Greece	542	866	987	1.4%	121	14%	445	82%	T2	NS	D, CS
Ireland	980	1,190	1,288	1.8%	98	8%	307	31%	T2	NS	D
Italy	8,697	12,641	11,934	16.6%	-707	-6%	3,237	37%	T2	NS	CS
Luxembourg	43	24	22	0.0%	-2	-6%	-20	-47%	T2	NS	D
Netherlands	12,011	6,059	5,646	7.9%	-413	-7%	-6,364	-53%	T2	AS	CS
Portugal	428	1,943	1,945	2.7%	3	0%	1,518	355%	T2	NS	CS,D
Spain	3,452	7,733	7,256	10.1%	-477	-6%	3,804	110%	T2	NS, Q	D, C, CS
Sweden	2,874	1,923	1,845	2.6%	-78	-4%	-1,029	-36%	T3	NS	D, CS
United Kingdom	49,625	19,471	19,408	27.1%	-63	0%	-30,218	-61%	M	AS	CS
EU-15	**130,417**	**74,742**	**71,731**	**100.0%**	**-3,011**	**-4%**	**-58,687**	**-45%**			

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 2006, CH_4 emissions from this source decreased by 43 % 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 71 % of the total EU-15 emissions. France and Italy had large absolute reductions between 1990 and 2006.

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 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Belgium	0	0	0	-	-	-	-	-	NA	NA	NA
Denmark	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Finland	IE,NO	NO	NO	-	-	-	-	-	NO	NO	NO
France	4,835	1,977	1,831	25.3%	-146	-7%	-3,004	-62%	CS/ T2	NS	CS
Germany	NO	NO	NO	-	-	-	-	-	T2	NS	CS/ D
Greece	1,255	1,525	1,614	22.3%	89	6%	359	29%	T2	NS	CS, D
Ireland	352	425	382	5.3%	-44	-10%	30	8%	T2	NS	D
Italy	4,601	1,795	1,704	23.5%	-92	-5%	-2,897	-63%	T2	NS	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Netherlands	NO	NO	NO	-	-	-	-	-	NA	NA	NA
Portugal	1,006	871	802	11.1%	-69	-8%	-204	-20%	T2	NS	CS,D
Spain	734	943	918	12.7%	-24	-3%	185	25%	T2	NS	D
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA	NA
United Kingdom	NA	NA	NA	-	-	-	-	-	NO	NO	NO
EU-15	**12,782**	**7,536**	**7,251**	**100.0%**	**-286**	**-4%**	**-5,531**	**-43%**			

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 2005 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 2005 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2005		Main explanations
	Gg	Percent	Gg	Percent	
Austria	0,0	0,0	17,0	0,9	
Belgium	0,0	0,0	17,6	2,1	
Denmark	0,0	0,0	-16,0	-1,5	
Finland	-13,7	-0,4	-14,2	-0,7	Corrected calculation error
France	0,0	0,0	3,3	0,0	
Germany	0,0	0,0	0,0	0,0	
Greece	0,0	0,0	0,0	0,0	
Ireland	0,2	0,0	-2,7	-0,2	
Italy	0,0	0,0	0,0	0,0	
Luxembourg	10,1	31,1	0,0	0,0	
Netherlands	0,0	0,0	128,4	2,2	Error corrections and improved activity data
Portugal	-859,2	-22,1	-403,3	-8,4	Revision of the DOCf value
Spain	152,9	3,8	48,3	0,6	New data have been received in questionnaires on waste deposited and landfill gas captured from managed landfills; that information was not available for the previous inventory edition. The emissions from managed SWDS having applied some system of combustion to captured biogas with energy recovery (boilers, turbines or engines), that were previously reported within 6.a.1 category of "Waste" sector, are now reported within category 1.A.1 of "Energy" sector.
Sweden	0,0	0,0	0,0	0,0	
UK	44,1	0,1	-28,9	-0,1	The methodology for calculating emissions from landfill sites in Guernsey has been improved.
EU-15	**-665**	**0**	**-251**	**0**	

8.2.2 Wastewater handling (CRF Source Category 6B) (EU-15)

Source category 6B includes two key sources: CH_4 and N_2O from 6B2 Domestic and commercial wastewater. Methane and nitrous oxide are produced from anaerobic decomposition of organic matter by bacteria in sewage facilities. N_2O may also be released from wastewater handling and human waste. Domestic and commercial wastewater includes the handling of liquid wastes and sludge from housing and commercial sources (including human waste) through wastewater collection and treatment, open pits/latrines, ponds, or discharge into surface waters. N_2O emissions from discharge of human sewage to aquatic environments are included here.

Table 8.5 shows total GHG, CH_4 and N_2O emissions by Member State from 6B Wastewater Handling. Between 1990 and 2006, CH_4 emissions from wastewater handling decreased by 22 %, N_2O emissions from wastewater handling increased by 6 %.

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 2006 (Gg CO_2 equivalents)	CH_4 emissions in 1990 (Gg CO_2 equivalents)	CH_4 emissions in 2006 (Gg CO_2 equivalents)	N_2O emissions in 1990 (Gg CO2 equivalents)	N_2O emissions in 2006 (Gg CO2 equivalents)
Austria	210	320	102	41	108	278
Belgium	490	407	219	134	270	273
Denmark	213	298	126	248	88	50
Finland	297	234	154	133	144	102
France	1,952	2,184	768	1,186	1,185	998
Germany	4,450	2,457	2,226	115	2,224	2,342
Greece	2,644	891	2,319	519	325	372
Ireland	129	162	15	24	114	138
Italy	3,852	4,387	1,988	2,390	1,864	1,996
Luxembourg	7	8	0	0	7	8
Netherlands	803	581	290	201	513	381
Portugal	2,884	2,413	2,442	1,836	442	577
Spain	2,313	3,425	1,240	2,210	1,072	1,215
Sweden	195	138	IE,NE,NO	IE,NE,NO	195	138
United Kingdom	1,743	2,058	710	810	1,034	1,248
EU-15	**22,183**	**19,963**	**12,598**	**9,849**	**9,585**	**10,114**

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 2006 emissions decreased by 29 %. 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 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	102	41	41	0.6%	0	1%	-60	-59%	D	NS	D,CS
Belgium	219	133	134	2.0%	1	1%	-86	-39%	T1/C	PS	D/C
Denmark	126	262	248	3.8%	-13	-5%	123	98%	D/CS	NS	D/CS
Finland	131	107	106	1.6%	-1	-1%	-26	-20%	D	NS	CS, D
France	768	1,164	1,186	18.1%	22	2%	418	55%	CS/ T2	NS	CS
Germany	2,226	123	115	1.8%	-8	-6%	-2,111	-95%	CS/ D	NS	CS/ D
Greece	2,211	406	406	6.2%	0	0%	-1,806	-82%	D	NS	D
Ireland	13	19	19	0.3%	0	2%	6	49%	T1	NS	D
Italy	711	1,106	1,145	17.5%	39	4%	434	61%	D	NS	D
Luxembourg	0	0	0	0.0%	0	-3%	0	-40%	T1	NS	D
Netherlands	190	172	171	2.6%	-2	-1%	-20	-10%	T2	NS	CS
Portugal	1,056	640	587	9.0%	-52	-8%	-469	-44%	D	NS	CS,D
Spain	756	1,522	1,582	24.2%	60	4%	826	109%	D	NS	D, CS
Sweden	IE,NE	IE,NE	IE,NE	-	-	-	-	-	NA	NA	NA
United Kingdom	701	799	801	12.2%	3	0%	100	14%	CS	CS	CS
EU-15	**9,211**	**6,492**	**6,542**	**100.0%**	**49**	**1%**	**-2,669**	**-29%**			

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 2005 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 2005 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2005		Main explanations
	Gg	Percent	Gg	Percent	
Austria	0,0	0,0	0,0	0,0	
Belgium	134,9	159,4	67,0	101,5	Harmonisation of Flemish methodology with other regions
Denmark	0,0	0,0	8,3	3,3	
Finland	0,0	0,0	0,0	0,0	
France	0,0	0,0	2,3	0,2	
Germany	0,0	0,0	32,1	35,2	New statistical data until 2002.
Greece	0,0	0,0	0,0	0,0	
Ireland	0,0	-	-1,3	-	
Italy	19,4	1,0	20,4	0,9	An error occurred in unit conversion of beer activity data
Luxembourg	0,0	100,0	0,0	100,0	
Netherlands	0,0	0,0	0,5	0,2	
Portugal	-247,4	-9,2	1.336,2	204,4	Revision of the background time series and some corrections
Spain	0,0	0,0	0,0	0,0	
Sweden	0,0	0,0	0,0	0,0	
UK	0,0	0,0	-0,4	0,0	
EU-15	**-93,1**	**-0,7**	**1.465,2**	**17,4**	

N_2O from 6B2 Domestic and Commercial wastewater accounts for 0.2 % of total EU-15 GHG emissions. Between 1990 and 2006 emissions increased by 5 % (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 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	104	209	221	2.3%	12	6%	117	112%	CS,D	NS	CS,D
Belgium	270	272	273	2.8%	1	1%	3	1%	D	IS/NS	D
Denmark	88	51	50	0.5%	-1	-1%	-38	-43%	D/CS	NS	D/CS
Finland	105	81	79	0.8%	-1	-2%	-26	-25%	D	NS	CS, D
France	1,093	908	900	9.4%	-9	-1%	-193	-18%	CS/ T2	NS	CS
Germany	2,224	2,345	2,342	24.3%	-3	0%	118	5%	D	NS	D
Greece	325	370	372	3.9%	2	0%	47	14%	D	NS	D
Ireland	114	134	138	1.4%	4	3%	24	21%	NE	NE	NE
Italy	1,794	1,910	1,929	20.0%	19	1%	135	8%	D	NS	D
Luxembourg	7	7	8	0.1%	0	2%	1	11%	T1	NS	CS D
Netherlands	513	390	381	4.0%	-9	-2%	-133	-26%	T2	NS	D
Portugal	286	353	354	3.7%	1	0%	68	24%	D	IS	D
Spain	1,072	1,197	1,215	12.6%	19	2%	143	13%	D	NS	D
Sweden	166	121	121	1.3%	0	0%	-45	-27%	CS	NS	D
United Kingdom	1,027	1,209	1,241	12.9%	32	3%	214	21%	D	CS	D
EU-15	**9,189**	**9,557**	**9,623**	**100.0%**	**66**	**1%**	**435**	**5%**			

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 2005.

Table 8.9 6B Wastewater Handling: Contribution of MS to EC recalculations in N_2O for 1990 and 2005 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2005		Main explanations
	Gg	Percent	Gg	Percent	
Austria	0,1	0,1	14,4	5,8	The interpolation of the connection rate was corrected
Belgium	0,0	0,0	0,0	0,0	
Denmark	0,0	0,0	-10,5	-17,1	
Finland	0,0	0,0	1,0	1,0	
France	-168,2	-12,4	-246,7	-19,7	Prise en compte du rendement d'élimination de l'azote des stations d'épuration (donnée IFEN) : modification rétroactive
Germany	0,0	0,0	70,4	3,1	New data on average Protein Consumption by FAO.
Greece	0,0	0,0	0,0	0,0	
Ireland	0,0	0,0	0,0	0,0	
Italy	819,8	78,5	908,0	84,9	An error occurred in unit conversion of beer activity data
Luxembourg	6,8	100,0	7,5	100,0	
Netherlands	0,0	0,0	-10,7	-2,7	
Portugal	-28,0	-6,0	-8,8	-1,5	Revision of the time series in order to increase consistency. Previous reporting was based on two different industrial surveys: one for 1990-1991 and other for 1992-2000. The revision performed discarded the 1990-1991 survey data, as the National Statistics Institute consider this as lower quality. In some cases the changes refer to error corrections.
Spain	0,0	0,0	0,0	0,0	
Sweden	0,0	0,0	0,9	0,7	
UK	0,0	0,0	0,0	0,0	
EU-15	**630,4**	**7,0**	**725,5**	**7,8**	

8.2.3 Waste incineration (CRF Source Category 6C) (EU-15)

Source category 6C Waste incineration includes one key category: CO_2 from 6C Waste Incineration. This category includes incineration of waste, not including waste-to-energy facilities. Emissions from waste burnt for energy are reported under 1A Fuel combustion activities. Emissions from burning of agricultural wastes should be reported under 4 Agriculture.

Table 8.10 and Table 8.11 summarise greenhouse gas emission trends by Member State. This source accounts for 0.1 % of total EU-15 GHG emissions. Between 1990 and 2006, CO_2 emissions from waste incineration decreased by 38 %; 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 2006 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO_2 emissions in 2006 (Gg)
Austria	27	12	27	12
Belgium	269	95	253	78
Denmark	0	0	IE	IE
Finland	0	0	IE	IE
France	2,594	2,090	2,295	1,782
Germany	0	0	NO	NO
Greece	0	1	NE	1
Ireland	0	0	NE	NE
Italy	785	639	537	234
Luxembourg	0	0	IE	IE
Netherlands	0	0	IE	IE
Portugal	10	1	10	1
Spain	95	10	85	4
Sweden	44	71	44	71
United Kingdom	1,389	493	1,207	441
EU-15	**5,214**	**3,411**	**4,457**	**2,624**

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

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2006	Change 2005-2006		Change 1990-2006	
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	27	12	12	0.5%	0	0%	-15	-54%
Belgium	253	115	78	3.0%	-36	-32%	-175	-69%
Denmark	IE	IE	IE	-	-	-	-	-
Finland	IE	IE	IE	-	-	-	-	-
France	2,295	1,732	1,782	67.9%	49	3%	-513	-22%
Germany	NO	NO	NO	-	-	-	-	-
Greece	NE	1	1	0.0%	0	0%	1	-
Ireland	NE	NE	NE	-	-	-	-	-
Italy	537	244	234	8.9%	-10	-4%	-303	-56%
Luxembourg	IE	IE	IE	-	-	-	-	-
Netherlands	IE	IE	IE	-	-	-	-	-
Portugal	10	1	1	0.0%	0	-46%	-10	-95%
Spain	85	4	4	0.1%	0	5%	-81	-95%
Sweden	44	91	71	2.7%	-21	-23%	27	61%
United Kingdom	1,207	457	441	16.8%	-15	-3%	-765	-63%
EU-15	**4,457**	**2,657**	**2,624**	**100.0%**	**-33**	**-1%**	**-1,833**	**-41%**

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 (EU-15)

The following considerations address national methods and circumstances which are available in the Member States' national inventory reports. The focus is laid on the reporting categories 6A1 CH_4 emissions from managed solid waste disposal sites and 6A2 CH_4 emissions from unmanaged solid waste disposal sites since they are EU-15 key sources and contribute 1.7 % and 0.2 % of total GHG emissions, 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) (EU-15)

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, which means that 100% of all EU-15 emissions are calculated using higher tier methods (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 State	Description of methods
Austria	For the calculation of emissions of solid waste disposal on land, IPCC Tier 2 method is applied. Where available, country-specific factors are used. If these were not available, IPCC defaulte values are taken.
Belgium	The methodology used to calculate the emissions from solid waste disposal on land differs between the two regions in Belgium where these sites are located (Flanders and Wallonia). In the Flemish region a combination of two models is used: a multiphase model for the estimation of emissions of the sites which are permitted and a first order decay model for all other, old waste disposal sites which are no longer permitted to dispose, but where still emissions occur after the ban of disposal on these sites (these are the solid waste disposal sites in after-care). Walloon region: The CO_2 and CH_4 emissions from solid waste disposal on land are calculated with a first-order decay model that considers separately the emissions of industrial and municipal waste. 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 solid waste disposal sites (SWDSs) are based on a First Order Decay (FOD) model suited to Danish conditions and according to an IPCC Tier 2 approach.
Finland	Finland uses a IPCC Tier 2 method as a basis basis for the estimation of CH_4 emissions. However Equation 5.1 from the GPG (2000) has been slightly modified, so that the term MCF (t) has been substituted by the term MCF (x) in the calculation of the methane generation potential $L_0(x)$. Calculations are not made separately for each landfill but the total waste amount and the average common MCF value for each year have been used. It has been thought that the situation in year t defines the MCF to be used for the emissions caused by waste amounts landfilled in the previous years (and degraded later in year t) as well.
France	IPCC Tier 2 Method
Germany	IPCC Tier 2 Method
Greece	IPCC Tier 2 Method
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 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 2006, 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 .
Luxembourg	IPCC Tier 2 Method (NIR 2006)
Netherlands	In order to calculate the CH_4 emissions from all the landfill sites in the Netherlands, the simplifying assumption was made that all the wastes are assumed to be landfilled on one landfill site, an action that started in 1945. However, as stated above, characteristics of individual sites vary substantially. CH_4 emissions from this 'national landfill' are then calculated using a first-order decomposition model (first-order decay function) with an annual input of the total amounts deposited and the characteristics of the land-filled waste and the amount of landfill gas extracted. This is equivalent to the IPCC Tier 2 methodology. Since the CH_4 emissions from landfills are a key source, the present methodology is in line with the IPCC Good Practice Guidance.
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 should 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 2008, 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 State	Data sources used for generating time series (6A1)
Austria	The quantities of "residual waste" from 1950 to 1997 were taken from national studies and the respective Bundesabfallwirtschaftsplan (Federal Waste Management Plan). However, the amount of waste from administrative facilities of industry is not considered (data from 1950 to 1999), whereas it is included in the Deponiedatenbank ("Austrian landfill database"), which is used for the activity data from 1998 onwards. 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 1960 to 1997 according to the relative known change in data from residual waste from households. The quantities of "non residual waste" from 1998 to 2006 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. 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 a report byVTT.
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. 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 included in various reports from research programs and studies, but refer to specific points in time rather than to a whole period, while different assumptions have been applied in each case for the estimation of quantities generated. Therefore, data for some years are either missing or are unreliable. For this reason, the quantities of municipal solid wastes for the whole period 1960-2006 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. For 1997, MSW generation rates were considered to be in the order of 0.8 – 1.1 kg/ capita and day, depending on the type of region (rural, semi-urban, urban, large urban regions). For the estimation of generation rates for the period 1990 – 2006, starting from 1997, the following assumptions were made taking into account relevant estimations developed by the Ministry for Environment: the MSW generation rate was assumed to change annually by 0.028 kg/ capita and day, while a higher figure (annual increase by 0.035 kg/capita and day) was assumed for the regions of Athens, Central Macedonia, Crete and the islands of South Aegean. A higher figure for MSW generation rate (2.1 kg/ capita and day) was considered for foreign visitors. For the period 1960 – 1990 the rates of annual per capita waste increase are lower (0.8% - 1.5% depending on the region). In order to estimate the quantities of MSW that end up at disposal sites (managed or unmanaged), data on the recycling of paper, aluminium, metals, plastics, and glass in different regions were collected. Recycled quantities estimated, include also the part of putrescibles used for compost production. It was assumed that after the

Member State	Data sources used for generating time series (6A1)
	subtraction of recycled materials, the remaining quantities of municipal solid waste end up to various disposal sites (managed or unmanaged). However, it should be mentioned that a certain amount of this remaining quantity is open-burned, but there are no data to quantify this amount.
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, and interim reports published on a yearly basis since 2001 by the 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. Since 1999, APAT yearly publishes a report, in which waste production data, as well as data concerning landfilling, incineration, composting and generally waste life-cycle data, are reported. It has been assumed that waste landfilling started in 1950. The complete database from 1975 of waste production, waste disposal in managed and unmanaged landfills and sludge disposal in landfills is reconstructed on the basis of different sources, national legislation and regression models based on population. Since waste production data are not available before 1975, they have been reconstructed on the basis of proxy variables. Gross Domestic Product data have been collected from 1950 and a correlation function between GDP and waste production has been derived from 1975; thus, the exponential equation has been applied from 1975 back to 1950. Consequently the amount of waste disposed into landfills has been estimated, assuming that from 1975 backwards the percentage of waste landfilled is constant and equal to 80%. 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.
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. The data can be found in the Internet; a corresponding documentation is also available, which contains the amount of methane recovered from landfill sites yearly.
Portugal	Since 1999, data on MSW is available, including production amounts, final disposal and, to a less extent, waste composition. For previous years information was available from the Strategic Plan on Municipal Solid Waste which was approved by the Government in 1997. This plan includes data from annual municipal registries. Another source of information is a research study performed by Quercus. The data was based on a survey performed in 1994, which enabled the calculation of per capita generation rates for 1994, based on the amounts of waste collected and the population served by waste collection. Before 1994, data on landfill wastes had to be estimated based on expert judgment for waste generation growth rates. For the period 1960-1980 it was considered a per capita waste generation growth rate of 2.5% per year; for the following years (1980-1994) 3% per year. To take into account the fact that part of the population (rural areas) was not served by an organised waste collection and waste disposal system, values of annual production were multiplied by the percentage of population served by waste collection in each municipality. After 2000, it was assumed that all the population of the country is served by waste collecting systems. The total amount of waste disposed to SWDS was then calculated based on this estimated value minus the amounts of waste incinerated and composted.
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: A first national survey was elaborated by EPA in 1980, similar data in 1985 and 1990 and 1994 were provided by Statistics Sweden, since 1994 an annual survey on landfilled waste is carried out by Avfall Sverige – Swedish Waste Management. Figures on sludge from wastewater treatment and garden waste are available since 1990. Industrial waste: Studies on quantities and treatment of organic waste from industry in 1993 and 1996 were carried out by the Swedish EPA. Landfilled wastewater sludge from the pulp industry (important waste fraction) was yearly documented until 2000 by the Swedish EPA. Today the sludge from the pulp industry is incinerated and composted.
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 2008, NIR 2006

Some Member States explicitly describe the consistency of their time series (compare Table 8.14).

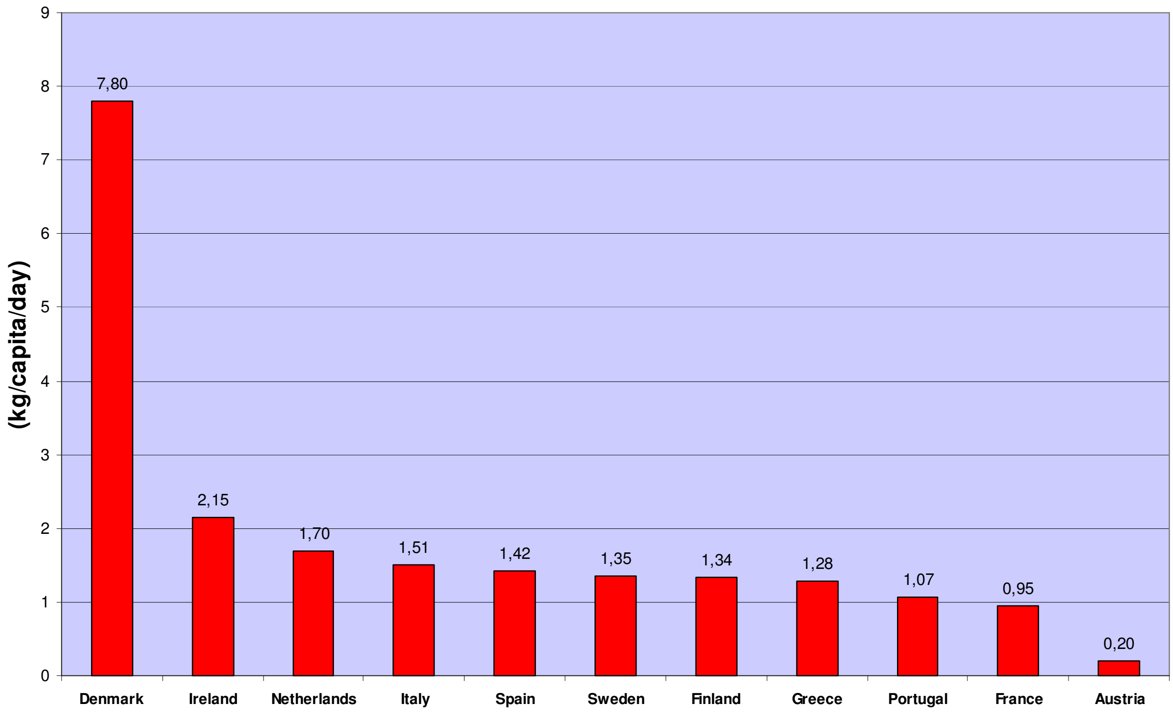
Table 8.14 6A1 Managed Solid Waste Disposal: Consistency of time series of activity data

Member State	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 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 .
Ireland	The time-series estimates given in the present submission also account for the inclusion of sewage sludge and are fully consistent over the period 1990-2006.
Italy	No detailed description of time series consistency .
Luxembourg	No information available.
Netherlands	The time-series consistency of the activity data is very good due to the continuity in data provided (NIR 2008). 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 2008.

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



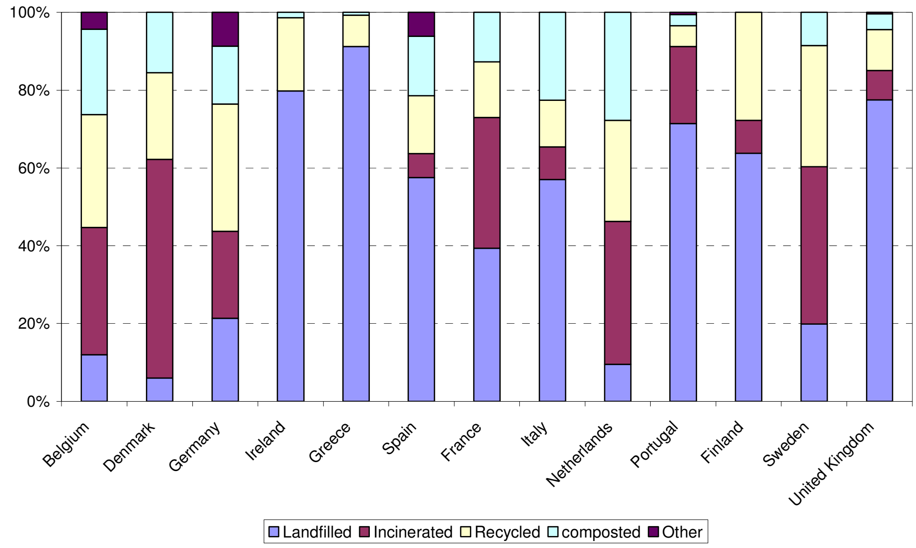
Source: CRF 2008, table 6 A, C Additional information

The waste generation rate per capita varies significantly among the Member States. Austria shows the lowest rate of 0.20 kg/capita/day, while Denmark reports the highest waste generation rate of 7.80 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 large number of tourists increase the waste amounts, but are not reflected in the population numbers. It is difficult, though, to explain the differences for all Member States from the information available in the NIR. Because of the different coverage of wastes included, the waste generation rate reported does not reflect policies and measures to reduce waste generation.

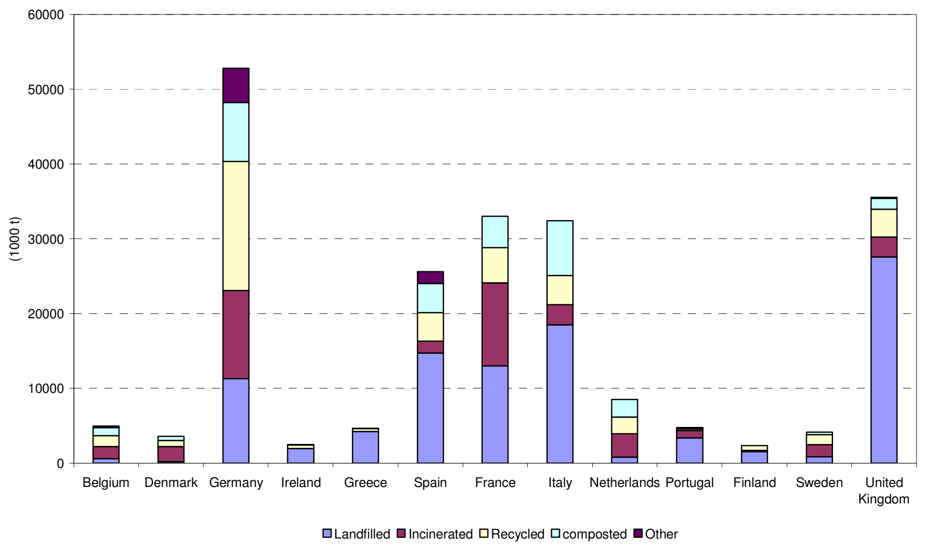
On the other hand the amount of waste generated on SWDS is strongly influenced by the waste management practices of the individual Member States: by the share of waste incinerated, recycled and composted, compare Figure 8.4 and 8.5.

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, France and Spain are currently representing more than 80% of landfilling in 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

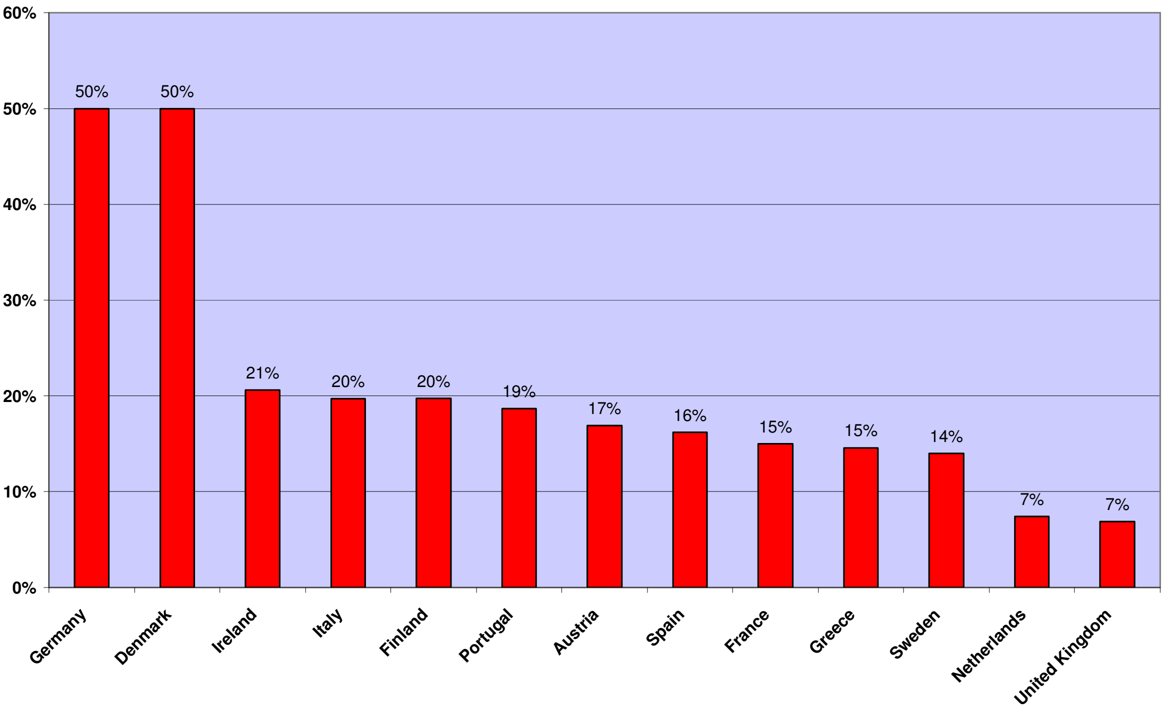
Member State	Composition of landfilled waste
Austria	Landfilled waste is differentiated in "residual waste" and ""non residual waste" (bulky waste, construction, mixed industrial waste, road sweeping, sewage sludge, rakings, residual matter from waste treatment). Detailed values such as for the half life period, DOC, and DOC_F are available for these waste types. The composition of residual waste is specified according to different waste fractions (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. Detailed DOC values are provided in the NIR.
France	Composition of landfilled waste is not mentioned explicitly in the NIR 2008. 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. 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 composition of generated MSW comprises the following fractions: Putrescibles, paper, plastics, metals, glass, and rest. However, accurate data on the composition of municipal solid waste generated at national level are not available, as a comprehensive analysis at national scale covering a complete time period has not been accomplished yet. However, measurements in some regions have been carried out, although they refer to different time periods. Recent estimates of the composition of MSW at national level exist only for 1997.
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	An in-depth survey has been carried out, in order to diversify waste composition over the years. Three slots (1950 – 1970; 1971 – 1990; 1991 – 2006) have been individuated to which different waste composition has been assigned. On the basis of data available on waste composition, the moisture content, the organic carbon content and the fraction of biodegradable organic carbon for each waste stream, the DOC contents and the methane generation potential values (L_0) have been generated. On the basis of the waste composition, waste stream have been categorized in three main types: rapidly biodegradable waste, moderately biodegradable waste and slowly biodegradable waste. The following waste fractions are considered: food waste, sewage sludge, garden and park waste, paper and paperboard, textiles and leather, and wood and straw.
Luxembourg	No information available (NIR 2006)
Netherlands	An average DOC value for waste as a whole is provided in the NIR.
Portugal	SWDS include solid municipal or urban waste (household, garden, commercial-services wastes) and industrial wastes. For the fermentable fractions of urban waste the following categories apply: paper and textiles, non-food fermentable materials, food waste, and wood or straw. For industrial waste several groups exist: paper and textiles, garden waste, park waste or other non-food organic putrescibles, food waste, wood or straw, fuels, plastics, sludge from natural origin, sludge from non-natural origin or hydrocarbons, synthetic fibres, and non-natural organic substances.
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 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, park and garden waste, sludge from the pulp industry and organic industrial waste, non-industry-specific industrial waste, and construction and demolition waste. Deposited waste is further broken down to the waste fractions paper, food, plastic, glass, textile, napkins, sludge from wastewater, sludge from pulp industry, wood, other inert, and other organic.

Member State	Composition of landfilled waste
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 2008, 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 2008 Table 6A,C Additional information.

Table 8.16 6A1 Managed Solid Waste Disposal: Further information on DOC values

Member State	Further information on DOC values
Austria	Detailed values for DOC_F and DOC differentiated with respect to the waste type are available in the NIR. A time series of bio-degradable organic carbon content of directly deposited residual waste is indicated for the years 1950 to 2006.
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. 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).
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 State	Further information on DOC values
	NIR.
France	The OMINEA report (February 2008) fixes a DOC of 150 kg/t, which corresponds to the value reported in the CRF.
Germany	Both national and IPCC default factors were used for the 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.
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, the moisture content, the organic carbon content and the fraction of biodegradable organic carbon for each waste stream, the DOC contents and the methane generation potential values (L_0) have been generated.
Luxembourg	No information available.
Netherlands	The change in DOC values over time is due to such factors as the prohibition of landfilling of 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.

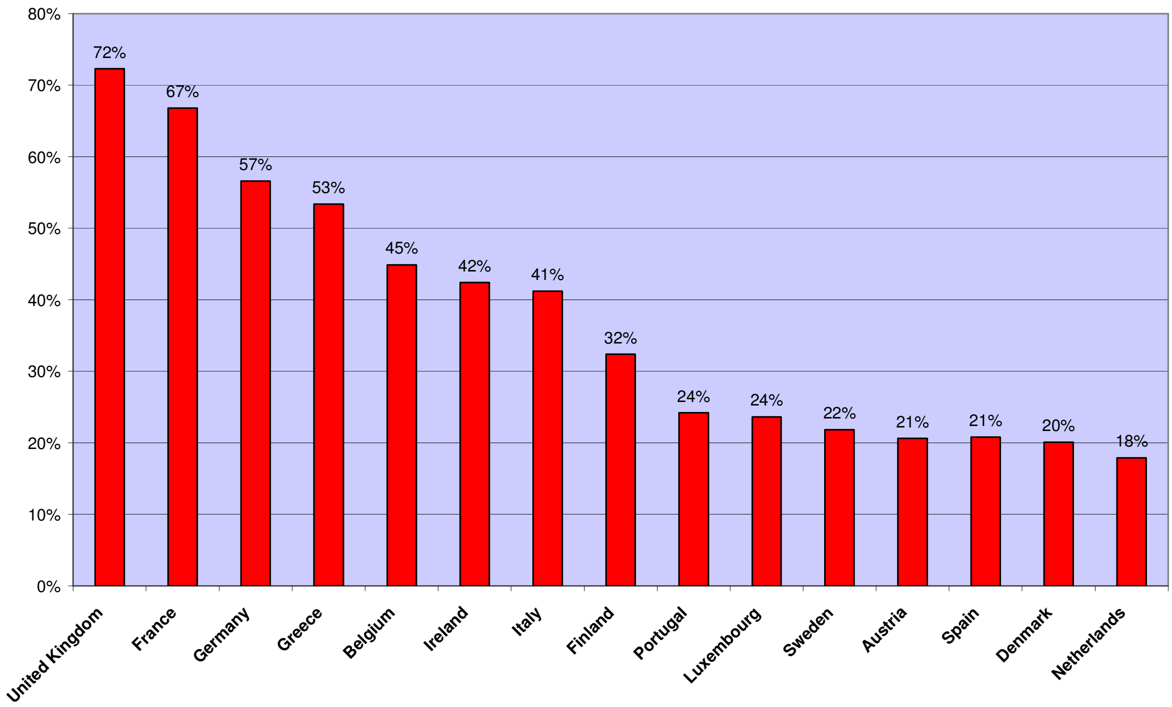
Source: NIR 2008,, CRF 2008, Table 6A,C Additional information

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 18% 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 2008 Table 6A,C

Table 8.17 6A1 Managed Solid Waste Disposal: Further information on methane recovery

Member State	**Number of SWDS recovering CH_4**	**Total number of SWDS**	**Further information on methane recovery**
Austria		Excavated-soil landfills: 279 Construction-waste landfills: 58 Residual waste/treated waste landfills: 18 Mass waste landfills: 47	In 2004, the Umweltbundesamt investigated the amount of annual collected landfill gas by questionnaires sent to landfill operators. 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 and results are expected for the 2009 submission.
Belgium	12 (Wallonia, 2002)		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 (2003)	134 (2001)	Data for landfill gas plants are reported according to Energy Statistics from the Danish Energy Agency.
Finland	33		Data on landfill gas recovery are obtained from Finnish Biogas Plant Register.
France	91%		91% 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 taking 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

Member State	Number of SWDS recovering CH_4	Total number of SWDS	Further information on methane recovery
			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 .
Ireland			Based on annual reports on renewable energy use using a top-down analysis, the amount of CH_4 captured for energy use is estimated from the reported electricity production from this source in the national energy balance, assuming assigned percentage conversion efficiency factors. Furthermore, bottom-up estimates on CH_4 utilized and flared from 65 individual landfills that were producing CH_4 in appreciable quantities are available.
Italy		303	Landfill gas recovered data have been reconstructed on the basis of information on extraction plants and electricity production.
Luxembourg	No information available.	No information available.	No information available.
Netherlands	50	23 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. The data can be found in the Internet; a corresponding documentation is also available, which contains the amount of methane recovered from landfill sites yearly.
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	23		23 in Spain have landfill gas recovery systems. Landfill gas is partly flared, partly utilized for energy purposes.
Sweden	70	160	Information on recovered gas (in energy units) is provided by Avfall Sverige 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: NIR 2008.

CH_4 recovery in EU-15 amounts to 57 % of generated CH_4. Methane recovery is further 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.

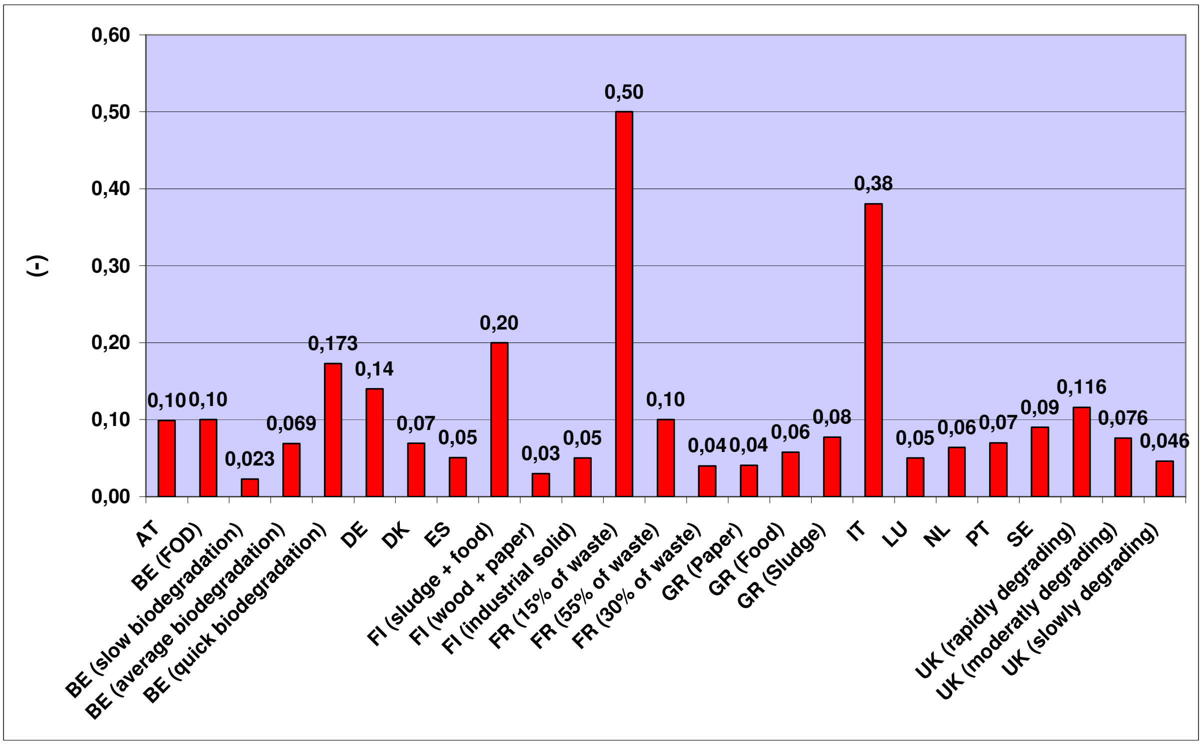
Table 8.18 6A1 Managed Solid Waste Disposal: Methodological issues regarding industrial waste

Member State	Industrial waste
Austria	"Mixed industrial waste" is considered under "non residual waste". Several waste types with their respective waste identification numbers are described. These are not clearly referenced as industrial wastes, though.
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 values 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, waste quantities from the following industry branches are considered: wastes from agriculture, horticulture, forestry, fishery and food processing, wastes from wood processing, wastes from the production of cellulose, paper and cardboard, wastes from the textiles industry, packaging wastes as well as the wood fraction from construction and demolition wastes.
Greece	Industrial waste is neither mentioned nor considered explicitly.
Ireland	Industrial waste is mentioned, but not considered explicitly.
Italy	Industrial waste is neither mentioned nor considered explicitly.
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 and construction wastes have been excluded from the total quantity of waste landfilled.
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. Waste quantities are obtained from studies, surveys, and models.

Source: NIR 2008, 2006

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 2008, Table 6 A,C Additional information, NIR 2008, OMINEA 2008 (France)

Table 8.19 6A1 Managed Solid Waste Disposal: Further information on the methane generation rate constant

Member State	Information on the half-time respectively the methane generation rate constant
Austria	Several values for the half life period of different waste types (residual waste, wood, paper, sludges, bulky waste and other waste, bio waste, textiles, construction waste and fats) are presented.
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 (February 2008) 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 landfilled. Considering the fact that climate in Greece is dry temperate (the ratio of mean annual precipitation to potential evapotranspiration is around 0.5), "half life" was estimated at 17 years for paper, 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).
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 in a study. Accordingly, waste streams have been categorized in three main types: rapidly biodegradable waste (food waste, sewage sludge, k1=0.69), moderately biodegradable waste (garden and park waste, 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. The weighted average CH_4 methane generation constant of the three different values corresponding to each waste category is k=0.38.
Luxembourg	No information available.

Member State	Information on the half-time respectively the methane generation rate constant
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 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 2008,, CRF 2008 Table 6 A,C Additional information, OMINEA 2008 (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) (EU-15)

CH_4 emissions from unmanaged solid waste disposal were reported in only six Member States in 2008 (France, Greece, Ireland, Italy, Portugal and Spain). Three of these six Member States (Spain, Greece and Ireland) still dispose MSW to unmanaged SWDS, compare column 'Annual MSW to unmanaged SWDS' in Table 8.20, while in France, Italy and Portugal waste disposals from the past still emits (see Table 8.3). 100% of all EU-15 emissions from this category are calculated using higher tier methods. The Methane Correction Factor (MCF) reflects the way in which MSW is managed and the effect of management practices on CH_4 generation. According to the Revised 1996 IPCC Guidelines, the MCF for unmanaged disposal of solid waste depends of the type of site – shallow, deep or uncategorized. Table 8.20 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 State	Emissions reported from unmanaged SWDS	Annual MSW to unmanaged SWDS (Gg)	MCF CH_4		
			Unmanaged SWDS	Deep	Shallow
France	X	0.00	0.50	NO	0.50
Greece	X	1,665.05	0.60	0.60	IE
Ireland	X	526.72	0.40	NA	0.40
Italy	X	NO	0.60	NO	0.60
Portugal	X	NO	0.60	IE	0.60
Spain	X	630.00	0.60	0.80	0.40

Source: CRF 2008 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 various 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

Member States	Unmanaged waste disposal on SWDS
	quantities disposed on unmanaged SWDS are given for 1960-2006. Unmanaged wastes are considered to be landfilled in sites of similar characteristics concerning their composition and management (depth of sites), while the starting year of disposal and degradation of total unmanaged waste is assumed to be 1960. A large number of unmanaged SWDS exists: in 1987 and for a number of about 6000 local authorities, almost 4690 unmanaged SWDS were registered. According to the Ministry for Environment, 2182 unmanaged SWDS were still operating in 2000. Following the National and Regional Planning of Solid Waste Management (compiled in the end of 2003), the process of closure and rehabilitation of unmanaged sites is in progress and is expected to be completed by the end of 2008, along with the construction of managed SWDS, following to the standards set by the EU directives, in order to cover the needs of the country.
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 0.96 for managed sites and 0.04 for unmanaged sites on the basis that over the coming years all landfills in Ireland will be classified in the managed category as defined by the IPCC.
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.
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 2008.

8.3.3 Waste water handling (CRF Source Category 6B) (EU-15)

CH_4 Emissions from domestic and commercial waste water handling (6B2) are a significant emission source in category 6B and key source in the EU. CH_4 emissions from waste water handling are calculated with the help of diverse methods (C, CS, D, M, T1 and T2). 24.8% of all EU-15 CH_4 emissions from wastewater handling (6B) are calculated using higher tiers (i.e. all methods besides default and T1 methods). Table 8.22 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 State	CH_4 emission sources and description of methods (municipal wastewater and sludge)
Austria	Municipal wastewater treatment in Austria uses mainly aerobic procedures. As a result no or negligible methane emissions are produced since such emissions only occur under anaerobic conditions. 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. The following parameters were used: Average organic load: 60 g BOD_5 per inhabitant and day, methane producing capacity B_o: 0,6 kg CH_4/ kg BoB_5, methane conversion factor MCF: 0.27. The amount of inhabitants not connected to sewage systems and wastewater treatment plants was taken from the respective Austrian reports on water pollution control. Data for the years 1971, 1981, 1991, 1995 and 1998, 2001 and 2003 were available. The missing data were interpolated. The amount of inhabitants connected to septic tanks in the years form 2001 to 2006 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.

Member State	CH_4 emission sources and description of methods (municipal wastewater and sludge)
Belgium	In this category, two sources of methane emissions are taken into account: the municipal wastewater treatment plants and the sceptic tanks. The methodology for the septic tanks is based on an article, 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 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 an IPCC background paper has been used for calculating the theoretical methane potential not emitted by the remaining disposal categories.
Finland	A national methodology that corresponds to the methodology given in the Revised 1996 Guidelines is used in the estimation of the CH_4 emissions. Emission sources cover municipal (domestic) and industrial wastewater handling plants and uncollected domestic waste water for CH_4 emissions. For uncollected domestic wastewaters the Check method with default parameters (IPCC Good Practice Guidance) has been used.
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. Considering the fact that there are not sufficient data regarding all the wastewater handling facilities of the country and as a result methane emissions are calculated based on the total population served, emissions from wastewater treatment and the sewage sludge removed from wastewater are not considered separately. However, methane emissions from sewage sludge disposed in managed sites have been estimated for the first time in the present inventory. Therefore, in order to avoid double counting of emissions from sludge treatment, the organic load (in biochemical oxygen demand) of sludge that is actually disposed on land was subtracted by the organic load of wastewater treated.
Ireland	It is assumed that all wastewaters sent to wastewater treatment plants are treated aerobically in both urban and industrial situations and as a result emissions of CH_4 do not occur. A national study indicates that 3 percent of sludge is anaerobically treated and is therefore an emission source. Emissions are derived using national statistics, country-specific values and 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. 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 2.7% of domestic and commercial wastewater is actually treated in Imhoff tanks, where the digestion of sludge occurs anaerobically without gas recovery..
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	In general, the emissions are calculated according to the IPCC guidelines, with country-specific parameters and emission factors being used for CH_4 emissions from wastewater handling (including sludge). The calculation methods are equivalent to the IPCC Tier 2 methods.
Portugal	CH_4 emissions from domestic wastewater handling were estimated using a methodology adapted from IPCC 1996 Revised Guidelines and Good Practice Guidance, which follows three basic steps: 1. Determination of the total amount of organic material originated in each wastewater handling system, 2. Estimation of emission factors and 3. Calculation of emissions.
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) and the methane emission factors, discounting from this product the amount of methane recovered. The

Member State	CH_4 emission sources and description of methods (municipal wastewater and sludge)
	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, the organic load is the activity variable selected, expressed in mass of Biochemical Oxygen Demand (BOD_5). For the calculation of this variable, the population data currently served by waste-water treatment stations has been used, as detailed in the publication "The Environment in Spain" from the Ministry of the Environment. For the degradable organic load, a value of 300 mg BOD_5/litre of waste water and a flow of 200 litres/inhabitant equivalent per day, and 365 operating days per year, have been assumed.
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 may be insignificant because of flaring, but is reported as NE (not estimated) 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 complies with the IPCC Good Practice Guidance as a national model. 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 2008, NIR 2006; CRF 2008 Tables 6, 6Bs1 and 6Bs2

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 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, Sweden, United Kingdom), or that emissions are reported elsewhere (Denmark).

Emissions from sludge handling are reported by two Member States (Ireland and Spain), other Member States either reported emissions as not estimated or not occurring (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).

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 State	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

Member State	CH_4 emissions from industrial wastewater		Methods for determining CH_4 emissions from industrial wastewater and sludge handling
	Waste water	Sludge	
			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 an IPCC background paper has been used for calculating the theoretical methane potential not emitted by the remaining disposal categories.
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 in the NIR.
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	**NO**	**NO**	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 followed: Collection of data regarding industrial production of approximately 25 industrial sectors / sub-sectors for the period 1990 – 2005. Data on industrial production for 2005 were not available and for this reason production was estimated through linear extrapolation. Calculation of wastewater generated, by using the default factors per industrial sector (m^3 of wastewater/t product) as suggested by the IPCC Good Practice Guidance. Calculation of degradable organic fraction of waste, by using the default factors (kg COD/m^3 wastewater) suggested by the IPCC Good Practice Guidance for each sector / sub-sector. The distribution between aerobic and anaerobic treatment of industrial wastewater for each industrial sector was estimated on the basis of data derived from a relevant project. The maximum methane production potential factors and the methane conversion factors for aerobic and anaerobic treatment, which were used for the final estimation of methane emissions, are similar to those used for domestic wastewater handling.
Ireland	**NO**	**X**	It is assumed that all wastewaters sent to wastewater treatment plants are treated aerobically in both urban and industrial situations and as a result emissions of CH_4 do not occur. A national study indicates that 3 percent of sludge is anaerobically treated and is therefore an emission source. Emissions are derived using national statistics, country-specific values and 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 industrialwastewater source. No country-specific emission factors of methane per Chemical Oxygen Demand are available so the default value of 0.25 kg CH_4 kg^{-1} DC, suggested in the IPCC Good Practice Guidance, has been used for the whole time series. As recommended by the Good Practice Guidance for key source categories, data have been collected for several industrial sectors (iron and steel, refineries, organic chemicals, food and beverage, paper and pulp, textiles and leather industry). The total amount of organic material for each industry selected has been calculated multiplying the annual production by the amount of wastewater consumption per unit of product and by the degradable organic component. Moreover, the fraction of industrial degradable organic component removed as sludge has been assumed equal to zero. The yearly industrial productions are reported in the national statistics, whereas the wastewater consumption factors and the degradable organic component are either from Good Practice Guidance or from national references. National data have been used in the calculation of the total amount of both COD produced and wastewater output for refineries, organic chemicals, beer production, wine, milk and sugar sectors, the pulp and paper sector, and the leather sector. CH_4 emissions from sludge generated from industries are included in the industrial wastewaters.
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**	The source category „wastewater handling" also includes the CH_4 emissions from anaerobic industrial wastewater treatment plants (WWTP), but these are small compared to urban wastewater treatment plants (WWTP).
Portugal	**X**	**IE**	Methane emissions from industrial wastewater handling also follow the default methodology proposed in the 1996 IPCC Guidelines and the Good Practice Guidance. The organic wastewater load (TOW) is

Member State	CH_4 emissions from industrial wastewater		Methods for determining CH_4 emissions from industrial wastewater and sludge handling
	Waste water	Sludge	
			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	**NE**	**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 may be insignificant because of flaring, but is reported as NE (not estimated) 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	**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 2008, NIR 2006; CRF 2008 Tables 6, 6.Bs1 and 6.Bs2

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 State	MCF	Specification of MCF	Further information on MCF
Austria	**0.27**	Cesspools and septic tanks	Value is taken from a national study.
Belgium	-	-	No information provided.
Denmark	**0.20**	Anaerobic treatment of sludge	Value for the year 2002.
Finland	**0.01** **0.005**	Municipal (domestic) wastewaters Industrial wastewaters	The estimated methane conversion factors for collected wastewater handling systems (industrial and domestic) are low in Finland because the handling systems included in the inventory are either aerobic or anaerobic with complete methane recovery. The emission factors mainly illustrate exceptional operation conditions. The MCF is based on expert knowledge.
France			No information provided.
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).
Ireland	**0**	Wastewater	All aerobic treatment.
Italy	**0.5**	Domestic and commercial	CH_4 emissions from sludge generated by domestic and

		wastewater sludge	commercial wastewater treatment have been calculated; the stabilization of sludge occurs in aerobic or anaerobic reactors; where anaerobic digestion is used, the reactors are covered and provided of gas recovery.
	0.25	Industrial wasterwater	For industrial wastewaters, no country-specific emission factors of methane per Chemical Oxygen Demand are available, so the default value of 0.25 kg CH_4 kg^{-1} DC, suggested in the IPCC Good Practice Guidance, has been used for the whole time series.
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 2008.

Most Member States report N_2O emissions from waste water handling. Different methods are applied (C, CS, D, T1 and T2). 5.0% of N_2O emissions from domestic wastewater handling are estimated by higher tier methods. 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

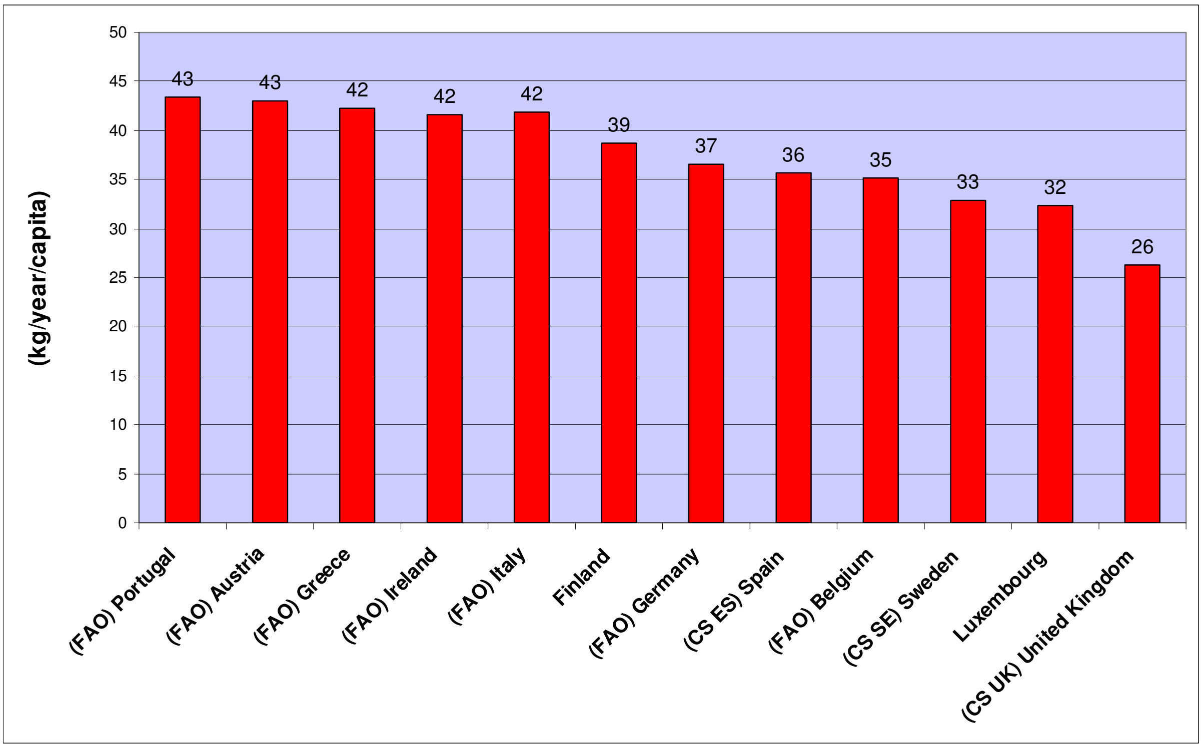
Member State	**N_2O emissions from wastewater [1)]**		**Description of methods used (N_2O)**
	Industrial	**Domestic**	
Austria	**X**	**X**	N_2O emissions from Urban Wastewater Handling are calculated by differing between wastewater arising from households connected and from households not connected to 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 plants are calculated by using a country-specific method based on IPCC. According to a national study, the amount of wastewater that is treated in sewage plants and the amount of nitrogen that is denitrificated should be considered 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. As this share represents only the situation in the 1990ies, the ERT recommended a survey to verify this share. In this survey, several methods and different international approaches were compared and a literature review was undertaken. It resulted in the conclusion that the consideration of industrial N_2O with 30% of N_2O emissions from urban wastewater treatment plants, is still justified. Data for the amount of wastewater that is treated in sewage plants as well as on the denitrification rate were taken from the Austrian reports on water pollution control and an evaluation of data from the Austrian database on sewage treatment plants; missing data in between were interpolated.
Belgium		**X**	The N_2O emissions from human sewage are estimated by using the methodology described in the IPCC Guidelines. The figure of protein consumption originates 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 aquaculture 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

Member State	N_2O emissions from wastewater [1)]		Description of methods used (N_2O)
	Industrial	Domestic	
			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 methodology suggested by IPCC.
Ireland	**NA, NE**	**X**	Estimates of emissions of N_2O from human sewage discharges are made using 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 time series of the protein intake is from the yearly FAO Food Balance.
Luxembourg	**NE**	**X**	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	**NE**	**X**	N_2O emissions from the biological N-removal processes in urban WWTP as well as indirect N_2O emission from effluents are calculated using the IPCC default emission factor of 0.01 tons N_2O-N per ton N removed or discharged, respectively. Since N_2O emissions from wastewater handling was identified in the previous NIR as a key source, the present Tier 2 methodology complies with the IPCC Good Practice Guidance.
Portugal	**X**	**X**	Emissions of N_2O from domestic wastewater were estimated following the proposal of IPCC 1996 Revised Guidelines. Activity data results of protein intake, according to FAO database, multiplied by total population. For industrial wastewater, the methodology proposed in the CORINAIR/EMEP Handbook, based on the knowledge of total production of wastewater, expressed in equivalent inhabitants, and the use of a simple and unspecific emission factor, was chosen.
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 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 default methodology.

1) according to table 6.Bs1 in CRF 2008; X= emissions are reported; NE= not estimated; IE= included elsewhere; NO=not occuring
Source: NIR 2008, NIR 2006; CRF 2008 Tables 6, 6.Bs1 and 6.Bs2

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 2008 Table 6 B; NIR 2008
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; CS UK: DEFRA, 2007: The Expenditure and Food Survey.

8.3.4 Waste Incineration (CRF Source Category 6C) (EU-15)

Emissions from waste incineration are reported by ten Member States in 2006 (Austria, Belgium, France, Greece, Sweden, United Kingdom, Italy, Luxembourg, Spain and Portugal). 87.6% of EU-15 CO_2 emissions are calculated using higher tier methods. 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 State	Emissions reported in CRF	Type of waste incinerated and methods applied
Austria	X	In this category emissions from incineration of waste oil are included as well as emissions from municipal waste incineration without energy recovery.In Austria waste oil is incinerated in especially designed so called "USK-facilities". The emissions of waste oil combustion for energy recovery (e.g. in cement industry) are reported under CRF sector 1 A. In general, municipal, industrial and hazardous waste are combusted for energy recovery in district heating plants or in industrial sites and therefore the emissions are reported in CRF sector 1 A. There is only one waste incineration plant without energy recovery which has been operated until 1991 with a capacity of 22 000 tons of municipal waste per year. This plant has been rebuilt as a district heating plant starting operation in 1996. Therefore the emissions since the re-opening of this plant are reported under CRF sector 1 A from 1996 onwards.
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 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

Member State	Emissions reported in CRF	Type of waste incinerated and methods applied
		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 and are integrated in the waste incineration sector. 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 EPA and EMEP/CORINAIR emission factors.
Denmark	IE	In Denmark, all municipal waste incineration is utilised for heat and power production. Thus, incineration of waste is included as stationary combustion in the IPCC Energy sector.
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 quite small. In annual reporting of the recycling of wastepaper, the incineration of wastepaper is estimated to be only 23,000 tons.
France	X	Emissions from waste incineration are reported for four categories: dangerous industrial waste incineration, municipal waste incineration without energy recovery, agricultural plastic film burning and incineration of other non-specified wastes. Furthermore, non-CO_2 emissions of incineration of biogenic waste are reported.
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.
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 2005, nearly 96% of the total amount of waste incinerated is treated in plants with energy recovery system.CH_4 emissions from biogenic, plastic and other non-biogenic wastes have been calculated. Regarding GHG emissions from incinerators, the methodology reported in the IPCC Good Practice Guidance has been applied, combined with that reported in the CORINAIR Guidebook. A single emission factor for each pollutant has been used combined with plant-specific waste activity data. Emissions have been calculated for each type of waste: municipal, industrial, hospital, sewage sludge and waste oils. A complete data base of these plants has been built, on the basis of various sources available for the period of the entire time series, extrapolating data for the years for which there was no information. For each plant a lot of information is reported, among which the year of the construction and possible upgrade, the typology of combustion chamber and gas treatment section, if it is provided of energy recovery (thermal or electric), and the type and amount of waste incinerated (municipal, industrial, etc.). Different procedures were used to estimate emission factors, according to the data available for each type of waste. As regards municipal waste, a distinction was made between CO_2 from fossil fuels (generally plastics) and CO_2 from renewable organic sources (paper, wood, other organic materials). Only emissions from fossil fuels, which are equivalent to 35% of the total, were included in the inventory. On the other hand, CO_2 emissions from the incineration of sewage sludge were not included at all, while all emissions relating to the incineration of hospital and industrial waste were considered. CH_4 and N_2O emissions from agriculture residues removed, collected and burnt 'off-site', are reported in the waste incineration sub-sector. Removable residues from agriculture production are estimated for each crop type taking into account the amount of crop produced, the ratio of removable residue in the crop, the dry matter content of removable residue, the ratio of removable residue burned, the fraction of residues oxidised in burning, the carbon and nitrogen content of the residues. CO_2 emissions have been calculated but not included in the inventory as biomass. All these parameters refer both to the IPCC Guidelines and country-specific values.
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

Member State	Emissions reported in CRF	Type of waste incinerated and methods applied
		incineration facilities also produce electricity or heat used for energetic purposes. Total CO_2 emissions – i.e. the sum of organic and fossil carbon – from waste incineration are reported per facility in the annual environmental reports. The fossil-based and organic CO_2 emissions from waste incineration (e.g. plastics) are calculated from the total amount of waste incinerated. Per waste stream (residential and several others) the composition of the waste is determined. For each of these types a specific carbon content and fossil carbon fractions are assumed, which will yield the CO_2 emissions. The method is described in detail in a national study and in a monitoring protocol.
Portugal	X	CO_2 emissions from incineration are calculated according to IPCC Guidelines, for each waste type (e.g. municipal solid waste (MSW), hazardous waste, clinical waste, and sewage sludge). Until 1999, incineration of solid wastes refers exclusively to incineration of hospital hazardous wastes. The figure for 1995 was used 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. More recently another unit started operating in Madeira. These units are dedicated to the combustion of MSW which is composed of domestic/commercial waste. Emissions associated with the components of fossil origin – plastics, synthetic fibres, and synthetic rubber – are accounted for in the net emissions, which include also the non-CO_2 emissions from the combustion of organic materials (e.g. food waste, paper). CO_2 emissions from the biogenic component are only reported as a memo item. Data on clinical waste incinerated refers only to Mainland Portugal and corresponds to data declared in registry maps of public hospital units (there is no incineration in private units). The quantities of clinical waste incinerated decreased strongly in recent years. 25 incinerators were closed in recent years in Mainland Portugal, only remaining at present one hospital incinerator. Other clinical wastes receive alternative treatment or are treated abroad. The non-biogenic components fractions are considered to be different for MSW, and clinical waste. 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: incineration of corpses and clinical waste, municipal solid waste incineration in incinerators in case there is no energy recovery and wastewater sludge incineration. Emissions deriving from industrial waste incineration have not been estimated yet. For the incineration of human corpses in crematories, the combustion of a supporting fuel and some other material elements incinerated during the process also account for emissions. 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. Since 2004, all municipal waste incinerators are equipped with energy recovery. Sludge incineration includes sludges from urban and industrial wastewater treatment. The main source of emission factors is the EMEP/CORINAIR Guidebook.
Sweden	X	Emissions from incineration of hazardous waste, and in later years also MSW and industrial waste, from one large plant are reported in CRF 6C. Reported emissions are for the whole time series obtained from the facility's Environmental report or directly from the facility on request. CO_2, SO_2 and NO_x are measured continuously in the fumes at the plant. In 2003 capacity was increased substantially at the plant by taking one new incinerator into operation. The new incinerator incinerates a mixture of MSW, industrial waste and hazardous waste. Only a minor part (less than 0.5%) of the total amount of MSW incinerated for energy purposes in Sweden are incinerated in the facility included in 6C. All other emissions from incineration of MSW are reported in CRF 1.Emissions reported are CO_2, NO_x, SO_2 and NMVOC. The CO_2 emission of biogenic origin of the MSW fraction of the waste, has since 2003 (when the incineration capacity increased dramatically, in order to treat MSW) been estimated using published information. According to information from the facility, occasional measurements concerning CH_4 and N_2O have been performed. The CH_4 measurement showed very low or non-detectable amounts. CH_4 is therefore reported as NE in the CRF tables. 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, NE=not estimated, NO=not occuring
Source: NIR 2008, NIR 2006, CRF 2008.

8.3.5 Waste – Other (CRF Source Category 6D) (EU-15)

Under CRF source category 6D ten Member States report emissions for 2006. 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, Spain indicates emissions from sludge spreading, Germany from mechanical-biological waste treatment plants and the Netherlands from recycling activities, compare Table 8.27.

Table 8.27 6D Other: Reported emissions

Member State	Specification of "other waste"	6 D CO_2	6 D CH_4	6 D N_2O	6 D NO_x
Austria	Compost production	NA	1.63	0.23	NA
Belgium	Compost production		1.85		
Denmark	Biogas production	NO	NO	NO	NO
Finland	Compost production	NO	2.99	0.20	NO
France	Compost production	NA	4.78	1.00	NA
France	Biogas production	NA	0.19	NA	NA
Germany	Compost production	NO	26.22	0.68	NO
Germany	Mechanical-biological waste treatment	NO	0.27	0.49	NO
Italy	Compost production	NA	0.21	NA	NA
Luxembourg	Compost production	NO	0.36	0.03	NE
Netherlands	Compost production	NA	3.12	0.12	0.00
Netherlands	Recycling activities	NA	NO	NO	0.01
Spain	Sludge spreading	NE	30.67	NE	NE

Source: CRF 2008 Table 6

In Table 8.28 the source category is described further in detail

Table 8.28 6D Other: Description and methodological issues

Member State	Waste – Other
Austria	Emissions were estimated using a country-specific methodology. To estimate the amount of composted waste it was split up into two fractions of composted waste: 1) mechanical-biological treated residual waste, 2) composted waste: bio waste collected separately, loppings, home composting. Emissions were calculated by multiplying the quantity of waste with the corresponding emission factor (CH_4 and N_2O) based on national references.
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 the methoden given in the 2006 IPPC Guidelines for Greenhous Gas Inventories.. Activity data are based on VAHTI database and the Water and Sewage Works Register. The activity data for composted municipal biowaste for the year 1990 are based on the estimates of the Advisory Board for Waste Management for municipal solid waste generation and treatment in Finland in 1989. Data on 1997, 2004 and 2005 are from the VAHTI database and the intermediate years have been interpolated. In addition, composted solid biowaste in the years 1991-1996 has been interpolated using auxiliary information from the National Waste Plan until 2005.
France	CH_4 and N_2O emissions from composting as well as CH_4 emissions from biogas production are considered. Emissions are estimated by multiplying emission factors with the amount of waste composted and the amount of waste used for the production of biogas, respectively.
Germany	In Germany, yearly increasing amounts of organic waste are composted. For this purpose, CH_4 and N_2O emissions from composting of municipal solid waste are estimated using a national method. Acitivity data is provided by the National Statistical Agency. Emission factors stem from a national study. Composting of garden and organic waste in individual households is not considered in this category. Since 1 June 2005, landfilling of biologically degradable waste is not permitted in Germany anymore. MSW has to be treated, therefore, prior to landfilling. Mechanical-biological treatment of waste is one of the options. A national method has been developed for the calculation of CH_4 and N_2O emissions in which the amount of waste treated in mechanical-biological treatment plants is multiplied with emission factors from a national study. Acitivity data is provided by the National Statistical Agency.
Italy	Under this source category CH_4 emissions from compost production have been reported. The composting plants are classified in plants that treat selected waste (food, market, garden waste, sewage sludge and other organic waste, mainly from the agro-food industry) and the mechanical-biological treatment plants, that treat the unselected waste to produce compost, refuse derived fuel (RDF), and a waste with selected characteristics for landfilling or incinerating system. It is assumed that 100% of the input waste to the composting plants from selected waste is treated as compost, while in mechanical-biological treatment plants 30% of the input waste is treated as compost on the basis of national studies and references. Information on input waste to composting plants are published yearly by APAT since 1996, including data for 1993 and 1994, while for 1987 and 1995 only data on compost production are available; on the basis of this information the whole time series has been reconstructed. Since no methodology is provided by the IPCC for these emissions, literature data have been used for the emission factor, 0.029 g CH_4 kg^{-1} treated waste, equivalent to compost production.
Luxembourg	Compost production sites generate CO_2 and CH_4 emissions. The CORINAIR (simple) methodology is applied. 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 compost production have been taken from the Environment Agency (internal report) (NIR 2006).

Member State	Waste – Other
Netherlands	This source category consists of the CH_4 and N_2O emissions from composting separately collected organic waste from households. A country-specific methodology for this source category is used with activity data based on the annual survey performed by the Working Group on Waste Registration at all the industrial composting sites in the Netherlands and emission factors based on the average emissions (per ton composted organic waste) of some facilities in the late 1990s (during a large scale monitoring programme in the Netherlands). Emissions from small-scale composting of garden waste and food waste by households are not estimated as these are assumed to be negligible. Since this source is not considered as a key source, the present methodology level complies with the IPCC Good Practice Guidance.
Spain	In this activity, emissions from the spreading of sludge from waste water treatment plants are covered. It was assumed that all sludges from wastewater treatments plants are dried by sludge spreading.

Source: NIR 2008, NIR 2006 and CRF 2008

8.4 EU-15 uncertainty estimates (EU-15)

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 N_2O 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 2006 1)	Emission trends 1990-2006	Level uncertainty estimates based on MS uncertainty estimates	Trend uncertainty estimates based on MS uncertainty estimates
6.C Waste incineration	CO_2	4.457	2.755	-38%	8%	4
6.A Solid waste disposal on land	CH_4	146.410	81.303	-44%	18%	11
6.B Waste water handling	CH_4	12.598	9.849	-22%	73%	19
6.C Waste incineration	CH_4	477	473	-1%	21%	24
6.D Other	CH_4	375	1.518	305%	30%	313
6.B Waste water handling	N_2O	9.585	10.114	6%	125%	13
6.C Waste incineration	N_2O	280	345	23%	95%	23
6.D Other	N_2O	132	851	543%	45%	1128
Total Waste	**all**	**174.548**	**107.062**	**-39%**	**19%**	**9**

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 (EU-15)

Under the Climate Change Committee a workshop was conducted in Spring 2005 on inventories and projections of greenhouse gas emissions from waste. The main objectives of the workshop were: (1) to provide an opportunity to learn about the methods used for inventories and projections in the different Member States, to share information, experience and best practice; (2) to compare the parameters chosen in the estimation methodologies across EU-15 Member States; (3) to compare emissions and methods used for GHG inventories with data and methods for EPER; and (4) to strengthen links between assessment of air pollution under the IPPC and emissions under the UNFCCC. In addition, the workshop provided an opportunity to discuss potential methodological changes or improvements of the draft 2006 IPCC inventory guidelines. The recommendations and presentations of this workshop can be downloaded from the Internet under the following link: http://air-climate.eionet.eu.int/docs/meetings/050502_GHGEm_Waste_WS/meeting050502.html.
Clarifications from discussions of individual parameters used in the estimation of emissions from

waste were incorporated in this report.

A second expert meeting under the Climate Change Committee on the estimation of CH_4 emissions from solid waste disposed to landfills was conducted in March 2006. This meeting was targeting in particular those EU Member States that do not yet use the IPCC FOD methods for their inventories (mostly new EU Member States). The objective of the expert meeting was to use the new default model provided by draft 2006 IPCC Guidelines for national GHG inventories in order to calculate CH_4 emissions for the participants' countries. 11 Member States, 2 EEA Member countries, and one accession country participated. 9 of the 14 countries had previously not estimated CH_4 emissions with a FOD method. The meeting enabled those Member States that still used Tier 1 method to use the FOD model with national/default data as available. Other Member States used the IPCC FOD model as quality check and for comparison with the results of the country-specific model with usually minor differences compared to the national model. The meeting also contributed to the exchange of experiences of specific circumstances regarding waste generation, composition and solid waste disposal in new Member States and on the estimation of CH_4 recovery in the absence of monitored data. In addition, the meeting provided recommendations to IPCC for further improvement and corrections of the draft default model.

8.6 Sector-specific recalculations (EU-15)

Table 8.30 shows that in the waste sector the largest recalculations in 1990 and 2005 were made for CH_4.

Table 8.30 Sector 6 Waste: Recalculations of total GHG and recalculations of GHG emissions for 1990 and 2005 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	-50.392	-1,6%	-851	-0,2%	-8.415	-2,1%	5	0,0%	617	3,7%	-51	-0,5%
Waste	-760	-14,0%	-851	-0,5%	518	5,5%	NO	NO	NO	NO	NO	NO
2005												
Total emissions and removals	33.796	1,1%	2.011	0,6%	-11.037	-3,3%	220	0,4%	-35	-0,6%	-70	-0,8%
Waste	-352	-11,6%	1.024	1,1%	671	6,4%	NO	NO	NO	NO	NO	NO

NO: not occurring

Table 8.31 provides an overview of Member States' contributions to EU-15 recalculations. Portugal had the largest recalculations for CH_4 in 1990 and 2005.

Table 8.31 Sector 6 Waste: Contribution of Member States to EU-15 recalculations for 1990 and 2005 by gas (difference between latest submission and previous submission Gg of CO_2 equivalents)

	1990						2005					
	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
Austria	0	0	0	NO	NO	NO	0	19	16	NO	NO	NO
Belgium	-84	135	-7	NO	NO	NO	0	83	1	NO	NO	NO
Denmark	IE,NA,NE,NO	0	0	NO	NO	NO	-2	-8	-10	NO	NO	NO
Finland	NE,NO	-14	0	NO	NO	NO	NE,NO	-14	1	NO	NO	NO
France	0	19	-228	NO	NO	NO	86	7	-210	NO	NO	NO
Germany	NE	0	0	NO	NO	NO	NE	41	49	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	-4	0	NO	NO	NO
Italy	0	19	820	NO	NO	NO	78	20	910	NO	NO	NO
Luxembourg	-10	10	7	NO	NO	NO	-10	7	14	NO	NO	NO
Netherlands	IE,NA,NO	0	0	NO	NO	NO	IE,NA,NO	129	-11	NO	NO	NO
Portugal	0	-1.107	-28	NO	NO	NO	-382	932	-39	NO	NO	NO
Spain	-666	42	-45	NO	NO	NO	-120	-158	-51	NO	NO	NO
Sweden	0	0	0	NO	NO	NO	0	0	1	NO	NO	NO
UK	0	44	0	NO	NO	NO	-2	-29	1	NO	NO	NO
EU-15	**-760**	**-851**	**518**	**NO**	**NO**	**NO**	**-352**	**1.024**	**671**	**NO**	**NO**	**NO**

NO: not occurring; NE: not estimated; NA: not applicable; IE: included elsewhere

8.7 Waste for EU-27

8.7.1 Overview of sector (EU-27)

Figure 8.10 Sector 6 Waste: EU-27 GHG emissions 1990–2005 from CRF in CO_2 equivalents (Tg)

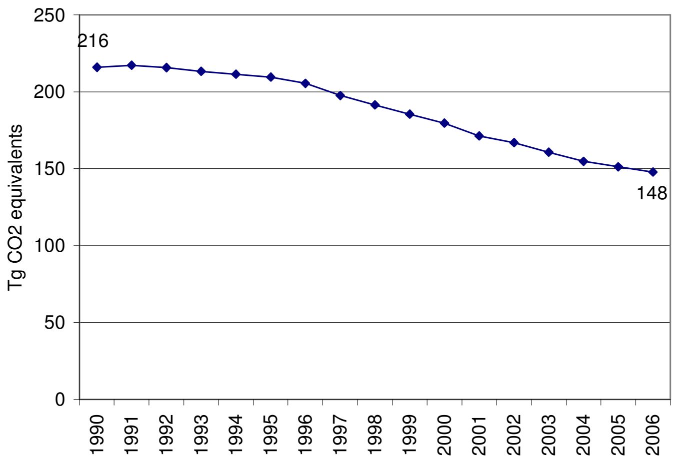
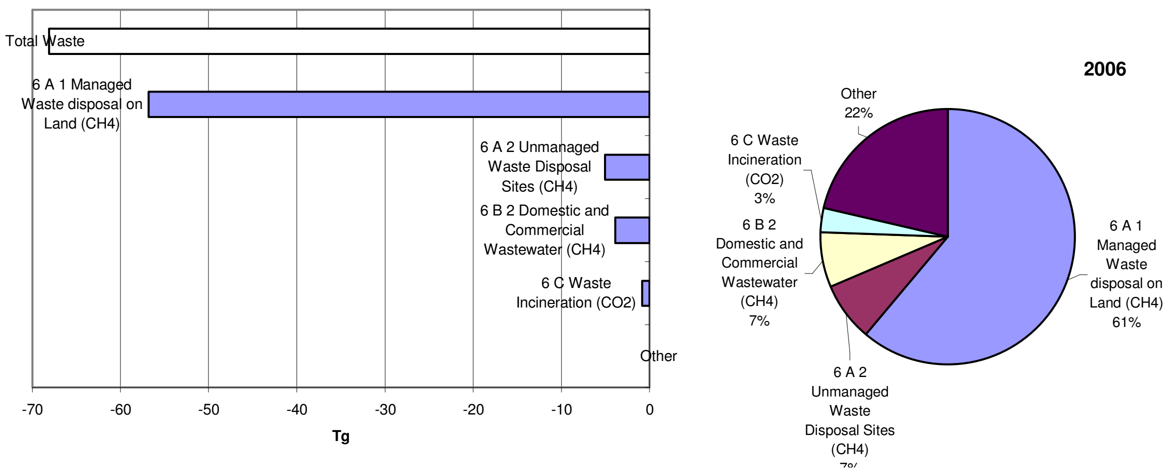


Figure 8.11 Sector 6 Waste: Absolute change of GHG emissions by large key source categories 1990–2006 in CO_2 equivalents (Tg) and share of largest key source categories in 2006



8.7.2 Source categories (EU-27)

6.7.2.6 Solid waste disposal on land (CRF Source Category 6A) (EU-27)

Table 8.32 6A1 Managed Waste Disposal on Land: CH_4 emissions of EU-27

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	130,417	74,742	71,731	79.3%	-3,011	-4%	-58,687	-45%			
Bulgaria	10,712	7,082	6,847	7.6%	-235	-3%	-3,865	-36%	T2	NS	CS
Cyprus	340	461	466	0.5%	5	1%	126	37%	T1	NS	D
Czech Republic	1,663	2,346	2,367	2.6%	21	1%	704	42%	T2	NS	D
Estonia	608	569	552	0.6%	-18	-3%	-56	-9%	T1	NS	D
Hungary	2,264	2,899	2,900	3.2%	1	0%	636	28%	T2	NS	D
Latvia	279	497	514	0.6%	17	3%	235	84%	T2	NS	D
Lithuania	690	596	588	0.6%	-8	-1%	-102	-15%	T2	NS	D
Malta	NA	368	373	0.4%	5	1%	373	-	T1	NS	D
Poland	IE	IE	IE	-	-	-	-	-	M	NS	D
Romania	NA	2,188	2,706	3.0%	518	24%	2,706	-	T1	NS	D
Slovakia	IE	986	992	1.1%	7	1%	992	-	T2	NS	CS
Slovenia	345	486	476	0.5%	-10	-2%	131	38%	T2	NS, PS	D
EU-27	**147,318**	**93,220**	**90,512**	**100.0%**	**-2,708**	**-3%**	**-56,806**	**-39%**			

Table 8.33 6A2 Unmanaged Waste Disposal on Land: CH_4 emissions of EU-27

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	12,782	7,536	7,251	66.8%	-286	-4%	-5,531	-43%			
Bulgaria	NE	NE	NE	-	-	-	-	-	NO	NO	NO
Cyprus	71	92	92	0.9%	1	1%	21	30%	NO	0.0	NO
Czech Republic	NO	NO	NO	-	-	-	-	-	NA	NA	NA
Estonia	NO	NO	NO	-	-	-	-	-	NO	0.0	NO
Hungary	NA,NO	NO	NO	-	-	-	-	-	---	---	---
Latvia	NE	NO	NO	-	-	-	-	-	NO	NO	NO
Lithuania	387	334	331	3.1%	-2	-1%	-55	-14%	T2	NS	D
Malta	261	NA,NO	NA,NO	-	-	-	-261	-100%	NO	0.0	NO
Poland	IE	IE	IE	-	-	-	-	-	M	NS	D
Romania	2,393	3,290	3,180	29.3%	-110	-3%	787	33%	T1	NS	D
Slovakia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Slovenia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
EU-27	**15,894**	**11,252**	**10,855**	**100.0%**	**-397**	**-4%**	**-5,039**	**-32%**			

6.7.2.7 Wastewater handling (CRF Source Category 6B) (EU-27)

Table 8.34 6B2 Domestic and commercial wastewater: CH_4 emissions of EU-27

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	9,211	6,492	6,542	61.3%	49	1%	-2,669	-29%			
Bulgaria	208	185	184	1.7%	-1	-1%	-24	-11%	D	NS	D, CS
Cyprus	18	23	24	0.2%	0	1%	6	33%	NA	0.0	NA
Czech Republic	214	182	185	1.7%	3	1%	-29	-13%	D	NS	CS
Estonia	IE,NO	IE,NO	IE,NO	-	-	-	-	-	NA	0.0	NA
Hungary	786	563	527	4.9%	-36	-6%	-259	-33%	CS	NS	D
Latvia	294	184	182	1.7%	-2	-1%	-112	-38%	D	NS	D
Lithuania	538	287	293	2.8%	7	2%	-245	-45%	T1	NS	D
Malta	1	1	1	0.0%	0	1%	1	78%	NA	0.0	NA
Poland	1,134	825	841	7.9%	16	2%	-294	-26%	D	NS	D/CS
Romania	1,334	1,257	1,260	11.8%	4	0%	-74	-6%	D	NS	D
Slovakia	585	537	528	5.0%	-8	-2%	-57	-10%	D	NS	CS
Slovenia	102	95	95	0.9%	0	0%	-7	-7%	T1	NS, Q	D
EU-27	**14,426**	**10,632**	**10,663**	**100.0%**	**31**	**0%**	**-3,763**	**-26%**			

Table 8.35 6B2 Domestic and Commercial Wastewater: N_2O emissions of EU-27

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006		Method applied	Activity data	Emission factor
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	9,189	9,557	9,623	81.0%	66	1%	435	5%			
Bulgaria	224	147	145	1.2%	-2	-1%	-79	-35%	D	NS	D
Cyprus	0	NA	NA	-	-	-	-	-	T1	0.0	D
Czech Republic	162	199	200	1.7%	1	0%	38	24%	D	NS	D
Estonia	40	35	34	0.3%	0	0%	-6	-14%	T1	0.0	D
Hungary	214	208	209	1.8%	1	0%	-5	-2%	D	NS	D
Latvia	57	49	49	0.4%	0	-1%	-8	-15%	D	NS	D
Lithuania	80	76	76	0.6%	0	0%	-5	-6%	T1	NS	D
Malta	10	11	11	0.1%	0	1%	1	12%	T1	0.0	D
Poland	1,096	749	727	6.1%	-22	-3%	-369	-34%	D	NS	D
Romania	601	714	718	6.0%	5	1%	118	20%	D	NS	D
Slovakia	NA,NO	14	29	0.2%	15	103%	29	-	OTH	NS	CS
Slovenia	60	63	63	0.5%	0	0%	3	6%	T1	NS, IS	D
EU-27	**11,731**	**11,821**	**11,884**	**100.0%**	**62**	**1%**	**152**	**1%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

6.7.2.8 Waste incineration (CRF Source Category 6C) (EU-27)

Table 8.36 6C Waste incineration: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2006	Change 2005-2006		Change 1990-2006	
	1990	2005	2006		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
EU-15	4,457	2,657	2,624	64.5%	-33	-1%	-1,833	-41%
Bulgaria	NO	NO	NO	-	-	-	-	-
Cyprus	0	NA	NA	-	-	-	-	-
Czech Republic	IE,NE	358	386	9.5%	28	8%	386	-
Estonia	NA	NA	NA	-	-	-	-	-
Hungary	63	316	382	9.4%	66	21%	319	507%
Latvia	NE,NO	0	2	0.0%	1	244%	2	-
Lithuania	4	6	5	0.1%	0	-5%	1	37%
Malta	0	0	0	0.0%	0	0%	0	-63%
Poland	459	318	309	7.6%	-9	-3%	-149	-33%
Romania	NA,NE	179	339	8.3%	160	90%	339	-
Slovakia	67	13	23	0.6%	10	80%	-44	-66%
Slovenia	NO	IE	IE	-	-	-	-	-
EU-27	**5,049**	**3,847**	**4,070**	**100.0%**	**222**	**6%**	**-980**	**-19%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

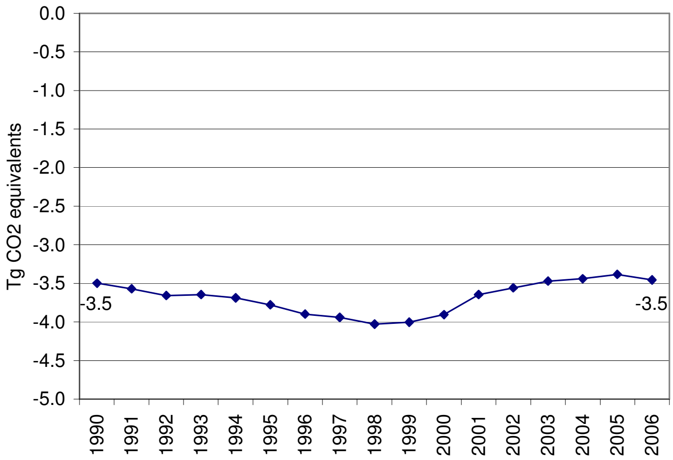
9 Other (CRF Sector 7)

This chapter provides information on emission trends and recalculations in CRF Sector 7 Other. No further information is provided because the emissions only refer to emissions from the UK. The negative emissions are related to non-EU territory; they are deducted from the EU-territory because the data for the UK for the other sectors includes these territories.

9.1 Overview of sector (EU-15)

CRF Sector 7 Other includes negative GHG emissions for the United Kindom. Total emissions from Other declined by 1.3 % from 1990 to 2006 (Figure 9.1); they were -3.5 Tg in 2006.

Figure 8.1 Sector 7 Other: EU-15 GHG emissions 1990–2006 from CRF in CO_2 equivalents (Tg)



9.2 Methodological issues and uncertainties (EU-15)

For information on methodological issues and uncertainties see the UK NIR.

9.3 Sector-specific quality assurance and quality control (EU-15)

There are no sector-specific QA/QC procedures for this sector.

9.4 Sector-specific recalculations (EU-15)

Table 9.1 shows the recalculations in 1990 and 2005. They are all due to the UK now including negative emissions for non-EU territoy. In the previous EU-15 inventory these emissions from non-EU territories were included.

Table 9.1 Sector 7 Other: Recalculations of total GHG and recalculations of GHG emissions for 1990 and 2005 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	-50.392	-1,6%	-851	-0,2%	-8.415	-2,1%	5	0,0%	617	3,7%	-51	-0,5%
Other	-2.901	100,0%	-456	-	-140	-	NO	NO	NO	NO	NO	NO
2005												
Total emissions and removals	33.796	1,1%	2.011	0,6%	-11.037	-3,3%	220	0,4%	-35	-0,6%	-70	-0,8%
Other	-2.978	100,0%	-250	-	-154	-	NO	NO	NO	NO	NO	NO

10 Recalculations and improvements

10.1 Explanations and justifications for recalculations

Tables 10.1 to 10.4 provide an overview of the main reasons for recalculating emissions in the year 1990 and 2005 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 EU-15 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	119		
CO_2 from 1A1	133	Correction of NCVs; shift between categories 1.A.1 and 1.A.2 and/or between final energy consumption and transformation input; calculation of emissions from natural gas distribution losses	AT NIR, March 2008, p. 352-353
CO_2 from 1A2	-133	Correction of NCVs; shift between categories 1.A.1 and 1.A.2 and/or between final energy consumption and transformation input; updated natural gas activity data	AT NIR, March 2008, p. 352-354
CO_2 from 1A4	130	Updated activity data (heating type split, new boiler sales statistics, energy data)	AT NIR, March 2008, p. 352-354
Belgium			
Total emissions excluding LUCF	-1 236		
PFC from 2E	680	Error correction	Direct communication, April 2008
N_2O from 1A4	-651	Harmonization of the applied emission factors for CH_4 and N_2O (switch to IPCC 2006 EFs in all regions)	BE NIR, March 2008, p. 70
CH_4 from 4B	-511	MCF for grazing animals has been corrected; changed activity data and emission factors used in the CH_4-model for manure management;	BE NIR, March 2008, p. 98-99
Denmark			
Total emissions excluding LUCF	-24		
CO_2 from 1A4	-185	Fuel adjustments for gas oil (fisheries); smaller amount of fuel used by gasoline fuelled working machinery;	DK NIR, March 2008, p. 166
CO_2 from 1A3	184	An error in the distribution of the total mileage between passenger cars and vans has been corrected; changed gasoline fuel consumption input data for the NERI model; emission factors of CH_4 and N_2O have been updated due to new emission data provided by the COPERT IV model developers; fuel consumption of heavy oil and gas oil for national sea transport	DK NIR, March 2008, p. 165
N_2O from 1A3	-22	An error in the distribution of the total mileage between passenger cars and vans has been corrected; changed gasoline fuel consumption input data for the NERI model; emission factors of CH_4 and N_2O have been updated due to new emission data provided by the COPERT IV model developers; fuel consumption of heavy oil and gas oil for national sea transport	DK NIR, March 2008, p. 165
Finland			
Total emissions excluding LUCF	-206		
CO_2 from 1A5	-134	Correction of data. NOx emissions have been calculated;	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
		reallocation of a plant in 1.A.2.c;	
CO_2 from 1A2	-47	Correction of plant specific factors; plant level data corrected; reallocation of plants	CRF 1990 Table 8(b)
CH_4 from 6A	-14	Corrected calculation error	
CO_2 from 2D	-14	NMVOC emissions from pulp and paper are non-fossile, no indirect CO_2.	CRF 1990 Table 8(b)
France			
Total emissions excluding LUCF	-884		
CO_2 from 1A2	2 472	New methodology for estimating CO_2 emissions from 1A2a; Amélioration de la comptabilisation de la biomasse en distinguant la liqueur noire et le bois et dérivés pour le secteur Papier - Carton; Ajustement des gaz sidérurgiques consommés par les GIC de la sidérurgie sous estimés dans l'édition précédente	FR NIR, March 2008, Annex 4
N_2O from 1A3	-1 153	Changed EF; improved methodology for civil aviation; modification du PARC; revised methodology for fuels from agriculture	FR NIR, March 2008, Annex 4
CO_2 from 2C	-953	Mise à jour des consommations et des FE selon la méthodologie validée lors du dernier GCIIE	FR NIR, March 2008, Annex 4
Germany			
Total emissions excluding LUCF	-172		
CO_2 from 1A1	-146	New available energy data of emission trading	CRF 1990 Table 8(b)
SF_6 from 2F	-143	The confidental emissions of sport shoes and AWACS maintenance are reallocated because of confidentiality reasons together with SF_6 emissions of 2.E at 2.G;the potential emissions of SF_6 of the last submission were because of technical problems too low.	CRF 1990 Table 8(b)
CO_2 from 1A3	-29	Revised EF	DE NIR, March 2008, p. 159
Greece			
Total emissions excluding LUCF	-4 140		
N_2O from 1A1	-1 673	EFs of N_2O emissions from the combustion of solid and liquid fuels were changed; Tier 2 methodology along with IPCC default EF were used.	Direct communication, April 2008
CO_2 from 1A3	-980	Reallocation_LPG & lubricans reported separately	CRF 1990 Table 8(b)
CO_2 from 1A1	-754	EF of CO_2 emissions from the combustion of lignite was changed	Direct communication, April 2008
Ireland			
Total emissions excluding LUCF	151		
CH_4 from 4A	156	Revised animal categorization and AWMS allocation; revised population estimate	CRF 1990 Table 8(b)
N_2O from 1A3	-18	New model for road transport. COPERT 4 version 4.0	CRF 1990 Table 8(b)
CH_4 from 4B	15	Revised animal categorization and AWMS allocation; revised population estimate	CRF 1990 Table 8(b)
Italy			
Total emissions excluding LUCF	-2 566		
N_2O from 1A4	-2 035	No information provided	CRF 1990 Table 8(b)
N_2O from 1A1	-1 180	Other minor liquid fuels have been added	CRF 1990 Table 8(b)
N_2O from 6B	820	An error occurred in unit conversion of beer activity data	CRF 1990 Table 8(b)
Luxembourg			
Total emissions excluding LUCF	500		

	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
N_2O from 4D	233	Reallocation of crops AD between N-fixing and non N-fixing crops	CRF 1990 Table 8(b)
CH_4 from 4A	74	Reallocation of mules & ases in CRF category 4.A.7	CRF 1990 Table 8(b)
CO_2 from 1A4	44	Corrected AD	CRF 1990 Table 8(b)
Netherlands			
Total emissions excluding LUCF	-1 313		
N_2O from 2G	-935	Indirect N_2O emissions and NH_3 emissions from non-agricultural sources were not included in the inventory; NOx emissions from the transport sector are calculated and reported according to IPCC definitions	NL NIR, March 2008, p. 140-141
N_2O from 2B	-474	Reported constant N_2O emissions have been replaced by a revised time series, based on: a production-index series over the period 1990-2004 received from the company	NL NIR, March 2008, p. 126
N_2O from 4B	118	Adjustment for NH_3 volatilization is removed	NL NIR, March 2008, p. 165
Portugal			
Total emissions excluding LUCF	-812		
CH_4 from 6A	-859	Revision of the DOCf value; emissions from open burning of industrial solid waste on land that were previously reported in the category 6D, are now reported under category 6A3	PT NIR, May 2008, p.458
CH_4 from 6B	-247	Revision of the background time series and some corrections	PT NIR, May 2008, p.457
N_2O from 4D	221	Revision of nitrogen excretion ratios for sheep; revision of time series of cultivated area in rice paddies; revision of activity data and volatilization rates for sythetic fertiliser use; correction of errors	PT NIR, May 2008, p.292
Spain			
Total emissions excluding LUCF	321		
CO_2 from 2C	666	Emissions from flaring in iron & steel industry (that were previously included in category 6C of waste sector) have been reallocated, following the UNFCCC Secretariat ERT's requirements, to category 2C1 of industrial processes	CRF 1990, Table 8 (b)
CO_2 from 6C	-666	New data have been received, which have been elaborated by the Institute for the Resources Sostenibility, from the Ministry of the Environment that did not provide information in the previous submission. The emissions from open burning of agricultural wastes (forestry sector)' have been removed from the waste sector as they are already accounted in LULUCF. The emissions from flaring in the iron&steel industry have been removed from 6.C.2 category of ""Waste"" sector"" and, following the request of the UNFCCC Secretariat's ERT, have been allocated to 2.C.1 category of the ""Industrial Processes"" sector	CRF 1990, Table 8 (b)
CH_4 from 4F	263	New data availability on olive and vine residues field burning;	CRF 1990, Table 8 (b)
Sweden			
Total emissions excluding LUCF	-147		
CO_2 from 1A2	-120	Revised activity data due to double counting of liquid fuels	CRF 1990, Table 8 (b)
N_2O from 2G	-66	Now included i 2D1	CRF 1990, Table 8 (b)
PFC from 2C3	-63	The calculation of PFC emissions from primary aluminium production is now in complete agreement with the Tier 2 calculation method described in IPCC Good Practice Guidance	CRF 1990, Table 8 (b)
United Kingdom			
Total emissions excluding LUCF	-2 934		
CO_2 from 2A	636	Revision to emission factor for cement production based on data	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
		from industry; Revision to activity data for lime production	
CO_2 from 2B	-281	Emission factor for energy recovery from waste solvents revised based on data from industry	CRF 1990, Table 8 (b)
N_2O from 4B	207	Revision to Nitrogen excretion rates used based on new research	CRF 1990, Table 8 (b)
CO_2 from 7	-2 901	Emissions from overseas territories are reported as negative values in sector 7, as these territories do not belong to the EU	CRF 1990, Table 8 (b)
CH_4 from 7	-456		
N_2O from 7	-140		

Table 10.2 Main recalculations in the EU-15 Member States for 2005 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	-20		
CO_2 from 1A4	-767	Updated activity data (heating type split, new boiler sales statistics, energy data)	AT NIR, March 2008, p. 353-354
CO_2 from 1A2	370	Correction of NCVs; shift between categories 1.A.1 and 1.A.2 and/or between final energy consumption and transformation input; updated natural gas activity data;	AT NIR, March 2008, p. 353-354
CO_2 from 1A1	262	Correction of NCVs; shift between categories 1.A.1 and 1.A.2 and/or between final energy consumption and transformation input; calculation of emissions from natural gas distribution losses	AT NIR, March 2008, p. 353-354
Belgium			
Total emissions excluding LUCF	-1 503		
CO_2 from 2B	781	In the 2007 submission the emissions reported under 2B5 were temporary figures in the Flemish region.	Direct communication, March 2008
N_2O from 1A4	-654	Harmonization of the applied emission factors for CH_4 and N_2O (switch to IPCC 2006 EFs in all regions)	BE NIR, March 2008, p.121
CO_2 from 1A1	-465	As the year 2005 contains a temporary estimation of the emissions during the 2007 submission, this year was almost completely revised during the January 15, 2008 submission.	Direct communication, March 2008
Denmark			
Total emissions excluding LUCF	-393		
N_2O from 1A3	-305	An error in the distribution of the total mileage between passenger cars and vans has been corrected; changed gasoline fuel consumption input data for the NERI model; emission factors of CH_4 and N_2O have been updated due to new emission data provided by the COPERT IV model developers; fuel consumption of heavy oil and gas oil for national sea transport	DK NIR, March 2008, p. 165
CO_2 from 1A4	-138	Fuel adjustments for gas oil (fisheries); smaller amount of fuel used by gasoline fuelled working machinery;	DK NIR, March 2008, p. 166
CO_2 from 1A2	35	Fuel consumption data for residual oil has been updated based on a research project improving the fuel consumption estimate for national sea traffic.	DK NIR, March 2008, p. 164
Finland			
Total emissions excluding LUCF	-228		
CO_2 from 1A5	-371	Correction of data; realloction of plants	CRF 2005, 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
CO_2 from 1A4	154	Plant level data corrected; reallocation of plants	CRF 2005, Table 8(b)
CO_2 from 1A2	-111	Correction of data	CRF 2005, Table 8(b)
France			
Total emissions excluding LUCF	1 738		
CO_2 from 1A1	4 858	changed fuel consumption; change in GIC data base; changed AD for district heating	FR NIR, March 2008, Annex 4
N_2O from 1A3	-3 710	changed EF; improved methodology for civil aviation; modification du PARC; revised methodology for fuels from agriculture	FR NIR, March 2008, Annex 4
CO_2 from 1A2	-2 641	new methodology for estimating CO_2 emissions from 1A2a; Amélioration de la comptabilisation de la biomasse en distinguant la liqueur noire et le bois et dérivés pour le secteur Papier - Carton; Ajustement des gaz sidérurgiques consommés par les GIC de la sidérurgie sous estimés dans l'édition précédente	FR NIR, March 2008, Annex 4
CO_2 from 1A4	2 605	Transfert des consommations des GIC + mise à jour du bilan de l'OE	FR NIR, March 2008, Annex 4
HFC from 2F	1 446	Mise à jour des données communiquées par l'EMP	FR NIR, March 2008, Annex 4
Germany			
Total emissions excluding LUCF	3 525		
CO_2 from 1A4	2 830	1A4a,c: new available energy data; 1A4b: new available data for peat;	CRF 2005, Table 8(b)
CO_2 from 1A2	863	New statistical data from a research project; 1A2d: new statistical data from industry	CRF 2005, Table 8(b)
N_2O from 2B	-297	In further researches it was found out, that because of reduction meseaures there are since 1992 no emissions of N_2O.	CRF 2005, Table 8(b)
Greece			
Total emissions excluding LUCF	-5 410		
N_2O from 1A2	-2 115	Disaggregation into different activities; revised EF	CRF 1990, Table 8(b)
HFC from 2F	-1 331	Error in data input	CRF 1990, Table 8(b)
N_2O from 1A4	-652	Changed EF	CRF 1990, Table 8(b)
Ireland			
Total emissions excluding LUCF	400		
CO_2 from 1A2	383	Revised fuel data in national energy balance	CRF 2005, Table 8(b)
N_2O from 1A3	-263	New model for road transport. COPERT 4 version 4.0	CRF 2005, Table 8(b)
CO_2 from 1A4	193	Revised fuel data in national energy balance	CRF 2005, Table 8(b)
Italy			
Total emissions excluding LUCF	-4 255		
N_2O from 1A4	-1 668	update of natural gas activity data	CRF 2005, Table 8(b)
N_2O from 1A1	-1 461	other minor liquid fuels have been added	CRF 2005, Table 8(b)
CO_2 from 1A4	-1 122	update of emission factor for natural gas, coal and fuel oil; update of natural gas and industrial waste activity data	CRF 2005, Table 8(b)
Luxembourg			
Total emissions excluding LUCF	553		
CO_2 from 1A1	1059	Revised AD for CRF category 1.A.1.a - other fuels (MSW incineration)	CRF 2005, Table 8(b)
CO_2 from 1A2	-774	Corrected AD	CRF 2005, Table 8(b)
N_2O from 4D	185	reallocation of mules & ases in CRF category 4.A.7, addition of 3 new animal categories under "Other Livestock" and reallocation of crops AD between N-fixing and non N-fixing crops	CRF 2005, Table 8(b)
Netherlands			

	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	-380		
N_2O from 2G	-618	Indirect N_2O emissions and NH_3 emissions from non-agricultural sources were not included in the inventory; NOx emissions from the transport sector are calculated and reported according to IPCC definitions	NL NIR, March 2008, p. 140-141
CH_4 from 6A	128	Error corrections and improved activity data	NL NIR, March 2008, p. 213
N_2O from 4B	113	Adjustment for NH_3 volatilization is removed	NL NIR, March 2008, p. 165
Portugal			
Total emissions excluding LUCF	1 882		
CO_2 from 1A1	1420	update of activity data for some LPS	CRF 2005, Table 8(b)
CH_4 from 6B	1336	Revision of the background time series and some corrections	PT NIR, May 2008, p.457
CH_4 from 6A	-403	Revision of the DOCf value; emissions from open burning of industrial solid waste on land that were previously reported in the category 6D, are now reported under category 6A3	PT NIR, May 2008, p.458
Spain			
Total emissions excluding LUCF	238		
N_2O from 2B	298	The amount of nitric acid produced has been revised following the new available information at a production plant	CRF 2005, Table 8(b)
CH_4 from 4F	276	The availability of information on olive and vine residues field burning has allowed the estimation of their emissions; new activity data (surface and crop production) available; Addition of olive and vine residues field burning emissions;	CRF 2005, Table 8(b)
N_2O from 4D	-270	New procedure in territorial allocation generates an slightly different output. The availability of information on olive and vine residues field burning has allowed the estimation of their emissions; Addition of olive and vine residues field burning emissions; new data available for synthtic fertilizers. Revision of the amount of total N in manure due to changes in number of animals (Swine and Poultry). New activity data (surface and crop production) available. New number of animal's surveys available and therefore change in number of animals. Slight revision of N in compost. Update data avaliable for municipal solid waste compost.	CRF 2005, Table 8(b)
Sweden			
Total emissions excluding LUCF	-55		
CO_2 from 1A2	86	Revised thermal values for coke oven gas and blast furnace gas; revised activity data	CRF 2005, Table 8(b)
N_2O from 2G	-86	Now included i 2D1	CRF 2005, Table 8(b)
CO_2 from 1A1	-83	Revised activity data	CRF 2005, Table 8(b)
United Kingdom			
Total emissions excluding LUCF	2 045		
CO_2 from 1A1	3105	Addition of emission factor for petroleum coke in power stations; Revision to activity data in power stations for gas oil (increase), Fuel oil (decrease) and coal. All due to change in activity data in National statistics. Addition of petroleum coke. Increase in activity data due to change in national statistics for natural gas used in petroleum refining; Reallocation of coal from other industrial combustion to power stations	CRF 2005, Table 8(b)
CO_2 from 1A2	-1431	Change to emission factor for coal from other industrial combustion. Emission factor takes into account changes in GCVs. Emission factor revisions for coal from autogeneration, waste solvent and scrap tyres from cement production (due to better available data); Revision to gas oil for other industrial combustion	CRF 2005, 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
		due to change in UK National statistics and also due to the reallocation of gas oil as a result of a change in rail emission methodology;	
CO_2 from 1A4	-943	Review and revisions to methodolgy for estimates of emissions from UK Oversea's Territories; Revision of UK National activity statistics for natural gas from public sector combustion and domestic combustion. Reallocation of gas oil to reflect new rail emission methodology	CRF 2005, Table 8 (b)
CO_2 from 7	-2 978	Emissions from overseas territories are reported as negative values in sector 7, as these territories do not belong to the EU	
CH_4 from 7	-250		
N_2O from 7	-154		

Table 10.3 Main recalculations in the new 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
Bulgaria			
Total emissions excluding LUCF	598		
CO_2 from 2B	492	No information provided	
N_2O from 3	51	use of N_2O for anaesthesia was calculated based on Switzerland´s methodology	BG NIR, March 2008, p. 109
CH_4 from 6A	33	Revised „k" value	BG NIR, March 2008, p. 110
Cyprus			
Total emissions excluding LUCF	0		
Czech Republic			
Total emissions excluding LUCF	-1 960		
CO_2 from 1A1	-647	Use of country-specific EF for coal instead of default values;	CZ NIR, March 2008, p. 140
N_2O from 1A1	-396	Use of IPCC default EF for stationary fuel combustion instead of former national values due to lack of transparency;	CZ NIR, March 2008, p. 140
CO_2 from 1A2	-318	Use of country-specific EF for coal instead of default values;	CZ NIR, March 2008, p. 140
Estonia			
Total emissions excluding LUCF	-2 002		
CO_2 from 1A1	-1 958	Addition of fuel consumption for the own use of power plants	EE NIR, March 2008, p. 59
CO_2 from 1A4	-427	Reallocation of emissions from use of diesel oil and gasoline in agriculture sector from 1A4c to 1A3e	EE NIR, March 2008, p. 67
CO_2 from 1A3	328	Reallocation of emissions from use of diesel oil and gasoline in agriculture sector from 1A4c to 1A3e	EE NIR, March 2008, p. 67
Hungary			
Total emissions excluding LUCF	-472		
CO_2 from 1A1	1 618		
CO_2 from 1A2	-1 618		
N_2O from 1A1	-435	Method is changed from T1 to T2 with detailed vehicle type information; old CS to IPCC, 2006 default max.- value	CRF 1990, Table 8(b)
Latvia			
Total emissions	13		

	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 1A4	128	Mistake in estimations of previous submission were corrected; data of autoproducers from transport sector heat plant were included	CRF 2005, Table 8 (b)
CO_2 from 1A3	-83	More precised activity data were used in estimations	CRF 2005, Table 8 (b)
CO_2 from 2C	-31	IPCC GPG Tier2 method is used based on carbon capture and carbon leakage during crude steel production from crude iron, pig iron and scrap metals; CO_2 emissions were recalculated according to IPCC GPG 2000.	LV NIR, March 2008, p. 73
Lithuania			
Total emissions excluding LUCF	1 311		
N_2O from 4D	814	Direct N_2O emissions from mineral N fertilisers applied to soils were recalculated using data on consumption of mineral N fertilisers reported in the statistical yearbooks of Lithuania were used for years 1990-1994. For remaining period starting from 1995 data from the International Fertilizer Industry Association (IFA) were used. Direct and indirect N_2O emissions associated with atmospheric deposition were recalculated using new data on application of mineral fertilisers and including emissions from animal manure.	LT NIR, Jan 2008, p. 21
CO_2 from 2A	397	CO_2 emissions from cement production were recalculated using clinker production as activity data obtained directly from cement plant. Country-specific calcium oxide (CaO) content was also provided by cement producer. Emissions from glass, bricks, ceramics and mineral wool production were included in the inventory for the first time. Tier 2 method from 2006 IPPC Guidelines has been used for estimation of carbon dioxide emissions in glass production.	LT NIR, Jan 2008, p. 20
CH_4 from 1B2	204	As country-specific emission factors are not available for emissions of CH_4 from natural gas distribution and transmission emissions were recalculated using default emission factors (averages) for countries with economies in transition provided in 2006 IPCC Guidelines. Instead transmission pipelines data on utility sales and marketable gas was applied.	Personal communication
Malta			
Total emissions excluding LUCF	-23		
CO_2 from 1A1	-48	No information provided	
CH_4 from 6A	24	No information provided	
N_2O from 1A5	-6	No information provided	
Poland			
Total emissions excluding LUCF	-32 664		
CO_2 from 1A1	-17 573	Activity data on fuel consumption were taken from EUROSTAT database (instead of Energy Statistics published by Central Statistical Office (GUS)) as a consequence of the initiated process of the harmonization data in GHG inventory with data provided by Poland for international statistical organization; revised EFs; default oxidation factors from the Revised 1996 IPCC guidelines were applied for all fuels.	PL Short-NIR, Jan 2008, Recalculations, p.1-2
CO_2 from 1A4	-7 527	Activity data on fuel consumption were taken from EUROSTAT database (instead of Energy Statistics published by Central Statistical Office (GUS)) as a consequence of the initiated process of the harmonization data in GHG inventory with data provided by Poland for international statistical organization; revised EFs; default oxidation factors from the Revised 1996 IPCC guidelines were applied for all fuels; Re-allocation of fuels from this subcategory into 1.A.4.a	PL Short-NIR, Jan 2008, Recalculations, p.1-2

	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
		Commercial/Institutional and 1.A.3.a Civil Aviation respectively; updated activity data	
CH_4 from 6B	-4 747	Methodology and emission factors were revised. New methodology is based on Revised IPCC Guidelines and national studies.	PL Short-NIR, Jan 2008, Recalculations, p.5
CO_2 from 2C	2 687	C balance for blast furnaces was revised. updated EFs; updated activity data;	PL Short-NIR, Jan 2008, Recalculations, p.3-4
CO_2 from 1A2	-2 466	Activity data on fuel consumption were taken from EUROSTAT database (instead of Energy Statistics published by Central Statistical Office (GUS)) as a consequence of the initiated process of the harmonization data in GHG inventory with data provided by Poland for international statistical organization; revised EFs; default oxidation factors from the Revised 1996 IPCC guidelines were applied for all fuels.	PL Short-NIR, Jan 2008, Recalculations, p.1-2
CO_2 from 1A3	-2 430	Re-allocation of fuels from this subcategory into 1.A.4.a Commercial/Institutional and 1.A.3.a Civil Aviation respectively; updated activity data; changed EFs for hard coal and fuel oil;	PL Short-NIR, Jan 2008, Recalculations, p.1-2
CH_4 from 1A4	2 098	EFs were updated according to 2006 IPCC Guidelines	PL Short-NIR, Jan 2008, Recalculations, p.1-2
CO_2 from 1A5	-1 760	Re-allocation of fuels from this subcategory into 1.A.4.a Commercial/Institutional and 1.A.3.a Civil Aviation respectively.	PL Short-NIR, Jan 2008, Recalculations, p.1-2
N_2O from 4D	-1 688	N_2O estimates from animal manure application to soils were revised using updated methodology IPCC Good Practice Guidance; revision of N_2O estimates from cultivated area based on publications	PL Short-NIR, Jan 2008, Recalculations, p.4
CH_4 from 6A	1 589	EFs were changed (to default ones). industrial wastes were added, composition of waste and percent of waste on SWDS was revised, based on national data. For years 2004 and 2005 recovery of methane was added.	PL Short-NIR, Jan 2008, Recalculations, p.5
Romania			
Total emissions excluding LUCF	-1 036		
CH_4 from 6B	2 169	For the amount of the industrial wastewater produced and degradable organic component values from IPCC GPG 2000 have been used instead of IPCC 1996. Revised emission factor CH_4/biochemical oxygen demand (BOD) for CH_4 emission from domestic and commercial wastewater (6.B.2.1); New values for protein consumption provided by Food and Agriculture Organization (6.B.2.2);	RO NIR, March 2008, p. 253
CO_2 from 1A3	-1 037	1A3a: Separation of the fuels consumption values between civil aviation and international aviation bunkers and also to the new activity data provided by the national relevant authorities; 1A3c: correction of the emission factor for diesel oil; 1A3d: Separation of the liquid fuels and lubricants consumption values between domestic navigation and international marine bunkers. Also, the CO_2 emission factor for gas/diesel oil was corrected according to the provisions in the Table 1-1 of the Reference Manual.	RO NIR, March 2008, p. 68-70
CH_4 from 4A	-834	Revised cattle and non-dairy cattle livestock data series due to the use of an incorrect algorithm to disaggregate the bovines livestock data series	RO NIR, March 2008, p. 166
Slovakia			
Total emissions excluding LUCF	660		
N_2O from 4D	-576	The nitrogen input into the soils from plants were recalculated	SK NIR, April 2008, p. 128
CH_4 from 4A	-451	Recalculation, according the Tier 2 methodology and country specific input data was made. Detail analysis of animal housing and digestion are known.	SK NIR, April 2008, p. 128
N_2O from 2B	396	Updated and harmonised EF in the Nitric acid production	SK NIR, April 2008, p. 128

	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
Slovenia			
Total emissions excluding LUCF	170		
CO_2 from 1B1	98	Addition of CO_2 fugitive emissions from coal mining and handling	Direct communication, April 2008
N_2O from 4D	28	Addition of N_2O emissions due to the cultivation of organic soils	Direct communication, April 2008
CO_2 from 1A3	18	The Copert III model has been used for the whole time serie.	CRF 1990, table 8(b)

Table 10.4 Main recalculations in the new Member States for 2005 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
Bulgaria			
Total emissions excluding LUCF	296		
CH_4 from 6A	1 407	Revised „k" value	BG NIR, March 2008, p. 110
CO_2 from 1A1	-958	Activity data about the consumed quantities of blast furnace gas for 2005 is corrected	BG NIR, April 2008, p. 108
HFC from 2F	-387	No information provided	
Cyprus			
Total emissions excluding LUCF	-23		
N_2O from 4D	-137	Amounts of fertilisers used were assumed constant for 1998-2005. In the new submission of 2008, the correct data is used for the estimation of emissions.	CY NIR, March 2008, p. 38
CO_2 from 1A4	121	No information provided	
HFC from 2F	86	No information provided	
Czech Republic			
Total emissions excluding LUCF	138		
CO_2 from 1A4	-1 256	Use of country-specific EF for coal instead of default values; recalculations based on official data from the final CSO balance	CZ NIR, March 2008, p. 140
CO_2 from 2C	915	Updated data corresponding to coke consumption from blast furnaces	CZ NIR, March 2008, p. 140
CO_2 from 1A1	-657	Use of country-specific EF for coal instead of default values; recalculations based on official data from the final CSO balance	CZ NIR, March 2008, p. 140
Estonia			
Total emissions excluding LUCF	-1 345		
CO_2 from 1A1	-1 524	Addition of fuel consumption for the own use of power plants	EE NIR, March 2008, p. 59
CO_2 from 1A3	130	Reallocation of emissions from use of diesel oil and gasoline in agriculture sector from 1A4c to 1A3e	EE NIR, March 2008, p. 67
CO_2 from 1A4	-130	Reallocation of emissions from use of diesel oil and gasoline in agriculture sector from 1A4c to 1A3e	EE NIR, March 2008, p. 67
Hungary			
Total emissions excluding LUCF	-346		

	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 1A2	-1 648	Emission factor of petroleum coke was change to the default EF.	HU NIR, March 2008, p. 144
CO_2 from 1A1	1 403	Emission factor of petroleum coke was change to the default EF.	HU NIR, March 2008, p. 144
N_2O from 1A1	-293	Method is changed from T1 to T2 with detailed vehicle type information; old CS to IPCC, 2006 default max.- value	CRF 1990, Table 8(b)
Latvia			
Total emissions excluding LUCF	250		
CO_2 from 1A3	143	More precised activity data were used in estimations	CRF 2005, Table 8 (b)
CO_2 from 1A4	121	1A4a: Mistake in estimations of previous submission were corrected; data of autoproducers from transport sector heat plant were included; 1A4a,b,c: statistical data of used wood products were changed; 1A4c: statistical data were changed - activity data of used diesel oil were changed	CRF 2005, Table 8 (b)
N_2O from 4D	53	As crop residue burning isn't occured then in the equation 4.28 FracBurn was excluded for emission calculation	CRF 2005, Table 8 (b)
Lithuania			
Total emissions excluding LUCF	112		
CO_2 from 3	92	Emission from 3 'Solvent and Other Product Use' were estimated in accordance with the EMEP/CORINAIR methodology approach based on per capita data for several source categories. Default per capita emission factors proposed in EMEP/CORINAIR guidebook were used, multiplying them by the number of inhabitants.	NIR, Jan 2008, p. 21
CO_2 from 2A	47	CO_2 emissions from cement production were recalculated using clinker production as activity data obtained directly from cement plant. Country-specific calcium oxide (CaO) content was also provided by cement producer. Emissions from glass, bricks, ceramics and mineral wool production were included in the inventory for the first time. Tier 2 method from 2006 IPPC Guidelines has been used for estimation of carbon dioxide emissions in glass production.	NIR, Jan 2008, p. 20
CH_4 from 1B2	-38	As country-specific emission factors are not available for emissions of CH_4 from natural gas distribution and transmission emissions were recalculated using default emission factors (averages) for countries with economies in transition provided in 2006 IPCC Guidelines. Instead transmission pipelines data on utility sales and marketable gas was applied.	Personal communication
Malta			
Total emissions excluding LUCF	-240		
CO_2 from 1A4	-242	No information provided	
CH_4 from 6A	108	No information provided	
CO_2 from 1A3	-88	No information provided	
Poland			
Total emissions excluding LUCF	-12 595		
CO_2 from 1A5	-6 282	Re-allocation of fuels from this subcategory into 1.A.4.a Commercial/Institutional and 1.A.3.a Civil Aviation respectively.	PL Short-NIR, Jan 2008, Recalculations, p.1-2
CO_2 from 1A3	-2 878	Re-allocation of fuels from this subcategory into 1.A.4.a Commercial/Institutional and 1.A.3.a Civil Aviation respectively; updated activity data; changed EFs for hard coal and fuel oil;	PL Short-NIR, Jan 2008, Recalculations, p.1-2
CH_4 from 6B	-2 514	Methodology and emission factors were revised. New methodology is based on Revised IPCC Guidelines and national studies.	PL Short-NIR, Jan 2008, Recalculations, p.5

	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
CH_4 from 1A4	2 300	EFs were updated according to 2006 IPCC Guidelines	PL Short-NIR, Jan 2008, Recalculations, p.1-2
N_2O from 4D	-2 134	N_2O estimates from animal manure application to soils were revised using updated methodology IPCC Good Practice Guidance; revision of N_2O estimates from cultivated area based on publications	PL Short-NIR, Jan 2008, Recalculations, p.4
Romania			
Total emissions excluding LUCF	-1 673		
CO_2 from 1A2	-4 673	Double counting of CO_2 emissions from solid fuels in the sectoral approach (for coke oven coke) with industrial processes	RO NIR, March 2008, p. 61
CH_4 from 6B	1 521	For the amount of the industrial wastewater produced and degradable organic component values from IPCC GPG 2000 have been used instead of IPCC 1996. Revised emission factor CH_4/biochemical oxygen demand (BOD) for CH_4 emission from domestic and commercial wastewater (6.B.2.1); New values for protein consumption provided by Food and Agriculture Organization (6.B.2.2);	RO NIR, March 2008, p. 253
CH_4 from 1B2	874	Misallocation of activity data (fuel consumption and transmission)	RO NIR, March 2008, p. 83
Slovakia			
Total emissions excluding LUCF	631		
N_2O from 4D	-606	The nitrogen input into the soils from plants were recalculated	SK NIR, April 2008, p. 128
CO_2 from 1A1	552	Revised EF for natural gas using extrapolation method based on national data after 2000; sectoral approach instead of reference approach	SK NIR, April 2008, p. 127
CO_2 from 2B	422	The CO_2 emissions were re-allocated from the energy sector, technological emissions from ammonia production were separated from combustion emission from the category 1A2c to the 2B2 category.	SK NIR, April 2008, p. 128
Slovenia			
Total emissions excluding LUCF	184		
CO_2 from 1B1	81	Addition of CO_2 fugitive emissions from coal mining and handling	Direct communication, April 2008
CH_4 from 6A	79	Due to the changes in historical data of biodegradable waste deposited on SWDS DOC values have been changed from 1989 on.	SI NIR, March 2008, p. 190
N_2O from 4D	19	New numbers of poultry have been provided from Statistical Office for 2002 and 2005; Addition of N_2O emissions due to the cultivation of organic soils	SI NIR, March 2008, p. 190

10.2 Implications for emission levels

Table 10.5 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 13 344 Gg (-0.31 %). EU-15 GHG emissions for 2005 decreased by 5953 Gg (- 0.1 %) due to recalculations.

In the EU-27, 1990 GHG emissions excluding LUCF have decreased by 48 748 Gg (-0.9 %). For 2005, they decreased by 20 564 Gg (-0.4 %) (Table 10.6).

Table 10.5 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	2005
Total CO_2 equivalent emissions including LULUCF (absolute)	-59.087	-61.478	-46.654	10.939	-35.366	2.735	-33.459	-6.117	-9.804	5.479	-17.474	2.512	-5.715	-38.538	-31.267	24.982
Total CO_2 equivalent emissions including LULUCF (percent)	-1,5%	-1,5%	-1,2%	0,3%	-0,9%	0,1%	-0,9%	-0,2%	-0,3%	0,1%	-0,5%	0,1%	-0,1%	-1,0%	-0,8%	0,6%
Total CO_2 equivalent emissions excluding LULUCF (absolute)	-13.344	-11.675	-15.714	-14.597	-13.351	-15.485	-16.217	-16.872	-16.204	-16.585	-16.288	-15.967	-15.333	-15.242	-10.956	-5.953
Total CO_2 equivalent emissions excluding LULUCF (percent)	-0,31%	-0,3%	-0,4%	-0,4%	-0,3%	-0,4%	-0,4%	-0,4%	-0,4%	-0,4%	-0,4%	-0,4%	-0,4%	-0,4%	-0,3%	-0,1%

Table 10.6 Overview of recalculations of EU-27 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	2005
Total CO_2 equivalent emissions including LULUCF (absolute)	-85.577	-81.478	-66.601	20.068	-44.831	-2.189	-50.748	-25.876	-33.513	-5.572	-18.300	-3.390	-18.717	-60.006	-50.874	5.578
Total CO_2 equivalent emissions including LULUCF (percent)	-1,6%	-1,6%	-1,4%	0,4%	-0,9%	0,0%	-1,0%	-0,5%	-0,7%	-0,1%	-0,4%	-0,1%	-0,4%	-1,3%	-1,1%	0,1%
Total CO_2 equivalent emissions excluding LULUCF (absolute)	-48.748	-38.159	-42.933	-20.126	-38.261	-35.147	-50.958	-46.352	-46.389	-39.429	-34.246	-33.845	-30.931	-35.379	-23.697	-20.564
Total CO_2 equivalent emissions excluding LULUCF (percent)	-0,9%	-0,7%	-0,8%	-0,4%	-0,7%	-0,7%	-0,9%	-0,9%	-0,9%	-0,8%	-0,7%	-0,7%	-0,6%	-0,7%	-0,5%	-0,4%

Table 10.7 provides an overview of recalculations for the EU-15 key source categories for 1990 and 2005 (see Section 1.5 for information on identification of EU-15 key sources). The table shows that the largest recalculations in absolute terms were made in the Key Source 1A1: 'Energy Industries': for 1990 for N_2O from 1A1 (- 2 960 Gg) and for 2005 for CO_2 from 1A1 (+9 210).

Table 10.8 and Table 10.9 give an overview of absolute and percentage changes of Member States' emissions due to recalculations for 1990 and 2005. Large recalculations in absolute terms were made in Poland, Italy, Greece, and the UK. Recalculations in relative terms of more than 3 % occurred in Greece, Italy, Luxembourg, Estonia, Lithuania, Malta and Poland.

Table 10.7 Recalculations for the EU-15 key source categories 1990 and 2005 (difference between latest submission and previous submission in Gg of CO_2 equivalents and in percentage)

Greenhouse Gas Source Categories	Gas	Recalculations 1990		Recalculations 2005	
		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
1A1 Energy Industries	CO_2	-632	-0,1%	9210	0,8%
1A1 Energy Industries	N_2O	-2960	-23,9%	-3766	-27,8%
1A2 Manufacturing Industries	CO_2	2237	0,4%	-4050	-0,7%
1A3 Transport	CO_2	-787	-0,1%	-862	-0,1%
1A3 Transport	CH_4	-373	-8,3%	-333	-15,6%
1A3 Transport	N_2O	-1224	-15,4%	-4324	-19,1%
1A4 Other Sectors	CO_2	-35	0,0%	2748	0,4%
1A4 Other Sectors	CH_4	18	0,2%	26	0,4%
1A5 Other	CO_2	-67	-0,3%	-358	-4,3%
1B1 Solid Fuels	CH_4	297	0,6%	255	2,1%
1B2 Oil and Natural Gas	CH_4	248	0,8%	-131	-0,5%
2A Mineral Products	CO_2	775	0,7%	450	0,4%
2B Chemical Industry	CO_2	-840	-2,9%	187	0,6%
2B Chemical Industry	N_2O	-193	-0,2%	541	1,2%
2C Metal Production	CO_2	-261	-0,3%	381	0,5%
2C Metal Production	PFC	-63	-0,5%	-137	-7,0%
2C Metal Production	SF_6	-70	-3,9%	10	0,4%
2E Production of Halocarbons and SF6	HFC	0	0,0%	-1	0,0%
2F Consumption of Halocarbons and SF6	HFC	5	1,0%	565	1,2%
2E Production of Halocarbons and SF6	PFC	-124	-1,7%	-232	-4,1%
2F Consumption of Halocarbons and SF6	SF_6	-124	-1,7%	-232	-4,1%
4A Enteric Fermentation	CH_4	-219	-0,2%	-76	-0,1%
4B Manure Management	CH_4	-482	-1,1%	349	0,8%
4B Manure Management	N_2O	364	1,5%	425	1,9%
4D Agricultural Soils	N_2O	483	0,2%	244	0,1%
6A Solid Waste Disposal on Land	CH_4	-665	-0,5%	-251	-0,3%
6B Waste-water Handling	CH_4	-93	-0,7%	1465	17,4%
6B Waste incineration		-760	-14,6%	-429	-14,3%

Note: Many of these source categories are more aggregated than the EU-15 key source categories identified in Section 1.5.

Table 10.8 Contribution of Member States to EU-27 and EU-15 recalculations of total GHG emissions without LUCF for 1990–2005 (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	2005
Austria	119	142	131	68	145	329	71	58	-13	269	20	223	486	346	485	-20
Belgium	-1.236	-1.526	-3.138	-1.979	-1.302	-1.944	-1.820	-1.917	-1.554	-2.178	-2.018	-1.752	-1.650	-1.744	-1.498	-1.503
Denmark	-24	-48	-65	82	207	-70	-158	-194	-225	-246	-257	-291	-263	-395	-356	-393
Finland	-206	-213	-208	-161	-201	-221	-50	-107	-169	-161	-258	-117	-199	-436	-344	-228
France	-884	405	-2.190	-2.342	-2.901	-3.620	-4.035	-4.395	-5.053	-4.508	-4.148	-4.385	-4.942	-3.902	-3.791	1.738
Germany	-172	-451	-576	-434	-305	-644	-406	-564	329	-58	-270	-401	-244	-753	2.627	3.525
Greece	-4.140	-3.054	-2.883	-3.086	-2.937	-2.702	-2.763	-2.861	-2.950	-2.770	-3.525	-3.720	-3.612	-3.784	-3.907	-5.410
Ireland	151	94	108	97	-41	-4	-89	-103	-96	25	-98	-188	-136	-162	42	400
Italy	-2.566	-2.571	-2.373	-2.208	-1.703	-2.067	-2.008	-1.921	-1.558	-1.657	-1.482	-1.913	-926	-1.235	-2.429	-4.255
Luxembourg	500	519	576	469	527	560	579	574	650	672	637	647	527	418	614	553
Netherlands	-1.313	-1.404	-1.384	-1.339	-1.081	-1.089	-1.042	-1.006	-987	-1.041	-803	-914	-869	-549	-714	-380
Portugal	-812	-812	-698	-757	-810	-872	-846	-871	-903	-1.021	-553	-49	-3	35	341	1.882
Spain	321	369	396	414	399	409	398	483	417	418	562	651	450	649	803	238
Sweden	-147	-24	-71	-53	-34	-47	-48	-47	-46	-39	-31	-29	-31	-16	-12	-55
UK	-2.934	-3.101	-3.340	-3.367	-3.313	-3.502	-3.999	-4.003	-4.048	-4.291	-4.064	-3.729	-3.922	-3.713	-2.817	-2.045
EU-15	**-13.344**	**-11.675**	**-15.714**	**-14.597**	**-13.351**	**-15.485**	**-16.217**	**-16.872**	**-16.204**	**-16.585**	**-16.288**	**-15.967**	**-15.333**	**-15.242**	**-10.956**	**-5.953**
Bulgaria	598	686	771	930	1.128	1.360	1.409	1.405	999	1.494	1.654	1.631	1.554	1.500	1.409	296
Cyprus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-23
Czech Republic	-1.960	-2.106	-1.166	-1.718	-5.289	-1.549	-1.682	-1.399	-5.392	-1.577	-2.067	-339	734	-1.977	-516	138
Estonia	-2.002	-1.572	-2.442	-1.812	-2.283	-2.361	-2.469	-2.491	-1.590	-1.201	-1.492	-1.515	-1.450	-1.886	-1.114	-1.345
Hungary	-472	-1.716	-1.591	-1.708	-1.804	-1.792	-1.877	-1.853	-1.502	-1.560	-1.474	-1.563	-1.605	-1.616	-148	-346
Latvia	13	27	29	-82	-202	9	-1	-9	-34	-25	-30	-82	-8	47	117	250
Lithuania	1.311	945	507	66	159	166	388	410	427	456	628	743	813	922	665	112
Malta	-23	-31	-38	-21	68	-7	-112	55	4	29	-168	211	-238	-43	-147	-240
Poland	-32.664	-24.548	-24.880	-497	-16.764	-12.562	-25.583	-19.161	-19.089	-18.301	-15.588	-16.599	-14.656	-17.011	-12.444	-12.595
Romania	-1.036	-1.166	-1.572	-2.508	-2.681	-2.870	-2.698	-3.059	-2.464	-927	135	727	-564	-620	-1.307	-1.673
Slovakia	660	2.838	2.984	1.625	2.560	-262	-2.333	-3.615	-1.774	-1.447	220	-1.309	-403	321	522	631
Slovenia	170	159	179	196	199	207	218	238	230	214	225	217	225	226	223	184
EU-27	**-48.748**	**-38.159**	**-42.933**	**-20.126**	**-38.261**	**-35.147**	**-50.958**	**-46.352**	**-46.389**	**-39.429**	**-34.246**	**-33.845**	**-30.931**	**-35.379**	**-23.697**	**-20.564**

Table 10.9 Contribution of Member States to EU-27 and EU-15 recalculations of total GHG emissions without LUCF for 1990–2005 (difference between latest submission and previous submission in percentage)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Austria	0,1	0,2	0,2	0,1	0,2	0,4	0,1	0,1	0,0	0,3	0,0	0,3	0,6	0,4	0,5	0,0
Belgium	-0,8	-1,0	-2,1	-1,4	-0,9	-1,3	-1,2	-1,3	-1,0	-1,5	-1,4	-1,2	-1,1	-1,2	-1,0	-1,0
Denmark	0,0	-0,1	-0,1	0,1	0,3	-0,1	-0,2	-0,2	-0,3	-0,3	-0,4	-0,4	-0,4	-0,5	-0,5	-0,6
Finland	-0,3	-0,3	-0,3	-0,2	-0,3	-0,3	-0,1	-0,1	-0,2	-0,2	-0,4	-0,2	-0,3	-0,5	-0,4	-0,3
France	-0,2	0,1	-0,4	-0,4	-0,5	-0,6	-0,7	-0,8	-0,9	-0,8	-0,7	-0,8	-0,9	-0,7	-0,7	0,3
Germany	0,0	0,0	-0,1	0,0	0,0	-0,1	0,0	-0,1	0,0	0,0	0,0	0,0	0,0	-0,1	0,3	0,4
Greece	-3,8	-2,8	-2,6	-2,8	-2,6	-2,4	-2,4	-2,4	-2,3	-2,2	-2,7	-2,8	-2,7	-2,8	-2,8	-3,9
Ireland	0,3	0,2	0,2	0,2	-0,1	0,0	-0,1	-0,2	-0,1	0,0	-0,1	-0,3	-0,2	-0,2	0,1	0,6
Italy	-0,5	-0,5	-0,5	-0,4	-0,3	-0,4	-0,4	-0,4	-0,3	-0,3	-0,3	-0,3	-0,2	-0,2	-0,4	-0,7
Luxembourg	3,9	4,0	4,5	3,6	4,3	5,7	5,9	6,2	7,7	7,5	6,7	6,6	4,9	3,7	4,8	4,3
Netherlands	-0,6	-0,6	-0,6	-0,6	-0,5	-0,5	-0,4	-0,4	-0,4	-0,5	-0,4	-0,4	-0,4	-0,3	-0,3	-0,2
Portugal	-1,4	-1,3	-1,1	-1,2	-1,2	-1,2	-1,2	-1,2	-1,2	-1,2	-0,7	-0,1	0,0	0,0	0,4	2,2
Spain	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,2	0,1	0,2	0,2	0,1
Sweden	-0,2	0,0	-0,1	-0,1	0,0	-0,1	-0,1	-0,1	-0,1	-0,1	0,0	0,0	0,0	0,0	0,0	-0,1
UK	-0,4	-0,4	-0,4	-0,5	-0,5	-0,5	-0,5	-0,6	-0,6	-0,6	-0,6	-0,6	-0,6	-0,6	-0,4	-0,3
EU-15	**-0,3**	**-0,3**	**-0,4**	**-0,4**	**-0,3**	**-0,4**	**-0,4**	**-0,4**	**-0,4**	**-0,4**	**-0,4**	**-0,4**	**-0,4**	**-0,4**	**-0,3**	**-0,1**
Bulgaria	0,5	0,7	0,9	1,1	1,4	1,6	1,7	1,7	1,4	2,2	2,5	2,4	2,4	2,2	2,0	0,4
Cyprus	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	-0,2
Czech Republic	-1,0	-1,2	-0,7	-1,1	-3,4	-1,0	-1,0	-0,9	-3,6	-1,1	-1,4	-0,2	0,5	-1,3	-0,4	0,1
Estonia	-4,6	-3,8	-8,0	-7,5	-9,0	-10,2	-10,2	-10,5	-7,5	-6,2	-7,6	-7,6	-7,5	-8,7	-5,3	-6,5
Hungary	-0,5	-1,9	-1,9	-2,1	-2,2	-2,2	-2,3	-2,3	-1,9	-1,9	-1,9	-1,9	-2,0	-2,0	-0,2	-0,4
Latvia	0,1	0,1	0,1	-0,5	-1,4	0,1	0,0	-0,1	-0,3	-0,2	-0,3	-0,8	-0,1	0,4	1,1	2,3
Lithuania	2,7	1,9	1,7	0,3	0,7	0,8	1,7	1,8	1,8	2,3	3,4	3,8	4,1	4,6	3,2	0,5
Malta	-1,0	-1,3	-1,5	-0,8	2,5	-0,2	-4,1	2,1	0,2	1,0	-5,9	8,0	-7,7	-1,4	-4,6	-7,0
Poland	-6,7	-5,2	-5,4	-0,1	-3,7	-2,8	-5,4	-4,1	-4,4	-4,4	-3,8	-4,1	-3,8	-4,2	-3,1	-3,2
Romania	-0,4	-0,6	-0,8	-1,4	-1,5	-1,5	-1,4	-1,8	-1,6	-0,7	0,1	0,5	-0,4	-0,4	-0,8	-1,1
Slovakia	0,9	4,5	5,1	3,0	5,0	-0,5	-4,4	-6,7	-3,4	-2,8	0,5	-2,5	-0,8	0,6	1,1	1,3
Slovenia	0,9	0,9	1,0	1,1	1,1	1,1	1,1	1,2	1,2	1,2	1,2	1,1	1,1	1,2	1,1	0,9
EU-27	**-0,9**	**-0,7**	**-0,8**	**-0,4**	**-0,8**	**-0,7**	**-1,0**	**-0,9**	**-0,9**	**-0,8**	**-0,7**	**-0,7**	**-0,6**	**-0,7**	**-0,5**	**-0,4**

10.3 Implications for emission trends, including time series consistency

Figure 10.1 shows that due to the fact that both the 1990 and 2005 emissions have decreased, the emission trend in the EU-15 has changed slightly. In the previous submission the trend of GHG excluding LUCF between 1990 and 2005 was – 1.5 %. In the latest submission this trend has decreased to – 1.4 %.

In the EU-27, the trend of GHG excluding LUCF between 1990 and 2005 changed from – 7.9 % in the previous submission to – 7.5 % in the latest submission (Figure 10.2).

Figure 10.1 Comparison of EU-15 GHG emission trends 1990–2005 (excl. LUCF) of the latest and the previous submission

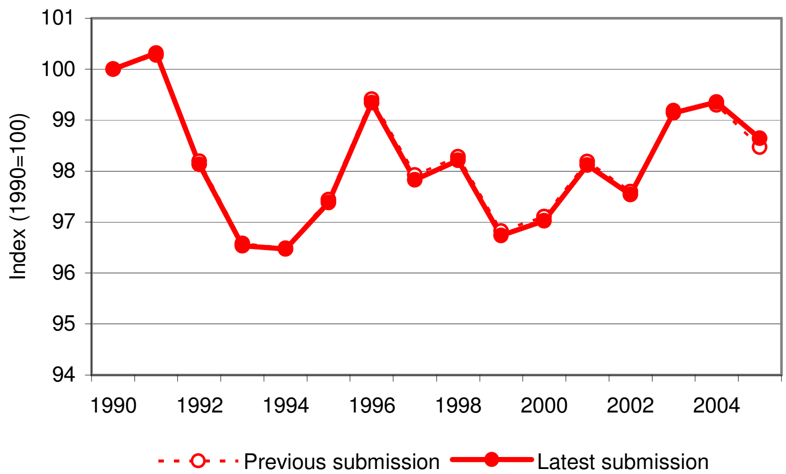
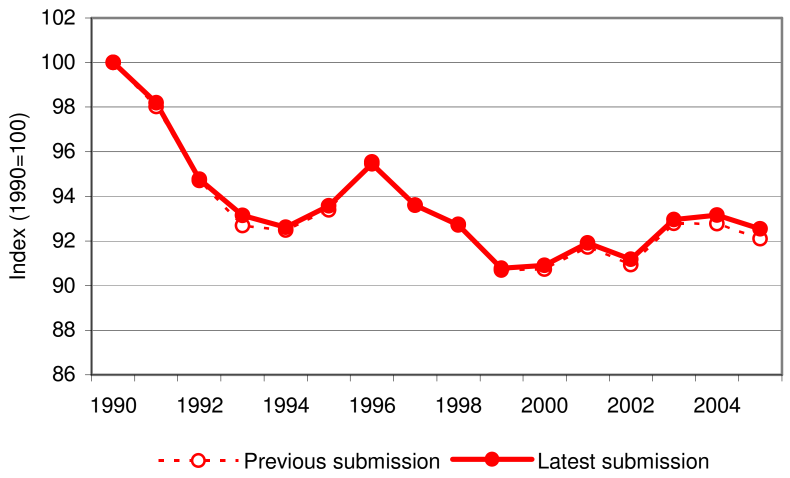


Figure 10.2 Comparison of EU-27 GHG emission trends 1990–2005 (excl. LUCF) of the latest and the previous submission



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 2008:

- **Inventory system:** By 15 April all Member States provided GHG inventories. Gap filling is only needed for F-gases for Malta.
- **QA/QC:** activities have been further extended on the basis of the EC QA/QC manual. Implied emission factors have been checked for all EC key sources for all EU-27 Member States. Also activity data has been checked for specific sectors.
- **Completeness:** CRF table Summary 3 is now completely filled on basis of the information provided by the Member States.
- **Transparency:** every cell in the CRF tables now includes a comment documenting the values/notation keys of every single MS. These comments also include information on methods and emission factors used.
- **Consistency:** the EC CRF tables are now fully consistent with the data used in the NIR for the EU-15 due to the inclusion of additional sources/gases in line with Member States. However, in a few cases still some reallocations were made (see Chapter 1.4).
- **Recalculations:** CRF table 8(b) now include information on which MS have made recalculations due to the reasons specified in CRF table 8(b).
- **EU-27:** a complete CRF submission was produced for the EU-27. In addition, the sector chapters now also include an overview of the emission trends, methods, activity data and emission factors used by the new MS.
- **NIR:** The review team also requested sections on time-series consistency, category-specific verification and category-specific planned improvements for each sector. However, it seemed more appropiate at the EU level to report on these issues in a more general way in order to address the different nature of the EC inventory. For example, the EC internal review has a different focus each year which is largely driven by the recommendations of the UNFCCC review of the EC inventory and MS' inventories. It seems more appropriate to describe such approaches as part of the general QA/QC procedures than separately in each source category.

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 ([32]). The table shows that a considerable amount of improvements were made compared since the previous submissions of Member States. In addition to the response to the UNFCCC review, a large number of additional improvements were implemented by Member States. However, an aggregation of all improvements conducted in all Member States would be too much information and too detailed to be included in this report.

Table 10.9 Improvements made by EU-15 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 NIR identifies areas for improvement. Source-specific planned improvements are: full implementation of tier 2 uncertainty analysis for all categories; and the updating and extending of the reporting of those LULUCF categories that have been estimated only partially or are not estimated (wetlands, settlements and other land). Areas for further improvement identified by the ERT: The ERT identified the following cross-cutting issues for improvement. The Party should: (a) Provide more precise descriptions of those methodologies that differ from the IPCC methodologies in the relevant NIR chapters, and highlight in the NIR all the work that has been done on QA/QC of the inventory information; (b) Extend its QA/QC and uncertainty analyses to all categories of the inventory, evaluate thoroughly the reliability of its statistical data and provide quantified uncertainty estimates. (paras 43, 35) FCCC/IRR/2007/AUT	• Tier 2 uncertainty analysis was performed • More complete estimation for wetlands, settlements and other land provided • Auditing of main data supplier (Statistik Austria) • Description of QA/QC activities in general way and for all source categories • Other recommendations unspecific and difficult to check
Belgium	The NIR identifies areas for improvement separately for each region, including the addition of estimates from some industrial processes and the improvement of methodology and time series consistency in the LULUCF sector. In its response to the issues raised during the review, Belgium indicated that it is working to improve its estimates according to the resources available. The ERT identified the following mandatory cross-cutting issue for improvement. The Party shall: (a) Develop a national QA/QC plan in accordance with decision 19/CMP.1 and implement this at both the regional level and the national level of inventory planning, preparation and management. The ERT identified the following cross-cutting issues for improvement. Belgium should: (a) Make all archived inventory information accessible by collecting and gathering it at a single location. (b) Submit estimates in its next inventory submission for all categories where emissions occur in the country; (c) Improve the transparency of the inventory by including in the NIR sufficient information to allow review of methodologies, region- and country-specific EFs and parameters, and models; (d) Structure the NIR according to the UNFCCC reporting guidelines; (e) Implement a formal process for improvements to the national inventory and create a national inventory improvement plan; (f) Harmonize methodologies, EFs and recalculation procedures between regions if there are no scientific or technological reasons for the differences. (para 44, 45, 46) FCCC/IRR/2007/BEL	• NIR 2008 includes QA/QC procedures as applied in three regions • NIR includes framework for a QA/QC plan, but explains that this will only be implemented when an additional staff person is employed. The framework addresses issues such as documentation and archiving, improvement plan approval process, however this is still part of the planning phase. • Methods and/or EFs were harmonized for source categories 1A2, 1A3b, 1A4 and 6B2 and emissions recalculated • Structure of the NIR was improved • Additional source categories were estimated, e.g. estimates for CO_2 emissions from glass industry and ceramics production were added to the inventory.

([32]) Issues related to the NIR are not included in this table as already addressed in Table 1.11.

Member State	Improvements as recommended by the review team	Improvements in response to UNFCCC review as indicated in the NIR
Denmark	The NIR identifies as areas for improvement: in industrial processes, the preparation of better uncertainty estimates and more detailed information on EFs, and continued work on collecting AD; in the agriculture sector, improved transparency through improved use of national data and national methodologies; and in the solvents and other product use and LULUCF sectors, improvement of data availability, which was raised in the 2005 review report. During the review, inventory partners indicated their plans to further develop data supply, models and estimates. These plans are linked to the partners' other activities but through cooperation between NERI and the partners most of the activities will be beneficial for the development and the quality of the inventory. One example is a European Community harmonization study, which aims for consistent reporting on energy consumption. The ERT identifies the following cross-cutting issues for improvement. The Party should: (a) Include information on the national system, institutional arrangements for inventory preparation, and the legal basis for the institutional arrangements as well as a clear statement on the status of agreements between NERI and the inventory partners, and between the Ministry of Environment and NERI in the next inventory submission under the Kyoto Protocol; (b) Compile an annual QA/QC plan and enhance integration with the QM systems of inventory partners; (c) Enhance the cooperation between NERI and other inventory partners on the compilation of the NIR in order to benefit fully from outside expertise and for verification of the NIR; (d) Increase the amount of concise background information in the NIR without unnecessarily expanding the volume of the report, notably in the energy sector; (e) Provide tier 2 uncertainty estimates in order to effectively focus the inventory improvement; (f) Undertake a tier 2 key category analysis; (g) Continue reporting of emission estimates for Greenland in the relevant categories instead of reporting under sector other, as well as update the estimates on an annual basis; (para 34,35) FCCC/IRR/2007/DNK	• Additional information on national system provided • QA/QC plan provided • Improvement and recalculations were performed in the industrial processes sector, solvents and other product use as well as the LULUCF sector. • Additional information from the EU ETS was included in the inventory
Finland	The inventory improvement plan in the NIR identifies the following areas for improvement: (1) direct use of emissions trading data for inventory verification; (2) verification of the F-gas (fluorinated gas) emission trend; (3) methodological developments for calculating CH_4 emissions from enteric fermentation from cattle; (4) improvement of data collection for agricultural soils; (5) inclusion of N_2O emissions from disturbance associated with land-use conversion to cropland; (6) implementation of a new method to estimate carbon stock change in living biomass; (7) separation of emission and removal estimates for land remaining in the same land category and land converted to other land categories; and (8) review of the waste composition data for municipal solid waste (MSW). During the in-country visit, Finland explained its further plans for improving the overall QA/QC system. The ERT identifies the following cross-cutting issues for improvement: (a) Improve the performance of the overall QA/QC system by further considering the resource implications for QA/QC for the different institutions involved in preparing the inventory; the use of internal audits for the sectors and systems audits in the QA/QC system; and further improvements to the systematic approach to quality checks; (b) The CRF and the NIR: further improve the completeness	• Table 10.4_2 of the Finnish NIR provides a detailed overview of the implementation of all ERT's recommendations in the GHG inventory • ETS data was used for verification of the inventory data • F-gas trend was further investigated • Finland revised its QA/QC plan for the preparation of the 2008 submission. The documentation of QA/QC has also been updated. Improvement of the procedures for QC checks in ongoing. • The NIR version management has been improved. The internal consistency of the sectoral chapters has been addressed in the annual quality meetings. The NIR has been improved accordingly. • Additional explanations were added to explain the trend of emissions from road transport based on the comments of the ERT • Additional verifications were performed for jet kerosene consumption data compared to IEA data, for iron and steel emissions • Consistent land area was used across the time-series

Member State	Improvements as recommended by the review team	Improvements in response to UNFCCC review as indicated in the NIR
	and consistency of the documentation provided in the NIR and consider an updated system for version management for the CRF and the NIR. (para 33,34) FCCC/IRR/2007/FIN	
France	The NIR identifies several generic areas for improvement. These include to: (a) Undertake research to improve the precision of the key categories; (b) Further develop and apply uncertainty information by estimating uncertainty ranges and using the information explicitly in inventory improvement; (c) Include any category not yet covered or insufficiently treated (e.g. non-energy use of fossil fuels); (d) Further improve procedures in the quality management system, especially the consultation with external experts in certain areas. The ERT identified the following cross-cutting issues for improvement over and above the issues identified by the Party. The Party should: (a) Improve transparency in the inventory through improving the explanatory power of both the NIR and the OMINEA reports by: (i) Reconsidering the balance between the NIR and the OMINEA report, and including or repeating some of the general explanations in the OMINEA report in the NIR; (ii) Decreasing the need for consultation of experts by giving the rationale for the selection of country-specific EFs and other parameters in the NIR/OMINEA report; (b) Improve QA in the system by implementing a review prior to each inventory submission; the ERT suggests that France consult with other EU member States that have already implemented such a procedure. (para 20,21) FCCC/IRR/2007/FRA	• Key category analysis was further refined. • Improved cross-references to the OMINEA report
Germany	The NIR identifies several areas for improvement. These relate in particular to: (a) Revisions to energy data for the new German Länder to improve consistency for the years 1991.1994; (b) Research projects to review EFs that are technology dependent; (c) Improved breakdown of energy versus non-energy use of fuels; (d) The production of more timely national energy balances. The ERT identifies the following cross-cutting issues for improvement. The Party should: (a) Provide a more precise description of country-specific methodologies that differ from the IPCC methodologies, focusing on choice of methodology, a description of the specific methods applied and detailed reference to equations and parameters, such as information on the development of EFs for emissions from composting; (b) Reduce the descriptions of IPCC methods already contained in the Revised 1996 IPCC Guidelines and the IPCC good practice guidance and focus more reporting and documentation in the NIR on: (i) Which method was used and why; (ii) A short description of the methodology; (iii) Clear references to the equations and parameters used; (c) Improve the timeliness of the national energy balances; (d) Continue the implementation of the QA/QC plan, in particular (where feasible and appropriate) the establishment of regular and systematic external peer reviews including QA/QC activities undertaken by agencies outside the UBA; (e) Continue to implement the policy paper on the national system. Key to this will be the establishment of the coordination committee, and an ongoing commitment to fund the relevant agencies for all aspects of data development and quality.	• Correction of EF for jet kerosene • Different focus of NIR in some areas • Detailed description of implementation of policy paper on national system provided

Member State	Improvements as recommended by the review team	Improvements in response to UNFCCC review as indicated in the NIR
	(para 38, 39) FCCC/IRR/2007/DEU	
Greece	Greece identifies in the NIR several areas for improvement. It plans to implement improvements to the centralized archiving of information; procedures for the evaluation and the consideration of the verified reports submitted by Greek installations under the European Union (EU) emissions trading scheme; revision of the national energy balance; enhancing the completeness of the inventory; and the use of higher-tier methods for some key categories (e.g. a tier 2 methodology for the estimation of methane emissions from the enteric fermentation of cattle). Greece has also indicated to the ERT that it is working to improve its estimates on land-use areas and areas included in land-use conversions. Here, Greece intends to implement a land measuring system equivalent to a tier 2 approach as described in the IPCC good practice guidance for LULUCF. The ERT identified the following areas for improvement. Greece should: (a) Address all the issues that led to adjustment calculations during the initial review (see the discussion on the energy sector in section II.B); (b) Improve the accuracy of the estimates of key categories in the energy sector. For instance, collect information on combustion technologies and implement a tier 2 method for estimating N_2O emissions from the combustion of solid and liquid fuels from the categories of energy industries (1.A.1) and manufacturing industries and construction (1.A.2); (c) Improve the transparency of the estimates by providing more precise and detailed descriptions and documentation of methods, activity data, emission factors, for all the key categories in its NIR; (d) Ensure that the national system of Greece fully meets the guidelines for national systems under Article 5, paragraph 1 and the Article 7 guidelines with respect to the functions of Greece's national system, including the maintenance of the institutional and procedural arrangements; the arrangements for the technical competence of the staff involved in the inventory development process; and the capacity for timely performance; (e) Further develop QA/QC system and subsequently implement QA/QC procedures in the inventory preparation, particularly by carrying out a domestic review of the inventory by independent national experts; (f) Include more information on QC activities in each sectoral chapter of its next NIR; (g) Use tier 2 methods for key categories in accordance with the IPCC good practice guidance, in particular for key categories under LULUCF, for example, for the estimation of CO_2 emissions from forest land remaining forest land (5.A.1) and cropland remaining cropland (5.B.1); (h) Include information on the rationale for the selection of uncertainty levels in each sectoral chapter of its next NIR; (i) Prepare and report estimates for categories currently not estimated, for example, subcategories of consumption of halocarbons and SF_6. The ERT also recommends Greece to establish a data collection scheme that allows the reporting of potential emissions of F-gases. (para 44, 45) FCCC/IRR/2007/GRC	• New organizational structure of the inventory system with decentralization of the inventory system and active participation of the Ministry for the Environment. • Establishment of Climate Team within Ministry for the Environment. • Redefinition of official consideration and approval of the inventory. • Establishment of a formal co-operation with data providing agencies. Specific contact person appointment. • Use activity data from verified emission reports of the installations covered by the emissions trading Directive. • Timing of data providing agencies' representatives • Review of the system by independent experts. • Recalculations of those source categories for which adjustments were calculated by the previous ERT during the in-country review of the initial report • Implementation of Tier 2 methodology for Non-CO_2 gases for fuel combustion installations and source categoriy 1A4 • Implementation of Tier 3 method for cement production, lime production, glass production and iron and steel production
Ireland	The NIR identifies several areas for improvement. These include: further implementation of the institutional arrangements and QA/QC; improving the oil energy balance; and further improvements to the agriculture sector estimates, with a focus on the methane emissions model, N_2O measurement studies, and process modelling of N_2O emissions.	• Memoranda of Understanding were implemented defining the relationships between the inventory agency and key data providers, outlining the responsibilities that are conferred to the data providers under the national system • An internal review of annual inventories will take place among all stakeholders • Comprehensive QA/QC procedures were implemented

Member State	Improvements as recommended by the review team	Improvements in response to UNFCCC review as indicated in the NIR
	The ERT identified the following cross-cutting issues for improvement. The Party should: (a) Include in the NIR additional information provided to the ERT during the course of the review (see annex I) on methodology descriptions; missing references for country specific emission factors; and rationale for selection of default EFs and parameters; (b) Provide a detailed explanation of its emission trends and the drivers of the trends; (c) Proceed to formalize MoUs with government data providers covering the provision of information, core requirements on the uncertainty and accuracy of the data, and quality control; (d) Further formalize agreements with non-government data providers where possible; (e) Improve the coverage of QA/QC across the inventory, and the archiving system. (para 34, 35) FCCC/IRR/2007/IRL	in this reporting cycle. The QA/QC elements include a plan and procedures for QA/QC in data selection and acquisition, data processing and reporting to comply with international requirements under Decision 280/2004/EC and the Kyoto Protocol. The plan provides guidance on and templates for appropriate quality checking, documentation and traceability, the selection of appropriate source data and calculation methodologies. It extends to peer review and expert review of inventory data and outlines the annual requirements of a continuous improvement programme for the inventory. Participation in the internal review mechanisms foreseen within the EU as part of the QA/QC plan developed for the EU inventory under Decision 280/2004/EC provides an opportunity to engage with other Member States in the examination and assessment of individual IPCC sectors.
Italy	The NIR identifies several areas for improvement of the GHG inventories, the main priority being the completion of a national system. For several categories, Italy is expected to have updated AD, EFs or other inventory parameters. An independent review of the inventory is under consideration. The ERT identifies the following cross-cutting issues for improvement: (a) Provide all CRF tables, including those relating to key category analysis and explanatory information on recalculations; (b) Provide the key category analysis for the base year; (c) Improve transparency on decisions based on expert judgment, explanations of methodologies and underlying assumptions in the elaboration of emission estimates, and the rationale behind recalculations in the next NIR; (d) Implement source-specific QA/QC procedures. (para 41, 42) FCCC/IRR/2007/ITA	• Further legislation related to the institutaional arrangements of the national system was adopted in 2008 • The institutional arrangements regarding future reporting of activities under article 3, paragraphs 3 and 4, of the Kyoto Protocol have been addressed in the current National Greenhouse Gas Inventory System. A ‘national Registry for Carbon sinks’ has been instituted by a Ministerial Decree in 2008 • For the LULUCF sector, a Scientific Committee, Comitato di Consultazione Scientifica del Registro dei Serbatoi di Carbonio Forestali, has been established constituted by the relevant national experts has been established by the Ministry for the Environment, Land and Sea in cooperation with the Ministry of Agriculture, Food and Forest Policies. • Source specific QC procedures were carried out for the key categories; uncertainty and key category analysis for the base year have been assessed. Uncertainty figures have been referenced and checked with the sectoral experts and are consistent with the IPCC Good Practice Guidance. • CRF tables including key categories were completed for the current submission even though some problems were highlighted for the inclusion of the overall set. • 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.
Luxembour g	The current inventory practice does not include any systematic identification of shortcomings in inventory compilation and reporting or a plan to address them. There are various statements as to planned improvements on most aspects of the inventory in the 2006 NIR, but there is no indication of their order of priority or particular targets for the next or subsequent reporting cycles. Improvements are sometimes made on an ad hoc basis, the latest of which were for the purpose of preparing the initial report. The ERT recognizes that Luxembourg has not previously been subject to an in-country review and consequently has not had the opportunity to benefit from the review process to the same extent as most other Annex I Parties. This means that many of the improvements now identified become a matter of some urgency. Based on the in-country review, the ERT identified the following cross-cutting issues as the priority items for improvement. The Party should: (a) Implement the national system as soon as possible under the Regulation adopted by the Government on 20 July 2007 and which entered into force on 7 August 2007; (b) Establish the formal institutional arrangements to implement the national system, ensuring that it facilitates	• No NIR provided until completion of this report

Member State	Improvements as recommended by the review team	Improvements in response to UNFCCC review as indicated in the NIR
	the inclusion of additional inventory experts, such as those who presented supplementary information and proposals for revised estimates during the review; (c) Implement the QA/QC management system that has been drawn up to underpin the national system; (d) Assign formal roles and responsibilities to ensure the timely supply of data and plan, prepare and manage the annual inventory; (e) Further develop and consolidate the methods for the estimation of emissions in agriculture and waste sectors that were adopted during the review as improved alternatives to the CORINAIR approach, and fully document their application in future NIRs; (f) Assign the responsibility for preparing the inventory submission to the inventory agency; (g) Prepare quantified estimates of uncertainty; (h) Ensure that the individual inventory compilers and experts describe the methods and data they have used for their respective components of the inventory as the primary means to improve the NIR; (i) Reorganize and extend management of the data archiving system to incorporate all essential data related to the GHG time-series in a secure manner that facilitates efficient identification and access to all electronic and hard-copy data elements; (j) Prepare a user manual to describe the content, structure, management and maintenance of the archiving system. (para 38, 39 FCCC/IRR/2007/LUX	
Netherlands	The NIR describes the improvements that have been made in response to the centralized review of the 2005 submission. It also identifies planned improvements such as a new tier 2 uncertainty analysis and updating of methodology protocols for the categories identified as key as a consequence of the tier 2 key category analysis. This includes examining the possibility of including anaerobic treatment in the methodology for calculating N_2O emissions from manure management and of conducting further research on N_2O emissions from soils. The ERT identified the following cross-cutting issues for improvement. The Party should: (a) Improve the transparency of the inventory by revising the NIR, either by increasing the information given in the NIR or by redesigning the annexes; (b) Improve the archiving procedures of the inventory to allow for fully centralized access to the inventory data and related information. (para 36, 37) FCCC/IRR/2007/NLD	• The documentation in the NIR and the protocols on sector specific QC will be further elaborated. A start has been made. In the NIR 2009 it will be further improved. • The recommendations of the ERT with respect to LULUCF will be further elaborated in 2008 and are not yet implemented; the results will be presented in the NIR 2009. • The review team recommended to further centralize the archiving of intermediate calculations. Most documentation and archiving was already centralized, with exception of some intermediate/supporting data calculations archived at task force level. This recommendation will also be considered during the data process in the coming years. • The major recommendations from the peer review are concerned with the readability of the NIR 2008 by providing more and more clear explanations and by improving the way of reasoning. In addition, the peer review gives suggestions for textual and layout improvement. Many of these recommendations are implemented in the present NIR 2008. • First Tier 2 uncertainty analysis was peformed.
Portugal	The NIR identifies several areas for improvement covering all sectors, for example, more extensive use of plant-specific emission factors in the energy sector; revision of the clinker emission factor in the industrial processes sector; improved estimates of emissions from the application of fertilizers in the agriculture sector; revision of carbon content of soils in the LULUCF sector; and a better quantification of the amount of CH_4 recovered and flared in the waste sector. Future improvements are defined under the PDM which is revised and agreed each year within the framework of the national inventory system. The ERT identified the following cross-cutting issues for improvement. The Party should: (a) Work on the completeness of the inventory by covering all source/sink categories; in particular, include LULUCF estimates for the autonomous regions of Madeira and the Azores Islands; (b) Try to reduce the size of the NIR. Delete all information	• As proposed by the ERT, emissions from a previously missing source (military fuel use) were also estimated (1A5), and • The value reported in international bunkers was revised in order to get a better consistency between the national bottom-up approach and the top-down Energy Balance data. • N_2O emissions recalculations are mostly associated with the Agriculture sector (Agriculture Soils), and in essence related to an issue identified by the ERT concerning the a fraction (20 per cent) of manure stored in anaerobic lagoon that was not considered previously in the inventory. • Inclusion of estimates for the Azores and Madeira Islands in the LULUCF sector • Improvments of the estimation of emissions from industrial wastewater • Inclusion of energy emissions from military • Correction of double counting and calculation errors in

Member State	Improvements as recommended by the review team	Improvements in response to UNFCCC review as indicated in the NIR
	concerning air pollutants (PM10, heavy metals) which are not included in the CRF. Concentrate on country-specific methods (which should be described in more detail) and relevant background information, and use references for standard methodological procedures; (c) Continue to work on implementation of the QA/QC system. Perform step-by-step reviews of the various parts of the inventory by independent national experts; (d) Include information on sector-specific QC in all sectoral chapters of the NIR; (e) Improve the description of recalculations for industrial wastewater handling and HFC emissions; (f) Continue to develop the integrated IT system for the management of the national system (SIGA); (g) Develop a tier 2 uncertainty analysis. (para 33, 34) FCCC/IRR/2007/PRT	category 2C1 Iron and steel production • Revision of the methodologies in some sub-categories of 2F Consumption of Halocarbons and SF_6 • Change in methodology of CH_4 emissions from rice cultivation • Renision of N excretion factors and synthetic fertilizers added to soils
Spain	In its response to the issues raised during the review, Spain indicated that it is working to improve its national system and cross-cutting areas related to the following aspects. It intends to: (a) Implement a tier 2 key category and uncertainty analysis in 2008; (b) Start a more intensive cooperation process with the formal working groups composed of ministerial focal points and the DGCEA; (c) Complete its estimation in the LULUCF sector; (d) Conduct QA procedures for the energy sector and for quality control procedures; (e) Fully implement the documentation system for QC checks and planned improvements. The ERT identified the following cross-cutting issues for improvement. The Party should: (a) Improve the institutional cooperation and administrative arrangements in relation to the reporting of consumption of liquid fuels in different sectors, and resolve and explain the time-series inconsistencies in the data for some major liquid fuels; (b) Improve the institutional cooperation between the inventory compilers and other ministries/departments in the agriculture and LULUCF sectors in the working group on LULUCF and agriculture. Clear responsibilities for the estimation of the missing categories and for the corresponding CRF tables in the LULUCF sector should be assigned. The working group should also improve Spain's land-use classification as well as its data for the estimation of emissions and removals from agricultural land uses; (c) Encourage participation of the autonomous regions in the formal working groups, and develop legal arrangements to enable a comparison of installation-specific AD and EFs reported under the EU ETS with the plant-specific data reported to the inventory agency; (d) Provide references and a list of references in the NIR. (para 40, 41) FCCC/IRR/2007/ESP	• Recalculation of the LULUCF sector • A number of recalculations in different sectors
Sweden	The NIR identifies planned improvements, including in the energy sector (revised EFs) and for LULUCF (inclusion of below-ground dead wood and improvements to the estimation of other pools). The ERT identified the following cross-cutting issues for improvement. The Party should: (a) Consider whether estimates could in fact be made of sources that are currently not estimated (see para. 22); (b) Make greater use of graphic and tabular material, possibly in annexes, to improve the transparency of the NIR (see para. 23); (c) Increase the use of interpolation to represent actual conditions and remove apparent outliers (see para. 24); (d) Extend the uncertainty analysis to take account of	• Double counting of emissions in CRF 1A2a Iron and Steel is deleted. • Transformation losses are reallocated from CRF 1A2a to CRF 1A5a to enable • Better comparison of IEF for solid fuels with other countries. • Reference approach has been overhauled and where needed activity data are updated. Explanations to the remaining differences between reference and sectoral approach are identified and described in the NIR. • More information on the model for estimating domestic and international LTO/Cruise emissions 1990-1994 is provided in the NIR. • The whole time series for CF4 and C2F6 from primary aluminium production has been recalculated to

Member State	Improvements as recommended by the review team	Improvements in response to UNFCCC review as indicated in the NIR
	correlations between data and to estimate trend uncertainties (see paras. 26 and 29). (para 31, 32) FCCC/IRR/2007/SWE	achieve complete agreement with the Tier 2 calculation method described in IPCC Good Practice Guidance. • Information on CaO content in clinker in CRF 2A1 is provided in the NIR to be in line with the IPCC Good Practice Guidance. • Emission factors for CH_4 for beef cows and reindeer are revised for the whole time series 1990-2005 to be more in line with the IPCC default values and the best current knowledge on regional circumstances. • Emissions from mineralization in connection to peat extraction are now reported. • More information on the utilization of gas recovery has been provided for solid waste disposal on land (CRF 6A) as well as for waste water handling (CRF 6B) in NIR. • The notation key "IE" (included elsewhere) has been changed to "NE" (not estimated) for CH_4 emissions from wastewater treatment. The notation key for sludge from domestic and industrial organic wastewater treatment plants is continued to be reported as "IE" (included elsewhere), since the sludge is landfilled and therefore included under SWDS (CRF 6A).
United Kingdom	Several areas for improvement have been identified in the United Kingdom's NIR. They concern: (a) The need to develop more formal agreements between DEFRA and key data providers in order to specify the framework of data supply. These agreements will formalize the acquisition of data and clarify the main requirements regarding quality, format, security and timely delivery of data for the national inventory; (b) The process for official consideration and approval of the GHG inventory, where the work will be focused on carrying out a pre-submission review of inventory data by a review group that is independent of the main GHG inventory compilation process; (c) Review of the QA/QC system. The Party has stated that in a few cases the resources for and the effectiveness of these systems within the key organizations that provide data could be significantly improved as they currently do not provide reliable data that are consistent across the inventory reporting time series; (d) Review by the United Kingdom National Inventory Steering Committee in the light of the ERT's feedback and other inputs, from which priorities for QA/QC and improvements to the inventory will be derived; (e) Full harmonization of reporting between the NIR and the CRF tables. The ERT identified the following cross-cutting issues for improvement: (a) Consistency between the NIR and the CRF and within the NIR should be improved; (b) It might be a useful exercise in good practice for the Party to use both tier 1 and tier 2 approaches for identifying the key categories, as this can provide additional insight into the reasons why particular categories are key and can assist in prioritizing activities to improve the quality of the inventory and reduce overall uncertainty; (c) Some additional information in the NIR could improve the transparency of the reporting of emissions/removals from the United Kingdom's overseas territories and Crown dependencies. (para 39, 40) FCCC/IRR/2007/GBR	• More detailed of coverage and methodologies provided for crown dependencies and overseas territories.

Table 10.10 Improvements made by new 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
Bulgaria	The NIR does not identify areas for improvement. After the in-country review, in its response to the issues raised by the ERT during the review, Bulgaria presented a plan for the further development of the available capacity and an outline of a QA/QC plan for the national inventory. The ERT identified the following cross-cutting issues for improvement: (a) Implement the capacity development plan to ensure sufficient capacity for timely submission of the GHG inventory; (b) Implement the QA/QC plan as outlined, including the development of the archiving system; (c) Improve the transparency of the estimates by providing in its NIR more precise descriptions of methodologies, EFs, data collection and processes for dealing with confidential information; (d) Revise and improve the use of notation keys (including the notation key for confidential data); (e) Provide a key category analysis including LULUCF. (para 25, 26 FCCC/ARR/2006/BGR)	• In all inventories until 2006 submission, the use of N_2O for anaesthesia sub-category has not been determine due to missing of the appropriate methodology and data. After the in-country review of UNFCCC Secretariat during, ERT recommended using data from Switzerland's methodology for calculation of N_2O emissions from sub-category 3D and emission estimates are provided. • N_2O emissions from aerosol cans were also estimated based on the ERT's recommendations • After the in-country review of UNFCCC Secretariat, ERT recommended determination of CO_2 emissions as a result from converting of NMVOCs emissions in a part of category 3D which was implemented. • During the in-country review of UNFCCC Secretariat, the k values for CH_4 emissions from solid waste disposal was revised and applied in the new inventory.
Czech Republic	The NIR identifies several areas for improvement. These relate in particular to: (a) Use of higher-tier methods in some sectors following recommendations of former ERTs (e.g., for CO_2 emissions from waste incineration); (b) Improving the completeness of the CRF tables; (c) The updating of country-specific parameters used in the inventory; (d) Improvement of the uncertainty estimates. In its response to the issues raised during the review, the Czech Republic revised its estimates of (a) CO_2 emissions from combustion of solid fossil fuels; (b) CH_4 emissions from fuel combustion; (c) N_2O emissions from fuel combustion; (d) CH_4 emissions from solid waste disposal sites. (para 35, 36) FCCC/IRR/2007/CZE	• Reallocation of emissions from non-energy use of fuels from 1.A fuel combustion to 2C1 and 2B1 • Reallocation of CO_2 emissions from sulphur removal from category 1B1c to 2A3 Limestone and Dolomite Use • Recalculation f time-series of CH_4 emissions from 1B2b fugitive emissions, natural gas • Emissions from limestone and dolomite use in sinter plants added to category 2A3 Limestone and Dolomite Use • Recalculation of CO_2 emissions from cement production with Tier 2 method based on clinker production data • Recalculation of CO_2 emissions from 2A2 Lime Production based on data on lime and hydrated lime and lime use • Addition of emissions in source category 2.A.7.2 Bricks and ceramics from decarbonisation and fossil-organic material oxidation • Revision and recalculation of time series for 2.A.7.1 Glass Production • Use of new Tier 2 method for actual emissions of F-gases • Recalculation of CH_4 emissions from agriculture • Recalculation of LULUCF sector in accordance with IPCC GPG for LULUCF
Estonia	Estonia has not described areas for improvement in either the NIR or the initial report. The ERT identified the following cross-cutting issues for improvement: (a) Provide more complete and transparent description of methodologies, including information on the collection of AD and the choice of method and EFs, and include in the NIR all the elements stipulated by the IPCC good practice guidance and the "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories" (hereinafter referred to as the UNFCCC reporting guidelines), especially for country-specific methods; (b) Provide complete CRF tables, by filling the reporting gaps, particularly in the LULUCF sector; (c) Include a description of the QA/QC plan and information	• More detailed assessment of completeness and reasons for incompleteness provided • Detailed QA checklist provided • Uncertainty assessment provided

Member State	Improvements as recommended by the review team	Improvements in response to UNFCCC review as indicated in the NIR
	on the QA/QC measures implemented in all sectors in the NIR; the QA/QC plan should be improved and implemented in all sectors; (d) Provide more disaggregated quantified uncertainty estimates and use more countryspecific uncertainty values; (e) Provide detailed explanations and analysis on the emission trends by sector and gas. (para 36, 37) FCCC/IRR/2007/EST	
Hungary	The NIR identifies several areas for improvement. In its response to the questions raised during the in-country review, Hungary indicated that it is working to improve its estimates in different categories (see details in the sectoral sections of this report below). Hungary also indicated that all the relevant inventory data will be gradually included in the centralized archiving system and that it is working to improve its estimates in the LULUCF sector and fully satisfy the requirements of decision 13/CP.9. Regarding sectoral improvements, the NIR identifies the following items. Hungary should: (a) Improve the consistency and accuracy of the time-series data for the CH_4 and N_2O EFs in the energy sector; (b) Further increase the accuracy of the EF on the basis of measurements and a longer data series for nitric acid production; (c) Further refine its consumption data for consumption of halocarbons and SF_6, primarily as regards final use; (d) Further enhance the accuracy of the information on the rearing and feeding conditions of livestock and use tier 2 methods for the most important categories (dairy cows and other cattle) under enteric fermentation; (e) Calculate country-specific EFs and use tier 2 methods for the most important categories (dairy cows, other cattle, swine) under manure management; (f) Further verify both the AD and the background inventory information for the forest land category; (g) Obtain more precise data and detailed information on municipal solid waste disposal sites and waste-water treatment, and complete the AD on industrial waste incinerators. The ERT identified the following cross-cutting issues for improvement. The ERT recommends that Hungary: (a) Provide a more detailed description of the approaches taken and the underlying assumptions used for the uncertainty estimates in the NIR; (b) Improve the transparency of its estimates by providing more precise descriptions and documentation of methodologies and EFs that differ from those of the IPCC. This should be done by the experts responsible for the estimates in the respective sectors. Hungary is also encouraged to check and better explain the fluctuations in implied emission factors (IEFs) in response to questions raised in previous review stages; (c) Improve consistency by systematic cross-checking of the information provided in the NIR and that provided in the CRF tables; (d) Further develop and then implement the QA/QC procedures for each sector, and in particular implement tier 2 QA/QC procedures for identified key categories; (e) Elaborate a management plan for the established centralized archiving system; (f) Elaborate a detailed inventory manual for inventory planning and management which reflects national circumstances and includes detailed descriptions of formal procedures, time schedules, data flow, documentation formats and guidance for improvements; (g) Strengthen its institutional capacity by ensuring adequate long-term financial support for inventory-related contracts and arrangements and by encouraging inventory experts to attend the UNFCCC training courses as soon	• IPCC GPG for LULUCF was implemented and revised estimates provided as well as methodological descriptions • Revision of CO_2 emissions from Agricultural lime application (whole time-series) • Revision of Soil emission of the Cropland category (whole time-series) • Revision of Soil emission of the Grassland category (whole time-series) • CO_2 emissions from navigation in case of liquid fuel were changed in the whole timeseries, because gasoline's emission factor was used instead of gas/diesel oils factor. • In the reference approach CO_2 emission from gas biomass was corrected with the adequate emission factor. • In the waste sector, the CO_2 emissions from waste incineration were recalculated from 2004. The recently established Hungarian Waste Information System gave the possibility to use the Tier 2 method. Beside municipal waste data more details are available about incinerated industrial waste. Concerning nitrous-oxide emissions, the new default emission factors were used from the 2006 Guidelines. The emissions from industrial wastewater treatment have also been recalculated using better activity data. However, this recalculation is limited to the years 2002-2005.

Member State	Improvements as recommended by the review team	Improvements in response to UNFCCC review as indicated in the NIR
	as possible; (h) Collect AD and develop well-documented country-specific EFs for use with higher-tier methods for key categories. (para 50, 51, 52) FCCC/IRR/2007/HUN	
Latvia	In the NIR, and during and following the in-country review, Latvia identified several areas for improvement, for example, the planned implementation of the new law, the Law on the Participation of the Republic of Latvia in the Flexible Mechanisms under the Kyoto Protocol and its regulations, which will provide the legal basis for requirements regarding the national system (including capacity); future implementation of the LEGMA QA/QC plan; further research on national EFs; the development and improvement of the data link between the GHG inventory and the EU ETS; the use of officially available revised AD for the energy sector (for the period 1990.1994); and cooperation with appropriate experts in industrial companies and other institutions to develop national methods and EFs and to improve the uncertainty estimates for the agriculture and LULUCF sectors. The ERT identified the following cross-cutting issues for improvement. The Party should: (a) Provide information in its next inventory submission on the roles, responsibilities and coordination of all the collaborating entities involved in inventory preparation, including the establishment of formal agreements with data collection agencies to reflect the provisions of the new regulations that will address the national system; (b) Further develop, implement and document the QA/QC plan, including coordination with the external agencies and entities involved in the development of the inventory in its NIR; and develop and improve QA (e.g. by means of independent review) and verification procedures in its next inventory submission; (c) Improve its documentation of country-specific methodologies, (e.g. for transportation categories); provide better documentation in the NIR of the AD values used in the calculations; make greater use of annexes to the NIR to document country-specific methods and EFs; and use the documentation boxes in the CRF tables; (d) Improve the accuracy of its future inventory submissions by using higher-tier methods for estimating key categories in line with the recommendations of the IPCC good practice guidance; (e) Improve completeness by addressing the calculation of categories that are currently reported as .NE.; (f) Implement and document the new method of the National Forest Inventory which is to be used for the LULUCF sector in the next NIR and use it consistently throughout the time series for the identification o land areas, including land areas for Article 3, paragraphs 3 and 4, activities; (g) Improve its uncertainty analysis and provide more detail about the rationale for the selection of uncertainty levels, and document expert judgement in its next inventory submission. (para 38, 37) FCCC/IRR/2007/LVA	• Improved description of institutional arrangements • Latvia has recalculated CO_2 emissions from 1.A.3.b – Gasoline with country-specific CO_2 emission factor as it was recommended by ERT (2007) that was assumed as Tier2 from IPCC 1996. • Improved background information provided in the sectors requested by the ERT • CO_2 emissions from Lime production are calculated based on data of dolomite use in lime production. According to ERT (2007) expert's recommendations (2007) purity factor from IPCC GPG 2000 was taken into account in CO_2 emission calculation. There is only one industrial lime producer in Latvia and only dolomite that is national easy available raw material for production of lime is used for production. • CO_2 emission from produced cement kiln dust were excluded from reported total CO_2 emissions from Cement Production sector to avoid double counting because it is assumed by ERT (2007) that CKD correction factor is already taken into account in default CO_2 emission factor 0,525 (t CO_2 / t production) from EU ETS Guidelines. • CO_2 emissions from iron and steel production were revised in accordance with ERT recommendations • Area used for Histosol calculation were reassessed according to recommendations by ERT during In-country review of Latvia's Initial Report under Kyoto Protocol; • N_2O emissions from manure Management were reassessed based on a time consistent N excretion values from swine for 2004 and 2005 according to recommendations by ERT during In-country review of Latvia's Initial Report under Kyoto Protocol • Activity data to estimate the area of cropland for the whole time series was corrected due to recommendations in the report of the review of the initial report of Latvia.
Lithuania	In its response to the issues raised during the review, Lithuania indicated that it is working to improve its estimates for a number of sectors by updating country-specific EFs for energy, coordinating with the National Forestry Service to improve the reporting on LULUCF, and to improve the pre-1990 time series for solid waste generation data. The ERT identified the following cross-cutting issues for improvement. The Party should: (a) Implement a QA/QC plan in accordance with the IPCC	• More transparent National Inventory report (NIR) provided with more precise descriptions of the methodologies, activity data and emission factors used was elaborated. • A number of missing emission sources were included in GHG inventory for the first time. • QA/QC plan was updated and implemented. • Table 9(a) provided with explanations for notation keys • Revision of estimation in LULUCF sector

Member State	Improvements as recommended by the review team	Improvements in response to UNFCCC review as indicated in the NIR
	good practice guidance and pursuant to decision 19/CMP.1; (b) Structure its NIR according to the structure outlined in the UNFCCC reporting guidelines; (c) Establish an inventory improvement plan that uses key category analysis and uncertainty analysis as tools to prioritise improvement of the inventory, and considers output from QA/QC procedures; (d) Provide more detailed description of methodologies in the NIR, particularly for higher tier methods, including assumptions, country-specific EFs and rationales for the choice of methods and default EFs; (e) Document expert judgement and uncertainty estimates in accordance with the IPCC good practice guidance for the uncertainty analysis; (f) Improve the consistency of the emission time series; (g) Include LULUCF in the key category analysis; (h) Report explanations for recalculations in CRF table 8(b) and the use of notation keys in CRF table 9(a). Information on recalculations should be provided in the NIR at the category level. (para 38, 39) FCCC/IRR/2007/LTU	
Poland	The NIR does not identify any areas for improvement. After the in-country review, in its response to the issues raised during the review, Poland indicated that it is working to improve its estimates in the LULUCF sector using the methodologies of the IPCC good practice guidance for LULUCF, as well as planning improvements to the transparency of the NIR and revisions to methods for a number of categories in other sectors (e.g. iron and steel, and industrial wastewater). The ERT identifies the following cross-cutting issues for improvement. The ERT recommends that Poland: (a) Adopt the draft Act on instruments supporting the reduction of GHG emissions and other substances that will strengthen the clear and independent legal basis for the national system and report on its adoption in its next submissions under the Kyoto Protocol; (b) Provide more precise descriptions and documentation on the legal, institutional and procedural arrangements of its national system, including plans for strengthen its institutional capacity, in its next submission under the Kyoto Protocol; (c) Implement the QA/QC plan and include information on the QA/QC plan, including QA/QC procedures for activities related to Article 3, paragraphs 3 and 4, of the Kyoto Protocol in the future NIRs; (d) Continue to develop the archiving system, ensuring that has sufficient capacity to organize and maintain all the necessary electronic information of inventory submissions and the supporting information required to produce the national emission inventory estimates; (e) Submit a single NIR covering the entire time series and following the structure outlined in the UNFCCC reporting guidelines, including more comprehensive and precise descriptions and documentation of methodologies and EFs that differ from those of the IPCC, and providing better explanations of the emissions trends; (f) Improve transparency of reporting by further elaboration of the NIR and inclusion of the relevant sections on trends, recalculations, future improvements and category-specific information on QA/QC, uncertainty and time-series consistency; (g) Include reporting of recalculations, their rationale, and explanation of methodological changes, ensuring that any future recalculations are consistently made, presented for all the years of the inventory, prepared in accordance with the IPCC good practice guidance and fully documented in its future NIRs; (h) Improve AD consistency and methods applied for a	• Improvements in the LULUCF sector by inclusion of belowground biomass and emissions from organic soils. Estimation of growing stock in private forests. • Recalculations, uncertainties and planned improvements addressed in separate subsectiorns of the sectoral chapters • Uncertainty estimation was improved

Member State	Improvements as recommended by the review team	Improvements in response to UNFCCC review as indicated in the NIR
	number of categories to bring them in line with the requirements of the IPCC good practice guidance and the UNFCCC reporting guidelines; (i) Collect country-specific AD and develop well-documented country-specific EFs for use with higher tier methods for key categories; (j) Use more country-specific information in calculations of uncertainties and include the qualitative discussions on uncertainty of the data used for all categories, and in particular for key categories, in its next NIR; (k) Improve the completeness of CRF tables by including tables 8(a) and 8(b) (recalculations), tables 9(a) and 9(b) (completeness) as well as systematic use of notation keys and better use of documentation boxes; (l) Provide estimates for the LULUCF sector according to the IPCC good practice guidance for LULUCF (para 44, 45) FCCC/IRR/2007/POL	
Romania	Following the 2007 UNFCCC review of the Initial Report and also of the Romanian 2006 version 2 GHGI, the main ERT recommendations were: - to collect the information needed to disaggregate bunker fuel emissions from domestic civil aviation in order to explain and document the derivation of the share of domestic fuel consumption for civil aviation (1.A.3.a); - to collect the information needed to disaggregate bunker fuel emissions from navigation in order to explain and document the derivation of the share of domestic fuel consumption for navigation (1.A.3.d); - to explain and document the value of the consumption of natural gas used for estimating the CH_4 emissions (1.B.2.b (v)); - to explain and document the value for coke consumption used in the estimation of GHG emissions for categories 1.A.2.f and 2.C.1 (1.A.2.f, 2.C.1); - to revise the estimation of the population of dairy cows in the base year and to find an estimate that is consistent with the milk production in that year, as reported by the National Institute of Statistics, and with the IPCC default milk productivity factor (4.A, 4.B, 4.D); - to explain and document the value for per capita protein intake used in the 2006 inventory (6.B); - to collect data which allow for use of the tier 2 methodology on the key categories level	All main ERT recommendations were taken into account, the recalculations performed, including their effects, being described at the sub-sectoral and also at the Chapter 10 of the NIR level.
Slovakia	The NIR identifies improvement of the consistency of the times series and transparency of choosing methodology and activity data as focus areas for improvement. The ERT identified the following cross-cutting issues for improvement: (a) Descriptions of methodologies used, including information on the collection of activity data and the choice of method and EFs, should be included in the NIR in order to increase the transparency of the reporting; (b) Key assumptions and parameters in models used in calculating the estimates should be provided in the NIR, including those for internationally verified methods; (c) The completeness of the inventory should be improved by filling the reporting gaps, that is, providing more disaggregated data for the estimates for the years 1990–1999, in the CRF tables; (d) The structure of the NIR should be improved so that it follows more closely the UNFCCC reporting guidelines, including at subheading level. All the sectoral chapters should also address cross-cutting issues; (e) The QA/QC plan should be improved and implemented in all sectors. (para 47, 48, FCCC/IRR/2007/SVK)	• NIR structure generally in line with recommendations • Emissions of methane from SWDS were estimated with the Tier 2 methodology (First Order Decay = FOD) according the advises of the ERT • Correction of EF for natural gas due to ERT recommendations • According the recommendations of the ERT from the in-depth review from last year 2007 several recalculations were implemented in the inventory of energy sector – sectoral approach and reference approach. • Recalculation of the energy sector based on improvement of methodology for allocation the fuel into the categories (solid, liquid, gaseous, biomass and other). • Recalculation based on improvement of the splitting-up the sectoral approach in 1991-1999. The splitting was required in the final report of the in-depth review conclusion and it was mostly technical problem with the comparability of the database systems before and after 2000. The changes in the secoral approach are not important and the total amount of the emissions in the categories remained constant. The splitting was performed manually by selection the important sources and statistical evaluation. • According recommendations of ERT final findings and IPCC GPG 2000, the recalculation in category 1.A.3d – Navigation was provided, emission estimation based

Member State	Improvements as recommended by the review team	Improvements in response to UNFCCC review as indicated in the NIR
		on fuel consumption and the international rule for inland shipping on the Danube river was evaluated.
Slovenia	The NIR identifies several areas for improvement. These relate in particular to: (a) Implementation of QA procedures, including independent peer review of the inventory; (b) Revision of the uncertainty estimates; (c) Preparation of CRF tables for the years 1987, 1988 and 1989; (d) Further improvement of the AD and EFs in the LULUCF sector. The ERT welcomed the following planned improvements to the national system which the Party identified in the course of the review: (a) Documentation of procedures and archiving (updating of the manual of procedures by 2008); (b) Improved implementation of QC procedures starting from 2008; and additional peer review sector by sector (one sector per year); (c) The allocation of additional human resources (three experts will be assigned for inventory preparation at the beginning of 2008); (d) A functional new database to be in place by 2009 (a test phase is planned in 2008). The ERT identified the following cross-cutting issues for improvement. The Party should: (a) Improve transparency by: (i) Providing complete explanations of the use of the notation keys and using them in a more consistent manner; (ii) Providing more detailed information on all data sources used; (iii) Integrating relevant information requested by the ERT during the in-country visit into its future NIRs; (b) Provide more precise descriptions of those methodologies that differ from the IPCC's, including summaries in English of background material that is only available in Slovenian; (c) Improve the key category analysis by addressing the LULUCF categories; (d) Assign a QA/QC coordinator; (e) Improve quality control documentation at all stages of inventory preparation, and with regard to the improvement of the inventory; (f) Improve completeness and robustness of record-keeping and archiving (e.g. by protecting the electronic database against changes and by introducing a library system for hard copies); (g) Implement a documented process for official approval of the inventory; (h) Develop an inventory improvement plan which will address the issues identified above; (para 32, 33, 34) FCCC/IRR/2007/SVN	• Key category analysis has been done by including the LULUCF sector for the year 1986 and 2006; • New uncertainty analysis based on Tier 1 methodology has been performed. For this analysis the level of disaggregation was lower than before, as was recommended during review process. Also some uncertainty estimates has been improved. • Explanations of the use of notation keys in CRF tables have been provided; • Archiving process has been improved; • Emission estimates from road traffic has been improved using COPERT III model for entire period 1986-2006 • Historical data set for determination of DOC value in waste sector has been improved;

10.4.3 Improvements planned at EC level

The following activities are planned at EC level with a view to improving the EC GHG inventory:

- Implement the recommendations from the initial review;
- Continue sector-specific QA/QC activities within the EC internal review;
- Further develop the CRF Aggregator database in order to support additonal QA/QC activities;
- Further develop the EC QA/QC activities on the basis of the experience in 2007/2008;
- Further refine the uncertainty analysis.

References

Agency for the Protection of the Environment and for Technical Services (APAT) 2006: *Report on the determination of Italy's assigned amount under Article 7, paragraph 4, of the Kyoto Protocol. Draft report to the European Commission.* 11 April 2006, Rome.

Agency for the Protection of the Environment and for Technical Services (APAT) 2008: *Italian Greenhouse Gas Inventory 1990-2006. National Inventory Report 2008*. Rome.
(IT NIR 2008)

AUTORITES FRANCAISES, 2006. *Note des Autorites Francaises: Préparation de la 1ère période d'engagement du Protocole de Kyoto. Rapport déterminant la quantité attribuée conformément à l'article 8, paragraphe 1, point d), de la décision n°280/2004/CE.* Paris.

Centre Interprofessionnel Technique d'Etudes de la Pollution Atmosphérique (CITEPA) 2006, *Inventaire des émissions de gaz à effet de serre en France au titre de la convention cadre des Nations Unies sur le changement climatique (CCNUCC)*, December 2006. Paris.
(FR NIR 2007)

Centre Interprofessionnel Technique d'Etudes de la Pollution Atmosphérique (CITEPA) 2007, *Organisation et Méthodes des Inventaires Nationaux des Emissions Atmosphériques en France (OMINEA)*. 4th edition. January 2007. Paris.

Centre Interprofesionnel Technique d'Etudes de la Pollution Atmosphérique (CITEPA) 2008.*Oraganisation et Méthodes des Inventaires Nationaux des Emissiones Atmosphériques en France (OMINEA).* 5th edition. February 2008. Paris.
(FR NIR 2008 (French)

Czech Hydrometeorological Institute (CHMI) 2007: *National greenhouse gas inventory of the Czech Republic, NIR. Reported Inventory 2005.* May 2007, Prague.
(CZ NIR 2007)

Department for Environment, Food and Rural Affairs (DEFRA), 2006. *UK's report to the European Commission made under Decision 280/2004/EC of the European Parliament and of the Council of 11 February 2004 concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol. Report on the determination of the UK's assigned amount.* London.

Environment Service, 2008. *National Greenhouse Gas Inventory Report of the Czech Republic (reported Inventory 2006)*. March 2008. Prague.
(CZ NIR 2008)

Environmental Agency of the Republic of Slovenia 2007. *SLOVENIA'S NATIONAL INVENTORY REPORT 2007.* March 2006, Ljubljana.
(SI NIR 2007)

Environmental Agency of the Republic of Slovenia, 2008. *Slovenia´s National Inventory Report 2008*. March 2008. Ljubljana.
(SI NIR 2008)

Environmental Protection Agency (EPA, Ireland) 2007. *Ireland - National Inventory Report 2007. Greenhouse Gas Emissions 1990-2005 reported to the UNFCCC.* May 2007, Wexford, Ireland.
(IE NIR 2007)

Environmental Protection Agency (EPA, Ireland) 2006. *Report on the Determination of the Assigned Amount pursuant to Article 8(1)(e) of Decision 280/2004/EC as required by Article 23 of Decision 2005/166/EC. Submitted to the European Commission in accordance with Decision 280/2004/EC and Decision 2005/166/EC.* Wexford, Ireland.

Environmental Protection Agency. *Greenhouse Gas emissions 1990-2006 reported to the United Nations Framework Convention on Climate Change.* March 2008. Wexford.
(IE NIR 2008)

European Commission (EC) 2000, *Guidelines under Council Decision 1999/296/EC for a monitoring mechanism of Community CO_2 and other greenhouse gas emissions. Part I: Guidelines for Member States and EC annual inventories*, 1 September 2000. Brussels

European Commission (EC) 2001, *Community under the UN Framework Convention on Climate Change*, Commission staff working paper, SEC(2001)2053. 20. December 2001. Brussels.

European Environment Agency (EEA) 2006a, *Annual European Community greenhouse gas inventory 1990–2004 and inventory report 2006. Submission to the UNFCCC Secretariat*, Technical report No 6/2006. Copenhagen.
(EC IR 2006)

European Environment Agency (EEA) 2006b, *Greenhouse gas emission trends and projections in Europe 2006*, EEA report No. 9/2006. Copenhagen.

European Environment Agency (EEA) 2006c, *The European Community's initial report under the Kyoto Protocol. Report to facilitate the calculation of the assigned amount of the European Community pursuant to Article 3, paragraphs 7 and 8 of the Kyoto Protocol.* Submission to the UNFCCC Secretariat. EEA Technical report No 10/2006. Copenhagen.

European Topic Centre on Air and Climate Change (ETC/ACC) 2007. *Analysis of European greenhouse gas inventories in the aviation sector*, ETC/ACC Technical Paper 2007/6, December 2007

Federal Public Service Health, Food Chain Safety and Environment, DG Environment - Climate Change Section, 2006b. *Belgium's National Inventory Systemfor the estimation of anthropogenic greenhouse gas emissions by sources and removals by sinks under Article 5, paragraph 1, of the Kyoto Protocol*, Brussels, January 2006.

Federal Public Service Health, Food Chain Safety and Environment DG Environment - Climate Change Section, 2006c. *Report by Belgium on the determination of the assigned amount pursuant to Article 8(1)(e) of Decision 280/2004/EC.* 15 March 2006. Brussels.

Federal Public Service Health, Food Chain Safety and Environment, DG Environment - Climate Change Section, 2007. *Belgium's greenhouse gas inventory (1990–2005). National inventory report, Submission to the UNFCCC Sectretariat and to the Commission of the European Communities*, Brussels, April 2007.
(BE NIR 2007)

Flemish Environment Agency (VMM), 2008. *Belgium´s Greenhouse Gas Inventory. (1990-2006) National Inventory Report submitted under the United Nations Framework Convention on Climate Change.* March 2008. Belgium.
(BE NIR 2008)

Hungarian Meteorological Service, 2008. *Greenhouse Gas Inventory Division National Inventory Report for 1985-2006.(Draft – Excerpts).* January 2008. Hungary.
(HU NIR 2008)

Institute of Environmental Protection, 2007. *Poland's National Inventory Report 2005.* Submission under the United Nations Framework Convention on Climate Change. April 2007, Warsaw.
(PL NIR 2007)

Institute of Environmental Protection, 2008. *Poland's National Inventory Report 2006.* Submission under the United Nations Framework Convention on Climate Change. April 2008, Warsaw.
(PL NIR 2008)

Intergovernmental Panel on Climate Change (IPCC), 1997. *Revised 1996 IPCC guidelines for national greenhouse gas inventories*. Geneva.

Intergovernmental Panel on Climate Change (IPCC), 2000. *Good practice guidance and uncertainty management in national greenhouse gas inventories*. Geneva.

Intergovernmental Panel on Climate Change (IPCC), 2003. *Good Practice Guidance for Land Use, Land-Use Change and Forestry.* Geneva.

Laitat, E.; Karjalainen, T.; Loustau, D. and Lindner, M. (2000), 'Introduction: towards an integrated scientific approach for carbon accounting in forestry', *Biotechnol. Agron. Soc. Environ.* 4:241–51.

Latvian Environment, Geology and Meteorology Agency (LEGMA), 2006b. *National inventory system (NIS).* January 2006, Riga.

Latvian Environment, Geology and Meteorology Agency (LEGMA), 2006c. *Latvian National Registry under Article 7 of the Kyoto Protocol. Report to the European Commission. pursuant to Article 3(1) d) of Decision No 280/2004/EC.* 15 March 2006. Riga.

Latvian Environment, Geology and Meteorology Agency (LEGMA), 2007. *Latvia's National Inventory Report 1990-2005 – submitted under United Nation's Convention on Climate Change,* April 2007, Riga.
(LV NIR 2007)

Ministerio de Medio Ambiente 2007. *Inventario de emisiones de gases de efecto invernadero de España años 1990-2005.* Comunicación a la Comisión de la Unión Europea. Abril 2007
(ES NIR 2007 (Spanish))

Ministerio de Medio Ambiente 2007. *Inventario de emisiones de gases de efecto invernadero de España años 1990-2006.* Comunicación a la Comisión de la Unión Europea. March 2008. (ES NIR 2008 (Spanish))

Ministry of Agriculture, Natural Resources and Environment Service, 2008. *National Inventory Report 2006. 2008 Submission. Under Article 3(1) of Decision No 280/2004/EC of the European Parliament and of the Council concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto*: March 2008. Cyprus.
(CY NIR 2008)

Ministry of Environment and Water, Executive Environment Agency, 2008. *National Report 2008 for Bulgarian Greenhouse Gas Emissions.* March 2008. Sofia.
(BG NIR 2008)

Ministry for the Environment and Land-Use Planning (Ministerio das Cidades, Ordenamento do Territorio e Ambiente, Instituto do Ambiente), 2006b. *Portuguese Report Based on Article 8 of Decision N.º 280/2004/EC Concerning a Mechanism for Monitoring Community Greenhouse Gas Emissions and for Implementing the Kyoto Protocol Report on the Determination of Portugal's Assigned Amount Pursuant to Article 23 Of Decision N.º 2005/166/Ec*. Amadora.

Ministry for the Environment and Land-Use Planning (Ministerio do Ambiente, do Ordenamento do Territorio e do Desenvolvimento Regional, Instituto do Ambiente), 2007, *Short draft Portuguese national inventory report on greenhouse gases, 1990–2005, submitted under Art 3.1 of Decision No. 280/2004/EC of the European Parliament and of the Council*. Amadora, February 2007.
(PT Short NIR 2007)

Ministry for the Environment and Land-Use Planning (Ministerio do Ambiente, do Ordenamento do Territorio e do Desenvolvimento Regional, Instituto do Ambiente), 2007, *Portuguese national inventory report on greenhouse gases, 1990–2005, submitted under the UNFCCC*. Amadora, April 2007.
(PT NIR 2007)

Ministry for the Environment, Physical Planning and Public Works 2006. *Greece - Draft Report on Establishing Assigned Amount.* Prepared by National Observatory of Athens (NOA). January 2006. Athens.

Ministry for the Environment, Physical Planning and Public Works 2006. *Greece - Climate Change Emissions Inventory-Information under Article 3(1) of the Decision 280/2004/EC.* January 2007. Athens.
(GR NIR 2007)

Ministry for the Environment, Physical Planning and Public Works 2006. *Greece - Climate Change Emissions Inventory- Annual inventory submission under the convention and the Kyoto protocol for greenhouse and other gases for the years 1990-2006.* April 2008. Athens.
(GR NIR 2008)

Ministry of Agriculture, Natural Resources and Environment, 2007: Emission Inventory of the Rebublic of Cyprys. Decision No 280/2004/EC Article 3(1): Reporting by Member States. March 2007. Nicosia.
(CY NIR 2007)

Ministry of Environment (Estonia), 2005. *Report pursuant to Article 3(1) of Monitoring Decision - 2006 Estonia.* December 2005, Tallinn.

Ministry of Environment (Estonia), 2006b. *Report to facilitate the estimation of Estonia's assigned amount under the Kyoto Protocol. Draft report to the European Commission.* 2006, Tallinn.

Ministry of Environment (Estonia), 2007a. *Report pursuant to Article 3(1) of Monitoring Decision - 2007 Estonia.* January 2007, Tallinn.

Ministry of Environment (Estonia), 2007b. *Greenhouse Gas Emissions In Estonia 1990–2005. National Inventory Report to the UNFCCC secretariat.* April 2007, Tallinn.
(EE NIR 2007)

Ministry of Environment of the Republic of Latvia and Latvian Environment Geology and Meteorology Agency, 2006. *Latvia's Initial Report under the Kyoto Protocol Determination of Assigned Amount.* Draft report to the European Commission. 15 June 2006

Ministry of Environment (Lithuania), 2007. *National Greenhouse Gas Emission Inventory Report 2007 of the Republic of Lithuania. Reported Inventory 1990-2005.* March 2007, Vilnius.
(LT NIR 2007)

Ministry of Housing, Spatial Planning and the Environment, 2006a. *Initial Report of The Netherlands. Draft.* Directorate General for Environmental Protection. The Hague.

Ministry of Housing, Spatial Planning and the Environment, 2006b. *Reporting to the European Commission under Article 3(1) of Decision No 280/2004/EC.* The Hague.

Ministry of Environment (Poland) 2006a, *Poland's Greenhouse gas inventory 1988–2004.* National Inventory Report 2004, version 1. February 2006, Warsaw.

Ministry of Environment (Poland) 2006b, *Report on the Determination of the Assigned Amount pursuant to Art. 7.4 of the Kyoto Protocol. Submitted to the European Commission in accordance with Art. 8.1 (e) of Decision 280/2004/EC of European Parliament and Council and Art. 23 of Commission Decision 2005/166/EC*. June 2006, Warsaw.

Ministry of Environment and Sustainable Development 2007, *Romania's Initial Report under the Kyoto Protocol (Assigned Amount Calculation).* Romania, May 2007

Ministry of Environment and Water 2007: *National Inventory Report for 2005 (Draft).* Hungary. January 2007.
(HU NIR 2007)

Ministry of the Agriculture, Department of Forest Resources, 2008. Latvia's National Inventory Report for 1990-2006 – submitted under the United Nations Convention on Climate Change. March 2008. Riga.
(LV NIR 2008)

Ministry of the Environment, 2008. *National Inventory Report Estonia 2008, Greenhouse Gas Emsissions in Estonia 1990-2006, National Inventory Report to the UNFCCC secretariat.* March 2008. Tallin.
(EE NIR 2008)

Ministry of the Environment (Denmark), 2006. Denmark's Report on Assigned Amount -to the European Commission. Copenhagen.

Ministry of the Environment (Spain), 2006. *Informe sobre Cantidad Asignada en el ámbito del Protocolo de Kioto – España. (Pendiente de actualización definitiva).* Abril de 2006. Madrid.

Ministry of the Environment and Spatial Planning (Slovenia), 2006. *Report on the determination of Slovenia's assigned amount under the Kyoto Protocol.* Report to the European Commission, June 2006

Ministry of the Environment of the Czech Republic, 2006. *Reporting under Article 3.1 of the Decision No 280/2004/EC Reporting under under Article 3.1 Decision 280/2004/EC.* January 2006, Prague.

Ministry of the Environment of the Czech Republic, 2007. *Reporting under Article 3.1 of the Decision No 280/2004/EC Reporting under under Article 3.1 Decision 280/2004/EC.* January 2007, Prague.

Ministry of the Environment of the Slovak Republic and Slovak Hydrometeorological Institute, 2006a. *SLOVAK REPUBLICAnnual Report 2006 according to the Article 3, paragraph 1 of the Decision No. 280/2004/EC of the European Parliament and of the Council of 11 February 2004 concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol.* Submitted by the Slovak Environmental Agency. January 2006, Bratislava.

Ministry of the Environment of the Slovak Republic and Slovak Hydrometeorological Institute, 2006c. *Slovak Republic. Report to facilitate the estimation of assigned amounts under the Kyoto Protocol.* Draft report to the European Commission. 15 June 2006. Bratislava.

National Environmental Agency, 2008. Portuguese National Inventory Report on Greenhouse Gases, 1990-2006 Submitted under the United Nations Framework Convention on Climate Change. January 2008. Amadora.
(PT NIR 2008)

National Environmental Protection Agency (NEPA) 2008, *Romania's Greenhouse Gas Inventory 1989-2006 – National Inventory Report*, March 2008, Bucharest
(RO NIR 2008)

National Environmental Research Institute (NERI) 2006, *Danish Annual EC Greenhouse Gas Inventory 1990-2004*, 13 January 2006, Copenhagen.

National Environmental Research Institute (NERI) 2007a: Danish Annual EC Greenhouse Gas Inventory 1990-2005 Copenhagen.
(DK Short NIR 2007)

National Environmental Research Institute (NERI) 2007b, *Denmark's national inventory report 2007*. Emission Inventories - Submitted under the United Nations Framework Convention on Climate Change, 1990-2005. Copenhagen.
(DK NIR 2007)

National Environmental Research Institute,University of Aarhus, 2008. *Denmark's National Inventory Report 2008, Emission Inventories 1990-2006 - submitted to the European Commission.* March 2008. Denmark.
(DK NIR 2008)

National Greenhouse Gas Emission Inventory Report 2007 of the Repbublic of Lithuania (reported Inventory 1990-2006), Annual report under the UN Framework Convention on Climate Change. December 2007. Vilnius.
(LI NIR 2008)

National Emissions Inventory System Team Malta Environment and Planning Authority, 2008. *National Greenhouse Gas Emissions Inventory Report for Malta 1990 – 2006. Annual Report for submission under the United Nations Framework Convention on Climate Change*

ad ecision No 280/2004/EC of the European Parliament and of the Council of 11 February 2004 concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol. March 2008. Malta.
(MT NIR 2008)

Department for Environment, Food and Rural Affairs, AEA Technology, 2007. *UK Greenhouse Gas Inventory 1990 to 2005: Annual Report for submission under the Framework Convention on Climate Change*, April 2007, Didcot, Oxon., UK
(GB NIR 2007)

Department for Environment, Food and Rural Affairs. AEA Technology, 2008. *UK Greenhouse Gas Inventory 1990 to 2006: Annual Report for submission under the Framework Convention on Climate Change.* March 2008. Didcot Oxfordshire.
(GB NIR 2008)

Netherlands Environmental Assessment Agency (MNP) 2007. *Greenhouse Gas Emissions in the Netherlands 1990-2005. National Inventory Report 2007.* MNP report 500080 006. April 2007, Bilthoven, The Netherlands, 2007.
(NL NIR 2007)

Netherlands Environmental Assessment Agency (MNP), 2008.*Greenhouse Gas Emissions in the*

Netherlands 1990-2006, National Inventory Report 2008, March 2008.Bilthoven.
(NL NIR 2008)

Slovak Hydrometeorological Institute*, 2008. National Inventory Report, Greenhouse Gas Emission Inventory in the SR 1990-200. March 2008*. Bratislava.
(SK NIR 2008)

Statistics Finland, 2006a. *Report to facilitate the estimation of Finland's assigned amount under the Kyoto Protocol Draft report to the European Commission.* 15 January 2006, Helsinki.

Statistics Finnland, 2008. *Greenhouse Gas Emissions in Finland 1990-2006, National Inventory Report to the European Union.* March 2008. Finland.
(FI NIR 2008)

Statistics Finland, 2006b. *National Greenhouse Gas Inventory System in Finland.* 5 January 2006, Helsinki.

Statistics Finland, 2007. *Greenhouse Gas Emissions in Finland 1990-2005.* National Inventory Report to the UNFCCC. April 2007. Helsinki.
(FI NIR 2007)

Swedish Environmental Protection Agency (EPA), 2006a. *Sweden's Initial Report under the Kyoto Protocol. Calculation of Assigned Amount.* Stockholm.

Swedish Environmental Protection Agency, 2007. *Sweden's National Inventory Report 2008, Submitted under the United Nations Framework Convention on Climate Change.* 2007. Stockholm.
(SE NIR 2008)

Umweltbundesamt (Austria), 2007b. *Austria's annual national greenhouse gas inventory 1990-2005. Submission under the United Nations Framework Convention on Climate Change.* REP-0048. Vienna, 2007.
(AT NIR 2007)

Umweltbundesamt, 2008. *Austria´s National Inventory Report 2008, Draft, Submission under the EC Monitoring Mechanism*. March 2008. Vienna.
(AT NIR 2008)

Umweltbundesamt (Germany), 2006b. AAU Bericht - Bericht zur Festlegung der zugewiesenen Mengen Umweltbundesamt. März 2006. Dessau.

Umweltbundesamt (Germany) 2007, *Deutsches Treibhausgasinventar 1990–2005. Nationaler Inventarbericht 2007*, Berichterstattung unter der Klimarahmenkonvention der Vereinten Nationen. April 2007, Dessau.
(DE NIR 2007 (German))

Umweltbundesamt ,2008. *Berichterstattung unter der Klimarahmenkonvention der Vereinten Nationen, 2008, Nationaler Inventarbericht zum Deutschen Treibhausgasinventar 1990 – 2006.* March 2008. Dessau.
(DE NIR 2008 (German)

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				