

Annual European Community greenhouse gas inventory 1990–2003 and inventory report 2005

Submission to the UNFCCC Secretariat

ISSN 1725-5597



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Cover design: EEA
Layout: Brandpunkt

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Luxembourg: Office for Official Publications of the European Communities, 2005

ISBN 92-9167-766-3

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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 Guegele (ETC). Other authors were, in alphabetical order, Odette Deuber (ETC), Sandro Federici (JRC), Michael Gager (ETC), Jakob Graichen (ETC), Anke Herold (ETC),

Adrian Leip (JRC), Nikolaos Roubanis (Eurostat), Elisabeth Rigler (ETC), Manfred Ritter (ETC), Zoltan Somogyi (JRC). The EEA project managers were André Jol and Andreas Barkman. 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 year the scope of the report has been extended to the new Member States due to the enlargement of the EC.

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 the EU-15 or EU-25. It is the direct sum of the national inventories. Only for the EU-15 reference approach for CO₂ from fossil fuels developed by the Intergovernmental Panel on Climate Change (IPCC), Eurostat energy data is used. 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 compilation of 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. On 28 February, the draft EC GHG inventory and inventory report are circulated to Member States for reviewing and commenting. Member States check their national data and information used in the EC 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.

ES.2 Summary of emission- and removal-related trends

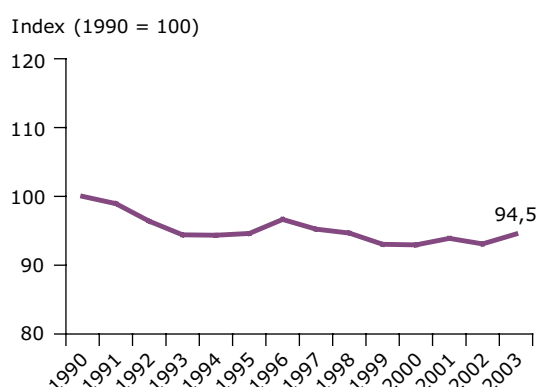
Total GHG emissions without LUCF in the EU-25 decreased by 5.5 % between 1990 and 2003 (Figure ES.1). Emissions increased by 1.5 % between 2002 and 2003.

Total GHG emissions without LUCF in the EU-15 were 1.7 % below the base year in 2003. In the Kyoto Protocol, the EC agreed to reduce its GHG emissions by 8 % by 2008–2012, from base year levels. Assuming a linear target path from 1990 to 2010, total EU-15 GHG emissions were 3.5 index points above this target path in 2003 (Figure ES.2).

Compared to 2002, EU-15 GHG emissions increased in 2003 by 1.3 % or 53 million tonnes. The increases mainly occurred from energy industries (+ 24 million tonnes or 2.1 %), mainly due to growing thermal power production and a 5 % increase of coal consumption in thermal power stations. The increase in thermal power production was driven by a combination of higher electricity consumption and an almost stable supply of electricity from hydro and nuclear power. In addition, greenhouse gas emissions from households and the services sector increased considerably (+ 18 million tonnes or + 2.8 %),

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

Figure ES.1 EU-25 GHG emissions 1990–2003 compared with target for 2008–2012 (excl. LUCF)



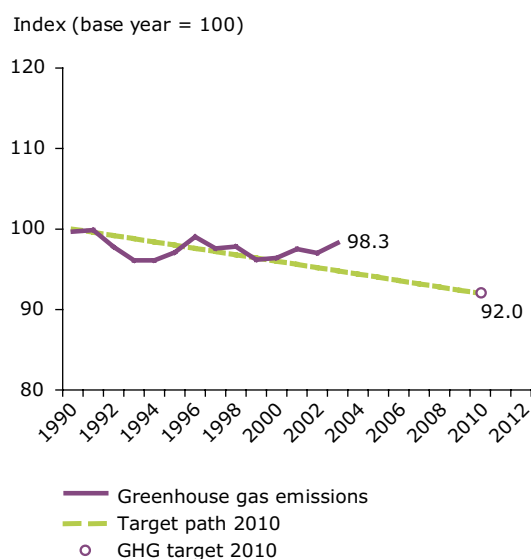
partly due to colder weather in the first quarter of 2003.

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Table ES.1 gives an overview of the main trends in EU-25 GHG emissions and removals for 1990–2003. The most important GHG by far is CO₂, accounting for 82 % of total EU-25 emissions in 2003. In 2003, EU-25 CO₂ emissions without LUCF were 4064 Tg, which was 1.6 % below 1990 levels. Compared to 2002, CO₂ emissions increased by 2.1 %.

Figure ES.2 EU-15 GHG emissions 1990–2003 compared with target for 2008–2012 (excl. LUCF)



Note: 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 2003 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 2003. 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 LUCF. 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. Thirteen Member States have chosen to select 1995 as the base year under the Kyoto Protocol, Finland and France have chosen to use 1990. Therefore, the EU-15 base year estimates for fluorinated gas emissions are the sum of 1995 emissions for 13 Member States and 1990 emissions for Finland and France. The index on the y axis refers to the base year (1995 for fluorinated gases for all Member States except Finland and France, 1990 for fluorinated gases for Finland and France and for all other gases). This means that the value for 1990 doesn't need to be exactly 100.

Table ES.2 gives an overview of the main trends in the EU-15 GHG emissions and removals for 1990–2003. Also in the EU-15 the most important GHG by far is CO₂, also accounting for 82 % of total EU-15 emissions in 2003. In 2003, EU-15 CO₂ emissions without LUCF were 3 447 Tg, which was 3.4 % above 1990 levels. Compared to 2002, CO₂ emissions increased by 1.8 %. The main

Table ES.1 Overview of EU-25 GHG emissions and removals from 1990 to 2003 in CO₂ equivalents (Tg)

GHG Emissions	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Net CO ₂ emissions/removals	3 818	3 748	3 645	3 567	3 561	3 571	3 657	3 597	3 619	3 542	3 562	3 606	3 560	3 669
CO ₂ emissions (without LUCF)	4 128	4 106	3 998	3 921	3 917	3 925	4 028	3 963	3 967	3 921	3 931	4 005	3 982	4 064
CH ₄	554	537	525	513	504	501	490	479	471	456	443	425	415	407
N ₂ O	474	460	447	431	439	441	448	448	424	407	408	402	391	389
HFCs	27	27	29	30	34	40	45	52	53	47	46	47	49	53
PFCs	17	16	13	12	11	11	11	10	9	8	7	7	6	6
SF ₆	11	11	12	13	14	15	15	14	12	10	10	9	10	10
Total (with net CO₂ emissions/removals)	4 902	4 798	4 670	4 566	4 563	4 579	4 666	4 600	4 589	4 471	4 477	4 496	4 432	4 533
Total (without CO₂ from LUCF)	5 212	5 157	5 023	4 920	4 919	4 933	5 038	4 965	4 936	4 850	4 846	4 895	4 854	4 928
Total (without LUCF)	5 212	5 156	5 023	4 919	4 917	4 931	5 036	4 964	4 935	4 849	4 844	4 894	4 852	4 925

Table ES.2 Overview of EU-15 GHG emissions and removals from 1990 to 2003 in CO₂ equivalents (Tg)

GHG Emissions	Base year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Net CO ₂ emissions/removals	3 111	3 111	3 088	3 023	2 970	2 964	3 004	3 063	3 008	3 053	3 010	3 044	3 086	3 058	3 138
CO ₂ emissions (without LUCF)	3 335	3 335	3 359	3 285	3 232	3 230	3 267	3 343	3 288	3 331	3 304	3 328	3 394	3 388	3 447
CH ₄	441	441	432	426	419	410	408	402	392	383	372	361	351	342	334
N ₂ O	408	408	403	396	383	391	392	398	399	376	352	352	344	336	336
HFCs	41	27	27	29	30	34	40	45	51	53	46	44	44	46	50
PFCs	12	16	14	12	10	10	9	9	8	8	7	6	6	6	6
SF ₆	15	10	11	12	12	13	15	15	13	12	10	10	9	10	9
Total (with net CO₂ emissions/removals)	4 029	4 015	3 976	3 897	3 825	3 823	3 868	3 932	3 872	3 884	3 797	3 817	3 839	3 798	3 873
Total (without CO₂ from LUCF)	4 253	4 238	4 246	4 159	4 087	4 089	4 131	4 212	4 151	4 162	4 092	4 101	4 148	4 127	4 182
Total (without LUCF)	4 252	4 238	4 246	4 159	4 087	4 088	4 129	4 211	4 150	4 160	4 091	4 100	4 146	4 126	4 180

Table ES.3 Overview of EU-25 GHG emissions in the main source and sink categories 1990 to 2003 in CO₂ equivalents (Tg)

GHG source and sink	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
1. Energy	4 123	4 113	4 003	3 931	3 910	3 914	4 023	3 948	3 944	3 894	3 895	3 970	3 946	4 015
2. Industrial processes	351	331	321	311	332	344	345	354	333	300	303	299	293	305
3. Solvent and other product use	12	11	11	11	10	11	11	11	11	11	11	10	10	10
4. Agriculture	547	524	509	493	494	494	496	497	493	496	491	483	476	468
5. Land-use change and forestry	- 310	- 358	- 353	- 354	- 354	- 351	- 370	- 364	- 346	- 378	- 365	- 398	- 421	- 392
6. Waste	178	176	177	173	171	167	160	154	154	148	143	131	126	125
7. Other	1	1	1	1	1	1	1	1	1	1	1	1	1	1

reason for increases between 1990 and 2003 was growing road transport demand. The large increase in road transport-related

CO₂ emissions was only partly offset by reductions in energy-related emissions from manufacturing industries.

Table ES.4 Overview of EU-15 GHG emissions in the main source and sink categories 1990 to 2003 in CO₂ equivalents (Tg)

GHG source and sink	Base														
	year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
1. Energy	3 310	3 310	3 344	3 273	3 221	3 203	3 235	3 316	3 253	3 292	3 264	3 280	3 347	3 339	3 393
2. Industrial Processes	328	313	301	292	283	302	313	315	320	298	265	266	259	258	265
3. Solvent and Other Product Use	10	10	10	10	10	10	10	10	10	10	10	10	9	9	9
4. Agriculture	462	462	449	442	433	436	437	440	442	440	437	435	426	420	414
5. Land- Use Change and Forestry	- 223	- 223	- 270	- 262	- 262	- 265	- 261	- 278	- 278	- 276	- 294	- 283	- 307	- 329	- 307
6. Waste	141	141	142	141	140	137	133	130	124	120	114	109	104	99	97
7. Other	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Table ES.5 Overview of Member States' contributions to EC GHG emissions excluding LUCF from 1990 to 2003 in CO₂ equivalents (Tg)

Member State	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Austria	79	83	76	76	77	80	83	83	83	80	81	85	86	92
Belgium	146	149	147	146	151	152	157	148	153	146	148	147	145	148
Cyprus	6	6	7	7	7	7	8	8	8	8	9	8	9	9
Czech Republic	192	178	164	158	152	153	155	159	149	140	148	148	143	145
Denmark	69	80	74	76	80	77	90	80	76	73	68	70	69	74
Estonia	43	41	30	23	24	22	23	24	22	20	20	19	20	21
Finland	70	69	67	68	74	71	77	76	73	72	70	76	77	86
France	568	593	585	559	555	563	578	572	584	566	560	564	554	557
Germany	1 244	1 191	1 142	1 126	1 108	1 103	1 121	1 084	1 057	1 021	1 017	1 028	1 015	1 018
Greece	109	109	110	110	113	114	118	123	128	127	132	134	134	138
Hungary	103	95	85	85	85	84	86	84	84	84	81	84	81	83
Ireland	54	55	56	56	57	58	60	63	65	67	69	71	69	68
Italy	511	513	509	505	496	528	519	525	535	544	551	556	555	570
Latvia	25	24	19	16	15	12	12	12	11	10	10	11	11	11
Lithuania	51	45	42	38	35	31	28	24	22	21	21	20	20	17
Luxembourg	13	13	13	13	13	10	10	9	8	9	10	10	11	11
Malta	2	2	3	3	3	3	3	3	3	3	3	3	3	3
Netherlands	212	216	215	221	221	224	233	225	227	215	214	216	213	215
Poland	460	438	440	430	440	417	437	427	404	402	386	383	370	384
Portugal	59	61	65	64	65	70	67	70	75	83	80	81	86	81
Slovakia	72	63	59	55	52	53	54	54	52	51	48	53	52	52
Slovenia	19	17	17	18	18	19	19	20	20	19	19	20	20	20
Spain	284	290	299	287	303	315	307	328	337	365	380	379	399	402
Sweden	72	72	72	72	75	73	77	73	73	70	67	68	69	71
United Kingdom	748	752	729	710	700	691	714	691	686	652	652	663	644	651
EU-25	5 212	5 156	5 023	4 919	4 917	4 931	5 036	4 964	4 935	4 849	4 844	4 894	4 852	4 925
EU-15	4 238	4 246	4 159	4 087	4 088	4 129	4 211	4 150	4 160	4 091	4 100	4 146	4 126	4 180

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

The increase of CO₂ emissions was compensated by decreases in CH₄ and N₂O in the same period: CH₄ decreased by 108 Tg (CO₂ equivalents) (- 24 %) and N₂O by 73 Tg (CO₂ equivalents) (- 18 %). The main reasons for declining CH₄ emissions were reductions in solid waste disposal on land,

the decline of coal-mining, and a falling cattle population. The main reason for large N₂O emission cuts were reduction measures in the adipic acid production. Fluorinated gas emissions are subject to two opposing trends. While HFCs from consumption of halocarbons showed large increases

Table ES.6 Greenhouse gas emissions in CO₂ equivalents (excl. LUCF) and Kyoto Protocol targets for 2008–2012

Member State	Base year ¹⁾ (million tonnes)	2003 (million tonnes)	Change 2002–2003	Change base year–2003	Targets 2008– 2012 under Kyoto
					Protocol and 'EU burden sharing'
Austria	78.5	91.6	5.9 %	16.6 %	– 13.0 %
Belgium	146.8	147.7	1.6 %	0.6 %	– 7.5 %
Cyprus	6.0	9.2	5.3 %	52.8 %	–
Czech Republic	192.1	145.4	1.8 %	– 24.3 %	– 8.0 %
Denmark	69.6	74.0	7.3 %	6.3 %	– 21.0 %
Estonia	43.5	21.4	9.7 %	– 50.8 %	– 8.0 %
Finland	70.4	85.5	10.8 %	21.5 %	0.0 %
France	568.0	557.2	0.7 %	– 1.9 %	0.0 %
Germany	1 248.3	1 017.5	0.2 %	– 18.5 %	– 21.0 %
Greece	111.7	137.6	3.1 %	23.2 %	25.0 %
Hungary	122.2	83.2	3.0 %	– 31.9 %	– 6.0 %
Ireland	54.0	67.6	– 2.6 %	25.2 %	13.0 %
Italy	510.3	569.8	2.7 %	11.6 %	– 6.5 %
Latvia	25.4	10.5	– 0.9 %	– 58.5 %	– 8.0 %
Lithuania	50.9	17.2	– 12.1 %	– 66.2 %	– 8.0 %
Luxembourg	12.7	11.3	4.3 %	– 11.5 %	– 28.0 %
Malta ²⁾	2.2	2.9	– 0.5 %	29.1 %	–
Netherlands	213.1	214.8	0.6 %	0.8 %	– 6.0 %
Poland ²⁾	565.3	384.0	3.7 %	– 32.1 %	– 6.0 %
Portugal	59.4	81.2	– 5.3 %	36.7 %	27.0 %
Slovakia	72.0	51.7	– 1.3 %	– 28.2 %	– 8.0 %
Slovenia	20.2	19.8	– 1.2 %	– 1.9 %	– 8.0 %
Spain	286.1	402.3	0.9 %	40.6 %	15.0 %
Sweden	72.3	70.6	1.5 %	– 2.4 %	4.0 %
United Kingdom	751.4	651.1	1.1 %	– 13.3 %	– 12.5 %
EU–15	4 252.5	4 179.6	1.3 %	– 1.7 %	– 8.0 %

⁽¹⁾ The base year for CO₂, CH₄ and N₂O is 1990; for the fluorinated gases, 13 Member States have chosen to select 1995 as the base year, whereas Finland and France 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 13 Member States and 1990 emissions for Finland and France.

⁽²⁾ Malta and Poland did not provide GHG emission estimates for 2003, therefore the data provided in this table are based on gap-filling (see Chapter 1.8.2).

Note: Malta and Cyprus do not have Kyoto targets.

between 1990 and 2002 (mainly due to the replacement of ozone-depleting substances), HFC emissions from production of halocarbons decreased substantially.

ES.3 Overview of source and sink emission estimates and trends

Table ES.3 gives an overview of EU-25 GHG emissions in the main source categories for

1990–2003. The most important sector by far is 'Energy' accounting for 80 % of total EU-25 emissions in 2003. The second largest sector is 'Agriculture' (10 %), followed by 'Industrial processes' (6 %)

Table ES.4 gives an overview of EU-15 GHG emissions in the seven sectors for 1990–2003. The emissions from the largest sector 'Energy', with an 81 % share of the total emissions, increased by 83 Tg CO₂ equivalents (2.5 %). This increase was offset

⁽²⁾ The EU-15 as a whole needs emission reductions of a total GHG of 8 %, i.e. 340 million tonnes on the basis of the 2005 inventory in order to meet the Kyoto target.

Table ES.7 Overview of EU-15 indirect GHG and SO₂ emissions for 1990–2003 (Gg)

GHG Emissions	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
NO _x	13 390	13 145	12 832	12 243	11 881	11 599	11 316	10 836	10 593	10 259	9 913	9 686	9 420	9 273
CO	50 457	48 605	46 522	44 276	41 983	40 325	38 766	36 854	35 303	33 246	30 618	29 199	27 263	26 481
NMVOc	15 556	14 865	14 451	13 774	13 436	13 085	12 519	12 322	11 808	11 346	10 643	10 244	9 782	9 594
SO ₂	16 527	14 977	13 825	12 563	11 347	10 229	8 852	8 047	7 519	6 753	6 093	5 875	5 669	5 234

by decreases in all other source categories: emissions from 'Industrial processes' decreased by 48 Tg CO₂ equivalents (– 15 %), emissions from 'Agriculture' by 47 Tg CO₂ equivalents (– 10 %), emissions from 'Waste' by 44 Tg CO₂ equivalents (– 31 %) and emissions from 'Solvent and other product use' by 1 Tg CO₂ equivalents (– 10 %).

Tables ES.5 and ES.6 give an overview of Member States' contributions to the EC GHG emissions for 1990–2003. Member States show large variations in GHG emission trends.

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-25 GHG emissions. These two Member States achieved total GHG emission reductions of 323 million tonnes compared to 1990 ⁽²⁾.

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 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 N₂O emission reduction measures in the adipic acid production.

Italy and France are the third and fourth largest emitters with a shares of 12 % and 11 %, respectively. Italy's GHG emissions were 12 % above 1990 levels in 2003. Italian GHG emissions increased since 1990 primarily from road transport, electricity and heat production and petrol-refining. France's emissions were 2 % below 1990 levels in 2003. In France, large reductions were achieved in N₂O emissions from the adipic acid production, but CO₂ emissions

from road transport increased considerably between 1990 and 2003.

Spain and Poland are the fifth and sixth largest emitters in the EU-25 each accounting for about 8 % of total EU-25 GHG emissions. Spain increased emissions by 42 % between 1990 and 2003 (+ 41 % since the base year). This was largely due to emission increases from road transport, electricity and heat production, and manufacturing industries. Poland decreased GHG emissions by 16 % between 1990 and 2003 ⁽³⁾ (– 32 % since the base year, which is 1988 in the case of Poland). Main factors for decreasing emissions in Poland — as for other new Member States — was the decline of energy inefficient heavy industry and the overall restructuring of the economy in the late 1980s and early 1990s. The notable exception was transport (especially road transport) where emissions increased.

Table ES.6 shows that 12 Member States (including Cyprus and Malta, which do not have a Kyoto target) were above base year levels in 2003, 13 Member States were below. The percentage changes of GHG emissions from the base year to 2003 range from – 66 % (Lithuania) to + 41 % (Spain).

ES.4 Information on indirect greenhouse gas emissions for the EU-15

Emissions of CO, NO_x, NMVOC and SO₂ 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

⁽³⁾ Note that for Poland, data for 2003 have been estimated by gap-filling because Poland did not provide GHG emission estimates before the data deadline of this report (see Chapter 1.8.2.).

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 2003. 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 13. Note that all Member States' submissions (CRF tables and inventory reports), which are included in Annex 13 and made available at the EEA website, are considered to be part of the EC submission. Several chapters in this report refer to information provided by the Member States, where additional insights can be gained. In many cases, this Member State information is presented in summary overview tables.

The EC greenhouse gas inventory has been compiled under Council Decision No 280/2004/EC concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol⁽⁴⁾. The emissions compiled in the EC GHG inventory are the sum of the respective emissions in the respective 15 or 25 national inventories, except for the IPCC reference approach for CO₂ from fossil fuels. Since the data are revised and updated for all years, they replace EC data previously

published, in particular, in the 2004 submission by the European Commission to the UNFCCC Secretariat of the *Annual European Community greenhouse gas inventory 1990–2002 and inventory report 2004* (EEA, 2004a) and in the report entitled *Analysis of greenhouse gas emission trends and projections in Europe 2004* (EEA, 2004b).

As of 1 May 2004, 10 new Member States have joined the European Community. This inventory report for the first time includes data for the EU-15 and for the EU-25 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 10 new Member States are Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia. Most chapters and annexes of this report refer to the EU-15 only, i.e. Chapters 3–10 and Annexes 1–12. Chapters 1 and 2 and also Annexes 12 and 13 refer to the EU-25, where relevant (for more detail see Section 1.8.5). This means that all the detailed information provided in previous reports for the EU-15 is also available in this report. In addition, basic information on data availability, QA/QC, uncertainty estimates, completeness and emission trends are provided for the EU-25.

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.

Secondly, under the monitoring mechanism, the European Commission has to assess annually whether the actual and projected

⁽⁴⁾ OJ L 49, 19.2.2004, p. 1.

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

The legal basis of the compilation of the EC inventory is Council Decision No 280/2004/EC concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol ⁽⁵⁾. The purpose of this decision is to: (1) monitor all anthropogenic GHG emissions covered by the Kyoto Protocol in the Member States; (2) evaluate progress towards meeting GHG reduction commitments under the UNFCCC and the Kyoto Protocol 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 (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF₆) during the year before last (X – 2);
- provisional data on their emissions of carbon monoxide (CO), sulphur dioxide (SO₂), 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);

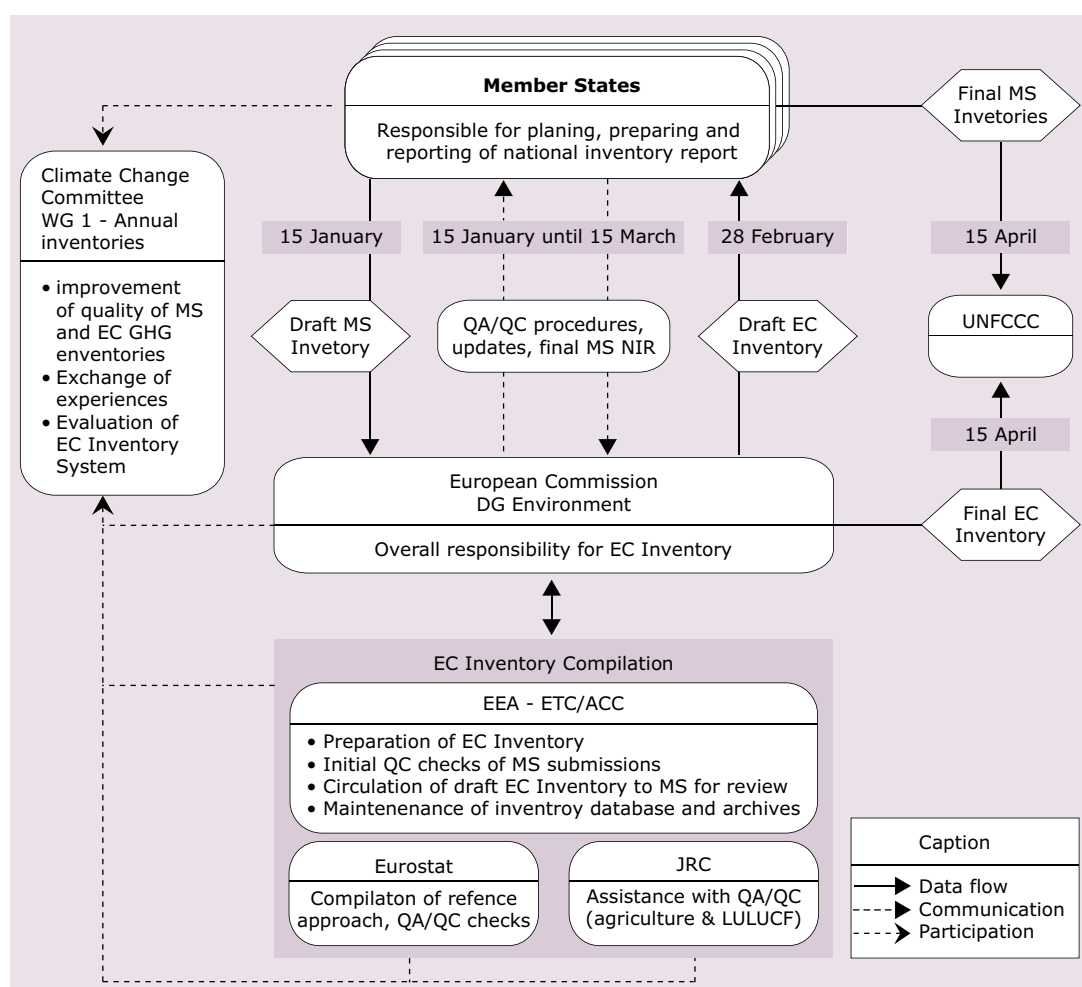
- information with regard to the accounting of emissions and removals from land-use, land-use change and forestry, in accordance with Article 3(3) and, where a Member State decides to make use of it, Article 3(4) of the Kyoto Protocol, and the relevant decisions thereunder, for the years between 1990 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 No 280/2004/EC are elaborated in the Commission decision laying down rules implementing 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 ⁽⁶⁾. According to the Council decision and the Commission decision, the reporting requirements are exactly the same as for the UNFCCC, regarding content and format. The EC and its Member States use the 'UNFCCC guidelines on reporting and review' (Document FCCC/CP/2002/8), and prepare inventory information in the common reporting format (CRF) and the 'national inventory report' that contains background information.

In accordance with UNFCCC guidelines, the EC and its Member States use the IPCC Good practice guidance and uncertainty management in national greenhouse gas inventories (IPCC, 2000), which is consistent with the Revised 1996 IPCC guidelines for national greenhouse gas

⁽⁵⁾ OJ L 49, 19.2.2004, p. 1.

⁽⁶⁾ This Commission decision was adopted on 14 February 2005 and will be published in the Official Journal of the European Community soon.

Figure 1.1 Inventory system of the European Community

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) (?).

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

1.2.1 The Member States

All Member States are Annex I parties to the UNFCCC except Cyprus and Malta.

(?) A draft staff working paper laying down the Community inventory system will be adopted soon. This paper will specify in more detail the responsibilities of the institutions involved in the preparation of the EC inventory, the preparation of the EC inventory, identification of key categories, estimation of uncertainties, recalculations, response to the UNFCCC review process and QA/QC of the EC inventory report.

(?) 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
Cyprus	Christos Malikkides Head, Industrial Pollution Control Section, Department of Labour Inspection Ministry of Labour and Social Insurance 12, Apellis Street, CY-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	Outi Berghäll Ministry of the Environment PO Box 35, FIN-00023 Government Jouko Petäjä Finnish Environment Institute PB 140, FIN-00251 Helsinki Kari Grönfors Statistics Finland PB 6A, FIN-00022 Statistics
France	Ministère de l'Ecologie et du Développement Durable (MEDD) 20 avenue de Ségur, F-75007 Paris Jean-Pierre Fontelle Centre Interprofessionnel 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, EE-10137 Tallinn
Germany	Michael Strogies Federal Environmental Agency Bismarckplatz 1, D-14193 Berlin
Greece	Dimitra Koutendaki Institute of Environmental Research and Sustainable Development GR-Athens
Hungary	László Gáspár National Directorate for Environment, Nature and Water Márvány u. 1/c, H-1012 Budapest
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, Kristīne Zommere Latvian Environment, Geology and Meteorology Agency Straumes Street 2, LV-2015 Jurmala,
Lithuania	Vytautas Krusinskas Lithuanian Ministry of Environment A. Jaksto 4/9, LT- 01105 Vilnius
Luxembourg	Frank Thewes Administration de l'Environnement, Division Air-Bruit 16 rue Eugène Ruppert, L-2453 Luxembourg
Malta	Sharon.Micallef Malta Environment Planning Authority PO Box 200, Marsa GPO 01, Malta

Member State/EU institution	Contact address
Netherlands	Jos Olivier RIVM PO Box 1, 3720 BA Bilthoven, The Netherlands
Poland	Krzysztof Olendrzynski Institute of Environmental Protection, National Emission Centre Kolektorska 4, PL-01-692 Warszawa
Portugal	Teresa Costa Pereira Direccao-Geral do Ambiente Rua da Murgueira — Bairro do Zambujal, P-2721-865 Amadora
Slovakia	Ministry of Environment SR, Department of Air Protection, director Ing. Lubomir ZIAK namestie L. Stura 1, SK-812 35 Bratislava
Slovenia	Tajda Mekinda Majaron Environmental Agency of the Republic of Slovenia Vojkova 1/b, SLO-1000 Ljubljana
Spain	Ángeles Cristóbal Ministerio de Medio Ambiente Plaza de San Juan de la Cruz s/n, E-28071 Madrid
Sweden	Per Rosenqvist Ministry of the Environment, S-103 33 Stockholm Sandra Pettersson Swedish Environmental Protection Agency Blekhölmsterassen 36, S-106 48 Stockholm
United Kingdom	JD Watterson National Environmental Technology Centre AEA Technology, Culham, Abingdon OX14 3ED, Oxon, United Kingdom
European Commission	Lars Mueller European Commission, DG Environment Rue de la Loi 200, B-1049 Brussels
European Environment Agency (EEA)	Andre Jol, Andreas Barkman European Environment Agency Kongens Nytorv 6, DK-1050 Copenhagen
European Topic Centre on Air and Climate Change (ETC/ACC)	Bernd Guegle, Elisabeth Rigler, Manfred Ritter European Topic Centre on Air and Climate Change Umweltbundesamt Spittelauer Laende 5, A-1090 Vienna
Eurostat	Nikolaos Roubanis Statistical Office of the European Communities (Eurostat), Jean Monnet Building, L-2920 Luxembourg
Joint Research Centre (JRC)	Frank Raes, Giorgio Matteucci, Adrian Leip Joint Research Centre, Institute for Environment and Sustainability, Climate Change Unit Via Enrico Fermi, I-21020 Ispra (VA)

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 No 280/2004/EC.

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.

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 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 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 Commission 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 National Institute of Public Health and the Environment — RIVM (the Netherlands) and EEA in March 2001. The ETC/ACC involves 13 organisations and institutions in eight European countries. The technical annex for the 2005 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 CO₂ emissions from fossil fuels using the IPCC reference approach. Eurostat compares these estimates with national estimates of CO₂ 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 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 CH₄ 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 N₂O 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 1.2. The Member States should submit their annual GHG inventory by 15 January each year to the European Commission's DG Environment. Then, the ETC/ACC, Eurostat and the JRC perform initial checks of the submitted data up to 28 February. The ETC/ACC transfers the nationally submitted data from the spreadsheet format of the common reporting format (CRF) tables into spreadsheets. From these spreadsheets the data are transferred into the EC CRF tables and into the ETC/ACC database.

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. In late April, the inventory and the inventory report are published on the EEA website (<http://www.eea.eu.int>) and the data are made available through the EEA data warehouse (<http://dataservice.eea.eu.int/dataservice>). In addition, the EC inventory report is published by the EEA as a printed report, with a CD-ROM including the data. 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.

Table 1.2 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	<p>Elements listed in Article 3(1) of Decision No 280/2004/EC as elaborated in Articles 2 to 7, in particular:</p> <ul style="list-style-type: none"> greenhouse gas emissions by sources and removals by sinks, for the year $n - 2$; an updated time series 1990, year $n - 3$, depending on recalculations; core elements of the NIR <p>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)</p>
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 checking 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 communicates 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	The 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.
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 corrects data or information 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.

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/CP/2002/8), to the extent possible⁽⁹⁾. In addition, the *Revised IPCC 1996 guidelines for national greenhouse gas inventories* have been applied as well as the *IPCC Good practice guidance and uncertainty management in national greenhouse gas inventories*, where appropriate and feasible⁽⁹⁾. In addition, for the compilation of the EC GHG inventory, Council Decision No 280/2004/EC and the Commission decision thereunder have been used.

The EC GHG gas inventory is compiled on the basis of the inventories of the 15 or 25 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 25 Member States. This is also valid for the base year estimate of the EU-15 GHG inventory. Currently, 13 Member States have indicated their choice of 1995 as the base year for fluorinated gases while Finland and France have indicated their choice of 1990. Therefore, the EU-15 base year estimates for fluorinated gas emissions are the sum of 1995 emissions for 13 Member States and 1990 emissions for Finland and France. The reference approach is calculated for the EU-15 on the basis of Eurostat energy data (see Section 3.6) and the key source analysis (Section 1.5) is separately performed at EU-15 level⁽¹⁰⁾.

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

of the emissions data, provided that each methodology is consistent with the IPCC good practice guidelines.

In general, no separate methodological information is provided at EC level except summaries of methodologies used by Member States. However, for some sectors quality improvement projects have 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 LUCF, and emissions from agriculture. In Spring 2005, a workshop for improving methods related to GHG inventories and projections will be organised for the waste sector.

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 to the Commission decision under Council Decision No 280/2004/EC. The sector-specific chapters list the methodologies and emission factors used by the Member States for each EC key source. Annex 13 includes the CRF Table Summary 3 for those Member States that submitted these tables in 2004. Detailed information on methodologies used by the Member States is available in the Member States national inventory reports, which are included in Annex 13. Note that all Member States' submissions (CRF tables and national inventory reports), which are included in Annex 13 and made available on the EEA website, are considered to be part of the EC submission.

Differences between EU-15 submissions and Member States' submissions in 2005

Due to the reporting required in Category 5 of CRF Table Summary 1.A., inconsistencies occur between the EU-15 CRF submission 2005 and the sum of the EU-15 Member States' submissions in 2005. Footnote 5 of CRF Table Summary 1.A. requires parties

⁽⁹⁾ At the moment, the EC is not able to provide some of the information required in the guidelines, such as specific sectoral background data tables. For more details on these issues, see Sections 1.7 and 1.8.5.

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

to report net emissions (emissions minus removals) from LUCF in each subcategory 5 and in the total sum of Category 5. Only a single number should be placed in either the CO₂ emissions or CO₂ removals column, as appropriate. Thirteen Member States reported net removals from LUCF for 2002, two Member States (Portugal and the Netherlands) reported net CO₂ emissions. At EU-15 level, CO₂ removals were larger than CO₂ emissions. Therefore, net removals were reported that resulted from adding the net removals of the 13 Member States and deducting the net emissions of Portugal and the Netherlands. This means that total CO₂ emissions at EU-15 level do not include net emissions from LUCF of Portugal and the Netherlands. (In turn, net emissions from LUCF of Portugal and the Netherlands reduce net removals of the EU-15.) The sum of CO₂ emissions of the national submissions to the UNFCCC Secretariat includes net emissions of Portugal and the Netherlands and therefore is higher. In turn, the sum of CO₂ removals in the national submissions to the UNFCCC is also higher.

Internal consistency of the EU-15 CRF tables

The EU-15 CRF tables include some internal inconsistencies (i.e. the sum of subcategories is not equal to the category total) in those categories where Member States have difficulties in allocating emissions to the subcategories. This refers mainly to the Source Categories 1.A.2, 1.A.5, 2.F). Member States use notation keys like IE or C if they cannot provide an emission estimate for a certain subcategory. 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 subcategory emission value is the sum of Member States' emission values and the information of the notation keys used by some Member States is lost in the EU-15 CRF submission. In order to make this more transparent, Annexes 4–11 of this report include the CRF Tables 1.A, 1, 2(I), 2(II), 3, 4, 5, 6 for each EU-15 Member State. In addition, some inconsistencies between CRF tables are due to missing data from Luxembourg for some tables (e.g. CRF Tables 1.C, 2(II)).

1.5. Description of key source categories

A key source analysis has been carried out according to the Tier 1 method (quantitative

approach) described in IPCC (2000). A key source 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 source analysis at EU-15 level, every Member State provides a national key source analysis which is independent from the assessment at EU-15 level. The EU-15 key source analysis is not intended to replace the key source analysis by Member States. The key source 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 source analysis helps to identify those categories that should receive special attention with regard to QA/QC at EC level. The Member States use their key source analysis for improving the quality of emission estimates at Member State level.

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

- Starting point for the key source identification for this report was the CRF sectoral report tables, i.e. CRF Tables 1, 2(I), 3, 4, 6 of the EU-15 GHG inventory. All source categories where GHG emissions occur were listed, at the most disaggregated level available at EU-15 level and split by gas. Then a few aggregations were made in particular for those source categories where several Member States have difficulties in allocating emissions to the subcategories (e.g. Source Categories 1.A.2, 2.E, 2.F).
- A level assessment was carried out for all years between the base year and 2003 and a trend assessment was performed for the base year to 2003. The detailed results of the key source analysis are included in Annex 1 (the grey shaded source categories are identified as key sources).
- This procedure resulted in the identification of 42 key source categories for the EU-15. The EU-15 key sources are listed in Table 1.3 and ranked according to their level contribution to total EU-15 GHG emissions in 2003. They cover 97.1 % of total EU-15 GHG emissions in 2003.

Table 1.3 EU-15 GHG source categories identified as key sources (emissions in Gg of CO₂ equivalents)

Source category gas	Base year	2003	Absolute change	% change	Level assessment	Cumulative total
1 A 1 a Public Electricity and Heat Production (CO ₂)	950 461	1 010 508	60 048	6 %	24.2 %	24.2 %
1 A 3 b Road Transportation (CO ₂)	638 574	790 731	152 157	24 %	18.9 %	43.1 %
1 A 2 Manufacturing Industries and Construction (CO ₂)	645 923	576 424	- 69 499	- 11 %	13.8 %	56.9 %
1 A 4 b Residential (CO ₂)	405 465	425 033	19 568	5 %	10.2 %	67.1 %
1 A 4 a Commercial/Institutional (CO ₂)	162 704	160 818	- 1 886	- 1 %	3.8 %	70.9 %
1 A 1 b Petroleum refining (CO ₂)	105 781	118 555	12 774	12 %	2.8 %	73.7 %
4 A 1 Cattle (CH ₄)	124 648	109 814	- 14 833	- 12 %	2.6 %	76.4 %
4 D 1 Direct Soil Emissions (N ₂ O)	112 793	100 402	- 12 392	- 11 %	2.4 %	78.8 %
2 A 1 Cement Production (CO ₂)	79 823	81 631	1 808	2 %	2.0 %	80.7 %
4 D 3 Indirect Emissions (N ₂ O)	76 918	66 213	- 10 705	- 14 %	1.6 %	82.3 %
6 A 1 Managed Waste disposal on Land (CH ₄)	99 564	63 693	- 35 871	- 36 %	1.5 %	83.8 %
1 A 4 c Agriculture/Forestry/Fisheries (CO ₂)	71 585	61 602	- 9 983	- 14 %	1.5 %	85.3 %
1 A 1 c Manufacture of Solid fuels and Other Energy Industries (CO ₂)	95 456	60 857	- 34 599	- 36 %	1.5 %	86.8 %
2 F Consumption of Halocarbons and Sulphur Hexafluoride (HFC)	5 495	41 075	35 580	648 %	1.0 %	87.8 %
4 B 8 Swine (CH ₄)	28 714	30 066	1 351	5 %	0.7 %	88.5 %
2 B 2 Nitric Acid Production (N ₂ O)	37 002	29 000	- 8 002	- 22 %	0.7 %	89.2 %
4 B 1 Cattle (CH ₄)	33 655	28 982	- 4 673	- 14 %	0.7 %	89.9 %
4 D 2 Animal Production (N ₂ O)	30 780	28 566	- 2 214	- 7 %	0.7 %	90.5 %
1 A 3 b Road Transportation (N ₂ O)	9 440	23 606	14 165	150 %	0.6 %	91.1 %
1 A 3 a Civil Aviation (CO ₂)	17 532	22 576	5 045	29 %	0.5 %	91.6 %
1 B 2 b Natural gas (CH ₄)	25 910	21 747	- 4 163	- 16 %	0.5 %	92.2 %
1 A 3 d Navigation (CO ₂)	19 028	20 332	1 304	7 %	0.5 %	92.7 %
2 C 1 Iron and Steel Production (CO ₂)	19 859	17 985	- 1 874	- 9 %	0.4 %	93.1 %
2 A 2 Lime Production (CO ₂)	16 878	17 510	632	4 %	0.4 %	93.5 %
4 B 12 Solid Storage and Dry Lot (N ₂ O)	19 023	17 438	- 1 585	- 8 %	0.4 %	93.9 %
1 B 1 a Coal Mining (CH ₄)	50 477	15 058	- 35 419	- 70 %	0.4 %	94.3 %
2 B 3 Adipic Acid Production (N ₂ O)	63 326	14 917	- 48 409	- 76 %	0.4 %	94.6 %
4 A 3 Sheep (CH ₄)	16 054	14 665	- 1 389	- 9 %	0.4 %	95.0 %
1 A 1 a Public Electricity and Heat Production (N ₂ O)	11 157	13 351	2 194	20 %	0.3 %	95.3 %
2 B 1 Ammonia Production (CO ₂)	14 392	12 416	- 1 976	- 14 %	0.3 %	95.6 %
2 E Production of Halocarbons and Sulphur Hexafluoride (HFC)	35 907	9 254	- 26 652	- 74 %	0.2 %	95.8 %
1 A 5 Other (CO ₂)	20 847	7 913	- 12 934	- 62 %	0.2 %	96.0 %
6 A 2 Unmanaged Waste Disposal Sites (CH ₄)	11369	7 215	- 4 155	- 37 %	0.2 %	96.2 %
1 A 4 b Residential (CH ₄)	9 546	7 101	- 2 445	- 26 %	0.2 %	96.4 %
2 F Consumption of Halocarbons and Sulphur Hexafluoride (SF ₆)	10 301	5 930	- 4 371	- 42 %	0.1 %	96.5 %
6 B 2 Domestic and Commercial Wastewater (CH ₄)	8 230	5 605	- 2 625	- 32 %	0.1 %	96.6 %
1 A 3 c Railways (CO ₂)	8 316	4 985	- 3 331	- 40 %	0.1 %	96.8 %
2 C 3 Aluminium production (PFC)	7 335	3 403	- 3 932	- 54 %	0.1 %	96.8 %
2 C 4 SF ₆ Used in Aluminium and Magnesium Foundries (SF ₆)	2 208	3 035	827	37 %	0.1 %	96.9 %
6 C Waste Incineration (CO ₂)	5 177	3 016	- 2 160	- 42 %	0.1 %	97.0 %

Source category gas	Base year	2003	Absolute change	% change	Level assessment	Cumulative total
1 A 3 b Road Transportation (CH ₄)	4 576	2 359	- 2 217	- 48 %	0.1 %	97.0 %
2 B 5 Other (N ₂ O)	4 400	1 534	- 2 866	- 65 %	0.0 %	97.1 %
All key sources	4 116 628	4 056 922	- 59 706	- 1 %	97.1 %	
Total	4 252 450	4 179 613	- 72 837	- 2 %	100.0 %	

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

1.6 Information on the quality assurance and quality-control plan

The EC GHG inventory is based on the annual inventories of the EC Member States. Therefore, the quality of the EC inventory depends on the quality of the Member States' inventories, the quality assurance and quality control (QA/QC) procedures of the Member States and the quality of the compilation process of the EC inventory. Most EC Member States and also the European Community as a whole are currently implementing QA/QC procedures in order to comply with the IPCC good practice guidance.

1.6.1 Quality assurance and quality control of the European Community inventory

In October 2004, the QA/QC programme for the inventory of the European Community was adopted in the Climate Change Committee. 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 provisions related to the inventory improvement plan are included.

Based on the EC QA/QC programme, a draft QA/QC manual was developed which includes all the specific details of the QA/QC procedures (in particular checklists and forms). Table 1.5 shows that in 2005 QA/QC activities are performed at three levels. Firstly, a range of checks ensures consistency and completeness of Member States data (initial checks). Secondly, a range of checks ensures that data are compiled correctly from data submitted by Member

States to the European Commission (checks during preparation of the EC inventory). Thirdly a number of sector-specific QA/QC procedures are carried out. In addition, procedures for documentation and archiving are outlined in Table 1.5: all material related to the inventory preparation, including the QA/QC checks, is archived electronically by the ETC/ACC; some material is also archived in paper copy.

The initial checks 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 the ETC/ACC by using a similar status report form as used by the UNFCCC Secretariat. The completed status reports are made available to Member States (through the

Table 1.4 QA/QC activities related to the EC inventory for the 2004 submission

Quality control activity	Check report/area	Checks
Initial checks of Member States submissions	Status report	Complete status report form for each Member State's submission
	Consistency and completeness report ⁽¹⁾	<ol style="list-style-type: none"> 1. UNFCCC data import checking routines in relation to completeness and consistency to check MS submissions. In relation to consistency, these procedures analyse and document deviations of time series by certain thresholds and deviations of time series against previous submissions: <ol style="list-style-type: none"> (a) check deviations in time series with UNFCCC algorithms; (b) check implied emission factors across the time series (focus on 18 largest key sources covering 90 % of EC GHG emissions); (c) check time series against previous submissions (document deviations +/- 5 %); (d) compare implied emission factors with implied emission factors of other MS for the three largest recalculations in absolute terms and for recalculations of more than one million tonnes and document large deviations; (e) check if previous year values have been used in latest submission; (f) check consistency between Table 1.A and Table 10; (g) check consistency between sectoral tables and Table 1.A. 2. Check correctness of summing of subcategories in Table 1.A and in sectoral tables. 3. Check completeness of information in those CRF tables that are necessary for the compilation of the EC inventory. 4. Check completeness to determine if gap-filling is required: <ol style="list-style-type: none"> (a) are all gases (CO₂, CH₄, N₂O, HFCs, PFCs, SF₆, NO_x, NMVOC, SO₂) for all years available? (b) are estimates for all EC key sources available which cover 95 % of EC GHG emissions? 5. Check consistency between NIR and CRF in those parts that are necessary for the compilation of the EC inventory report. 6. Check whether methodological and data changes resulting in recalculations of MS data are documented appropriately in the CRF (refer to three largest recalculations in absolute terms and recalculations of more than one million tonnes). 7. Check if Tier 1 uncertainty estimates are available. For which years? Are Excel sheets available? 8. Document any further findings and procedures applied.
Checks during the preparation of the EC inventory	Preparation report (CRF and inventory report)	<ol style="list-style-type: none"> 1. Check that all initial submissions and all updates of inventory data received until 15 March from Member States are correctly accounted for in the EC inventory and correctly documented and catalogued 2. Check for errors associated with data input from Member States' CRF files to the EC inventory database and with data transfer and aggregation during intermediate stages of inventory compilation 3. Ensure that gap-filling, where applicable, has been undertaken in accordance with the methods set down in the implementing provisions 4. Check calculations in aggregating Member States' inventory data for all source and sink categories and gases at EC level 5. Check whether emissions and removals estimates are correctly aggregated from lower reporting levels to higher reporting levels when preparing summaries at EC level 6. Check whether Member States' submissions use the same type of input data (e.g. energy consumption, animal population data) and report the same units for activity data which are aggregated at EU level in sectoral background data tables 7. Check whether units and conversion factors are correctly used at EC level and that they are consistent with those in Member States' inventories.

Quality control activity	Check report/area	Checks
		<p>8. Check whether the number of significant digits or decimal places for common parameters, conversion factors, emission factors, or activity data is consistent across source categories; total emissions should also be reported consistently (in terms of significant digits or decimal places) across source categories.</p> <p>9. Check whether uncertainties in emissions and removals are estimated correctly at EC level in accordance with agreed procedures under the UNFCCC and the Kyoto Protocol and that they are documented correctly.</p> <p>10. Check if estimates of emissions and removals are reported at EC level for all relevant source and sink categories of the 1996 revised IPCC guidelines and for all years from the appropriate base year to the current inventory.</p> <p>11. Check that any findings from the initial checks of the EC inventory prepared by the UNFCCC Secretariat, which are relevant for Member States, are forwarded to these Member States; check that all relevant resubmissions provided by Member States are included in the EC resubmission.</p> <p>12. Check that recalculations conducted by Member States are documented including changes in methodology, data or other reasons provided as justification for recalculation (refer to three largest recalculations in absolute terms and recalculations of more than one million tonnes).</p> <p>13. Compare trend in activity data to relevant international statistics, where available, or to other sources of national statistics, where available.</p> <p>14. Check correct calculations of summing of Member States inventory data for all source categories and gases and document findings.</p> <p>15. Check the inventory report (layout, consistency, tables and figures, references, general format).</p>
	Data file integrity	<p>1. Confirm that the appropriate data processing steps and data relationships are correctly represented in the database.</p> <p>2. Ensure that data fields are properly labelled and have the correct design specifications.</p> <p>3. Ensure that adequate documentation of database, model structure and operation are archived.</p> <p>4. Create pull down menus that limit permissible entries or, where possible, automatically enter data.</p> <p>5. Use cell protection so that fixed data cannot accidentally be changed.</p> <p>6. Check whether the same electronic data file (whether obtained electronically or transcribed) is used for different source categories that use identical data.</p> <p>7. Build in computerised checks to highlight possible problems.</p>
Documentation and archiving	Procedures documentation and archiving	<p>When the annual inventory is finalised, the annual documentation file becomes part of the archives. At that time, it should be complete, and should contain:</p> <ol style="list-style-type: none"> 1. an electronic and paper copy of the list of the full content of the documentation file for that year; 2. paper and electronic copies of each of the draft and final EC inventory report, paper and electronic copies of the draft and final CRF tables; 3. electronic copies of all the final, linked source category spreadsheets for the inventory estimates (including all spreadsheets that feed the emission spreadsheets), as well as any important printouts; 4. for the inventory overall and for individual source categories, the documentation should contain adequate explanation of the linkages among the spreadsheets and the inventory document; 5. all information and data received in the project file from each Member State; 6. all additional materials received and included in the project file; 7. copies of all checklists, reports, and forms that were completed as part of QA/QC procedures. <p>Adequate backup routines should be in place for all electronic data.</p>
	Checks documentation and archiving	<ol style="list-style-type: none"> 1. Check whether all inventory data, supporting data, and inventory records are archived and stored appropriately in the database. 2. Specify, for the EC inventory, the exact data source of summary data in each MS submission (e.g. are data taken from Table 1.A or Table 10?). 3. Check whether known data gaps that result in incomplete source category emission estimates are documented. 4. Check whether all recalculations resulting from MS recalculations are documented appropriately in CRF and NIR. 5. Check whether internal documentation is consistent and complete, e.g. check that spreadsheets and references are consistently documented and procedures are consistently applied. 6. Check whether bibliographical data references are properly cited and catalogued in the internal documentation.

Quality control activity	Check report/area	Checks
Sector-specific QA/QC	Energy	<ol style="list-style-type: none"> 1. Check that all formulas are correct. 2. Compare trend of latest Eurostat reference approach with previous Eurostat reference approach, identify reasons for differences and document findings. 3. Compare trend of Eurostat reference approach with latest MS reference approach, identify reasons for differences and document findings. 4. Compare trend of Eurostat reference approach with latest EC GHG inventory sectoral approach, identify reasons for differences and document findings. 5. Check that any further findings and procedures applied are documented.
	Agriculture	<ol style="list-style-type: none"> 1. General check of background agriculture tables (4.A, 4.B(a), 4.B(b), 4.C, 4.D) for completeness and correctness. 2. Comparison of consistency between activity data across background Tables 4.A, 4.B(a), and 4.B(b). 3. Check on the calculation of emissions for Categories 4.A, 4.B and 4.D. 4. Comparison of calculated emissions in Sector 4 with the numbers submitted in 2003. 5. Checks on the consistency of total amount of nitrogen produced by livestock, distributed over the animal waste management systems, and used for documented purposes. 6. Check on the calculation of nitrogen used for estimating indirect emissions from atmospheric deposition.
	LUCF	<ol style="list-style-type: none"> 1. General checks of CRF Tables 5 and 5.A to 5.E for completeness and correctness. 2. Comparison of Table 5 or 5.A against those submitted in 2003 to check for inconsistency. 3. Analysis of reported forest type, methods used, completeness and quality assigned to the inventory by Member States. 4. Calculation of Member States' contributions to EC net emissions in LUCF Category 5.A and ratio of emissions/removals for each Member State. 5. Comparing data as reported in the NIR and the CRF tables. 6. Comparing data in the 'old' and the 'new' CRF tables, including checks for consistency and recalculation. 7. Provision of additional information on other QA/QC activities related to Sector 5.A.

(¹) The consistency and completeness reports were sent to the Member States on 28 February and are available from the EEA on request.

Eionet and the circulation on 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 to this report.

The consistency checks of Member States data primarily aim at identifying main problems in time series or subcategory sums. For the time series check, 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 and completeness report and are made available to the Member States, in order to obtain, if needed, revised emission estimates or additional information.

The initial checks listed in Table 1.5 are performed for EU-15 Member State

submissions. For the new Member States, limited initial checks are performed; they basically include the completion of the status reports and the performance of checks 1f) and 2 for the consistency and completeness report.

After the initial checks of the emission data, the ETC/ACC transfers the national data from the CRF tables into spreadsheets and into the ETC/ACC database on emissions of GHG and air pollutants. The versions of the data received by ETC/ACC are numbered, in order to be traced back to their source. The ETC/ACC database is a relational database (MS Access) and is maintained and managed by Umweltbundesamt Austria. A number of further checks are carried out during the compilation of the EC inventory and before submitting the final EC GHG inventory and inventory report (see Table 1.4).

Sector-specific QA/QC activities to improve the quality of the EC inventory are performed by Eurostat together with ETC/ACC in the energy sector (see also Sections 3.4 and 3.7)

Table 1.5 Overview of quality assurance and quality-control procedures in place at Member State level (NIR descriptions)

Austria	<p>A quality management system (QMS) has been designed to contribute to the objectives of good practice guidance, namely to improve transparency, consistency, comparability, completeness and confidence in national inventories of emissions estimates. After having been fully implemented during the development of the UNFCCC submission 2004, the accreditation of the Department for Air Emissions as inspection body is scheduled to take place in autumn 2005.</p> <p>The QMS was drawn up to meet requirements of the International Standard ISO/IEC 17020:1998 General Criteria for the operation of various types of bodies performing inspections. The International Standard ISO 17020 has replaced the European Standard EN 45004.</p> <p>During the year 2004 QA/QC activities were focused on transparent documentation, adaptation of SOPs (standard operation procedures) to be more practical and user-friendly. SOPs comply with both IPCC-GPG and ISO 17020 requirements. QC procedures follow the recommendations of IPCC-GPG Chapter 8 on quality assurance and quality control. Priority is given to key sources. For all sources, fundamental checks such as completeness of estimates, time series consistencies, data transcription and documentation are checked. For key sources, activity data, emission factors, emissions and uncertainty analysis are assessed using the Tier 1 checklist. In addition, where applicable, Tier 2 QC procedures are employed. Special attention is given to documentation, archiving and reporting as outlined in Section 8.10 of IPCC-GPG.</p> <p>One of the core activities was the re-design of the key management process 'Corrective and preventive actions'. An efficient process was established to gain transparency when collecting and analysing findings by UNFCCC review experts or any other discrepancies found during inventory compilation.</p>	NIR 2005, p. 30
Belgium	<p>The working group on 'emissions' of the Coordination Committee for International Environmental Policy (CCIEP) has conducted internal quality insurance and quality-control work by continuously exchanging information about methodologies used and estimated results. Feedback is given and extra controls are made by the responsible person for compiling the Belgian GHG emission inventory. Following the IPCC GPG, QC procedures (Tier 1) will be implemented to check the inventory on selected sets of data and processes. In a first approach, the key sources categories will be checked over their input data, their parameters and their calculations. With this in mind, several meetings have been conducted since January 2003 with the three regions to identify for each sector on which level the good practice guidance (e.g. uncertainty analysis, QA/QC, etc.) has to be implemented and to devise a work programme until the next submission. Independent audits of the greenhouse gas inventories of the regions and the national inventory have started in the course of 2002. The purpose of these audits is to analyse the difficulties encountered while compiling the regional and national emission inventories in order to improve the quality and completeness of the Belgian national emission inventory.</p> <p>In the beginning of 2004, a study was started in Flanders to calculate uncertainties (Tier 1 and Tier 2 levels) and to guide in the implementation of a quality system (QA/QC plan) of the emission inventory of greenhouse gases. The quality system set up in Flanders is completely based on ISO 9001:2000. A complete development of the system (among others, a further description in detail of all the procedures involved) as well as a first internal review will become operational in the course of 2005, full implementation for all sectors and on the most detailed level is expected in the course of 2006. The results of this Flemish study will be taken into account to set up a comparable system in the two other regions in Belgium.</p>	NIR 2005, p. 12
Cyprus	-	-
Czech Republic	<p>The Czech Republic has not implemented a general QA/QC or verification plan. Nevertheless, several checks have been formalised. In general terms, these include: a stepwise procedure in the preparation of the final national inventory, including recalculation to ensure time series consistency, checking of data and relevant information collected by cooperating institutions, QC of emission estimates through comparison with corresponding figures calculated earlier and consistency checks for subsequent years.</p>	NIR 2004, p. 17
Denmark	<p>In the preparation of Denmark's annual emission inventory several quality control (QC) procedures have been carried out already and the QA/QC plan will improve this activity in the future. The Danish Tier 1 QC includes:</p> <ul style="list-style-type: none"> • a check of time series of the CRF and SNAP source categories as they are found in the Corinair databases. Considerable trends and changes are checked and explained; • a comparison to inventory of the previous year on the level of the categories of the CRF as well as on SNAP source categories. Any major changes are checked, verified, etc.; • total emissions when aggregated to CRF source categories are compared to totals based on SNAP source categories (control of data transfer); • a manual log table has been introduced into the emission databases to collect information about recalculations. <p>Apart from the UNFCCC's in-depth-reviews, quality assurance (QA) with independent reviews of the inventories has been carried out for energy and transport. In 2005 priority sources listings will be used to secure implementation of the full quality scheme on the most relevant sources. Verification in relation to other countries is undertaken for priority sources during the first part of the year 2005.</p>	NIR 2005, p. 26
Estonia	-	NIR 2004

Finland	<p>A quality management system is currently being developed as an integrated part of the national system and annual inventory process. 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 a national entity, Statistics Finland bears the responsibility and has the resources for the coordination of the quality management measures for the partners of the Finnish national system and for the quality management of the greenhouse gas inventory at national level. A quality manual of the national greenhouse gas inventory system including guidelines, annual plans, templates, descriptions of methodologies and work processes and checklists of QA/QC procedures is in preparation and will be in place by the end of 2005. Only rather general quality objectives were set in the situation of transitional arrangements of the national inventory system until the end of 2004. More specific quality objectives will be set in 2005. Tier 1 QC procedures are performed in several stages during the compilation of the CRF report. QA procedures at the national inventory level are under development and not yet fully implemented. The verification of the emission estimates for the year 2003 is scheduled for the first quarter of 2005.</p>	NIR 2005, p. 21
France	<p>CITEPA, responsible for the compilation of the inventory, is currently implementing a quality management system according to ISO 9001: 2000 with the objective of being certified during 2004. This system will fulfil the requirements defined in the IPCC GPG.</p>	NIR 2004, p. 29
Germany	<p>A QA/QC plan was defined in a research project (FKZ: 202 42 266) and an initial version is now available in NIR 2004 (Section 1.6 and Appendix (Anhang) 6). By the time of completion of NIR 2005, the QA/QC plan could not be finished. It will consist of the following elements:</p> <ul style="list-style-type: none"> • annual review of implementation of QA/QC activities in data collection and reporting (both Tier 1 and Tier 2); • annual planning of milestones in data collection and reporting; • organisational matrix showing the responsibilities in the QA/QC plan and improvement plan. <p>Each QA/QC plan will be valid for one year.</p> <p>Since November 2003, the quality of the source-specific data has been checked by national experts with the help of a checklist also containing the results of the review report of the UNFCCC.</p>	NIR 2005, p. 32
Greece	<p>A QA/QC plan based on the ISO 9001:2000 standard has been developed since the previous inventory submission. The processes cover the QA/QC system management, QC directly related to the estimation of emissions, QA, archiving, uncertainty estimation and inventory improvement. The objectives of the QA/QC plan are the compliance with IPCC/ UNFCCC guidelines, the continuous improvement of GHG emissions/removals estimates and timeliness of submission of necessary information. The implementation of the plan started in April 2004 and the first internal review was carried out in June based on the documentation of the system. QA/QC activities since April 2004 were focused on the improvement of the archiving of information and the development of a long- term improvement plan, as was also suggested by the in-country review (ICR) of the Greek GHG inventory, carried out last September. Both activities are still in progress.</p>	NIR 2005, p. 15
Hungary	<p>The expert groups of the Hungarian inventory agency do not have any quality assurance accreditation. However, certain checks were performed to ensure the preparation of an inventory of appropriate quality (e.g. multiple-checking of certain data, controlling of results by comparing time series).</p>	NIR 2005, p. 15
Ireland	<p>Ireland has not yet developed formal quality assurance and quality-control (QA/QC) systems on the scale recommended by the IPCC good practice guidance. In particular, a system for review of annual inventories that could be regarded as the basis for quality assurance has not been set up. Such a system would require the timely and coordinated participation of several competent institutions on a routine basis following inventory preparation. A worthwhile review would shorten the already limited time available for annual inventory compilation and reporting and it would demand significant operational and management resources. The establishment of review procedures in accordance with the UNFCCC guidelines is well recognised as a key element in the improvement of inventories overall but formal arrangements in this regard are likely to be deferred for a few more years. The inventory preparation process employed in Ireland does incorporate a number of activities that may be regarded as fundamental elements of quality control.</p>	NIR 2005, p. 8
Italy	<p>A proper QA/QC plan has not been applied even though verification and controls are made by means of different procedures. The national atmospheric emissions inventory and the Italian greenhouse gas inventory are compiled and maintained by the National Environmental Protection Agency which is the inventory agency responsible for data submission. All the information used for the inventory compilation is traceable back to its source. The inventory is composed by spreadsheets to calculate emission estimates; activity data and emission factors as well as methodologies are referenced to their data sources, while all information and documentation are held at the agency so as to be consulted whenever needed.</p> <p>Data entries are checked several times during the compilation of the inventory; special attention is paid to sources which show significant changes from one year to another or new sources. Final checks involve a consistency check on the whole time series. When revisions of the estimation methodologies are applied, emissions for all previous years are recalculated as a matter of course.</p> <p>A specific procedure undertaken for the inventory improvement regards the establishment of national expert panels (specifically, in road transport, forests and energy production sectors) involving, on a voluntary basis, different institutions, local agencies and industrial associations which cooperate for activity data and emission factors accuracy. Development of other expert panels in the agriculture and waste sectors are planned to start in 2004.</p> <p>Quality-control activities, except for usual control activities related to the compilation of the inventory, derive also from drawbacks due to the communication of data to different institutions and/or at local level. The preparation of environmental reports where data are needed at different aggregation levels or refer to different contexts such as environmental and economic accountings (e.g. the Eurostat NAMEA project) is another tool of control. International reviews and pilot project activities also contribute to improve the inventory and individuate errors.</p>	NIR 2003, p. 8

Latvia	Uncertainties and quality assurance and quality control (QA/QC) according to the IPCC GPG were not evaluated because of lack of financial and human resources. It is the nearest future job. Compilers of inventory assessed inventory quality on their own view and it was showed in the CRF Table 7 for all years. Generally for quality assurance and control it was taken into account how many activity data were available, how many were covered in emission calculation regarding methodology as well as how many assumptions and experts view were used.	NIR 2005, p.15
Lithuania	Lithuania has not yet developed a QA/QC system.	NIR 2005, p. 26
Luxembourg	-	-
Malta	-	-
Netherlands	In 2001, a programme was started to adapt the monitoring of greenhouse gases in the Netherlands and to transform it into a national system, as described under Article 5 of the Kyoto Protocol. The first phase of the QA/QC improvement project (finished in 2002) included an assessment of the present situation as compared to the UNFCCC/IPCC requirements. The second phase, to be finalised in 2005, involves the description of relevant processes and procedures, including adaptation where needed, of the QA/QC procedures. As part of this process a QA/QC programme that complies with the national system requirements is being developed and implemented. This is to be finalised in 2005. (For the NIR 2005 a brief QA/QC plan has been used, based on the draft QA/QC programme). The third phase, implemented in parallel, comprises the formal and legal arrangements, needed for the structural embedding of the protocols. This is done by the Ministry and is to be finalised in 2005. The full QA/QC system will be in operation by the end of 2005 as part of the national system. For the CRF/NIR 2005 a brief QA/QC plan has been used, based on a draft for the more detailed QA/QC programme.	NIR 2005, p. 1-19
Poland	Poland has not yet implemented a formal QA/QC procedure, including verification plan, for the national emission inventory. However, several checks are routinely carried out to eliminate possible errors. The calculated emissions figures for a given year are compared to the respective figures from previous years (time series), and outliers are scrutinized in more detail or, in other words, an extended QA/QC is carried out for doubtful figures. The first draft of the inventory in form of IPCC tables and draft CRF, is usually produced 12-14 months after the end of the given year depending primarily on the availability of required activity data. During the following several weeks, extensive checks are done in the form of consultations with data providers. The consultations cover both correctness of data and their proper interpretation. Wherever possible, various different datasets are used for comparison purposes. Here the most important institutional sources include: Central Statistical Office, Agency for Energy Market, and a number of collaborating individual experts and institutions. After the checking period is completed, the final CRF is prepared together with the accompanying report.	NIR 2004, p. 12
Portugal	No formal quality assurance and quality-control (QA/QC) procedures have been established so far for the national inventory that are in accordance with the IPCC GPG. In particular, a system of review procedures by personnel not directly involved in the inventory preparation that could be regarded as quality assurance has not been set up. However the inventory compilation process already includes a number of technical activities that can be considered as fundamental elements of quality control. Activities such as: accuracy checks on data acquired and estimated, the use of well documented emission estimation methodologies and emission factors, and adequate information archiving and reporting with a proper back-up scheme, can be regarded as quality-control procedures. These procedures assure calculation and reporting error detection and retrace former estimates enabling a degree of confidence in the final results. During the recent development of the Portuguese national plan on greenhouse gas emissions (PNAC) and the plan for emission ceiling (PTEN) extensive interaction has occurred with the team responsible for those plans, with institutional organisms (Ministry of Agriculture, DGF, INR, DGE) and also economic sectors' representatives (electricity sector, cement, paper pulp, chemical industry, glass industry and ceramics), where these have been given an opportunity to be briefly informed of basic methodologies, activity data and emission factors, and some of their comments were used to improve the quality of the inventory.	NIR 2003, p. 7
Slovakia	The emission estimates elaborated for individual sectors by external consultants are controlled and recalculated at the Department of Air Quality of the Slovak Hydrometeorological Institute. Activity data for major sources are compared with national statistics and with the previous year's submitted data. Energy balance from energy statistics is compared with summary fuel consumption reported by sources. Fuel consumption in the transport sector based on fuels sold is compared with the model results. External reviewers (from the Czech Republic) are regularly invited to comment on the inventory results. Control procedures are continuously developed and built in to the national emission system. Structural changes of the current national inventory system, in accordance with the new air protection act (transposition of EU air pollution legislation), is an ongoing process. Harmonisation of all pollutant inventories and ISO9001 are introduced. In accordance with these requirements the inventory results for the year N are completed by 31 December (N+1) and the inventory results of the basic pollutants for the year N are completed by 15 January (N+2) draft and 15 April (N+2) final version..	NIR 2005, p. 12
Slovenia	Slovenia prepared a QA/QC plan in February 2005.	Direct communication
Spain	No information was provided on QA/QC procedures	NIR 2005
Sweden	The Swedish Environmental Protection Agency is responsible for the QA/QC plan for the inventory. The current system complies with the Tier 1 procedures outlined in the IPCC good practice guidance. The system is being developed as an integral part of the national system according to Article 5.1 of the Kyoto Protocol and will be fully implemented during 2005. Parts of the quality system are already implemented and were used during the compilation of this submission. 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 listing all quality-control steps that must be undertaken during inventory work (Tier 1 and where appropriate Tier 2). The QA/QC plan also consists of a corrective action list, a recalculation list and documented procedures for handling and responding to UNFCCCs review of the Swedish inventory.	NIR 2005, p. 14

United Kingdom	<p>The national atmospheric emissions inventory and the UK greenhouse gas inventory are compiled and maintained by the National Environmental Technology Centre of AEA Technology plc. Whilst significant parts of the inventory (i.e. agriculture, land-use change and forestry) are compiled by other agencies and contractors, Netcen is responsible for coordinating QA/QC activities.</p> <p>The system has developed over the years. A new online database system was adopted for the 1997 inventory in 1998, and since then, developments have proceeded to build QA/QC procedures into the online system. The database consists essentially of a table of activity data and a table of emission factors for the NAEI base source categories. These are then multiplied together to produce emissions according to the IPCC and Corinair formats to be generated.</p> <p>The inventory has been subject to ISO 9000 since 1994 (it is now subject to BS EN ISO 9001:2000) and 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 six 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 coordinator. The National Environmental Technology Centre is currently accredited to BS EN ISO 9001:2000, and was last audited in May 2003 by Lloyds.</p> <p>UK DEFRA is in the process of implementing an EU Decision No 280/2004/EC on a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol which will require them and their contractors to establish a series of more formal memoranda of understanding for all the major data providers and will include specific criteria for QA/QC.</p> <p>The system incorporates the following activities, which are carried out each year as the inventory is compiled: documentation, database, checking, recalculation, uncertainties (Tier 1 and Tier 2) and archiving.</p>	NIR 2004, p. 12
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and by the JRC in the agriculture and LUCF sectors (see also Sections 6.4 and 7.3).

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, 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, 2004b); the report identifies sectoral indicators, for socioeconomic driving forces of greenhouse gas emissions, by using data from Eurostat or from Member States' detailed inventories. In addition, it compares and analyses Member States' emission trends in the EC key sources and provides main explanations, either socioeconomic developments or policies and measures, for these trends in some Member States.

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

As the EC GHG inventory is based on the annual inventories of the EC Member States, the quality of the EC inventory depends on the quality of the Member States' inventories and their QA/QC procedures. The following Table 1.5 gives an overview of QA/QC procedures in place at Member State level. The information is taken from the Member State national inventory reports 2004 and 2005.

The following Table 1.6 gives an overview of QA/QC procedures in place at Member State level on the basis of information collected for the 'Workshop on quality control and quality assurance of greenhouse gas inventories and the establishment of national inventory systems' which was held in September 2004 in Copenhagen. It shows that a number of QA/QC procedures are already in place in the EC Member States. Generally, the implementation of QA/QC procedures is more advanced in the EU-15 than in the new Member States.

1.6.3 Further improvement of the QA/QC procedures

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 quality-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.

Table 1.6 Overview of quality-assurance and quality-control procedures in place at Member State level

Activity	Austria	Belgium	Czech Republic	Denmark	Finland
QA/QC coordinator designated	Yes	No	No	Yes	Yes
Quality objectives established	Integrated in QMS (improvement plan), not as an extra document	Partial	No		Yes
QA/QC plan in place	Yes	Partial	No	No	In preparation
QC procedures in place	Yes	Informal	Preparing	Partial	Partial
Tier 1	Yes		Preparing	Partial	Partial
All key sources checked?	Yes	No	No	Partial	No (under development)
Checklists used?	Yes	No	No	Yes	Partial
Electronic/automated checks used?	Yes	No (manual)	No	Yes	Partial
Tier 2	Partial	No	No	Partial	Partial
Emission data	Yes (where possible)	No	No	Partial	Partial
Sectors/gas	Mainly energy, recalculations	No	No	Energy/CO ₂	Energy/CO ₂ Industrial processes/F-gases
QC checks of country-specific emission factors?	Yes (where possible)	No	No	Partial/Energy	Yes (under development)
Activity data	Yes (where possible)	No	Partial by Czech Statistical Office		Partial
Sectors	Mainly transport, F-gases, solvents	No	No		Energy, Industrial processes (under development), F-gases
Uncertainty estimates	For all KS, for some non-KS	Yes	No		Yes
QC in outside agencies?	Partial	Partial	No		Yes (under development)
QA procedures in place	Partial	No	No	Partial	Partial (under development)
Expert peer reviews	No	No	No (apart from UNFCCC review)	Stationary combustion	Partial (F-gases: Yes)
Audits	Yes (2 nd party)	Yes	No	No	Yes (voluntary in-country review, voluntary adjustment)
Verification of emissions	Partial	No	Partial	No	No
Sectors/gas	Transport, F-gases, solvents (verification of activity data)		F-gases, data from Custom Office and F-gas users		No
Comparisons with other inventories	No		Partial, CO ₂ emissions database REZZO1 and data for NAP		Partial
QA/QC manual in place	Yes	No	No	No	In preparation
Quality management system in place	EN45004 (accreditation application has been made)	No	CHMI adaptation of ISO 9000		QMS in preparation (ISO 9001-certification under consideration)

Activity	France	Germany	Greece	Italy	Netherlands
QA/QC coordinator designated	Yes	September 2004	Yes	Yes (official arrangements in preparation)	'Yes' (official arrangements still under preparation)
Quality objectives established	Integrated in QMS and elaborated by a national committee led by French ministry in charge of environment	Yes	Yes	Yes	Partially, further elaboration for next NIR
QA/QC plan in place	Yes	September 2004	Partial	In preparation	Yes, further detailing and upgrading for next NIR Improvement programme in progress.
QC procedures in place	Yes		Yes	Yes	Yes. Upgrading to be finalised in 2005
Tier 1	Yes	2005	Yes	Yes	
All key sources checked?	Yes	2005	Yes	Yes	Yes (new protocols)
Checklists used?	Yes	2005	Yes	Yes	Yes
Electronic/automated checks used?	Yes	2005	No (manually)	Yes	Yes (consistency, completeness)
Tier 2	Partial	Partial (review findings)	No	Partial	Partial
Emission data	Yes (where possible)	Partial (review findings)	No	Yes	Partial
Sectors/gas	Mainly energy and manufacturing industry sectors	Partial (review findings)	No	All, mainly cases where methodological and data changes result in recalculation	Energy/CO ₂ and CH ₄ Agriculture/CH ₄ and N ₂ O Industrial Processes/ N ₂ O and F-gas Waste/CH ₄
QC checks of country-specific emission factors?	Yes (where possible)	Partial (review findings)	Partial	Yes	Yes
Activity data	Yes (where possible)	Partial (review findings)	No	Yes	Partial
Sectors	Mainly energy and manufacturing industry sectors	Partial (review findings)	No	Energy, industry, solvent use, agriculture, waste, LUCF	Energy, industry, agriculture, waste
Uncertainty estimates	Yes	Partial	Yes (Tier 1 methodology)	No	Partial
QC in outside agencies?	Partial	Planned	No	Partial	Upgrade ongoing
QA procedures in place	Partial	No	Yes	No	
Expert peer reviews	By a national committee led by French ministry in charge of environment and by sectors experts	Yes	No (apart from UNFCCC review)	No	Yes
Audits	No	Yes	No	No	Under consideration
Verification of emissions	Partial	Partial	No	Yes	Planned, if data available
Sectors/gas	Mainly energy and transports (verification of activity data/CO ₂)	CO ₂	No	Yes	Agriculture/CH ₄ Energy/CO ₂
Comparisons with other inventories	No	Partial	No	Yes	Planned
QA/QC manual in place	Yes	September 2004	Yes	No	Update in preparation
Quality management system in place	ISO 9001 (AFAQ No 22708)	Country specific, September 2004	ISO 9001:2000	No	Changes/update in preparation as result of organisational changes in PER

Activity	Poland	Portugal	Slovak Republic	Slovenia	Spain	Sweden	UK
QA/QC coordinator designated	No	No	No	No	No	No	Yes
Quality objectives established	No	According to IPCC guidelines	No	Yes	Being discussed, not formally adopted	Yes	Yes
QA/QC plan in place	No	In implementation	No	Yes	In preparation	No	Yes
QC procedures in place	Partial	Partial	Partial	Partial	Partial		Yes
Tier 1	Yes	Partial	Partial	Yes	Partial	Yes	Yes
All key sources checked?	No	Partial	No	Yes	Yes	Yes	Yes
Checklists used?	No	No (in implementation)	No	No	Existing checklists to be extended	Yes	Yes
Electronic/automated checks used?	Calculation checks, analysing data trend (flagging suspected data)	No (in implementation)	No	No	Most automated, some manual	Yes	Yes
Tier 2	No	Partial	No	Partial	Limited implementation	Partial	Partial
Emission data	No	Partial	No	Partial	Order of magnitude checks, time series outliers checks	Partial	
Sectors/gas	No	Industry/CO ₂	No	Energy/CO ₂		Partial	
QC checks of country-specific emission factors?	Based on national studies	Partial	Yes	Yes		Partial	
Activity data	No	Partial	Partial, Statistical Office	Partial	Limited implementation	Partial	
Sectors	No	Agriculture	Energy	Energy/ industrial processes		Partial	
Uncertainty estimates	At progress for 2002 GHG inventory	Qualitative	Yes	No	No	Yes	Yes
QC in outside agencies?	Partial	No	Partial	No	Being checked	Yes	Currently verifying
QA procedures in place	No	Yes	No	No	Limited implementation	Partial	Yes
Expert peer reviews	No	Yes	No	No		Partial	Yes
Audits	No	No	No	No		No	Yes
Verification of emissions	Partial		Partial	No	No	No	partial
Sectors/gas	-		F-gases, energy	-			CH ₄ , N ₂ O, HFCs
Comparisons with other inventories	Compared to inventories of countries with similar characteristics of fuels use, economy or population		Yes	-			No
QA/QC manual in place	No	In implementation	No	Yes	No	Almost	Yes
Quality management system in place	No	In implementation in the Institute for Environment	No	ISO 9001	No	ISO 14001	ISO 9001

The workshop's most important recommendations for the further implementation of the QA/QC procedures and the national systems are as follows:

General recommendations:

- Member States are encouraged to use consistent definitions for terms used in

relation to national systems and QA/QC. The definitions are based on those used in the IPCC GPG and the UNFCCC guidelines for national systems (Decision 20/CP.7).

- In developing a national QA/QC system, Member States could use the EC QA/QC programme and the QA/QC procedures listed in the summary table in Annex 1 to this workshop report as a starting point.
- Member States are encouraged to make available any information related to their national system in addition to the NIR for other Member States via the Circa website of the Climate Change Committee.
- Member States should supply the Commission with a list of websites concerning their NIR and related background information to be distributed in WG I as soon as this information is available.
- WG I should continue to discuss data quality objectives for national inventories.
- Member States should take into account recommendations made by UNFCCC reviews of the inventory.

Recommendations concerning the national system:

- In developing their national systems, Member States should ensure that the single national entity is provided with resources and a legal basis to fulfil all the requirements outlined by the UNFCCC, the Kyoto Protocol and Decision No 280/2004/EC (Monitoring decision). Member States should implement national systems as soon as possible.
- WG I should periodically evaluate the implementation and functioning of national inventory systems. Another workshop on this issue could be held after having gained first experiences.
- Member States and the EC should use national systems to promote synergies between activities under the UNFCCC and other international conventions (e.g. CLRTAP) with respect to consistent reporting of air emission and GHG inventories.

- Member States should consider the implementation of written agreements with outside agencies concerning data availability and QA/QC procedures.
- Member States and the EC could consider implementing a quality management system as outlined in international standards.

Recommendations concerning quality assurance

- Member States and the EC are encouraged to compare emission estimates with other independently compiled estimates and analyse and explain significant discrepancies.
- Member States are encouraged to conduct cross country/peer/public reviews.

Recommendations concerning quality control

- Member States and the EC shall provide detailed information on their QA/QC system in their national inventory report as part of the documentation requirements. Parties should supply a summary of implemented QA/QC procedures and key findings.
- Member States should supply national emission factors including uncertainty estimates, net calorific values (NCV) and detailed information upon applicability to the IPCC emission factor database.

For more 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

In May 2004, a 'Workshop on emissions of greenhouse gases from aviation and navigation' was held in Copenhagen. The aim of this workshop was to improve the inventories of GHG emissions from aviation and navigation with special attention to the disaggregation between domestic and international bunker fuels. The workshop brought together national experts from statistical institutes or other organisations that are responsible for energy balances and/or aviation and navigation transport statistics, the national experts responsible for annual GHG inventories and the experts from international organisations that are performing relevant projects (for more details see Section 3.7).

Table 1.7 Availability of Table 6.1 of the Tier 1 uncertainty analysis as of 15 April 2005

Member State	Year	Coverage	Member State	Year	Coverage
Austria	2003	96 %	Ireland	2003	100 %
Belgium	2001	99 %	Italy	2002	100 %
Denmark	2002	92 %	Netherlands	2002	100 %
Finland	2002	97 %	Spain	2002	100 %
France	2002	100 %	Sweden	2003	100 %
Germany	2003	100 %	United Kingdom	2002	100 %
Greece	2002	100 %			

Table 1.8 Tier 1 uncertainty estimates of EU-15 GHG emissions

Source category	Gas	Emissions 2003 ¹⁾	Emissions for which MS uncertainty estimates are available ²⁾	Share of emissions for which MS uncertainty estimates are available	Uncertainty estimates based on MS uncertainty estimates
Fuel combustion stationary	all	2 463 964	2 403 737	98 %	1 %
Transport	all	872 311	800 635	92 %	3 %
Fugitive emissions	all	57 046	61 519	108 %	11 %
Industrial processes	all	265 030	230 150	87 %	6 %
Agriculture	all	414 427	403 063	97 %	41 % – 74 %
Waste	all	96 728	87 634	91 %	17 %
Total	all	4 179 613	3 986 738	95 %	4 % – 8 %

A further workshop is being planned for Spring 2005 on inventories and projections of greenhouse gas emissions from waste. The main objectives of the workshop are: (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 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 will provide an opportunity to discuss potential methodological changes and improvements of the draft 2006 IPCC inventory guidelines. The workshop is targeted at experts who have direct experience in compiling and analysing GHG emission projections and inventories from the waste sector.

Apart from the activities mentioned in this chapter further sector specific QA/QC procedures are mentioned in Chapters 3 to 9.

1.7 Uncertainty evaluation

By 15 April, Tier 1 uncertainty analyses were available from 13 EU-15 Member

States. These Member States covered about 95 % of total EU-15 GHG emissions in 2003. Table 1.7 shows the availability of Table 6.1 of the Tier 1 uncertainty analysis. For four Member States, Tier 1 uncertainty analyses were available for 2003, for eight Member States the latest year available was 2002, for Belgium it was 2001. Most Member States cover all source categories in their uncertainty estimates.

The EU-15 Tier 1 uncertainty analysis was made on the 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. Table 1.8 shows the main results of the uncertainty analysis for the EU-15. The lowest uncertainty estimates are for stationary fuel combustion (1 %) and transport (3 %), the highest estimates are for agriculture (41–74 %). For agriculture a range of uncertainties is provided depending on the assumption on N₂O emissions from soils. The lower bound assumes that all MS uncertainty estimates of N₂O from agricultural soils are uncorrelated, the upper bound assumes that all uncertainty estimates are correlated. Overall uncertainty estimates of all EU-15 GHG

emissions is calculated to be between 4 and 8 %. More detailed uncertainty estimates for the source categories are provided in Chapters 3–8.

Table 1.9 gives an overview of information provided by Member States on uncertainty estimates in their national inventory reports 2004 or 2005 and presents summarised results of these estimates. The table includes information from 14 Member States. From the remaining 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 1.9 Overview of uncertainty estimates available from Member States (from Member States' national inventory reports 2003, 2004 and 2005)

Member State	Austria		Belgium		Czech Republic		Croatia	
Citation	Austrian NIR 2005, p. 25-39		Belgian NIR 2005, p. 13-19		Czech NIR 2004, p. 16-17		Croatian NIR 2005, p. 4-5	
Method used	Tier 1, Tier 2		Tier 1		Tier 1		Tier 1	
Documentation available in NIR (according to Table 6.1 of GPG)	Partially (Table 7)		Yes (provided as a separate table)		Yes: Table 1.3		Yes: Annex 3 (Table A3-1)	
Years and sectors included	Tier 1: base year and 1995 - Key sources Tier 2: 1990, 1997 (from year 1999) - All sectors		2001-All sectors except LULUCF; for Flanders, a complete uncertainty study was conducted both on Tier 1 and Tier 2 level		1990, 2001 - All sources (key sources and "others")		1990, 2001 - All Sectors (except LULUCF)	
Uncertainty (%)	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2
CO ₂	Base year: 2,5 % 1995: 2,0%	1990: 2,3 % 1997: 2,1	3.6 %	-				
CH ₄	Base year: 19,1 % 1995: 20,3 %	1990: 48,3 % 1997: 47,4 %	24.0 %	-				
N ₂ O	Base year: 104,3 % 1995: 101,2 %	1990: 89,6% 1997: 85,9%	91.0 %	-				
F-gases	-	-	-	-				
Total	Base year: 4,1 % 1995: 5,5 %	1990: 9,8 % 1997: 8,9 %	8.1 %	-	7.0 %		36.1 %	
Uncertainty in trend (%)	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2
CO ₂	-	-	-	-				
CH ₄	-	-	-	-				
N ₂ O	-	-	-	-				
F-gases	-	-	-	-				
Total	-	-	3.8 %	-	2.9 %		6.7 %	

Member State	Denmark		Finland		France		Germany	
Citation	Danish NIR 2005 p. 34-36		Finnish NIR 2005 p. 24-27, Annex 1 (Tables A-D)		French NIR 2003 p. 30-31		German NIR 2005, p. 1-33-36, Annex 7	
Method used	Tier 1		Tier 1, Tier 2		Tier 1		Tier 1	
Documentation available in NIR (according to Table 6.1 of GPG)	Partially: Table 1.4		Yes: Annex 1 (Table A-D)		Yes: Annex 2 (no reference source information)		Yes: Annex (Anhang) 7 (not according to Table 6.1 of GPG)	
Years and sectors included	1990, 2003 - The sources included in the uncertainty estimate cover 99.7 % of the total Danish greenhouse gas emission (CO ₂ eq., without CO ₂ from LUCF).		1990, 2003 - All sectors		1990, 2002 (from year 2004) - All sources (key sources and "others")		1990, 2002 - nearly complete estimation for sources 1A, 2A1, 2A2, 2C1, 2C3, 4A(2002 only), 5A(2002 only)	
Uncertainty (%)	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2
CO ₂	2.5 %		+/- 15 % (with LULUCF) +/- 2 % (without LULUCF)		-	-	-	-
CH ₄	20 %		+/- 20 %		-	-	-	-
N ₂ O	57 %		-40 to +100 %		-	-	-	-
F-gases	129 %		-10 to +20 %		-	-	-	-
Total	6.8 %		+/- 16 % (with LULUCF)	- 14 to + 15 % (with LULUCF)	22.1	-	-	-
				- 4 to + 8 % (without LULUCF)				
Uncertainty in trend (%)	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2
CO ₂	1.9 %		-	-	-	-	-	-
CH ₄	9.3 %		-	-	-	-	-	-
N ₂ O	14 %		-	-	-	-	-	-
F-gases	54 %		-	-	-	-	-	-
Total	2.1 %		+/- 19 % (with LULUCF)	- 18 to + 23 % (with LULUCF)	3.5	-	-	-
				- 6 to + 4 % (without LULUCF)				
Member State	Greece		Ireland		Italy		Netherlands	
Citation	Greek NIR 2005, p. 18-20, Annex IV, Table IV.1		Irish NIR 2005, p. 8-9, 14-15 (Tab. 1.4)		Italian NIR 2004, p. 18, Annex 1		Dutch NIR 2005, p. 1-23 to 1-26, Annex 1.2	
Method used	Tier 1		Tier 1		Tier 1		Tier 1	
Documentation available in NIR (according to Table 6.1 of GPG)	Yes: Annex IV.1		Yes: Table 1.4		Yes (Table A1.2)		Partially (Table 1.4)	
Years and sectors included	1990, 2003 - All sources		1990, 2003 - All sources		1990, 2002 - All sources		1990/95, 2003 - All sources	
Uncertainty (%)	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2

Member State	Greece		Ireland		Italy		Netherlands	
CO ₂	3,7 % (witout LULUCF)	-	1.4	-	-	-	+/- 5 %	-
	5 % (with LULUCF)							
CH ₄	34.4 %	-	3.5	-	-	-	+/- 25 %	-
N ₂ O	104.1 %	-	11.6	-	-	-	+/- 50 %	-
F-gases	69.9 %	-	0.2	-	-	-	HFC +/- 50 % PFCs +/- 50 % SF6 +/- 50 %	-
Total	10,8 % (without LUCF)	-	12.2	-	2.5%	-	6%	-
	11,5 % (with LULUCF)							
Uncertainty in trend (%)	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2
CO ₂	-	-	2.2	-	-	-	5 %	-
CH ₄	-	-	2.5	-	-	-	6 %	-
N ₂ O	-	-	7.0	-	-	-	15 %	-
F-gases	-	-	0.2	-	-	-	7 %	-
Total	8 %	-	7.7	-	2.4 %	-	4 %	-

Member State	Slovakia		Spain		Sweden		United Kingdom	
Citation	Slovakian NIR 2005, p. 12-13; Coverletter 2005 (Data of greenhouse gas emissions): Table on Tier 1 uncertainty calculation and reporting		Spanish NIR 2005, p.46-55		Swedish NIR 2005, p. 16-20		UK NIR 2004 (draft) Annex 7, Table A7.4	
Method used	Tier 1		Tier 1		Tier 1		Tier 1, Tier 2	
Documentation available in NIR (according to Table 6.1 of GPG)	Yes: Table on Tier 1 uncertainty calculation and reporting		Yes: Table 5.5.2 and 5.5.3		Partially (Annex 2)		Yes: Annex 7 (no composite table on references included)	
Years and sectors included	1990, 2003 - All sources		2001, 2002 (from year 2005) - All sources (key sources and "other emission sources")		2003 (from year 2005) - All sources		1990, 2002 (from year 2004) - All sources	
Uncertainty (%)	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2
CO ₂			-	-	3.5	-	-	2.1
CH ₄			-	-	1.66	-	-	13
N ₂ O			-	-	5.99	-	-	231
F-gases					0.31	-	-	HFC 25 PFCs 19 SF6 13
Total	10.0 %		2001 +/- 17 %	-	6.93	-	17.9	15
			2002 +/- 15.8 %					
Uncertainty in trend (%)	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2
CO ₂			-	-	-	-	-	-
CH ₄			-	-	-	-	-	-
N ₂ O			-	-	-	-	-	-
F-gases			-	-	-	-	-	-
Total	3.2 %		2001 +/- 2.65 %	-	-	-	2	-
			2002 +/- 3.95 %					

1.8 General assessment of the completeness

1.8.1 Completeness of Member States' submissions

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

Table 1.10 summarises timeliness and completeness of the Member States' submissions on 20 May 2005. It shows that

GHG inventories were submitted by 23 Member States. The complete time series was provided by 20 Member States. Some 18 Member States submitted all or almost all tables (i.e. more than 90 %) of the CRF tables for 1990–2003; four Member States at least for 2003. The new LUCF tables are available for 10 Member States. The completeness of national submissions with regard to individual CRF tables in the 2004 submission can be found in the status reports in Annex 3. In addition, EU-15 Member State information on the completeness of their emission estimates at source level can be seen from Tables 1.11

Table 1.10 Date of latest submission or update, years covered and CRF tables available from Member States by 20 May 2005

Member States	Submission dates	Latest data available	Years covered	CRF Tables(1)	New LUCF tables	Old LUCF tables
Austria	14 Jan. 2005	2003	1990–2003	All	1990–2003	
	15 Apr. 2005	2003	1990–2003	All	1990–2003	
	20 Apr. 2005	2003	1990–2003	All	1990–2003	
Belgium	14 Jan. 2005	2003	1990–2003	All	-	
	15 Mar. 2005	2003	1990–2003	All	1990–2003	Yes
Cyprus	29 Mar. 2005	2003	1990–2003	All	-	Yes
Czech Republic	14 Jan. 2005	2003	1990, 1992, 1994–2003	Full CRF only for 2003.	-	Yes
	14 Apr. 2005	2003	1990, 1992, 1994–2003	Full CRF only for 1995 and 2003.	-	Yes
Denmark	14 Jan. 2005	2003	1990–2003	All	1990–2003	
	15 Mar. 2005	2003	1990–2003	All	-	Yes
	15 Apr. 2005	2003	1990–2003	All	1990–2003	Yes
Estonia	4 Jan. 2005	2003	1990–2003	Full CRF only for 2003.	-	Yes
	15 Apr. 2005	2003	1990–2003	All	-	Yes
Finland	14 Jan. 2005	2003	1990–2003	All	2003	
	15 Mar. 2005	2003	1990–2003	All	1990–2003	Yes
	15 Apr. 2005	2003	1990–2003	All	-	Net
France	7 Jan. 2005	2003	1990–2003	All	-	Yes
	14 Apr. 2005	2003	1990–2003	All	-	Yes
Germany	14 Jan. 2005	2003	1990–2003	All	1990–2003	Mapping
Greece	17 Jan. 2005	2003	1990–2003	All	1990–2003	
	1 Mar. 2005	2003	1990–2003	LUCF	-	Net
	31 Mar. 2005	2003	1990–2003	All	-	
Hungary	17 Feb. 2005	2003	1990–2003	Full CRF only for 2003.	-	
	17 Mar. 2005	2003	1990–2003	Full CRF only for 2003.	-	Yes
	21 Apr. 2005	2003	1990–2003	Full CRF only for 2003.	-	Yes
Ireland	17 Jan. 2005	2003	1990–2003	All	-	Yes
	12 Apr. 2005	2003	1990–2003	All	-	Yes
Italy	17 Mar. 2005	2003	1990–2003	LUCF	1990–2003	
	25 Mar. 2005	2003	1990–2003	All	-	Net
	7 Apr. 2005	2003	1990–2003	All	-	Net
	14 Apr. 2005	2003	1990–2003	All	-	Net

Member States	Submission dates	Latest data available	Years covered	CRF Tables(1)	New LUCF tables	Old LUCF tables
	16 May 2005	2003	1990–2003	All	-	Net
Latvia	19 Jan. 2005 (earlier to COM)	2003	1990–2003	All	-	
	15 Mar. 2005	2003	1990–2003	All	-	Yes
	18 Apr. 2005	2003	1990–2003	All	-	Yes
Lithuania	18 Jan 2005	2003	1998, 2001–2003	Full CRF only for 2003.	2003	-
	18 Mar 2005	2003	1998, 2001–2003	Full CRF only for 2003.	-	-
Luxembourg	11 Apr. 2005	2003	2003	Limited	-	Yes
Malta						
Netherlands	14 Jan. 2005	2003	1990–2003	All	1990, 2000, 2003	
	15 Mar. 2005	2003	1990–2003	All	1990–2003	Yes
	14 Apr. 2005	2003	1990–2003	All	1990–2003	
Poland						
Portugal	14 Mar. 2005	2003	1990–2003	All	-	Yes
Slovakia	19 Jan. 2005	2003	1990–2003	Full CRF only for 2003.	-	
	7 Mar. 2005	2003	1990–2003	Full CRF only for 2003.	-	Yes
	15 Apr. 2005	2003	1990–2003	Full CRF only for 2003.	-	Yes
Slovenia	14 Jan. 2005	2003	1990–2003	Full CRF only for 2003.	-	
	15 Mar. 2005	2003	1986, 1990–2003	All	-	Yes
	15 Apr. 2005	2003	1986, 1990–2003	All	-	Yes
Spain	1 Mar. 2005	2003	1990–2003	All	-	Yes
Sweden	14 Jan. 2005	2003	1990–2003	All	-	
	15 Mar. 2005	2003	1990–2003	All	-	Yes
	14 Apr. 2005	2003	1990–2003	All	-	Yes
United Kingdom	21 Jan. 2005	2003	1990–2003	All	-	
	22 Feb. 2005	2003	1990–2003	LUCF	1990–2003	
	11 Mar. 2005	2003	1990–2003	LUCF	1990–2003	
	15 Mar. 2005	2003	1990–2003	All	-	Yes
	15 Apr. 2005	2003	1990–2003	All	1990–2003	Yes

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

and 1.12 below and in the overview tables in Chapters 3 to 8 which are based on the CRF Table 7 of the Member States.

Table 1.11 shows the availability of Member States' national inventory reports or

additional inventory information and a short characterisation of the 2005 report. The column 'Report structure 2005' indicates whether the Member States used the UNFCCC structure of national inventory report (¹¹).

(¹¹) FCCC/CP/2002/8.

Table 1.11 National inventory reports or additional information available from Member States as by 25 May 2005

Member State	2005	References	Report structure 2005 as in the revised UNFCCC reporting guidelines adopted by Decision 18/CP.8.2	Characterisation of the 2005 report
Austria	Umweltbundesamt (2005)	Umweltbundesamt 2005. <i>Austria's national inventory report 2005. Submission under the United Nations Framework Convention on Climate Change</i> , BE-268. Vienna, 2005	Yes	National inventory report, including general information on the inventory, emission trends, sector and source-specific methodological information and data sources, QA/QC activities, key source analysis, uncertainty evaluation, recalculations and inventory improvements.
Belgium	Directorate-General for Environment (2005)	DG Environment 2005. <i>Belgium's greenhouse gas inventory (1990–2003). National inventory report 2005. Submission to the UNFCCC Secretariat and to the Commission of the European Communities</i> . Brussels, March 2005	Yes	National inventory report, including general information on the inventory, emission trends, sector and source-specific methodological information and data sources, QA/QC activities, key source analysis, uncertainty evaluation, recalculations and inventory improvements.
Cyprus				Greek only
Czech Republic	–			(NIR not yet submitted)
Denmark	National Environmental Research Institute (2005)	National Environmental Research Institute 2005. <i>Denmark's national inventory report 2005. Submitted under the United Nations Framework Convention on Climate Change, 1990–2003</i> ,. April 2005	Yes	National inventory report, including general information on the inventory, emission trends, sector and source-specific methodological information and data sources, recalculations, key source analysis, QA/QC activities, uncertainty evaluation and inventory improvements
Estonia	Ministry of Environment	Ministry of Environment 2005. <i>Greenhouse gas emissions in Estonia 1990–2003. National inventory report to the UNFCCC Secretariat</i> . Tallinn, January 2005	Yes	National inventory report, including general information on the inventory, sector and source specific methodological information and data sources, recalculations and key source analysis. No information on Emission trends, QA/QC activities and improvements.
Finland	Statistics Finland (2005)	Statistics Finland 2005. <i>Greenhouse gas emissions in Finland 1990–2003. National inventory report to the European Commission</i> . April 2005.	Yes	National inventory report, including general information on the inventory, emission trends, sector and source-specific methodological information and data sources, QA/QC activities, key source categories, uncertainty evaluation, recalculations and inventory improvements.
France	–			(NIR not yet submitted)
Germany	Umweltbundesamt (2005)	Umweltbundesamt 2005. <i>Deutsches Treibhausgasinventar 1990–2003. Nationaler Inventarbericht 2005. Berichterstattung unter der Klimarahmenkonvention der Vereinten Nationen</i> . Berlin, January 2005	Yes	National inventory report, including general information on the inventory, emission trends, sector and source-specific methodological information and data sources, QA/QC activities, key source analysis, uncertainty analysis, recalculations and inventory improvements.
Greece	Ministry of the Environment, Physical Planning and Public Work (2005)	Ministry of the Environment, Physical Planning and Public Works 2005. <i>Climate change emissions inventory-National inventory for greenhouse and other gases for the years 1990–2003</i> . Athens, February 2005	Yes	National inventory report, including general information on the inventory, emission trends, QA/QC activities, key source analysis, sector and source specific methodological information and data sources, uncertainty evaluation, recalculations and inventory improvements.
Hungary	National Directorate for Environment, Nature and Water (2005)	National Directorate for Environment, Nature and Water 2005. <i>National inventory report for 2003 and recalculated years (1985–2002) Hungary</i> . Budapest, February 2005	yes	National inventory report, including general information on the inventory, emission trends, recalculations, inventory improvements, uncertainty analysis, QA/QC and key source analysis.
Ireland	Environmental Protection Agency (2005)	Environmental Protection Agency 2005. <i>Ireland: National inventory report 2005, Greenhouse gas emissions 1990–2003 reported to the United Nations Framework Convention on Climate Change</i> . Wexford, January 2005	Yes	National inventory report, including general information on the inventory, emission trends, sector and source-specific methodological information and data sources, QA/QC activities, key source analysis, uncertainty evaluation, recalculations and inventory improvements.

Member State	2005	References	Report structure 2005 as in the revised UNFCCC reporting guidelines adopted by Decision 18/CP.8.2	Characterisation of the 2005 report
Italy	–			(NIR not yet submitted)
Luxembourg	–			(NIR not yet submitted)
Latvia	Latvian Environment, Geology and Meteorology Agency (2005)	Latvian Environment, Geology and Meteorology Agency 2005. <i>Latvia's national inventory report for 1990–2002 – Submitted under the United Nations Convention on Climate Change</i> . Jurmala, April 2005.	Yes	National inventory report, including general information on the inventory, emission trends, sector and source specific methodological information and data sources, key source analysis, recalculations and inventory improvements. QA/QC activities and uncertainty evaluation are not included.
Lithuania		<i>National greenhouse gas emission inventory report of the Republic of Lithuania (Reported inventory 2003)</i> . Vilnius, 2005	Yes	National inventory report, including general information on the inventory, emission trends, sector and source specific methodological information and data sources, QA/QC activities, key source analysis, uncertainty evaluation and inventory improvements. Recalculations are not included.
Malta	–			(NIR not yet submitted)
Netherlands	Klein Goldewijk, K., Olivier, J.G.J., Peters, J.A.H.W., Coenen, P.W.H.G. and Vreuls H.H.J. (2005)	RIVM 2005. <i>Greenhouse gas emissions in the Netherlands 1990–2003</i> . National inventory report 2005.	Yes	National inventory report, including general information on the inventory, emission trends, sector and source-specific methodological information and data sources, QA/QC activities, key source analysis, uncertainty evaluation, recalculations and inventory improvements.
Poland	–			(NIR not yet submitted)
Portugal	–			(NIR not yet submitted)
Slovakia	Slovak Hydrometeorological Institute 2005	Slovak Hydrometeorological Institute 2005. <i>Greenhouse gas emission inventory in Slovakia 1990–2003</i> . Bratislava 2005	Yes	National inventory report, including general information on the inventory, emission trends, sector and source-specific methodological information and data sources, QA/QC activities, key source analysis, uncertainty evaluation, recalculations and inventory improvements.
Slovenia	–			(NIR not yet submitted)
Spain	Ministry of the Environment 2005	Ministry of the Environment 2005. <i>Greenhouse gas emissions inventories report from Spain 1990–2003 Communication to the European Commission (Decision 2004/280/EC)</i> . Madrid, February 2005	Yes	National inventory report, including general information on the inventory, sector and source specific methodological information and data sources, key source analysis, uncertainty evaluation and recalculations. Not included are QA/QC activities, emission trends, and inventory improvements.
Sweden	Swedish Environmental Protection Agency (2005)	Swedish Environmental Protection Agency 2005. <i>Sweden's National Inventory Report 2005 – Submitted under the monitoring mechanism of Community greenhouse gas emissions</i> . Stockholm, January 2005	Yes	National inventory report, including general information on the inventory, emission trends, sector and source-specific methodological information and data sources, QA/QC activities, key source analysis, uncertainty evaluation, recalculations and inventory improvements.
United Kingdom	–			(NIR not yet submitted)

The following tables refer to the EU-15 only. Table 1.12 compiles the characterisation of the 2004 NIRs of Member States as well as the findings from the individual review of Member States' inventories conducted by the UNFCCC Secretariat in 2004 and compares those findings with the NIRs submitted in 2005 by Member States. This analysis intends to increase information

on completeness of methodological descriptions, underlying data and key parts of the inventory submission by Member States that form the basis of the EC submission.

Table 1.13 provides an overview regarding incomplete estimation of source categories and completeness of geographical coverage

Table 1.12 Characterisation of Member States' national inventory reports 2004 and changes in 2005

Member State	Characterisation of the report in the 2004 UNFCCC inventory review	Changes to the report in 2005 in response to the review
Austria	<p>UNFCCC status report 2004: The organisation of chapters in the NIR, in general, follows the structure as outlined in the revised UNFCCC reporting guidelines (Decision 18/CP.8). However, some of the information required in the annexes is not provided, e.g. Tables 6.1 and 6.2 of the IPCC good practice guidance.</p> <p>UNFCCC review report 2004: Austria provided an NIR of high quality. The applied methodologies are well documented and a detailed description of the overall system is provided. The NIR conforms with the UNFCCC guidelines and the IPCC good practice guidance. Some small areas for improvement still exist. (FCCC/WEB/IRI/2004/AUT, para. 2)</p>	The NIR is still very detailed. In response to the UNFCCC review the reports in some areas have been further improved.
Belgium	<p>UNFCCC status report 2004: The organisation of the NIR, in general, follows the structure as outlined in the revised UNFCCC reporting guidelines (Decision 18/CP.8). However, the executive summary and some of the recommended sections and annexes (e.g. Tables 6.1 and 6.2 of the IPCC good practice guidance) are not provided.</p> <p>UNFCCC review report 2004: The NIR is highly developed and shows some improvements since the last submissions. For a better transparency of the NIR the applied methods need to be described in more detail and the inventory needs to be completed. The split of information according to the three regions also impacts the transparency of the NIR and harmonisation is needed. Some inconsistency between CRF tables and the NIR exists. (FCCC/WEB/IRI/2004/BEL, para. 2)</p>	Work regarding the completeness and transparency of the inventory is still ongoing. Inconsistencies between the three regions were reduced but work is still ongoing.
Denmark	<p>UNFCCC status report 2004: The organisation of the chapters in the NIR, in general, follows the structure outlined in the revised UNFCCC reporting guidelines adopted by Decision 18/CP.8. However, the executive summary is not provided.</p> <p>UNFCCC review report 2004: The NIR, in general, conforms with the guidelines, except in the LUCF chapter. Since the last submission, some improvements have taken place. Some categories are still not reported. (FCCC/WEB/IRI/2004/DNK, para 2)</p>	The report provides additional categories. Wastewater handling, land use and land-use change have been reported this time.
Finland	<p>UNFCCC status report 2004: The organisation of the NIR, in general, follows the structure as outlined in the revised UNFCCC reporting guidelines (Decision 18/CP.8). However, some of the recommended annexes have not been provided. The NIR further provides a web link to a report on the methodologies for calculating the greenhouse gas emissions inventory.</p> <p>UNFCCC review report 2004: The NIR is, in general, complete and transparent. Some more information and a detailed description about complex methodologies and more precise references could still enhance the transparency. The NIR has improved since the last submission. (FCCC/WEB/IRI/2004/FIN, para. 2)</p>	More detailed and updated description on methodologies and data sources are provided in the new report.
France	<p>UNFCCC status report 2004: The organisation of the NIR, in general, follows the outline of the revised UNFCCC reporting guidelines (Decision 18/CP.8). However, the report only provides summary information on the methodologies for all sectors.</p> <p>UNFCCC review report 2004: The NIR follows, in general, the guidelines but it does not provide information about methodologies. This information is provided in the OMINEA report. The OMINEA report does not provide the methodologies for all sectors. The ERT recommends including all relevant information in the NIR including the methodologies for all sectors. (FCCC/WEB/IRI/2004/FRA, para. 2)</p>	(NIR not yet submitted.)
Germany	<p>UNFCCC status report 2004: The organisation of the chapters in the NIR follows the structure as outlined in the revised UNFCCC reporting guidelines, adopted by Decision 18/CP.8.</p> <p>UNFCCC review report 2004: Germany provided an appropriate report for the years 1990–2002. Following the NIR structure as outlined in the guidelines has greatly improved the transparency of the report. There are some gaps regarding the CRFs. Recalculations are still not very transparent.</p> <p>To increase the transparency of the NIR, the ERT recommends that Germany consider making more use of annexes for detailed technical information and providing more straightforward information in the body of the NIR itself. (paras 9–29, FCCC/WEB/IRI/2004/DEU)</p>	The transparency of the report was increased by structuring and shortening the report. Detailed descriptions of methodologies are available in the annexes.
Greece	<p>UNFCCC status report 2004: The organisation of chapters in the NIR, in general, follows the structure as outlined in the revised UNFCCC reporting guidelines (Decision 18/CP.8). However, some of the recommended annexes are not provided.</p> <p>UNFCCC review report 2004: In general, Greece provided a complete and transparent inventory. The NIR and CRF tables cover all major sources and sinks with a few exceptions and inconsistencies. A systematic key source analysis should be used to prioritise inventory improvements and development. This should be facilitated by the implementation of the QA/QC plan and the recommendations that will come from the plan.</p> <p>The ERT noted that improvements are needed, particularly in the areas of transparency and documentation of calculation procedures and all elements of the methodologies used. (paras 6–27, FCCC/WEB/IRI/2004/GRC)</p>	Since the last submission a QA/QC plan has been developed. QA/QC activities were focused on the improvement of the archiving of information and the development of a long-term improvement plan but the work is still in progress.

Member State	Characterisation of the report in the 2004 UNFCCC inventory review	Changes to the report in 2005 in response to the review
Ireland	<p>UNFCCC status report 2004: The organisation of the NIR does not follow the structure as outlined in the revised UNFCCC reporting guidelines (Decision 18/CP.8). The NIR contains information on key sources, recalculations, QA/QC, trends, completeness and planned improvements. Calculation sheets are provided in appendices to the NIR.</p> <p>UNFCCC review report 2004: NIR, CRF tables and inventory methods are highly developed. Only one inconsistency related to recalculations was found between CRFs and NIR (para. 6). Not all recommendations from the in-country review 2003 have been implemented but this is planned for the future (para. 7). FCCC/WEB/IRI/2004/IRL</p>	Ireland recognises the need to deliver annual submissions in close conformity with the UNFCCC reporting guidelines on annual inventories to facilitate the work of expert review teams in conducting productive and efficient technical reviews of greenhouse gas inventories. Recalculations have been made in response to the recommendation of the 2003 review report.
Italy	<p>UNFCCC Review report 2004: The NIR conforms with the guidelines and is almost complete and transparent. Some methods need to be described in more detail to enhance transparency and some emissions are not estimated. Italy presents a good diagnosis of the problems in developing an NIR and makes an effort to address them. (FCCC/WEB/IRI/2004/ITA, para. 2)</p>	(NIR not yet submitted)
Luxembourg	<p>UNFCCC status report 2004: An NIR has not been submitted. Information on CO₂ emissions from road traffic for the years 1998, 2000 and 2002 is provided in a separate file.</p>	(NIR not yet submitted)
Netherlands	<p>UNFCCC status report 2004: The organisation of chapters in the NIR follows the structure as outlined in the revised UNFCCC reporting guidelines (Decision 18/CP.8).</p> <p>UNFCCC review report 2004: The Netherlands provided a complete, carefully documented and highly transparent NIR for the years 1990–2002. The key source assessment is made by subsectors (e.g. energy industry) and not by fuel types as recommended in the IPCC guidelines. Some source categories like the removals from agricultural soils, forest and grassland conversion are not reported. A discussion about planned improvements is already included in the NIR and some further improvements are recommended by the ERT. (paras 9–24, FCCC/WEB/IRI/2004/NLD)</p>	The NIR has been further improved since the last submission. As recommended, the IPCC guidelines have been applied.
Portugal	<p>UNFCCC review report 2004: In general, the NIR is complete, transparent and comprehensive. Compared to the previous NIR there was a significant improvement. Some source categories (e.g. CO₂ emissions from asphalt roofing etc.) are not included in the inventory. Also transparency still needs to be improved in some areas.</p> <p>Portugal does not yet have a formal quality assurance/quality -control plan and procedure in place in accordance with the IPCC good practice guidance and has not yet provided quantitative uncertainty estimates (paras 5–44, FCCC/WEB/IRI/2004/PRT)</p>	(NIR not yet submitted)
Spain	<p>UNFCCC status report 2004: The organisation of the NIR does not follow the structure as outlined in the revised UNFCCC reporting guidelines (Decision 18/CP.8). The NIR contains information on methodologies used, inventory principles, trends and recalculations, uncertainty analysis and key sources, and discussion of key sources under each IPCC sector, including information on activity data and factors used in the calculation of estimates.</p> <p>UNFCCC review report 2004: Efforts have been made to improve the quality of the NIR and the CRFs and the implementation of the IPCC guidelines for the preparation process. The implementation of the IPCC guidelines is not fully completed. The QA/QC system is not in place (para. 7). Areas for improvement have been identified by the parties. The ERT suggests implementing the improvements in the 2005 submission (para. 8). The main outstanding improvement is to provide more detailed information on methodologies (para. 9). FCCC/WEB/IRI/2004/ESP</p>	Recalculations have been made which contributed significantly to an improvement in the accuracy and completeness of the inventories series. IPCC good practice guidelines have been further implemented.
Sweden	<p>UNFCCC status report 2004: The organisation of the NIR, in general, follows the structure as outlined in the revised UNFCCC reporting guidelines (Decision 18/CP.8). However, some of the recommended annexes are not provided (e.g. Tables 6.1 and 6.2 of the IPCC good practice guidance).</p> <p>UNFCCC review report 2004: The submitted data cover all years, all gases, sectors and sources/sinks. Some country specific methods are used to report additional sources, e.g. N-fixation in hayfields. The NIR is informative, but more information about applied country-specific methods, its key assumption and its advantages would be helpful. Improvements in comparison to the last submission have been made. For the first time, quantitative uncertainty estimates have been made. (FCCC/WEB/IRI/2004/SWE, para. 2)</p>	Detailed explanations about applied methods are available in the report. Also explanation about country specific methods and why these methods are applied is provided in the report.
United Kingdom	<p>UNFCCC status report 2004: The organisation of the chapters in the NIR follows the structure outlined in the revised UNFCCC reporting guidelines (Decision 18/CP.8).</p> <p>UNFCCC review report 2004: The UK inventory is in conformity with the guidelines. Very strong is the methodological implementation in the cross-cutting activities. Some gaps in the transparency and consistency occur in the sections of industrial processes and waste. Also, the corresponding explanations for the recalculations could be strengthened. In comparison to the last report, the transparency in the energy, agricultural and LUCF sector increased. (FCCC/WEB/IRI/2004/GBR, paras 2–3)</p>	(NIR not yet submitted)

Table 1.13 Overview of completeness as reported by Member States in CRF Table 9 and in the 2005 NIR

Member State	Summary of information on completeness in Member States' NIRs and CRF Table 9 (NE)
Austria	<p>Completeness by emission sources:</p> <p>CRF 1.B.2a: CO₂ and CH₄ emissions assumed to be negligible.</p> <p>CRF 2.B.5: CH₄ emissions from carbon black, methanol, ethylene included in the NMVOC estimate.</p> <p>CRF 5: CH₄ and N₂O emissions not estimated due to lack of data.</p> <p>CRF 5.A, 5.B.2.1, 5.C.2.1, 5.D.2.1, 5.E.2.1, 5.F.2.1: no measured data available for C stock change in soils, reassessments planned for near future.</p> <p>Compared to last year's submission, some additional sources have been included in the inventory.</p> <p>Completeness by geographical coverage: Complete territory covered.</p>
Belgium	CO ₂ emissions from agricultural soils are not estimated. A study is going on at national level, but will not be finalised before 2005.
Denmark	<p>Completeness by emission sources:</p> <p>CRF 2.A.3, 2.A.4: CO₂ emissions included in glass production, improvements planned.</p> <p>CRF 2.A.5, 2.A.6: CO₂ emissions estimates are under development.</p> <p>CRF 4.A: CH₄ emissions from enteric fermentation (poultry and fur farming) not estimated due to lack of default EF, considered of minor importance.</p> <p>CRF 4.D: CH₄ emissions from soils not estimated due to lack of default methodology, considered of minor importance; N₂O emissions not estimated because FracNCRBF and FracNCRO unknown.</p> <p>CRF 5.D: CO₂ emissions from cultivation for mineral soils not estimated, on-going survey will prepare estimates.</p> <p>CRF 6.A.1: CO₂ emission from waste disposal not estimated as considered negligible.</p> <p>LULUCF: Denmark is a highly intensive agricultural country. Deforestation was banned 200 years ago and drainage of wetlands has not occurred in the last 20 years. Field burning was banned on 1 January 1990. Due to the demand for land for settlements and infrastructure, the agricultural area is decreasing continuously. Re-establishment of wetlands is occurring. As a consequence, the transition from one land category to another is restricted and almost unidirectional. The consequences for the overall emission is assumed to be very little. However, this has not been investigated thoroughly and hence NE has been used in many places due to lack of data. In future, a closer examination of the areas will be made.</p> <p>Completeness by geographical coverage: Complete territory covered.</p>
Finland	<p>Completeness by emission sources:</p> <p>CRF 1.B.2: Fugitive emissions from oil and natural gas: emissions of CO₂, CH₄ and N₂O are estimated to be nearly zero (negligible). This has to be rechecked in the future inventories.</p> <p>CRF 1: International bunkers/lubricants: emissions of CO₂, CH₄ and N₂O are estimated to be nearly zero (negligible). This has to be rechecked in the future inventories.</p> <p>CRF 2.A, B, D: Emissions from industrial processes: CO₂ emissions from some source categories are estimated to be nearly zero (negligible). This has to be rechecked in the future inventories.</p> <p>CRF 3.A,B,D: No compound specific data of NMVOC emissions available for conversion to CO₂.</p> <p>CRF 4.A: N₂O emissions from enteric fermentation not estimated due to lack of methodology.</p> <p>CRF 4.F: CH₄ and N₂O emissions from field burning of agricultural residues is considered negligible.</p> <p>CRF 6: Wastewater handling not estimated due to lack of default methodology.</p> <p>CRF 6: Other (composting): emissions of CH₄ and N₂O are estimated to be nearly zero (negligible).</p> <p>LULUCF: emissions from land converted to cropland and grassland not available due to lack of estimates; C stock change in dead organic matter and soils are not estimated but will be included in the 2006 submission; Methods are under development for CO₂ emissions from wetlands and biomass burning and N₂O emissions from drainage of soils.</p> <p>Completeness by geographical coverage:</p> <p>The inventory includes emissions from the autonomic territory of Åland (Ahvenanmaa). Information on the specified emissions for the territory of Åland estimated by the Finnish Environment Institute will be available at the website http://www.environment.fi/state_of_the_environment/air/Finland's_GHG_emissions_by_the_end_of_March_2005.</p> <p>Completeness by temporal coverage:</p> <p>In general, complete CRF tables are provided for all years. In the energy sector, recent studies on emission factors, more developed estimation models and updated energy data have caused some inconsistencies in the time series. The time series will be recalculated in the future inventories to remove inconsistencies.</p>
France	(No information on completeness has been provided)

Member State	Summary of information on completeness in Member States' NIRs and CRF Table 9 (NE)
Germany	<p>Completeness by emission sources:</p> <p>CRF 1.A.3.b: CH₄ emissions from natural gas vehicles not estimated.</p> <p>CRF 2.A: CH₄ and N₂O emissions from mineral products not estimated due to lack of information.</p> <p>CRF 2.A.3, 2.A.4, 2.A.5 and 2.A.6: CO₂ emissions not estimated, but methods are in preparation.</p> <p>CRF 2.C: Metal production: N₂O considered negligible.</p> <p>CRF 4: CH₄ □ not provide the number of animals.</p> <p>Further assessment is needed regarding the complete coverage of blast-furnace gas, refinery gas as well as the energy use of CH₄ from coal mines.</p>
Greece	<p>Completeness by emission sources:</p> <p>CRF 1.A.3.b: CH₄ and N₂O emissions not estimated due to lack of information.</p> <p>CRF 1.B.: CO₂, CH₄ and N₂O emissions not estimated for fugitive emissions.</p> <p>CRF 1.C.: CH₄ and N₂O emissions not estimated, no appropriate emission factors.</p> <p>CRF 2.A.5, 2.A.6, 2.D.2: Soda ash production and use, asphalt roofing, road-paving, food and drink: CO₂ emissions not estimated due to lack of activity data but considered minor.</p> <p>CRF 2.B.1: Ammonia production: CH₄ emissions not estimated due to lack of activity data. N₂O emissions not estimated due to missing emission factor.</p> <p>CRF 2.B.5: CO₂ and CH₄ emissions not estimated due to lack of activity data.</p> <p>CRF 2.C.2., 2.C.3.: No estimation of CH₄ emissions due to missing emission factors.</p> <p>CRF 3 A,B,C: N₂O emissions not estimated due to lack of data.</p> <p>CRF 4.A.9: CH₄ emissions not estimated, no appropriate emission factor.</p>
(Greece)	<p>CRF 4.D: Agricultural soils: CH₄ emissions not estimated due to lack of method.</p> <p>CRF 5: For grassland converted to forest land, forest and croplands converted to grassland, land converted to wetlands, land converted to settlements and land converted to other land, not estimated due to lack of activity data, emissions considered negligible.</p> <p>CRF 6.B: CH₄ emissions from sludge treatment not estimated.</p> <p>No estimates of potential emissions have been calculated for fluorinated gases (HFCs, PFCs, SF₆).</p> <p>Completeness by geographical coverage: complete territory covered.</p>
Ireland	<p>CRF 2.A.5, 2.A.6, 2.A.7: CO₂ not estimated due to lack of activity data.</p> <p>CRF 2.F.3: HFCs from fires extinguishers not estimate due to lack of data.</p> <p>CRF 4.D.1, 4.D.2, 4.D.3: CH₄ not estimated, awaiting results of major national research project.</p> <p>CRF 5.B, 5.C, 5.D: CO₂, CH₄ and N₂O not estimated, awaiting results of major national research project.</p>
Italy	<p>CRF 1.A.2: CO₂, CH₄ and N₂O emissions for manufacturing industries and construction — Pulp, paper and print, biomass not estimated, no information available.</p> <p>CRF 3: N₂O, no estimation so emissions for other use of N₂O.</p> <p>For PFCs no estimation of potential emissions.</p> <p>CRF 5.E.1, 5 □ insufficient data.</p> <p>CRF 6.B: no estimates of N₂O emissions from wastewater handling.</p> <p>No estimations for HFCs in the industrial process sector.</p>
Luxembourg	(No information on completeness has been provided)
Netherlands	<p>CRF 1.B.2: Fugitive emissions of CO₂ and CH₄ from several subsource categories not estimated, emissions considered minor.</p> <p>CRF 2.A.5: CO₂ emissions from asphalt roofing not estimated, considered minor.</p> <p>CRF 2.A.7: CO₂ and CH₄ emissions from other building materials not estimated, considered minor.</p> <p>CRF 4.A.9: No CH₄ emissions from enteric fermentation for poultry estimated.</p> <p>CRF 5.B and 5.E: CH₄ and N₂O for forest and grassland conversion and other not estimated, considered to be minor. CRF 6B: N₂O emissions from industrial wastewater and human sewage not estimated.</p> <p>For PFCs and SF₆ not all potential emissions (= total consumption data) are reported at present due to the limited number of companies for which, currently, consumption figures are available.</p> <p>Completeness by geographical coverage:</p> <p>The territory of the Netherlands from which emissions are reported is the legal territory; this includes a 12-mile zone from the coastline and 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 in the Netherlands' part of the continental shelf are included.</p>

Member State	Summary of information on completeness in Member States' NIRs and CRF Table 9 (NE)
Portugal	<p>CRF 2-4A: CO₂ emissions from soda ash production and use.</p> <p>International marine bunkers, CO₂ emissions from lubricants, lack of methodology.</p> <p>CRF 1: CH₄, fugitive emissions from natural gas/other leakages are not estimated.</p> <p>CRF 2: CH₄ and N₂O from ammonia production are not estimated because emission factors are not available.</p> <p>CRF 3: N₂O, use of N₂O for anaesthesia, fire extinguishers, etc. and emissions from HFCs for fire extinguishers and foam blowings and SF₆ emissions from electrical equipment disposal are not available.</p> <p>CRF 4: CH₄, agricultural soils, direct and indirect emissions.</p> <p>No estimates of potential emissions have been calculated for fluorinated gases (HFCs, PFCs, SF₆).</p> <p>CRF 5.B, 5.A: CO₂ and N₂O emissions not estimated.</p> <p>CRF 5.B to 5.E: CO₂, C stock change in living biomass, only insufficient data available.</p> <p>CRF 5.A-5.E: CO₂, net carbon stock change in dead organic matter and soils, no evaluation of C contents and C stock changes in soils in Portugal</p>
Spain	<p>CRF 5.B: CO₂, CH₄ and N₂O emissions/removals not estimated due to lack of statistical data.</p> <p>5.C, 5.D: CO₂ emissions/removals not estimated due to lack of statistical data.</p> <p>No estimates of potential emissions have been calculated for fluorinated gases (HFCs, PFCs, SF₆).</p>
Sweden	<p>Energy: Estimated emissions are complete for most sources. There might still be some problems with in-house generated fuels in the chemical industry, smaller companies in the iron and steel industry and refineries. Fugitive emissions, i.e. venting and flaring of liquid and gaseous fuels, are most likely not complete for smaller companies.</p> <p>CRF 1.B.2: CO₂, CH₄ and N₂O emissions not estimated due to lack of data.</p> <p>Industrial processes: For most sources, and particularly for the most important sources, the estimates are in accordance with the requirements concerning completeness as laid out in the GPG. However, some exceptions do exist. These are primarily in sectors with a large number of smaller facilities, with minor emissions. The possible incompleteness from these sectors concerns NMVOC emissions.</p> <p>The completeness is considered to be good for all greenhouse gases, possibly with the exception of CH₄, for a few sources.</p> <p>CRF 2.B.1: Ammonia production: CO₂ and CH₄ emissions not estimated due to lack of data.</p> <p>CRF 2.C.2, 2.C.3, 2.C.5: CH₄ and N₂O emissions not estimated due to lack of data.</p> <p>CRF 2.D.2: Food and drink: CO₂ emissions not estimated due to lack of data.</p> <p>CRF 2.F: Consumption of halocarbons and SF₆: destroyed amounts of HFCs, PFCs and SF₆ not estimated.</p> <p>Solvent and product use: For solvent and product use, the assessment of completeness is uncertain. For NMVOC, some specified sectors that are treated and reported separately in the inventory fulfil the requirements of completeness. The completeness of national total estimates of NMVOC from Sector 3 is more difficult to judge, since Sector 3 comprises many different types of emissions sources. However, the estimates are judged to be of the right order of magnitude.</p> <p>Agriculture: All relevant agricultural emissions and sources are reported in the inventory. Reindeer, which are not normally considered as a part of the agricultural sector, have been included in the inventory. The majority of the country's horses do not belong to farms, but are included in the agricultural sector of the inventory. There are, however, some marginal animal groups which are not included, such as turkeys and fur animals (minks, foxes and chinchilla). These groups are very small and there is no methodology developed for estimating GHG emissions.</p> <p>All sales of fertilisers are included, even quantities used in other sectors. N-fixing crops used in lay are included, and sludge used as fertiliser is also included in this submission of the inventory, which means that all anthropogenic inputs to agricultural soils should be covered.</p> <p>Land use change and forestry: Carbon from all relevant land use classes except trees in urban areas is reported. The forest and grassland conversions and abandonment of managed lands are very limited and reported as zero. Due to the high variation in carbon concentration in mineral soils and the lack of data on stones and boulders, no reliable estimate of carbon stock changes in mineral soils has so far been made.</p> <p>CRF 5.B: CO₂ emissions from forest and grassland conversion not estimated, very limited area is converted.</p> <p>CRF 5.C: CO₂ emissions from abandonment of managed land not estimated, considered negligible.</p> <p>Waste: Completeness of data is considered to be good except on construction and demolition waste, which will be studied further.</p>
United Kingdom	<p>CRF 2.A.5, 2.A.6: Asphalt roofing/road-paving: CO₂ emissions not estimated as no methodology is available.</p> <p>CRF 2.B.1: Ammonia production: CH₄ emissions not estimated as manufacturers do not report emission and is considered as negligible.</p> <p>CRF 2.C.1: Iron and steel: CH₄ emissions only estimated for EAF and flaring, as no methodology is available for other sources.</p> <p>CRF 2.C.2, 2.C.3: Ferroalloys and aluminium production: CH₄ emissions not estimated as no methodology is available.</p> <p>CRF 3: CO₂ equivalent of solvent use not included in total, but provided for information.</p> <p>CRF 3.D: Other: Anaesthesia: N₂O emissions not estimated as no activity data available and considered negligible.</p> <p>CRF 5.C: Abandonment of managed lands: CO₂ emissions/removals not estimated as considered as negligible.</p> <p>CRF 6.B.1: Wastewater handling: CH₄ emissions from industrial wastewater not estimated as no activity data are available and considered negligible.</p>

as reported by Member States as far as this information was provided. The table also indicates briefly the reasons why certain source categories were not estimated. Since this overview table reflects the level of completeness of the underlying inventories,

it represents an aggregate guide to the completeness of the EC inventory.

Table 1.14 gives a very broad indication of incomplete source categories. However, a large number of the source categories

Table 1.14 Completeness of Member States' inventories as indicated in UNFCCC review reports and responses in 2005

Member State, type and year of UNFCCC review	Findings related to completeness from UNFCCC review report	Response in 2005 submission
Austria, centralised review 2004	<p>Austria has submitted GHG inventories for the years 1990–2002 using the CRF and a very comprehensive NIR. The geographic coverage is complete and all major sources and sinks are covered (page 2).</p> <p>Industrial processes: Regarding completeness, CO₂ emissions from soda ash production, asphalt roofing, road paving with asphalt and ferroalloys have not been estimated ('NE' is reported). Austria has indicated that CO₂ emissions from asphalt roofing and road paving with asphalt will be estimated for the 2005 submission by also accounting for the carbon content of non-methane volatile organic compound (NMVOC) emissions as CO₂ emissions (page 6).</p> <p>FCCC/WEB/IRI/2004/AUT</p>	<p>Addition of source categories:</p> <p>2 C 2 Ferroalloys (CO₂) has been added to the inventory.</p> <p>Changes in the use of notation keys:</p> <p>2 A 5 asphalt roofing and 2 A 6 road paving with asphalt:</p> <p>emissions are now reported as 'IE', as emissions are already included in the solvents sector.</p> <p>2 A 4 soda ash production and use:</p> <p>CO₂ emissions from soda ash Production are now reported as 'IE', as coke used in the process is already considered as fuel in the energy sector (1 A 2 c chemical industries).</p>
Belgium, desk review 2004	<p>Belgium has provided inventory data for the years 1990–2002 and included all the required tables except the sectoral background data tables for the fluorinated gases (F-gases) (Tables 2(II)C, E and 2(II)F). In the LUCF sector, no estimates have been provided for Categories 5.B, 5.C and 5.D, and for a number of sub-sources in some sectors. In the energy sector, even though the energy data have been recalculated, some gaps where 'not estimated' ('NE') is reported still exist, mainly in biomass and other fuel data (Categories 1.A.1a and b), and further work on completeness is also necessary in Energy Tables 1.B.2 and 1.C (the tables are only partly filled in). In the CRF tables, not all the cells contain data or notation keys, leaving unexplained data gaps.</p> <p>Energy: All significant emission sources are included in the inventory, but a few sub-sources of CO₂, CH₄ and N₂O under fugitive emissions from the oil and natural gas category and CH₄ and N₂O from marine bunker fuels are still not estimated ('NE' is reported) (page 5).</p> <p>Waste: The inventory is practically complete in terms of gases, sources and years covered. CH₄ and N₂O emissions from industrial wastewater handling are not estimated because it is not considered to be a significant source (page 12).</p> <p>FCCC/WEB/IRI/2004/BEL</p>	<p>All sectoral tables have been filled in in this submission. CRF tables are completed with the standard indicators (notation keys), providing information on data gaps, methods applied, emission factors used, completeness and quality. In all regions, the emissions were completely updated for the time series 1990–2002 and provisional emissions are calculated for 2001.</p> <p>The completeness of the energy sector has been improved. Biomass and other fuel data in Table 1.A.1 are either estimated or flagged as not occurring. CO₂ and CH₄ emissions from natural gas category and CH₂ emissions from marine bunkers are reported.</p>
Denmark, centralised review 2004	<p>In general, the ERT found the Danish inventory to be complete. It covers all years from 1990 to 2002 and all six mandatory GHGs. Some sources are not included, as identified in the CRF (e.g. wastewater handling, limestone and dolomite use, soda ash use). In addition, in the LUCF category, emissions from abandonment of managed lands and forest and grassland conversion, and CO₂ emissions and removals from soils are not reported. However, the completeness of the reporting has improved with the inclusion of categories that were previously missing (e.g. nitric acid pAoduction). In Annex 6 to the NIR Denmark reports, GHG emissions data for the Faroe Islands (up to 2001) and Greenland (only CO₂ emissions), but these data are not included in the CRF tables (page 2).</p> <p>Agriculture: The submission is almost complete in terms of gases, sources and time series. The ERT encourages Denmark to complete these tables with the appropriate notation keys (page 7).</p> <p>Waste: The NIR and the CRF tables report estimates only for CH₄ emissions from the source category 'Solid waste disposal on land', not including estimates for other source categories as required by the UNFCCC reporting guidelines (page 11).</p> <p>FCCC/WEB/IRI/2004/DNK</p>	<p>This submission includes emission estimates for land use, land-use change from 1990 to 2003 in the inventory. The previous inventories included only forestry.</p> <p>Also included for the first time is the methodology leading to estimates of emissions of CH₄ and N₂O for wastewater handling.</p> <p>Category 4 D is fully completed. GHG emission inventories for the Faroe Island and Greenland have been included in a separate version of CRFs.</p>

Member State, type and year of UNFCCC review	Findings related to completeness from UNFCCC review report	Response in 2005 submission
Finland, centralised review 2004	<p>Finland has submitted GHG inventories for the years 1990–2002 using the CRF tables and has provided a comprehensive NIR. The geographical coverage is complete and all major sources and sinks as well as the relevant GHGs and the indirect GHGs are covered. The inventory is sufficiently complete and the missing categories do not suggest any major gaps in coverage (page 2).</p> <p>Energy: — complete (page 4).</p> <p>Industrial processes: The CRF includes estimates of most gases and sources of emissions from the industrial processes sector. Not included in the inventory are 2.A.3 limestone and dolomite use, 2.A.4 soda ash production and use, 2.A.5 asphalt roofing and 2.A.6 road paving with asphalt (page 7).</p> <p>Agriculture: Information for the most recent years (2000 and beyond) and for some sub-sources (reindeer) is not available and this hinders assessment of the recalculations. The ERT encourages Finland to update this supporting material or include full documentation in the NIR (page 9).</p> <p>Waste: Finland's estimates in this sector are mostly complete (page 12).</p> <p>FCCC/WEB/IRI/2004/FIN</p>	<p>In this submission, correct notation keys have been used.</p> <p>Limestone and dolomite use and soda ash production and use are included in the inventory for the first time.</p> <p>Emissions from the agricultural sector have been reallocated to the LULUCF sector and CH₄ emissions are reported for the subcategories in agriculture.</p>
France, centralised review 2004	<p>France's inventory is by and large complete. Potential emissions of HFCs, PFCs and SF₆ are not reported separately. In some tables, the additional background information requested is not provided (e.g. Tables 4.A, 4.D, 6.A and 6.B). The notation keys are used in a limited way in the tables (e.g. Tables 4.E, 4.F and 5.C) (pages 2–3).</p> <p>Energy: For the energy sector, complete inventories and CRF tables have been submitted for the years 1990–2002, with the exception of information on the reference approach in Tables 1.A(b), 1.A(c) and 1.A(d) for the years 1991–97 and 2002 (page 5).</p> <p>Agriculture: The CRF tables are not filled in completely and notation keys are not always used (page 10).</p> <p>LUCF: As observed in previous review reports, the CRF tables have not been filled in completely. Some inconsistencies still remain between the sectoral report and the sectoral background data tables. The source category 'Other' has not been clearly explained (page 12).</p> <p>Waste: The information contained in CRF Table 6.A is not complete in terms of the additional information. The notation key 'not applicable' ('NA') has been used for the data on waste incineration, recycling and disposal in the additional information table (page 14).</p> <p>FCCC/WEB/IRI/2004/FRA</p>	<p>Completeness of CRF tables has been improved. Many background information are available in this submission. The use of notation keys was increased.</p> <p>Table 1.A.b, c,d regarding the reference approach have been completed.</p> <p>In the waste sector, CRF tables have been improved by eliminating the notation key NA.</p>
Germany, in-country review 2004	<p>Complete set of CRFs from 1990–2002, but there are some gaps in the CRF. Tables 8(a) and 8(b) (Recalculations) are not reported for all years although it is clear from both the CRF and the NIR that recalculations have been made. Table 9 (Completeness) has not been filled in at all (page 4).</p> <p>Energy: Not included are: CO₂ emissions from fuel combustion activities in the reference approach for the years 2000–02; disaggregation of emissions in all sub-source categories under 1.A.2 Manufacturing industries and construction; feedstocks and non-energy use of fuels for the years 2000–2002; the fraction of feedstocks which is combusted for the whole time series; fugitive emissions of CH₄ from some mining and oil and gas operations, as well as all corresponding releases of CO₂; and recalculations (page 7).</p> <p>Industrial processes: Not included are limestone and dolomite use, soda ash use, asphalt roofing (only AD provided), road paving with asphalt, production of silicon carbide, carbon black, ethylene, dichloroethylene, styrene and methanol, food and drink production and ferroalloys production. In addition, there are some emission sources for which an emissions estimate is given in the CRF but which are not described in the NIR (soda ash production, glass manufacture, and food and drink) (page 13).</p> <p>Agriculture: GHG emissions from enteric fermentation and manure management of goats, mules and asses are not reported. The number of horses is actually twice as high as the figure in the official statistics (page 17).</p> <p>Land-use change and forestry: The 2002 CRF includes only estimates of CO₂ emissions/removals under LUCF. Emissions estimates are not reported for Categories 5.B Forest and grassland conversion and 5.C Abandonment of managed land, but the notation keys 'NE' and 'NO' are used in the CRF. The estimates for 5.D CO₂ emissions and removals from soils are reported only for cultivation of organic agricultural soils and for liming of agricultural and forest soils (page 20).</p> <p>Waste: The CRF includes estimates of all gases and sources of emissions from the waste sector except for N₂O in industrial wastewater handling (page 23).</p> <p>FCCC/WEB/IRI/2004/DEU</p>	<p>The missing CO₂ emissions from fuel combustion activities in the reference approach for the years 2000–2002 are provided in the 2005 submission and Table 9 is filled out. Emission from the production of methanol, dichloroethylene and calcium carbide are reported for the first time.</p> <p>Research projects in order to improve the quality of the data are ongoing and results will be available until the next submission. Other issues remain to be addressed.</p>

Member State, type and year of UNFCCC review	Findings related to completeness from UNFCCC review report	Response in 2005 submission
Greece, in-country review 2004	<p>In general, the Greek inventory is complete. It includes an NIR and a complete set of CRF tables, with the exceptions of Tables 8(b) and 11. A few sources are not included. The ERT also notes the limited use of notation keys in the CRF tables and the use of '0' for 'not estimated' ('NE') (page 5).</p> <p>Energy: Fugitive emissions are only estimated for CH₄. Greece reports in the CRF that fugitive emissions of CO₂ from Surface mines, CH₄ from solid fuel transformation, and CO₂ and N₂O from venting and flaring were not estimated because of lack of AD and/or estimation methodologies. Fugitive emissions of CO₂ from oil and natural gas were not estimated mainly because of the lack of the AD (page 10).</p> <p>Industrial processes: CO₂ emissions are not estimated from the following subcategories: limestone and dolomite use; soda ash production and use; asphalt roofing; and road paving with asphalt. CO₂ and CH₄ emissions are reported as 'NE' for ammonia production for the whole period. In the metal production subcategory, emissions from ferroalloys production are not estimated. Potential emissions for the ozone depleting substances (ODS) substitutes are not calculated because of lack of export/import data. For this last subsector, only emissions from refrigeration and air conditioning are reported (page 14).</p> <p>Agriculture — complete (page 18).</p> <p>Land use change and forestry: The CRF includes estimates of most gases, sources and sinks from the LUCF sector. Greece has estimated Categories 5.A, 5.B and 5.D partially, while estimates for category 5.C have not been made (page 21).</p> <p>Waste: CH₄ emissions from sludge, N₂O emissions from industrial wastewater treatment and emissions from waste incineration are not estimated (page 24). FCCC/WEB/IRI/2004/GRC</p>	<p>General improvement of the use of notation keys.</p> <p>In the industrial sector CO₂ emissions from limestone and dolomite use are available in this submission.</p> <p>Other issues still need to be addressed.</p>
Ireland, in-country review 2004	<p>The inventory is in general complete. Comprehensive information on the completeness of the inventory is given in the NIR. Some gaps were noted in following sectors: industrial processes, agriculture, LUCF and waste.</p> <p>Energy: All significant emission sources and gases are included in the inventory. Emissions from the consumption of aviation gasoline in domestic civil aviation (1.A.3a) are not estimated ('NE' is reported), nor are fugitive CH₄ and CO₂ emissions from natural gas transmission systems (1.B.2b(ii)). Ireland responded to the draft of this report that with regard to fugitive emissions, only CH₄ emissions from natural gas distribution are a relevant source (para. 22).</p> <p>Industrial processes: Emissions are reported for most sources and gases, except for asphalt roofing and road paving with asphalt for which no emissions have been estimated ('NE' is reported), and for N₂O from solvent and other product use. Actual emissions from consumption of HFCs, PFCs and SF₆ have not been provided for the years 1990–1994. Metal production occurred in Ireland only prior to 2001. The only ammonia and nitric acid production plants closed down in June 2002 (para. 40).</p> <p>Agriculture: CH₄ emissions from manure management from non-cattle livestock species and N₂O emissions from organic soils and the burning of agricultural residues are not estimated because they are not considered significant source categories. Rice cultivation and prescribed burning of savannas do not occur in Ireland (para. 51).</p> <p>LUCF: CO₂ emissions/removals are reported for category 5.A Changes in forest and other woody biomass stocks. Emissions or removals from land-use change (Categories 5.B Forest and grassland conversion and 5.C Abandonment of managed lands) are not estimated, nor is category 5.D CO₂ Emissions and removals from soil, except for emissions from lime application (para. 64).</p> <p>Waste: The data in the CRF tables for category 6.A are not consistent with the results presented in the NIR, and it is not clear which of the numbers are the correct ones (para. 74). FCCC/WEB/IRI/2004/IRL</p>	<p>General components of the IPCC good practice guidance have now been addressed in a routine manner. In the agricultural sector CH₄ emissions for swine and poultry have been estimated. Other issues still need to be addressed.</p>
Italy, centralised review 2004	<p>All years 1990–2002, all gases, all sectors and practically all source/sink categories are covered in the 2004 inventory submission. The following emissions have not been estimated: CH₄ from waste incineration, N₂O from solvents and other product use, and potential emissions of HFCs. Italy reports in the NIR that it plans to estimate and report these emissions in its next submission.(page 2).</p> <p>Energy: Italy reports in the NIR that emissions from multilateral operations are not estimated because no AD are available (page 4).</p> <p>FCCC/WEB/IRI/2004/ITA</p>	<p>CH₄ emissions from waste incineration are reported in the CRF tables. Potential emissions of HFCs have been estimated. Other issues remain to be addressed.</p>
Luxembourg	No 2003 NIR provided	–
Netherlands, in-country review 2004	<p>The Netherlands has provided inventory data for the years 1990–2002 and included all required tables in the CRF. Not all relevant cells in the CRF include a data entry or notation key. The source categories that are not reported include the potentially significant subcategories of CO₂ emissions and removals from agricultural soils, and forest and grassland conversion (page 4).</p> <p>Energy: The CRF tables for 2002 are largely complete. Emissions not fully included are primarily emissions of CO₂ and N₂O from solid and other fuels from manufacturing industries and construction, as well as emissions from the petroleum refining subsector. At present, the information provided in Table 9 is not complete (page 7).</p>	<p>The submitted data have been improved since the last submission and try to respond to all issues. Most of the relevant cells are filled out.</p>

Member State, type and year of UNFCCC review	Findings related to completeness from UNFCCC review report	Response in 2005 submission
(Netherlands, in-country review 2004)	<p>Industrial processes: The source coverage and gases included are substantially complete. Minor sources such as asphalt roofing and road paving with asphalt are shown as 'NE'. Many of the tables include blank cells where data or a notation key should be entered (page 15).</p> <p>Agriculture: The information provided in the NIR is generally complete and well documented. Explanations for inter-annual changes in the CH₄ IEFs for enteric fermentation, as well as manure management, are not included in the NIR. Indirect N₂O emissions from atmospheric deposition are not estimated. Enteric fermentation emissions from poultry are not estimated, although AD are provided. CH₄ and N₂O from horse manure (category 4.B) are omitted (page 21).</p> <p>Land-use change and forestry: The CRF includes estimates for CO₂ sources and sinks from subcategory 5.A only. Estimates for CO₂, N₂O and CH₄ for Categories 5.B, 5.C, 5.D and 5.E are not included in the CRF because adequate information is not available. However, emissions/removals in Categories 5.B and 5.D may be significant and it is recommended that the party compile estimates for these sources (page 24).</p> <p>Waste: Not estimated are N₂O and CH₄ emissions from 6.B.2 Wastewater handling, with the exception of emissions from sludge management in wastewater treatment plants (WWTPs), and AD for the biogenic fraction of waste incinerated under 6.C Waste incineration (page 26). FCCC/WEB/IRI/2004/NLD</p>	<p>The lacking sources from the last submission are now included in the inventory and the CRF: CO₂ emissions from solid fuels and from the petroleum refining subsector are estimated. Indirect N₂O emissions from atmospheric deposition (Category 4D); CH₄ and N₂O from horse manure (Category 4B); Emissions/sinks for LULUCF Subcategories 5A to 5E, except for the CO₂ sink in Category 5A2; CH₄ and N₂O emissions from industrial wastewater treatment (6B) and from large-scale compost production from organic waste (6D).</p>
Portugal, in-country review 2004	<p>In general, the Portuguese inventory is complete. Some source categories are not included in the inventory, the most important being, CO₂ from asphalt roofing, N₂O from solvent and other product use, F-gases from fire extinguishers and semiconductors, potential emissions of F-gases, and CO₂ Emissions and removals from soils.. However, the land-use change and forestry (LUCF) sector does not include emissions and removals from the two autonomous regions of Madeira and the Azores Islands (page 5).</p> <p>Energy — complete (page 9).</p> <p>Industrial processes: Not included are potential emissions for HFCs, PFCs and SF₆. Actual emissions of PFCs have not been estimated, while only partial estimates of actual emissions of HFCs have been provided for a number of source categories. Emissions have not been estimated for asphalt roofing, fire extinguishers and semiconductors, as well as N₂O emissions from solvent and other product use (page 13).</p> <p>Agriculture: Not included in the CRF tables is the application of sewage sludge to agricultural soils in Category 4.D (page 16).</p> <p>Land-use change and forestry: Emissions of CO₂ from land-use conversions (5.B Forest and grassland conversion, and 5.C Abandonment of managed lands) are not reported (page 20).</p> <p>Waste: Emissions have been estimated in most of the source categories except in 6.B Industrial wastewater handling, where emissions from sludge were reported as 'not estimated' ('NE'). In addition, CH₄ recovered and flared (both in wastewater and in sludge) are reported as 'NE' (page 22). FCCC/WEB/IRI/2004/PRT</p>	<p>CRF tables show no response and an NIR 2005 has not yet been provided. Not (yet) addressed.</p>
Spain, in-country review 2004	<p>The inventory is in general complete. In the 2004 submission, the same categories as in the 2003 submission have not been estimated. The ERT recommends to estimate all categories in the 2005 submission that have not been estimated until now (para. 10). The use of notation keys has improved but is still not very correct (para. 11).</p> <p>Energy: Emissions from the following sources are not estimated: 1.A.3b Road transportation (CO₂, CH₄ and N₂O from natural gas), 1.A.5 Other (CO₂, CH₄ and N₂O), 1.B.2.a Oil exploration (CO₂ and CH₄) and 1.B.2.b Natural gas exploration (CO₂ and CH₄), 1.B.2.c Venting (CO₂ and CH₄) and 1.B.2.c Flaring oil (N₂O). Notation keys are not used all the time and it is not sure whether military activities are included in the GHG inventory at all (para. 27).</p> <p>Industrial processes: Minor sources have not been estimated: CO₂ emissions from limestone and dolomite use, CO₂ emissions from asphalt roofing and from road paving with asphalt, and CH₄ emissions from ethylene, dichloroethylene and styrene production. Estimates of HFC, PFC and SF₆ emissions and time series from refrigeration and air conditioning equipment are calculated on the basis of an incomplete AD time series. Potential emissions of HFCs, PFCs and SF₆ have not been supplied, mainly because of the current lack of information on imports and exports per gas. CRF Table 9 is not filled in (para. 47).</p> <p>Agriculture: No additional information is provided in CRF Tables 4.A and 4.B (a), and no comparable estimation parameters are provided in the NIR. The ERT recommends Spain to add such parameters in either the CRF or the NIR (where this is more appropriate to the method used). Spain explained that no histosols are cultivated in the country and that, therefore, the use of the notation key 'NO' for this source category is appropriate (para. 58).</p>	<p>CO₂ emissions from limestone & dolomite use are estimated in this submission. Further issues still need to be addressed.</p>

Member State, type and year of UNFCCC review	Findings related to completeness from UNFCCC review report	Response in 2005 submission
(Spain, in-country review 2004)	<p>LUCF: Spain reports estimates under Category 5.A Changes in forest and other woody biomass stocks, but does not report any estimates under Categories 5.B Forest and grassland conversion, 5.C Abandonment of managed lands or 5.D CO₂ emissions and removals from soil (CO₂ emissions from soils are not reported in the agriculture sector either). Spain indicates in the NIR that this is due to a lack of statistical data (para. 72).</p> <p>Waste: Emissions from incineration of industrial waste have not been estimated because of difficulties in obtaining information on this activity. All the CRF tables have been completed for the period 1990–2002. The information provided in the additional information tables and documentation boxes of the CRF is complete for solid waste disposal on land, but in the case of wastewater handling and waste incineration the information provided is only partial (para. 79). FCCC/WEB/IRI/2004/ESP</p>	CO ₂ emissions from limestone & dolomite use are estimated in this submission. Further issues still need to be addressed.
Sweden, centralised review 2004	<p>All years 1990–2002, all gases, all sectors and practically all source/sink categories are covered in the 2002 inventory (page 2).</p> <p>FCCC/WEB/IRI/2004/SWE</p>	Submitted data are complete. No special response was required.
United Kingdom, centralised review 2004	<p>The national inventory submitted by the United Kingdom is comprehensive and complete. All major source/sink categories and direct and indirect GHGs are reported, with the exception of N₂O emissions from domestic wastewater treatment. Disaggregation of emissions for some subsectors of manufacturing industries and construction is not reported. The UK has provided inventory data for the years 1990–2002. Minor gaps, where they exist, reflect the limits of disaggregating available activity data (AD) to smaller subcategories. (page 2–3).</p> <p>Energy: — complete (page 4).</p> <p>Agriculture: — complete (page 9).</p> <p>FCCC/WEB/IRI/2004/GBR</p>	<p>N₂O emissions from domestic waste water treatment are reported.</p> <p>No further response was required.</p>

indicated by Member States can be considered as negligible in quantitative terms in relation to the total emissions of the EC inventory. In order to get more specific information on the relevant omissions, the information on completeness was compiled from UNFCCC inventory review reports of Member States (Table 1.15). However, in a number of cases, those reports only provide a list of incomplete source categories without a clarification if these omissions are considered as relevant in quantitative terms. The last column of Table 1.15 indicates if Member States introduced changes to their NIRs regarding the completeness issues addressed during the review in 2004.

1.8.2 Data gaps and gap-filling

The EC GHG inventory is compiled by using the inventory submissions of the EC Member States. 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 CO₂ emissions from the energy sector are concerned, extrapolation of emissions should be based on the percentage change of Eurostat CO₂ 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' (4) 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' (12) without application of the conservativeness factor.

(12) As included in FCCC/SBSTA/2003/10/Add.2.

Table 1.15 Overview of missing data

Member State	CO ₂	CH ₄	N ₂ O	HFCs	PFCs	SF ₆
Cyprus				1990–2003	1990–2003	1990–2003
Czech Republic	1991; 1993	1991; 1993	1991; 1993	1990–1994	1990–1994	1990–1994
Estonia				1990–2003	1990–2003	
Greece						1990–2003
Ireland						1990–94
Lithuania	1991–1997; 1999–2000	1991–1997; 1999–2000	1991–1997; 1999–2000	1990–2000	1990–2003	1990–2003
Luxembourg	Summary 1A for 1991–1993 1); Tables 1, 1A(a), 2(I), 3, 4, 5, 6 for 1990–1997; 1999; 2001	Summary 1A for 1991–1993; Tables 1, 1A(a), 2(I), 3, 4, 5, 6 for 1990–1997; 1999; 2001	Summary 1A for 1991–1993; Tables 1, 1A(a), 2(I), 3, 4, 5, 6 for 1990–1997; 1999; 2001	1990–1997; 1999	1990–1997; 1999	1990–1997; 1999
Malta	2001–2003	2001–2003	2001–2003	1990–2003	1990–2003	1990–2003
Poland	2003	2003	2003	1990–1994; 2003	1990–1994; 2003	1990–1994; 2003

(¹) Total CO₂ emissions for 1991–1993 are available for Luxembourg but without sector and category split.

Table 1.15 shows that data gaps exist for nine Member States.

The following overview shows the general approaches used for obtaining estimates for the missing data; these approaches are based on the principles mentioned above:

Estimates at the beginning or at the end of a time series

Fuel combustion related GHG emissions (CO₂, CH₄, N₂O of sector 1A):

The percentage change from Eurostat CO₂ emission estimates was used for extrapolation, where available

If there were no Eurostat CO₂ emission estimates available, fuel combustion estimates were extrapolated on basis of GDP elasticity of fuel related GHG emissions.

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 1990–2002. If only a limited number of years were available or a more consistent time series was available for specific years then these years were used for trend extrapolation.

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 downloaded from the Eurostat web site in March 2005.

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 provided by Eurostat in March 2005.

The following country-specific approaches were derived from the general approaches:

Cyprus Republic	
HFC	Emissions estimated on basis of average per capita emissions of ES, GR, IT; PT for 2F1 'Refrigeration and air conditioning equipment'
SF₆	Emissions estimated on basis of average emissions per electricity consumption of ES, IT; PT for 2F7 'Electrical equipment'
Czech Republic	
CO₂, CH₄, N₂O	Linear interpolation between 1990 and 1992 for 1991 and linear interpolation between 1992 and 1994 for 1993
SF₆	Linear trend extrapolation 1995-2003 for 1990-1994
Estonia	
HFC	Emissions estimated on basis of per capita emissions of Latvia for 2F1 'Refrigeration and air conditioning equipment'
Greece	
SF₆	Emission estimates calculated on basis of preliminary information for the year 2004 were provided by Greece.
Ireland	
HFC, PFC, SF₆	Linear trend extrapolation 1995-2003 for 1990-1994; the extrapolation of the single gases of PFCs for 1990-1994 was made on basis of the shares of these gases in 1995.
Lithuania	
CO₂, CH₄, N₂O	Linear interpolation between 1990 and 1998 for 1991-1997 and linear interpolation between 1998 and 2001 for 1999-2000
HFC	Linear trend extrapolation 2001-2003 for 1990-2000
SF₆	Emissions estimated on basis of emissions per electricity consumption of Latvia for 2F7 'Electrical equipment'
Luxembourg:	
CH₄, N₂O: totals	Values were estimated by linear interpolation between 1990 and 1994.
CO₂, CH₄, N₂O: sectoral tables	Values for the years 1990-1997, 1999, 2001 were estimated by applying the detailed category split (percentage shares in the sectoral tables) of 1998 (reported by Luxembourg) to the years 1990-1997 and 1999, and the detailed category split (percentage shares in the sectoral tables) of 2000 to the year 2001.
Table 1A(a)	For the estimation of Tables 1A(a) for the years 1990-1997, 1999 and 2001 GHG emissions by fuel groups were estimated on basis of shares in 1998 for 1990-1997 and 1999 and on basis of 2000 for 2001. Then the activity data for 1990-1997 and 1999 was estimated on basis of the implied emission factors of CO ₂ for 1998 and the activity data for 2001 was estimated on basis of implied emission factors of CO ₂ for 2000. In addition, for the years 1998, 2000 and 2002 CO ₂ emissions by fuel for road transport were estimated on basis of average implied emission factors of EU-14.
HFC, PFC, SF₆	For fluorinated gases 1998 emissions were used for 1990-1997 and 1999.
Malta	
CO₂, CH₄, N₂O: fuel combustion related	Extrapolation on basis of percentage change of Eurostat CO ₂ emissions for 2001; for 2002 and 2003 extrapolation on basis of GDP elasticity of GHG emissions
CO₂, CH₄, N₂O: non-fuel combustion related	Linear trend extrapolation 1990-2000; in a few cases previous year values were used.
HFC	Emissions estimated on basis of average per capita emissions of ES, GR, IT; PT for 2F1 'Refrigeration and air conditioning equipment'
SF₆	Emissions estimated on basis of average emissions per electricity consumption of ES, IT; PT for 2F7 'Electrical equipment'
Poland:	
General:	Trend extrapolation refers to 1995-2002 because in it was assumed that the time series is more consistent for these years.
CO₂, CH₄, N₂O: fuel combustion related	

Extrapolation on basis of percentage change of Eurostat CO₂ emissions

CO₂, CH₄, N₂O: non-fuel combustion related

Linear trend extrapolation 1995-2002; in a few cases previous year values were used

HFC

HFC for 2F were extrapolated on basis of total HFCs for 1995-1999; then linear trend extrapolation 1995-2002 for 1990-1994; linear trend extrapolation 1995-2002 for 2003.

PFC

PFC from 2C were extrapolated on basis of total PFCs for 1995-1999; then linear trend extrapolation 1995-2001 for 1990-1994; previous year value for 2003.

PFC from 2F were extrapolated on basis of total PFCs for 1995-1999; then linear trend extrapolation 1995-2000 for 1990-1994

SF₆

SF₆ from 2F extrapolated on basis of total SF₆ emissions for 1995-1999; then 1995 values for 1990-1994; linear trend extrapolation 2000-2002 for 2003.

Table 1.16 Sources of GHG emissions data for CRF Table Summary 1.A by Member State and type of submission

Member State	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Austria	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05
Belgium	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05
Cyprus	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05
Czech Republic	Inv02	Gap filling	Inv04	Gap filling	Inv03	Inv05	Inv04	Inv04	Inv04	Inv04	Inv04	Inv03	Inv04	Inv05
Denmark	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05
Estonia	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05
Finland	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05
France	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05
Germany	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05
Greece	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05
Hungary	Trend Inv05	Trend Inv05	Trend Inv05	Trend Inv05	Trend Inv05	Trend Inv05	Trend Inv05	Trend Inv05	Trend Inv05	Trend Inv05	Trend Inv05	Trend Inv05	Trend Inv05	Inv05
Ireland	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05
Italy	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05
Latvia	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05
Lithuania	Inv04	Gap-filling	Gap-filling	Gap-filling	Gap-filling	Gap-filling	Gap-filling	Gap-filling	Inv04	Gap-filling	Gap-filling	Inv04	Inv04	Inv05
Luxembourg	Inv00	Gap-filling	Gap-filling	Gap-filling	Inv97	Inv98	Inv98	Inv00	Inv04	Inv01	Inv04	Inv03	Inv04	Inv05
Malta	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Gap-filling	Gap-filling	Gap-filling
Netherlands	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05
Poland	Inv03	Inv03	Inv03	Inv03	Inv03	Inv03	Inv03	Inv03	Inv03	Inv03	Inv03	Inv04	Inv04	Gap filling
Portugal	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05
Slovakia	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05
Slovenia	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05
Spain	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05
Sweden	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05
UK	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05	Inv05

(¹) For Cyprus no CRF Tables Summary 1.A are available but only national totals for 1990-2000.

Note: This table indicates the source of GHG emission data and whether data were available for specific years. It does not indicate whether the submission for a year covers all gases, categories or CRF tables. All data sources which are not from 2005 are shaded.

Data on CO₂ emissions, GDP, population and electricity consumption were either downloaded from the Eurostat home page or provided by Eurostat in March 2005. Note that all estimates which were derived from the gap-filling approaches described above are marked grey in the tables of the next chapter. In addition, they are documented in the relevant annexes: red font refers to gap-filling in 2005; blue font refers to gap-filling in previous years.

1.8.3 Data basis of the European Community greenhouse gas inventory

The 2005 EC GHG inventory data consist of:

- the GHG submissions of the Member States to the Commission in 2005;
- previous GHG submissions, in cases where Member States did not provide

the complete time series for each gas in 2002;

- emission estimates derived from data gap filling in cases where no data were available for a specific gas and year (used only in few cases).

Table 1.16 shows the sources of GHG emissions data by Member State and type of submission.

Tables 1.17 to 1.20 show the data basis of the 2004 EC GHG inventory. Values in white cells without a frame are data provided by Member States in 2004 in the CRF Table Summary 1.A. Framed cells indicate that the emission data have been taken from Member States' submissions in previous years. Shaded values derive from gap-filling. 'NE' ('not estimated') indicates that data are not available and that no gap-filling has been made.

Table 1.17 Data basis of CO₂ emissions excluding LUCF (Tg)

EC Member State	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Austria	61.3	64.8	59.3	59.9	60.2	63.1	66.6	66.5	66.2	64.6	65.5	69.3	71.0	76.2
Belgium	119.0	122.1	120.2	119.1	122.5	123.6	127.7	122.2	127.4	122.0	123.8	123.4	123.0	126.3
Cyprus	4.6	4.7	5.3	5.6	5.6	5.6	5.9	5.9	6.4	6.4	6.7	6.6	6.8	7.2
Czech Republic	164.0	151.9	139.8	135.2	130.6	131.4	132.8	137.4	128.3	121.1	127.9	128.0	123.0	127.1
Denmark	52.9	63.6	57.8	60.1	63.7	60.6	74.0	64.5	60.4	57.5	53.1	54.6	54.3	59.3
Estonia	38.1	35.9	26.1	20.6	21.4	19.3	20.3	20.2	18.3	16.8	16.8	17.1	17.3	19.1
Finland	56.3	55.8	54.5	54.7	61.1	58.1	63.4	62.3	59.5	59.2	57.6	63.2	65.0	73.2
France	396.9	421.5	413.7	393.5	389.0	395.3	409.2	403.1	422.3	411.2	405.0	410.8	403.2	408.2
Germany	1 015.0	976.9	929.5	920.0	905.6	902.2	924.9	893.5	885.2	857.4	860.1	873.9	863.9	865.4
Greece	84.0	83.7	84.7	85.3	87.2	87.3	89.5	94.3	98.9	98.2	104.1	106.3	106.2	110.0
Hungary	72.3	68.4	62.0	62.7	61.6	60.9	62.2	60.5	60.1	60.0	57.8	59.4	57.7	60.5
Ireland	31.8	32.5	33.1	32.7	34.1	34.8	36.0	38.3	40.2	42.1	44.2	46.5	45.8	44.4
Italy	430.6	430.5	429.5	424.4	417.3	446.7	438.9	443.1	453.0	460.3	467.5	472.0	471.4	487.3
Latvia	18.7	17.2	13.3	11.9	11.5	9.0	9.2	8.7	8.1	7.4	6.9	7.4	7.3	7.4
Lithuania	38.9	33.9	31.2	28.4	25.6	22.8	20.0	17.2	15.7	14.9	14.1	13.3	12.7	12.3
Luxembourg	12.0	12.2	12.0	12.3	12.0	9.3	9.4	8.6	7.7	8.4	8.9	9.2	10.2	10.7
Malta	1.9	2.1	2.2	2.2	2.3	2.3	2.3	2.3	2.4	2.5	2.4	2.4	2.5	2.5
Netherlands	158.0	162.9	161.1	165.5	165.5	169.7	177.3	170.2	172.2	166.9	168.9	174.4	173.9	176.9
Poland	380.7	367.0	371.6	363.1	371.6	348.2	372.5	361.6	337.4	329.7	314.8	317.8	308.3	321.3
Portugal	43.6	45.4	49.5	48.1	49.3	53.2	50.3	53.5	58.1	64.8	63.6	64.7	68.8	64.3
Slovakia	59.4	52.1	48.4	45.4	42.4	43.8	44.4	44.7	43.6	42.6	39.5	44.4	43.8	43.1
Slovenia	14.6	13.6	13.5	14.0	13.9	14.8	15.6	16.1	16.0	15.2	15.2	16.2	16.3	16.1
Spain	228.4	235.1	243.2	233.4	244.9	255.5	242.7	262.6	270.8	295.9	308.2	310.5	331.1	331.8
Sweden	56.3	56.7	56.5	56.1	58.7	57.6	61.2	56.8	57.5	54.7	52.4	53.5	54.8	56.0
United Kingdom	588.8	595.4	580.1	566.4	559.1	550.3	572.2	548.4	551.2	541.0	545.3	562.3	545.3	557.5
EU-25	4 128.2	4 105.9	3 997.9	3 920.6	3 916.6	3 925.3	4 028.4	3 962.5	3 966.9	3 920.8	3 931.1	4 005.1	3 982.1	4 063.9

Note: Values in white cells without a frame are data provided by Member States in 2004 in the CRF Table Summary 1.A. Framed cells indicate that the emission data have been taken from Member States' submissions in previous years. Shaded values derive from gap-filling. 'NE' ('not estimated') indicates that data are not available and that no gap-filling has been made.

Table 1.18 Data basis of CH₄ emissions in CO₂ equivalents (Tg)

EC Member State	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Austria	9.8	9.8	9.5	9.4	9.3	9.1	9.0	8.7	8.6	8.4	8.1	8.0	7.9	7.8
Belgium	10.8	10.8	10.8	10.6	10.7	10.8	10.6	10.5	10.4	10.1	9.8	9.2	8.8	8.5
Cyprus	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.9	0.9	0.9	1.0	1.0
Czech Republic	16.8	15.6	14.4	13.7	13.0	12.9	12.6	12.1	11.4	10.7	10.7	10.5	10.4	10.2
Denmark	5.7	5.8	5.8	6.0	6.0	6.1	6.2	6.1	6.0	6.0	5.9	6.0	6.0	5.9
Estonia	4.4	3.7	3.0	2.4	2.6	2.6	2.8	3.0	2.8	2.5	2.5	2.0	1.9	2.0
Finland	6.4	6.4	6.4	6.4	6.4	6.2	6.1	6.1	5.8	5.7	5.5	5.4	5.2	5.0
France	68.1	68.7	68.3	68.7	70.2	70.9	70.4	66.9	66.6	65.3	64.9	63.7	62.0	60.6
Germany	132.1	121.1	117.4	112.8	108.7	104.9	100.5	97.2	91.9	88.4	82.9	79.3	76.5	75.2
Greece	10.1	10.0	10.2	10.3	10.5	10.6	10.8	10.9	11.2	10.4	10.5	10.1	10.1	10.2
Hungary	11.9	11.4	10.8	10.1	9.9	10.1	10.2	10.1	10.4	10.0	10.1	10.4	9.8	9.5
Ireland	12.0	12.3	12.4	12.5	12.6	12.7	12.9	13.1	13.1	13.0	13.0	12.8	12.8	12.8
Italy	38.3	39.0	37.8	38.0	38.0	38.3	38.2	38.5	38.3	38.5	38.1	37.1	35.9	34.6
Latvia	3.7	3.6	3.1	2.3	2.2	2.4	2.3	2.3	2.3	2.3	2.2	2.2	2.2	1.9
Lithuania	7.9	7.4	6.9	6.4	5.8	5.3	4.8	4.3	3.7	3.5	3.4	3.2	3.6	3.6
Luxembourg	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Malta	0.3	0.3	0.3	0.4	0.3	0.4	0.4	0.3	0.3	0.3	0.4	0.3	0.3	0.3
Netherlands	25.6	25.9	25.4	25.0	24.2	23.8	23.2	22.1	21.3	20.2	19.5	19.0	18.2	17.5
Poland	58.8	54.4	52.0	51.1	51.8	51.6	47.3	47.8	49.0	47.3	45.9	38.8	37.8	37.9
Portugal	10.2	10.6	10.2	10.2	10.4	10.9	10.8	11.0	11.5	11.8	10.8	10.5	10.8	12.1
Slovakia	6.3	5.9	5.5	5.1	5.0	5.2	5.2	5.0	4.7	4.6	4.6	4.4	4.7	4.6
Slovenia	2.2	2.1	2.1	2.0	2.0	2.0	2.0	2.0	2.2	2.0	2.0	2.0	2.0	2.0
Spain	27.8	28.0	28.8	29.1	30.0	30.6	32.0	32.9	34.1	34.4	35.4	36.3	36.7	37.1
Sweden	6.5	6.5	6.6	6.7	6.6	6.5	6.5	6.4	6.2	6.0	5.8	5.8	5.6	5.5
United Kingdom	77.5	76.7	75.6	73.0	66.3	66.0	64.1	61.0	57.6	53.7	49.9	47.0	45.0	40.6
EU-25	554.4	536.9	524.8	513.4	504.0	501.0	490.3	479.4	470.9	456.4	443.3	425.4	415.4	406.7
EU-15	441.5	431.9	425.9	419.2	410.4	407.9	401.9	391.7	383.2	372.3	360.7	350.7	341.9	333.7

Note: Values in white cells without a frame are data provided by Member States in 2004 in the CRF Table Summary 1.A. Framed cells indicate that the emission data have been taken from Member States' submissions in previous years. Shaded values derive from gap-filling. 'NE' ('not estimated') indicates that data are not available and that no gap-filling has been made.

Table 1.19 Data basis of N₂O emissions in CO₂ equivalents (Tg)

EC Member State	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Austria	5.7	6.1	5.7	5.6	6.0	6.1	5.8	5.9	6.0	5.8	5.8	5.7	5.6	5.5
Belgium	12.2	12.2	11.8	12.2	13.2	13.1	13.5	13.1	13.3	13.1	12.9	12.7	12.2	11.3
Cyprus	0.7	0.7	0.8	0.8	0.8	0.8	0.9	0.9	0.9	0.9	1.0	0.9	1.0	1.0
Czech Republic	11.3	10.2	9.2	8.8	8.3	8.8	9.2	8.8	8.4	8.1	8.2	8.3	8.2	8.2
Denmark	10.7	10.6	10.1	9.9	9.8	9.7	9.4	9.2	9.1	8.8	8.6	8.4	8.0	8.1
Estonia	1.0	1.0	0.8	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.3
Finland	7.6	7.2	6.6	6.7	6.8	7.1	7.1	7.4	7.2	7.1	6.5	6.5	6.6	6.7
France	93.1	92.8	93.7	89.0	91.0	92.5	92.9	94.9	87.7	80.4	80.9	78.5	75.8	74.6
Germany	86.4	82.8	84.2	80.8	81.1	80.9	82.2	79.0	65.8	62.0	62.2	62.5	61.6	63.7
Greece	14.2	13.9	14.0	13.1	13.4	13.1	13.6	13.4	13.3	13.2	13.5	13.2	13.2	13.3
Hungary	18.9	15.2	12.3	12.0	13.2	12.4	13.3	13.2	13.2	13.1	12.6	13.5	12.6	12.4
Ireland	10.0	10.1	10.2	10.2	10.4	10.6	10.8	10.9	11.2	11.4	11.3	10.9	10.2	9.7
Italy	39.9	41.2	40.6	40.9	39.8	41.0	40.8	42.0	41.8	42.9	43.0	43.0	43.0	42.4
Latvia	3.1	2.9	2.2	1.5	1.3	1.1	1.1	1.1	1.1	1.0	1.0	1.1	1.1	1.2
Lithuania	4.1	3.9	3.7	3.5	3.3	3.0	2.8	2.6	2.4	2.9	3.4	3.8	3.3	1.3
Luxembourg	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1

EC Member State	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Malta	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
Netherlands	21.3	21.7	22.4	23.1	22.3	22.4	22.2	22.0	21.7	20.9	19.9	18.9	18.0	17.3
Poland	19.4	16.1	15.6	15.4	15.6	16.7	16.7	16.7	16.0	23.3	23.9	23.9	22.6	23.0
Portugal	6.1	6.0	5.8	5.6	5.8	6.0	6.2	6.1	6.1	6.4	6.1	6.3	6.4	6.5
Slovakia	6.0	5.2	4.4	3.9	4.1	4.2	4.2	4.3	4.0	3.8	3.8	4.0	3.9	3.9
Slovenia	1.5	1.4	1.5	1.4	1.4	1.4	1.4	1.4	1.7	1.5	1.5	1.5	1.5	1.5
Spain	24.3	23.9	23.1	21.5	23.5	23.1	25.7	25.0	25.7	26.8	28.0	26.8	26.4	27.9
Sweden	8.9	8.7	8.7	8.8	8.9	8.7	8.9	8.8	8.8	8.4	8.3	8.2	8.2	8.2
United Kingdom	67.9	66.0	59.1	55.4	58.6	57.1	59.1	60.8	58.1	45.0	44.9	42.6	41.0	40.4
EU25	474.5	459.8	446.5	430.8	439.3	440.6	448.4	448.3	424.1	407.3	407.5	402.0	390.8	388.5
EU-15	408.5	403.2	396.1	383.0	390.9	391.7	398.2	398.8	376.0	352.4	351.8	344.4	336.3	335.7

Note: Values in white cells without a frame are data provided by Member States in 2004 in the CRF Table Summary 1.A. Framed cells indicate that the emission data have been taken from Member States' submissions in previous years. Shaded values derive from gap-filling. 'NE' ('not estimated') indicates that data are not available and that no gap-filling has been made.

Table 1.20 Data basis of actual HFCs, PFCs and SF₆ emissions in CO₂ equivalents (Gg)

Member State		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Austria	HFC	219	335	387	444	505	555	637	730	813	867	1 019	1 122	1 219	1 308
	PFC	1 079	1 087	463	53	59	69	66	97	45	65	72	82	87	103
	SF ₆	503	653	698	794	986	1 139	1 218	1 120	908	684	633	637	641	594
Belgium	HFC	255	255	255	255	255	255	386	526	669	691	759	920	1 148	1 322
	PFC	1 753	1 678	1 830	1 759	2 113	2 335	2 217	1 211	669	348	361	228	108	209
	SF ₆	1 663	1 576	1 744	1 677	2 035	2 205	2 120	525	270	120	109	105	94	75
Cyprus	HFC	0	0	0	0	1	2	4	6	10	14	19	25	31	38
	PFC	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
	SF ₆	1	1	1	1	2	2	3	3	3	2	2	2	3	4
Czech Republic	HFC	0	0	0	0	0	2	135	296	382	412	674	1 045	1 092	0
	PFC	0	0	0	0	0	0	4	7	9	3	9	14	18	0
	SF ₆	113	124	135	146	156	167	183	323	132	111	206	223	212	0
Denmark	HFC	0	0	3	94	135	218	329	324	411	503	605	647	672	695
	PFC	0	0	0	0	0	1	2	4	9	12	18	22	22	19
	SF ₆	44	64	89	101	122	107	61	73	59	65	59	30	25	31
Estonia	HFC	0	0	0	0	0	0	1	1	2	3	4	5	6	7
	PFC	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
	SF ₆	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Finland	HFC	0	0	0	0	7	29	77	168	245	319	502	657	463	652
	PFC	0	0	0	0	0	0	0	0	0	28	22	20	13	15
	SF ₆	94	67	37	34	35	69	72	76	53	52	51	55	51	42
France	HFC	3 633	4 195	3 618	2 311	1 536	2 068	3 394	4 246	4 720	5 747	6 857	8 390	9 902	11 412
	PFC	3 458	2 811	2 527	2 328	2 037	1 275	1 303	1 399	1 578	1 830	1 545	1 249	1 609	1 319
	SF ₆	2 195	2 220	2 247	2 274	2 301	2 329	2 353	2 267	2 179	1 899	1 858	1 725	1 567	1 585
Germany	HFC	3 510	3 547	3 677	4 950	5 178	6 360	5 768	6 356	6 979	7 280	6 630	8 130	8 247	8 247
	PFC	2 626	2 286	2 068	1 942	1 607	1 759	1 723	1 377	1 481	1 247	790	723	786	786
	SF ₆	3 967	4 350	4 876	5 401	5 808	6 633	6 359	6 274	6 038	4 414	4 018	3 325	4 197	4 197
Greece	HFC	935	1 107	908	1 638	2 209	3 369	3 916	4 194	4 670	5 436	4 273	3 873	4 009	4 140
	PFC	258	258	252	153	94	83	72	165	204	132	148	91	88	77
	SF ₆	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Hungary	HFC	NO	NO	0	0	1	2	2	45	125	347	206	281	393	478
	PFC	271	234	135	146	159	167	159	161	172	189	211	199	203	190
	SF ₆	40	53	49	52	68	70	69	68	68	127	140	107	120	162

Member State		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Ireland	HFC	0	0	0	0	0	21	58	79	104	152	190	231	253	288
	PFC	0	0	5	30	54	75	103	131	62	196	305	297	207	224
	SF ₆	113	110	107	103	100	83	101	132	91	63	52	67	71	100
Italy	HFC	351	355	359	355	482	671	450	755	1 181	1 452	2 005	2 759	3 561	4 575
	PFC	1 808	1 423	799	631	355	337	243	252	270	258	346	452	414	494
	SF ₆	333	356	358	370	416	601	683	729	605	405	493	795	738	486
Latvia	HFC	NO/NE	NO/NE	NO/NE	NO/NE	NO/NE	0	1	2	5	7	9	10	12	13
	PFC	NO/NE	NO/NE	NO/NE	NO/NE	NO/NE	0	0	0	0	0	0	0	0	0
	SF ₆	0	0	0	0	0	0	0	1	1	1	1	2	3	4
Lithuania	HFC	0	0	0	0	0	0	0	4	8	12	16	14	35	22
	PFC	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
	SF ₆	0	0	0	0	0	0	0	1	1	1	2	3	5	6
Luxembourg	HFC	43	43	43	43	43	43	43	43	43	43	43	43	43	43
	PFC	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SF ₆	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Malta	HFC	0	0	0	0	1	1	2	4	5	8	11	14	17	21
	PFC	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
	SF ₆	0	1	1	1	1	1	2	2	1	1	1	1	2	2
Netherlands	HFC	4 432	3 452	4 447	4 998	6 518	6 011	7 664	8 295	9 348	4 868	3 839	1 492	1 566	1 450
	PFC	2 115	2 095	1 905	1 926	1 853	1 806	2 002	2 177	1 730	1 466	1 521	1 417	1 416	1 396
	SF ₆	217	134	143	150	191	301	312	345	329	317	335	357	359	334
Poland	HFC	0	0	0	0	0	22	68	192	224	555	890	1 283	1 257	1 510
	PFC	829	825	821	816	812	820	775	829	810	777	720	881	266	266
	SF ₆	2	2	2	2	2	2	1	3	6	17	17	18	18	19
Portugal	HFC	0	0	0	0	0	0	0	1	6	12	24	37	49	62
	PFC	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SF ₆	0	0	0	0	0	5	5	5	5	6	6	7	7	7
Slovakia	HFC	3	3	3	3	3	25	45	70	44	66	78	83	104	134
	PFC	271	267	249	156	132	114	35	33	24	14	12	11	11	21
	SF ₆	0	0	0	0	9	10	11	11	12	13	13	13	14	15
Slovenia	HFC	0	0	0	0	0	31	30	38	0	34	45	56	69	83
	PFC	257	303	243	251	282	286	240	194	276	106	106	106	116	119
	SF ₆	7	7	7	7	7	25	22	21	7	21	21	21	21	21
Spain	HFC	2 403	2 179	2 763	2 258	3 458	4 645	5 197	6 126	5 809	7 164	8 170	5 284	3 892	4 963
	PFC	883	827	790	831	819	833	797	820	769	704	412	240	264	267
	SF ₆	67	73	76	80	88	106	114	135	153	198	225	227	255	296
Sweden	HFC	4	8	11	33	73	129	181	276	311	372	419	441	462	471
	PFC	440	433	336	351	349	391	351	324	309	329	270	267	301	299
	SF ₆	107	110	109	98	102	129	111	156	99	101	92	115	103	66
United Kingdom	HFC	11 375	11 854	12 323	13 000	14 010	15 491	16 720	19 181	17 268	10 830	9 081	9 728	10 418	10 699
	PFC	1 394	1 164	571	485	481	457	496	450	441	446	541	438	384	377
	SF ₆	1 082	1 130	1 176	1 219	1 235	1 291	1 319	1 275	1 312	1 472	1 852	1 458	1 594	1 559
Total	HFC	27 163	27 333	28 797	30 384	34 415	39 952	45 109	51 957	53 382	47 194	46 366	46 569	48 921	52 635
	PFC	17 443	15 690	12 993	11 857	11 206	10 808	10 588	9 632	8 859	8 149	7 411	6 738	6 314	6 179
	SF₆	10 557	11 039	11 861	12 517	13 672	15 285	15 125	13 551	12 340	10 097	10 196	9 301	10 107	9 613

Note: Values in white cells without a frame are data provided by Member States in 2004 in the CRF Table Summary 1.A. Framed cells indicate that the emission data have been taken from Member States' submissions in previous years. Shaded values derive from gap-filling. 'NE' ('not estimated') indicates that data are not available and that no gap-filling has been made.

Table 1.21 Geographical coverage of the EC inventory

Member State	Geographical coverage
Austria	Austria
Belgium	Belgium
Cyprus	Cyprus
Czech Republic	Czech Republic
Denmark	Denmark (excluding Greenland and the Faeroe Islands)
Estonia	Estonia
Finland	Finland and Åland Islands
France	France, the overseas departments (Guadeloupe, Martinique, Guyana and Reunion) and the overseas territories (New Caledonia, Wallis and Futuna, French Polynesia, Mayotte, Saint-Pierre and Miquelon)
Germany	Germany
Greece	Greece
Hungary	Hungary
Ireland	Ireland
Italy	Italy
Latvia	Latvia
Lithuania	Lithuania
Luxembourg	Luxembourg
Malta	Malta
Netherlands	Netherlands, including a 12-mile zone from the coastline and inland water bodies, emissions from offshore oil and gas production at the Netherland's part of the continental shelf. Excluded are Aruba and the Netherlands Antilles
Poland	Poland
Portugal	Portugal, Madeira, Azores
Slovakia	Slovakia
Slovenia	Slovenia
Spain	Spanish part of Iberian mainland, Canary Islands, Balearic Islands, Ceuta and Melilla
Sweden	Sweden
United Kingdom	England, Scotland, Wales, Northern Ireland

1.8.4 Geographical coverage of the European Community inventory

Table 1.21 shows the geographical coverage of the Member States' national inventories. As the EC inventory is the sum of the Member States' inventories, the EC inventory covers the same geographical area as the inventories of the Member States.

1.8.5 Completeness of the European Community submission

National inventory report

This year the EC submission provides GHG emission data for the EU-25 and for the EU-15. Most chapters and annexes of this report refer to the EU-15 only, i.e. Chapters 3–10 and Annexes 1,2,4–11. Chapters 1 and 2 and also Annexes 3, 12 and 13 refer to EU-25, where relevant. This means that all the detailed information provided in previous reports for the EU-15 is also available in this report. In addition, basic information on data availability, QA/QC, uncertainty

estimates, completeness and emission trends are provided for the EU-25. Table 1.22 shows which information is provided for EU-25 and which chapters refer to the EU-15 only.

CRF tables in Annex 2

This year more information is provided in the EU-15 CRF tables. Tables 1.C and 2(II) are included for the first time and in some other sectoral background data tables activity data have been included in order to allow the calculation of implied emission factors at EU-15 level. In addition, overview tables have been included in the inventory report, including background information on activity data and implied emission factors by the EU-15 Member States.

The main reasons for including only a limited number of 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-

Table 1.22 Coverage of EC national inventory report (EU-25 or EU-15 only)

Chapter/Annex		EU-25	EU-15 only
Chapter 1	Introduction		
1.1	Background information	☒	
1.2	Institutional arrangements	☒	
1.3	Process of inventory preparation	☒	
1.4	General description of methods and data sources	☒	
1.5	Key source categories		☒
1.6	QA/QC	☒	
1.7	Uncertainty evaluation	☒	
1.8	Completeness	☒ (not Tables 1.13–1.15)	Tables 1.13–1.15
Chapter 2	Emission trends		
2.1	Aggregated GHG emissions	☒	
2.2	Emission trends by gas	☒	
2.3	Emission trends by sector	☒	
2.4	Emission trends by Member States	☒	
2.5	Emission trends for indirect GHG and SO ₂		☒
Chapter 3	Energy		☒
Chapter 4	Industrial processes		☒
Chapter 5	Solvent use		☒
Chapter 6	Agriculture		☒
Chapter 7	LUCF		☒
Chapter 8	Waste		☒
Chapter 9	Other		☒
Chapter 10	Recalculations and improvements		☒
Annex 1	Key sources		☒
Annex 2	EC CRF tables		☒
Annex 3	Status reports	☒	
Annex 4	CRF Table Summary 1.A		☒
Annex 5	CRF Table 1		☒
Annex 6	CRF Table 2(I)		☒
Annex 7	CRF Table 2(II)		☒
Annex 8	CRF Table 3		☒
Annex 9	CRF Table 4		☒
Annex 10	CRF Table 5		☒
Annex 11	CRF Table 6		☒
Annex 12	CRF Table 10 for EU-25	☒	
Annex 13	MS CRF and NIR	☒	

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 simply be 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 less 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 13, which is available at the EEA

website <http://www.eea.eu.int>). However, in order to support the understanding of the emission trends at EU-15 level and in order to enable the calculation of some important implied emission factors, this year the EU-15 provides a selected number of activity data. The focus of these activity data are on the largest EU-15 key sources.

Table 1.23 provides an overview of 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.

Table 1.23 Inclusion of CRF tables in Annex 2

Table	Included in Annex 2	Comment
Energy		
Table 1	Yes	
Table 1.A (a)	Yes	Includes estimates for Luxembourg for 1990–1997, 1999 and 2001
Table 1.A (b)	Yes	
Table 1.A (c)	Yes	
Table 1.A (d)	Yes	
Table 1.B.1	Yes	Refers to EU-15 (does not include Luxembourg)
Table 1.B.2	No	Type of activity data used by the MS varies; overview table for 1B2b included in the NIR
Table 1.C	Yes	Refers to EU-15 (does not include Luxembourg)
Industrial processes		
Table 2(I)	Yes	
Table 2(II)	Yes	Refers to EU-15 (does not include Luxembourg)
Table 2(I). A–G	No	Type of activity data used by the MS varies; overview tables for large key sources included in the NIR
Table 2(II). C,E	No	Type of activity data used by the MS varies; limited data availability; confidentiality issues
Table 2(II). F	No	Limited data availability; confidentiality issues
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	Animal population size and IEF included
Table 4. B(a)	Yes	Animal population size and IEF included
Table 4. B(b)	Yes	Animal population included
Table 4. C	Yes	Activity data and IEF are included
Table 4. D	Yes	Activity data and IEF are included with the exception of crops (because these data vary between MS)
Table 4. E	Yes	
Table 4. F	Yes	Activity data and IEF are included
LUCF		
Table 5	Yes	
Table 5. A	No	Type of activity data used by the MS varies; limited data availability
Table 5. B	No	Type of activity data used by the MS varies; limited data availability
Table 5. C	No	Type of activity data used by the MS varies; limited data availability
Table 5. D	No	Type of activity data used by the MS varies; limited data availability
Table 5. E	No	Type of activity data used by the MS varies; limited data availability
Waste		
Table 6	Yes	
Table 6. A, C	Yes	Annual MSW at the SWDS, DOC degraded, CH ₄ recovery and IEF are included
Table 6. B	No	Limited data availability
Summary and other		
Summary 1.A	Yes	
Summary 1.B	Yes	
Summary 2	Yes	
Summary 3	Yes	
Table 7	Yes	
Table 8(a)	Yes	
Table 8(b)	Yes	
Table 9	Yes	
Table 10	Yes	
Table 11	Yes	

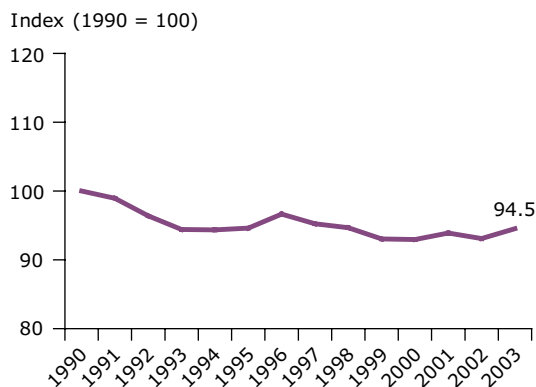
2 European Community greenhouse gas emission trends

This chapter presents the main GHG emission trends in the EC. Firstly, aggregated results are described for the EU-25 and the EU-15 as regards total GHG emissions and progress towards fulfilling the EC Kyoto target (for the 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 SO₂ emissions are also presented for the EU-15 only.

2.1 Aggregated greenhouse gas emissions

Total GHG emissions without LUCF in the EU-25 decreased by 5.5 % between 1990 and 2003 (Figure 2.1). Emissions increased by 1.5 % between 2002 and 2003.

Figure 2.1 EU-25 GHG emissions 1990–2003 compared with target for 2008–2012 (excl. LUCF)

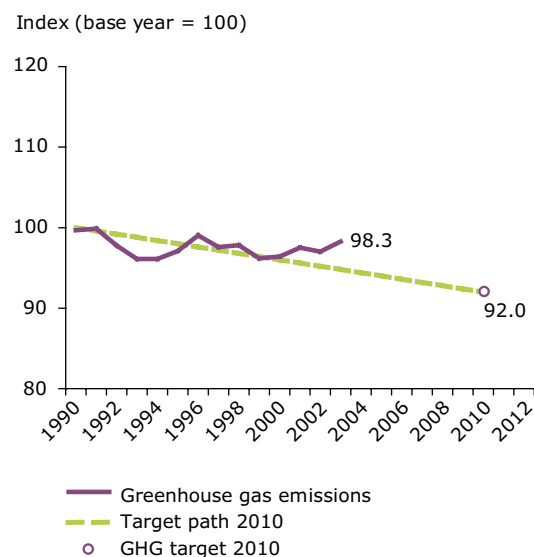


Total GHG emissions without LUCF in the EU-15 were 1.7 % below the base year in 2003. In the Kyoto Protocol, the EC agreed to reduce its GHG emissions by 8 % by 2008–2012, from base year levels. Assuming a linear target path from 1990 to 2010, total EU-15 GHG emissions were 3.5 index points above this target path in 2003 (Figure 2.2).

Compared to 2002, EU-15 GHG emissions increased in 2003 by 1.3 % or 53 million tonnes. The increases mainly occurred from energy industries (+ 24 million tonnes or 2.1 %), mainly due to growing thermal

power production and a 5 % increase of coal consumption in thermal power stations. The increase in thermal power production was driven by a combination of higher electricity consumption and an almost stable supply of electricity from hydro and nuclear power. In addition, greenhouse gas emissions from households and the services sector increased considerably (+ 18 million tonnes or + 2.8 %), partly due to colder weather in the first quarter of 2003.

Figure 2.2 EU-15 GHG emissions 1990–2003 compared with target for 2008–2012 (excl. LUCF)



Note: 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 2003 are to a linear path of emissions reductions from 1990 to the Kyoto target for 2008–2012, 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 2008–2012, but aims at evaluating overall EU-15 GHG emissions in 2003. 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 LUCF. 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. Thirteen Member States have indicated to

Table 2.1 Overview of EU-25 GHG emissions and removals from 1990 to 2003 in CO₂ equivalents (Tg)

GREENHOUSE GAS Emissions	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Net CO ₂ emissions/ removals	3 818	3 748	3 645	3 567	3 561	3 571	3 657	3 597	3 619	3 542	3 562	3 606	3 560	3 669
CO ₂ emissions (without LUCF)	4 128	4 106	3 998	3 921	3 917	3 925	4 028	3 963	3 967	3 921	3 931	4 005	3 982	4 064
CH ₄	554	537	525	513	504	501	490	479	471	456	443	425	415	407
N ₂ O	474	460	447	431	439	441	448	448	424	407	408	402	391	389
HFCs	27	27	29	30	34	40	45	52	53	47	46	47	49	53
PFCs	17	16	13	12	11	11	11	10	9	8	7	7	6	6
SF ₆	11	11	12	13	14	15	15	14	12	10	10	9	10	10
Total (with net CO₂ emissions/ removals)	4 902	4 798	4 670	4 566	4 563	4 579	4 666	4 600	4 589	4 471	4 477	4 496	4 432	4 533
Total (without CO₂ from LUCF)	5 212	5 157	5 023	4 920	4 919	4 933	5 038	4 965	4 936	4 850	4 846	4 895	4 854	4 928
Total (without LUCF)	5 212	5 156	5 023	4 919	4 917	4 931	5 036	4 964	4 935	4 849	4 844	4 894	4 852	4 925

Table 2.2 Overview of EU-15 GHG emissions and removals from 1990 to 2003 in CO₂ equivalents (Tg)

GREENHOUSE GAS Emissions	Base year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Net CO ₂ emissions/ removals	3 111	3 111	3 088	3 023	2 970	2 964	3 004	3 063	3 008	3 053	3 010	3 044	3 086	3 058	3 138
CO ₂ emissions (without LUCF)	3 335	3 335	3 359	3 285	3 232	3 230	3 267	3 343	3 288	3 331	3 304	3 328	3 394	3 388	3 447
CH ₄	441	441	432	426	419	410	408	402	392	383	372	361	351	342	334
N ₂ O	408	408	403	396	383	391	392	398	399	376	352	352	344	336	336
HFCs	41	27	27	29	30	34	40	45	51	53	46	44	44	46	50
PFCs	12	16	14	12	10	10	9	9	8	8	7	6	6	6	6
SF ₆	15	10	11	12	12	13	15	15	13	12	10	10	9	10	9
Total (with net CO₂ emissions/ removals)	4 029	4 015	3 976	3 897	3 825	3 823	3 868	3 932	3 872	3 884	3 797	3 817	3 839	3 798	3 873
Total (without CO₂ from LUCF)	4 253	4 238	4 246	4 159	4 087	4 089	4 131	4 212	4 151	4 162	4 092	4 101	4 148	4 127	4 182
Total (without LUCF)	4 252	4 238	4 246	4 159	4 087	4 088	4 129	4 211	4 150	4 160	4 091	4 100	4 146	4 126	4 180

select 1995 as the base year under the Kyoto Protocol, Finland and France have indicated to use 1990. Therefore, the EU-15 base year estimates for fluorinated gas emissions are the sum of 1995 emissions for 13 Member States and 1990 emissions for Finland and France.

The index on the y axis refers to the base year (1995 for fluorinated gases for all Member States except Finland and France, 1990 for fluorinated gases for Finland and France and for all other gases). This means

that the value for 1990 doesn't need to be exactly 100.

2.2 Emission trends by gas

Table 2.1 gives an overview of the main trends in EU-25 GHG emissions and removals for 1990–2003. The most important GHG by far is CO₂, accounting for 82 % of total EU-25 emissions in 2003. In 2003, EU-25 CO₂ emissions without LUCF were 4 064 Tg, which was 1.6 % below 1990 levels.

Compared to 2002, CO₂ emissions increased by 2.1 %.

Table 2.2 gives an overview of the main trends in EU-15 GHG emissions and removals for 1990–2003. Also in the EU-15, the most important GHG by is CO₂, also accounting for 82 % of total EU-15 emissions in 2003. In 2003, EU-15 CO₂ emissions without LUCF were 3 447 Tg, which was 3.4 % above 1990 levels (Figure 2.3). Compared to 2002, CO₂ emissions increased by 1.8 %. The largest four key sources account for 81 % of total CO₂ emissions in 2003. Figure 2.4 shows that the main reason for increases between 1990 and 2003 was growing road transport demand. The large increase in road transport-related

CO₂ emissions was only partly offset by reductions in energy-related emissions from manufacturing industries and from ‘Other’. The largest reductions of ‘Other’ as shown in Figure 2.4 occurred in 1.A.1.c ‘Manufacture of solid fuels and other energy industries’ and in 1.A.5 ‘Other’.

CH₄ emissions account for 8 % of total EU-15 GHG emissions and have decreased by 24 % since 1990 to 334 Tg (CO₂ equivalents) in 2003 (Figure 2.5). The two largest key sources account for slightly more than 50 % of CH₄ emissions in 2003. Figure 2.6 shows that the main reasons for declining CH₄ emissions were reductions in solid waste disposal on land, the decline of coal-mining and falling cattle population.

Figure 2.3 CO₂ emissions without LUCF 1990 to 2003 in CO₂ equivalents (Tg) and share of largest key source categories in 2003 for EU-15

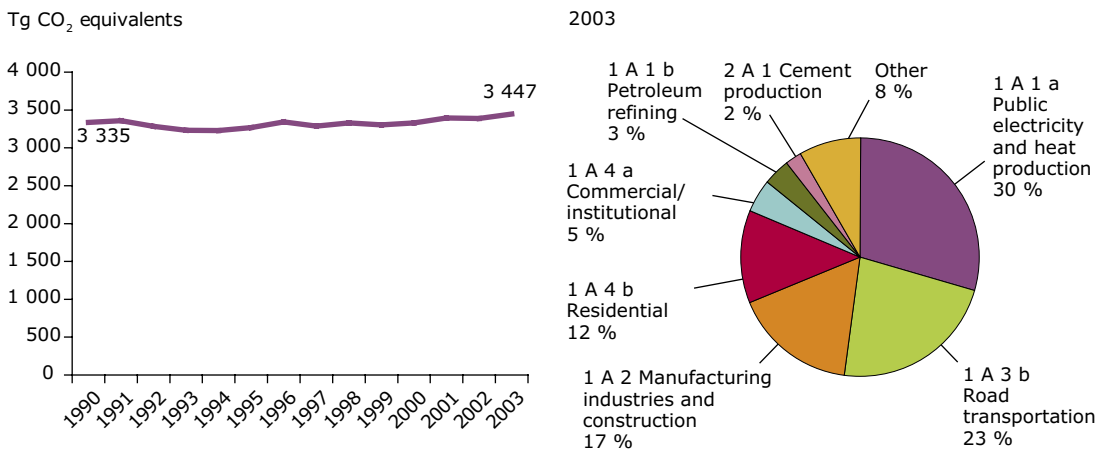


Figure 2.4 Absolute change of CO₂ emissions by large key source categories 1990 to 2003 in CO₂ equivalents (Tg) for EU-15

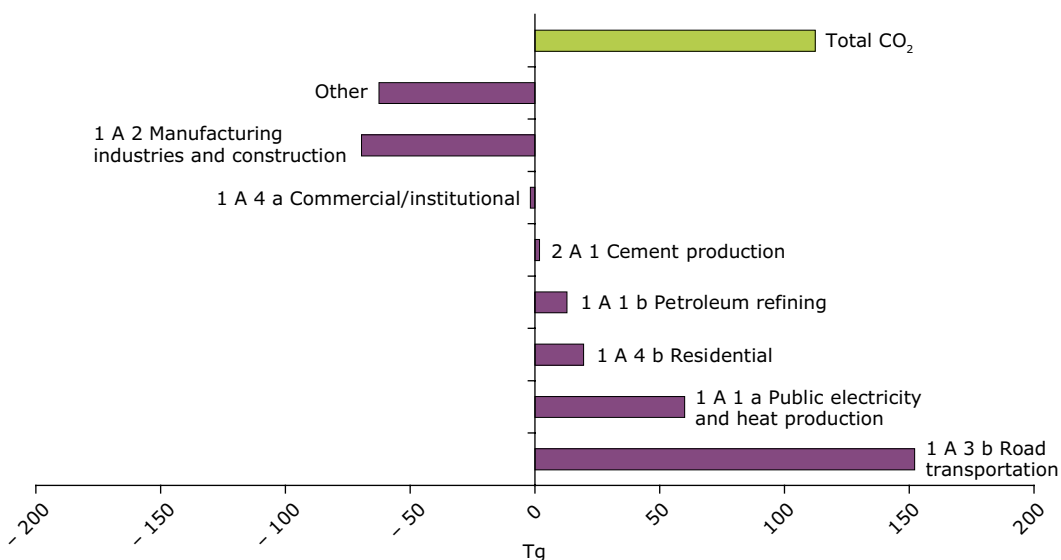


Figure 2.5 CH₄ emissions 1990 to 2003 in CO₂ equivalents (Tg) and share of largest source categories in 2003 for EU-15

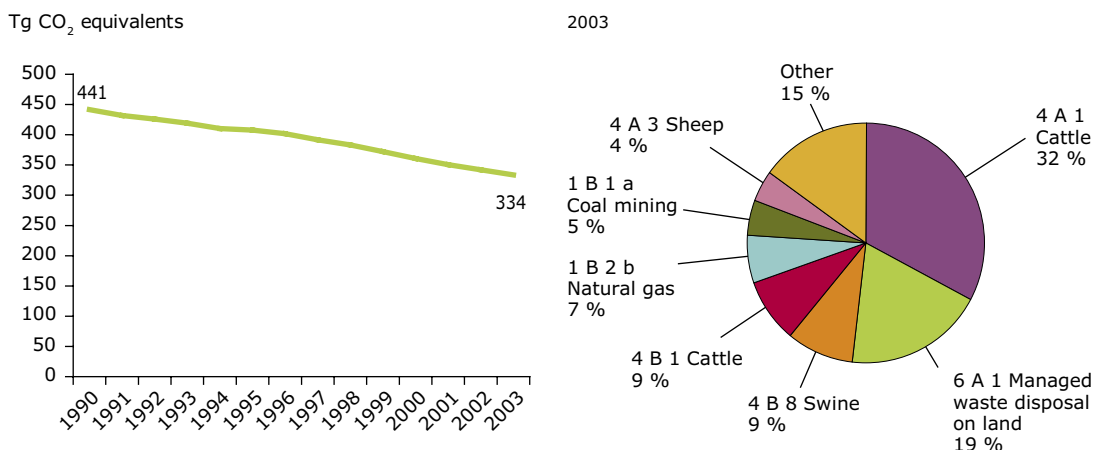


Figure 2.6 Absolute change of CH₄ emissions by large key source categories 1990 to 2003 in CO₂ equivalents (Tg) for EU-15

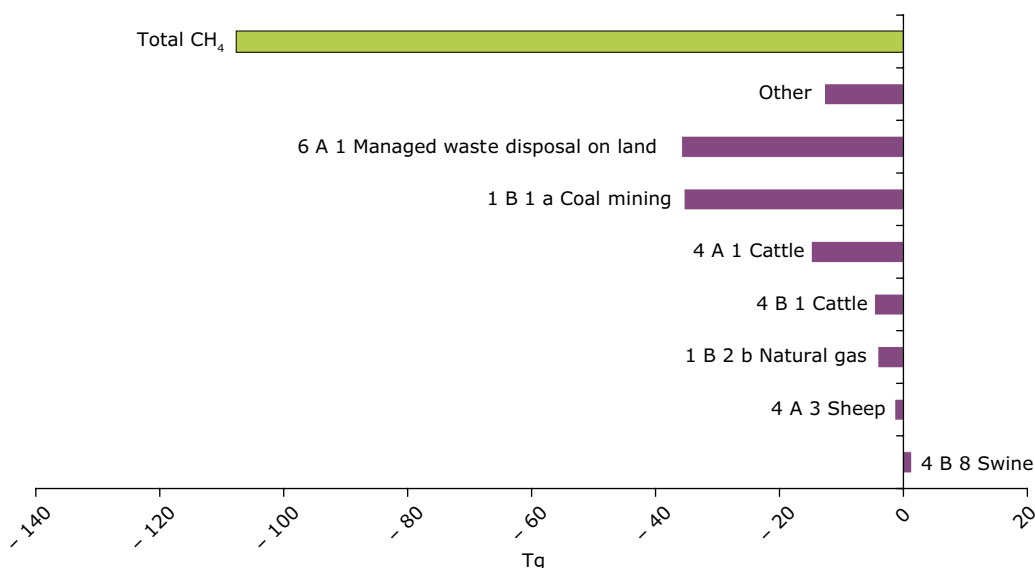


Figure 2.7 N₂O emissions 1990 to 2003 in CO₂ equivalents (Tg) and share of largest source categories in 2003 for EU-15

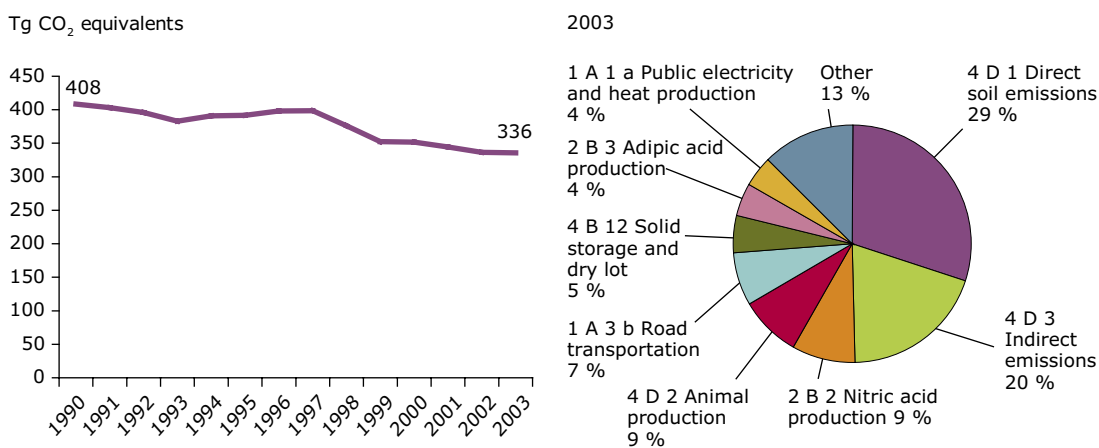


Figure 2.8 Absolute change of N₂O emissions by large key source categories 1990 to 2003 in CO₂ equivalents (Tg) for EU-15

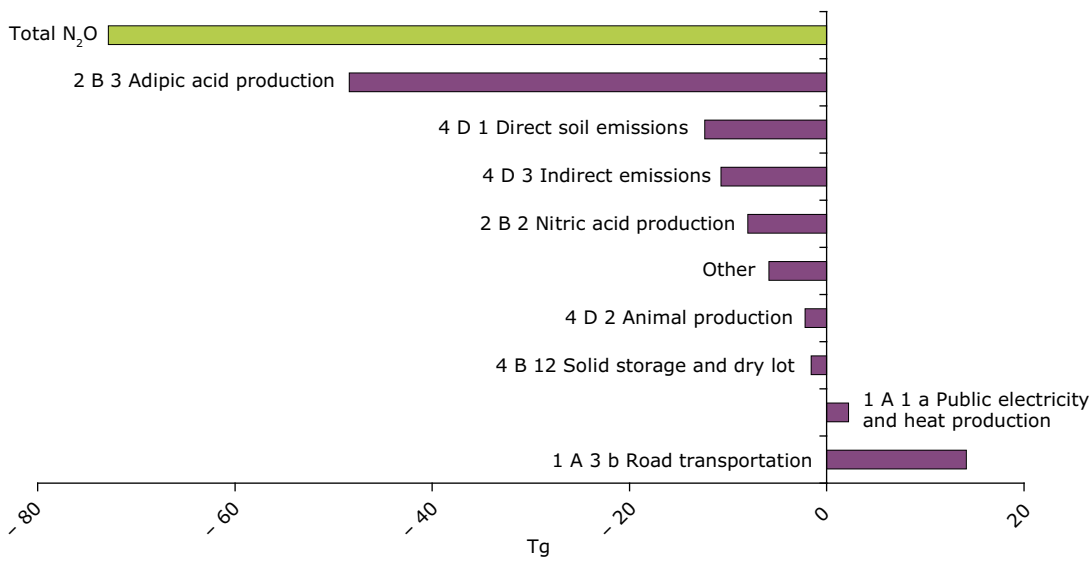


Figure 2.9 Fluorinated gas emissions 1990 to 2003 in CO₂ equivalents (Tg) and share of largest source categories in 2003 for EU-15

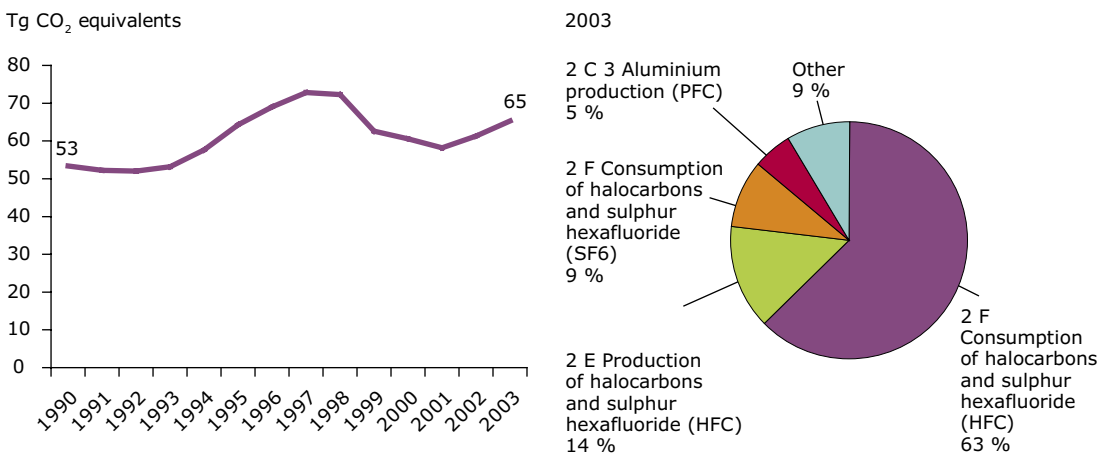


Figure 2.10 Absolute change of fluorinated gas emissions by large key source categories 1990 to 2003 in CO₂ equivalents (Tg) for EU-1

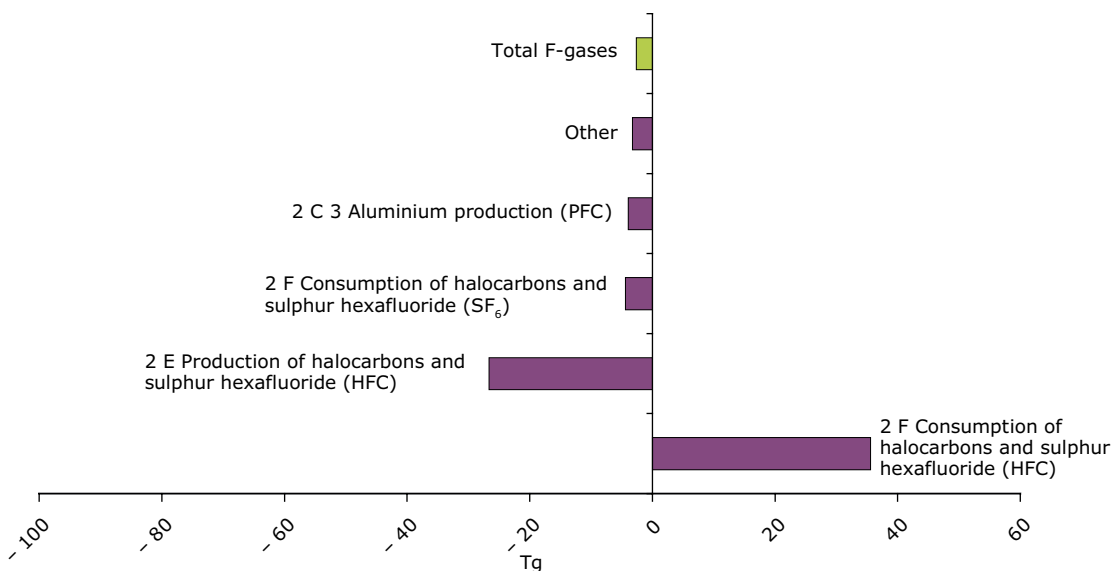


Table 2.5 Overview of Member States' contributions to EC GHG emissions excluding LUCF from 1990 to 2003 in CO₂ equivalents (Tg)

Member State	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Austria	79	83	76	76	77	80	83	83	83	80	81	85	86	92
Belgium	146	149	147	146	151	152	157	148	153	146	148	147	145	148
Cyprus	6	6	7	7	7	7	8	8	8	8	9	8	9	9
Czech Republic	192	178	164	158	152	153	155	159	149	140	148	148	143	145
Denmark	69	80	74	76	80	77	90	80	76	73	68	70	69	74
Estonia	43	41	30	23	24	22	23	24	22	20	20	19	20	21
Finland	70	69	67	68	74	71	77	76	73	72	70	76	77	86
France	568	593	585	559	555	563	578	572	584	566	560	564	554	557
Germany	1 244	1 191	1 142	1 126	1 108	1 103	1 121	1 084	1 057	1 021	1 017	1 028	1 015	1 018
Greece	109	109	110	110	113	114	118	123	128	127	132	134	134	138
Hungary	103	95	85	85	85	84	86	84	84	84	81	84	81	83
Ireland	54	55	56	56	57	58	60	63	65	67	69	71	69	68
Italy	511	513	509	505	496	528	519	525	535	544	551	556	555	570
Latvia	25	24	19	16	15	12	12	12	11	10	10	11	11	11
Lithuania	51	45	42	38	35	31	28	24	22	21	21	20	20	17
Luxembourg	13	13	13	13	13	10	10	9	8	9	10	10	11	11
Malta	2	2	3	3	3	3	3	3	3	3	3	3	3	3
Netherlands	212	216	215	221	221	224	233	225	227	215	214	216	213	215
Poland	460	438	440	430	440	417	437	427	404	402	386	383	370	384
Portugal	59	61	65	64	65	70	67	70	75	83	80	81	86	81
Slovakia	72	63	59	55	52	53	54	54	52	51	48	53	52	52
Slovenia	19	17	17	18	18	19	19	20	20	19	19	20	20	20
Spain	284	290	299	287	303	315	307	328	337	365	380	379	399	402
Sweden	72	72	72	72	75	73	77	73	73	70	67	68	69	71
United Kingdom	748	752	729	710	700	691	714	691	686	652	652	663	644	651
EU25	5 212	5 156	5 023	4 919	4 917	4 931	5 036	4 964	4 935	4 849	4 844	4 894	4 852	4 925
EU-15	4 238	4 246	4 159	4 087	4 088	4 129	4 211	4 150	4 160	4 091	4 100	4 146	4 126	4 180

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

for 1990–2003. Member States show large variations in GHG emission trends.

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-25 GHG emissions. These two Member States achieved total GHG emission reductions of 323 million tonnes compared to 1990 ⁽¹³⁾.

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 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 N₂O emission reduction measures in the adipic acid production.

Italy and France are the third and fourth largest emitters with a shares of 12 and 11 %, respectively. Italy's GHG emissions were 12 % above 1990 levels in 2003. Italian GHG emissions increased since 1990 primarily from road transport, electricity and heat production, and petrol-refining. France's emissions were 2 % below 1990 levels in 2003. In France, large reductions were achieved in N₂O emissions from the adipic acid production, but CO₂ emissions from road transport increased considerably between 1990 and 2003.

⁽¹³⁾ The EU-15 as a whole needs emission reductions of total GHG of 8 %, i.e. 340 million tonnes on the basis of the 2005 inventory in order to meet the Kyoto target.

Table 2.6 Greenhouse gas emissions in CO₂ equivalents (excl. LUCF) and Kyoto Protocol targets for 2008–2012

Member State	Base year ¹⁾	2003	Change 2002	Change base	Targets 2008–12
	(million tonnes)		(million tonnes)	–2003	year–2003
			(%)	(%)	(%)
Austria	78.5	91.6	5.9 %	16.6 %	– 13.0 %
Belgium	146.8	147.7	1.6 %	0.6 %	– 7.5 %
Cyprus	6.0	9.2	5.3 %	52.8 %	–
Czech Republic	192.1	145.4	1.8 %	– 24.3 %	– 8.0 %
Denmark	69.6	74.0	7.3 %	6.3 %	– 21.0 %
Estonia	43.5	21.4	9.7 %	– 50.8 %	– 8.0 %
Finland	70.4	85.5	10.8 %	21.5 %	0.0 %
France	568.0	557.2	0.7 %	– 1.9 %	0.0 %
Germany	1 248.3	1 017.5	0.2 %	– 18.5 %	– 21.0 %
Greece	111.7	137.6	3.1 %	23.2 %	25.0 %
Hungary	122.2	83.2	3.0 %	– 31.9 %	– 6.0 %
Ireland	54.0	67.6	– 2.6 %	25.2 %	13.0 %
Italy	510.3	569.8	2.7 %	11.6 %	– 6.5 %
Latvia	25.4	10.5	– 0.9 %	– 58.5 %	– 8.0 %
Lithuania	50.9	17.2	– 12.1 %	– 66.2 %	– 8.0 %
Luxembourg	12.7	11.3	4.3 %	– 11.5 %	– 28.0 %
Malta ²⁾	2.2	2.9	– 0.5 %	29.1 %	–
Netherlands	213.1	214.8	0.6 %	0.8 %	– 6.0 %
Poland ²⁾	565.3	384.0	3.7 %	– 32.1 %	– 6.0 %
Portugal	59.4	81.2	– 5.3 %	36.7 %	27.0 %
Slovakia	72.0	51.7	– 1.3 %	– 28.2 %	– 8.0 %
Slovenia	20.2	19.8	– 1.2 %	– 1.9 %	– 8.0 %
Spain	286.1	402.3	0.9 %	40.6 %	15.0 %
Sweden	72.3	70.6	1.5 %	– 2.4 %	4.0 %
United Kingdom	751.4	651.1	1.1 %	– 13.3 %	– 12.5 %
EU-15	4 252.5	4 179.6	1.3 %	– 1.7 %	– 8.0 %

(¹⁾ For EU-15 the base year for CO₂, CH₄ and N₂O is 1990; for the fluorinated gases 13 Member States have chosen to select 1995 as the base year, whereas Finland and France 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 13 Member States and 1990 emissions for Finland and France.

(²⁾ Malta and Poland did not provide GHG emission estimates for 2003, therefore the data provided in this table are based on gap-filling (see Chapter 1.8.2.).

Note: Malta and Cyprus do not have Kyoto targets.

Table 2.7 Overview of EU-15 indirect GHG and SO₂ emissions for 1990–2003 (Gg)

GHG Emissions	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
NO _x	13 390	13 145	12 832	12 243	11 881	11 599	11 316	10 836	10 593	10 259	9 913	9 686	9 420	9 273
CO	50 457	48 605	46 522	44 276	41 983	40 325	38 766	36 854	35 303	33 246	30 618	29 199	27 263	26 481
NMVO	15 556	14 865	14 451	13 774	13 436	13 085	12 519	12 322	11 808	11 346	10 643	10 244	9 782	9 594
SO ₂	16 527	14 977	13 825	12 563	11 347	10 229	8 852	8 047	7 519	6 753	6 093	5 875	5 669	5 234

Spain and Poland are the fifth and sixth largest emitters in the EU-25 each accounting for about 8 % of total EU-25 GHG emissions. Spain increased emissions by 42 % between 1990 and 2003 (+ 41 %

since the base year). This was largely due to emission increases from road transport, electricity and heat production, and manufacturing industries. Poland decreased GHG emissions by 16 %

(¹⁴) Note that for Poland, data for 2003 have been estimated by gap-filling because Poland did not provide GHG emission estimates before the data deadline of this report (see Chapter 1.8.2.).

Table 2.8 Overview of EU-15 Member States' contributions to EU-15 NO_x emissions for 1990–2003 (Gg)

Member State	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Austria	211	221	210	203	195	192	212	199	211	199	204	214	220	229
Belgium	358	362	358	348	354	347	332	326	327	300	308	296	284	278
Denmark	283	332	290	290	290	273	311	265	243	225	208	203	201	209
Finland	294	274	266	267	268	246	250	243	228	222	208	210	210	218
France	1 816	1 895	1 857	1 750	1 706	1 653	1 624	1 558	1 537	1 468	1 394	1 349	1 288	1 237
Germany	2 846	2 611	2 418	2 299	2 130	2 000	1 918	1 823	1 766	1 717	1 634	1 560	1 497	1 428
Greece	300	312	314	314	321	320	325	332	349	337	330	343	341	343
Ireland	116	118	129	117	114	114	118	117	120	117	123	132	121	117
Italy	1 947	2 000	2 019	1 921	1 840	1 808	1 732	1 654	1 553	1 456	1 378	1 367	1 276	1 260
Luxembourg	22	22	22	22	22	20	22	18	19	16	17	17	17	17
Netherlands	560	432	423	407	380	475	455	418	410	414	395	384	373	366
Portugal	260	276	290	281	279	293	283	277	286	297	293	289	296	291
Spain	1 237	1 282	1 315	1 292	1 319	1 342	1 306	1 355	1 365	1 435	1 464	1 448	1 511	1 507
Sweden	315	305	299	284	286	274	262	250	243	232	219	214	208	204
United Kingdom	2 827	2 704	2 621	2 449	2 376	2 240	2 165	2 003	1 935	1 822	1 737	1 660	1 577	1 569
EU-15	13 390	13 145	12 832	12 243	11 881	11 599	11 316	10 836	10 593	10 259	9 913	9 686	9 420	9 273

between 1990 and 2003⁽¹⁴⁾ (– 32 % since the base year, which is 1988 in the case of Poland). Main factors for decreasing emissions in Poland — as for other new Member States — was the decline of energy inefficient heavy industry and the overall restructuring of the economy in the late 1980s and early 1990s. The notable exception was transport (especially road transport) where emissions increased.

Table 2.6 shows that 12 Member States (including Cyprus and Malta, which do not have a Kyoto target) were above base year levels in 2003, 13 Member States were below. The percentage changes of GHG emissions from the base year to 2003 range from – 66 % (Lithuania) to + 72 % (Cyprus).

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

Emissions of CO, NO_x, NMVOC and SO₂ 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 SO₂ emissions

in the EU-15 between 1990 and 2003. All emissions were reduced significantly from 1990 levels: the largest reduction was achieved in SO₂ (– 68 %) followed by CO (– 48 %) NMVOC (– 38 %) and NO_x (– 31 %).

Table 2.8 shows the NO_x emissions of the EU-15 Member States between 1990 and 2003. The largest emitters, the United Kingdom, Spain, and Germany made up almost 50 % of the total NO_x emissions in 2003. The United Kingdom and Germany reduced their emissions from 1990 levels. This was partly counterbalanced by increases from Spain, Greece, Portugal, Austria and Ireland. All other Member States reduced emissions.

Table 2.9 shows the CO emissions of the EU-15 Member States between 1990 and 2003. The largest emitters, France, Italy and Germany that made up 55 % of the total CO emissions in 2003, reduced their emissions from 1990 levels. Also, all other Member States reduced emissions.

Table 2.10 shows the NMVOC emissions of the EU-15 Member States between 1990 and 2003. The largest emitters France, Germany and Italy that made up 57 % of the total NMVOC emissions in 2003, reduced their emissions from 1990 levels. All Member States except for Greece, Portugal and Spain reduced emissions.

Table 2.9 Overview of EU-15 Member States' contributions to EU-15 CO emissions for 1990–2003 (Gg)

Member State	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Austria	1 244	1 255	1 205	1 165	1 106	1 018	1 032	962	923	876	810	804	775	802
Belgium	1 347	1 309	1 286	1 171	1 086	1 058	1 020	973	938	941	927	868	865	742
Denmark	772	814	805	812	781	772	771	718	655	626	615	618	590	593
Finland	702	673	662	651	636	632	623	624	620	611	594	585	575	564
France	10 962	10 852	10 393	9 858	9 176	9 010	8 440	7 996	7 834	7 344	6 770	6 480	6 176	5 968
Germany	11 212	9 528	8 351	7 701	7 080	6 581	6 166	5 994	5 554	5 199	4 913	4 561	4 300	4 153
Greece	1 302	1 312	1 341	1 344	1 340	1 334	1 360	1 361	1 391	1 316	1 364	1 275	1 244	1 200
Ireland	397	391	391	347	326	301	303	308	313	281	275	270	251	235
Italy	7 150	7 451	7 654	7 602	7 380	7 144	6 846	6 602	6 191	5 907	5 225	5 131	4 519	4 430
Luxembourg	172	172	172	172	145	104	102	80	58	49	49	53	48	48
Netherlands	1 127	785	752	708	691	849	832	754	745	721	696	661	628	611
Portugal	1 038	1 152	980	919	870	1 028	874	799	895	812	885	781	814	1 306
Spain	3 538	3 605	3 664	3 441	3 414	3 106	3 198	3 029	3 004	2 752	2 597	2 544	2 427	2 377
Sweden	1 189	1 166	1 146	1 097	1 073	1 058	1 021	938	902	850	794	758	724	694
United Kingdom	8 306	8 140	7 720	7 289	6 878	6 330	6 177	5 716	5 278	4 961	4 106	3 809	3 325	2 757
EU-15	50 457	48 605	46 522	44 276	41 983	40 325	38 766	36 854	35 303	33 246	30 618	29 199	27 263	26 481

Table 2.10 Overview of EU-15 Member States' contributions to EU-15 NMVOC emissions for 1990–2003 (Gg)

Member State	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Austria	286	273	245	239	221	221	216	204	191	180	181	185	182	182
Belgium	328	317	314	297	286	270	255	247	238	227	208	200	190	186
Denmark	229	227	222	218	214	201	208	200	173	169	172	140	145	159
Finland	223	209	202	192	188	182	175	170	166	161	155	153	148	144
France	3 691	3 675	3 611	3 478	3 441	3 388	3 152	3 240	3 068	3 100	2 935	2 912	2 781	2 705
Germany	3 534	3 082	2 807	2 581	2 404	2 248	2 110	2 042	1 966	1 842	1 697	1 592	1 494	1 460
Greece	280	288	296	302	308	305	309	308	312	307	299	294	289	288
Ireland	106	107	110	101	103	101	107	111	113	94	85	83	78	74
Italy	2 032	2 093	2 150	2 112	2 050	2 023	1 972	1 909	1 803	1 714	1 544	1 456	1 346	1 311
Luxembourg	19	19	19	19	18	17	17	17	14	12	13	12	11	11
Netherlands	483	278	262	247	243	356	322	290	289	278	259	241	229	225
Portugal	274	288	285	275	281	293	287	286	293	280	279	278	282	316
Spain	1 135	1 177	1 189	1 119	1 142	1 093	1 112	1 126	1 184	1 181	1 162	1 147	1 139	1 146
Sweden	517	496	482	449	429	420	406	376	353	331	320	311	303	301
United Kingdom	2 419	2 336	2 257	2 144	2 108	1 965	1 868	1 796	1 645	1 469	1 334	1 239	1 165	1 087
EU-15	15 556	14 865	14 451	13 774	13 436	13 085	12 519	12 322	11 808	11 346	10 643	10 244	9 782	9 594

Table 2.11 shows the SO₂ emissions of the EU-15 Member States between 1990 and 2003. The largest emitters, Spain and the United Kingdom, that made up 45 % of

the total SO₂ emissions in 2003, reduced their emissions from 1990 levels. All other Member States except for Greece reduced emissions.

Table 2.11 Overview of EU-15 Member States' contributions to EU-15 SO₂ emissions for 1990–2003 (Gg)

Member State	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Austria	76	71	57	55	49	48	46	42	37	36	33	34	33	34
Belgium	356	361	353	326	283	256	242	221	207	168	165	164	152	127
Denmark	177	236	181	147	145	135	171	99	76	55	28	26	25	31
Finland	241	200	153	133	120	100	104	101	92	86	77	89	87	99
France	1 372	1 500	1 314	1 159	1 102	1 034	1 008	861	874	759	664	602	559	551
Germany	5 324	3 994	3 305	2 943	2 471	1 936	1 337	1 037	834	733	634	641	608	614
Greece	487	525	544	542	513	536	523	518	527	544	493	502	513	545
Ireland	183	180	170	161	175	161	147	166	176	157	131	126	96	76
Italy	1 795	1 677	1 578	1 477	1 388	1 320	1 209	1 133	995	899	753	708	632	506
Luxembourg	15	15	15	15	15	15	15	6	4	4	3	3	2	2
Netherlands	190	108	101	98	87	128	121	102	94	88	73	73	66	65
Portugal	323	313	374	321	299	335	274	294	342	343	307	294	293	201
Spain	2 165	2 166	2 132	1 997	1 946	1 795	1 565	1 748	1 597	1 607	1 488	1 446	1 550	1 352
Sweden	112	111	106	92	91	78	75	69	66	52	49	49	50	51
United Kingdom	3 711	3 521	3 443	3 098	2 663	2 354	2 014	1 653	1 598	1 219	1 194	1 118	1 002	979
EU-15	16 527	14 977	13 825	12 563	11 347	10 229	8 852	8 047	7 519	6 753	6 093	5 875	5 669	5 234

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, emission factors, completeness, and qualitative uncertainty estimates. The chapter includes also sections on uncertainty estimates, sector-specific QA/QC, recalculations, the reference approach, and international bunkers.

3.1 Overview of sector

CRF Sector 1: 'Energy' contributes 81 % to total GHG emissions and is the largest emitting sector in the EU-15. Total GHG emissions from this sector increased by 2.5 % from 3 310 Tg in 1990 to 3 393 Tg in 2003 (Figure 3.1). In 2003, emissions increased by 1.6 % compared to 2002.

The most important energy-related gas is CO₂ that makes up 79 % of the total

Figure 3.1 EU-15 GHG emissions for 1990–2003 from CRF Sector 1: 'Energy' in CO₂ equivalents (Tg) and share of largest key source categories in 2003

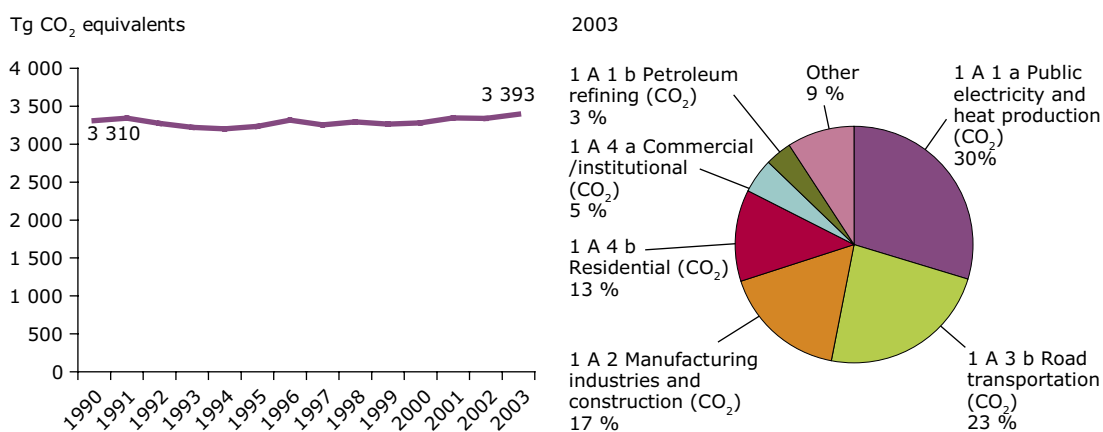
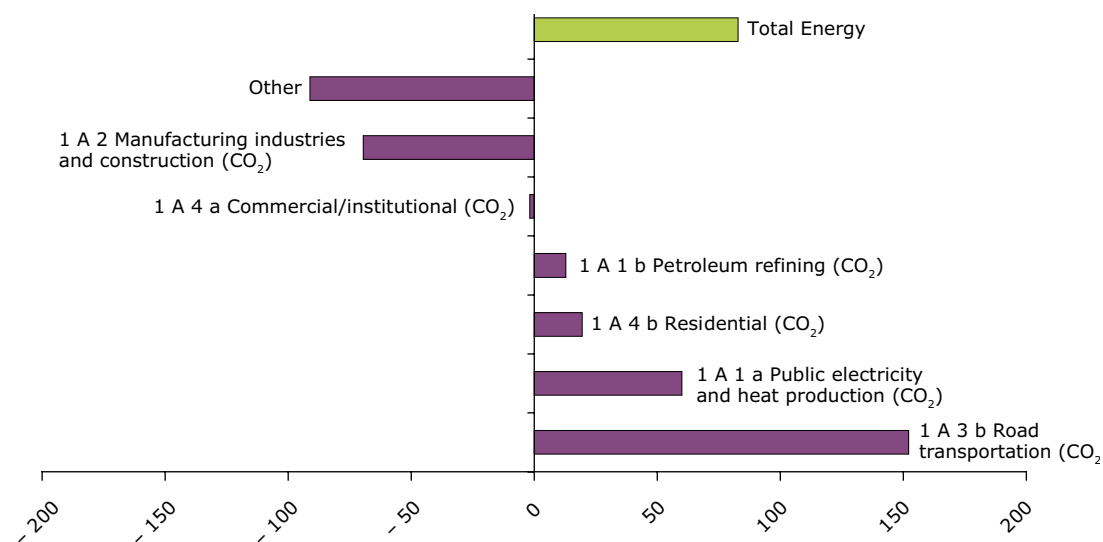


Figure 3.2 Absolute change of GHG emissions by large key source categories 1990–2003 in CO₂ equivalents (Tg) in CRF Sector 1: 'Energy'



EU-15 GHG emissions. CH₄ and N₂O 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 (CO₂)
- 1.A.1.a Public electricity and heat production (N₂O)
- 1.A.1.b Petroleum-refining (CO₂)
- 1.A.1.c Manufacture of solid fuels and other energy industries (CO₂)
- 1.A.2 Manufacturing industries and construction (CO₂)
- 1.A.3.a Civil aviation (CO₂)
- 1.A.3.b Road transportation (CH₄)
- 1.A.3.b Road transportation (CO₂)
- 1.A.3.b Road transportation (N₂O)
- 1.A.3.c Railways (CO₂)
- 1.A.3.d Navigation (CO₂)
- 1.A.4.a Commercial/institutional (CO₂)
- 1.A.4.b Residential (CH₄)
- 1.A.4.b Residential (CO₂)
- 1.A.4.c Agriculture/forestry/fisheries (CO₂)
- 1.A.5 Other (CO₂)
- 1.B.1.a Coal-mining (CH₄)
- 1.B.2.b Natural gas (CH₄)

Figure 3.1 shows that the six largest key sources account for about 90 % of emissions in Sector 1.

Figure 3.2 shows that CO₂ emissions from road transport had the highest increase in absolute terms of all energy-related emissions, while CO₂ emissions from manufacturing industries decreased substantially between 1990 and 2003. 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 (CH₄) and decreasing CO₂ emissions from 1.A.1.c: 'Manufacture of solid fuels and other energy industries' and from 1.A.5: 'Other' are the main reasons for the large absolute emission reductions from 'Other' in Figure 3.2.

3.2 Source categories

3.2.1 Energy industries (CRF Source Category 1.A.1)

Table 3.1 summarises information by Member State on methodologies, emission factors, completeness and qualitative uncertainty estimates for CO₂ from 1.A.1: 'Energy industries'. CO₂ emissions from energy industries increased by 3.3 % between 1990 and 2003. Most Member States had increases in this source during this time, but the large Member States Germany

Table 3.1 Member States' contributions to CO₂ emissions from 1.A.1: 'Energy industries' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO ₂ equivalents)	GHG emissions in 2003 (Gg CO ₂ equivalents)	Methods applied ¹⁾	EF ¹⁾	Estimate ²⁾	Quality ²⁾
Austria	13 622	16 030	C	CS	ALL	H
Belgium	29 907	29 141	CS	CS		
Denmark	26 173	31 402	C	CS	ALL	H
Finland	18 517	36 047	CS (T2)	CS/PS/D	ALL	H
France	68 016	63 802	C	CS	ALL	H
Germany	413 945	362 582	CS	CS	All	H
Greece	43 194	56 100	C	C and CS	ALL	
Ireland	11 057	15 480	T1	PS, CS	Full	H
Italy	134 951	160 883	T3	CS	ALL	H
Luxembourg	1 277	266	C/D	C/D		
Netherlands	51 626	67 347	T2	PS, CS,D	ALL	H
Portugal	15 944	20 009	T2	D+C	All	H
Spain	77 493	105 332	D,C,CS	D C,PS	ALL	H
Sweden	10 187	12 769	T2/T3 + T1, CS	CS, D	ALL	H
United Kingdom	235 786	212 729	T2	CS	ALL	H
EU-15	1 151 697	1 189 920	C,CS,D,T1,T2,T3	C, CS, D, PS	ALL	H

(¹⁾ Information source: CRF Summary Table 3 for 2002.

(²⁾ Information source: CRF Table 7 for 2002.

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.2 Member States' contributions to CO₂ emissions from 1.A.1.a: 'Electricity and heat production'

Member State	Greenhouse gas emissions (Gg CO ₂ equivalents)			Share in EU-15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO ₂ equivalents)	(%)	(Gg CO ₂ equivalents)	(%)			
Austria	10 864	10 625	13 292	1.3 %	2 667	25 %	2 428	22 %	C	NS, PS	CS
Belgium	23 465	22 566	23 548	2.3 %	981	4 %	82	0 %	CS	PS, RS	CS, PS
Denmark	24 736	24 060	28 869	2.9 %	4 809	20 %	4 133	17 %	C	NS, PS	CS, C
Finland	16 248	26 149	33 177	3.3 %	7 029	27 %	16 929	104 %	T2(CS)	PS	D, CS, PS
France	48 131	42 271	45 359	4.5 %	3 088	7 %	- 2 772	- 6 %	C	PS	CS
Germany	334 619	316 865	322 642	31.9 %	5 778	2 %	- 11 976	- 4 %	CS	NS	CS
Greece	40 632	51 561	52 709	5.2 %	1 148	2 %	12 077	30 %	C	NS	C, CS
Ireland	10 876	15 830	15 109	1.5 %	- 722	- 5 %	4 232	39 %	T3	NS, PS	PS
Italy	109 678	125 330	128 129	12.7 %	2 799	2 %	18 452	17 %	T3	NS, PS	CS
Luxembourg	1 277	266	266	0.0 %	0	0 %	- 1 011	79 %			
Netherlands	39 759	54 022	54 586	5.4 %	565	1 %	14 828	37 %	CS	NS, Q	PS, CS
Portugal	13 960	21 920	17 512	1.7 %	- 4 408	- 20 %	3 552	25 %	D	PS	D
Spain	64 341	98 896	91 078	9.0 %	- 7 818	- 8 %	26 737	42 %	D, CS	Q	D, PS
Sweden	7 622	9 034	9 765	1.0 %	731	8 %	2 143	28 %	T2, T3	PS	CS
United Kingdom	204 251	164 236	174 467	17.3 %	10 231	6 %	- 29 785	- 15 %	T2	PS, NS	CS
EU-15	950 461	983 630	1 010 508	100.0 %	26 878	3 %	60 048	6 %			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.3 Member States' contributions to CO₂ emissions from 1.A.1.b: 'Petroleum-refining'

Member State	Greenhouse gas emissions (Gg CO ₂ equivalents)			Share in EU-15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO ₂ equivalents)	(%)	(Gg CO ₂ equivalents)	(%)			
Austria	2 456	2 551	2 526	2.1 %	- 25	- 1 %	70	3 %	C	NS, PS	PS
Belgium	4 299	4 767	5 156	4.3 %	390	8 %	857	20 %	CS	PS	CS
Denmark	897	971	1 013	0.9 %	42	4 %	115	13 %	C	NS, PS	CS, C
Finland	2 225	2 708	2 782	2.3 %	73	3 %	557	25 %	T2(CS)	PS	D, CS, PS
France	13 239	14 635	13 543	11.4 %	- 1 092	- 7 %	305	2 %	C	PS	CS
Germany	19 419	19 675	19 373	16.3 %	- 302	- 2 %	- 46	0 %	CS	NS	CS
Greece	2 465	3 449	3 305	2.8 %	- 144	- 4 %	840	34 %	C	NS	C
Ireland	181	371	372	0.3 %	1	0 %	191	105 %	T3	NS, PS	PS
Italy	16 329	24 551	23 433	19.8 %	- 1 118	- 5 %	7 104	44 %	T3	NS, PS	CS
Luxembourg	0	0	0	0.0 %	0	-	0	-			
Netherlands	11 028	10 874	11 187	9.4 %	313	3 %	159	1 %	CS	NS, Q	PS, CS
Portugal	1 910	2 492	2 497	2.1 %	5	0 %	587	31 %	D	PS	D, CS
Spain	10 907	12 738	12 433	10.5 %	- 304	- 2 %	1 526	14 %	D, C, CS	Q	D, C, PS
Sweden	2 151	2 752	2 668	2.3 %	- 84	- 3 %	517	24 %	T2, T3	PS	CS, D
United Kingdom	18 275	19 178	18 266	15.4 %	- 911	- 5 %	- 9	0 %	T2	NS	CS
EU-15	105 781	121 711	118 555	100.0 %	- 3 156	- 3 %	12 774	12 %			

Abbreviations explained in the Chapter 'Units and abbreviations'.

and the United Kingdom reduced their emissions by 12 and 10 %, respectively.

This source category includes three key sources: CO₂ from 1.A.1.a: 'Electricity and

Table 3.4 Member States' contributions to CO₂ emissions from 1.A.1.c: 'Manufacture of solid fuels and other energy industries'

Member State	Greenhouse gas emissions (Gg CO ₂ equivalents)			Share in EU-15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO ₂ equivalents)	(%)	(Gg CO ₂ equivalents)	(%)			
Austria	302	172	212	0.3 %	40	24 %	- 90	- 30 %	C	NS	CS
Belgium	2 143	424	438	0.7 %	14	3 %	- 1 705	- 80 %	CS	PS, RS	CS
Denmark	540	1 522	1 520	2.5 %	- 2	0 %	981	182 %	C	NS	CS, C
Finland	44	90	89	0.1 %	- 1	- 1 %	45	101 %	T2(CS)	PS	D, CS, PS
France	6 647	4 786	4 900	8.1 %	114	2 %	- 1 746	- 26 %	C	AS, PS	CS
Germany	59 907	20 063	20 566	33.8 %	502	3 %	- 39 342	- 66 %	CS	NS	CS
Greece	97	99	86	0.1 %	- 13	- 13 %	- 11	- 12 %	C	NS	C
Ireland	NO	NO	NO	-	-	-	-	-			
Italy	8 945	9 621	9 321	15.3 %	- 300	- 3 %	375	4 %	T3	NS, PS	CS
Luxembourg	0	0	0	0.0 %	0	-	0	-			
Netherlands	839	1 728	1 574	2.6 %	- 154	- 9 %	735	88 %	CS	NS, Q	PS, CS
Portugal	75	0	0	0.0 %	0	-	- 75	- 100 %	D	PS	D
Spain	2 244	1 831	1 821	3.0 %	- 10	- 1 %	- 423	- 19 %	D, C, CS	MS, IS, Q	D, C, PS
Sweden	413	325	335	0.6 %	10	3 %	- 78	- 19 %	T2, T3	PS	CS
United Kingdom	13 260	20 154	19 996	32.9 %	- 159	- 1 %	6 736	51 %	T2	AS, NS	CS
EU-15	95 456	60 815	60 857	100.0 %	41	0 %	- 34 599	- 36 %			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.5 Member States' contributions to N₂O emissions from 1.A.1: 'Energy industries' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO ₂ equivalents)	GHG emissions in 2003 (Gg CO ₂ equivalents)	Methods applied ¹⁾	EF ¹⁾	Estimate ²⁾	Quality ²⁾
Austria	47	68	C	CS	ALL	L
Belgium	284	360	C	D		
Denmark	276	328	C	C	ALL	L
Finland	279	548	CS (T2)	CS/PS	ALL	L
France	736	1 055	C	CS	ALL	L
Germany	4 494	3 791	T2	CS	ALL	M
Greece	1 782	2 244	C	C	ALL	
Ireland	431	548	T1	C	FULL	L
Italy	1 683	2 030	T3	D		
Luxembourg	0	0	C/D	C/D		
Netherlands	159	217	T1	D	ALL	L
Portugal	61	96	T2	D+C	ALL	L
Spain	284	665	D,C	D,C	ALL	L
Sweden	339	443	T2/T3 + T1	CS	ALL	M
United Kingdom	2 333	2 805	T2	CS/D/C	ALL	L
EU-15	13 186	15 196	C,CS,D,T1,T2,T3	C,CS,D,PS	ALL	L

⁽¹⁾ Information source: CRF Summary Table 3 for 2002.

⁽²⁾ Information source: CRF Table 7 for 2002.

Abbreviations explained in the Chapter 'Units and abbreviations'.

heat production' and CO₂ from 1.A.1.b: 'Petroleum-refining', and CO₂ from 1.A.1.c: 'Manufacture of solid fuels and other energy industries'.

Table 3.6 Member States' contributions to N₂O emissions from 1.A.1.a: 'Electricity and heat production'

Member State	Greenhouse gas emissions (Gg CO ₂ equivalents)			Share in EU-15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO ₂ equivalents)	(%)	(Gg CO ₂ equivalents)	(%)			
Austria	44	59	65	0.5 %	5	9 %	21	48 %	C	NS, PS	CS
Belgium	79	46	46	0.3 %	0	0 %	- 33	- 42 %	C	PS, RS	D, C
Denmark	260	247	298	2.2 %	52	21 %	38	15 %	C	NS, PS	CS, C
Finland	259	464	523	3.9 %	59	13 %	264	102 %	T2 (CS)	PS	CS, PS
France	592	883	925	6.9 %	42	5 %	334	56 %	C	PS	CS
Germany	3 651	3 387	3 462	25.9 %	75	2 %	- 189	- 5 %	T2	NS	CS
Greece	1 688	2 075	2 119	15.9 %	43	2 %	431	26 %	C	NS	C
Ireland	427	604	540	4.0 %	- 64	- 11 %	113	27 %	T3	NS, PS	C
Italy	1 532	1 755	1 861	13.9 %	106	6 %	329	21 %	T3	NS, PS	D
Luxembourg	0	1	0	0.0 %	- 1	- 100 %	0	-			
Netherlands	150	201	205	1.5 %	3	2 %	54	36 %	CS, T1	Q	PS/D
Portugal	52	100	85	0.6 %	- 14	- 15 %	34	66 %	T2	PS	CS
Spain	197	595	554	4.1 %	- 41	- 7 %	356	181 %	D, C	Q	D, C
Sweden	303	353	403	3.0 %	51	14 %	100	33 %	T2, T3	PS	CS
United Kingdom	1 922	2 162	2 265	17.0 %	103	5 %	342	18 %	T2	NS	CS, D, C
EU-15	11 157	12 932	13 351	100.0 %	418	3 %	2 194	20 %			

Abbreviations explained in the Chapter 'Units and abbreviations'.

CO₂ emissions from 1.A.1.a: 'Electricity and heat production' are the largest key source in the EU-15 accounting for 24.2 % of total GHG emissions in 2003. Between 1990 and 2003, CO₂ emissions from electricity and heat production increased by 6 % in EU-15 (Table 3.2). The emissions from this key source are due to fossil fuel consumption in public electricity and heat plants, which increased by 18 % between 1990 and 2003. Emissions did not increase in line with fuel consumption mainly because of the shift from coal to gas: coal consumption in heat and power plants decreased by 7 % between 1990 and 2003, whereas gas consumption more than tripled.

Between 1990 and 2003, large emission decreases in absolute terms had been achieved by the United Kingdom and Germany, whereas emissions increased considerably in Spain. The most important reason for German CO₂ reductions from electricity and heat production were efficiency improvements in coal-fired power plants. In the United Kingdom, the most important factor for emission reductions was the fuel switch from coal to gas in power production. The fossil fuel consumption in electricity and heat production in Spain increased by 53 % between 1990 and 2003, affecting also emissions from this source.

CO₂ emissions from 1.A.1.b: 'Petroleum-refining' are the sixth largest key source in the EU-15 accounting for 2.8 % of total GHG emissions in 2003. Between 1990 and 2003, CO₂ emissions from this source increased by 12 % in the EU-15 (Table 3.3).

Between 1990 and 2003, minor emission decreases in absolute terms had been achieved by the United Kingdom and Germany, whereas all other Member States reported increases. Italy had the largest increases in absolute terms.

CO₂ emissions from 1.A.1.c: 'Manufacture of solid fuels and other energy industries' account for 1.5 % of total EU-15 GHG emissions in 2003. Between 1990 and 2003, CO₂ emissions from this source decreased by 36 % in the EU-15 (Table 3.4). Between 1990 and 2003, Germany had large emission decreases in absolute and relative terms, whereas absolute emissions increased considerably in the United Kingdom.

Table 3.5 summarises information by Member State on methodologies, emission factors, completeness and qualitative uncertainty estimates for the N₂O emissions from 1.A.1: 'Energy industries'. N₂O emissions from this source increased by

Table 3.7 Member States' contributions to CO₂ emissions from 1.A.2: 'Manufacturing industries and construction' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO ₂ equivalents)	GHG emissions in 2003 (Gg CO ₂ equivalents)	Methods applied ¹⁾	EF ¹⁾	Estimate ²⁾	Quality ²⁾
Austria	12 971	14 163	C	CS	ALL	H
Belgium	32 882	30 361	C	C, CS		
Denmark	5 376	5 404	C	CS	ALL	H
Finland	14 925	13 824	CS (T2)	CS/PS/D	ALL	H
France	83 256	77 634	C	CS	ALL	H
Germany	196 315	129 056	D,CS	D,CS	ALL	H
Greece	10 491	10 000	C	C	ALL	
Ireland	3 833	4 785	T1	PS, CS	FULL	H
Italy	84 969	85 035	T2	CS	ALL	H
Luxembourg	5 258	2 301	C/D	C/D		
Netherlands	32 768	27 056	T2	PS, CS,D	ALL	H
Portugal	9 103	10 722	T2	D+C	ALL	H
Spain	45 761	67 235	D,C,CS	D C,PS	ALL	H
Sweden	10 724	11 129	T2/T3 + T1	CS	ALL	H
United Kingdom	97 291	87 720	T2	CS	ALL	H
EU-15	645 923	576 424	C,CS,D,T1,T2,T3	C, CS, D, PS	ALL	H

(¹⁾ Information source: CRF Summary Table 3 for 2002.

(²⁾ Information source: CRF Table 7 for 2002.

Abbreviations explained in the Chapter 'Units and abbreviations'.

25 % between 1990 and 2003. Most Member States had increases in this source during this time. In absolute terms, Germany had the only decrease in these emissions. The countries contributing the most to the increasing trend were Spain, the United Kingdom, Greece and Italy.

This source category includes one key source: N₂O from 1.A.1.a: 'Electricity and heat production'.

N₂O emissions from 1.A.1.a: 'Electricity and heat production' account for 0.3 % of total EU-15 GHG emissions in 2003. Between 1990 and 2003, N₂O emissions from this source increased by 20 % in the EU-15 (Table 3.6). Most Member States had increases in this source during this time. The countries contributing the most to the increasing trend were Spain, Greece, France and the United Kingdom. In absolute terms, Germany had the highest decrease in these emissions.

3.2.2. Manufacturing industries and construction (CRF Source Category 1.A.2)

Tables 3.7 and 3.8 summarise information by Member State on emission trends, methodologies, emission factors,

completeness and qualitative uncertainty estimates for the CO₂ from 1.A.2: 'Manufacturing industries and construction'.

CO₂ emissions from 1.A.2: 'Manufacturing industries and construction' are the third largest key source in the EU-15 accounting for 14 % of total GHG emissions in 2003. Between 1990 and 2003, CO₂ emissions from manufacturing industries declined by 11 % in the EU-15. The emissions from this key source are due to fossil fuel consumption in manufacturing industries and construction, which decreased by 4 % between 1990 and 2003. Also in industry, a shift from solid fuels to gas took place.

Between 1990 and 2003, Germany shows by far the largest emission reductions in absolute terms. Also France, Belgium, the United Kingdom, Luxembourg and the Netherlands show emission reductions of more than two million tonnes, whereas large emission increases occurred mainly in Spain. The main reason for the large decline in Germany was the restructuring of industry and efficiency improvements after German reunification.

3.2.3 Transport (CRF Source Category 1.A.3)

Table 3.9 summarises information by Member State on methodologies, emission factors,

Table 3.8 Member States' contributions to CO₂ emissions from 1.A.2: 'Manufacturing industries and construction'

Member State	Greenhouse gas emissions (Gg CO ₂ equivalents)			Share in EU-15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	
	1990	2002	2003		(Gg CO ₂ equivalents)	(%)	(Gg CO ₂ equivalents)	(%)			
Austria	12 971	14 395	14 163	2.5 %	- 231	- 2 %	1 193	9 %	C	NS	CS, PS
Belgium	32 882	30 593	30 361	5.3 %	- 232	- 1 %	- 2 521	- 8 %	C	RS	C, CS
Denmark	5 376	5 559	5 404	0.9 %	- 154	- 3 %	28	1 %	C	NS	CS, C
Finland	14 925	13 196	13 824	2.4 %	628	5 %	- 1 101	- 7 %	T2 (CS)	PS	D, CS, PS
France	83 256	78 580	77 634	13.5 %	- 946	- 1 %	- 5 621	- 7 %	C	NS, AS, PS	CS
Germany	196 315	132 054	129 056	22.4 %	- 2 998	- 2 %	- 67 259	- 34 %	D, CS	NS	D, CS
Greece	10 491	10 255	10 000	1.7 %	- 255	- 2 %	- 491	- 5 %	C	NS	C
Ireland	3 833	4 892	4 785	0.8 %	- 107	- 2 %	952	25 %	T1	NS, PS	C
Italy	84 969	79 890	85 035	14.8 %	5 144	6 %	66	0 %	T2	NS	CS
Luxembourg	5 258	2 341	2 301	0.4 %	- 40	- 2 %	- 2 956	- 56 %			
Netherlands	32 768	26 662	27 056	4.7 %	393	1 %	- 5 712	- 17 %	CS, T2	NS, Q	PS, D
Portugal	9 103	11 049	10 722	1.9 %	- 327	- 3 %	1 619	18 %	D	NS, PS	D, CS
Spain	45 761	63 186	67 235	11.7 %	4 049	6 %	21 473	47 %	D, C, CS	NS, IS, Q	D, C, PS
Sweden	10 724	10 515	11 129	1.9 %	614	6 %	404	4 %	T2, T3	PS	CS
United Kingdom	97 291	83 218	87 720	15.2 %	4 501	5 %	- 9 571	- 10 %	T2	AS, NS	CS
EU-15	645 923	566 385	576 424	100.0 %	10 039	2 %	- 69 499	- 11 %			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.9 Member States' contributions to CO₂ emissions from 1.A.3: 'Transport' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO ₂ equivalents)	GHG emissions in 2003 (Gg CO ₂ equivalents)	Methods applied ¹⁾	EF ¹⁾	Estimate ²⁾	Quality ²⁾
Austria	12 405	22 692	M, CS	CS	ALL	H
Belgium	19 752	25 297	C,M	C,M		
Denmark	10 441	12 785	M/C	CS	ALL	H
Finland	12 316	13 067	CS (M)	CS	ALL	H
France	119 100	141 384	C/CS/M	C/M/CS	ALL	H
Germany	162 360	170 209	T1,T3,CS	CS	ALL	H
Greece	15 355	21 230	C, T2a	C, T2A	ALL	
Ireland	5 020	11 393	T1	CS	FULL	H
Italy	101 858	126 015	D, T1, T2a, C	CS	ALL	H
Luxembourg	2 724	6 019	C/D	C/D		
Netherlands	26 008	34 157	T2	CS, D	ALL	H
Portugal	10 137	19 583	M	D+C	ALL	H
Spain	56 513	95 499	D,C	D,C	ALL	H
Sweden	18 352	20 056	T1, T2, CS	CS	ALL	H
United Kingdom	117 209	125 974	T3	CS	ALL	H
EU-15	689 550	845 361	C,CS,D,M,T1, T2, T2a, T3	C, CS, D, M, T2A	ALL	H

(¹⁾ Information source: CRF Summary Table 3 for 2002.

(²⁾ Information source: CRF Table 7 for 2002.

Abbreviations explained in the Chapter 'Units and abbreviations'.

completeness and qualitative uncertainty estimates for the CO₂ emissions from 1.A.3: 'Transport'. CO₂ emissions from 'Transport' increased by 23 % between 1990 and 2003. Most Member States had increases in this source during this time. The growth was less than 10 % only in Finland, the United Kingdom, Sweden and Germany.

This source category includes four key sources: CO₂ from 1.A.3.a: 'Civil Aviation', 1.A.3.b: 'Road transportation', 1.A.3.c: 'Railways', and 1.A.3.d: 'Navigation'.

CO₂ emissions from 1.A.3.a 'Civil aviation' account for 0.5 % of total GHG emissions in 2003. Between 1990 and 2003, CO₂ emissions from civil aviation increased by 29 % in the EU-15 (Table 3.10).

The Member States France, Spain and Germany contributed the most to the emissions from this source (66 %). Most Member States increased emissions from civil aviation between 1990 and 2003. The Member States with the highest increases in absolute terms were Germany, Italy and Spain. The countries with the most reductions were Greece and Denmark.

CO₂ emissions from 1.A.3.b: 'Road transportation' are the second largest key

source in EU-15 accounting for 19 % of total GHG emissions in 2003. Between 1990 and 2003, CO₂ emissions from road transportation increased by 24 % in the EU-15 (Table 3.11). The emissions from this key source are due to fossil fuel consumption in road transport, which increased by 24 % between 1990 and 2003.

The Member States Germany, France and the United Kingdom contributed the most to the emissions from this source (53 %). All Member States increased emissions from road transportation between 1990 and 2003. The Member States with the highest increases in absolute terms were Spain, France and Italy. The countries with the lowest increase were Finland and Germany.

CO₂ emissions from 1.A.3.c: 'Railways' account for 0.1 % of total EU-15 GHG emissions in 2003. Between 1990 and 2003, CO₂ emissions from rail transportation decreased by 40 % in the EU-15 (Table 3.12). The emissions from this key source are due to fossil fuel consumption in rail transport, which decreased by 41 % between 1990 and 2003.

The Member States France, Germany and the United Kingdom contributed the most to the emissions from this source (66 %). Nearly all Member States decreased emissions from rail

Table 3.10 Member States' contributions to CO₂ emissions from 1.A.3.a: 'Civil aviation'

Member State	Greenhouse gas emissions (Gg CO ₂ equivalents)			Share in EU-15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO ₂ equivalents)	(%)	(Gg CO ₂ equivalents)	(%)			
Austria	32	75	67	0.3 %	- 8	- 11 %	35	109 %	CS	NS	CS
Belgium	12	15	15	0.1 %	0	0 %	3	22 %	C, M	PS	C
Denmark	243	140	138	0.6 %	- 2	- 2 %	- 105	- 43 %	C	NS	C
Finland	320	313	316	1.4 %	4	1 %	- 4	- 1 %	T2 (M)	NS	CS
France	4 541	5 501	5 186	23.0 %	- 315	- 6 %	645	14 %	M	NS	M
Germany	2 897	4 205	4 288	19.0 %	82	2 %	1 390	48 %	T1	NS	CS
Greece	1 455	1 218	1 164	5.2 %	- 54	- 4 %	- 291	- 20 %	T2a	NS, AS	T2a
Ireland	59	105	103	0.5 %	- 2	- 2 %	43	74 %	T2a	NS	CS
Italy	1 596	2 677	2 771	12.3 %	94	4 %	1 175	74 %	T1, T2a	NS	CS
Luxembourg	0	0	0	0.0 %	0	-	0	-			
Netherlands	41	41	41	0.2 %	0	0 %	0	0 %	CS	NS	CS
Portugal	245	375	394	1.7 %	18	5 %	149	61 %	T2b	NS, AS	D
Spain	4 135	5 091	5 397	23.9 %	306	6 %	1 262	31 %	D, C	NS, IS	C
Sweden	673	601	582	2.6 %	- 18	- 3 %	- 91	- 14 %	T1	NS	CS
United Kingdom	1 282	2 074	2 115	9.4 %	41	2 %	833	65 %	T3	NS	CS
EU-15	17 532	22 431	22 576	100.0 %	146	1 %	5 045	29 %			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.11 Member States' contributions to CO₂ emissions from 1.A.3.b: 'Road transportation'

Member State	Greenhouse gas emissions (Gg CO ₂ equivalents)			Share in EU-15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO ₂ equivalents)	(%)	(Gg CO ₂ equivalents)	(%)			
Austria	11 924	20 138	21 883	2.8 %	1 745	9 %	9 959	84 %	M	NS	CS
Belgium	19 270	24 279	24 813	3.1 %	534	2 %	5 543	29 %	C, M, CS	NS	C, CS
Denmark	9 351	11 388	11 864	1.5 %	476	4 %	2 513	27 %	COPERT3	NS	C
Finland	10 800	11 206	11 447	1.4 %	241	2 %	647	6 %	T2 (M)	NS	CS
France	111 403	132 594	132 260	16.7 %	- 335	0 %	20 857	19 %	M	NS	M
Germany	150 262	165 898	159 842	20.2 %	- 6 056	- 4 %	9 581	6 %	T3	NS	CS
Greece	11 873	16 979	18 015	2.3 %	1 036	6 %	6 142	52 %	COPERT3	NS	C
Ireland	4 680	10 833	10 993	1.4 %	160	1 %	6 313	135 %	T1	NS	CS
Italy	93 995	115 119	116 346	14.7 %	1 226	1 %	22 350	24 %	COPERT3	NS, AS	CS
Luxembourg	2 708	5 396	5 993	0.8 %	597	11 %	3 285	121 %			
Netherlands	25 472	32 853	33 433	4.2 %	580	2 %	7 960	31 %	T1	NS	CS
Portugal	9 249	18 831	18 747	2.4 %	- 84	0 %	9 498	103 %	D	NS	D
Spain	50 442	83 014	87 135	11.0 %	4 120	5 %	36 692	73 %	COPERT3	NS, IS	CS
Sweden	16 677	18 222	18 414	2.3 %	192	1 %	1 737	10 %	T1	NS	CS
United Kingdom	110 467	119 742	119 548	15.1 %	- 194	0 %	9 080	8 %	T3	NS	CS
EU-15	638 574	786 493	790 731	100.0 %	4 238	0.5 %	152 157	24 %			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.12 Member States' contributions to CO₂ emissions from 1.A.3.c: 'Railways'

Member State	Greenhouse gas emissions (Gg CO ₂ equivalents)			Share in EU-15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO ₂ equivalents)	(%)	(Gg CO ₂ equivalents)	(%)			
Austria	174	177	174	3.5 %	- 2	- 1 %	0	0 %	M	NS	CS
Belgium	202	130	126	2.5 %	- 4	- 3 %	- 76	- 38 %	C, M	RS	C
Denmark	297	210	218	4.4 %	8	4 %	- 78	- 26 %	C	NS	C
Finland	191	134	134	2.7 %	0	0 %	- 58	- 30 %	T2 (M)	NS	CS
France	1 070	743	703	14.1 %	- 40	- 5 %	- 367	- 34 %	C	NS	CS
Germany	2 879	1 675	1 612	32.3 %	- 64	- 4 %	- 1 268	- 44 %	T1	NS	CS
Greece	203	129	129	2.6 %	0	0 %	- 74	- 37 %	C	NS	C
Ireland	147	124	125	2.5 %	0	0 %	- 23	- 15 %	T1	NS	CS
Italy	441	383	207	4.2 %	- 175	- 46 %	- 234	- 53 %	D	NS	CS
Luxembourg	13	21	21	0.4 %	0	0 %	8	64 %			
Netherlands	91	106	103	2.1 %	- 3	- 3 %	12	14 %	T1	AS	CS
Portugal	173	110	95	1.9 %	- 15	- 14 %	- 78	- 45 %	D	NS	D
Spain	415	305	310	6.2 %	5	2 %	- 105	- 25 %	D, C	Q	C
Sweden	105	70	66	1.3 %	- 4	- 6 %	- 39	- 37 %	CS	AS	CS
United Kingdom	1 915	1 065	963	19.3 %	- 102	- 10 %	- 952	- 50 %	T2	NS	CS
EU-15	8 316	5 382	4 985	100.0 %	- 397	- 7 %	- 3 331	40 %			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.13 Member States' contributions to CO₂ emissions from 1.A.3.d: 'Navigation'

Member State	Greenhouse gas emissions (Gg CO ₂ equivalents)			Share in EU-15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO ₂ equivalents)		(Gg CO ₂ equivalents)				
				(%)	(%)	(%)	(%)				
Austria	52	80	84	0.4 %	5	6 %	32	62 %	M	NS	CS
Belgium	267	339	343	1.7 %	4	1 %	76	28 %	C, M	RS	C
Denmark	551	581	565	2.8 %	- 15	- 3 %	14	3 %	C	NS	C
Finland	361	501	519	2.6 %	18	4 %	158	44 %	T2 (M)	NS	CS
France	1 873	2 419	2 565	12.6 %	146	6 %	691	37 %	C	NS	CS
Germany	2 050	738	769	3.8 %	32	4 %	- 1 280	- 62 %	T1	NS	CS
Greece	1 825	1 937	1 923	9.5 %	- 14	- 1 %	98	5 %	C	NS	C
Ireland	85	59	61	0.3 %	2	3 %	- 24	- 29 %	T1	NS	CS
Italy	5 419	6 085	6 148	30.2 %	62	1 %	729	13 %	T1, T2	NS	CS
Luxembourg	4	6	6	0.0 %	0	0 %	2	46 %			
Netherlands	403	580	580	2.9 %	0	0 %	176	44 %	CS	NS, Q	CS
Portugal	470	221	347	1.7 %	126	57 %	- 123	- 26 %	D	NS	D
Spain	1 500	2 287	2 374	11.7 %	87	4 %	874	58 %	C	AS, IS	C
Sweden	658	669	752	3.7 %	83	12 %	94	14 %	T1	NS	CS
United Kingdom	3 511	1 775	3 297	16.2 %	1 522	86 %	- 214	- 6 %	T1	NS	CS
EU-15	19 028	18 277	20 332	100.0 %	2 055	11 %	1 304	7 %			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.14 Member States' contributions to CO₂ emissions from 1.A.3.e: 'Other'

Member State	Greenhouse gas emissions (Gg CO ₂ equivalents)			Share in EU-15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO ₂ equivalents)		(Gg CO ₂ equivalents)				
				(%)	(%)	(%)	(%)				
Austria	223	505	484	7.2 %	- 20	- 4 %	262	117 %	C	NS	CS
Belgium	0	0	0	0.0 %	0	-	0	-	C, M	RS	C
Denmark	0	0	0	0.0 %	0	-	0	-	NO	NO	NO
Finland	644	656	651	9.7 %	- 4	- 1 %	8	1 %	T2 (M)	NS	CS
France	213	583	671	10.0 %	87	15 %	457	214 %	C	PS	CS
Germany	4 272	3 717	3 699	54.9 %	- 19	- 1 %	- 573	- 13 %	T1	NS	CS
Greece	NO	NO	NO	-	-	-	-	-			
Ireland	48	109	112	1.7 %	3	3 %	63	131 %			
Italy	406	643	543	8.1 %	- 100	- 16 %	137	34 %	D	NS	CS
Luxembourg	0	0	0	0.0 %	0	-	0	-			
Netherlands	NO	NO	NO	-	-	-	-	-	T1	NS, Q	D
Portugal	0	0	0	0.0 %	0	-	0	-	NO	NO	NO
Spain	20	283	283	4.2 %	0	0 %	263	1 298 %	C	NS	C
Sweden	239	240	242	3.6 %	2	1 %	4	2 %	T1	NS	CS
United Kingdom	34	49	51	0.8 %	2	3 %	16	48 %	M	NS	CS
EU-15	6 099	6 785	6 736	100.0 %	- 49	- 1 %	637	10 %			

Abbreviations explained in the Chapter 'Units and abbreviations'.

transportation between 1990 and 2003, only Luxembourg and the Netherlands increased their emissions. The Member States with the highest decreases in absolute terms were Germany and the United Kingdom.

CO₂ emissions from 1.A.3.d: 'Navigation' account for 0.5 % of total EU-15 GHG emissions in 2003. Between 1990 and 2003, CO₂ emissions from navigation increased by 7 % in the EU-15 (Table 3.13). The emissions

Table 3.15 Member States' contributions to CH₄ emissions from 1.A.3: 'Transport' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO ₂ equivalents)	GHG emissions in 2003 (Gg CO ₂ equivalents)	Methods applied ¹⁾	EF ¹⁾	Estimate ²⁾	Quality ²⁾
Austria	61	23	M, T1	CS	ALL	M
Belgium	73	40	C,M	C,M		
Denmark	57	65	M/C	M/C	ALL	M
Finland	103	59	CS (M)	CS/M	ALL	M
France	770	517	C/CS	C/M/CS	ALL	L
Germany	1 334	240	T1,CS	M,CS	All	M
Greece	114	164	C, T2a	C, T2a	ALL	
Ireland	37	49	T1	C	Full	L
Italy	775	615	D, T1, T2a, C	C, CS	ALL	M
Luxembourg	7	9	C/D	C/D		
Netherlands	158	74	CS/T3(road); CS/T1/T2(non-r)	CS (road), D	ALL	M
Portugal	58	53	M	D+C+CS	All	M
Spain	237	194	C	C	ALL	L
Sweden	269	139	T1, T2, CS	CS, C	PART	M
United Kingdom	625	217	T2/T3	D/C	ALL	L
EU-15	4 678	2 457	C, CS, D, M, T1, T2, T2a, T3	C, CS, D, M, T2a	ALL, PART	M

(¹⁾ Information source: CRF Summary Table 3 for 2002.

(²⁾ Information source: CRF Table 7 for 2002.

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.16 Member States' contributions to CH₄ emissions from 1.A.3.b: 'Road transportation'

Member State	Greenhouse gas emissions (Gg CO ₂ equivalents)			Share in EU-15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	
	1990	2002	2003		(Gg CO ₂ equivalents)	(%)	(Gg CO ₂ equivalents)	(%)			
Austria	61	23	22	0.9 %	- 1	- 6 %	- 39	- 64 %	M	NS, Q	CS
Belgium	72	41	39	1.7 %	- 2	- 5 %	- 33	- 45 %	C, M	RS	C
Denmark	55	63	62	2.6 %	- 1	- 2 %	7	13 %	COPERT3	NS	C
Finland	90	50	47	2.0 %	- 3	- 5 %	- 42	- 47 %	T3 (M)	NS	CS
France	763	551	511	21.7 %	- 40	- 7 %	- 252	- 33 %	M	NS	M
Germany	1 317	269	229	9.7 %	- 40	- 15 %	- 1 088	- 83 %	T3	NS	CS, M
Greece	108	156	158	6.7 %	3	2 %	50	46 %	COPERT3	NS	C
Ireland	37	52	49	2.1 %	- 3	- 6 %	12	33 %	T3	NS	COPERT3
Italy	743	613	579	24.6 %	- 33	- 5 %	- 164	- 22 %	COPERT3	NS, AS	CS
Luxembourg	7	9	9	0.4 %	0	- 1 %	2	34 %			
Netherlands	157	77	72	3.1 %	- 5	- 6 %	- 84	- 54 %	T3	NS, Q	CS
Portugal	56	55	52	2.2 %	- 4	- 7 %	- 4	- 8 %	M	NS, AS	C
Spain	234	189	189	8.0 %	0	0 %	- 45	- 19 %	COPERT3	NS, IS	CS
Sweden	262	144	132	5.6 %	- 12	- 8 %	- 130	- 50 %	T2	NS	CS
United Kingdom	614	238	207	8.8 %	- 31	- 13 %	- 407	- 66 %	T3	NS	CS
EU-15	4 576	2 531	2 359	100.0 %	- 172	- 7 %	- 2 217	- 48 %			

Abbreviations explained in the Chapter 'Units and abbreviations'.

from this key source are due to fossil fuel consumption in navigation, which increased by 7 % between 1990 and 2003.

Four Member States (Italy, France, Spain and the United Kingdom) contributed the most to the emissions from this source (71 %).

Table 3.17 Member States' contributions to N₂O emissions from 1.A.3: 'Transport' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO ₂ equivalents)	GHG emissions in 2003 (Gg CO ₂ equivalents)	Methods applied ¹⁾	EF ¹⁾	Estimate ²⁾	Quality ²⁾
Austria	171	281	M, T1	CS	ALL	M
Belgium	356	797	C,M	C,M		
Denmark	147	429	M/C	M/C	ALL	L
Finland	173	529	CS (M)	CS/M	ALL	L
France	1 666	4 346	C/CS	C/M/CS	ALL	L
Germany	3 079	4 237	T1,T2,T3,CS	M,CS	All	M
Greece	175	463	C, T2a	C, T2a	ALL	
Ireland	87	409	T1	C	Full	L
Italy	1 724	3 769	D, T1, T2a, C	C, CS	ALL	M
Luxembourg	12	56	C/D	C/D		
Netherlands	272	472	CS/T3(road);CS/T1 (non-r)	CS(road)/D(rest)	ALL	L
Portugal	145	531	M	D+C+CS	All	M
Spain	782	2 412	D,C	D,C	ALL	L
Sweden	324	715	T1, T2, CS	CS, C	ALL	M
United Kingdom	1 337	5 046	T2/T3	D	ALL	L
EU-15	10 449	24 492	C, CS, D, M, T1, T2,T2a,T3	C, CS, D, M	ALL	L

(¹⁾ Information source: CRF Summary Table 3 for 2002.

(²⁾ Information source: CRF Table 7 for 2002.

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.18 Member States' contributions to N₂O emissions from 1.A.3.b: 'Road transportation'

Member State	Greenhouse gas emissions (Gg CO ₂ equivalents)			Share in EU-15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO ₂ equivalents)	(%)	(Gg CO ₂ equivalents)	(%)			
Austria	160	270	268	1.1 %	- 1	- 1 %	109	68 %	M	NS, Q	CS
Belgium	297	735	739	3.1 %	3	0 %	442	149 %	C, M	RS	C
Denmark	131	394	415	1.8 %	21	5 %	284	217 %	COPERT3	NS	C
Finland	160	481	516	2.2 %	35	7 %	356	223 %	T3 (M)	NS	CS
France	1 592	4 110	4 258	18.0 %	147	4 %	2 666	167 %	M	NS	M
Germany	2 932	4 475	4 093	17.3 %	- 382	- 9 %	1 161	40 %	T3	NS	CS, M
Greece	123	375	421	1.8 %	46	12 %	299	243 %	COPERT3	NS	C
Ireland	56	369	383	1.6 %	14	4 %	327	582 %	T3	NS	COPERT3
Italy	1 612	3 545	3 670	15.5 %	125	4 %	2 058	128 %	COPERT3	NS, AS	CS
Luxembourg	12	53	53	0.2 %	0	- 1 %	41	345 %			
Netherlands	271	482	470	2.0 %	- 12	- 2 %	199	74 %	T3	NS, Q	CS
Portugal	128	509	518	2.2 %	9	2 %	391	306 %	M	NS, AS	C
Spain	678	2 139	2 298	9.7 %	160	7 %	1 620	239 %	COPERT3	NS, IS	CS
Sweden	261	640	661	2.8 %	21	3 %	400	153 %	T2	NS	CS, C
United Kingdom	1 028	4 669	4 842	20.5 %	173	4 %	3 814	371 %	T3	NS	CS
EU-15	9 440	23 246	23 606	100.0 %	360	2 %	14 165	150 %			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Nearly all Member States increased emissions from navigation between 1990 and 2003, only Germany, Ireland, Portugal and the United

Kingdom decreased their emissions. The Member States with the highest decreases in absolute terms were Germany and the United Kingdom.

Table 3.19 Member States' contributions to CO₂ emissions from 1.A.4: 'Other sectors' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO ₂ equivalents)	GHG emissions in 2003 (Gg CO ₂ equivalents)	Methods applied ¹⁾	EF ¹⁾	Estimate ²⁾	Quality ²⁾
Austria	14 392	14 702	C	CS	ALL	H
Belgium	27 232	31 239	C	C		
Denmark	9 129	7 402	C	CS	ALL	H
Finland	6 968	6 031	CS (T2, T1)	CS/D	ALL	H
France	94 417	100 454	C	CS	ALL	H
Germany	204 414	177 792	CS	CS	All	H
Greece	8 026	14 295	C	C	ALL	
Ireland	9 726	10 263	T1	CS	Full	H
Italy	76 262	84 162	T2	CS	ALL	H
Luxembourg	1 277	1 368	C/D	C/D		
Netherlands	37 431	40 151	T2	D, CS	ALL	H
Portugal	4 025	6 595	T2	D+C	All	H
Spain	25 773	35 813	D,C	D,C	ALL	H
Sweden	10 506	6 166	T2/T3 + T1	CS	ALL	H
United Kingdom	110 175	111 020	T2	CS	ALL	H
EU-15	639 753	647 453	C,CS,D,T1,T2,T3	C, CS, D	ALL	H

(¹⁾ Information source: CRF Summary Table 3 for 2002.

(²⁾ Information source: CRF Table 7 for 2002.

Abbreviations explained in the Chapter 'Units and abbreviations'.

CO₂ emissions from 1.A.3.e: 'Other' account for 0.2 % of total EU-15 GHG emissions in 2003. This source includes mainly pipeline transport and ground activities in airports and harbours. Between 1990 and 2003, CO₂ emissions from 'Other' sources increased by 10 % in the EU-15 (Table 3.14). The emissions from this key source are due to fossil fuel consumption in other transportation, which increased by 15 % between 1990 and 2003. A fuel shift occurred from oil to gas.

Two Member States (Germany and France) contributed the most to the emissions from this source (65 %). Several Member States increased emissions from other sources between 1990 and 2003.

Table 3.15 summarises information by Member State on methodologies, emission factors, completeness and qualitative uncertainty estimates for CH₄ emissions from 1.A.3: 'Transport'. CH₄ emissions from transport decreased by 47 % between 1990 and 2003. Most Member States had decreases in this source during this time.

This source category includes one key source: CH₄ from 1.A.3.b: 'Road transportation'.

CH₄ emissions from 1.A.3.b: 'Road transportation' account for 0.1 % of total EU-15 GHG emissions in 2003. Between 1990 and 2003, CH₄ emissions from 'Road transportation' sources decreased by 48 % in the EU-15 (Table 3.16). Two Member States (Italy and France) contributed the most to the emissions from this source (46 %). Most Member States reduced CH₄ emissions from 'Road transportation' between 1990 and 2003. The Member State with the highest decreases in absolute terms was Germany.

Table 3.17 summarises information by Member State on methodologies, emission factors, completeness and qualitative uncertainty estimates for the N₂O emissions from 1.A.3: 'Transport'. N₂O emissions from 'Transport' increased by 134 % between 1990 and 2003. All Member States had increases in this source during this time. This source category includes one key source: N₂O from 1.A.3.b: 'Road transportation'.

Table 3.20 Member States' contributions to CO₂ emissions from 1.A.4.a: 'Commercial/institutional'

Member State	Greenhouse gas emissions (Gg CO ₂ equivalents)			Share in EU-15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO ₂ equivalents)	(%)	(Gg CO ₂ equivalents)	(%)			
Austria	2 214	1 656	1 823	1.1 %	167	10 %	- 391	- 18 %	C	NS	CS
Belgium	4 278	6 068	6 419	4.0 %	351	6 %	2 141	50 %	C	RS	C
Denmark	1 403	874	854	0.5 %	- 20	- 2 %	- 549	- 39 %	C	NS	CS, C
Finland	1 915	1 219	1 314	0.8 %	95	8 %	- 601	- 31 %	T1, T2	NS, PS	D, CS
France	28 126	27 814	29 745	18.5 %	1 931	7 %	1 619	6 %	C	NS	CS
Germany	61 816	47 431	48 694	30.3 %	1 264	3 %	- 13 121	- 21 %	CS	NS	CS
Greece	527	1 030	1 131	0.7 %	101	10 %	604	115 %	C	NS	C
Ireland	2 314	2 999	3 044	1.9 %	45	1 %	730	32 %	T1	NS	CS
Italy	15 579	17 326	19 413	12.1 %	2 087	12 %	3 834	25 %	T2	NS	CS
Luxembourg	607	656	646	0.4 %	- 11	- 2 %	38	6 %			
Netherlands	7 419	10 399	11 405	7.1 %	1 006	10 %	3 985	54 %	CS	NS	CS
Portugal	744	2 804	3 246	2.0 %	442	16 %	2 503	337 %	D	NS	D
Spain	3 783	7 986	7 905	4.9 %	- 81	- 1 %	4 122	109 %	D, C	IS	D, C
Sweden	2 532	1 227	1 134	0.7 %	- 93	- 8 %	- 1 398	- 55 %	T1	NS	CS
United Kingdom	29 447	25 036	24 047	15.0 %	- 988	- 4 %	- 5 400	- 18 %	T2	NS	CS
EU-15	162 704	154 523	160 818	100.0 %	6 295	4 %	- 1 886	- 1 %			

Abbreviations explained in the Chapter 'Units and abbreviations'.

N₂O emissions from 1.A.3.b: 'Road transportation' account for 0.6 % of total EU-15 GHG emissions in 2003. Between 1990 and 2003, N₂O emissions from 'Road transportation' increased by 150 % in the EU-15 (Table 3.18). 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.

The Member States the United Kingdom, Germany, Italy and France contributed the most to the emissions from this source (71 %). All Member States increased N₂O emissions from 'Road transportation' between 1990 and 2003. The Member States with the highest increases in absolute terms were the United Kingdom, France and Italy.

3.2.4 Other sectors (CRF Source Category 1.A.4)

Table 3.19 summarises information by Member State on methodologies, emission factors, completeness and qualitative uncertainty estimates for the source

1.A.4: 'Other sectors'. CO₂ emissions from 'Other sectors' increased by 1 % between 1990 and 2003. Most Member States had increases in this source during this time. The relative growth was highest in Greece (78 %).

This source category includes three key sources: CO₂ from 1.A.4.a: 'Commercial/institutional', CO₂ from 1.A.4.b: 'Residential' and CO₂ from 1.A.4.c: 'Agriculture/forestry/fisheries'.

CO₂ emissions from 1.A.4.a: 'Commercial/institutional' are the fifth largest key source of GHG emissions in the EU-15 and account for 3.9 % of total GHG emissions in 2003. Between 1990 and 2003, CO₂ emissions from services decreased by 1 % in the EU-15 (Table 3.20). Main factors influencing CO₂ emissions from this key source 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 services increased by 8 % between 1990 and 2003, with a fuel shift from coal and oil to gas.

Table 3.21 Member States' contributions to CO₂ emissions from 1.A.4.b 'Residential'

Member State	Greenhouse gas emissions (Gg CO ₂ equivalents)			Share in EU-15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO ₂ equivalents)	(%)	(Gg CO ₂ equivalents)	(%)			
	Austria	10 130	10 234		11 087	2.6 %	853	8 %			
Belgium	20 224	21 231	22 527	5.3 %	1 297	6 %	2 304	11 %	C	RS	C
Denmark	5 033	4 027	3 971	0.9 %	- 55	- 1 %	- 1 061	- 21 %	C	NS	CS, C, D
Finland	3 059	2 675	2 652	0.6 %	- 23	- 1 %	- 408	- 13 %	T1	NS	D, CS
France	55 572	57 688	60 821	14.3 %	3 133	5 %	5 249	9 %	C	NS	CS
Germany	129 279	120 090	122 442	28.8 %	2 353	2 %	- 6 837	- 5 %	CS	NS	CS
Greece	4 684	8 518	10 036	2.4 %	1 518	18 %	5 352	114 %	C	NS	C
Ireland	6 752	6 461	6 382	1.5 %	- 78	- 1 %	- 370	- 5 %	T1	NS	CS
Italy	52 337	52 300	56 378	13.3 %	4 078	8 %	4 041	8 %	T2	NS	CS
Luxembourg	609	658	648	0.2 %	- 11	- 2 %	39	6 %			
Netherlands	19 264	18 663	19 122	4.5 %	459	2 %	- 142	- 1 %	CS	NS	CS
Portugal	1 621	2 260	2 273	0.5 %	13	1 %	652	40 %	D	NS	D
Spain	12 982	17 381	17 522	4.1 %	141	1 %	4 541	35 %	D, C	IS	D, C
Sweden	6 417	3 695	3 420	0.8 %	- 275	- 7 %	- 2 997	- 47 %	T1	NS	CS
United Kingdom	77 502	86 865	85 750	20.2 %	- 1 115	- 1 %	8 248	11 %	T2	NS	CS
EU-15	405 465	412 746	425 033	100.0 %	12 287	3 %	19 568	5 %			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.22 Member States' contributions to CO₂ emissions from 1.A.4.c: 'Agriculture/forestry/fisheries'

Member State	Greenhouse gas emissions (Gg CO ₂ equivalents)			Share in EU-15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO ₂ equivalents)	(%)	(Gg CO ₂ equivalents)	(%)			
	Austria	2 048	1 772		1 792	2.9 %	19	1 %			
Belgium	2 730	2 308	2 293	3.7 %	- 15	- 1 %	- 437	- 16 %	C	RS	C
Denmark	2 693	2 580	2 577	4.2 %	- 3	0 %	- 117	- 4 %	C	NS	CS, C
Finland	1 994	2 045	2 066	3.4 %	20	1 %	72	4 %	T1, T2	NS	D, CS
France	10 719	10 203	9 888	16.1 %	- 316	- 3 %	- 831	- 8 %	C	NS	CS
Germany	13 319	6 732	6 655	10.8 %	- 77	- 1 %	- 6 664	- 50 %	CS	NS	CS
Greece	2 815	2 713	3 128	5.1 %	415	15 %	313	11 %	C	NS	C
Ireland	660	836	837	1.4 %	0	0 %	177	27 %	T1	NS	CS
Italy	8 347	8 285	8 372	13.6 %	86	1 %	25	0 %	T2	NS	CS
Luxembourg	61	75	75	0.1 %	0	0 %	14	23 %			
Netherlands	10 747	9 721	9 624	15.6 %	- 97	- 1 %	- 1 123	- 10 %	CS	NS, Q	CS
Portugal	1 660	1 327	1 076	1.7 %	- 252	- 19 %	- 584	- 35 %	D	NS	D
Spain	9 008	10 381	10 386	16.9 %	6	0 %	1 378	15 %	D, C	NS, IS	D, CS
Sweden	1 557	1 560	1 612	2.6 %	53	3 %	55	4 %	T1	NS	CS
United Kingdom	3 227	2 054	1 223	2.0 %	- 831	- 40 %	- 2 003	- 62 %	T2, M	NS	CS
EU-15	71 585	62 594	61 602	100.0 %	- 992	- 2 %	- 9 983	14 %			

Abbreviations explained in the Chapter 'Units and abbreviations'.

The Member States Germany, France and the United Kingdom contributed the most to the emissions from this source

(64 %). The Member States with the highest increases in absolute terms were Spain, Italy and the Netherlands. The

Member State with the highest reduction was Germany.

CO₂ emissions from 1.A.4.b: 'Residential' are the fourth largest key source of GHG emissions in the EU-15 and account for 10 % of total GHG emissions in 2003. Between 1990 and 2003, CO₂ emissions from households increased by 5 % in the EU-15 (Table 3.21). Main factors influencing CO₂ emissions from this key source 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 13 % between 1990 and 2003, with a fuel shift from coal and oil to gas.

Between 1990 and 2003, the largest reduction in absolute terms was reported by Germany reducing emissions by seven million tonnes. Also, Denmark and Sweden show emission reductions of more than one million tonnes. The United Kingdom had the largest emission increases in absolute terms. One reason for the performance of the

Nordic countries seems to be increased use of district heating. As district heating replaces heating boilers in households, an increase in the share of district heating reduces CO₂ 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.

CO₂ emissions from 1.A.4.c: 'Agriculture/forestry/fisheries' account for 1.5 % of total EU-15 GHG emissions in 2003. Between 1990 and 2003, CO₂ emissions from 'Agriculture/forestry/fisheries' decreased by 14 % in the EU-15 (Table 3.22).

Three Member States (Spain, France and the Netherlands) contributed the most to the emissions from this source (49 %). The Member State with the highest increase in absolute terms was Spain, the highest decreases were in Germany, the United Kingdom and the Netherlands. In the Netherlands, this decrease was due to significant energy conservation measures in greenhouse horticulture

Table 2.23 Member States' contributions to CH₄ emissions from 1.A.4: 'Other sectors' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO ₂ equivalents)	GHG emissions in 2003 (Gg CO ₂ equivalents)	Methods applied ¹⁾	EF ¹⁾	Estimate ²⁾	Quality ²⁾
Austria	397	293	C	CS	ALL	L
Belgium	129	94	C	D		
Denmark	90	165	C	CS/C	ALL	M
Finland	304	324	CS (T2, T1)	CS/PS	ALL	L
France	3 985	3 375	C	CS	ALL	L
Germany	2 559	669	T2	CS	All	M
Greece	214	211	C	C	ALL	
Ireland	89	44	T1	C	Full	L
Italy	310	480	T2	C	ALL	M
Luxembourg	12	7	C/D	C/D		
Netherlands	393	390	T2	CS	ALL	M
Portugal	348	314	T2	D+C	All	L
Spain	820	653	C	C	ALL	L
Sweden	225	243	T2/T3 + T1	CS	ALL	M
United Kingdom	1 468	477	T2	CS/C/D	ALL	L
EU-15	11 341	7 740	C,CS,D,T1,T2,T3	C, CS, D, PS	ALL	L

(¹⁾ Information source: CRF Summary Table 3 for 2002.

(²⁾ Information source: CRF Table 7 for 2002.

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.24 Member States' contributions to CH₄ emissions from 1.A.4.b: 'Residential'

Member State	Greenhouse gas emissions (Gg CO ₂ equivalents)			Share in EU-15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO ₂ equivalents)	(%)	(Gg CO ₂ equivalents)	(%)			
Austria	385	242	260	3,7 %	18	7 %	- 124	- 32 %	C	NS	CS
Belgium	122	83	86	1,2 %	2	3 %	- 36	- 30 %	C	RS	D
Denmark	67	97	99	1,4 %	2	2 %	32	48 %	C	NS	CS, C
Finland	240	269	269	3,8 %	- 1	0 %	29	12 %	T1	NS	D, CS
France	3 906	3 010	3 308	46,6 %	298	10 %	- 598	- 15 %	C	NS	CS
Germany	1 200	553	578	8,1 %	25	5 %	- 621	- 52 %	T2	NS	CS
Greece	205	207	204	2,9 %	- 3	- 2 %	- 1	- 1 %	C	NS	C
Ireland	84	44	36	0,5 %	- 8	- 18 %	- 47	- 57 %	T1	NS	C
Italy	260	343	369	5,2 %	26	8 %	109	42 %	T2	NS	C
Luxembourg	6	3	3	0,0 %	0	1 %	- 3	- 45 %			
Netherlands	356	343	346	4,9 %	3	1 %	- 10	- 3 %	CS	NS, Q	PS, CS
Portugal	344	303	308	4,3 %	5	2 %	- 36	- 10 %	T2	NS	CS
Spain	775	603	612	8,6 %	9	1 %	- 163	- 21 %	C	IS	C
Sweden	216	212	234	3,3 %	22	10 %	18	8 %	T1	CS	CS
United Kingdom	1 381	605	389	5,5 %	- 216	- 36 %	- 992	- 72 %	T1, T2, M	NS	CS, C
EU-15	9 546	6 920	7 101	100,0 %	182	3 %	- 2 445	- 26 %			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.25 Member States' contributions to N₂O emissions from 1.A.4: 'Other sectors' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO ₂ equivalents)	GHG emissions in 2003 (Gg CO ₂ equivalents)	Methods applied ¹⁾	EF ¹⁾	Estimate ²⁾	Quality ²⁾
Austria	294	305	C	CS	ALL	L
Belgium	784	847	C	D		
Denmark	110	95	C	C	ALL	L
Finland	114	111	CS (T2, T1)	CS/PS	ALL	L
France	1 287	1 401	C	CS	ALL	L
Germany	1 037	575	T2	CS	All	M
Greece	631	894	C	C	ALL	
Ireland	328	399	T1	C	Full	L
Italy	3 439	3 322	T2	C	ALL	M
Luxembourg	6	0	C/D	C/D		
Netherlands	45	43	T1	D	ALL	L
Portugal	237	176	T2	D+C	All	L
Spain	304	330	D,C	D,C	ALL	L
Sweden	320	283	T2/T3 + T1	CS	PART	M
United Kingdom	599	212	T2	CS/D	ALL	L
EU-15	9 534	8 995	C,CS,D,T1,T2,T3	C, CS, D, PS	ALL, PART	M

(¹) Information source: CRF Summary Table 3 for 2002.

(²) Information source: CRF Table 7 for 2002.

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.26 Member States' contributions to N₂O emissions from 1.A.4.b: 'Residential'

Member State	Greenhouse gas emissions (Gg CO ₂ equivalents)			Share in EU-15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO ₂ equivalents)	(%)	(Gg CO ₂ equivalents)	(%)			
Austria	138	136	146	2.7 %	10	8 %	8	6 %	C	NS	CS
Belgium	517	508	562	10.5 %	54	11 %	46	9 %	C	RS	NS
Denmark	57	51	50	0.9 %	0	- 1 %	- 6	- 11 %	C	NS	C, CS
Finland	71	74	74	1.4 %	0	0 %	3	4 %	T1	NS	D, CS
France	959	959	1 036	19.4 %	77	8 %	77	8 %	C	NS	CS
Germany	799	385	394	7.4 %	9	2 %	- 405	- 51 %	T2	NS	CS
Greece	283	422	480	9.0 %	58	14 %	197	70 %	C	NS	C
Ireland	184	200	195	3.7 %	- 5	- 2 %	11	6 %	T1	NS	C
Italy	2 122	1 772	1 853	34.7 %	81	5 %	- 269	- 13 %	T2	NS	C
Luxembourg	3	3	0	0.0 %	- 3	- 100 %	- 3	- 100 %			
Netherlands	26	23	23	0.4 %	0	- 2 %	- 4	- 14 %	CS	NS	D
Portugal	84	77	78	1.5 %	1	1 %	- 6	- 7 %	T1	NS	CS
Spain	206	205	204	3.8 %	0	0 %	- 2	- 1 %	D, C	IS	D, C
Sweden	134	106	110	2.1 %	4	4 %	- 23	- 17 %	T1	CS	CS
United Kingdom	277	169	131	2.5 %	- 38	- 22 %	- 146	- 53 %	T1, T2	NS	CS, D
EU-15	5 861	5 091	5 338	100.0 %	248	5 %	- 522	- 9 %			

Abbreviations explained in the Chapter 'Units and abbreviations'.

which account for approximately 85 % of the primary energy use of the Dutch agricultural sector.

Table 3.23 summarises information by Member State on methodologies, emission factors, completeness and qualitative uncertainty estimates for CH₄ from 1.A.4: 'Other sectors'. CH₄ emissions from 'Other sectors' decreased by 32 % between 1990 and 2003. Most Member States had decreases in this source during this time. The relative growth was highest in Denmark (83 %), the decrease was highest in Germany (74 %).

This source category includes one key source: CH₄ from 1.A.4.a: 'Residential'.

CH₄ emissions from 1.A.4.b: 'Residential' account for 0.2 % of total GHG emissions in 2003. Between 1990 and 2003, CH₄ emissions from households decreased by 26 % in the EU-15. France contributed by 47 % to this source. Between 1990 and 2003, the largest reduction in absolute terms was reported by Germany and France.

Table 3.25 summarises information by Member State on methodologies, emission factors, completeness and qualitative uncertainty estimates from 1.A.4: 'Other sectors'. N₂O emissions from 'Other sectors' decreased by 6 % between 1990 and 2003. Most Member States had decreases in this source during this time. The relative growth was highest in Greece (42 %), the decrease was highest in Germany.

This source category includes one key source: N₂O from 1.A.4.b: 'Residential'.

N₂O emissions from 1.A.4.b: 'Residential' account for 0.1 % of total GHG emissions in 2003. Between 1990 and 2003, N₂O emissions from households decreased by 9 % in the EU-15 (Table 3.26). Italy and France contributed the most to this source (54 %). Between 1990 and 2003, the largest reductions in absolute terms was reported by Germany and Italy. Greece had the largest emission increases in absolute terms.

Table 3.27 Member States' allocation of sources to 1.A.5: 'Other'

Member State	Source allocation to 1.A.5: 'Other'	Source
Austria	Mobile: Military	CRF Table 1.s.2
Belgium	Mobile: Military aviation	CRF Table 1.s.2
Denmark	Mobile: Emission from military combustion of fuels	CRF Table 1.s.2
Finland	Stationary + Mobile	CRF Table 1.s.2
France	No 'Other' emissions	CRF Table 1.s.2
Germany	Military: stationary and mobile	CRF Table 1.s.2
Greece	No 'Other' emissions	CRF Table 1.s.2
Ireland	No 'Other' emissions	CRF Table 1.s.2
Italy	Mobile	CRF Table 1.s.2
Luxembourg	No 'Other' emissions	CRF Table 1.s.2
Netherlands	Mobile: Military fuel	CRF Table 1.s.2
Portugal	No 'Other' emissions	CRF Table 1.s.2
Spain	No 'Other' emissions	CRF Table 1.s.2
Sweden	Mobile: Military use	CRF Table 1.s.2
United Kingdom	Mobile: Military aircraft and naval vessels	CRF Table 1.s.2

Table 3.28 Member States' contributions to CO₂ emissions from 1.A.5: 'Other' and information on methods applied and quality of these emission estimate

Member State	GHG emissions in 1990 (Gg CO ₂ equivalents)	GHG emissions in 2003 (Gg CO ₂ equivalents)	Methods applied ¹⁾	EF ¹⁾	Estimate ²⁾	Quality ²⁾
Austria	35	36	M, CS	CS	ALL	H
Belgium	166	96	C	C		
Denmark	119	92				
Finland	956	1 447	CS (T2, T1)	CS/D	ALL	H
France	0	0	C	CS	NO	
Germany	11 826	2 053	CS	CS	All	H
Greece	NO	NO			NO	
Ireland	NO	NO	NA	NA	NE	NE
Italy	1 041	660	T2	CS	ALL	H
Luxembourg	0	0	C/D	C/D		
Netherlands	566	437	CS/T2	CS	ALL	M
Portugal	8	0	T2	D+C		
Spain	NE	NE	NE		IE	
Sweden	845	299	T1	CS	ALL	H
United Kingdom	5 285	2 793	T2	CS	ALL	M
EU-15	20 847	7 913	C,CS,D,M,T1, T2,T3	C, CS, D	ALL, IE, NE	H

(¹⁾ Information source: CRF Summary Table 3 for 2002.

(²⁾ Information source: CRF Table 7 for 2002.

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.29 Member States' contributions to CO₂ emissions from 1.A.5: 'Other'

Member State	Greenhouse gas emissions (Gg CO ₂ equivalents)			Share in EU-15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO ₂ equivalents)	(%)	(Gg CO ₂ equivalents)	(%)			
Austria	35	41	36	0.5 %	- 5	- 12 %	1	3 %	M	AS	CS
Belgium	166	96	96	1.2 %	0	0 %	- 70	- 42 %	C	RS	C
Denmark	119	89	92	1.2 %	3	4 %	- 27	- 23 %	C	NS	C
Finland	956	1 424	1 447	18.3 %	23	2 %	491	51 %	T1, T2	NS	D, CS
France	0	0	0	0.0 %	0	-	0	-	C	NS	CS
Germany	11 826	1 963	2 053	25.9 %	90	5 %	- 9 773	- 83 %	CS	NS	CS
Greece	NO	NO	NO	-	-	-	-	-			
Ireland	NO	NO	NO	-	-	-	-	-			
Italy	1 041	314	660	8.3 %	347	111 %	- 381	- 37 %	T2	NS	CS
Luxembourg	0	0	0	0.0 %	0	-	0	-			
Netherlands	566	499	437	5.5 %	- 62	- 12 %	- 129	- 23 %	CS, T2	NS, Q	CS
Portugal	8	0	0	0.0 %	0	-	- 8	- 100 %	D	NS	D
Spain	NE	NE	NE	-	-	-	-	-			
Sweden	845	319	299	3.8 %	- 19	- 6 %	- 546	- 65 %	T1	NS	CS
United Kingdom	5 285	3 057	2 793	35.3 %	- 264	- 9 %	- 2 492	- 47 %	T2	NS, AS	CS
EU-15	20 847	7 801	7 913	100.0 %	112	1 %	- 12 934	- 62 %			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.30 Member States' contributions to 1.B.1: 'Fugitive CO₂ emissions from solid fuels' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO ₂ equivalents)	GHG emissions in 2003 (Gg CO ₂ equivalents)	Methods applied ¹⁾	EF ¹⁾	Estimate ²⁾	Quality ²⁾
Austria	0	0	NA	NA	NA	NA
Belgium	0	0	NA	NA		
Denmark	0	0	NO	0	NO	
Finland	503	547	CS	CS	ALL	L
France	0	0	C	CS	IE	H
Germany	NE	NE	NE	NE	NE	
Greece	0	0			PART	
Ireland	NO	0	NA	NA	NO	NA
Italy	0	0			NO	
Luxembourg	0	0	C/D	C/D		
Netherlands	403	464	CS/T2	CS	ALL	H
Portugal	9	0	MB	C	All	L
Spain	18	72	CS	PS	ALL	H
Sweden	947	700	T2/T3	CS	PART	H
United Kingdom	861	114	T2/T3	CS	ALL	M
EU-15	2 740	1 898	C, CS, D, MB, T2, T3	C, CS, PS	ALL, IE, NE, PART	M

(¹⁾ Information source: CRF Summary Table 3 for 2002.

(²⁾ Information source: CRF Table 7 for 2002.

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.31 Member States' contributions to a 1.B.1.b: 'Fugitive CO₂ emissions from solid fuel transformation'

Member State	Greenhouse gas emissions (Gg CO ₂ equivalents)			Share in EU-15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO ₂ equivalents)	(%)	(Gg CO ₂ equivalents)	(%)			
Austria	IE	IE	IE	-	-	-	-	-	IE	IE	IE
Belgium	0	NA	NA	-	-	-	-	-	N/A	N/A	N/A
Denmark	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Finland	NO	NO	NO	-	-	-	-	-	NO	NO	NO
France	0	0	0	0.0 %	0	-	0	-			
Germany	NE	NE	NE	-	-	-	-	-			
Greece	NE	NE	NE	-	-	-	-	-			
Ireland	NO	NO	NO	-	-	-	-	-			
Italy	NO	NO	NO	-	-	-	-	-			
Luxembourg	0	0	0	0.0 %	0	-	0	-			
Netherlands	403	430	464	-	-	-	-	-	CS	NS, Q	CS
Portugal	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Spain	18	14	72	11.1 %	58	399 %	54	309 %	CS	NS, Q	PS
Sweden	NA	NA	NA	-	-	-	-	-	N/A	N/A	N/A
United Kingdom	861	113	114	17.6 %	2	2 %	- 746	- 87 %	T2, T3	NS, AS	CS
EU-15	1 281	557	651	100.0 %	93	17 %	- 630	- 49 %			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.32 Member States' contributions to 1.B.1: 'Fugitive CH₄ emissions from solid fuels' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO ₂ equivalents)	GHG emissions in 2003 (Gg CO ₂ equivalents)	Methods applied ¹⁾	EF ¹⁾	Estimate ²⁾	Quality ²⁾
Austria	11	8	T1	D	ALL	L
Belgium	44	22	C	C		
Denmark	72	93	D	D	ALL	L
Finland	5	6	CS	CS	ALL	L
France	4 331	1 058	C	CS	ALL	M
Germany	25 772	6 891	T2,CS	CS	All	L
Greece	1 095	1 441	T1	D	PART	
Ireland	0	0	NA	NA	NO	NA
Italy	122	95	T1	D, C,CS	ALL	M
Luxembourg	0	0	C/D	C/D		
Netherlands	30	23	T1	C	ALL	M
Portugal	66	0	T2	D+C	All	L
Spain	1 789	1 009	C,CS	C,CS	ALL	M
Sweden	0	0	T2/T3	CS	ALL	M
United Kingdom	18 286	4 790	T2	CS	ALL	M
EU-15	51 624	15 435	C,CS,D,T1,T2,T3	C, CS, D	ALL, PART	L

(¹⁾ Information source: CRF Summary Table 3 for 2002.

(²⁾ Information source: CRF Table 7 for 2002.

Abbreviations explained in the Chapter 'Units and abbreviations'

Table 3.33 Member States' contributions to a 1.B.1.a: 'Fugitive CH₄ emissions from coal-mining'

Member State	Greenhouse gas emissions (Gg CO ₂ equivalents)			Share in EU-15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO ₂ equivalents)	(%)	(Gg CO ₂ equivalents)	(%)			
Austria	11	8	8	0.1 %	0	0 %	- 3	- 26 %	C	NS	C
Belgium	NE	NO	NO	-	-	-	-	-	NO	NO	NO
Denmark	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Finland	NO	NO	NO	-	-	-	-	-	NO	NO	NO
France	3 569	1 336	912	6.1 %	- 424	- 32 %	- 2 656	- 74 %	C	AS	CS
Germany	25 644	7 260	6 871	45.6 %	- 389	- 5 %	- 18 773	- 73 %	T2	NS	CS
Greece	1 095	1 487	1 441	9.6 %	- 46	- 3 %	346	32 %	TS	NS	D
Ireland	NO	NO	NO	-	-	-	-	-			
Italy	55	35	54	0.4 %	19	53 %	- 1	- 1 %	T1	NS	D, CS
Luxembourg	0	0	0	0.0 %	0	-	0	-			
Netherlands	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Portugal	66	0	0	0.0 %	0	-	- 66	- 100 %	T1	NS	D
Spain	1 766	1 000	989	6.6 %	- 11	- 1 %	- 776	- 44 %	CS	NS	CS
Sweden	NO	NO	NO	-	-	-	-	-	NO	NO	NO
United Kingdom	18 271	6 331	4 781	31.8 %	- 1 550	- 24 %	- 13 490	- 74 %	T1, T2	NS, AS	CS
EU-15	50 477	17 459	15 058	100.0 %	- 2 401	- 14 %	- 35 419	- 70 %			

Abbreviations explained in the Chapter 'Units and abbreviations'.

3.2.5 Other (CRF Source Category 1.A.5)

Table 3.27 provides an overview of Member States' source allocation to Source Category 1.A.5: 'Other'.

Tables 3.28 and 3.29 summarise information by Member State on emission trends, methodologies, emission factors, completeness and qualitative uncertainty estimates for the key source CO₂ from 1.A.5: 'Other'.

CO₂ emissions from 1.A.5: 'Other' account for 0.2 % of total GHG emissions in 2003. Between 1990 and 2003, CO₂ emissions from this source decreased by 62 % in the EU-15. The United Kingdom contributed by 35 % to these emissions. Between 1990 and 2003, the largest reduction in absolute terms was reported by Germany, which was partly due to reduced military operations after German reunification.

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

Table 3.30 summarises information by Member State on methodologies, emission factors, completeness and qualitative uncertainty estimates for the CO₂ emissions from 1.B.1: 'Fugitive emissions from solid fuels'. CO₂ emissions from 'Fugitive emissions from solid fuels' decreased by 31 % between 1990 and 2003. Most Member States did not report any emissions from this source.

CO₂ emissions from 1.B.1.b: 'Fugitive CO₂ emissions from solid fuel transformation' account for 0.02 % of total GHG emissions in 2003. Between 1990 and 2003, CO₂ emissions from this source decreased by 49 % in the EU-15 (Table 3.31). Most Member States did not report emissions from this source. Of the two reporting Member States, Spain had emission increases between 1990 and 2003, and the United Kingdom had emission reductions.

Table 3.34 Member States' contributions to 1.B.2: 'Fugitive CO₂ emissions from oil and natural gas' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO ₂ equivalents)	GHG emissions in 2003 (Gg CO ₂ equivalents)	Methods applied ¹⁾	EF ¹⁾	Estimate ²⁾	Quality ²⁾
Austria	102	233	T1, CS	D, CS, PS	PART	L
Belgium	281	286	CS	CS		
Denmark	263	550	C	C	ALL	L
Finland	123	63	CS	PS	PART	M
France	4 306	3 861	C	CS	ALL	H
Germany	IE	IE	IE	IE	IE	
Greece	0	0	0	0	PART	
Ireland	139	59	T1	CS	Full	M
Italy	3 048	2 499	T2	CS	ALL	M
Luxembourg	0	0	C/D	C/D		
Netherlands	839	405	CS/T3	CS	ALL	L
Portugal	118	754	MB	C+CS	Part	L
Spain	1 743	1 915	C,CS	C,PS	ALL	H
Sweden	100	80	T1 + T2	CS, D	PART	M
United Kingdom	6 764	5 226	T3	CS	ALL	H
EU-15	17 826	15 931	C, CS, MB, T1, T3	C, CS, D, PS	ALL, IE, PART	H

(¹⁾ Information source: CRF Summary Table 3 for 2002.

(²⁾ Information source: CRF Table 7 for 2002.

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.35 Member States' contributions to 1.B.2.c: 'CO₂ emissions from venting and flaring'

Member State	Greenhouse gas emissions (Gg CO ₂ equivalents)			Share in EU-15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO ₂ equivalents)	(%)	(Gg CO ₂ equivalents)	(%)			
Austria	0	0	0	0.0 %	0	-	0	-	IE	IE	IE
Belgium	84	145	145	2.5 %	0	0 %	61	73 %	CS	PS, AS	CS
Denmark	263	535	550	9.5 %	14	3 %	286	109 %	C	NS, PS	CS
Finland	123	68	63	1.1 %	- 5	- 7 %	- 60	- 49 %	CS	PS	PS
France	297	277	314	5.4 %	37	13 %	17	6 %			
Germany	IE	IE	IE	-	-	-	-	-	NE	NE	NE
Greece	0	0	0	0.0 %	0	-	0	-			
Ireland	NO	0	0	0.0 %	0	-	-	-			
Italy	681	202	206	3.5 %	3	2 %	- 475	- 70 %	T2	NS	CS
Luxembourg	0	0	0	0.0 %	0	-	0	-			
Netherlands	660	271	268	4.6 %	- 4	-	- 392	-	CS, T3	AS	CS
Portugal	49	53	42	0.7 %	- 11	- 21 %	- 6	- 13 %	D	PS	CS
Spain	179	218	174	3.0 %	- 43	- 20 %	- 5	- 3 %	C, CS	Q	C, PS
Sweden	78	80	78	1.3 %	- 2	-	0	-	T2	PS	CS, D
United Kingdom	4 677	4 573	3 955	68.3 %	- 618	- 14 %	- 722	- 15 %	T2	NS	CS
EU-15	7 091	6 424	5 795	100.0 %	- 629	- 10 %	- 1 296	- 18 %			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.36 Member States' contributions to 1.B.2: 'Fugitive CH₄ emissions from oil and natural gas' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO ₂ equivalents)	GHG emissions in 2003 (Gg CO ₂ equivalents)	Methods applied ¹⁾	EF ¹⁾	Estimate ²⁾	Quality ²⁾
Austria	267	313	T1, CS	CS, D	PART	L
Belgium	517	395	CS	CS		
Denmark	38	84	C	C	ALL	L
Finland	11	62	CS/T1	CS/T1	PART	M
France	2 471	1 882	C	CS	ALL	M
Germany	7 008	7 351	T2,T3,CS	M,CS	All	H,M
Greece	40	212	T1	D	PART	
Ireland	151	79	T1	CS	Full	M
Italy	6 631	4 993	T2, T3	CS	ALL	H
Luxembourg	28	59	C/D	C/D		
Netherlands	2 045	1 039	CS/T3	CS	ALL	M
Portugal	35	286	C+T2	D+C	Part	L
Spain	584	812	C,CS	C,PS	ALL	M
Sweden	0	0	T1 + T2	CS	PART	M
United Kingdom	10 661	6 169	T3	CS	ALL	M
EU-15	30 486	23 736	C,CS,D,T1,T2,T3	C, CS, D, M, PS, T1	ALL, PART	M

(¹⁾ Information source: CRF Summary Table 3 for 2002.

(²⁾ Information source: CRF Table 7 for 2002.

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.37 Member States' contributions to a 1.B.2.b: 'CH₄ emissions from natural gas'

Member State	Greenhouse gas emissions (Gg CO ₂ equivalents)			Share in EU-15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO ₂ equivalents)	(%)	(Gg CO ₂ equivalents)	(%)			
Austria	166	211	225	1.0 %	14	7 %	59	36 %	D	AS	D
Belgium	514	395	390	1.8 %	- 6	- 1 %	- 124	- 24 %	CS	AS	CS
Denmark	6	4	4	0.0 %	0	6 %	- 1	- 27 %	C	NS	CS
Finland	4	47	52	0.2 %	4	9 %	48	1354 %	CS, T1	CS	CS, T1
France	2 457	1 888	1 878	8.6 %	- 10	- 1 %	- 580	- 24 %	C	PS	CS
Germany	6 383	7 216	7 214	33.2 %	- 2	0 %	831	13 %	CS	NS	M, CS
Greece	15	163	183	0.8 %	20	12 %	168	1121 %	T1	NS	D
Ireland	151	82	79	0.4 %	- 4	- 5 %	- 72	- 48 %	CS	NS	CS
Italy	6 494	4 874	4 905	22.6 %	31	1 %	- 1 589	- 24 %	T2	NS	CS
Luxembourg	28	58	59	0.3 %	0	1 %	31	113 %			
Netherlands	780	603	596	2.7 %	- 7	- 1 %	- 184	- 24 %	CS, T3	AS	CS
Portugal	0	241	244	1.1 %	3	1 %	244	-	T1	NS	D
Spain	553	1 053	777	3.6 %	- 276	- 26 %	224	40 %	C, CS	NS, AS, Q	C, CS
Sweden	0	0	0	0.0 %	0	- 100 %	0	-	T1	NS	CS
United Kingdom	8 360	7 110	5 143	23.6 %	- 1 968	- 28 %	- 3 218	- 38 %	T2	NS	CS
EU-15	25 910	23 948	21 747	100.0 %	- 2 200	- 9 %	- 4 163	- 16 %			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Member State	Method applied	Activity data	Emission factor	GHG source category	1990			2003			CH ₄ emissions (Gg)				
					Activity data			Implied emission factor (kg/unit)	CH ₄ emissions (Gg)	Activity data			Implied emission factor (kg/unit)		
					Description	Unit	Value			Description		Unit		Value	
Finland	CS, T1	CS	CS, T1	Natural Gas			0	0	0.17			0	0	2.47	
	Transmission emission reported by industry partly based on measurements (NIR 2005)			Exploration			0	0.00	NO			NO	NO	NO	
				i. Production/Processing			NO	0.00	NO			NO	NO	NO	
				ii. Transmission	PJ gas consumed	PJ	92	1 855.49	0.17	PJ gas consumed	PJ	171	3 345.03	0.57	
				iii. Other Leakage	PJ gas distributed via local networks	PJ	5	0.00	NO	PJ gas distributed via local networks	PJ	7 257	452.57	1.90	
					at industrial plants and power stations			0	0.00	0.00			0	0.00	0.00
					in residential and commercial sectors			0	0.00	0.00			0	0.00	0.00
France	C	PS	CS	Natural Gas			0	0	117.01			0	0	89.41	
				Exploration			0	0.00	0.00			0	0.00	0.00	
				i. Production/Processing	PJ Production	PJ	309	1 614.89	0.50	PJ Production	PJ	170	612.59	0.10	
				ii. Transmission	PJ Consumed	PJ	1 055	110 440.22	116.51	PJ Consumed	PJ	1 646	54 256.35	89.31	
				iii. Other Leakage			0	0.00	0.00			0	0.00	0.00	
				at industrial plants and power stations			0	0.00	0.00			0	0.00	0.00	
				in residential and commercial sectors			0	0.00	0.00			0	0.00	0.00	
Germany	T2,T3,CS	NS	M, CS	Natural Gas			0	0	303.96			0	0	343.52	
	Detailed methodology based on AD from energy statistics and associations of industries. EF from literature and companies (NIR 2005)			Exploration	Natural gas	TJ	556 007	28.76	15.99	Natural gas	TJ	658 800	27.00	17.79	
				i. Production/Processing	Natural gas from crude oil extraction	TJ	563 382	64.40	36.28	Natural gas from crude oil extraction	TJ	665 000	62.00	41.23	
				ii. Transmission	Total amount of gas consumed	TJ	2 292 780	9.74	22.32	Total amount of gas consumed	TJ	3 224 000	9.00	29.02	
				iii. Other Leakage	Distribution net	km	246 710	789.14	194.69	Distribution net	km	417 065	452.07	188.54	
					at industrial plants and power stations	Gas consumed	TJ	825 669	42.00	34.68	Gas consumed	TJ	1 594 000	42.00	66.95
					in residential and commercial sectors			NO	NO	NO			NO	NO	NO
Greece	T1	NS	D	Natural Gas			0	0	0.71			0	0	8.72	
	Tier 1 methodology and default emission factors are used; activity data is taken from the national energy balance (NIR 2005)			Exploration			NO	NO	NO			NO	NO	NO	
				i. Production/Processing	Natural gas production	PJ	6 21 000.00	0.12		Natural gas production	PJ	1 21 000.00	0.03		
				ii. Transmission	Natural gas consumption	PJ	6	IE	IE	Natural gas consumption	PJ	85	IE	IE	
				iii. Other Leakage	Natural gas consumption	PJ	6 102 500.00	0.59		Natural gas consumption	PJ	85 102 500.00	8.70		
					at industrial plants and power stations			NE	NE	0.00			NE	NE	0.00
					in residential and commercial sectors			0	0.00	0.00			0	0.00	0.00

Member State	Method applied	Activity data	Emission factor	GHG source category	1990			2003						
					Activity data			Implied emission factor (kg/unit)	CH ₄ emissions (Gg)	Activity data			Implied emission factor (kg/unit)	CH ₄ emissions (Gg)
					Description	Unit	Value			Description	Unit	Value		
Ireland	CS	NS	CS	Natural Gas			0	0	7.18			0	0	3.74
							NO	0.00	NO			NE	0.00	NE
				Exploration										
				i. Production/Processing	PJ of Gas produced	PJ	79	14 328.25	1.13	PJ of Gas produced	PJ	23	18 299.87	0.42
				ii. Transmission			NO	0.00	NO			NE	0.00	NE
				iii. Other Leakage			NO	0.00	NO	PJ of gas consumed	PJ	56	59 715.92	3.32
				at industrial plants and power stations	Network Leakage	PJ	24	250 870.79	6.05			NO	0.00	NO
				in residential and commercial sectors			NO	0.00	NO			NO	0.00	NO
Italy	T2	NS	CS	Natural Gas			0	0	309.24			0	0	233.57
							0	IE	IE			0	IE	IE
				Exploration										
				i. Production/Processing	Mm3 gas produced	Mm3	17 296	1 398.37	24.19	Mm3 gas produced	Mm3	13 996	178.03	2.49
				ii. Transmission	Mm3 gas transported	Mm3	45 684	827.60	37.81	Mm3 gas transported	Mm3	76 307	305.04	23.28
				iii. Other Leakage	Mm3 gas transported	Mm3	20 632	11 983.60	247.25	Mm3 gas transported	Mm3	29 000	7 165.66	207.80
				at industrial plants and power stations			0	0.00	0.00			0	0.00	0.00
				in residential and commercial sectors			0	IE	IE			0	IE	IE
Netherlands	CS, T3	AS	CS	Natural Gas			0	0	37.14			0	0	28.37
							79	IE	IE	Number of wells drilled/ tested	number	34	IE	IE
				Exploration	Number of wells drilled/ tested	number				Number of wells drilled/ tested	number			
				i. Production/Processing	Gas produced	PJ	2 292	IE	IE	Gas produced	PJ	2 171	IE	IE
				ii. Transmission	Gas transported	PJ	2 292	2 763.02	6.33	Gas transported	PJ	2 437	1 473.62	3.59
				iii. Other Leakage	Natural gas distribution network	1000 km	99	312 154.33	30.80	Natural gas distribution network	1000 km	118	210 646.12	24.78
				at industrial plants and power stations			IE	IE	0.00			IE	IE	0.00
				in residential and commercial sectors			0	NE	NE			0	NE	NE
Portugal	T1	NS	D	Natural Gas			0	0	0.00			0	0	11.61
							NO	0.00				NO	0.00	
				Exploration										
				i. Production/Processing			NO	0.00				NO	0.00	
				ii. Transmission	Gas consumed	TJ	NO	0.00	NO	Gas consumed	TJ	116 149	100.00	11.61
				iii. Other Leakage				0.00					0.00	
				at industrial plants and power stations			NO	0.00	NE			NE	0.00	NE
				in residential and commercial sectors				0.00					0.00	

Member State	Method applied	Activity data	Emission factor	GHG source category	1990			2003						
					Activity data			Implied emission factor	CH ₄ emissions	Activity data			Implied emission factor	CH ₄ emissions
								(kg/unit)	(Gg)				(kg/unit)	(Gg)
					Description	Unit	Value			Description	Unit	Value		
Spain	C, CS	NS,AS,Q	C, CS	Natural Gas		0	0	26.35		0	0	37.02		
				Exploration		NE	NE	NE		NE	NE	NE		
				i. Production/Processing	PJ gas produced (NCV)	PJ	51	70 889.00	3.63	PJ gas produced (NCV)	10	70 889.00	0.73	
				ii. Transmission	PJ gas (NCV)	PJ	207	31 791.11	6.57	PJ gas (NCV)	894	11 776.17	10.53	
				iii. Other Leakage	PJ gas consumed (NCV)	PJ	214	75 583.54	16.16	PJ gas consumed (NCV)	905	28 473.14	25.76	
				at industrial plants and power stations			NE	NE	0.00		NE	NE	0.00	
				in residential and commercial sectors			NE	NE	NE		NE	NE	NE	
Sweden	T1	NS	CS	Natural Gas		0	0	0.00		0	0	0.00		
				Exploration			NO	0.00	NO		NO	NO	NO	
				i. Production/Processing			NO	0.00	NO		NO	NO	NO	
				ii. Transmission	Pressure levelling losses	TJ	NO	0.00	NO	Pressure levelling losses	TJ	NO	NO	NO
				iii. Other Leakage			NE	0.00	NE		NE	NE	NE	
				at industrial plants and power stations			NO	0.00	NE		NE	NE	NE	
				in residential and commercial sectors			NE	0.00	NE		NE	NE	NE	
United Kingdom	T2	NS	CS	Natural Gas		0	0	398.11		0	0	244.89		
				Exploration		IE	IE	0.00	IE		IE	IE	0.00	IE
				i. Production/Processing		IE	IE	0.00	IE		IE	IE	0.00	IE
				ii. Transmission		IE	IE	0.00	IE		IE	IE	0.00	IE
				iii. Other Leakage	Gas consumed	PJ	1 573	253 016.23	398.11	Gas consumed	PJ	3337	73 388.66	244.89
				at industrial plants and power stations		NE	NE	0.00	NE		NE	NE	0.00	NE
				in residential and commercial sectors			0	0.00	0.00		0	0.00	0.00	

than 0.4 % of total GHG emissions in 2003. Between 1990 and 2003, CO₂ emissions from this source decreased by 70 % in the EU-15 (Table 3.33). Several Member States did not report emissions from this source. In 2003, the largest share on total emissions from this source had Germany and the United Kingdom (77 %). Both Member States reduced their emissions between 1990 and 2003 substantially due to the decline of coal-mining.

3.2.7 Fugitive emissions from oil and natural gas (CRF Source Category 1.B.2)

Table 3.34 summarises information by Member State on methodologies, emission factors, completeness and qualitative uncertainty estimates for the CO₂ emissions from the source 1.B.2: 'Fugitive emissions from oil and natural gas'. CO₂ emissions from 'Fugitive emissions from oil and

Table 3.39 EU-15 uncertainty estimates for the sector 'Energy' excluding 1.A.3 and 1.B

Source category	Gas	Emissions 2003 ¹⁾	Emissions for which MS uncertainty estimates are available ²⁾	Share of emissions for which MS uncertainty estimates are available	Uncertainty estimates based on MS uncertainty estimates
1.A.1.a Public electricity and heat production	CO ₂	1 010 508	578 607	57 %	3 %
1.A.1.b Petroleum refining	CO ₂	118 555	60 893	51 %	2 %
1.A.1.c Manufacture of solid fuels	CO ₂	60 857	21 052	35 %	6 %
1.A.2 Manufacturing industries and construction	CO ₂	576 424	294 680	51 %	3 %
1.A.4.a Commercial/institutional	CO ₂	160 818	55 007	34 %	7 %
1.A.4.b Residential	CO ₂	425 033	297 565	70 %	3 %
1.A.4.c Agriculture/Forestry/Fisheries	CO ₂	61 602	12 480	20 %	10 %
1.A.5 Other	CO ₂	7 913	2 150	27 %	13 %
1.A stationary combustion unspecified	CO ₂		1 041 039		1 %
1.A.1.a Public electricity and heat production	CH ₄	1 892	227	12 %	25 %
1.A.1.b Petroleum refining	CH ₄	79	9	12 %	62 %
1.A.1.c Manufacture of solid fuels	CH ₄	345	9	3 %	38 %
1.A.2 Manufacturing industries and construction	CH ₄	1 058	227	21 %	22 %
1.A.4.a Commercial/institutional	CH ₄	369	72	20 %	84 %
1.A.4.b Residential	CH ₄	7 101	4 211	59 %	21 %
1.A.4.c Agriculture/Forestry/Fisheries	CH ₄	270	30	11 %	84 %
1.A.5 Other	CH ₄	15	8	57 %	40 %
1.A stationary combustion unspecified	CH ₄		4 747		28 %
1.A.1.a Public electricity and heat production	N ₂ O	13 351	4 349	33 %	39 %
1.A.1.b Petroleum refining	N ₂ O	1 068	408	38 %	36 %
1.A.1.c Manufacture of solid fuels	N ₂ O	778	262	34 %	48 %
1.A.2 Manufacturing industries and construction	N ₂ O	6 816	1 825	27 %	56 %
1.A.4.a Commercial/institutional	N ₂ O	1 406	245	17 %	215 %
1.A.4.b Residential	N ₂ O	5 338	4 349	81 %	42 %
1.A.4.c Agriculture/Forestry/Fisheries	N ₂ O	2 250	228	10 %	386 %
1.A.5 Other	N ₂ O	117	29	25 %	44 %
1.A stationary combustion unspecified	N ₂ O		19 027		105 %
Total	all	2 463 964	2 403 737	98 %	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 countries 2002 data and for Belgium 2001 data

natural gas' decreased by 11 % between 1990 and 2003.

This source category includes one key source: CO₂ from 1.B.2.c: 'Venting and flaring'.

Fugitive CO₂ emissions from 1.B.2.c: 'Venting and flaring' account for 0.1 % of total GHG emissions in 2003. Between 1990 and 2003, CO₂ emissions from this source decreased by 18 % in the EU-15 (Table 3.35). The United Kingdom was responsible for 68 % of the emissions from this source. The reductions in the United Kingdom (15 %) contributed mainly to the reduction trend in the EU-15 between 1990 and 2003.

Table 3.36 summarises information by Member State on methodologies, emission factors, completeness and qualitative uncertainty estimates for the CH₄ emissions from the source 1.B.2: 'Fugitive emissions from oil and natural gas'. CH₄ emissions from 'Fugitive emissions from oil and natural gas' decreased by 22 % between 1990 and 2003.

This source category includes one key source: CH₄ from 1.B.2.b: 'CH₄ emissions from natural gas'.

CH₄ emissions from 1.B.2.b 'Fugitive CH₄ emissions from natural gas' account for 0.5 % of total GHG emissions in 2003.

Table 3.40 EU-15 uncertainty estimates for the Source Category 1.B 'Fugitive emissions'

Source category	Gas	Emissions 2003 ¹⁾	Emissions for which MS uncertainty estimates are available ²⁾	Share of emissions for which MS uncertainty estimates are available	Uncertainty estimates based on MS uncertainty estimates
1.B.1 Solid fuels	CO ₂	1 898	6 283	331 %	58 %
1.B.2 Oil and natural gas	CO ₂	15 931	14 265	90 %	8 %
1.B.1 Solid fuels	CH ₄	15 435	15 145	98 %	29 %
1.B.2 Oil and natural gas	CH ₄	23 736	25 775	109 %	14 %
1.B.1 Solid fuels	N ₂ O	3	3	121 %	50 %
1.B.2 Oil and natural gas	N ₂ O	43	47	110 %	104 %
Total	all	57 046	61 519	108 %	11 %

(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 countries 2002 data and for Belgium 2001 data.

Table 3.41 EU-15 uncertainty estimates for the Source Category 1.A.3 'Transport'

Source category	Gas	Emissions 2003 ¹⁾	Emissions for which MS uncertainty estimates are available ²⁾	Share of emissions for which MS uncertainty estimates are available	Uncertainty estimates based on MS uncertainty estimates
1.A.3.a Civil aviation	CO ₂	22 576	16 523	73 %	24 %
1.A.3.b Road transport	CO ₂	790 731	735 077	93 %	3 %
1.A.3.c Railways	CO ₂	4 985	1 963	39 %	17 %
1.A.3.d Navigation	CO ₂	20 332	14 587	72 %	11 %
1.A.3.e Other	CO ₂	6 736	8 682	129 %	21 %
1.A.3.a Civil aviation	CH ₄	11	7	62 %	66 %
1.A.3.b Road transport	CH ₄	2 359	1 472	62 %	14 %
1.A.3.c Railways	CH ₄	7	3	39 %	36 %
1.A.3.d Navigation	CH ₄	64	52	82 %	40 %
1.A.3.e Other	CH ₄	16	25	154 %	55 %
1.A.3.a Civil aviation	N ₂ O	245	130	53 %	145 %
1.A.3.b Road transport	N ₂ O	23 606	21 543	91 %	41 %
1.A.3.c Railways	N ₂ O	278	58	21 %	71 %
1.A.3.d Navigation	N ₂ O	256	179	70 %	152 %
1.A.3.e Other	N ₂ O	107	333	310 %	96 %
Total	all	872 311	800 635	92 %	3 %

(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 countries 2002 data and for Belgium 2001 data

Between 1990 and 2003, CH₄ emissions from this source decreased by 16 % in the EU-15 (Table 3.37). The United Kingdom, Germany and Italy were responsible for 79 % of the emissions from this source. The decreases in the United Kingdom (– 38 %) contributed largely to the reduction trend in the EU-15 between 1990 and 2003.

Table 3.38 shows information on methods applied, activity data, emission factors for CH₄ emissions from 1.B.2:b natural gas for 1990 and 2003. It suggests that at least about

85 % of EU-15 emissions are estimated on the basis of higher tier methods. Activity data and implied emission factors cannot be presented at EU-15 level because Member States use different types of activity data.

3.3 Methodological issues and uncertainties

The previous section presented for each EU-15 key source in CRF Sector 1 an overview of the Member States' contributions to the key source

in terms of level and trend, and information on methodologies, emission factors, completeness and qualitative uncertainty estimates.

Detailed information on national methods and circumstances is available in the Member States' national inventory reports.

Table 3.39 shows the total EU-15 uncertainty estimates for the sector 'Energy' excluding 1.A.3 'Transport' and 1.B 'Fugitive emissions' 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 uncertainty was estimated for N₂O from 1.A.4.c and the lowest for CO₂ from 'stationary combustion unspecified'. For a description of the Tier 1 uncertainty analysis carried out for the EU-15, see Chapter 1.7.

Table 3.40 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 uncertainty was estimated for N₂O from 1.B.2 and the lowest for CO₂ from 1.B.2.

Table 3.41 shows the total EU-15 uncertainty estimates for the sector 1.A.3 'Transport' and the uncertainty estimates for the relevant gases for each source category. The highest uncertainty was estimated for N₂O from 1.A.3.d and the lowest for CO₂ from 1.A.3.b.

3.4 Sector-specific quality assurance and quality control

The main sector-specific QA/QC activity is the project led by Eurostat on the harmonisation of the energy data used for energy balances and CO₂ inventories. The work programme for this project foresees that Member States perform the following tasks:

- examine the energy data used by the two submissions (CRF to UNFCCC and the European Commission's DG Environment, and joint questionnaires to Eurostat and the IEA) for 1990, 1995 and 2000 and identify and explain the differences;
- establish a procedure at national level that will eliminate discrepancies in the

two reporting mechanisms in future; this procedure will be agreed with Eurostat;

- provide the updated energy data in the form of annual questionnaires for the period 1990–2000 ensuring comparable data under the two reporting mechanisms.

By the end of 2004, final reports of 10 EU-15 Member States were available (Austria, Denmark, France, Germany, Ireland, Italy, Netherlands, Portugal, Sweden and the United Kingdom). Currently a project is ongoing with two objectives: (1) to produce a synthetic report which will include the main findings in the national reports and recapitulate the issues for which divergence of the two reporting procedures existed; (2) carry out a detailed comparative analysis between the available environmental data and Eurostat data for the period 1990–2002 for each Member State.

Following the submission of each Member State's final report, Eurostat will update information in its database and will be in the position to produce CO₂ emission figures based on the energy balances, with minimum deviation from those reported by the Member States and a full understanding of any discrepancies. This will help to improve the quality of the EU-15 GHG inventory for Sector 1: 'Energy'.

In 2003, a workshop on 'Energy balances and energy-related greenhouse gas emission inventories' was organised under Working Group I of the EC Climate Change Committee, and linked to the Eurostat Energy Statistics Committee. The objectives of the workshop were to: (1) share best practice between countries, both statistical institutes and national GHG inventory compilers; (2) strengthen the links between the reporting mechanisms of energy data (Eurostat/IEA) and GHG inventories (UNFCCC/Commission); (3) make recommendations to improve coherency in the data reported under the two reporting mechanisms. More than 60 experts attended the workshop from almost all EU-15 Member States and accession and candidate countries, the European Commission (DG Environment, Eurostat), the EEA and ETC/ACC. Representatives from the IEA, the UNFCCC Secretariat and the European non-energy use research network, attended as observers. The workshop report with the

Table 3.42 Recalculations of total greenhouse gas emissions and recalculations of greenhouse gas emissions in CRF Sector 1: 'Energy' for the years 1990 and 2002 by gas in Gg and percentage

1990	CO ₂		CH ₄		N ₂ O		HFCs		PFCs		SF ₆	
	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent
Total emissions and removals	- 122 396	- 3.8 %	- 9 539	- 2.1 %	16 013	4.1 %	200	0.7 %	- 276	- 1.7 %	125	1.2 %
Energy	- 4 141	- 0.1 %	- 3 914	- 3.7 %	- 3 505	- 7.8 %	NO	NO	NO	NO	NO	NO
2002												
Total emissions and removals	- 165 492	- 5.1 %	- 7 491	- 2.1 %	8 640	2.6 %	- 3 682	- 7.4 %	279	5.2 %	406	4.4 %
Energy	- 3 353	- 0.1 %	- 2 542	- 4.3 %	- 3 549	- 6.1 %	NO	NO	NO	NO	NO	NO

NO: not occurring

Table 3.43 Contribution of Member States to EU-15 recalculations in CRF Sector 1: 'Energy' for 1990 and 2002 by gas (difference between latest submission and previous submission Gg of CO₂ equivalents)

	1990						2002					
	CO ₂	CH ₄	N ₂ O	HFCs	PFCs	SF ₆	CO ₂	CH ₄	N ₂ O	HFCs	PFCs	SF ₆
Austria	308	2	- 274	NO	NO	NO	605	0	- 422	NO	NO	NO
Belgium	1 389	13	10	NO	NO	NO	- 2.228	- 62	- 64	NO	NO	NO
Denmark	16	20	1	NO	NO	NO	78	7	8	NO	NO	NO
Finland	- 3.126	61	- 352	NO	NO	NO	- 2.757	30	- 349	NO	NO	NO
France	706	- 91	37	NO	NO	NO	- 2.723	- 86	49	NO	NO	NO
Germany	0	- 3.214	- 757	NO	NO	NO	- 311	- 1.776	- 137	NO	NO	NO
Greece	591	302	22	NO	NO	NO	76	- 2	- 100	NO	NO	NO
Ireland	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
Italy	- 594	- 42	7	NO	NO	NO	1 417	- 162	23	NO	NO	NO
Luxembourg	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
Netherlands	- 8.477	- 1.736	0	NO	NO	NO	- 7.677	- 1.507	55	NO	NO	NO
Portugal	- 650	- 36	- 5	NO	NO	NO	283	- 105	- 45	NO	NO	NO
Spain	926	5	- 1.930	NO	NO	NO	2 614	- 37	- 2.363	NO	NO	NO
Sweden	147	- 148	- 236	NO	NO	NO	- 183	- 81	- 223	NO	NO	NO
UK	4 623	949	- 28	NO	NO	NO	7 454	1 240	20	NO	NO	NO
EU-15	- 4.141	- 3.914	- 3.505	NO	NO	NO	- 3.353	- 2.542	-3.549	NO	NO	NO

Abbreviations explained in the Chapter 'Units and abbreviations'.

recommendations can be downloaded from the ETC/ACC website: <http://air-climate.eionet.eu.int/>.

A number of these recommendations were addressed by Eurostat this year, namely timelines of energy data (about 90 % of joint energy questionnaires were available by end of February) and the first draft of an EU legal basis on energy statistics was prepared. Issues related to recommendations on the methodology of energy statistics were also addressed in the Energy Statistics Working Group of 16–17 November in Paris co-organised by Eurostat and the IEA. It

was agreed that the 2005 joint Eurostat/IEA/UNECE energy statistics questionnaires will have a more detailed fuel breakdown (inclusion of anthracite, tars, etc.) which is more in line with the emissions reporting requirements, calorific values for oil products will be included and definitions of bunker fuels will be improved. More information on the outcome of this Working Group can be found at: <http://www.iea.org/Textbase/stats/questionnaire/background.asp>.

Also, the workshop on emissions of greenhouse gases from aviation and navigation organised in May 2004 (see

Table 3.44 Main reasons for recalculations > 1000 Gg of CO₂ equivalents in CRF sector 1 'Energy'

BE	CO ₂	1.A.1: Emission factors/activity data: use of directly reported emissions for large power plants instead of calculations based on activity data and default IPCC emission factors
FI	CO ₂	1.B.1: Emission factors: revised EF based on preliminary results of new measurements Activity data: improved activity data from surveys Addition/removal/replacement: emissions from areas previously reported as areas reserved for peat production have been removed due to improved data collection and identified double counting with Agriculture/LULUCF sector (cultivation of organic soils)
FR	CO ₂	1.A.1a: Emission factor: review of CO ₂ emission factor for domestic waste incineration with energy recovery; activity data: updated 1.A.2: Activity data: energy consumption for manufacturing industries updated 1.A.4: Activity data: energy consumption for commercial, institutional and residential updated
NL	CO ₂	1.A.2; 1.A.3; 1.A.4: Methods: based on energy statistics; activity data: improved data; emission factors: improved data
UK	CO ₂	1.A.1; 1.A.2, 1.A.4, 1.B.1: See Tables 10.1 and 10.2
DE	CH ₄	1.B.1a: Activity data: information is now based on more detailed and exact statistical data by the 'Statistic coal industries e.V.' from base year onwards
NL	CH ₄	1.B.2: Activity data: improved data; emission factors: improved data

Section 3.7) was a follow-up activity of the workshop on energy balances and energy-related greenhouse gas emissions.

3.5 Sector-specific recalculations

Table 3.42 shows that in the energy sector the largest recalculations in absolute terms were made for CO₂ in 1990 and for N₂O in 2002. However, in relative terms the recalculations of CO₂ emissions in the energy sector were below 1 %.

Table 3.43 provides an overview of Member States' contributions to EU-15 recalculations. In absolute terms, the Netherlands had the most influence on CO₂ recalculations in the EU-15. For CH₄ it was Germany and for N₂O it was Spain. Explanations for the largest recalculations by Member State are provided in Section 10.1.

Explanations for recalculations of more than 1 000 Gg of CO₂ equivalents are given in Table 3.44. Reasons for other recalculations are provided in Section 10.1.

3.6 Comparison between the sectoral approach and the reference approach

The IPCC reference approach for CO₂ from fossil fuels for the EU-15 is based on Eurostat energy data (NewCronos

database, May 2005 version). This submission includes the reference approach tables for 1990–2003.

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 CO₂ emissions from fossil fuels by Member State and for the EU-15 as a whole.

The Eurostat data for the EU-15 IPCC reference approach includes activity data, net calorific values and carbon emission factors as available in the Eurostat NewCronos database. In the CRF Table 1.A(b), some fuel categories are grouped and average net calorific values are used: 'Orimulsion' is included in 'Residual fuel oil'. 'Natural gas liquids' is included in 'Crude oil'. 'Other kerosene' is included in 'Total kerosene'. 'Anthracite', 'Coking coal' and 'Other bituminous coal' are referred to in the Eurostat NewCronos database as 'Hard coal' and are included in CRF Table 1.A(b) under 'Other bituminous coal'. 'Sub-bituminous coal' and 'Peat' are included in 'Lignite'. 'Solid biomass', 'Liquid biomass' and 'Gas biomass' is included in 'Total biomass'. For international bunkers, only fuel consumption for international navigation is available in the NewCronos

Table 3.45 Apparent EU-15 energy consumption (in PJ) according to the reference approach (Eurostat data)

Fuel types	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Liquid Fuels	21 825	22 442	23 296	22 431	22 739	22 799	23 334	23 257	24 153	23 347	22 852	23 818	23 257	23 413
Solid Fuels	12 643	11 896	11 109	10 268	10 130	9 860	9 781	9 315	9 303	8 628	8 960	9 092	9 110	9 293
Gaseous Fuels	9 354	10 068	10 003	10 588	10 648	11 480	12 780	12 670	13 211	13 782	14 205	14 549	14 636	15 328
Total energy consumption	43 822	44 406	44 408	43 288	43 517	44 138	45 895	45 242	46 667	45 757	46 017	47 459	47 003	48 033

Table 3.46 IPCC reference approach (Eurostat data) and sectoral approach (Member State data) for EU-15 (in Tg)

CO ₂ emissions	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Sectoral approach	3 148	3 182	3 112	3 063	3 053	3 085	3 166	3 109	3 150	3 125	3 147	3 216	3 210	3 267
Reference approach	3 129	3 132	3 108	3 013	3 014	3 036	3 144	3 073	3 162	3 073	3 085	3 193	3 175	3 239
Percentage difference	- 0.58	- 1.56	- 0.14	- 1.65	- 1.27	- 1.57	- 0.72	- 1.15	0.37	- 1.67	- 1.95	- 0.71	- 1.09	- 0.86

Table 3.47 Comparison between Eurostat and national reference approach for CO₂ from fuel combustion (CRF 1.A) (Tg)

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		425 914		28 686	432 880	28 565	1.6 % - 0.4 %
Solid fossil fuels		169 442		16 326	168 733	15 914	- 0.4 % - 2.5 %
Gaseous fossil fuels		217 047		11 825	219 239	12 238	1.0 % 3.5 %
Total		812 403		56 837	820 853	56 716	1.0 % - 0.2 %
2003	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		550 614		37 403	580 291	38 645	5.4 % 3.3 %
Solid fossil fuels		165 881		16 031	166 443	15 684	0.3 % - 2.2 %
Gaseous fossil fuels		316 296		17 423	319 491	17 834	1.0 % 2.4 %
Total		1 032 790		70 856	1 066 225	72 163	3.2 % 1.8 %

Belgium						
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	692 880	45 246	747 716	49 182	7.9 %	8.7 %
Solid fossil fuels	408 855	38 484	443 046	41 148	8.4 %	6.9 %
Gaseous fossil fuels	342 022	18 739	342 955	18 819	0.3 %	0.4 %
Total	1 443 757	102 469	1 533 717	109 149	6.2 %	6.5 %
2003	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	819 551	50 414	962 201	61 702	17.4 %	22.4 %
Solid fossil fuels	257 111	24 287	260 254	24 159	1.2 %	- 0.5 %
Gaseous fossil fuels	602 983	32 956	604 628	33 097	0.3 %	0.4 %
Total	1 679 645	107 657	1 827 083	118 958	8.8 %	10.5 %

Denmark

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	314 962	22 014	317 323	22 344	0.7 %	1.5 %
Solid fossil fuels	255 386	24 079	254 879	24 129	- 0.2 %	0.2 %
Gaseous fossil fuels	76 099	4 241	76 098	4 269	0.0 %	0.7 %
Total	646 447	50 334	648 300	50 742	0.3 %	0.8 %
2003	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	324 126	23 069	321 099	23 062	- 0.9 %	0.0 %
Solid fossil fuels	237 195	22 362	237 214	22 452	0.0 %	0.4 %
Gaseous fossil fuels	195 134	10 875	195 133	10 947	0.0 %	0.7 %
Total	756 454	56 306	753 446	56 461	- 0.4 %	0.3 %

Finland

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	403 746	26 151	441 576	29 436	9.4 %	12.6 %
Solid fossil fuels	212 396	20 488	223 400	21 943	5.2 %	7.1 %
Gaseous fossil fuels	94 646	5 257	91 620	5 121	- 3.2 %	- 2.6 %
Total	710 788	51 895	756 596	56 500	6.4 %	8.9 %
2003	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	410 699	27 883	396 436	26 474	- 3.5 %	- 5.1 %
Solid fossil fuels	344 167	33 115	343 570	33 024	- 0.2 %	- 0.3 %
Gaseous fossil fuels	171 004	9 498	171 432	9 536	0.3 %	0.4 %
Total	925 870	70 495	911 438	69 034	- 1.6 %	- 2.1 %

France						
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	3 523 645	227 303	3 534 399	223 844	0.3 %	- 1.5 %
Solid fossil fuels	824 313	78 009	803 792	74 941	- 2.5 %	- 3.9 %
Gaseous fossil fuels	1 089 913	59 276	1 089 913	59 718	0.0 %	0.7 %
Total	5 437 871	364 588	5 428 104	358 502	- 0.2 %	- 1.7 %
2002	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	3 640 795	233 211	3 613 632	225 641	- 0.7 %	- 3.2 %
Solid fossil fuels	569 483	54 071	529 248	49 523	- 7.1 %	- 8.4 %
Gaseous fossil fuels	1 569 394	85 833	1 569 394	86 498	0.0 %	0.8 %
Total	5 779 672	373 114	5 712 274	361 662	- 1.2 %	- 3.1 %

Germany						
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	4 997 285	310 913	5 034 262	327 838	0.7 %	5.4 %
Solid fossil fuels	5 572 479	541 333	5 508 185	566 742	- 1.2 %	4.7 %
Gaseous fossil fuels	2 302 935	126 614	2 302 935	123 971	0.0 %	- 2.1 %
Total	12 872 699	978 860	12 845 382	1 018 550	- 0.2 %	4.1 %
2003	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	4 955 654	300 103	4 976 400	322 051	0.4 %	7.3 %
Solid fossil fuels	3 557 007	345 492	3 602 000	353 381	1.3 %	2.3 %
Gaseous fossil fuels	3 316 297	183 162	3 256 000	177 857	- 1.8 %	- 2.9 %
Total	11 828 958	828 757	11 834 400	853 290	0.0 %	3.0 %

Greece						
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	499 503	35 301	512 865	36 302	2.7 %	2.8 %
Solid fossil fuels	338 766	33 462	337 777	40 141	- 0.3 %	20.0 %
Gaseous fossil fuels	5 764	259	5 783	248	0.3 %	- 4.0 %
Total	844 032	69 022	856 426	76 692	1.5 %	11.1 %
2003	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	658 828	46 290	707 910	49 712	7.4 %	7.4 %
Solid fossil fuels	372 505	36 909	372 071	44 822	- 0.1 %	21.4 %
Gaseous fossil fuels	84 835	4 633	84 835	4 640	0.0 %	0.2 %
Total	1 116 167	87 832	1 164 816	99 175	4.4 %	12.9 %

Ireland						
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	186 241	13 085	165 588	12 323	- 11.1 %	- 5.8 %
Solid fossil fuels	150 303	14 478	147 417	14 334	- 1.9 %	- 1.0 %
Gaseous fossil fuels	78 417	4 040	78 586	4 318	0.2 %	6.9 %
Total	414 961	31 603	391 591	30 975	- 5.6 %	- 2.0 %
2003	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	329 627	23 635	314 898	23 208	- 4.5 %	- 1.8 %
Solid fossil fuels	105 347	10 106	103 381	10 270	- 1.9 %	1.6 %
Gaseous fossil fuels	153 956	8 580	154 271	8 476	0.2 %	- 1.2 %
Total	588 930	42 322	572 550	41 954	- 2.8 %	- 0.9 %

Italy						
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	3 687 152	245 827	3 755 112	251 788	1.8%	2.4%
Solid fossil fuels	612 156	57 748	614 758	57 389	0.4%	- 0.6%
Gaseous fossil fuels	1 632 906	89 716	1 644 135	87 144	0.7%	- 2.9%
Total	5 932 213	393 291	6 014 005	396 321	1.4%	0.8%
2003	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	3 568 286	237 650	3 786 846	247 807	6.1%	4.3%
Solid fossil fuels	624 813	59 314	623 076	59 494	- 0.3%	0.3%
Gaseous fossil fuels	2 652 467	147 115	2 670 093	145 521	0.7%	- 1.1%
Total	6 845 567	444 079	7 080 015	452 823	3.4%	2.0%

Netherlands						
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	932 788	51 326	964 000	49 701	3.3 %	- 3.2 %
Solid fossil fuels	384 249	36 081	368 000	34 034	- 4.2 %	- 5.7 %
Gaseous fossil fuels	1 289 950	70 140	1 305 000	71 020	1.2 %	1.3 %
Total	2 606 987	157 547	2 637 000	154 755	1.2 %	- 1.8 %
2003	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	1 063 656	59 506	1 203 000	55 471	13.1 %	- 6.8 %
Solid fossil fuels	365 564	34 467	367 000	34 148	0.4 %	- 0.9 %
Gaseous fossil fuels	1 507 182	82 364	1 508 000	82 614	0.1 %	0.3 %
Total	2 936 403	176 337	3 078 000	172 233	4.8 %	- 2.3 %

Portugal						
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	465 808	29 073	491 139	30 470	5.4 %	4.8 %
Solid fossil fuels	108 009	10 181	115 571	10 555	7.0 %	3.7 %
Gaseous fossil fuels	0	0	0	0	-	-
Total	573 817	39 254	606 709	41 025	5.7 %	4.5 %
2003	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	605 230	39 164	638 775	41 179	5.5 %	5.1 %
Solid fossil fuels	137 381	12 949	140 399	12 683	2.2 %	- 2.1 %
Gaseous fossil fuels	110 376	6 152	122 660	6 847	11.1 %	11.3 %
Total	852 986	58 264	901 834	60 708	5.7 %	4.2 %

Spain						
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	1 838 371	119 009	1 869 635	120 077	1.7 %	0.9 %
Solid fossil fuels	790 770	75 139	795 722	77 451	0.6 %	3.1 %
Gaseous fossil fuels	208 105	11 310	213 880	11 520	2.8 %	1.9 %
Total	2 837 246	205 459	2 879 237	209 048	1.5 %	1.7 %
2003	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	2 719 117	180 680	2 727 987	174 834	0.3 %	- 3.2 %
Solid fossil fuels	844 234	79 723	839 025	80 269	- 0.6 %	0.7 %
Gaseous fossil fuels	894 006	49 463	895 993	49 734	0.2 %	0.5 %
Total	4 457 356	309 867	4 463 004	304 837	0.1 %	- 1.6 %

Sweden						
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	586 804	36 161	628 532	38 906	7.1 %	7.6 %
Solid fossil fuels	112 065	10 719	121 965	11 161	8.8 %	4.1 %
Gaseous fossil fuels	21 740	1 212	21 536	1 217	- 0.9 %	0.4 %
Total	720 609	48 092	772 032	51 283	7.1 %	6.6 %
2003	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	646 616	41 041	654 334	42 555	1.2 %	3.7 %
Solid fossil fuels	112 597	10 840	106 267	10 126	- 5.6 %	- 6.6 %
Gaseous fossil fuels	33 470	1 865	33 375	1 886	- 0.3 %	1.1 %
Total	792 683	53 747	793 975	54 566	0.2 %	1.5 %

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	3 207 839	210 668	3 249 999	213 104	1.3 %	1.2 %
Solid fossil fuels	2 656 489	250 330	2 626 382	241 511	- 1.1 %	- 3.5 %
Gaseous fossil fuels	1 976 312	108 696	1 976 478	109 002	0.0 %	0.3 %
Total	7 840 640	569 694	7 852 859	563 618	0.2v%	- 1.1 %
2003	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	2 965 799	189 954	2 989 422	191 804	0.8 %	1.0v%
Solid fossil fuels	1 594 972	150 520	1 607 096	147 620	0.8 %	- 1.9 %
Gaseous fossil fuels	3 596 149	199 790	3 599 536	204 248	0.1 %	2.2v%
Total	8 156 921	540 264	8 196 055	543 672	0.5 %	0.6 %

database; data on international aviation are added to the reference approach separately from the joint (Eurostat/IEA/UNECE) oil questionnaire. For the calculation of CO₂ emissions, the IPCC default carbon emission factors adjusted for the non-oxidised fraction 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) is 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 Table 1.A(b) from the joint (Eurostat/IEA/UNECE) oil questionnaire, as in the Eurostat NewCronos database data at this level of disaggregation are not available.

Step 4: For the calculations of carbon stored in Table 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 3.45 shows the apparent energy consumption from fossil fuel combustion from 1990 to 2003 as provided in Table 1.A(b). Total fossil fuel energy consumption increased by 10 % between 1990 and 2003. Large increases had gas consumption (+ 64 %), whereas solid fuel combustion declined by 26 %. Table 3.46 compares EU-15 CO₂ emissions calculated with the IPCC

⁽¹⁶⁾ 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.

reference approach based on Eurostat data and the sectoral approach available from Member States. Both, reference and sectoral approach, increase by 4 % between 1990 and 2003; the percentage differences between the two data sets are smaller than 2 %.

Table 3.41 provides an overview by Member State on differences between the Eurostat and national reference approach for 1990 and 2002/03, as far as available. The differences can occur due to differences in the basic energy data or due to differences when calculating CO₂ 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).

To explain and resolve these differences, Eurostat launched a project for harmonisation of the two (joint questionnaires and CRF) reporting systems of energy data and for revision of reported energy data back to 1990 (see Section 3.4). The main reasons for diverging CO₂ 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.

Table 3.47 shows the comparison between Eurostat and national reference approach for CO₂ from fuel combustion. If 1990 is taken, apparent consumption of the two approaches is within 2 % for several Member States (Austria, Denmark, France, Germany, Greece, Italy, Netherlands, Spain and the UK). Differences of more than 5 % can be observed for Belgium,

Finland, Ireland, Portugal and Sweden. The differences of CO₂ emissions for 1990 range from – 0.2 % (Austria) to 11.1 % (Greece). A comparison of the differences between 1990 and 2002/03 shows that for apparent consumption there are six Member States with larger differences in 1990 and seven Member States with larger differences in 2002/03. As regards CO₂ emissions, seven Member States have larger differences in 1990 than in 2002/03. A comparison of these tables with the tables provided in the 2004 submission shows not much change with regard to 1990, but a better match between the two approaches for the latest year.

3.7 International bunker fuels

International bunker emissions of the EC inventory are the sum of the international bunker emissions of the Member States⁽¹⁶⁾. A project shared between the Commission (Eurostat and DG Environment), Eurocontrol and EEA has been initiated to improve the quality of the estimates of CO₂ emissions from international aviation. In a first phase of the project, Eurocontrol, the European Organisation for the Safety of Air Navigation and responsible for the coordination of the European air traffic management system, provided Eurostat with aggregated air traffic data. Several comparisons have been made between energy and emission estimates based on Eurocontrol data on the one hand and data from the energy statistics and GHG inventories on the other hand. The main results of these comparison exercises are as follows:

(1) There are large discrepancies when comparing fuel consumption calculated on the basis of air movement data, with energy statistics. These discrepancies are due to several reasons (a) aircraft carrying fuel reserves — they do not refuel at every landing and take-off (b) the inclusion or exclusion of overseas territories (c) inaccurate coefficients for some older aircraft types (d) ground operations. Discrepancies of up to 20 % were seen as acceptable, but larger differences should be investigated.

(2) A comparison between emissions data provided by Eurostat (calculated on the basis of Eurocontrol data) for the years 1996–2001 with data from Member States' GHG

inventories revealed that total CO₂ emissions for aviation reported in the 2000 CRF tables by most Member States are within 10 % of the estimates provided by Eurostat. The share of domestic emissions is usually higher in Member States' estimates, especially as new Member States tend to overestimate the domestic sector.

In May 2004, a 'Workshop on emissions of greenhouse gases from aviation and navigation' was held in Copenhagen. The aim of this workshop was to improve the inventories of GHG emissions from aviation and navigation with special attention given to the disaggregation between domestic and international bunker fuels. The workshop brought together the national experts from statistical institutes or other organisations that are responsible for energy balances and/or aviation and navigation transport statistics, the national experts responsible for annual GHG inventories and the experts from international organisations that are performing relevant projects. The workshop report with the recommendations can be downloaded from the ETC/ACC website: <http://air-climate.eionet.eu.int/>. The most important recommendations of the workshop are as follows.

Legal arrangements

- Member States should consider strengthening their legal arrangements for cooperation on bunkers data collection and emissions calculations.

Emissions estimations methods and data

- Member States should work towards using flight movement data for compiling their inventories. The use of flight movement data usually increases transparency.
- Member States should use at least IPCC Tier 2a method for estimating emissions, especially if the emissions are from a key source. Methodologies based solely on flight movement data such as Corinair detailed methodology are also recommended.
- Where severe resource constraints exist, Member States could consider using Tier 2 periodically (for example every 3–5 years) and to interpolate based on fuel consumption data.

- It is recommended to add a new methodology to the IPCC guidelines based solely on flight movement data (for example Corinair detailed methodology) as a higher tier method, because such methods offer possibilities to compare and verify emissions calculated by the two independent methods (based on fuel consumption and flight movement data).
- Further cooperation between those responsible for compiling energy statistics in Member States and aviation authorities is necessary in order to understand the differences in fuel consumption from different methods.
- Member States should further work on methods for recalculation of time series in cases where flight movement data are not available for all years back to 1990.
- Member States and relevant international organisations should work to improve the quality of marine activity data.
- Member States and relevant marine organisations should further consider how bunker delivery notes required for Annex VI of Marpol 73/78 could be used for estimating emissions from maritime transportation.
- An important criterion for elaboration of future emission estimation methods is how well these methods are able to reflect the effectiveness of measures regarding the reduction of fuel consumption and CO₂ emissions and other impacts.

Separation of domestic and international emissions and definitions

- Member States should use the definition of 'domestic territory' which is consistent with their instrument of ratification to the UNFCCC and the Kyoto Protocol, for the purposes of splitting domestic and international emissions.
- Domestic and international emissions should be separated based on flight movement data and Member States should aim to apply the definitions used in IPCC guidelines.

- The meeting identified some scope for improving the IPCC definitions mainly related to difficulties in obtaining the information on passenger and freight drop-offs and pick-ups at stops in the same country required in the IPCC good practice guidance.
- IEA's proposal for improved definitions in the joint Eurostat/IEA energy questionnaires should be considered by member countries, by those responsible for compiling and reporting GHG inventories and energy statistics.

Emissions factors

- Further work should be undertaken towards establishing consistent emissions factors for aircraft and engine types across the EU. This work should feed into the IPCC emissions factors database.
- The IPCC N₂O emissions factor for non-road diesel engines for Europe of 30 mg/MJ from Table 1-49 on page 1.91 of 1996 IPCC guidelines for national greenhouse gas inventories should be reconsidered.

Quality-assurance/quality-checking (QA/QC) programmes

- Member States should work towards establishing QA/QC procedures for emissions from aviation and navigation as part of their QA/QC programmes for national inventories.

Eurocontrol data to assist EU Member States

- The majority of Member States would appreciate assistance from Eurocontrol with estimates for emissions from aviation for the purposes of validating their emissions inventories.
- Member States will establish which types of assistance, background information or data, they would like to receive from Eurocontrol, via the Climate Change Committee Working Group 1.
- Methodological approaches based on data collected pre-1996 by Eurocontrol or in different and less comprehensive databases, need to be developed. This is because the problem of establishing a consistent time series for the years 1990–96 when using Eurocontrol data, remains to be resolved. The database of detailed flight movement data only exists for the years post-1996.

Cooperation within Member States

- Emissions inventory experts should work closely with energy statistics experts, to ensure that the origin of differences in results between emissions estimates related to fuel consumption and to flight movement data are understood and can be explained.

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, emission factors, completeness and qualitative uncertainty estimates. The quantitative uncertainty estimates are summarised in a separate section. Finally, the chapter includes a section on recalculations. A section on sector-specific QA/QC is not

included as such activities have not yet started in this sector.

4.1 Overview of sector

CRF Sector 2 'Industrial processes' is the third largest sector contributing 6 % to total EU-15 GHG emissions. The most important GHGs from 'Industrial processes' are CO₂ (4 % of total GHG emissions), HCFs and N₂O (1 % each). The emissions from this sector decreased by 15 % from 313 Tg in

Figure 4.1 EU-15 GHG emissions for 1990–2003 from CRF Sector 2: 'Industrial processes' in CO₂ equivalents (Tg) and share of largest key source categories in 2003

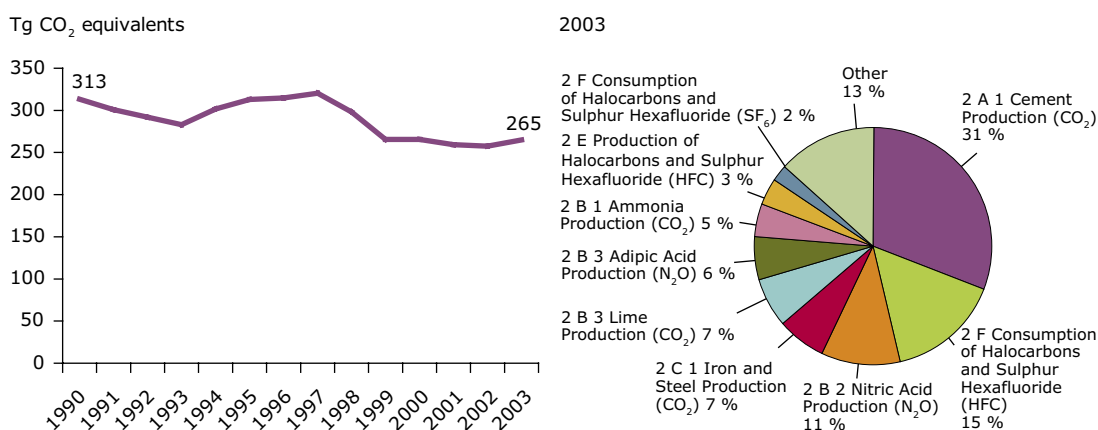


Figure 4.2 Absolute change of GHG emissions by large key source categories 1990–2003 in CO₂ equivalents (Tg) in CRF Sector 2: 'Industrial processes'

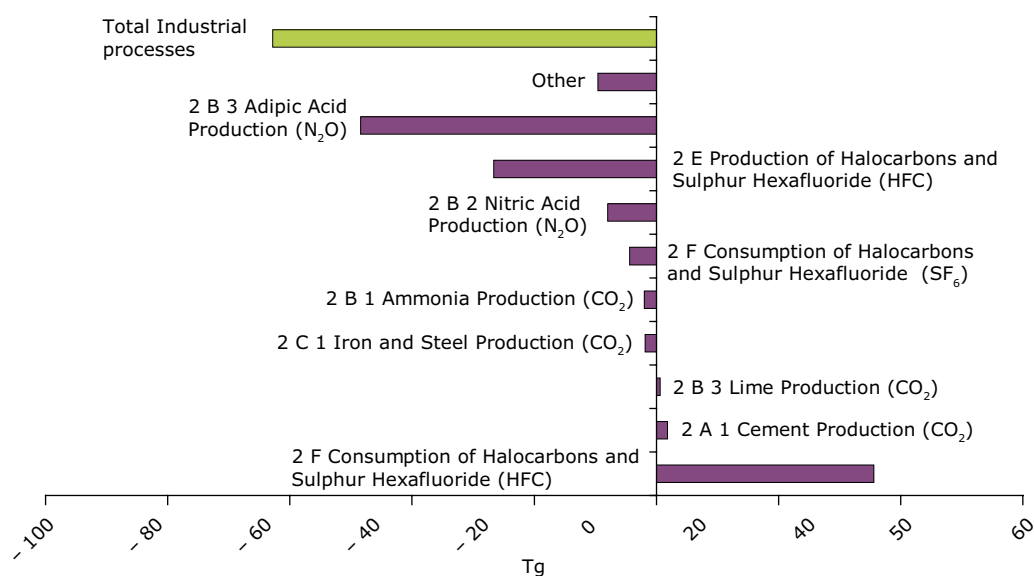


Table 4.1 Member States' contributions to CO₂ emissions from 2.A: 'Mineral products' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO ₂ equivalents)	GHG emissions in 2003 (Gg CO ₂ equivalents)	Methods applied ¹⁾	EF ¹⁾	Estimate ²⁾	Quality ²⁾
Austria	3 243	3 060	T2	D, CS	ALL	H
Belgium	5 382	5 512	CS	CS		
Denmark	1 037	1 486	CS	CS	ALL	M
Finland	1 286	1 181	T2/D	PS/CS	PART	H
France	14 734	11 993	C	CS	ALL	H
Germany	22 970	20 758	D,CS; NE	D,CS	All	H
Greece	6 330	7 307	T1, T2	D	PART	
Ireland	941	2 360	D	D	Part	M
Italy	21 875	23 483	D, T2	CS, PS	ALL	M
Luxembourg	585	461	C/D	C/D		
Netherlands	1 216	1 349	T2(clincer)/T1/CS/D	PS,CS,D	ALL	M
Portugal	3 375	4 198	D	D+C+CS	All	M
Spain	15 669	20 962	D,T2,CS	D,T2,C,CS	PART	H
Sweden	1 917	1 924	T2, CS, D	CS, D, PS	PART	H
United Kingdom	9 554	7 866	T2	D	PART	H
EU-15	110 115	113 901	C, CS, D, T1, T2	C, CS, D, PS, T2	ALL, PART	H

(¹⁾ Information source: CRF Summary Table 3 for 2002.

(²⁾ Information source: CRF Table 7 for 2002.

Abbreviations explained in the Chapter 'Units and abbreviations'.

1990 to 265 Tg in 2003 (Figure 4.1). In 2003, the emissions increased by 2.9 % compared to 2002. Cement production dominates the trend until 1997. Factors for declining emissions in the early 1990s were low economic activity and cement imports from east 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 increase in 2003 compared to the previous year is mainly due to emission increases from refrigeration and air conditioning, nitric acid production, cement production and iron and steel production.

The key sources in this sector are:

- 2.A.1: Cement production (CO₂)
- 2.A.2: Lime production (CO₂)
- 2.B.1: Ammonia production (CO₂)
- 2.B.2: Nitric acid production (N₂O)
- 2.B.3: Adipic acid production (N₂O)
- 2.B.5: Other (N₂O)
- 2.C.1: Iron and steel production (CO₂)
- 2.C.3: Aluminium production (PFCs)
- 2.C.4: SF₆ used in aluminium and magnesium foundries (SF₆)

- 2.E: Production of halocarbons and sulphur hexafluoride (HFCs)
- 2.F: Consumption of halocarbons and sulphur hexafluoride (HFCs)
- 2.F: Consumption of halocarbons and sulphur hexafluoride (SF₆)

Figure 4.1 shows that the three largest key sources account for about 57 % of total process-related GHG emissions in the EU-15.

Figure 4.2 shows that large emission reductions occurred in adipic acid production (N₂O) mainly due to reduction measures in Germany, France and the UK and in production of halocarbons and SF₆ (HFCs). Large emission increases can be observed of HFCs from consumption of halocarbons and SF₆.

4.2 Source categories

4.2.1 Mineral products (CRF Source Category 2.A)

Table 4.1 summarises information by Member State on methodologies, emission factors, completeness and qualitative uncertainty estimates for CO₂ from 2.A:

Table 4.2 Member States' contributions to CO₂ emissions from 2.A.1: 'Cement production'

Member State	Greenhouse gas emissions (Gg CO ₂ equivalents)			Share in EU-15 emissions in 2003	Change 2002-2003		Change 1990-2003	
	1990	2002	2003		(Gg CO ₂ equivalents)	(%)	(Gg CO ₂ equivalents)	(%)
Austria	2 033	1 736	1 736	2.1 %	0	0 %	- 298	- 15 %
Belgium	2 824	2 939	2 939	3.6 %	0	0 %	115	4 %
Denmark	882	1 452	1 370	1.7 %	- 82	- 6 %	488	55 %
Finland	786	517	500	0.6 %	- 17	- 3 %	- 286	- 36 %
France	10 948	8 651	8 564	10.5 %	- 87	- 1 %	- 2 384	- 22 %
Germany	15 146	12 696	13 373	16.4 %	678	5 %	- 1 772	- 12 %
Greece	5 778	6 331	6 386	7.8 %	55	1 %	608	11 %
Ireland	750	2 021	2 157	2.6 %	136	7 %	1 407	188 %
Italy	16 084	16 616	17 322	21.2 %	706	4 %	1 237	8 %
Luxembourg	538	460	405	0.5 %	- 55	- 12 %	- 133	- 25 %
Netherlands	507	489	434	0.5 %	- 55	- 11 %	- 73	- 14 %
Portugal	3 107	3 824	3 538	4.3 %	- 286	- 7 %	432	14 %
Spain	12 534	15 853	16 371	20.1 %	518	3 %	3 837	31 %
Sweden	1 245	1 253	1 181	1.4 %	- 73	- 6 %	- 65	- 5 %
United Kingdom	6 659	5 466	5 356	6.6 %	- 110	- 2 %	- 1 303	- 20 %
EU-15	79 823	80 304	81 631	100.0 %	1 327	2 %	1 808	2 %

'Mineral products'. Between 1990 and 2003, CO₂ emission from 'Mineral products' increased by 3.4 %. The relative decrease was largest in Luxembourg, the relative growth was largest in Ireland.

This source category includes two key sources: CO₂ from 2.A.1: 'Cement production' and CO₂ from 2.A.2: 'Lime production'.

Table 4.2 provides information on emission trends of the key source CO₂ from 2.A.1: 'Cement production' by Member State. CO₂ emissions from cement production account for 2.0 % of total EU-15 GHG emissions in 2003. In 2003, CO₂ emissions from cement production were 2 % above 1990 levels in the EU-15.

Table 4.3 Information on methods applied, activity data, emission factors for CO₂ emissions from 2.A.1: 'Cement production' for 1990 and 2003

Member State	Method applied	Activity data	Emission factor	Methodology comment	1990			2003				
					Activity data		CO ₂ emissions (Gg)	Activity data		Implied emission factor (t/t)	CO ₂ emissions (Gg)	
					Description	(kt)		Description	(kt)			
Austria	T2	PS	PS	Detailed methodology based on raw material composition (NIR2005)	Clinker production	3 694	0.55	2033	Clinker production	3 118	0.56	1 736
Belgium	CS	PS	CS	Detailed methodology based on raw material composition (NIR2005)	Cement production	5 292	0.53	2824	Cement production	5 583	0.53	2 939
Denmark	CS/T2	PS	PS	Detailed methodology based on raw material composition (NIR2005)	Cement production	1 620	0.54	882	Cement production	2 546	0.54	1 370

Member State	Method applied	Activity data	Emission factor	Methodology comment	1990			2003				
					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)		
Finland	T2	PS	PS	Detailed methodology based on raw material composition (NIR2005)	Clinker production	1 470	0.53	786	Clinker production	940	0.53	500
France	C	AS	PS	Methodology based on national statistics (clinker statistics) and emission factors from industry. (NIR2004)	Clinker production	20 854	0.53	10 948	Clinker production	16 313	0.53	8 564
Germany	CS	NS	CS	Methodology based on activity data from associations of industries (clinker production) and a CS EF (which is also obtained from associations of industries based on detailed data, average value for 1999-2001)	Clinker production	28 577	0.53	15 146	Clinker production	25 233	0.53	13 373
Greece	T2	NS	CS	Methodology based on activity data and parameters for emission calculations collected from industry (NIR2005)	Clinker production	10 645	0.54	5 778	Clinker production	11 755	0.54	6 386
Ireland	D	NS, PS	PS	According to the NIR2005 emission calculation is linked to clinker production. However, for the years 1990 to 2000/2001 reported clinker production only presents a rough estimate (due to difficulties in data availability from the only producer), and also the EF used is a rough estimate.	Clinker production	1 500	0.50	750	Clinker production	3 967	0.54	2 157

Member State	Method applied	Activity data	Emission factor	Methodology comment	1990				2003			
					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)		
Italy	T2	NS	CS, PS	Methodology based on activity data from national statistics (clinker production) and the IPCC default EF. (NIR2004)	Clinker production	29 786	0.54	16 084	Clinker production	32 077	0.54	17 322
Luxembourg												
Netherlands	CS, T2	Q	PS, CS	Detailed methodology based on measured data (NIR2005)	Clinker production	939	0.54	507	Clinker production	804	0.54	434
Portugal	T2	PS	D	Clinker production is obtained from each plant, IPCC default EF is used (NIR 2004)	Clinker production	6 128	0.51	3 107	Clinker production	6 980	0.51	3 538
Spain	CS	AS	CS	Clinker production data and the applied EF are obtained from associations of industries (NIR2005)	Clinker production	23 212	0.54	12 534	Clinker production	30 317	0.54	16 371
Sweden	T2	PS	PS	AD (clinker production) is obtained from industry, the default value from the GHG protocol of WRI is used. (NIR2005)	Clinker production	2 348	0.53	1 245	Clinker production	2 235	0.53	1 181
UK	T2	AS		AD (clinker production) and CS EF is obtained from industry (NIR2004)	Clinker production	13 199	0.50	6 659	Clinker production	10 616	0.50	5 356
EU-15					EU-15 w/o BE, LU and DK (about 95%)	142 351	0.53	75 579		144 354	0.53	76 918

Abbreviations explained in the Chapter 'Units and abbreviations'.

Germany, France and the United Kingdom had large reductions in absolute terms, whereas especially Spain had large increases. Italy is the largest emitter accounting for 21 % of EU-15 emissions, followed by Spain and Germany (20 and 16 %, respectively). These results should be interpreted with care as different criteria are used by Member States to decide whether

particular emissions are allocated to fossil fuel combustion or to the relevant industrial process.

Table 4.3 shows information on methods applied, activity data, emission factors for CO₂ emissions from 2.A.1: 'Cement production' for 1990 and 2003. The table shows that most MS report clinker

Table 4.4 Member States' contributions to CO₂ emissions from 2.A.2: 'Lime production'

Member State	Greenhouse gas emissions (Gg CO ₂ equivalents)			Share in EU-15 emissions in 2003	Change 2002-2003		Change 1990-2003	
	1990	2002	2003		(Gg CO ₂ equivalents)	(%)	(Gg CO ₂ equivalents)	(%)
Austria	396	547	547	3.1 %	0	0 %	150	38 %
Belgium	2 156	2 144	2 144	12.2 %	0	0 %	- 12	- 1 %
Denmark	138	130	102	0.6 %	- 28	- 22 %	- 35	- 26 %
Finland	383	439	513	2.9 %	74	17 %	130	34 %
France	2 576	2 445	2 469	14.1 %	25	1 %	- 106	- 4 %
Germany	5 891	5 299	5 383	30.7 %	84	2 %	- 508	- 9 %
Greece	445	589	605	3.5 %	16	3 %	160	36 %
Ireland	191	182	202	1.2 %	20	11 %	11	6 %
Italy	1 711	1 941	2 092	11.9 %	151	8 %	381	22 %
Luxembourg	0	0	0	0.0 %	0	-	0	-
Netherlands	NE	NE	NE	-	-	-	-	-
Portugal	178	396	417	46.2 %	21	5 %	239	134 %
Spain	1 123	1 513	1 571	9.0 %	58	4 %	448	40 %
Sweden	500	549	564	3.2 %	15	3 %	64	13 %
United Kingdom	1 192	811	901	5.1 %	90	11 %	- 290	- 24 %
EU-15	16 878	16 985	17 510	100.0 %	525	3 %	632	4 %

production as activity data. However, even those who report cement production as activity data, base their calculation on raw material composition and not on e.g. default emission factors. The implied emission factors per tonne of clinker produced vary slightly from 0.5 for the UK to 0.56 for Austria; most MS use country-specific emission factors. The EU-15 IEF (excluding Belgium, Luxembourg and Denmark) is 0.53 t/t of clinker produced. The table also suggests that more than 95 % of EU-15

emissions are estimated with higher tier methods.

CO₂ emissions from 2.A.2: 'Lime production' account for 0.4 % of total GHG emissions in 2003. Between 1990 and 2003, CO₂ emissions from this source increased by 4 % in the EU-15 (Table 4.4). Germany was responsible for 31 % of the emissions from this source. The decreases in Germany (- 9 %) contributed largely to the reduction trend in the EU-15 between 1990 and 2003.

Table 4.5 Information on methods applied, activity data, emission factors for CO₂ emissions from 2.A.2: 'Lime production' for 1990 and 2003

Member State	Method applied	Activity data	Emission factor	Methodology comment	1990		2003					
					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	PS	Higher tier methodology based on detailed lime composition data (NIR2005)	Lime Production	513	0.77	396	Lime Production	719	0.76	547
Belgium	CS	PS	CS	Higher tier methodology considering lime composition or raw material composition, respectively. (NIR2005)	Lime Production	2 735	0.79	2 156	Lime Production	2 681	0.80	2144

Member State	Method applied	Activity data	Emission factor	Methodology comment	1990		2003					
					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)				
Denmark	D	NS	D	Lower tier methodology based on lime production data and the IPCC default emission factor (NIR2005)	Production of Lime and Bricks	446	0.31	138	Production of Lime and Bricks	441	0.23	102
Finland	D	PS	PS	Higher tier methodology based on detailed lime composition data (NIR2005)	Lime Production	519	0.74	383	Lime Production	691	0.74	513
France	C	AS	PS	Methodology based on national statistics and emission factors from industry. (NIR2004)	Lime Production	3 315	0.78	2 576	Lime Production	3 200	0.77	2469
Germany	D	NS	D	Lower tier methodology based on lime production data (without consideration of types of lime) and the IPCC default emission factor (NIR2005)	Lime Production	7 504	0.79	5 891	Lime Production	6 857	0.79	5 383
Greece	T1	NS	D	Higher tier methodology considering types of lime (NIR2004)	Lime Production	596	0.75	445	Lime Production	811	0.75	605
Ireland	D	NS, PS	PS	Lower tier methodology based on lime production data obtained from industry with out consideration of types of lime and the IPCC default emission factor for quicklime (NIR2005)	Lime production	255	0.75	191	Lime production	273	0.74	202
Italy	D	NS	CS, PS	Only hydraulic lime is considered; AD obtained from NS and information from associations of industry. IPCC default EF are used (NIR2004)	Lime production	2 176	0.79	1 711	Lime production	2 624	0.80	2 092
Luxembourg												
Netherlands	NO	NO	NO			NE	NE	NE		NE	NE	NE

Member State	Method applied	Activity data	Emission factor	Methodology comment	1990		2003					
					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)			
Portugal	D	NS, PS	D	Lower tier methodology based on lime production data (without consideration of types of lime) and the IPCC default emission factor (NIR2004)	Lime production	268	0.66	178	Lime production	561	0.74	417
Spain	CS	AS	CS	Higher tier methodology considering different types of lime and using EF obtained from national association (NIR2004)	Lime production	1 475	0.76	1 123	Lime production	2 050	0.77	1 571
Sweden	D	PS	D, CS	Higher tier methodology considering different types of lime and using default EF (NIR2005)	Lime Production	923	0.54	500	Lime Production	1 064	0.53	564
UK	T2	AS		Lower tier methodology using limestone consumption data and not distinguishing between types of lime; stoichiometric ratio was used as EF (= default) (NIR2004)	Limestone consumption	2 708	0.44	1 192	Limestone consumption	2 048	0.44	901
EU-15					Average w/o DK and UK (>90%)	20 280	0.77	15 549		21 533	0.77	16 507

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.5 shows information on methods applied, activity data, emission factors for CO₂ emissions from 2.A.2: 'Lime production' for 1990 to 2003. The table shows that most MS use lime production as activity data for calculating CO₂ emissions. The EU-15 IEF (excluding Denmark and the UK) is 0.77 t/t of lime produced. The implied emission factors per tonne of lime produced vary between 0.53 for Sweden and 0.8 for Belgium. The reason for the low IEF in Sweden is that limestone production in pulp and paper and food industries where CO₂ is partly rebound is also reported under 'Lime production'. The table also suggests that

most MS use default methodologies; about 30 % of EU-15 emissions are estimated with higher tier methods.

4.2.2 Chemical industry (CRF Source Category 2.B)

Table 4.6 summarises information by Member State on methodologies, emission factors, completeness and qualitative uncertainty estimates for CO₂ from 2.B: 'Chemical industry'. Between 1990 and 2003, CO₂ emission from 'Chemical industry' decreased by 12 %. The relative decrease

Table 4.6 Member States' contributions to CO₂ emissions from 2.B: 'Chemical industry' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990	GHG emissions in 2003	Methods applied ¹⁾	EF ¹⁾	Estimate ²⁾	Quality ²⁾
	(Gg CO ₂ equivalents)	(Gg CO ₂ equivalents)				
Austria	464	559	PS	PS	ALL	H
Belgium	909	2 024	CS	CS		
Denmark	2	3				
Finland	60	147	CS	PS	NE	NE
France	3 537	2 063	C	CS/PS	ALL	H
Germany	2 191	2 014	CS	CS	All	H
Greece	0	0	D	D	NE	
Ireland	989	0	D,T1a	D	Part	M
Italy	2 186	1 243	D	C, PS	ALL	M
Luxembourg	0	0	C/D	C/D		
Netherlands	3 538	2 935	CS/T2/T1	CS	ALL	M
Portugal	633	1 736	MB+D	D+C	All	M
Spain	673	593	D,C	D,C	ALL	H
Sweden	69	48	D	PS	PART	H
United Kingdom	1 322	1 164	T1	CS	ALL	H
EU-15	16 572	14 529	C,CS,D,MB, PS, T1, T1a, T2	C, CS, D, PS	ALL, NE, PART	H

(¹⁾ Information source: CRF Summary Table 3 for 2002.

(²⁾ Information source: CRF Table 7 for 2002.

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.7 Member States' contributions to CO₂ emissions from 2.B.1: 'Ammonia production'

Member State	Greenhouse gas emissions (Gg CO ₂ equivalents)			Share in EU-15 emissions in 2003	Change 2002-2003		Change 1990-2003	
	1990	2002	2003		(Gg CO ₂ equivalents)	(%)	(Gg CO ₂ equivalents)	(%)
Austria	396	445	494	4.0 %	48	11 %	98	25 %
Belgium	694	1 253	1 247	10.0 %	- 6	- 1 %	553	80 %
Denmark	NO	NO	NO	-	-	-	-	-
Finland	NO	NO	NO	-	-	-	-	-
France	3 357	2 198	2 044	16.5 %	- 153	- 7 %	- 1 313	- 39 %
Germany	1 747	1 830	1 998	16.1 %	167	9 %	250	14 %
Greece	IE	IE	IE	-	-	-	-	-
Ireland	989	810	NO	-	- 810	- 100 %	- 989	- 100 %
Italy	1 710	558	680	5.5 %	122	22 %	- 1 030	- 60 %
Luxembourg	0	0	0	0.0 %	0	-	0	-
Netherlands	3 058	2 871	2 686	21.6 %	- 185	- 6 %	- 372	- 12 %
Portugal	569	1 528	1 622	13.1 %	94	6 %	1 053	185 %
Spain	550	477	481	3.9 %	5	1 %	- 69	- 12 %
Sweden	NO	NO	NO	-	-	-	-	-
United Kingdom	1 322	1 233	1 164	9.4 %	- 69	- 6 %	- 157	- 12 %
EU-15	14 392	13 203	12 416	100.0 %	- 787	- 6 %	- 1 976	- 14 %

Abbreviations explained in the Chapter 'Units and abbreviations'.

was largest in Ireland, the relative growth was largest in Portugal.

This source category includes one key source: CO₂ from 2.B.1: 'Ammonia production'.

CO₂ emissions from 2.B.1: 'Ammonia production' account for 0.3 % of total EU-15 GHG emissions in 2003. Between 1990 and 2003, CO₂ emissions from this source decreased by 14 % (Table 4.7). The Netherlands, France, Germany, and Portugal

Member State	Method applied	Activity data	Emission factor	Methodology comment	1990			2003						
					Activity data		CO ₂ emissions (Gg)	Activity data		CO ₂ emissions (Gg)				
					Description	(kt)		Description	(kt)					
Netherlands	CS	PS,Q	PS, CS	Emissions are calculated from the amount of natural gas used as feedstock (equivalent to IPCC Tier 1b) and a 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 2005)	Ammonia production	C	C	3 058	Ammonia production	C	C	2 686		
Portugal	D	NS, PS	PS	Emissions are estimated using natural gas consumption data and a PS emission factor. (NIR2004)	Ammonia production	C	0.00	569	Ammonia production	C	0.00	1 622		
Spain	CS	AS	CS		Ammonia production		601	0.91	550	Ammonia production		525	0.92	481
Sweden	NO	NO	NO				374	0.00	0			NO	NO	NO
UK				Estimates based on reported data from industry and natural gas consumption (NIR2004)	Ammonia production: natural gas consumption PJ net		44	29.87	1 322	Ammonia production: natural gas consumption PJ net		32	35.87	1 164
EU-15					EU-15 w/o BE, GR, NL, PT and UK (45% - 60%)		7 781	1.12	8 749			5 915	0.96	5 696

Abbreviations explained in the Chapter 'Units and abbreviations'.

Netherlands, Portugal and the UK) is 0.96 t/t of ammonia produced. The decrease of the IEF from 1990 to 2003 is rather due to changing ratios of production of the different countries than to emission reduction measures. The table also suggests that about 75 % of EU-15 emissions are estimated with higher tier methods.

Table 4.9 summarises information by Member State on methodologies, emission factors, completeness and qualitative uncertainty estimates for N₂O from 2.B:

'Chemical industry'. Between 1990 and 2003, N₂O emission from 'Chemical industry' decreased by 57 %. The relative decrease was largest in Ireland, emissions increased in Italy and Portugal.

This source category includes three key sources: N₂O from 2.B.2: 'Nitric acid production', N₂O from 2.B.3: 'Adipic acid production', and N₂O from 2.B.5: 'Other'.

N₂O emissions from 2.B.2: 'Nitric acid production' account for 0.7 % of total

Table 4.9 Member States' contributions to N₂O emissions from 2.B: 'Chemical industry' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO ₂ equivalents)	GHG emissions in 2003 (Gg CO ₂ equivalents)	Methods applied ¹⁾	EF ¹⁾	Estimate ²⁾	Quality ²⁾
Austria	912	883	PS	PS	ALL	H
Belgium	3 934	3 137	CS	CS		
Denmark	1 043	895				
Finland	1 595	1 395	D	PS	ALL	L
France	24 143	9 084	C	CS/PS	ALL	M
Germany	23 484	10 373	PS, CS	D, PS, CS	part	M
Greece	713	401	D	D	NE	
Ireland	1 035	0	D	CS	Part	L
Italy	6 748	7 061	D	D, PS	ALL	M
Luxembourg	0	0	C/D	C/D		
Netherlands	7 570	6 014	CS/T2/T1	PS,D,CS	CS	L
Portugal	567	597	D	D+C	All	M
Spain	2 884	1 965	DC	C,CS	ALL	M
Sweden	829	446	T2, CS	PS	ALL	H
United Kingdom	29 270	3 199	PS	CS	ALL	M
EU-15	104 727	45 451	C, CS, D, PS, T1, T2	C, CS, D, PS	ALL, PART	M

(¹⁾ Information source: CRF Summary Table 3 for 2002.

(²⁾ Information source: CRF Table 7 for 2002.

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.10 Member States' contributions to N₂O emissions from 2.B.2: 'Nitric acid production'

Member State	Greenhouse gas emissions (Gg CO ₂ equivalents)			Share in EU-15 emissions in 2003	Change 2002-2003		Change 1990-2003	
	1990	2002	2003		(Gg CO ₂ equivalents)	(%)	(Gg CO ₂ equivalents)	(%)
Austria	912	807	883	3.0 %	76	9 %	- 29	- 3 %
Belgium	3 562	3 685	2 922	10.1 %	- 763	- 21 %	- 640	- 18 %
Denmark	1 043	774	895	3.1 %	121	16 %	- 148	- 14 %
Finland	1 595	1 310	1 395	4.8 %	85	6 %	- 200	- 13 %
France	6 570	4 403	4 600	15.9 %	197	4 %	- 1 971	- 30 %
Germany	4 673	4 007	6 589	22.7 %	2 581	64 %	1 915	41 %
Greece	713	401	401	1.4 %	0	0 %	- 312	- 44 %
Ireland	1 035	292	NO	-	- 292	- 100 %	- 1 035	- 100 %
Italy	2 169	585	644	2.2 %	59	10 %	- 1 525	- 70 %
Luxembourg	0	0	0	0.0 %	0	-	0	-
Netherlands	6 330	5 032	5 060	17.4 %	28	1 %	- 1 269	- 20 %
Portugal	567	590	597	2.1 %	7	1 %	31	5 %
Spain	2 884	1 937	1 965	6.8 %	28	1 %	- 919	- 32 %
Sweden	814	441	431	1.5 %	- 10	- 2 %	- 383	- 47 %
United Kingdom	4 134	2 412	2 618	9.0 %	205	9 %	- 1 516	- 37 %
EU-15	37 002	26 677	29 000	100.0 %	2 322	9 %	- 8 002	- 22 %

EU-15 GHG emissions in 2003. Between 1990 and 2003, N₂O emissions from this source decreased by 22 % (Table 4.10). The Netherlands, France, Germany and Belgium

are responsible for 66 % of these emissions in the EU-15. Nearly all Member States had reductions from this source between 1990 and 2003. France had the greatest reductions

Table 4.11 Information on methods applied, activity data, emission factors for N₂O emissions from 2.B.2: 'Nitric acid production' for 1990 and 2003

Member State	Method applied	Activity data	Emission factor	Methodology comment	1990			2003				
					Activity data	Implied emission factor (t/t)	N ₂ O emissions (Gg)	Activity data	Implied emission factor (t/t)	N ₂ O emissions (Gg)		
					Description	(kt)		Description	(kt)			
Austria	CS	CS	PS	Estimates based on reported data from industry (NIR2005)	Nitric acid production	530	0.0056	2.9	Nitric acid production	558	0.0051	2.8
Belgium	CS	PS	CS	Estimates are partly calculated using nitric acid production figures and a french EF and partly reported by industry based on monitoring data (NIR2005)	Nitric acid production	364	0.0316	11.5	Nitric acid production	1 716	0.0055	9.4
Denmark	D	PS	PS	Estimates are based on PS activity data using the PS EF for 2002. (NIR2005)	Nitric acid production	450	0.0075	3.4	Nitric acid production	386	0.0075	2.9
Finland	D	PS	PS	Emission factors are plant specific and based on measurements in 1999. (NIR 2005)	Nitric acid production	549	0.0094	5.1	Nitric acid production	477	0.0094	4.5
France	C	AS	PS		Nitric acid production	3 200	0.0066	21.2	Nitric acid production	2 702	0.0055	14.8
Germany	CS	NS	CS	Activity data taken from national statistics, country-specific emission factor is assumed to be constant (NIR 2005)	Nitric acid production	2 741	0.0055	15.1	Nitric acid production	3 864	0.0055	21.3
Greece	D	NS	D	Estimates are based on activity data from industry and average IPCC default EF (NIR 2005)	Nitric acid production	511	0.0045	2.3	Nitric acid production	288	0.0045	1.3
Ireland	D	NS, PS	CS, PS	Nitric acid production was closed in 2002	Nitric acid production	339	0.0099	3.3	NO	0	0.0000	NO
Italy	D	NS, PS	D, PS	Emissions are calculated based on nitric acid production and a CS emission factor taken from EPER (NIR2004)	Nitric acid production	1 037	0.0068	7.0	Nitric acid production	554	0.0038	2.1

Member State	Method applied	Activity data	Emission factor	Methodology comment	1990			2003				
					Activity data	Implied emission factor (t/t)	N ₂ O emissions (Gg)	Activity data	Implied emission factor (t/t)	N ₂ O emissions (Gg)		
					Description	(kt)		Description	(kt)			
Luxembourg												
Netherlands	CS	Q, NS	PS	Estimates are based on data reported by industry and calculated with Tier 2 method, emission factors are based on plant-specific measured data which are confidential. (NIR 2005)	Nitric acid production	C	C	20.4	Nitric acid production	C	C	16.3
Portugal	D	NS, PS	PS	Estimates are calculated from nitric acid production data using the PS EF from one plant (NIR2004)	Nitric acid production	C	0.0000	1.8	Nitric acid production	C	0.0000	1.9
Spain	CS	AS	CS	Emission factor obtained from national business association (NIR 2005)	Nitric acid production	1329	0.0070	9.3	Nitric acid production	906	0.0070	6.3
Sweden	T2	PS	PS	Estimates are based on activity data and emission factors as reported by industry. (NIR 2005)	Nitric acid production	NO	0.0000	NO	Nitric acid production	258	0.0054	1.4
UK		PS	CS	Estimates are based on PS data as well as calculated using nitric acid production and the average IPCC default value (NIR 2004)	Nitric acid production	2408	0.0055	13.3	Nitric acid production	1625	0.0052	8.4
EU-15					EU-15 w/o NL and PT (80 %)	13 457	0.0070	94		13 334	0.0056	75

Abbreviations explained in the Chapter 'Units and abbreviations'.

in absolute terms. The largest growth was in Germany.

Table 4.11 shows information on methods applied, activity data, emission factors for N₂O emissions from 2.B.2: 'Nitric acid production' for 1990 to 2003. The table shows that almost all MS report nitric acid production as activity data; for some MS this information is confidential. The implied

emission factors per tonne of nitric acid produced vary for 2003 between 0.0038 for Italy and 0.0094 for Finland. The EU-15 IEF (excluding Netherlands and Portugal) is 0.0056 t/t of nitric acid produced. The decrease of the IEF is mainly due to changing production ratios in the different MS having different technological standards and close down of older plants in some MS rather than due to introduction of emission

Table 4.12 Member States' contributions to N₂O emissions from 2.B.3: 'Adipic acid production'

Member State	Greenhouse gas emissions (Gg CO ₂ equivalents)			Share in EU-15 emissions in 2003	Change 2002– 2003		Change 1990– 2003	
	1990	2002	2003		(Gg CO ₂ equivalents)	(%)	(Gg CO ₂ equivalents)	(%)
Austria	NO	NO	NO	-	-	-	-	-
Belgium	NO	NO	NO	-	-	-	-	-
Denmark	NO	NO	NO	-	-	-	-	-
Finland	NO	NO	NO	-	-	-	-	-
France	14 806	3 979	4 140	27.8 %	161	4 %	- 10 666	- 72 %
Germany	18 805	3 848	3 778	25.3 %	- 70	- 2 %	- 15 026	- 80 %
Greece	NO	NO	NO	-	-	-	-	-
Ireland	NO	NO	NO	-	-	-	-	-
Italy	4 579	6 882	6 417	43.0 %	- 465	- 7 %	1 838	40 %
Luxembourg	0	0	0	0.0 %	0	-	0	-
Netherlands	NO	NO	NO	-	-	-	-	-
Portugal	NO	NO	NO	-	-	-	-	-
Spain	NO	NO	NO	-	-	-	-	-
Sweden	NO	NO	NO	-	-	-	-	-
United Kingdom	25 136	656	582	3.9 %	- 74	- 11 %	- 24 555	- 98 %
EU-15	63 326	15 365	14 917	100.0 %	- 448	- 3 %	- 48 409	- 76 %

Table 4.13 Information on methods applied, activity data, emission factors for N₂O emissions from 2.B.3: 'Adipic acid production' for 1990 and 2003

Member State	Method applied	Activity data	Emission factor	Methodology comment	1990			2003				
					Activity data		N ₂ O emissions (Gg)	Activity data		N ₂ O emissions (Gg)		
					Description	(kt)		Description	(kt)			
France	C	PS	PS	Emission data obtained from industry on plant level (NIR 2004)	Adipic acid production	100	0.48	47.8	Adipic acid production	156	0.09	13.4
Germany		PS	PS, D	Estimates are based on PS data as well as calculated using nitric acid production and the IPCC default value for years before mid 90ies (NIR 2005)	Adipic acid production	C	C	60.7	Adipic acid production	C	C	12.2
Italy	D	PS	PS	Emission data obtained from industry on plant level (NIR 2004)	Adipic acid production	49	0.30	14.8	Adipic acid production	69	0.30	20.7
Sweden	NO	NO	NO			55	0.00			NO	NO	NO
UK				Emission data obtained from industry on plant level (NIR 2004)	Adipic acid production	265	0.31	81.1	Adipic acid production	189	0.01	1.9
EU-15					EU-15 w/o DE (>70%)	470	0.44	204		414	0.12	48

Abbreviations explained in the Chapter 'Units and abbreviations'.

reduction measures. The table also suggests that more than 95 % of EU-15 emissions are estimated with higher tier methods.

N₂O emissions from 2.B.3: 'Adipic acid production' account for 0.4 % of total EU-15 GHG emissions in 2003. Between 1990 and 2003, N₂O emissions from this source decreased by 76 % (Table 4.12). Italy is responsible for 43 % of these emissions in the EU-15 and it had increases in emissions from this source between 1990 and 2003. All other Member States that reported emissions from this source had large emissions reductions between 1990 and 2003 due to reduction measures in adipic acid production.

Table 4.13 shows information on methods applied, activity data, emission factors for N₂O emissions from 2.B.3: 'Adipic acid production' for 1990 to 2003. The table shows that in 2003 adipic acid was produced in four MS only. Three MS report adipic acid production as activity data; for Germany this information is confidential. The implied emission factors per tonne of adipic acid produced vary for 2003 between 0.01 for the UK and 0.3 for Italy. The EU-15 IEF (excluding Germany) is 0.12 t/t of adipic acid produced. With the exception of Italy the implied emission factors have been reduced substantially due to emission reduction measures. The table suggests that 100 % of

EU-15 emissions are estimated with higher tier methods.

N₂O emissions from 2.B.5: 'Other' account for 0.04 % of total EU-15 GHG emissions in 2003. Between 1990 and 2003, N₂O emissions from this source decreased by 65 % (Table 4.14). The Netherlands and France are responsible for 85 % of these emissions in the EU-15. Their decreases had the most influence on the reductions in the EU-15.

4.2.3 Metal production (CRF Source Category 2.C)

Table 4.15 summarises information by Member State on methodologies, emission factors, completeness and qualitative uncertainty estimates for CO₂ from 2.C: 'Metal production'. Between 1990 and 2003, CO₂ emission from 'Metal production' decreased by 9 %. The relative decrease was largest in Denmark, the relative growth was largest in Greece.

This source category includes one key source: CO₂ from 2.C.1: 'Iron and steel production'.

CO₂ emissions from 2.C.1: 'Iron and steel production' account for 0.4 % of total EU-15 GHG emissions in 2003. Between 1990 and 2003, CO₂ emissions from this source decreased by 9 % (Table 4.16). Austria and

Table 4.14 Member States' contributions to N₂O emissions from 2.B.5: 'Other'

Member State	Greenhouse gas emissions (Gg CO ₂ equivalents)			Share in EU-15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO ₂ equivalents)	(%)	(Gg CO ₂ equivalents)	(%)			
Austria	0	0	0	0.0 %	0	-	0	-			
Belgium	372	287	215	14.0 %	- 72	- 25 %	- 157	- 42 %	CS	PS	CS
Denmark	0	0	0	0.0 %	0	-	0	-	NE		
Finland	0	0	0	0.0 %	0	-	0	-	NO	NO	NO
France	2 767	646	345	22.5 %	- 301	- 47 %	- 2 422	- 88 %	C	PS	PS
Germany	6	6	6	0.4 %	0	-	0	-			
Greece	0	0	0	0.0 %	0	-	0	-			
Ireland	0	0	0	0.0 %	0	-	0	-			
Italy	0	0	0	0.0 %	0	-	0	-			
Luxembourg	0	0	0	0.0 %	0	-	0	-			
Netherlands	1 240	1 240	954	62.2 %	- 286	- 23 %	- 286	- 23 %	CS	PS, Q	CS
Portugal	0	0	0	0.0 %	0	4 %	0	101 %	D	NS, PS	CS
Spain	0	0	0	0.0 %	0	-	0	-			
Sweden	16	15	15	1.0 %	0	2 %	- 1	- 4 %	CS	PS	PS
United Kingdom	0	0	0	0.0 %	0	-	0	-	NO	NO	NO
EU-15	4 400	2 194	1 534	100.0 %	- 659	- 30 %	- 2 866	65 %			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.15 Member States' contributions to CO₂ emissions from 2.C: 'Metal production' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO ₂ equivalents)	GHG emissions in 2003 (Gg CO ₂ equivalents)	Methods applied ¹⁾	EF ¹⁾	Estimate ²⁾	Quality ²⁾
Austria	3 725	4 532	C, T2	D, CS, PS	ALL	M
Belgium	1 873	1 908	CS	CS		
Denmark	28	0				
Finland	0	0	NO	NO	IE	IE
France	4 519	3 512	C	CS	ALL	H
Germany	1 012	904	T3,CS	D,CS	All	H
Greece	435	657	T1	D	PART	
Ireland	0	0	NA	NA	NO	NA
Italy	2 205	1 810	D	C, CS	ALL	M
Luxembourg	850	263	C/D	C/D		
Netherlands	2 909	1 968	T2 (carbon inputs)/T1	CS	ALL	M
Portugal	29	26	D	D+C+CS	All	L
Spain	2 785	2 843	D,C	D,C,CS,PS	ALL	H
Sweden	2 266	2 533	T1,T2,CS	CS, PS	ALL	H
United Kingdom	2 304	1 844	T3/T2	CS	ALL	H
EU-15	24 939	22 800	C, CS, D, T1, T2, T3	C, CS, D, PS	ALL, IE, PART	H

(¹⁾ Information source: CRF Summary Table 3 for 2002.

(²⁾ Information source: CRF Table 7 for 2002.

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.16 Member States' contributions to CO₂ emissions from 2.C.1: 'Iron and steel production'

Member State	Greenhouse gas emissions (Gg CO ₂ equivalents)			Share in EU-15 emissions in 2003	Change 2002-2003		Change 1990-2003	
	1990	2002	2003		(Gg CO ₂ equivalents)	(%)	(Gg CO ₂ equivalents)	(%)
Austria	3 546	4 618	4 513	25.1 %	- 105	- 2 %	967	27 %
Belgium	1 873	1 930	1 908	10.6 %	- 21	- 1 %	36	2 %
Denmark	28	0	0	0.0 %	0	-	- 28	- 100 %
Finland	IE	IE	0	-	-	-	-	-
France	4 007	2 644	2 863	15.9 %	219	8 %	- 1 144	- 29 %
Germany	IE	IE	IE	-	-	-	-	-
Greece	203	443	399	2.2 %	- 43	- 10 %	197	97 %
Ireland	NE	NO	NO	-	-	-	-	-
Italy	1 346	1 348	1 384	7.7 %	36	3 %	37	3 %
Luxembourg	850	270	263	1.5 %	- 7	- 3 %	- 588	- 69 %
Netherlands	2 514	1 409	1 558	8.7 %	149	11 %	- 956	- 38 %
Portugal	27	21	23	0.1 %	3	14 %	- 3	- 12 %
Spain	1 835	1 853	1 697	9.4 %	- 156	- 8 %	- 139	- 8 %
Sweden	1 776	1 679	2 060	11.5 %	381	23 %	285	16 %
United Kingdom	1 853	643	1 316	7.3 %	673	105 %	- 538	- 29 %
EU-15	19 859	16 856	17 985	100.0 %	1 128	7 %	- 1 874	- 9 %

France are responsible for 51 % of these emissions in the EU-15. France had the largest decreases in absolute terms between 1990 and 2003 while the largest increases were in Austria.

Table 4.17 shows information on methods applied, activity data, emission factors for CO₂ emissions from 2.C.1: 'Iron and steel production' for 1990 and 2003. For 2.C.1 'Iron and steel production' it is not useful to

Table 4.17 Information on methods applied, activity data, emission factors for CO₂ emissions from 2.C.1: 'Iron and steel production' for 1990 and 2003

Member State	Method applied	Emission factor	1990				2003					
			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	T2	NS	PS/D	Iron and steel production	0	0.00	3 546	Iron and steel production	0	0.00	4 513	
				Total emission data (1A2a/2C1) reported by industry, split on the basis of national study.	Steel production	4 291	0.12	503	Steel production	6 275	0.11	685
				Iron production	3 444	0.88	3 043	Iron production	4 677	0.82	3 828	
				Sinter production	4 384	0.00	IE	Sinter production	3 528	0.00	IE	
				Coke production	1 725	0.00	IE	Coke production	1	0.00	IE	
				Other	0	0.00	0	Other	0	0.00	0	
Belgium	CS	PS	CS	Iron and steel production	0	0.00	1 873	Iron and steel production	0		1 908	
				Steel	7 621	0.12	946	Steel	7 700	0.09	675	
				Pig iron	9 415	0.06	546	Pig iron	7 704	0.07	538	
				Sinter	13 735	0.03	381	Sinter	12 676	0.05	686	
				Coke	IE	IE	IE	Coke	IE	IE	0	
				Other	0	0.00	0	Other	0	0.00	9	
				Use of electrodes	15 666	0.00	0	Use of electrodes	0	0.00	9	
Denmark	T2	PS	D	Iron and steel production	0	0.00	28	Iron and steel production	0	0.00	0	
				Steel	614	0.05	28	Steel	NO	0.00	NO	
				Pig Iron	NO	0.00	NO	Pig Iron	NO	0.00	NO	
				Sinter	NO	0.00	NO	Sinter	NO	0.00	NO	
				Coke	NO	0.00	NO	Coke	NO	0.00	NO	
				Other	0	0.00	0	Other	0	0.00	0	
Finland	IE	IE	IE	Iron and steel production	0	0.00	IE	Iron and steel production	0	0.00	0	
				The CO ₂ emissions from coke and residual fuel oil used in blast furnaces are allocated in metal production in the energy sector CRF 1.A.	Steel	NA	0.00	IE	Steel	NA	IE	IE
				Pig iron	NA	0.00	IE	Pig iron	NA	IE	IE	
				Sinter	NA	0.00	IE	Sinter	NA	IE	IE	
				Coke	487	0.00	IE	Coke	895	IE	IE	
				Other	0	0.00	0	Other	0	0.00	0	
France	C	AS, NS	CS	Iron and steel production	0	0.00	4 007	Iron and steel production	0	0.00	2 863	
				Steel	19 073	0.08	1 487	Steel	19 976	0.08	1 566	
				Pig iron	228 193	0.01	2 016	Pig iron	215 323	0.00	1 038	
				Sinter	22 000		IE	Sinter	19 389		IE	
				Coke	0	0.00	NO	Coke	0	0.00	NO	
				Other	0	0.00	504	Other	0	0.00	259	
				Rolling mills, blast furnace charging	16 848	0.03	504	Rolling mills, blast furnace charging	18 348	0.01	259	
Germany	T3, CS	NS	D, CS	Iron and steel production	NE	NE	0	Iron and steel production	NE	NE	0	
				Steel	43 915	NE	NE	Steel	44 809	NE	NE	
				Pig iron	32 263	NE	NE	Pig iron	29 481	NE	NE	
				Sinter	29 869	NE	NE	Sinter	26 811	NE	NE	
				Coke	NE	NE	NE	Coke	NE	NE	NE	
				Other	0	0.00	0	Other	0	0.00	0	
				Iron & Steel Foundries	4 450	NE	NE	Iron & Steel Foundries	3 858	NE	NE	
Greece	T2	NS	CS	Iron and steel production	0	0.00	203	Iron and steel production	0	0.00	399	
				Steel production in EAF	999	0.20	203	Steel production in EAF	1 701	0.23	399	
				Pig iron	NO	NO	NO	Pig iron	NO	NO	NO	
				Sinter	NO	NO	NO	Sinter	NO	NO	NO	
				Coke	NO	NO	NO	Coke	NO	NO	NO	
				Other	0	0.00	0	Other	0	0.00	0	

Member State	Method applied	Emission factor	1990					2003				
			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)				
Ireland	NE, NO	NE, NO	NE, NO	Iron and steel production	0	0.00	NE	Iron and steel production	0	0.00	0	
				Steel	0	0.00	NE	Steel	0	0.00	NO	
				Pig Iron	0	0.00	NE	Pig Iron	0	0.00	NO	
				Sinter	0	0.00	NE	Sinter	0	0.00	NO	
				Coke	0	0.00	NE	Coke	0	0.00	NO	
				Other	0	0.00	0	Other	0	0.00	0	
Italy	D	NS	C, CS	Iron and steel production	0	0.00	1 346	Iron and steel production	0	0.00	1 384	
				According to the NIR2004, emissions from blast furnaces are included in 1 A 2 (estimated using consumption data of blast furnace gas)	Steel	25 467	0.05	1 346	Steel	26 832	0.05	1 384
				Pig Iron	11 852	0.00	0	Pig Iron	10 123	0.00	0	
				Sinter	0	0.00	0	Sinter	0	0.00	0	
				Coke	0	0.00	0	Coke	0	0.00	0	
				Other	0	0.00	0	Other	0	0.00	0	
Netherlands	CS, T2	PS	PS, CS	Iron and steel production	5 162	0.49	2 514	Iron and steel production	6 590	0.24	1 558	
				Carbon input (coke) minus output (BFG, BOFGas) are reported as process emissions	Crude steel production	5 162	0.01	43	Crude steel production	6 590	0.01	55
				Pig iron	0	0.00	0	Pig iron	0	0.00	0	
				Sinter	0	NA	NA	Sinter	0	NA	NA	
				Coke see 1B1b	IE	IE	IE	Coke see 1B1b	IE	IE	IE	
				Other	0	0.00	2 471	Other	0	0.00	1 503	
				Coke a.o. inputs in blast-furnace (- BF and oxy-gas): carbon input	2 298	0.97	2 223	Coke a.o. inputs in blast-furnace (- BF and oxy-gas): carbon input	2 689	0.45	1 203	
Limestone use: limestone equiv. use	595	0.42	249	Limestone use: limestone equiv. use	718	0.42	300					
Portugal	T2	PS	D	Total steel production	316	0.08	27	Total steel production	1	26.82	23	
				According to the NIR2004, emissions from blast furnaces are included in 1 A 2 (estimated using consumption data of blast furnace gas)	Steel	IE	0.00		Steel	IE	0.00	
				Pig Iron	NO	0.00		Pig Iron	NO	0.00		
				Sinter	IE	0.00		Sinter	IE	0.00		
				Coke	IE	0.00		Coke	IE	0.00		
				Other	0	0.00	0	Other	0	0.00	0	
Spain	CS	AS, Q	CS, PS	Iron and steel production	0	0.00	1 835	Iron and steel production	0	0.00	1 697	
				Steel production	13 229	0.08	1 052	Steel production	15 719	0.07	1 150	
				Pig iron production	5 588	0.04	246	Pig iron production	3 837	0.07	268	
				Sinter production	6 947	0.08	538	Sinter production	4 999	0.06	278	
				Coke production	3 211	IE	IE	Coke production	2 711	IE	IE	
				Other	0	0.00	0	Other	0	0.00	0	
Sweden	CS, T1, T2	PS	CS, PS	Iron and steel production	0	0.00	1 776	Iron and steel production	0	0.00	2 060	
				Consumption of BFG reported as process emissions (including limestone use)	Steel: use of reducing agents	IE	0.00	IE	Steel: use of reducing agents	IE	IE	IE
				Pig iron: use of blast furnace gas, TJ	5 142	0.30	1 537	Pig iron: use of blast furnace gas, TJ	6 008	0.30	1 797	
				Sinter	IE	0.00	IE	Sinter	IE	IE	IE	
				Coke	IE	0.00	IE	Coke	IE	IE	IE	
				Other	0	0.00	238	Other	0	0.00	264	
				Steel production: coal/anthracite	18	2.89	53	Steel production: coal/anthracite	25	2.92	72	
				Steel production: coke	41	3.15	128	Steel production: coke	37	3.15	117	
				Steel production: electrodes	9	3.66	32	Steel production: electrodes	4	3.63	15	
Steel production: other	444	0.06	25	Steel production: other	1 490	0.04	60					

Member State	Method applied			1990			2003					
				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)			
UK	T2	AS	CS	Iron and steel production	0	0.00	1 853	Iron and steel production	0	0.00	1 316	
				Split follows energy balance	Steel production (EAF)	4 546	0.01	60	Steel production (EAF)	2 550	0.01	34
				final consumption of coke	Pig iron production (BF)	12 463	0.00	0	Pig iron production (BF)	10 229	0.00	0
				and blast furnace gas	Sinter	NA	0.00	NA	Sinter	NA	0.00	NA
				(excluding limestone use)	Coke consumed in blast furnaces	5 180	0.00	0	Coke consumed in blast furnaces	4 246	0.00	0
				Other	0	0.00	1 793	Other	0	0.00	1 282	
				Steel production (OC)	13 169	0.00	0	Steel production (OC)	10 630	0.00	0	
				Pig iron production (ISW)	12 463	0.00	0	Pig iron production (ISW)	10 188	0.00	0	
				Blast furnace gas flared (PJ)	7	273.87	1 793	Blast furnace gas flared (PJ)	5	257.35	1 282	

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 subcategory) is very different in different MS. It ranges from including all emissions in the energy sector (e.g. Finland, Portugal, Italy) to reporting all emissions related to carbon input in blast furnaces in the industrial processes sector (e.g. UK, Sweden) or using a split based on country-specific information (e.g. Austria).

Tables 4.18 to 4.20 summarise information by Member State on emission trends, methodologies, emission factors, completeness and qualitative uncertainty estimates for the key source PFCs from 2.C: 'Metal production'.

PFC emissions from 2.C.3 'Aluminium production' account for 0.1 % of total EU-15 GHG emissions in 2003. Between 1990 and 2003, PFC emissions from this source decreased by 73 %. The Netherlands and France are responsible for 57 % of these

Table 4.18 Member States' contributions to PFC emissions from 2.C: 'Metal production' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO ₂ equivalents)	GHG emissions in 2003 (Gg CO ₂ equivalents)	Methods applied ¹⁾	EF ¹⁾	Estimate ²⁾	Quality ²⁾
Austria	1 050	0	NA	NA	NA	NA
Belgium	0	0				
Denmark	0	0				
Finland	0	0	NO	NO	NO	NO
France	2 290	739	C/T2	PS	ALL	H
Germany	2 486	431	T3	CS	All	H
Greece	258	77	PS	PS	ALL	
Ireland	0	0	NA	NA	NO	NA
Italy	1 673	277	T1, T2	PS	ALL	M
Luxembourg	0	0				
Netherlands	2 097	1 204	CS/T2	M, PS		
Portugal	0	0			NO	
Spain	883	190	T2	T2	ALL	H
Sweden	440	282	T2	PS	ALL	H
United Kingdom	1 327	203	T2/PS	CS	ALL	M
EU-15	12 504	3 403	C,CS,PS,T1,T2,T3	C, CS, PS, T3a	ALL	H

(¹) Information source: CRF Summary Table 3 for 2002.

(²) Information source: CRF Table 7 for 2002.

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.19 Member States' contributions to PFC emissions from 2.C:3 'Aluminium production'

Member State	Greenhouse gas emissions (Gg CO ₂ equivalents)			Share in EU-15 emissions in 2003	Change 2002-2003		Change 1990-2003	
	1990	2002	2003		(Gg CO ₂ equivalents)	(%)	(Gg CO ₂ equivalents)	(%)
Austria	1 050	NO	NO	-	-	-	- 1 050	- 100 %
Belgium	NO	NO	NO	-	-	-	-	-
Denmark	NO	NO	NO	-	-	-	-	-
Finland	NO	NO	NO	-	-	-	-	-
France	2 290	973	739	21.7 %	- 234	- 24 %	- 1 551	- 68 %
Germany	2 486	431	431	12.7 %	0	0 %	- 2 055	- 83 %
Greece	258	88	77	2.3 %	- 11	- 12 %	- 180	- 70 %
Ireland	NO	NO	NO	-	-	-	-	-
Italy	1 673	199	277	8.1 %	78	39 %	- 1 397	- 83 %
Luxembourg	0	0	0	0.0 %	0	-	0	-
Netherlands	2 097	1 249	1 204	35.4 %	- 45	- 4 %	- 893	- 43 %
Portugal	NO	NO	NO	-	-	-	-	-
Spain	883	199	190	5.6 %	- 9	- 4 %	- 693	- 78 %
Sweden	440	283	282	8.3 %	- 1	0 %	- 158	- 36 %
United Kingdom	1 327	209	203	6.0 %	- 6	- 3 %	- 1 123	- 85 %
EU-15	12 504	3 631	3 403	100.0 %	- 227	- 6 %	- 9 101	- 73 %

Table 4.20 Information on methods applied, activity data, emission factors for PFC emissions from 2.C. 'Metal production' for 1990 and 2003

Member State	Method applied	Activity data	Emission factor	Methodology comment	Gas	1990				2003			
						Activity data	Implied emission factor (kg/t)	Emissions (t)	Description	Activity data	Implied emission factor (kg/t)	Emissions (t)	
													Description
Austria	C	NS	PS	Data is obtained from industry (methodology is equivalent to IPCC T2)	CF ₄	Aluminium production	88 021	1.56	137	Aluminium production	NO		
					C ₂ F ₆	Aluminium production	88 021	0.19	17	Aluminium production	NO		
France	C	NS	PS	Data is obtained from industry (methodology is equivalent to IPCC T2)	CF ₄	Aluminium production	325 900	0.95	309	Aluminium production	444 852	0.22	100
					C ₂ F ₆	Aluminium production	325 900	0.09	31	Aluminium production	444 852	0.02	10
Germany	T3	NS	CS	A CS EF is derived from PS data for 1996 and 2001; (NIR2005)	CF ₄	Anode effects	NE	NE	NE	Anode effects	654 502	0.0001	58
					C ₂ F ₆	Anode effects	NE	NE	NE	Anode effects	654 502	0.00	6
Greece	T3b	PS	PS	Estimates are provided by industry based on measurements according to the PESHINEY methodology (NIR 2005)	CF ₄	Aluminium production	C	C 35		Aluminium production	C	C	10
					C ₂ F ₆	Aluminium production	C	C 3		Aluminium production	C	C	1

Member State	Method applied	Activity data	Emission factor	Methodology comment	Gas	1990				2003			
						Activity data		Implied emission factor (kg/t)	Emissions (t)	Activity data		Implied emission factor (kg/t)	Emissions (t)
						Description	(t)			Description	(t)		
Italy	T1, T2	PS	PS	For 1990-1999 default Efs have been used, for the years after PS was used. (NIR 2004)	CF ₄	Aluminium production	231 800	0.86	198	Aluminium production	191 663	0.19	36
					C ₂ F ₆	Aluminium production	231 800	0.18	42	Aluminium production	191 663	0.02	5
Netherlands	T2, T3	PS	PS	Data is obtained from industry using Tier 2 methodology and emission factors based on measured data (NIR 2005)	CF ₄	Aluminium production	272 122	0.00	281	Aluminium production	282 999	0.001	162
					C ₂ F ₆	Aluminium production	272 122	0.00	29	Aluminium production	282 999	0.0001	16
Spain	T2	Q	PS	Activity data and parameters for estimating emissions have been obtained by industry (NIR 2005)	CF ₄	Aluminium production	C	C	122	Aluminium production	C	C	26
					C ₂ F ₆	Aluminium production	C	C	10	Aluminium production	C	C	2
Sweden	T2	PS	PS	Plant specific data is used to estimate emissions, for years before 1995 IEFs were used to calculate emission or expert judgement was used (NIR 2005)	CF ₄	Aluminium production	96 300	0.61	59	Aluminium production	101 231	0.37	38
					C ₂ F ₆	Aluminium production	96 300	0.07	7	Aluminium production	101 231	0.04	4
UK	T2	PS	CS	Estimates are based on actual emissions data provided by industry using Tier 2 methodology (NIR 2005)	CF ₄	Aluminium production	289 796	0.68	196	Aluminium production	342 748	0.09	30
					C ₂ F ₆	Aluminium production	IE	0.00	IE	Aluminium production	IE	0.00	IE
EU-15					Average SE/NL/IT/FR (about 75% of emissions)	CF₄	926 122	0.91	846	1020745	0.33	335	
					Average SE/NL/IT/FR	C₂F₆	926 122	0.12	109	1020745	0.03	35	

Abbreviations explained in the Chapter 'Units and abbreviations'.

emissions in the EU-15. All Member States reduced their emissions from this source between 1990 and 2003. Germany had the largest decreases in absolute terms.

Table 4.20 shows information on methods applied, activity data, emission factors for PFC emissions from 2.C. 'Metal production'

for 1990 to 2003. The table shows that in 2003 aluminium production was reported by most MS as activity data; for some MS this information is confidential. The implied emission factors for CF₄ per tonne of aluminium produced vary for 2003 between 0.001 kg/t for the Netherlands and 0.37 kg/t for Sweden. The EU-15 IEF

Table 4.21 Member States' contributions to HFC emissions from 2.E: 'Production of halocarbons and SF₆' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO ₂ equivalents)	GHG emissions in 2003 (Gg CO ₂ equivalents)	Methods applied ¹⁾	EF ¹⁾	Estimate ²⁾	Quality ²⁾
Austria	NO	NO	NA	NA	NO	NO
Belgium	0	0				
Denmark	0	0	NO		NO	
Finland	0	0	NO	NO	NO	NO
France	3 605	364	CS	CS/PS	ALL	M
Germany	3 510	1 212	T1	CS		H
Greece	935	3 195	T1	D	ALL	
Ireland	0	0	NA	NA	NO	NA
Italy	351	23	CS	PS	ALL	M
Luxembourg	0	0				
Netherlands	4 432	560	CS/T2	PS	ALL	M
Portugal	0	0			NE	
Spain	2 403	1 710	D,T2,CS	D,T2,PS	ALL	H
Sweden	NO	NO	NO	NO	NO	
United Kingdom	11 374	2 191	T2/PS	CS	ALL	M
EU-15	26 610	9 254	CS, D, PS, T1, T2	C, CS, D, PS, T2	ALL, NE	M

(¹) Information source: CRF Summary Table 3 for 2002.

(²) Information source: CRF Table 7 for 2002.

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.22 Member States' contributions to HFC emissions from 2.E: 'Production of halocarbons and SF₆'

Member State	Greenhouse gas emissions (Gg CO ₂ equivalents)			Share in EU-15 emissions in 2003	Change 2002-2003		Change 1990-2003	
	1990	2002	2003		(Gg CO ₂ equivalents)	(%)	(Gg CO ₂ equivalents)	(%)
Austria	NO	NO	NO	-	-	-	-	-
Belgium	NO	NO	NO	-	-	-	-	-
Denmark	NO	NO	NO	-	-	-	-	-
Finland	NO	NO	NO	-	-	-	-	-
France	3 605	509	364	3.9 %	- 146	- 29 %	- 3 241	- 90 %
Germany	3 510	1 212	1 212	13.1 %	0	0 %	- 2 298	- 65 %
Greece	935	3 195	3 195	34.5 %	0	0 %	2 260	242 %
Ireland	NO	NO	NO	-	-	-	-	-
Italy	351	21	23	0.2 %	2	8 %	- 328	- 94 %
Luxembourg	0	0	0	0.0 %	-	-	0	-
Netherlands	4 432	782	560	6.1 %	- 222	- 28 %	- 3 872	- 87 %
Portugal	NO	NO	NO	-	-	-	-	-
Spain	2 403	1 171	1 710	18.5 %	539	46 %	- 693	- 29 %
Sweden	NO	NO	NO	-	-	-	-	-
United Kingdom	11 374	2 292	2 191	23.7 %	- 101	- 4 %	- 9 183	- 81 %
EU-15	26 610	9 182	9 254	100.0 %	73	1 %	- 17 355	- 65 %

(average of Sweden, Netherlands, Italy and France) is 0.33 kg/t. The decrease of the IEF from 1990 to 2003 is mainly due to emission reduction measures that have been implemented. The table suggests that more 100 % of EU-15 emissions are estimated

with higher tier methods. The implied emission factors for C2F₆ per tonne of aluminium produced vary for 2003 between 0.0001 kg/t for the Netherlands and 0.04 kg/t for Sweden. The EU-15 IEF (average of Sweden, Netherlands, Italy and France) is

0.03 kg/t. The table suggests that for 2003 all reported emissions are estimated using higher tier methods (based on plant specific data). For 1990 Italy used a T1 approach to estimate emissions.

4.2.4 Production of halocarbons and SF₆ (CRF Source Category 2.E)

Tables 4.21 to 4.23 summarise information by Member State on emission trends, methodologies, emission factors, completeness and qualitative uncertainty estimates for the key source HFCs from 2.E: 'Production of halocarbons and SF₆'.

HFC emissions from 2.E: 'Production of halocarbons and SF₆' account for 0.2 % of total EU-15 GHG emissions in 2003. Between 1990 and 2003, HFC emissions from this source decreased by 65 %. Greece and the United Kingdom are responsible for 58 % of these emissions in the EU-15. Greece was the only Member State with emission increases from this source between 1990 and 2003.

Table 4.23 shows information on methods applied, activity data, emission factors for HFC emissions from 2.E: 'Production of halocarbons and SF₆' for 1990 and 2003. For production of halocarbons, it is not possible to

Table 4.23 Information on methods applied, activity data, emission factors for HFC emissions from 2.E. 'Production of halocarbons and SF₆' for 1990 and 2003

Member State	Method applied	Activity data	Emission factor	Methodology comment	Gas	1990						2003		
						Activity data			Implied emission factor (kg/t)	Emissions (t)	Activity data		Implied emission factor (kg/t)	Emissions (t)
						Description	(t)	Description			(t)			
France	C	PS	PS	Emissions reported by industry (NIR2004)	By-product emissions	HFC-23	HCFC-22 production	C	0.00	140.1	HCFC-22 production	C	0.00	20.8
						Fugitive emissions	HFC-125	HFC production	C	0.00	8.8	HFC production	C	0.00
	C	PS	PS	Emissions reported by industry (NIR2004)	Fugitive emissions	HFC-134a	HFC production	C	0.00	8.8	HFC production	C	0.00	10.4
						HFC-143a	HFC production	C	0.00	508.0	HFC production	C	0.00	21.1
						HFC-152a	HFC production	C	0.00	0.0	HFC production	C	0.00	0.0
						HFC-365mfc	HFC production	C	0.00	0.0	HFC production	C	0.00	2.3
Germany	T1	CS	Emission data are reported by industry (NIR2005)	By-product emissions	HFC-23	HCFC-22 production	NE	NE	NE	HCFC-22 production	30 000	0.0033	100.0	
					Fugitive emissions	HFC-227ea	Destillation	NE	NE	NE	Destillation	C	C	C
					Fugitive emissions	HFC-23	Production	NE	NA	NA	Production	C	NA	NA
					Fugitive emissions	HFC-134a	Production	NE	NE	NE	Production	C	C	C
Greece	T1	PS	D	Emission estimates based on production statistics and a reference emission factor (NIR 2005)	By-product emissions	HFC-23	HCFC-22 production	C	C	79.9	HCFC-22 production	C	C	273.0
						Fugitive emissions	0	NO	NO	NO	NO	NO	NO	NO
Italy	CS	PS	PS	Emissions reported by industry (NIR2004)	By-product emissions	HFC-23	HCFC-22 production	0	0.00	30.0	HCFC-22 production	0	0.00	0.0
						Fugitive emissions	0	0.00	0.0	0	0.00	0.0		

Member State	Method applied	Activity data	Emission factor	Methodology comment	Gas	1990					2003				
						Activity data			Implied emission factor (kg/t)	Emissions (t)	Activity data			Implied emission factor (kg/t)	Emissions (t)
						Description	(t)	Description			(t)				
Netherlands	CS/T2	Q	PS	For estimating HFC-23 emissions from HCFC-22 manufacture Tier 2 method is used (NIR 2005)	By-product emissions	HFC-23	HCFC-22 production	C	C	378.8	HCFC-22 production	C	C	39.4	
					Fugitive emissions	HFCs		0	NO	NO	0	NO	NO		
Spain	D, T2, CS	Q	D, T2, PS	Emissions are estimated using a combined T1/T2 approach (NIR 2005)	By-product emissions	HFC-23	HCFC-22 production	7619	0.03	205.4	HCFC-22 production	C	C	134.4	
					Fugitive emissions	HFC-143a		0	0.00	0.0	Production of HFC-143a	C	C	18.6	
					Fugitive emissions	HFC-227ea		0	0.00	0.0	Production of HFC-227ea	C	C	6.3	
					Fugitive emissions	HFC-32		0	0.00	0.0	Production of HFC-32	C	C	0.7	
					Fugitive emissions	HFC-23		0	0.00	0.0	Production of HFC-32	C	C	4.1	
UK	T2	PS	CS	HFC emissions from HCFC-22 production are estimated from reported data from the manufacturers (NIR 2004)	By-product emissions	HFC-23	HCFC-22 production	IE	0.00	IE	HCFC-22 production	IE	0.00	IE	
					Other	All HFCs	HFC production	24 375	39.91	972.8	HFC production	33 538	7.13	239.1	
					Fugitive emissions	All HFCs	IE	IE	0.00	IE	IE	IE	0.00	IE	

Abbreviations explained in the Chapter 'Units and abbreviations'.

give an average IEF for the EU-15 because for most countries activity data are confidential. Except for Greece, all reported emissions are estimated with higher tier methods.

4.2.5 Consumption of halocarbons and SF₆ (CRF Source Category 2.F)

Tables 4.24 to 4.26 summarise information by Member State on emission trends, methodologies, emission factors, completeness and qualitative uncertainty estimates for the key source HFCs from 2.F: 'Consumption of halocarbons and SF₆'.

HFC emissions from 2.F: 'Consumption of halocarbons and SF₆' account for 1.0 % of total EU-15 GHG emissions in 2003. HFC emissions in 2003 were 74 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, the UK and Italy had the most significant absolute increases from this source between 1990 and 2003.

Table 4.26 shows the subcategories of HFC emissions from 2.F. 'Consumption of halocarbons and SF₆' by Member State (more analysis added after 15 March). It shows that 'Refrigeration and air conditioning equipment' is by far the largest subcategory accounting for 72 % of HFC emissions in Source Category 2.F. 'Aerosols/metered dose inhalers' and foam blowing account for 13 and 9 %, respectively. Note that subcategories in this source do not fully add up to category totals because of confidentiality reasons for Germany.

Tables 4.27 and 4.28 summarise information by Member State on emission trends, methodologies, emission factors, completeness and qualitative uncertainty estimates for the key sources from 2.F: 'Consumption of halocarbons and SF₆'.

Table 4.24 Member States' contributions to HFC emissions from 2.F: 'Consumption of halocarbons and SF₆' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO ₂ equivalents)	GHG emissions in 2003 (Gg CO ₂ equivalents)	Methods applied ¹⁾	EF ¹⁾	Estimate ²⁾	Quality ²⁾
Austria	219	1 308	CS	CS	ALL	M
Belgium	255	1 322				
Denmark	0	695	M/CS	CS	ALL	M
Finland	0	652	T2, T1a & T1b	D	ALL	H
France	28	11 048	CS/T2/M	CS	ALL	M
Germany	NE	7 035	M,T2	CS, D, M	ALL	H
Greece	0	945	T2a	D	PART	
Ireland	0	288	T2	D, CS	Full	M
Italy	0	4 553	T2a, CS	D, CS, PS	ALL	M
Luxembourg	43	43	C/D	C/D		
Netherlands	0	890	CS/T2	CS, D	ALL	M
Portugal	0	62	D	D + CS	Part	L
Spain	0	3 253	D, T2, CS	D, T2, PS	ALL	L
Sweden	4	471	T2	CS, D, PS	ALL	M
United Kingdom	2	8 508	T2	D/CS	ALL	H
EU-15	550	41 075	C, CS, D, M, T1a, T1b, T2, T2a	C, CS, D, M, PS, T2	ALL, PART	M

(¹⁾ Information source: CRF Summary Table 3 for 2002.

(²⁾ Information source: CRF Table 7 for 2002.

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.25 Member States' contributions to HFC emissions from 2.F: 'Consumption of halocarbons and SF₆'

Member State	Greenhouse gas emissions (Gg CO ₂ equivalents)			Share in EU-15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO ₂ equivalents)	(%)	(Gg CO ₂ equivalents)	(%)			
Austria	219	1 219	1 308	3.2 %	89	7 %	1 089	497 %	CS	Q	CS
Belgium	255	1 148	1 322	3.2 %	174	15 %	1 067	418 %	T2, CS	AS, PS	CS
Denmark	0	672	695	1.7 %	23	3 %	695	-	T2	AS, Q	CS
Finland	0	463	652	1.6 %	189	41 %	652		T1a, T1b, T2	Q	D
France	28	9 393	11 048	26.9 %	1 655	18 %	11 021		C, M, T2	NS, AS, PS, Q	CS, D, PS
Germany	NE	7 035	7 035	17.1 %	0	0 %	-	-	M, T2		CS, D, M
Greece	0	814	945	2.3 %	131	16 %	945	-	T2a	Q	D
Ireland	0	253	288	0.7 %	35	14 %	288	-	T2	PS, NS	D, CS
Italy	0	3 539	4 553	11.1 %	1 013	29 %	4 553	-	T2a, CS	AS, PS	CS, D, PS
Luxembourg	43	43	43	0.1 %	0	0 %	0	0 %			
Netherlands	0	784	890	2.2 %	106	13 %	890	-	CS, T2	Q	CS
Portugal	0	49	62	0.2 %	13	27 %	62	-	T2a	NS, AS	D
Spain	0	2 722	3 253	7.9 %	531	20 %	3 253	-	D, T2, CS	AS, Q	D, T2, PS
Sweden	4	462	471	1.1 %	9	2 %	467		T2	CS, PS, NS	CS, D, PS
UK	2	8 127	8 508	20.7 %	382	5 %	8 507		T2	AS, Q	D, CS
EU-15	550	36 724	41 075	100.0 %	4 351	12 %	40 524				

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.26 Member States' sub-categories of HFC emissions from 2.F: 'Consumption of halocarbons and SF₆' for 2003 (Gg CO₂ equivalents)

Member State	Consumption of Halocarbons and SF ₆	Refrigeration and Air Conditioning Equipment	Foam Blowing	Fire Extinguishers	Aerosols/ Metered Dose Inhalers	Solvents	Semiconductor Manufacture	Electrical Equipment	Other (please specify)
Austria	1 308	463	815	26	NO	NO	4	NO	NO
Belgium	1 322	1 054	108	39	121	0	0	NO	0
Denmark	695	557	129	0	10	0	0	0	0
Finland	652	561	24	0	0	0	0	NO	67
France	11 048	8 551	649	100	1 516	219	13	0	0
Germany	7 035	4 875	1 492	6	648	C	C	NO	NO
Greece	945	945	0	0	0	0	0	NE	0
Ireland	288	236	12	12	25	0	4	0	0
Italy	4 553	4 263	58	38	186	0	9	0	0
Luxembourg	43	34	6	0	3	0	0	0	0
Netherlands	890	775	0	0	115	0	0	NO	0
Portugal	62	40	22	0	0	0	0	0	0
Spain	3 253	1 970	0	1 121	162	0	0	0	0
Sweden	471	340	97	6	28	0	0	NA	NA
United Kingdom	8 508	4 952	406	356	2 669	21	NO	NO	104
EU-15	41 075	29 615	3 817	1 704	5 483	241	30	0	171

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.27 Member States' contributions to SF₆ emissions from 2.F: 'Consumption of halocarbons and SF₆' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO ₂ equivalents)	GHG emissions in 2003 (Gg CO ₂ equivalents)	Methods applied ¹⁾	EF ¹⁾	Estimate ²⁾	Quality ²⁾
Austria	249	594	CS	CS	ALL	M
Belgium	103	75				
Denmark	13	31	M/CS	CS	ALL	M
Finland	94	42	T2, T1a & T1b	D	ALL	H
France	1 060	846	CS/T2	CS	ALL	M
Germany	3 728	2 564	M,CS,T1,T2	D,CS	All	H
Greece	3	3				
Ireland	113	100	T2	D, CS	Full	M
Italy	213	350	T3c, CS	CS, PS	ALL	M
Luxembourg	4	4	C/D	C/D		
Netherlands	217	334	T2	PS,CS,D	PART	L
Portugal	0	7	D	CS	All	M
Spain	67	296	CS,T2	CS,T2	ALL	M
Sweden	83	31	T2, CS	CS, D, PS	ALL	M
United Kingdom	604	651	T2	CS	ALL	H
EU-15	6 553	5 930	C,CS,D,M,T1, T1a,T1b,T2,T3c	C, CS, D, PS, T2	ALL, PART	H

(¹⁾ Information source: CRF Summary Table 3 for 2002.

(²⁾ Information source: CRF Table 7 for 2002.

Abbreviations explained in the Chapter 'Units and abbreviations'.

SF₆ emissions from 2.F: 'Consumption of halocarbons and SF₆' account for 0.1 % of total EU-15 GHG emissions in 2003. Between 1990 and 2003, SF₆ emissions from

this source decreased by 10 %. Germany and France are responsible for 58 % of total EU-15 emissions from this source. In absolute terms, Germany had also the

Table 4. 28 Member States' contributions to SF₆ emissions from 2.F: 'Consumption of halocarbons and SF₆'

Member State	Greenhouse gas emissions (Gg CO ₂ equivalents)			Share in EU-15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO ₂ equivalents)	(%)	(Gg CO ₂ equivalents)	(%)			
	Austria	249	633		594	10.0 %	- 40	- 6 %			
Belgium	103	94	75	1.3 %	- 19	- 20 %	- 28	- 27 %	T2, CS	AS, PS	CS
Denmark	13	25	31	0.5 %	6	25 %	18	134 %	T2	AS, Q	CS
Finland	94	51	42	0.7 %	- 10	- 19 %	- 53	- 56 %	T1a, T1b, T2	Q	D
France	1 060	828	846	14.3 %	18	2 %	- 214	- 20 %	C, T2	AS	CS
Germany	3 728	2 564	2 564	43.2 %	0	0 %	- 1 164	- 31 %	M, CS, T1, T2		D, CS
Greece	3	3	3	0.1 %	0	0 %	0	0 %			
Ireland	113	71	100	1.7 %	29	41 %	- 13	- 11 %	T2	PS, NS	D, CS
Italy	213	338	350	5.9 %	12	4 %	137	64 %	CS, T3c	PS, AS	PS, CS
Luxembourg	4	4	4	0.1 %	0	0 %	0	0 %			
Netherlands	217	359	334	5.6 %	- 24	- 7 %	117	54 %	T2	AS	CS
Portugal	0	7	7	0.1 %	0	7 %	7	-	T2a	PS	PS
Spain	67	255	296	5.0 %	41	16 %	229	341 %	CS, T2	AS, Q	CS, T2
Sweden	83	35	31	0.5 %	- 4	- 11 %	- 52	- 62 %	T2, CS	CS	CS, D, PS
United Kingdom	604	662	651	11.0 %	- 11	- 2 %	47	8 %	T2	AS, Q	CS
EU-15	6 553	5 929	5 930	100.0 %	0	0 %	- 624	- 10 %			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.29 EU-15 uncertainty estimates for the sector 'Industrial processes'

Source category	Gas	Emissions 2003 1)	Emissions for which MS uncertainty estimates are available 2)	Share of emissions for which MS uncertainty estimates are available	Uncertainty estimates based on MS uncertainty estimates
2.A.1 Cement production	CO ₂	81 631	79 120	97 %	4 %
2.A.2 Lime production	CO ₂	17 510	13 796	79 %	13 %
2.A.3 Limestone and dolomite use	CO ₂	8 017	6 098	76 %	5 %
2.A.4 Soda ash production and use	CO ₂	2 160	736	34 %	12 %
2.A.7 Other	CO ₂	4 571	2 105	46 %	15 %
2.B Chemical industry	CO ₂	14 529	7 517	52 %	7 %
2.C Metal production	CO ₂	22 800	12 917	57 %	8 %
2.G Other	CO ₂	715	3 865	540 %	11 %
2.B Chemical industry	CH ₄	803	456	57 %	134 %
2.C Metal production	CH ₄	123	162	132 %	37 %
2.G Other	CH ₄	45	54	120 %	45 %
2.B Chemical industry	CH ₄	45 451	44 944	99 %	20 %
2.E Production of halocarbons and SF ₆	HFC	9 254	5 116	55 %	49 %
2.F Consumption of halocarbons and SF ₆	HFC	41 075	39 986	97 %	26 %
2.C Metal production	PFC	3 403	3 398	100 %	9 %
2.F Consumption of halocarbons and SF ₆	PFC	1 903	1 029	54 %	41 %
2.C Metal production	SF ₆	3 035	3 986	131 %	33 %
2.F Consumption of halocarbons and SF ₆	SF ₆	5 930	4 867	82 %	60 %
Total	all	265 030	230 150	87 %	6 %

(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 countries 2002 data and for Belgium 2001 data.

Table 4.30 Recalculations of total greenhouse gas emissions and recalculations of greenhouse gas emissions in CRF Sector 2: 'Industrial processes', for 1990 and 2002 by gas (Gg and percentage)

	CO ₂		CH ₄		N ₂ O		HFCs		PFCs		SF ₆	
	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent
1990												
Total emissions and removals	- 122 396	- 3.8 %	- 9 539	- 2.1 %	16 013	4.1 %	200	0.7 %	- 276	- 1.7 %	125	1.2 %
Industrial Processes	7 452	5.1 %	498	90.4 %	1 897	1.8 %	200	0.7 %	- 276	- 1.7 %	125	1.2 %
2002												
Total emissions and removals	- 165 492	- 5.1 %	- 7 491	- 2.1 %	8 640	2.6 %	- 3 682	- 7.4 %	279	5.2 %	406	4.4 %
Industrial Processes	11 393	8.2 %	514	122.6 %	1 103	2.5 %	- 3 682	- 7.4 %	279	5.2 %	406	4.4 %

Table 4.31 Contribution of Member States to EU-15 recalculations in CRF Sector 2: 'Industrial processes' for 1990 and 2002 by gas (difference between latest submission and previous submission Gg of CO₂ equivalents)

	1990						2002					
	CO ₂	CH ₄	N ₂ O	HFCs	PFCs	SF ₆	CO ₂	CH ₄	N ₂ O	HFCs	PFCs	SF ₆
Austria	55	1	0	215	116	- 15	718	- 1	0	186	62	- 36
Belgium	- 126	0	0	0	0	0	- 298	0	- 227	- 357	0	0
Denmark	16	0	0	0	0	0	6	0	0	0	0	3
Finland	171	0	0	0	0	0	266	0	0	0	0	0
France	232	- 51	0	5	0	0	254	- 46	1	- 41	- 5	0
Germany	- 541	332	6	0	- 70	72	71	356	780	0	0	416
Greece	- 921	0	0	0	0	3	363	0	- 165	10	0	3
Ireland	0	0	0	- 21	- 75	30	0	0	0	0	0	0
Italy	111	- 13	938	0	0	0	1 023	- 59	1	- 3 545	0	- 22
Luxembourg	0	0	0	0	0	0	0	0	0	0	0	0
Netherlands	6 462	228	954	0	- 301	0	4 792	262	714	- 6	216	15
Portugal	134	0	0	0	0	0	1 120	0	0	0	0	0
Spain	2 587	1	0	0	55	11	2 957	2	- 8	- 4	7	16
Sweden	240	0	0	0	0	24	211	0	0	76	0	10
UK	- 969	- 1	0	0	0	0	- 90	0	8	0	0	0
EU-15	7 452	498	1 897	200	- 276	125	11 393	514	1 103	- 3 682	279	406

Table 4.32 Main reasons for the most important recalculations in CRF sector 2 'Industrial processes'

NL	CO ₂	2.B, 2.C: Method: now partly based on NEU from energy statistics; activity data: improved data; emission factors: improved data
ES	CO ₂	2.A: See Tables 10.1 and 10.2
IT	HFCs	2.F: Emission factor for 2002 has been corrected

most significant decreases from this source between 1990 and 2003.

4.3 Methodological issues and uncertainties

The previous section presented for each EU-15 key source in CRF Sector

2 an overview of the Member States' contributions to the key source in terms of level and trend, information on methodologies, emission factors, completeness and qualitative uncertainty estimates. Detailed information on national methods and circumstances is available in the Member States' national inventory reports.

Table 4.29 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 uncertainty was estimated for CH₄ from 2.B and the lowest for CO₂ from 2.A.1. For a description of the Tier 1 uncertainty analysis carried out for the EU-15, see Chapter 1.7.

4.4 Sector-specific quality assurance and quality control

There are no sector-specific QA/QC procedures for this sector.

4.5 Sector-specific recalculations

Table 4.30 shows that in the industrial processes sector the largest recalculations in

absolute terms were made for CO₂. Largest recalculations in relative terms were made for CH₄.

Table 4.31 provides an overview of Member States' contributions to EU-15 recalculations. The Netherlands had the most influence on the CO₂ recalculations, Germany on CH₄ recalculations and the Netherlands on N₂O recalculations. For HFCs, Italy made the largest contribution to recalculations in 2002, for PFCs the Netherlands contributed the most and for SF₆ it was Germany.

Explanations for most recalculations of more than 1 000 Gg of CO₂ equivalents are given in Table 4.32. Reasons for other recalculations are provided in Section 10.1.

5 Solvent and other product use (CRF Sector 3)

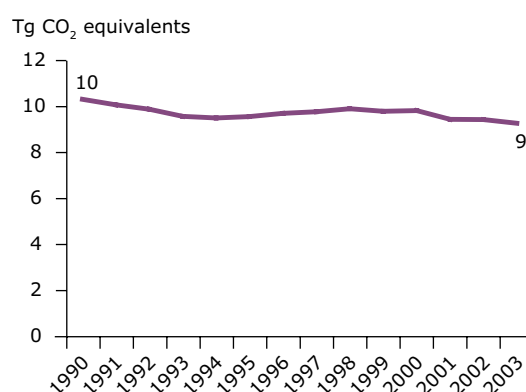
This chapter provides two short sections on emission trends and on recalculations in CRF Sector 3 'Solvent and other product use'. No section on methodological issues and uncertainty is included in this chapter because the sector does not contain an EU-15 key source (17). Neither is included in a section on sector-specific QA/QC as no such activities are performed in this sector.

5.1 Overview of sector

CRF Sector 3 'Solvent and other product use' contributes 0.2 % to the total EU-15 GHG emissions. The most important GHG from 'Solvent and other product use' is CO₂ (0.13 % of the total GHG emissions). The emissions from this sector decreased by 10 % from 10 Tg to 9 Tg in 2003 (Figure 5.1). In 2003, the emissions decreased by 1.7 % compared to 2002.

This sector does not contain any key source. The Member States Italy, Germany and Spain are responsible for 62 % of the total emissions in this sector (Table 5.1).

Figure 5.1 EU-15 GHG emissions for 1990–2003 from CRF Sector 3: 'Solvent and other product use' in CO₂ equivalents (Tg)



5.2 Methodological issues and uncertainties

This sector does not contain any key source; therefore, no additional overview information on methodologies and qualitative uncertainty estimates is provided.

Table 5.1 Member States' contributions to greenhouse gas emissions from CRF Sector 3: 'Solvent and other product use'

Member State	Greenhouse gas emissions (Gg CO ₂ equivalents)			Share in EU-15 emissions in 2003	Change 2002–2003		Change 1990–2003	
	1990	2002	2003		(Gg CO ₂ equivalents)	(%)	(Gg CO ₂ equivalents)	(%)
Austria	515	426	426	4.6 %	0	0 %	- 89	- 17 %
Belgium	253	253	253	2.7 %	0	0 %	0	0 %
Denmark	317	151	206	2.2 %	54	36 %	- 111	- 35 %
Finland	62	44	40	0.4 %	- 4	- 9 %	- 22	- 36 %
France	1 934	1 537	1 428	15.4 %	- 109	- 7 %	- 505	- 26 %
Germany	1 922	1 922	1 922	20.7 %	0	0 %	0	0 %
Greece	170	155	156	1.7 %	1	0 %	- 14	- 8 %
Ireland	92	109	111	1.2 %	2	1 %	19	21 %
Italy	2 544	2 250	2 180	23.5 %	- 70	- 3 %	- 363	- 14 %
Luxembourg	12	9	9	0.1 %	0	0 %	- 2	- 21 %
Netherlands	541	249	250	2.7 %	2	1 %	- 291	- 54 %
Portugal	220	312	318	3.4 %	6	2 %	98	45 %
Spain	1 329	1 716	1 672	18.0 %	- 44	- 3 %	343	26 %
Sweden	411	303	305	3.3 %	3	1 %	- 105	- 26 %
United Kingdom	0	0	0	0.0 %	0	-	0	-
EU-15	10 321	9 437	9 277	100.0 %	- 160	- 2 %	- 1 043	- 10 %

5.3 Sector-specific quality assurance and quality control

There are no sector-specific QA/QC procedures for this sector.

in absolute terms). In relative terms, the highest recalculation was made for N₂O.

Table 5.3 provides an overview of Member States' contributions to EU-15 recalculations. The Netherlands contributed the most to CO₂ and Italy to N₂O recalculations.

5.4 Sector-specific recalculations

Table 5.2 shows that in the solvent sector only minor recalculations were made (in particular

Table 5.2 Recalculations of total greenhouse gas emissions and recalculations of greenhouse gas emissions in CRF Sector 3, 'Solvent and other product use', for 1990 and 2002 by gas (Gg and %)

	1990						2002					
	CO ₂	CH ₄	N ₂ O	HFCs	PFCs	SF ₆	CO ₂	CH ₄	N ₂ O	HFCs	PFCs	SF ₆
Austria	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
Belgium	NE	0	0	NO	NO	NO	NE	0	- 2	NO	NO	NO
Denmark	193	0	0	NO	NO	NO	39	0	0	NO	NO	NO
Finland	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
France	- 3	0	0	NO	NO	NO	- 24	0	0	NO	NO	NO
Germany	NE	0	0	NO	NO	NO	NE	0	0	NO	NO	NO
Greece	-6	0	0	NO	NO	NO	0	0	0	NO	NO	NO
Ireland	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
Italy	14	0	796	NO	NO	NO	96	0	913	NO	NO	NO
Luxembourg	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
Netherlands	316	0	0	NO	NO	NO	160	0	- 2	NO	NO	NO
Portugal	- 3	0	0	NO	NO	NO	-1	0	0	NO	NO	NO
Spain	- 1	0	0	NO	NO	NO	23	0	0	NO	NO	NO
Sweden	0	0	0	NO	NO	NO	- 10	0	0	NO	NO	NO
UK	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
EU-15	511	0	796	NO	NO	NO	283	0	909	NO	NO	NO

Table 5.3 Contribution of Member States to EU-15 recalculations in CRF Sector 3: 'Solvent and other product use' for 1990 and 2002 by gas (difference between latest submission and previous submission Gg of CO₂ equivalents)

1990	CO ₂		CH ₄		N ₂ O		HFCs		PFCs		SF ₆	
	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent
Total emissions and removals	- 122 396	- 3.8 %	- 9 539	- 2.1 %	16 013	4.1 %	200	0.7 %	- 276	- 1.7 %	125	1.2 %
Solvent and other product use	511	8.8 %	0	0.0 %	796	24.7 %	NO	NO	NO	NO	NO	NO
2002												
Total emissions and removals	- 165 492	- 5.1 %	- 7 491	- 2.1 %	8 640	2.6 %	- 3 682	- 7.4 %	279	5.2 %	406	4.4 %
Solvent and other product use	283	5.6 %	0	0.0 %	909	28.5 %	NO	NO	NO	NO	NO	NO

Abbreviations explained in the Chapter 'Units and abbreviations'.

6 Agriculture (CRF Sector 4)

This chapter starts with an overview on emission trends in CRF Sector 4 'Agriculture'. 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, information on methodologies, emission factors, completeness, and qualitative uncertainty estimates. The chapter also provides information on quantitative uncertainty estimates, sector-specific QA/QC, and recalculations.

6.1 Overview of the sector

CRF Sector 4 'Agriculture' contributes 10 % 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 (both 5 % of the total GHG emissions). The emissions from this sector decreased by 10 % from 462 Tg in 1990 to 414 Tg in 2003 (Figure 6.1). In 2003, the emissions decreased by 1.3 % compared to 2002. 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.12: Solid storage and dry lot (N_2O)
- 4.B.8: Swine (CH_4)
- 4.D.1: Direct soil emissions (N_2O)
- 4.D.2: Animal production (N_2O)
- 4.D.3: Indirect emissions (N_2O)

Figure 6.1 shows that the three largest key sources account for about 67 % of agricultural GHG emissions of the EU-15.

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.

6.2 Source categories

6.2.1 Enteric fermentation (CRF Source Category 4.A)

Table 6.1 summarises information by Member State on methodologies, emission factors, completeness and qualitative uncertainty estimates for CH_4 from 4.A: 'Enteric fermentation'. Between 1990 and 2003, CH_4 emission from 'Enteric fermentation' decreased by 11 %. The relative decrease was largest in Germany, the relative increase was largest in Spain.

This source category includes two key sources: CH_4 from 4.A.1: 'Cattle' and CH_4 from 4.A.3: 'Sheep'.

Enteric fermentation from cattle is the largest single source of CH_4 emissions in the EU-15 accounting for 2.6 % of total GHG

Figure 6.1 EU-15 GHG emissions for 1990–2003 from CRF Sector 4: 'Agriculture' in CO_2 equivalents (Tg) and share of largest key source categories in 2003

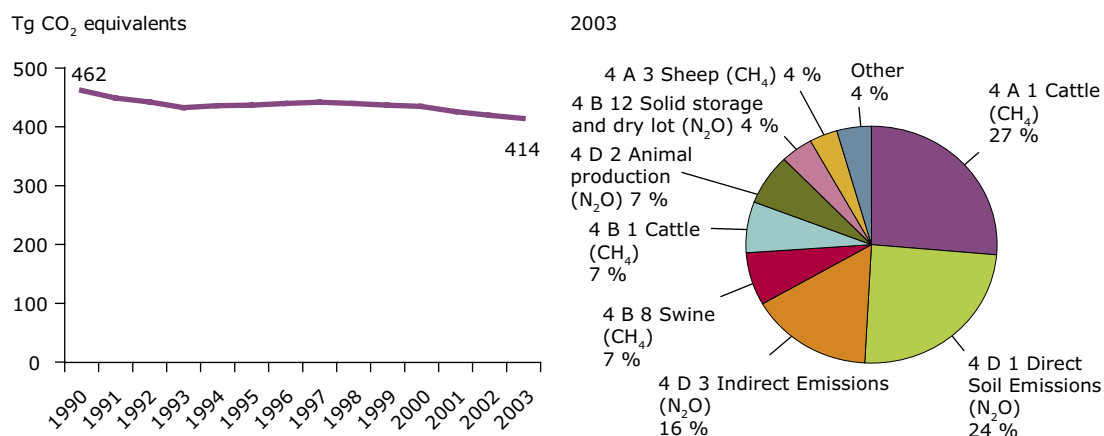


Figure 6.2 Absolute change of GHG emissions by large key source categories 1990–2003 in CO₂ equivalents (Tg) in CRF Sector 4: 'Agriculture'

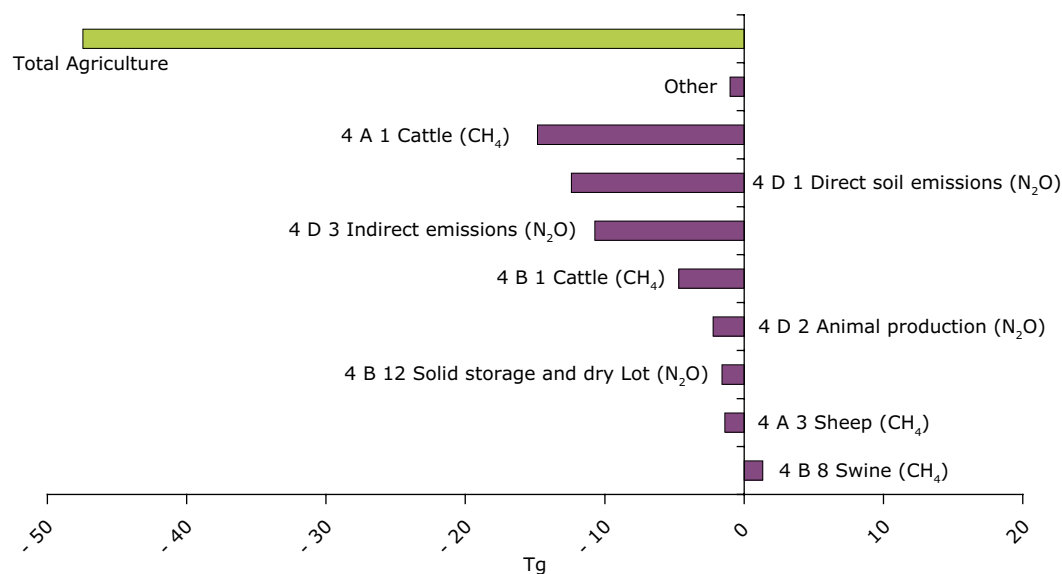


Table 6.1 Member States' contributions to CH₄ emissions from 4.A: 'Enteric fermentation' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO ₂ equivalents)	GHG emissions in 2003 (Gg CO ₂ equivalents)	Methods applied ¹⁾	EF ¹⁾	Estimate ²⁾	Quality ²⁾
Austria	3 573	3 094	T1, T2	D, CS	ALL	M
Belgium	4 494	4 017	M	CS		
Denmark	3 110	2 734	T1/T2	CS	ALL	H
Finland	1 868	1 537	T1/T2	CS/D	ALL	M
France	30 890	28 308	C	CS	ALL	M
Germany	34 294	25 173	T1, CS, C, D	T1, CS, C, D	All	H
Greece	2 861	2 882	T1, T2	D, CS	ALL	
Ireland	9 180	9 294	D	CS, D	Full	M
Italy	12 341	10 933	T1, T2	D, CS	ALL	H
Luxembourg	346	317	C/D	C/D		
Netherlands	7 322	6 062	cattle CS/T2; rest: T1	cattle: CS/T2; rest: CS/D	ALL	M
Portugal	2 594	2 493	T1	D+CS	All	M
Spain	12 651	14 917	T1,T2,CS	T1,T2	ALL	M
Sweden	3 027	2 817	T1 + CS	D + CS	ALL	H
United Kingdom	18 173	16 170	T2	D/CS	ALL	M
EU-15	146 724	130 748	C, CS, D, M, T1, T2	C, CS, D, T1, T2	ALL	M

⁽¹⁾ Information source: CRF Summary Table 3 for 2002.

⁽²⁾ Information source: CRF Table 7 for 2002.

Abbreviations explained in the Chapter 'Units and abbreviations'.

emissions in 2003. Between 1990 and 2003, CH₄ emissions from enteric fermentation from cattle declined by 12 % in the EU-15 (Table 6.2). In 2003, the emissions were 2 % lower compared to 2002. The main driving force of CH₄ emissions from enteric fermentation is the number of cattle, which

was 15 % below 1990 levels in 2003. The Member States with most emissions from this source were France and Germany (45 %). All Member States except Ireland and Spain reduced CH₄ emissions from enteric fermentation of cattle between 1990 and 2003.

Table 6.2 Member States' contributions to CH₄ emissions from 4.A.1: 'Cattle'

Member State	Greenhouse gas emissions (Gg CO ₂ equivalents)			Share in EU-15 emissions in 2003	Change 2002–2003		Change 1990–2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO ₂ equivalents)	(%)	(Gg CO ₂ equivalents)	(%)			
	Austria	3 372	2 922		2 888	2.6 %	- 34	- 1 %			
Belgium	4 301	3 892	3 828	3.5 %	- 65	- 2 %	- 473	- 11 %	M	NS	CS
Denmark	2 794	2 412	2 331	2.1 %	- 81	- 3 %	- 463	- 17 %	T2	NS	CS
Finland	1 745	1 444	1 417	1.3 %	- 27	- 2 %	- 328	- 19 %	T2	NS, AS	CS
France	28 382	26 746	26 111	23.8 %	- 635	- 2 %	- 2 271	- 8 %	C	NS	CS
Germany	32 593	24 304	23 702	21.6 %	- 602	- 2 %	- 8 891	- 27 %	T1, CS, C, D	NS	CS, C, D
Greece	866	815	811	0.7 %	- 4	0 %	- 55	- 6 %	T1	NS	D
Ireland	8 020	8 398	8 205	7.5 %	- 193	- 2 %	186	2 %	T1	NS	CS, D
Italy	10 227	9 551	8 789	8.0 %	- 762	- 8 %	- 1 437	- 14 %	T2	NS	D, CS
Luxembourg	341	311	311	0.3 %	0	0 %	- 30	- 9 %			
Netherlands	6 561	5 495	5 418	4.9 %	- 77	- 1 %	- 1 143	- 17 %	T2	NS	CS
Portugal	1 820	1 774	1 769	1.6 %	- 5	0 %	- 52	- 3 %	T1	NS	D
Spain	7 411	9 268	9 442	8.6 %	174	2 %	2 031	27 %	T2, CS	NS	D
Sweden	2 729	2 570	2 525	2.3 %	- 46	- 2 %	- 205	- 7 %	CS	NS	CS
United Kingdom	13 484	12 135	12 267	11.2 %	132	1 %	- 1 217	- 9 %	T2	NS, RS	D, CS
EU-15	124 648	112 037	109 814	100.0 %	- 2 222	- 2 %	- 14 833	12 %			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 6.3 Member States' contributions to CH₄ emissions from 4.A.3: 'Sheep'

Member State	Greenhouse gas emissions (Gg CO ₂ equivalents)			Share in EU-15 emissions in 2003	Change 2002–2003		Change 1990–2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO ₂ equivalents)	(%)	(Gg CO ₂ equivalents)	(%)			
	Austria	52	51		55	0.4 %	4	7 %			
Belgium	28	21	21	0.1 %	0	0 %	-7	-25 %	M	NS	CS
Denmark	33	27	30	0.2 %	3	13 %	-3	-10 %	T2	NS	CS
Finland	17	16	17	0.1 %	0	3 %	-1	-5 %	T1	NS	D
France	1 923	1 573	1 560	10.6 %	-13	-1 %	-363	-19 %	C	NS	D
Germany	544	457	443	3.0 %	- 14	- 3 %	- 101	- 19 %	T1, CS, C, D	NS	CS, C, D
Greece	1 345	1 405	1 411	9.6 %	5	0 %	65	5 %	T2	NS	D
Ireland	1 103	1 042	1 004	6.8 %	- 38	- 4 %	- 98	- 9 %	T1	NS	CS, D
Italy	1 468	1 367	1 336	9.1 %	- 31	- 2 %	- 132	- 9 %	T1	NS	D, CS
Luxembourg	1	2	1	0.0 %	0	- 4 %	0	2 %			
Netherlands	286	199	199	1.4 %	0	0 %	- 87	- 30 %	T1	NS	D
Portugal	565	575	572	3.9 %	- 3	- 1 %	7	1 %	T1	NS	D
Spain	4 267	4 336	4 326	29.5 %	- 10	0 %	59	1 %	T2, CS	NS	D
Sweden	68	72	75	0.5 %	4	5 %	7	10 %	T1	NS	D
United Kingdom	4 354	3 619	3 616	24.7 %	- 3	0 %	- 738	- 17 %	T2	NS, RS	D, CS
EU-15	16 054	14 762	14 665	100.0 %	- 97	- 1 %	- 1 389	- 9 %			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 6.4 Member States' contributions to CH₄ emissions from 4.B: 'Manure management' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990	GHG emissions in 2003	Methods applied ¹⁾	EF ¹⁾	Estimate ²⁾	Quality ²⁾
	(Gg CO ₂ equivalents)	(Gg CO ₂ equivalents)				
Austria	1 021	885	T1, T2	D, CS	ALL	M
Belgium	2 565	2 445	M	CS		
Denmark	743	972	T2	CS	ALL	M
Finland	215	222	T2	CS/D	ALL	M
France	13 794	13 107	C/T1	D/CS	ALL	M
Germany	27 098	23 109	C, D, T1	C, D	All	H
Greece	497	487	T1	D	ALL	
Ireland	1 261	1 350	D	CS, D	Full	M
Italy	4 026	3 821	T1, T2	D, CS	ALL	H
Luxembourg	24	22	C/D	C/D		
Netherlands	2 969	2 423	CS/T2	CS	ALL	L
Portugal	1 558	1 388	T2	D (CS)	All	M
Spain	6 221	8 667	T1, T2,CS	T1, T2	ALL	M
Sweden	361	459	T1 + CS	D + CS	ALL	H
United Kingdom	2 923	2 610	T2	D/CS	ALL	M
EU-15	65 275	61 967	C, CS, D, M, T1, T2	C, CS, D, T1, T2	ALL	M

(¹⁾ Information source: CRF Summary Table 3 for 2002.

(²⁾ Information source: CRF Table 7 for 2002.

Abbreviations explained in the Chapter 'Units and abbreviations'

Table 6.5 Member States' contributions to CH₄ emissions from 4.B.1: 'Cattle'

Member State	Greenhouse gas emissions (Gg CO ₂ equivalents)			Share in EU-15 emissions in 2003	Change 2002–2003		Change 1990–2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO ₂ equivalents)	(%)	(Gg CO ₂ equivalents)	(%)			
	Austria	547	455		450	1.6 %	- 5	- 1 %			
Belgium	1 128	971	945	3.3 %	- 26	- 3 %	- 183	- 16 %	M	NS	CS
Denmark	282	262	267	0.9 %	6	2 %	- 15	- 5 %	T2	NS	CS
Finland	101	94	92	0.3 %	- 2	- 2 %	- 9	- 9 %	T2	NS, AS	CS
France	8 781	8 001	7 832	27.0 %	- 169	- 2 %	- 949	- 11 %	C, T1	NS	D, CS
Germany	14 609	11 948	11 730	40.5 %	- 217	- 2 %	- 2 878	- 20 %	C, D, T1	NS	C, D
Greece	202	190	189	0.7 %	- 1	0 %	- 13	- 6 %	T1	NS	D
Ireland	1 115	1 153	1 125	3.9 %	- 28	- 2 %	11	1 %	T1	NS	D, CS
Italy	2 217	2 054	1 855	6.4 %	- 199	- 10 %	- 362	- 16 %	T2	NS	D, CS
Luxembourg	23	21	21	0.1 %	0	0 %	- 2	- 10 %			
Netherlands	1 573	1 463	1 432	4.9 %	- 31	- 2 %	- 141	- 9 %	CS, T2	NS	CS
Portugal	58	57	57	0.2 %	0	0 %	0	- 1 %	T2	NS	CS
Spain	670	765	776	2.7 %	11	1 %	106	16 %	T2, CS	NS	D
Sweden	236	285	300	1.0 %	15	5 %	65	27 %	T2	NS	D
United Kingdom	2 114	1 901	1 909	6.6 %	8	0 %	- 204	- 10 %	T2	NS, RS	D, CS
EU-15	33 655	29 620	28 982	100.0 %	- 638	- 2 %	- 4 673	- 14 %			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Enteric fermentation from sheep is the seventh largest single source of CH₄ emissions in the EU-15 and accounts for 0.4 % of total GHG emissions in 2003.

Between 1990 and 2003, CH₄ emissions from enteric fermentation of sheep declined by 9 % in the EU-15 (Table 6.3). In 2003, the emissions were 1 % lower compared to 2002.

Table 6.6 Member States' contributions to CH₄ emissions from 4.B.8: 'Swine'

Member State	Greenhouse gas emissions (Gg CO ₂ equivalents)			Share in EU-15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO ₂ equivalents)	(%)	(Gg CO ₂ equivalents)	(%)			
	Austria	448	403		410	1.4 %	7	2 %			
Belgium	1 315	1 423	1 380	4.6 %	- 43	- 3 %	65	5 %	M	NS	CS
Denmark	448	692	692	2.3 %	0	0 %	244	54 %	T2	NS	CS
Finland	81	93	97	0.3 %	4	5 %	16	20 %	T2	NS	CS
France	4 252	4 548	4 491	14.9 %	- 56	- 1 %	239	6 %	C, T1	NS	D, CS
Germany	12 262	10 937	11 139	37.0 %	203	2 %	- 1 123	- 9 %	C, D, T1	NS	C, D
Greece	146	142	142	0.5 %	0	0 %	- 4	- 3 %	T1	NS	D
Ireland	124	199	198	0.7 %	0	0 %	75	60 %	T1	NS	D, CS
Italy	1 413	1 386	1 484	4.9 %	98	7 %	71	5 %	T2	NS	D, CS
Luxembourg	1	1	1	0.0 %	0	- 6 %	0	- 5 %			
Netherlands	1 141	960	918	3.1 %	- 42	- 4 %	- 223	- 20 %	CS, T2	NS	CS
Portugal	1 441	1 283	1 266	4.2 %	- 17	- 1 %	- 174	- 12 %			
Spain	5 076	7 356	7 406	24.6 %	50	1 %	2 330	46 %	T2, CS	NS	D
Sweden	90	119	122	0.4 %	3	3 %	32	36 %	T2	NS	D
United Kingdom	476	352	318	1.1 %	- 34	- 10 %	- 158	- 33 %	T2	NS, RS	D, CS
EU-15	28 714	29 893	30 066	100.0 %	172	1 %	1 351	5 %			

Abbreviations explained in the Chapter 'Units and abbreviations'.

The main driving force of CH₄ emissions from enteric fermentation is the number of sheep, which was 12 % below 1990 levels in 2003. The Member States with most emissions from this source were Spain and the United Kingdom (54 %). Nine Member States reduced CH₄ emissions from enteric fermentation of sheep, six States did not.

6.2.2 Manure management (CRF Source Category 4.B)

Table 6.4 summarises information by Member State on methodologies, emission factors, completeness and qualitative uncertainty estimates for CH₄ from 4.B: 'Manure management'. Between 1990 and 2003, CH₄ emission from 'Manure management' decreased by 5 %. The relative decrease was largest in the Netherlands, the relative increase was largest in Spain.

This source category includes two key sources: CH₄ from 4.B.1: 'Cattle' and CH₄ from 4.B.8: 'Swine'.

CH₄ emissions from 4.B.1: 'Cattle' account for 0.7 % of total EU-15 GHG emissions in 2003. Between 1990 and 2003, CH₄ emissions from this source decreased by 14 % (Table 6.5). Germany and France are responsible for

68 % of the total EU-15 emissions from this source. All Member States except Ireland, Spain and Sweden had reductions between 1990 and 2003. In absolute and relative terms, Germany had the most significant decreases from this source.

CH₄ emissions from 4.B.8: 'Swine' account for 0.7 % of total EU-15 GHG emissions in 2003. Between 1990 and 2003, CH₄ emissions from this source increased by 5 % (Table 6.6). Germany 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 while Germany had the largest reductions.

Table 6.7 summarises information by Member State on methodologies, emission factors, completeness and qualitative uncertainty estimates for N₂O from 4.B: 'Manure management'. Between 1990 and 2003, N₂O emission from 'Manure management' decreased by 12 %. The relative decrease was largest in Germany and Sweden, the relative increase was largest in Portugal.

This source category includes one key source: N₂O from 4.B.12: 'Solid storage'.

Table 6.7 Member States' contributions to N₂O emissions from 4.B: 'Manure management' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990	GHG emissions in 2003	Methods applied ¹⁾	EF ¹⁾	Estimate ²⁾	Quality ²⁾
	(Gg CO ₂ equivalents)	(Gg CO ₂ equivalents)				
Austria	786	704			ALL	M
Belgium	975	890	D	D		
Denmark	685	560			ALL	M
Finland	623	462	D	D/CS	ALL	L
France	6 899	6 299	C/T1	D/CS	ALL	M
Germany	4 475	2 926	C,CS	D	All	H
Greece	301	283	D	D		
Ireland	627	660	D	CS, D	Full	M
Italy	3 829	3 972	D	D, CS	ALL	H
Luxembourg	0	0	C/D	C/D		
Netherlands	670	598	CS/T2	D	ALL	L
Portugal	943	1 032	T2	D (CS)	All	M
Spain	1 632	1 607	D, CS	D	ALL	M
Sweden	799	560	T1 + T2	D + CS	ALL	M
United Kingdom	1 514	1 320	T1	D/CS	ALL	M
EU-15	24 756	21 873	C, CS, D, T1, T2	C, CS, D	ALL	M

(¹⁾ Information source: CRF Summary Table 3 for 2002.

(²⁾ Information source: CRF Table 7 for 2002.

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 6.8 Member States' contributions to N₂O emissions from 4.B.12: 'Solid storage and dry lot'

Member State	Greenhouse gas emissions (Gg CO ₂ equivalents)			Share in EU-15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO ₂ equivalents)	(%)	(Gg CO ₂ equivalents)	(%)			
	Austria	738	662		658	3.8 %	- 4	- 1 %			
Belgium	909	858	821	4.7 %	- 37	- 4 %	- 88	- 10 %	D	NS	D
Denmark	590	506	480	2.8 %	- 26	- 5 %	- 110	- 19 %	T1	NS	D
Finland	612	457	450	2.6 %	- 6	- 1 %	- 162	- 26 %	D	AS, Q	D
France	6 664	6 211	6 067	34.8 %	- 144	- 2 %	- 597	- 9 %	C, T1	NS	D, CS
Germany	IE	IE	IE	-	-	-	-	-			
Greece	282	263	262	1.5 %	- 1	- 1 %	- 20	- 7 %	D	NS	D
Ireland	578	620	608	3.5 %	- 12	- 2 %	29	5 %	T1	NS	D, CS
Italy	3 688	3 789	3 572	20.5 %	- 217	- 6 %	- 117	- 3 %	D	NS	D, CS
Luxembourg	0	0	0	0.0 %	0	-	0	-			
Netherlands	493	605	465	2.7 %	- 140	- 23 %	- 28	- 6 %	CS	NS	CS
Portugal	915	1 009	1 007	5.8 %	- 2	0 %	93	10 %	D	NS	D, CS
Spain	1 564	1 539	1 516	8.7 %	- 22	- 1 %	- 48	- 3 %	D, CS	NS	D
Sweden	709	475	435	2.5 %	- 40	- 8 %	- 274	- 39 %	T1	NS	D
United Kingdom	1 280	1 112	1 096	6.3 %	- 16	- 1 %	- 184	- 14 %	T1	NS, RS	D, CS
EU-15	19 023	18 106	17 438	100.0 %	- 669	- 4 %	- 1 585	- 8 %			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 6.9 Member States' contributions to N₂O emissions from 4.B.13: 'Other'

Member State	Greenhouse gas emissions (Gg CO ₂ equivalents)			Share in EU-15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO ₂ equivalents)	(%)	(Gg CO ₂ equivalents)	(%)			
	Austria	26	24		25	0.7 %	1	4 %			
Belgium	3	11	9	0.3 %	- 2	- 15 %	6	214 %	D	NS	D
Denmark	0	0	0	0.0 %	0	-	0	-	NO	NO	NO
Finland	0	0	0	0.0 %	0	-	0	-	D	AS, Q	D
France	0	0	0	0.0 %	0	-	0	-	C, T1	NS	D, CS
Germany	4 475	2 971	2 926	82.9 %	- 45	- 1 %	- 1 548	- 35 %			
Greece	13	14	14	0.4 %	0	1 %	1	10 %	D	NS	D
Ireland	0	0	0	0.0 %	0	-	0	-	T1	NS	CS, D
Italy	0	262	275	7.8 %	14	5 %	275	-			
Luxembourg	0	0	0	0.0 %	0	-	0	-			
Netherlands	0	0	0	0.0 %	0	-	0	-	CS	NS	CS
Portugal	0	0	0	0.0 %	0	-	0	-	D	NS	D, CS
Spain	3	2	2	0.1 %	0	- 5 %	- 1	- 31 %	D, CS	NS	D
Sweden	74	94	103	2.9 %	8	9 %	29	40 %	T1	NS	D
United Kingdom	175	174	174	4.9 %	0	0 %	- 1	- 1 %	T1	NS, RS	D, CS
EU-15	4 768	3 552	3 528	100.0 %	- 23	- 1 %	- 1 240	- 26 %			

Abbreviations explained in the Chapter 'Units and abbreviations'.

N₂O emissions from 4.B.12: 'Solid storage and dry lot' account for 0.4 % of total EU-15 GHG emissions in 2003. Between 1990 and 2003, N₂O emissions from this source decreased by 8 % (Table 6.8). Italy and France are responsible for 55 % of the total EU-15 emissions from this source. In absolute terms, France had the most significant decrease from this source while Portugal had the largest increases. In relative terms, Sweden had the largest decrease from 1990–2003.

N₂O emissions from 4.B.13: 'Other' account for 0.1 % of total EU-15 GHG emissions in 2003. Between 1990 and 2003, N₂O emissions from this source decreased by 26 % (Table 6.9). Germany is responsible for 83 % of the total EU-15 emissions from this source. Germany had the most significant decreases from this source both in absolute and relative terms.

6.2.3 Agricultural soils (CRF Source Category 4.D)

Table 6.10 summarises information by Member State on methodologies, emission factors, completeness and qualitative uncertainty estimates for N₂O from 4.D: 'Agricultural soils'. N₂O emissions from 4.D: 'Agricultural soils' decreased by 11 %

between 1990 and 2003. Most EU-15 Member States decreased emissions.

This source category includes three key sources: N₂O from 4.D.1: 'Direct soil emissions', N₂O from 4.D.2: 'Animal production', and N₂O from 4.D.3: 'Indirect emissions'.

Table 6.11 provides information on emission trends of the key source from 4.D.1: 'Direct soil emissions' by Member State. Direct N₂O emissions from agricultural soils is the largest source category of N₂O emissions and accounts for 2.4 % of total EU-15 GHG emissions in 2003. Direct N₂O emissions from agricultural soils occur from the application of mineral nitrogen fertilisers and organic nitrogen from animal manure. Between 1990 and 2003, emissions declined by 11 % in the EU-15, compared to 2002 they decreased by 1 %. The Member States with most emissions from this source were France and Germany. All Member States except Ireland, Spain and the Netherlands reduced N₂O emissions from agricultural soils.

The main driving force of direct N₂O emissions from agricultural soils is the use of nitrogen fertiliser and animal manure, which were 16 % and 6 %, respectively, below 1990 levels in 2003. N₂O emissions

Table 6.10 Member States' contributions to N₂O emissions from 4.D: 'Agricultural soils' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in		Methods applied ¹⁾	EF ¹⁾	Estimate ²⁾	Quality ²⁾
	1990 (Gg CO ₂ equivalents)	2003 (Gg CO ₂ equivalents)				
Austria	3 067	2 656	T1	D	ALL	M
Belgium	4 405	3 877	D	CS		
Denmark	8 308	5 632	CS/M	CS/M	ALL	M
Finland	4 221	3 200	D	D/CS	ALL	L
France	56 051	50 149	C/T1	D/CS	ALL	L
Germany	43 876	36 753	C,CS	C,D	All	H
Greece	9 749	8 214	T1a, T1b	D	ALL	
Ireland	7 294	7 443	D	CS, D	Full	M
Italy	18 866	18 444	D	D, CS	ALL	H
Luxembourg	146	0	C/D	C/D		
Netherlands	10 878	8 761	CS/T1b (Direct and indirect)	CS (indirect), D (direct)	ALL	L
Portugal	3 515	3 170	D	D	All	M
Spain	16 264	18 519	D,CS	D, CS	ALL	L
Sweden	5 395	4 889	D, C	CS	ALL	M
United Kingdom	30 410	25 749	T1a/T1b	D	ALL	L
EU-15	222 445	197 455	C, CS, D, M, T1, T1a, T1b, T2	C, CS, D, M	ALL	M

(¹⁾ Information source: CRF Summary Table 3 for 2002.

(²⁾ Information source: CRF Table 7 for 2002.

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 6.11 Member States' contributions to N₂O emissions from 4.D.1: 'Direct soil emissions'

Member State	Greenhouse gas emissions (Gg CO ₂ equivalents)			Share in EU-15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO ₂ equivalents)	(%)	(Gg CO ₂ equivalents)	(%)			
	Austria	1 649	1 534		1 414	1.4 %	- 120	- 8 %			
Belgium	2 343	2 176	2 130	2.1 %	- 46	- 2 %	- 212	- 9 %	D	NS	CS
Denmark	4 180	2 967	2 892	2.9 %	- 75	- 3 %	- 1 289	- 31 %	D, CS	NS	D
Finland	3 369	2 567	2 522	2.5 %	- 45	- 2 %	- 846	- 25 %	T1a	NS, AS	D
France	26 459	23 796	23 336	23.2 %	- 460	- 2 %	- 3 123	- 12 %	C, T1	NS	D, CS
Germany	27 645	23 720	23 686	23.6 %	- 33	0 %	- 3 959	- 14 %	C, CS	NS	C, D
Greece	2 760	1 803	1 751	1.7 %	- 53	- 3 %	- 1 009	- 37 %	T1a, T1b	NS	D
Ireland	3 083	3 217	3 159	3.1 %	- 58	- 2 %	76	2 %	T1a	NS	D
Italy	9 122	8 984	8 771	8.7 %	- 212	- 2 %	- 350	- 4 %	D	NS	D, CS
Luxembourg	0	0	0	0.0 %	0	-	0	-			
Netherlands	4 604	4 923	4 817	4.8 %	- 105	- 2 %	214	5 %	T2	NS	CS
Portugal	1 565	1 361	1 358	1.4 %	- 2	0 %	- 206	- 13 %	T1b	NS	D, CS
Spain	8 523	8 391	9 433	9.4 %	1 042	12 %	910	11 %	D, CS	NS	D
Sweden	3 227	2 889	2 897	2.9 %	8	0 %	- 331	- 10 %	C, D	NS	CS, T1
United Kingdom	14 265	12 689	12 235	12.2 %	- 454	- 4 %	- 2 030	- 14 %	T1a, T1b	NS, RS	D
EU-15	112 793	101 016	100 402	100.0 %	- 614	- 1 %	- 12 392	- 11 %			

Abbreviations explained in the Chapter 'Units and abbreviations'.

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-

Table 6.12 Member States' contributions to N₂O emissions from 4.D.2: 'Animal production'

Member State	Greenhouse gas emissions (Gg CO ₂ equivalents)			Share in EU-15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO ₂ equivalents)	(%)	(Gg CO ₂ equivalents)	(%)			
	Austria	207	212		216	0.8 %	4	2 %			
Belgium	941	859	848	3.0 %	- 12	- 1 %	- 93	- 10 %	D	NS	CS
Denmark	312	300	292	1.0 %	- 8	- 3 %	- 20	- 6 %	D, CS	NS	D
Finland	108	84	82	0.3 %	- 2	- 2 %	- 26	- 24 %	D	AS, Q	D
France	8 539	7 853	7 659	26.8 %	- 195	- 2 %	- 880	- 10 %	C, T1	NS	D, CS
Germany	2 519	1 964	1 910	6.7 %	- 53	- 3 %	- 609	- 24 %	C, CS	NS	C, D
Greece	3 383	3 532	3 547	12.4 %	15	0 %	164	5 %	D	NS	D
Ireland	2 780	2 883	2 813	9.8 %	- 70	- 2 %	33	1 %	T1a	NS	D
Italy	1 867	1 743	1 682	5.9 %	- 61	- 3 %	- 185	- 10 %	D	NS	D, CS
Luxembourg	0	0	0	0.0 %	0	-	0	-			
Netherlands	1 299	688	691	2.4 %	3	0 %	- 608	- 47 %		NS	
Portugal	580	553	551	1.9 %	- 2	0 %	- 30	- 5 %	T1a	NS	D, CS
Spain	2 794	3 278	3 371	11.8 %	93	3 %	577	21 %	D, CS	NS	D
Sweden	228	304	305	1.1 %	1	0 %	77	34 %	D	NS	CS, T1
United Kingdom	5 223	4 603	4 600	16.1 %	- 3	0 %	- 623	- 12 %	T1a, T1b	NS, RS	D
EU-15	30 780	28 856	28 566	100.0 %	- 290	- 1 %	- 2 214	- 7 %			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 6.13 Member States' contributions to N₂O emissions from 4.D.3: 'Indirect emissions'

Member State	Greenhouse gas emissions (Gg CO ₂ equivalents)			Share in EU-15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO ₂ equivalents)	(%)	(Gg CO ₂ equivalents)	(%)			
	Austria	1 204	1 075		1 016	1.5 %	- 59	- 5 %			
Belgium	1 121	998	898	1.4 %	- 101	- 10 %	- 223	- 20 %	D	NS, AS	CS
Denmark	3 787	2 438	2 378	3.6 %	- 59	- 2 %	- 1 409	- 37 %	CS, M	NS	D
Finland	735	600	592	0.9 %	- 8	- 1 %	- 143	- 19 %	D, T1b	NS, AS	D
France	20 363	18 756	18 064	27.3 %	- 692	- 4 %	- 2 299	- 11 %	C, T1	NS	D, CS
Germany	13 712	11 156	11 156	16.8 %	0	0 %	- 2 555	- 19 %	C, CS	NS	C, D
Greece	3 606	2 945	2 917	4.4 %	- 28	- 1 %	- 689	- 19 %	T1a	NS	D
Ireland	1 431	1 495	1 471	2.2 %	- 24	- 2 %	40	3 %	T1a	NS	D
Italy	7 878	8 128	7 991	12.1 %	- 137	- 2 %	113	1 %	D	NS	D, CS
Luxembourg	0	0	0	0.0 %	0	-	0	-			
Netherlands	4 976	3 326	3 252	4.9 %	- 74	- 2 %	- 1 724	- 35 %	T1a, T1b	NS, M	D
Portugal	1 370	1 263	1 260	1.9 %	- 2	0 %	- 109	- 8 %	D	NS	D, CS
Spain	4 836	5 194	5 533	8.4 %	340	7 %	697	14 %	D, CS	NS	D
Sweden	1 148	947	938	1.4 %	- 9	- 1 %	- 211	- 18 %	C	NS	T1
United Kingdom	10 754	8 965	8 747	13.2 %	- 219	- 2 %	- 2 007	- 19 %	T1a, T1b	NS, RS	D
EU-15	76 918	67 286	66 213	100.0 %	- 1 073	- 2 %	- 10 705	- 14 %			

Abbreviations explained in the Chapter 'Units and abbreviations'.

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).

N₂O emissions from 4.D.2: 'Animal production' account for 0.7 % of total EU-15 GHG emissions in 2003. Between 1990 and 2003, N₂O emissions from this source decreased by 7 % (Table 6.12). France, the United Kingdom, Spain and Greece are responsible for 67 % of the total EU-15 emissions from this source. France had the greatest reduction in absolute terms while Spain had the largest increases.

N₂O emissions from 4.D.3: 'Indirect emissions' account for 1.6 % of total EU-15 GHG emissions in 2003. Between 1990 and 2003, N₂O emissions from this source decreased by 14 % (Table 6.13). France, Germany, Italy and the United Kingdom are responsible for 69 % of the total EU-15 emissions from this source. Each of these Member States had large absolute reductions between 1990 and 2003.

N₂O emissions from 4.D.4: 'Other' account for 0.1 % of total EU-15 GHG emissions in 2003. Between 1990 and 2003, N₂O emissions from this source increased by 26 % (Table 6.14). Sweden and France are responsible for 81 % of the total EU-15 emissions from this source. Between 1990 and 2003, Sweden had the largest absolute reductions from this source, while the French emissions increased.

6.3 Methodological issues and uncertainties

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 subcategories are considered (CRF Tables 7s2). CH₄ emissions from rice fields are reported for France, Greece, Italy, Portugal and Spain. There were no changes in the evaluation of the completeness of Member States agricultural inventory since 2002; no information is available for Belgium, Greece and Luxembourg.

Table 6.14 Member States' contributions to N₂O emissions from 4.D.4: 'Other'

Member State	Greenhouse gas emissions (Gg CO ₂ equivalents)			Share in EU-15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO ₂ equivalents)	(%)	(Gg CO ₂ equivalents)	(%)			
Austria	7	9	9	0.4 %	0	0 %	2	26 %	T1b	NS	D
Belgium	0	0	0	0.0 %	0	0 %	0	1 %	D	NS	CS
Denmark	28	70	70	3.1 %	0	0 %	42	151 %	D, CS	NS	D
Finland	9	3	3	0.1 %	0	3 %	- 6	- 65 %	D	NS, AS	D
France	691	1 080	1 091	48.0 %	11	1 %	400	58 %	C, T1	NS	D, CS
Germany	0	0	0	0.0 %	0	-	0	-	C, CS	NS	C, D
Greece	0	0	0	0.0 %	0	-	0	-			
Ireland	0	0	0	0.0 %	0	-	0	-	T1a	NS	D
Italy	0	0	0	0.0 %	0	-	0	-			
Luxembourg	0	0	0	0.0 %	0	-	0	-			
Netherlands	0	0	0	0.0 %	0	-	0	-			
Portugal	0	0	0	0.0 %	0	-	0	-	NO	NO	NO
Spain	111	172	182	8.0 %	10	6 %	71	64 %	D, CS	NS	D, CS
Sweden	792	757	750	33.0 %	- 7	- 1 %	- 42	- 5 %	D, C	NS	CS, T1
United Kingdom	169	162	168	7.4 %	6	3 %	- 1	- 1 %	T1a, T1b	NS, RS	D
EU-15	1 808	2 255	2 274	100.0 %	19	1 %	466	26 %			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 6.15 Quality of the emission estimates in Member State's inventory for the sector agriculture

Member State	4A. Enteric Fermentation	4B(a). Manure Management CH ₄	4B(b). Manure Management N ₂ O	4C. Rice Cultivation	4D. Agricultural soils
Austria	M	M	M	NO	M
Belgium					
Denmark	H	M	M		M
Finland	M	M	L	NO	L
France	M	M	M	L	L
Germany	H	H	H		H
Greece					
Ireland	M	M	M	NA	M
Italy	H	H	H	H	H
Luxembourg					
Netherlands	M	L	L		L
Portugal	M	M	M	M	M
Spain	M	M	M	M	L
Sweden	H	H	M		M
United Kingdom	M	M	M		L

Information on source: CRF Tables 7s 2 for 2003, submitted in 2005.

Abbreviations explained in the Chapter 'Units and abbreviations'.

There were also no changes in Member State's evaluation of the quality of the inventory in the agricultural sector since the submission in 2004. Table 6.15 shows the quality of the emission estimates for the Categories 4.A through 4.D. Only Germany and Italy are considering the emission estimates of all categories as high quality; in most cases the emission estimates have been evaluated as medium quality. Generally, a lower quality is assumed for N₂O emission estimates, with five countries evaluating the estimate in category 4.D as being of low quality.

In the following section an overview is given for the central data required to assess the EU-15 inventory for agriculture. Detailed information will be given for the categories 'enteric fermentation', 'manure management' (both CH₄ and N₂O), 'rice cultivation' and 'agricultural soils'. Each section contains the following information:

- an overview of the source category (composition, changes since 1990, etc.)
- a table with the most important information taken from the national inventory reports on the methodologies and emission factors used
- a table with essential activity data by Member States

- a table with the implied emission factors by Member States for the most important subcategories
- a table with information aggregated at EU-15 level with activity data, emissions, and implied emission factors for the most important subcategories. This table compares also the situation between 2003 and 1990.

Quantitative estimates of the contribution of agriculture to the overall uncertainty of the national GHG inventories are reported in Table 6.16. For several countries, N₂O emissions from agricultural soils are by far dominating the uncertainty of the national inventory (uncertainty from 0.7 to 20.9 % of total national emissions of Austria and France, respectively, with the corresponding overall uncertainties of 5.5 % and 22.1 % for Austria and France, respectively); whereby some countries allocate the biggest contribution to the direct emissions and others to the indirect emissions of N₂O. For example, the uncertainty of direct N₂O emissions is estimated in the Greece inventory of being 5.1 % of the national total versus 1.2 % uncertainty of the indirect emissions. On the other hands, the Netherlands estimate an uncertainty of 1.3 % and 3.1 % for direct and indirect N₂O emissions from agricultural soils, respectively. CH₄ emissions from enteric fermentation are less uncertain (0.3 to

Table 6.16 Member States' uncertainty estimates using Tier 1 methodology for agriculture.

Member State	Year analysed	Total uncertainty of GHG inventory	Enteric ferm.	Manure Man.	Manure Man.	Agricultural soils (4D)				Source	
			(4A) CH ₄	(4B) CH ₄	(4B) N ₂ O	total N ₂ O	direct N ₂ O	indirect N ₂ O	animal prod. N ₂ O		
		% of total emissions	uncertainties expressed as % of total GHG emissions								
Austria	2003	5.5	0.3	0.7	0.6	0.7	0.0	0.0	0.0	NIR 2005	p. 35 ff
Belgium	2003	8.1	1.2	0.0	0.0	7.2	0.0	0.0	0.0	NIR 2005	p. 13 ff; direct comm.
Denmark	2003	6.8	0.5	1.3	0.8	1.6	0.0	0.0	0.0	NIR 2005	Tier 1, p. 155; annex p. 186
Finland	2003	15.9	0.7	0.1	0.6	0.0	8.8	2.9	0.0	NIR 2005	Tier 1; p. 178 ff
Finland	2003	0.0	0.4	0.0	0.3	0.0	5.3	1.8	0.0	NIR 2005	Tier 2; p. 174 ff
France	2002	22.1	2.3	1.4	0.3	20.9	0.0	0.0	0.0	NIR 2004	Tier 1; p. 32
Germany		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0
Greece	2003	10.8	0.6	0.2	0.2	0.0	5.1	1.2	2.9	NIR 2005	Tier 1, Annex IV, p. 214f
Ireland	2003	12.2	2.8	1.2	1.0	11.5	0.0	0.0	0.0	NIR 2005	Tier 1; p. 14 f
Italy	2001	2.5	0.7	0.4	0.8	0.0	0.5	0.7	0.4	NIR 2003	Tier 1; p. 81 ff
Luxembourg		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0
Portugal		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0
Spain	2002	15.8	0.8	4.4	0.8	0.0	8.0	11.8	0.9	NIR 2005	Tier 1; p. 54 f
Sweden	2003	6.9	1.2	0.3	0.4	5.9	0.0	0.0	0.0	NIR 2005	Tier 1 p. 202f
The Netherlands	2003	6.0	0.5	0.0	0.3	0.0	1.3	3.1	0.0	NIR 2005	Tier 1, p. A-8
United Kingdom	2002	17.9	0.5	0.1	0.9	17.6	0.0	0.0	0.0	NIR 2004	Tier 1. A7-305 ff

- 1) Relative uncertainties: Cattle: ±8 %; Horses: ±10 %; Swine: ±42 %; Sheep, Goats: ±62 %.
- 2) Relative uncertainty: 24 %.
- 3) Uncertainty of total inventory given in NIR; sectoral uncertainties calculated from relative uncertainties and emission data.
- 4) Range 14 ... 15.
- 5) Dairy: 0.7 %; Non-dairy: 2.6 %; Other livestock: 0.8 %.
- 6) Cattle: 0.5 %, other livestock: 0.1 %.
- 7) Total uncertainty resulting from Tier 2: analysis: 15 %.
- 8) For Tier 2 calculation: lognormal distribution with 97.5 per-centile 100 times the 2.5 percentile.

2.8 % of total national GHG emissions) and manure management contributes with usually less than 1.5 % to uncertainty. This last sector represents, only in Spain, an important source of uncertainty (4.4 % of total emissions with the uncertainty of Category 4.D being 8.0 % and 11.8 % for direct and indirect emissions, respectively, and a overall uncertainty of 15.8 %).

6.3.1 Enteric fermentation (CRF Source Category 4.A)

CH₄ emissions in the source category 'Enteric fermentation' stem from 10 Member States to over 85 % from the subcategory 'Cattle'. Substantial emissions from the subcategory 'Sheep' (11–49 % of emissions in Category 4.A.) are reported by Greece, Spain, Portugal, the United Kingdom, Italy and Ireland. Emissions accounting for more than 5 % of the emissions in this category are further reported by Greece for the

subcategory 'Goats' (21 %) and Denmark and the Netherlands for the subcategory 'Swine' (11 % and 6 %, respectively).

Accordingly, higher tier methodologies and country-specific methodologies are used for the estimation of CH₄ emissions from cattle. About three quarters of the EU-15 CH₄ emissions from 4.A.3 and at least 80 % of CH₄ emissions from 4.A.1 were estimated by the use of higher tier methods. Table 6.17 gives an overview of the methodologies and emission factors used for calculation of CH₄ emissions from enteric fermentation. Animal population of dairy and non-dairy cattle, sheep, goat, swine, and poultry in 2003 are given in Table 6.18. An overview of the implied emission factors and the methane conversion factors as far as reported by the Member States, are given in Table 6.19.

Regarding animal numbers, some major changes have occurred since 1990. In

all countries, the numbers of cattle are considerably reduced, on average by 26 % for dairy cattle and 7 % for non-dairy cattle (Table 6.19). An increase in the number of cattle has only been observed in the category of non-dairy cattle in Sweden (5 %), Ireland (12 %), and Spain (60 %). In Luxembourg, the dairy cattle population decreased by 31 %, the population of non-dairy cattle (including suckling cows) decreased by 6 %.

A similar situation is given for sheep populations with an EU-15 wide decrease by 12 %. 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 2003 increased by 200 % respective to the population in 1990; in the Netherlands this figure amounts to 351 %. The swine population has been increasing especially in Denmark (36 %), Spain (48 %) and Ireland (60 %). Poultry numbers were increasing in almost all countries moderately with an average increase of 7 % between 1990 and 2003; only Austria reported CH₄ emissions from enteric fermentation of poultry.

Characterisation 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. However, a few differences can be found in the numbers, which can be explained in the following way.

- In the United Kingdom, dairy cattle include also dairy heifers for the calculation of CH₄ emissions from manure management, which is different from the assumptions made in Table 4.A.
- As Table 4.B(b) does not offer to report animal numbers for goats, these are included in the category 'sheep' in the Danish inventory, while being reported separately in Tables 4.A and 4.B(a).
- Young swine are included in Table 4.A for Austria only, which explains the lower number reported for emissions from manure management.
- CH₄ emissions from enteric fermentation are considered to be lower for young animals in the Flemish inventory. In order to use the same emission factors as for adult animals, the population of young animals is corrected by a factor of 0.4 for sheep younger than 1 year, 0.6

Table 6.17 Member State's background information for the calculation of CH₄ emissions in Category 4A

Member State	Comments
Austria NIR 2005, p. 197-207	Cattle: Tier 2. Other animal categories: Tier 1. Tier 2 is based on Tier 1 with national EFs for different sub-categories. For the emissions from poultry the IPCC Tier 2 method with Swiss EFs (Gross Energy Intake, MCF) was used, assuming very similar conditions to Austrian conditions. In 1993, Austria changed the animal counting system with a subsequent shift from the number of "Young swine" to "Fattening pigs". The age class split for swine categories of the years 1990-1992 was adjusted using the split from 1993. Cattle: country-specific values for the Gross Energy Intake for dairy and non-dairy cattle based on typical diets and milk yields between 3000 and 8000 kg per cow and year. Emissions from organic and conventional farming practices have been calculated separately. Swine: a flat emission factor of 1.5 kg/head/year.
Belgium NIR 2005, p. 61; CRF Table4.A for 2003	Tier 1 methodology using IPCC default factors except if country specific data are available. Further harmonisation of the EFs between the regions is foreseen. The EFs presented are a weighted average of the regional EFs. Flanders formerly used the IPCC-emission factors from 1994. In this submission, emission factors from the IPCC guidelines 1996 have been used for the entire time series in Flanders. The IPCC emission factor for swine will be used in Wallonia in the next submission.
Denmark DK NIR 2005, p. 138 ff	All animal categories: Tier 2. Feeding data based on Danish norm figures. Changes in fodder conditions and stable systems are accounted for in each year. MCF for non-dairy cattle: 4 % for rearing of bull calves, 6 % other. Emissions calculated in the framework of the DIEMA model, which include about 30 different livestock categories (by animal type, weight and age classes), which are further sub-divided according to stable types (about 100 combinations). Emissions are calculated for each sub-category and aggregated to IPCC categories.
Finland NIR 2005, p. 104-109	Cattle: Tier 2. Other animal categories: Tier 1. Reindeer: emissions are calculated on basis of Finnish literature. The EFs are very preliminary and needs to be developed further. Additional information: animal weight, daily weight gain, milk production for dairy and suckling cow, digestible energy of forage and length of pasture season national.
France NIR 2004, p. 77 CRF Table4.D for 2003	Diary cattle: country-specific method based on national expert data (emission factors), other animals: Tier 1

Member State	Comments
Germany NIR 2005, p. 6-5 Daemmgen et al., 2004	Dairy cattle: national methodology; other cattle (key source category) and all other animals: Tier 1. The calculation of the EF for dairy cattle is based on a regression approach based on milk production, animal weight (derived from milk production data), and animal feed. The latter (grass/grass silage or maize/maize silage) is derived from the regional agricultural model RAUMIS. The emission factors used for other cattle (IPCC default for Western Europe; default values from the CORINAIR guidebook: EMEP, 2003) reflect the general situation in Germany.
Greece NIR 2005, p. 105	Sheep (half of CH ₄ emissions from enteric fermentation): Tier 2. All animal categories: Tier 1.
Ireland NIR 2005, p. 51	All animal categories: Tier 1. It has not been possible to acquire and apply the full range of input data necessary for Tier 2 EFs. Nevertheless, the suitability of the default EFs for cattle has been assessed and changes that are considered justifiable for Irish conditions have been made. Investigations indicated that the value of 100 kg CH ₄ /head/year value was generally appropriate for dairy cattle in Ireland, where the feed is largely based on grass and silage. For other cattle a weighted EF of 50 kg CH ₄ /head/year was adopted in 2000 during the preparation of Ireland's Climate Change Strategy (determined by Irish agricultural experts in accordance to Tier 2, but not documented for the Irish inventory agency).
Italy CRF Table4.A for 2003	The Tier 2 approach has been followed.
Luxembourg	
Netherlands NIR 2005, p.6-3	Cattle: emission factor from country-specific Tier 2 analysis. The emission factors are calculated every year for several subcategories of dairy and non-dairy cattle, respectively. Other animal categories: Tier 1. Sheep and goats: the same EF is used because sheep and goats roughly consume per animal the equal amount of dry matter.
Portugal NIR 2004, p. 231-232 CRF Table4.A for 2003	All animal categories: Tier 1 level. 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.
Spain NIR 2005, p. 127	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 and national methodologies have been used for their calculation (usually based on disaggregation by breeds, and their characteristics, within the different animal species). Disaggregation in animal types is finer than in IPCC and based on statistics published by MAPA.
Sweden NIR 2005, p. 136, 152-153	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 is based on feed energy requirements expressed as metabolisable energy (initial steps similar to Tier 2). The calculations have been revised recently. For other cattle groups, the conclusion is to use a common emission factor for this group, 50 kg CH ₄ /head and year. For dairy cows the calculation is performed for a lactation period of 305 days and a non-lactating period of 60 days.).
United Kingdom NIR 2004, p. 79	Dairy cattle: Tier 2, varying from year to year. Beef and other cattle: Tier 2, not varying. Lambs and deer: Tier 2. Other animals: Tier 1. For dairy cattle, the animal weight assumed to increase 1 % year ⁻¹ . The calculation is based on the population on the 'dairy breeding herd' rather than 'dairy cattle in milk' because the latter definition includes 'cows in calf but not in milk'. The enteric emission factors for beef cattle were almost identical to the IPCC Tier I default so the default was used in the estimates. The emission factor for lambs is assumed to be 40 % of that for adult sheep.

for horses younger than six months, and 0.5 for all ponies. Swine with a weight less than 20 kg are not counted for CH₄ emissions from enteric fermentation.

- The Belgian (Flemish region) N₂O emission inventory for poultry includes more animal categories such as ostriches for which no CH₄ emission factor is known and therefore a larger poultry population is reported in Table 4.B(b).

Considerable variation is found in the IEF for dairy and non-dairy cattle with values between 81 kg CH₄ head⁻¹ yr⁻¹ (Greece) and 129 kg CH₄ head⁻¹ yr⁻¹ (Sweden) for dairy cattle, and 33 kg CH₄ head⁻¹ yr⁻¹ (The Netherlands) and 73 kg CH₄ head⁻¹ yr⁻¹ (Germany) for non-dairy cattle. The difference could partly be explained with a different classification scheme for cattle and

partly by the different level of intensity for dairy production.

At the aggregated level for EU-15, the implied emission factor for dairy cattle increase from 93 kg CH₄ head⁻¹ yr⁻¹ to 102 kg CH₄ head⁻¹ yr⁻¹ while at the same time the animal number of dairy cattle decreased by 26 %, resulting in a decrease of European CH₄ emissions from enteric fermentation in the category of dairy cattle by 16 %.

Note, however, that the increase of the implied emission factor of 10 % is due to changes reported in 11 countries only, as the others do not use time varying emission factors; for those countries, the increase of methane emission for each dairy cow amounts to 13 %. The implied emission factors for non-dairy cattle, not being linked to the increasing milk yield,

Table 6.18 Animal population (1000 heads) in 2003

Member State	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine	Poultry
Austria	558	1 494	325	55	1 578	13 027
Belgium	787	2 052	146	26	6 526	31 401
Denmark	596	1 128	83	12	12 949	17 796
Finland	334	667	98	7	1 375	10 354
France	4 156	15 757	9 283	1 389	10 237	284 542
Germany	4 363	9 248	2 638	NE	19 534	122 056
Greece	217	376	9 083	5 744	964	31 756
Ireland	1 152	5 510	5 979	8	1 750	12 683
Italy	1 901	4 730	7 952	961	9 111	196 511
Luxembourg ²⁾	41	149	9		84	79
Netherlands	2 661	1 098	1 185	274	11 169	74 896
Portugal	335	1 057	3 406	520	2 296	43 381
Spain	1 115	5 537	23 498	3 162	25 208	153 234
Sweden	403	1 204	448	5	1 902	16 402
United Kingdom	2 192	8 325	35 846	88	5 047	175 414
EU-15	20 811	58 333	99 981	12 251	109 731	1 183 533

1) Information source: CRF Table 4A for 2003, submitted in 2005

2) Information source: background information submitted by Luxembourg

was estimated to be more stable over time and increased in nine countries by 4 % (from 49 kg CH₄ head⁻¹ yr⁻¹ to 51 kg CH₄ head⁻¹ yr⁻¹) and remained stable at EU-15 level. The only country where the IEF for cattle (in the subcategory of non-dairy cattle) decreased (by 6 % and 3 %) between 1990 and 2003 are the Netherlands and Spain, respectively.

For sheep, the implied emission factors changed since 1990 in three countries (Belgium, Spain, and UK) by – 2 %, 3 %, and 3 %, respectively. Note that the IEF for sheep and goats used in Denmark (Tier 2 methodology) is with 17.2 kg CH₄ head⁻¹ yr⁻¹ and 13.2 kg CH₄ head⁻¹ yr⁻¹ considerably higher than the IPCC default values and the numbers used in other Member States.

Table 6.19 Implied emission factors for CH₄ emissions from enteric fermentation and CH₄ conversion factors used in Member State's inventory

Member State	Implied EF (kg CH ₄ /head/yr ¹⁾)					CH ₄ conversion (%) ¹⁾				
	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine
Austria	105	53	8.0	5.0	1.5	6.0	6.0	NE	NE	NE
Belgium	105	48	8.2	9.0	1.5	NE	NE	NE	NE	NE
Denmark	118	36	17.2	13.2	1.1	6.0	4.00/6.00	6.0	5.0	0.6
Finland	117	43	8.0	5.0	1.5	6.0	6.0	NA	NA	NA
France	103	52	8.0	5.0	1.5	NA	NA	NA	NA	NA
Germany	103	73	8.0	NE	2.0	NE	NE	NE	NE	NE
Greece	81	56	7.4	5.0	1.5	NA	NA	5.1	NA	NA
Ireland	100	50	8.0	5.0	1.5	0.0	0.0	0.0	0.0	0.0
Italy ^y	100	48	8.0	5.0	1.5	5.2	4.4		0.0	0.0
Luxembourg	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Netherlands	83	33	8.0	8.0	1.5	NE	NE	NE	NE	NE
Portugal	100	48	8.0	5.0	1.5	NE	NE	NE	NE	NE
Spain	110	59	8.8	4.9	1.3	0.1	0.1	0.1	NA	NA
Sweden	129	57	8.0	5.0	1.6	6.7	7.0	6.0	5.0	0.6
United Kingdom	104	43	4.8	5.0	1.5	6.0	6.0	NE	NE	NE

NA: Not Applicable - NE: Not Estimated

1) Information source: CRF Table 4B(a) for 2003, submitted in 2005

Table 6.20 Total CH₄ emissions and implied Emission Factor at EU-15 level for the years 1990 and 2003

	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine
1990					
Total Emissions of CH ₄ (Gg CH ₄)	2 607	3 312	764	63	163
Total Population (1 000 heads)	28 163	62 500	113 113	12 722	106 326
Implied Emission Factor (kg CH ₄ /head/year)	93	53	7	5	2
	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine
2003					
Total Emissions of CH ₄ (Gg CH ₄)	2 118	3 112	698	62	164
Total Population (1 000 heads)	20 811	58 333	99 956	12 251	109 694
Implied Emission Factor (kg CH ₄ /head/year)	102	53	7	5	2
	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine
2003 value in percent of 1990					
Total Emissions of CH ₄ (Gg CH ₄)	81 %	94 %	91 %	98 %	101 %
Total Population (1 000 heads)	74 %	93 %	88 %	96 %	103 %
Implied Emission Factor (kg CH ₄ /head/year)	110 %	101 %	103 %	101 %	98 %

Source of information: CRF Table4s1 and 4.A for 1990 and 2003. Additional background information for Luxembourg.

6.3.2 Manure management (CH₄) (CRF Source Category 4.B(a))

Table 6.24 shows that at European level, swine and cattle contribute more or less equally to CH₄ emissions from manure management (47 % and 49 %, respectively). For cattle, the contributions of dairy and non-dairy cattle are also at the same level (24 % and 23 %, respectively). The highest contribution of cattle to CH₄ emissions from manure management are observed in Ireland with 83 % of total emissions, the lowest in Portugal, where cattle contribute with only 5 %. This is compensated with the emissions from swine manure with 90 % of the total CH₄ from manure management. As also for enteric fermentation, significant emissions from sheep and goat occur in Greece with 11 % and 4.5 % of total CH₄ from manure management emissions, respectively. Greece has also the highest contribution of poultry to CH₄ emissions from manure management with 16 %.

An overview of the methodologies and emission factors used in Member State's inventory is given in Table 6.21. About one quarter of the EU-15 CH₄ emissions from 4.B.1 and about 40 % of the CH₄ emissions

from 4.B.8 were estimated by the use of higher tier methodologies. Table 6.22 summarises 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. 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 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. In Denmark for dairy cattle, there was a shift from manure managed in solid systems to liquid systems, which increased from 70 % of the total manure in 1990 to 76 % in 2003. This was compensated by a reduction in the percentage of manure managed in

Table 6.21 Member State's background information for the calculation of CH₄ emissions in Category 4B (CH₄)

Member State	Comments
Austria NIR 2005, p. 208-213	Tier 2: cattle and swine. Other animals: Tier 1. Manure management systems for dairy cattle, suckling cows and cattle 1-2 years in "summer situation" and "winter situation". In summer, 14.1 of Austrian dairy cows and suckling cows are on alpine pastures 24 hours/day. 43.6 % are on pasture for 4 hours/day; rest not on pasture. This results in 21.3 % pasture/range/paddock during summer. VS country-specific as a function of manure production (based on milk yield) and feed diet with country-specific feed rations under organic and conventional management. No change in feed intake for non-dairy cattle occurred and a constant VS excretion rate was used. VS excretion for swine country-specific constant value
Belgium NIR 2005, p. 61-62	Flanders: Tier 2 method with country-specific data. In the calculation, a 'integrator' is used to account for the fact that the weight of the cattle of the whole lifetime is not the same as the slaughter weight, and integrates therefore between the weight at birth and the slaughter weight. Wallonia: EFs for each animal category by Sinterem taking into account type and volume of manure produced during time spent in stables, density, carbon content, and carbon volatilization ratio. The parameters come from studies conducted in Wallonia or France.
Denmark NIR 2005, p. 141 ff	All animal types: Tier 2; disaggregation as for category 4A with estimates based on national data for feed consumption and standards for ash content and digestibility. MCF for liquid systems national (10 %). Reduction of CH ₄ emissions in biogas plants included in the inventory.
Finland NIR 2005, p. 109-116	Tier 2 for all animal categories. EF both national and default. Cattle national: digestible energy, fraction of animal's manure managed annually in each AWMS, average milk production and animal weight. For MCF, a default value of 10 % (IPCC 1997) has been used instead of 39 % (IPCC 2000) due to Finland's climatic conditions.
France NIR 2004, p. 78 CRF Table4.B(a) for 2003	Tier 1. AWMS distribution national. Milk heifers are counted with non-dairy cattle. But heifers more than 2 years old (40 % of the total heifer livestock) are considered as dairy cattle.
Germany NIR 2005, p. 6-16	As detailed data for the application of the Tier 2 methodology are missing, emissions are estimated using the "simple" CORINAIR (EMEP, 2003) methodology. The emission factors represent the general situation in Germany. Calculations are done at the district level.
Greece NIR 2005, p. 109	Tier 1. AWMS distribution estimated on the basis of IPCC and country-specific values and kept constant.
Ireland	Tier 2 with IPCC default values for B ₀ , V _s , and MCF, while accounting for conditions that would be representative for Ireland. Only emissions from cattle and swine are relevant.
Italy	
Luxembourg	
Netherlands NIR 2005, p. 6-6	Tier 2 methodology for all animal categories distinguishing three manure management systems: liquid manure, solid manure and pasture. Country-specific EFs expressed in kg CH ₄ per kg of manure and are based on volatile solids and maximum methane producing capacity for all AWMS and additionally on storage temperature and storage period for liquid manure systems.
Portugal NIR 2004, p. 236-242	Tier 2
Spain NIR 2005, p. 128-129	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 NIR 2005, p. 136, 144-145	Cattle and Swine: Tier 2; all other animal groups: Tier 1. Default values for MCF and B _{0i} factors except for MCF for liquid manure, where the value of 10 % is adopted as national value. This is considered to be a more appropriate value 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. Since dairy cows often are stabled during the night, the data on stable period for this animal category is combined with an assumption that 45 % (Swedish Board of Agriculture, 1995) of its manure was produced in the stable (assumption made in STANK model)
United Kingdom NIR 2004, p. 92	Dairy cattle: Tier 2. Other animals: Tier 1. IPCC default with the exception of lambs (40 % of adult sheep) and deer. 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.

solid storage systems while the proportion of manure from dairy cattle excreted on pasture, range and paddock remained constant at 15 %. The situation was different for non-dairy cattle, where the proportion of the liquid systems decreased from 37 to 23 % of the manure with a corresponding increase of the use of solid system (from 36 to 40 %) and an increase in the fraction of manure

excreted in pasture, range and paddock (from 28 to 37 %).

On the contrary, liquid systems were more frequently used to manage manure from dairy cattle in Sweden (from 24 % in 1990 to 49 %) and Germany (from 66 to 83 %) with a corresponding decrease of the importance of solid storage systems. The trend for

Table 6.22 Member State's allocation of animal waste management systems over liquid systems, solid storage and dry lot, and pasture range and paddock in 2003

Member State	Dairy Cattle - Allocation of AWMS (%) ¹⁾			Non-Dairy Cattle - Allocation of AWMS (%) ¹⁾			Swine - Allocation of AWMS (%) ¹⁾		
	Liquid system ²⁾	Solid storage and dry lot	Pasture range paddock	Liquid system ²⁾	Solid storage and dry lot	Pasture range paddock	Liquid system ²⁾	Solid storage and dry lot	Pasture range paddock
Austria	19	70	11	24	66	10	71	29	
Belgium									
Denmark	76	9	15	23	40	37	91	8	1
Finland	25	47	28	23	51	25	57	43	
France	11	42	47	19	29	51	84	16	0
Germany	83	17		54	46		91	9	
Greece									
Ireland	30	12	58	17	18	65	100		
Italy	33	58	10	35	60	5	100		
Luxembourg									
Netherlands									
Portugal	35	35	30		60	40	98	1	1
Spain									
Sweden	49	29	21	15	25	45	74	23	
United Kingdom	31	10	46	6	21	51	31	55	7

NA: Not Applicable - NE: Not Estimated. The portion lacking for 100% are reported as daily spread (only UK) and 'other'.

1) Information source: CRF Table 4B(a) for 2003, submitted in 2005

2) Anaerobic lagoon + Liquid system. Anaerobic lagoon contributes only in Ireland with 2% of the manure managed.

non-dairy cattle goes in the other direction in Sweden with a decreasing portion of manure managed in liquid systems (21 % in 1990 and 15 % in 2003) and increasing use of solid storage systems. In Sweden, the fraction of manure on pasture, range and paddock increased for both dairy (from 17 to 21 %) and non-dairy cattle (from 31 to 45 %).

In Finland, the largest shifts in manure management systems was observed for swine, where over 90 % were managed in liquid systems in 2003, while in 1990 more than half of the manure was managed in solid storage systems. The same trend occurred in Sweden where 74 % of manure from swine was stored in liquid systems in 2003, compared to 44 % in 1990. In Germany, liquid systems were already the major manure management system for swine in 1990 (85 %) and the importance increased during the last 13 years up to 91 %.

The implied emission factors for CH₄ emissions from manure management vary substantially among the Member States, as shown in Table 6.23. The range of the implied emission factors for dairy cattle, non-dairy cattle and swine covers more than 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 CH₄ head⁻¹ y⁻¹ is proposed for cool climate regions and a factor of 81 kg CH₄ 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 30 for dairy cattle, and 12 for non-dairy cattle and 13, 11 and 11 for sheep, goats and swine. Thus, it is not surprising that the highest implied emission factor for dairy cattle is found for Germany, which manages 83 % of the manure in liquid systems, and a much lower IEF is reported by Austria, where only 19 % of the manure is managed in liquid systems.

Also, the trend in the implied emission factors does not correspond to climate regions. By far the highest IEF for dairy cattle is used in the German inventory (85.6 kg CH₄ head⁻¹ y⁻¹), followed by the UK, The Netherlands, Belgium, and Italy (25.5 to 20.0 kg CH₄ head⁻¹ y⁻¹). IEFs between 10 and 20 kg CH₄ head⁻¹ y⁻¹ are reported by most countries and an implied emission factor smaller than 10 kg CH₄ head⁻¹ y⁻¹ is used only by Finland (8.5) and Portugal (2.9). The ranking of the countries for their IEFs

Table 6.23 Implied emission factors for CH₄ emissions from manure management used in Member State's inventory

Member State	Implied EF (kg CH ₄ /head/yr) ¹⁾				
	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine
Austria	19.1	7.2	0.2	0.1	12.4
Belgium	21.7	13.6	1.4	1.4	10.1
Denmark	18.0	1.8	0.3	0.3	2.5
Finland	8.5	2.3	0.2	0.1	3.4
France	18.5	18.8	0.3	0.2	20.9
Germany	85.6	20.0	0.2	NE	27.2
Greece	19.0	13.0	0.3	0.2	7.0
Ireland	15.9	6.4			5.4
Italy	20.0	10.6	0.2	0.1	7.8
Luxembourg					
Netherlands	24.0	3.8	0.2	0.3	3.9
Portugal	2.9	1.7	0.2	0.1	26.3
Spain	14.3	3.8	0.2	0.2	14.0
Sweden	17.8	5.9	0.2	0.1	3.0
United Kingdom	25.5	4.2	0.1	0.1	3.0

NA: Not Applicable - NE: Not Estimated

1) Information source: CRF Table 4B(a) for 2003, submitted in 2005

Table 6.24 Total CH₄ emissions from manure management and implied emission factor at EU-15 level

	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Horses	Swine	Poultry
1990							
Total Emissions of CH ₄ (Gg CH ₄)	796	806	20	2	5	1367	107
Total Population (1 000 heads)	28 110	62 559	113 191	12 433	2 335	105 375	1 109 492
Implied Emission Factor (kg CH ₄ /head/year)	28	13	0.2	0.2	2	13	0.1
	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Horses	Swine	Poultry
2003							
Total Emissions of CH ₄ (Gg CH ₄)	697	684	18	2	6	1 432	107
Total Population (1 000 heads)	20 811	58 184	99 981	12 251	2 698	109 731	1 183 533
Implied Emission Factor (kg CH ₄ /head/year)	33	12	0.2	0.2	2	13	0.1
	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Horses	Swine	Poultry
2003 value in percent of 1990							
Total Emissions of CH ₄ (Gg CH ₄)	88 %	85 %	92 %	101 %	120 %	105 %	100 %
Total Population (1 000 heads)	74 %	93 %	88 %	99 %	116 %	104 %	107 %
Implied Emission Factor (kg CH ₄ /head/year)	118 %	91 %	104 %	102 %	103 %	101 %	93 %

Source of information: CRF Table 4s1 and 4.A for 1990 and 2003. Additional background information for Luxembourg.

of non-dairy cattle and swine are different; they have in common only that the highest IEF is used in Germany.

Note that, for dairy cattle for example, most countries are allocating 100 % of the population to the cool climate region,

with Italy, Portugal and Spain allocating a part of the population to the temperate region (89 %, 49 %, and 72 %, respectively) and only Greece allocating 100 % of the animals to the temperate climate region. France assumes 98 % of the dairy cattle in the temperate and 2 % of the cattle in the warm climate region. Looking at another animal type, as for example swine, the distribution across the climate regions is somewhat different. In Italy, the higher proportion of the swine population lives in the cool climate region (95 %), while in Portugal and Spain, the portion of animals living in the cool climate region is smaller than for dairy (and non-dairy) cattle with 21 % and 38 %, respectively. In France, the same allocation across the climate regions for swine is assumed as for dairy cattle. For the categories dairy cattle, non-dairy cattle and swine, only in few cases did the allocation of animal population to climate regions change since 1990; this is most distinctly for Belgium, which assigned 100 % of the animal population to the temperate climate region in 1990 and 100 % to the cool climate region in 2003. In Spain, the swine population shifted from a majority living in the cool climate region (53 %) in 1990 to the temperate climate region (62 %) in 2003.

At EU-15 level, CH₄ emissions from manure management have decreased for most animal types (cattle, sheep, swine, and poultry), and have increased for goats (combined effect of a small increase in the goat population and in the implied emission factor used) and horse (increase of the animal number by 16 %). The emissions from poultry decreased slightly despite the falling animal numbers due to higher emission factors used for the 2003 inventory. The opposite applies for dairy cattle, where a large decrease in the animal population (-22 %) is compensated partly by enhanced manure production (15 %).

6.3.3 Manure management (N₂O) (CRF Source Category 4.B(b))

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 78 % in Sweden and 99 % in Portugal. Note that in the German inventory, N₂O emissions from manure management are estimated according to the mass-flow approach using IPCC Tier 1 methodologies (an overview of the methodologies and emission factors

used in all Member States is given in Table 6.25), but report N₂O emissions from manure management under the subcategory 'other' and do not report implied emission factors or emissions separated for liquid and solid manure storage systems. About 10 % of the EU-15 N₂O emissions from 4.B.12 were estimated by the use of higher tier methods.

Generally, GHG emissions (in CO₂-equivalents) from manure management are predominantly CH₄ rather than N₂O emissions. This is seen most significantly in the German inventory, where 7.9 times as much is emitted as CH₄ compared to N₂O, followed by Spain (ratio 5.3). Values close or smaller to unity are found for Finland (0.5), Sweden (0.8), Austria (1.3), and Portugal (1.4). Table 6.27 shows that the implied emission factors used for N₂O emission from manure management are IPCC default for all countries are close to the default value. Thus, the differences of the ratio across the countries can partly be explained by the implied emission factor used for CH₄ emissions in the manure management category (see discussion above), and partly by the nitrogen excretion factors. Total nitrogen excretion by Member State and manure management system are given in Table 6.26.

These numbers are based on the used nitrogen excretion rate per head and year, where a range by a factor of ca. 2.5 between the highest and the lowest value used is found. For example, for dairy cattle, we have a range between 55.8 kg N head⁻¹ y⁻¹ for Austria and 129.5 kg N head⁻¹ y⁻¹ for Denmark (factor 2.3). The largest range is found for sheep with values between 5.2 kg N head⁻¹ y⁻¹ (Sweden) and 21.2 kg N head⁻¹ y⁻¹ (Denmark). The range for non-dairy cattle is the narrowest one with values ranging between 29.6 kg N head⁻¹ y⁻¹ and 57.9 kg N head⁻¹ y⁻¹ for Austria and France, respectively.

Emissions of N₂O, amount of nitrogen excreted and implied emission factors for anaerobic lagoons, liquid systems, and solid storage and dry lot, are reported for the EU-15 in Table 6.28. Since 1990, the total amount of nitrogen excreted and managed in liquid or solid storage systems has been reduced by 5 % for the EU-15. Parallel to this development, the amount of nitrogen excreted on pasture, range and paddock decreased by 5 %. However, there are large differences in the development between the Member States. In Belgium,

Table 6.25 Member State's background information for the calculation of N₂O emissions in Category 4B(b)

Member State	Comments
Austria NIR 2005, p. 209	Tier 1. For cattle and swine: country-specific EFs. N excretion from dairy cattle based on milk yield; N excretion from non-dairy cattle national. N excretion of cattle < 1 year: from revised German inventory, cattle > 2 year: from Swiss inventory. N excretion from swine: national.
Belgium NIR 2005, p. 63-65	Nitrogen excreted by each animal category is estimated through local production factors. In Wallonia, the methane emissions from the manure applied during grazing are reported under agricultural soils (category 4.D). It will be checked if these emissions should not rather be included in the manure management category.
Denmark NIR 2005, p. 143 ff	Country-specific calculation of nitrogen excretion figures in the framework of the DIEMA model complex. IPCC default factors. Reduction of N ₂ O emission in biogas plant included in the inventory.
Finland NIR 2005, p. 109-116	IPCC - default factors
France NIR 2004, p. 78 CRF Table4.B(b) for 2003	Tier 1. AWMS distribution is based on country specific data. For nitrogen excretion: heifers more than 2 years old are considered as dairy cattle but this livestock is counted with Non-dairy cattle.
Germany Daemmgen et al., 2004 NIR 2005, p. 6-16	Emissions of nitrogen compounds from manure management is done with the mass-flow (EMEP, 2003), using IPCC methodologies (Tier 1) for N ₂ O and NO emission estimates, which are no key sources. The distribution over manure management systems takes 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 . All calculations are done on the district level using the agricultural model RAUMIS. N-excretion factors are calculated on the basis of milk productivity for dairy cattle and national data for other animals. Values for the content of total ammoniacal nitrogen (TAN) were estimated for cattle, swine, sheep, horses, and poultry.
Greece	
Ireland NIR 2005, p. 52	Proportion of manure nitrogen assigned to each applicable AWMS and nitrogen excretion rates for cattle: national. N-excretion rates for sheep, swine and poultry: IPCC default. The same values are used for all years.
Italy	
Luxembourg	
Netherlands NIR 2005, p. 6-6	IPCC default factors for liquid and solid manure management systems. Activity data are collected at Tier 2 level for cattle and swine.
Portugal NIR 2004, p. 244-248	IPCC with country-specific nitrogen excretion factors
Spain NIR 2005, p. 132	IPCC methodology using Nex fraction of the "Near East & Mediterranean" climate region and applying age-related correction factors.
Sweden	IPCC methodology
United Kingdom NIR 2004, p. 93-95	IPCC methodology. It is assumed that 20 % of the total N emitted by livestock volatilises as NO _x and NH ₃ - Nex factors used in the AWMS estimates are 20 % less than total nitrogen excreted.

Source: CRF Tables.4B (B) for 2003, submitted in 2005.

for example, only 42 % of the amount of nitrogen was excreted in 2003 on pasture, range and paddock compared to 1990 (while total manure production decreased by 7 %). On the other site, nitrogen excretion on pasture, range and paddock increased in Sweden by 24 % while total manure excretion dropped by 2 %.

The amount of manure managed in liquid systems decreased from 1990 to 2003 from 2 010 Gg N to 1 894 Gg N (6 %). Significant increases of the amount of nitrogen managed in liquid systems occurred in Ireland (9 %) and Sweden (40 %).

As all countries are using IPCC default values for the IEF or values that are close to it, these numbers apply also for the EU-15 N₂O inventory for manure management. Also, no changes occurred in the IEFs used since 1990, the decreases in N₂O emissions of 9 % and 7 % for liquid and solid manure storage systems are solely due to decreases in nitrogen excretion by the same fraction. The slight difference in the numbers presented in Table 6.29 for the reduction of N₂O emissions from and N excretion into liquid management systems are due to a slight decrease of the implied emission factor used in Denmark from 0.10 % in 1990 to 0.09 % in 2003.

Table 6.26 Total nitrogen excretion by animal waste management system (Gg N) – 2003

Member State	Anaerobic lagoon	Liquid systems	Daily Spread	Solid storage and dry lot	Pasture range paddock	Other	Total
Austria		41		68	22	10	141
Belgium		122	52	84	43	4	304
Denmark		191		50	32		273
Finland		22		40	17		78
France		476		623	802		1 901
Germany		7		3	2		12
Greece		14	1	27	364	6	411
Ireland	9	98		62	289		459
Italy		258		367	173	28	825
Luxembourg							
Netherlands		316		55			371
Portugal	35	16		103	57		211
Spain		182	113	156	433	1	884
Sweden		47		45	43	11	145
United Kingdom		104	106	112	470	93	885
EU-15	44	1 894	272	1 795	2 745	152	6 902

(¹) Information source: CRF Table 4C for 2003 and 1990, submitted in 2005

Table 6.27 Implied Emission factors for N₂O emissions from manure management used in Member State's inventory

Member State	Implied EF (kg N ₂ O-N/kg N) ¹⁾		
	Anaerobic lagoon	Liquid system	Solid storage and dry lot
Austria		0.100 %	2.00 %
Belgium	NO	0.100 %	2.00 %
Denmark		0.09 %	1.96 %
Finland	NO	0.104 %	2.34 %
France		0.100 %	2.00 %
Germany	NO	IE	IE
Greece		0.100 %	2.00 %
Ireland	0.10 %	0.100 %	2.00 %
Italy	NO	0.100 %	2.00 %
Luxembourg			
Netherlands	NO	0.087 %	1.73 %
Portugal	0.10 %	0.100 %	2.00 %
Spain	NO	0.100 %	2.00 %
Sweden	NO	0.100 %	2.00 %
United Kingdom		0.098 %	2.01 %

NA: Not Applicable - NE: Not Estimated

(¹) Information source: CRF Table 4B(b) for 2003, submitted in 2005.

6.3.4 Rice cultivation (CH₄) (CRF Source Category 4.C)

Rice cultivation occurs in five EU-15 countries: France, Greece, Italy, Portugal, and Spain. Italy is by far the largest producer of rice in Europe, with 2 187 km² of rice cultivation, followed by Spain with an area of 1 170 km². The other three countries have rice producing areas around 200 km², as shown in Table 6.29 for the rice

cultivation practices continuously flooded, intermittently flooded with single aeration, and intermittently flooded with multiple aeration. All countries but Italy report 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

Table 6.28 Total N₂O emissions, nitrogen excreted and implied Emission Factor for Category 4B(b) at EU-15 level

	Anaerobic lagoon	Liquid systems	Solid storage and dry lots
1990			
Total Emissions of N ₂ O (Gg N ₂ O-N)	0.08	3.0	61.4
Total Nitrogen excreted (Gg N)	49	2 010	1 968
Implied Emission Factor (kg N ₂ O-N/kg N)	0.10 %	0.10 %	1.98 %
	Anaerobic lagoon	Liquid systems	Solid storage and dry lots
2003			
Total Emissions of N ₂ O (Gg N ₂ O-N)	0.07	2.9	56.3
Total Nitrogen excreted (Gg N)	44	1 894	1 795
Implied Emission Factor (kg N ₂ O-N/kg N)	0.10 %	0.10 %	1.99 %
	Anaerobic lagoon	Liquid systems	Solid storage and dry lots
2003 value in percent of 1990			
Total Emissions of N ₂ O (Gg N ₂ O-N)	90 %	94 %	92 %
Total Nitrogen excreted (Gg N)	91 %	94 %	91 %
Implied Emission Factor (kg N ₂ O-N/kg N)	100 %	100 %	101 %

The figure for the EC-total animal numbers exclude Luxembourg, as no background information are available. The contribution of Luxembourg to total EC emissions in sector 4.A equals 0.35% for dairy cattle and 0.24% for non-dairy cattle.

each, can happen in 85 % of rice paddies, a clearly uninterrupted submersion in 13–14 % and about one month delayed submersion in 1–2 % (IT NIR 2003).

The trend in rice-growing areas in these countries is diverse: while in Italy, the area cultivated with rice fluctuated since 1990, its level in 2003 was 2 % larger than in 1990. The harvested area in Spain increased from 1990 to 2003 by 28 %, but around 1993–1995 rice production was only half of the area in 1990; also Greece increased its rice production since 1990 by 37 %. The trend was opposite in France with peaks in rice

production during 1993–1995 and about the same level in 1990 and 2003. Finally, Portugal saw a decline in rice production, amounting to 24 % since 1990.

A summary of the implied emission factors used by these countries is given in Table 6.30. France and Greece use 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

Table 6.29 Harvested area rice in the Member States in 2003 and 1990

Member State	Harvested area in 2003 (109 m ²)		
	Continuously Flooded	Intermittently flooded: single aeration	Intermittently flooded: multiple aeration
2003			
France	0.23		
Greece	0.23	NO	NO
Italy	0.31	0.02	1.86
Portugal	0.26	NO	NO
Spain	1.16	NO	NO
Member State	Harvested area in 1990 (109 m ²)		
1990	Continuously Flooded	Intermittently flooded: single aeration	Intermittently flooded: multiple aeration
France	0.24		
Greece	0.16	NO	NO
Italy	0.30	0.02	1.83
Portugal	0.34	NO	NO
Spain	0.90	NO	NO

NA: Not Applicable - NE: Not Estimated

(¹) Information source: CRF Table 4C for 2003 and 1990, submitted in 2005

Table 6.30 Implied emission factors for CH₄ emissions from rice cultivation used in Member State's inventory

Member State	Implied EF (g CH ₄ · m ⁻²) ⁽¹⁾		
	Continuously Flooded	Intermittently flooded: single aeration	Intermittently flooded: multiple aeration
France	20.0		
Greece	20.0	NO	NO
Italy	59.4	44.6	29.7
Portugal	29.6	0.0	0.0
Spain	12.0	NO	NO

NA: Not Applicable - NE: Not Estimated - NO: Not Occurring

(¹) Information source: CRF Table 4B(a) for 2003, submitted in 2005

Table 6.31 Total CH₄ emissions, area harvested and implied Emission Factor for category 4.C at EU-15 level

	Continuously Flooded	Intermittently flooded: single aeration	Intermittently flooded: multiple aeration
1990			
Total Emissions of CH ₄ (Gg CH ₄)	49.0	1.0	54.4
Total Area harvested (109 m ² y ⁻¹)	1.9	0.0	1.8
Implied Emission Factor (g CH ₄ /m ²)	25.2	44.6	29.7
	Continuously Flooded	Intermittently flooded: single aeration	Intermittently flooded: multiple aeration
2003			
Total Emissions of CH ₄ (Gg CH ₄)	48.8	1.0	55.2
Total Area harvested (109 m ² y ⁻¹)	2.2	0.0	1.9
Implied Emission Factor (g CH ₄ /m ²)	22.4	44.6	29.7
	Continuously Flooded	Intermittently flooded: single aeration	Intermittently flooded: multiple aeration
2003 value in percent of 1990			
Total Emissions of CH ₄ (Gg CH ₄)	100 %	102 %	102 %
Total Area harvested (109 m ² y ⁻¹)	112 %	102 %	102 %
Implied Emission Factor (g CH ₄ /m ²)	89 %	100 %	100 %

a seasonally averaged emission factor). In Italy, as reference factor 33 g m⁻² CH₄ per year has been selected (Schuetz et al., 1989) ⁽¹⁸⁾, which is based on averaged CH₄ flux measurements over three years during the growing period only, carried out in continuously flooded rice paddies in the Po valley, without organic matter amendment or mineral fertilisation (Tani, 2000) ⁽¹⁹⁾. The value has been adapted to 39.6 g m⁻² CH₄ per year to take into account the post-harvest emissions (Tani, 2000). This value has been multiplied with the factor of 1.5 to account for the assumed emissions of rice fields that are amended with organic matter (factor of two) representing about 50 % of the area cultivated. A scaling factor

of 25 % and 50 % has then been applied to estimate the emissions from single and multiple aeration management regimes (IT NIR 2003). No changes in implied emission factors occurred since 1990. Spain uses a seasonal emission factor of 12 g m⁻², which has been obtained from Table 4-9 of the IPCC guidelines reporting a study carried out in Spain (Seiler et al., 1984); the values used by Portugal in 1990 and 2003 are the abovementioned values of 36 g m⁻² measured by Schuetz et al. (1989) and 29.6 g m⁻², respectively.

At EU-15 level, the implied emission factor amounts to 22.4 g m⁻² in 2003 for continuous flooded rice fields, which

⁽¹⁸⁾ Schütz, H., Seiler, W., and Conrad, R.: Processes involved in formation and emission of methane in rice paddies, *Biogeochem.*, 7, 33-3, 1989.

⁽¹⁹⁾ Tani, A.: Methane emissions from rice paddies: review, assessment and perspectives for Italian lands, technical report carried out for APAT, 2000.

Table 6.32 Member State's background information for the calculation of N₂O emissions in Category 4D

Member State	Comments
Austria	Link between ammonia and nitrous oxide inventories.
NIR 2005, p. 218-231	Direct emissions: mineral fertilizers and urea application; manure application; nitrogen fixation and crop residues using default EF. Crop residues: national values for crop to residue ratios Nitrogen fixation: national values for N fixation legumes and clover-hey Indirect due to volatilization: FracGASF 23 % for mineral fertilizers and 15.3 % for urea fertilizers (CORINAIR) Leaching and run-off: FracGASM is calculated as Nlosses/Nextotal, considering nitrogen excreted during grazing, NH ₃ losses during housing and manure storage and N ₂ O emissions during manure management and upon application on land are according to CORINAIR (see Austria's Informative Report 2004 under the UNECE CLRTAP) resulting (for 2003) in 20 % loss. Sewage sludge: N content 3.9 % dry matter.
Belgium	Direct emissions: daily spread, mineral and organic fertilisers, crop residues using IPCC default EF. Nitrogen content in the non-N-fixing crops and fraction of crop residues removed as crop has been changed from the IPCC default values to crop-specific values. Grazing animals: based on number of days in pasture, N excretion, and volatilisation. Default IPCC EF. Indirect emissions: leaching and runoff and atmospheric deposition. FracGASF 2.3 % in Wallonia (recommended by IIASA for different fertiliser types); 4.3 % in Flanders (weighted average for NH ₃ and NO volatilisation). Leaching and run-off estimated on the basis on N from grazing animals, fertilisers, crop residues, sludge and atmospheric deposition. National FracLEACH 17 %, default IPCC EF.
NIR 2005, p. 60-64	
Denmark	N ₂ O emissions are closely related to the N balance calculated in the framework of the DIEMA modelling complex. EFs are IPCC default
NIR 2005, p. 145 ff	Synthetic fertiliser: Ca. 1-2 % of the fertiliser is applied on parks, golf courses and private gardens. Manure: Amount of N applied = N-excretion in stables minus the emissions of ammonia in stables, storage, and in relation to application of manure, is obtained from ammonia emission inventory Nitrogen-fixing crops: Tier 1b. Emissions from clover-grass are included (contribution in 2003: 63 %). Estimates of amount of N fixed model-based (DIAS) Crop residues: cereals: aboveground residues are straw+stubble+husks. Straw is given in the census and amounts used for feeding, bedding, and fuel are subtracted. Straw for feeding and bedding are subtracted as they are later returned to the soil with the manure. Cultivation of histosols: a constant fraction of 10 % of the organic soil cultivation is assumed to be in rotation Indirect due to volatilization: NH ₃ from fertilizer, crops, NH ₃ -t
Finland	□ age
NIR 2005, p. 116-123	sludge, cultivation of organic soils. indirect emissions from nitrogen volatilisation and nitrogen leaching from synthetic fertiliser, manure and sewage sludge applied to soils. Emissions from nitrogen excreted to pasture range and paddocks. Default emission factors. National values for FracGASF (0.006), FracGASM (0.31), and FracLEACH (0.15). Some national values for crop residue to crop product ratio, dry matter fraction, and nitrogen fraction in crop residues. Correction for volatilisation for synthetic fertiliser and manure applied. Indirect emissions due to volatilisation calculated from volatilised synthetic fertiliser and total manure and sewage sludge.
France	Country-specific.
CRF Table 4.D for 2003	
Germany	N ₂ O and NO emissions are calculated using default emission factors for N ₂ O (0.0125 kg kg ⁻¹ N) and emission factors for NO (0.007 kg kg ⁻¹ N) and N ₂ (0.1 kg kg ⁻¹ N). Sub-categories included: Synthetic fertiliser, manure, N-fixing crops, crop residues, organic soils, grazing animals, and indirect emissions following volatilization of N-compounds and leaching and run-off. Emissions from the application of sewage sludge are not included. N-fixing crops: national data on the amount of nitrogen fixed per hectare, disaggregated for leguminous crops (250 kg ha ⁻¹ N), clover and clover/grass and clover/alfalfa (200 kg ha ⁻¹ N), and alfalfa (300 kg ha ⁻¹ N). Crop residues: national data for nitrogen content in crop residues in kg ha ⁻¹ N. Grazing animals: N input calculated with the mass-flow approach with default factors for N ₂ O, NH ₃ , and NO emissions (IPCC, EMEP)
NIR 2005, p. 6-23 - 6-30	
Greece	All source categories considered with IPCC default methodologies.
NIR 2005, p. 112-115	Crop residues: Tier 1b using default factors. Fraction burned in fields assumed to be 10 % (IPCC GPG)
Ireland	All sources for direct N ₂ O emissions are considered except application of sewage sludge (not quantified) and cultivation of organic soils (is taken as negligible).
NIR 2005, p. 53-55	N-fixing crops and crop residues: Tier 1b with default IPCC input parameter Grazing animals: default EF Indirect due to volatilisation: Volatilisation of NH ₃ from synthetic fertiliser and animal wastes taken from NH ₃ inventory (CORINAIR emission factors, based on quantitative information, manure management practices and synthetic fertiliser types). NOx emissions are assumed to be negligible. Indirect due to leaching and run-off: national value for FracLEACH (10 %), based on estimates of the nitrogen load as in Irish rivers under the OSPAR convention suggesting that 10 % of all applied nitrogen in Ireland is lost through leaching.

Member State	Comments
Italy	Crop residues: all burned crop residues are considered: residues from cereal production reported in cat 4D, residues removed, collected and burnt on open fields (olives and vineyard residues) in sector 6 (response to centralised review of 2004 submission)
Luxembourg	
Netherlands NIR 2005, p. 6-9 f	<p>Country-specific activity data on N input to soil and NH₃ volatilisation during grazing, manure management and manure application. Most of these data are estimated on a Tier 2 level (or higher). Country-specific EFs for direct N₂O emissions and emissions from animal production.</p> <p>Syn <input type="checkbox"/> fertiliser.</p> <p>Manure: distinction between organic and inorganic soils and between manure application methods.</p> <p>Histosols, crop residues, and N-fixing crops: Tier 2</p> <p>Indirect due to volatilisation: Tier 1, country-specific data on ammonia volatilisation</p> <p>Nitrogen leaching and run-off: Tier 1</p>
Portugal NIR 2004, p. 249-266	<p>Ma <input type="checkbox"/> introduces a 'fraction of manure-nitrogen used as fertilizer'. The equation splits also the volatilization fraction into 'volatilization during housing and storage' and 'volatilization upon application' (calculated using CORINAIR methodology). FracGASM in Table 4.D corresponds to the volatilization upon application.</p> <p>Crop residues: includes annual crops, permanent crops, carob production. Tier 1b methodology with mostly IPCC default and some national parameters.</p> <p>Indirect due to volatilization: considered volatilised of NH₃+NOx from housing, storage, and excretion of manure during grazing, and application of manure and synthetic fertiliser.</p> <p>Nitrogen leaching and run-off: quantity of nitrogen volatilised as NH₃+NOx subtracted before applying FracLEACH.</p> <p>No estimation of emissions from histosols and sewage sludge, which are considered minor.</p>
Spain NIR 2005, p. 130-131	<p>Crop residues: national methodology</p> <p>Grazing animals: N contained in manure calculated as described for cat. 4B(b)</p> <p>Indirect due to volatilization: FracGASF is the value of NH₃ and NOx calculated in the inventory</p> <p>Nitrogen leaching and run-off: FracLEACH of 15 % used</p>
Sweden NIR 2005, p. 137-143, 154-155	<p>Synthetic fertilizer: correction for FracGASF - statistics on sold fertilizer. The fertiliser sales values are however a bit higher than the estimated use of fertilisers (e.g horticulture). National EF (Klemedtsson, 2001) of 0.8 %.</p> <p>Manure: correction for FracGASM; Grazing period considered in the equation. FracGASM estimated by Statistics Sweden and Swedish EPA. The estimates are model-based and take into account many factors that influence gas emissions. National EF (Klemedtsson, 2001) of 2.5 %.</p> <p>Sewage sludge: included in inventory with FracGASM of 30 %; differentiation between direct and indirect emissions of N₂O.</p> <p>Nitrogen fixing crops: national value for N-fixation (fraction of yield: 0.047)</p> <p>Lay land (N-fixing crops): based the amount of leguminous crops in lay land (Nfixing factor) by county, calculated by a model NPK-FLO</p> <p>Crop residues: IPCC GPG methodology with national values for the fraction of crop residue to crop product and nitrogen content in crop residues.</p> <p>Background emissions: also for mineral soils (national EF=0.5 kg N₂O-N/ha), for organic soils default EF</p> <p>Grazing animals: Nitrogen lost as ammonia is excluded; in consistency to the calculation of indirect emissions. Default EF except cattle: weighted EF of 1.8 % (manure on permanent grassland (20 %) and temporary grassland or fertilised arable land (80 %))</p> <p>Indirect due to volatilization: FracGASF based on Corinair methodology; FracGASM national; FracGASG included: fraction of manure from grazing animals emitted as ammonia.</p> <p>Nitrogen leaching and run-off: SOILNDB model, which is part of the SOIL/SOILN model (Johnsson, 1990; Swedish EPA, 2002). By using nati <input type="checkbox"/> regions. These regions are based on similarities in agricultural production. LEACHFACTOR is estimated as 27 kg N/ha for 1990-1997 and 23 kg N/ha since 1999. 1998 interpolated. Implied FracLEACH depends on sum of nitrogen in fertiliser</p>
United Kingdom NIR 2004, p. 94-96	<p>All categories considered, IPCC default factors.</p> <p>Nitrogen-fixing crops: includes contribution from improved grass (4 kg N/ha/year)</p>

represents a decrease in the implied emission factor by 11 % since 1990 (see Table 6.31), which can be explained by the higher contribution of Spain. Note that the implied emission factors for intermittently flooded fields stem from the Italian inventory only. Here it is smaller than

the emissions from continuously flooded fields, at 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 6.33 Activity data for the calculation of N₂O emissions from agricultural soils

Member States	Synthetic Fertilizer	Animal Wastes appl.	N-fixing crops	Crop residue	Cultiv. of Histosols	Animal	Atmosph.	Nitrogen Leaching and run-off	Other 1 ¹⁾	Other 2 ¹⁾	Other 3 ¹⁾
Austria	97	92	20	23	NO	22	32	71	2		
Belgium	151	135	22	3 502	25 200	87	52	53			
Denmark	197	182	32	53	18 440	30	78	164	8	4	
Finland	159	48	1	26	282 767	14	29	37	1		
France ²⁾	2 051	866	5 244	46 587	NO	786	601	1 244	NA	32	NA
Germany	1 788	909		NA	1 413 326	196	495	718	NO		
Greece	220	38	24	4378	6665	364	107	197			
Ireland	359	140		19		289	94	83			
Italy	745	395	4 177	17 288	9000	173	403	495			
Luxembourg											
Netherlands	291	309	5	35	231 000	93	110	743			
Portugal	110	82	56	4508	NO	57	56	81			
Spain	1 100	290	54	106	NO	346	359	311	13	17	0
Sweden	180	68	116	11470	240 000	39	39	61	1	2	1
United Kingdom	1 125	391	801	22331	39 200	470	338	583	28		
EU-15	8 573	3 945	-	-	2 265 598	2 965	2 793	4 841			

Information source: CRF Table 4.D 2003 submitted in 2005

- 1) Other: AT(1):Sewage sludge (N from sewage sludge spreading (kg N/yr)) — BE(1):0(Sludge spreading) — DK(1):Industrial waste used as fertiliser (kg N/yr) — DK (2):Sewage sludge used as fertilizer (kg N/yr)— FI (1):Sludge spreading(Nitrogen input from sewage sludge applied to soils (kg N/yr)) — FR (1) :Overseas territories (0) — FR(2) :Sewage sludge spreading (Nitrogen input from sludge applied to soils (kg N/yr)) — FR(3):Cultures without fertilisers(0) — DE(1):0(0) — ES(1):Municipal solid wastes compost (Nitrogen input from municipal solid wastes compost applied to soils (kg N/yr)) — ES(2):Domestic wastewater sludges (Nitrogen input from domestic wastewater sludges applied to soils (kg N/yr)) — SE(1):Sewage sludge (Use of sewage sludge (kg N/yr)) — SE(2):Cultivation of mineral soils (Area of cultivated mineral soils (ha)) — SE(3):N-fixation in hayfields (Area or hayfields etc. with clover (ha)) — UK(1):Improved grass (N fixed by improved grassland (kg N/yr))
- 2) Input of animal wastes reported in Table 4.D for France erroneously amount to 999 Gg N. This value has been corrected here. Also, the amount of nitrogen input to pasture, range and paddock in the French inventory excludes the quantity produced in overseas territories, which are included in Table 4.B(b)

6.3.5 Agricultural soils (CRF Source Category 4.D)

As described above, N₂O emissions from agricultural soils belong to the most uncertain source categories of national GHG inventories. For direct N₂O emissions, the highest uncertainty is attributed to the emission factor, which ranges between 24 % Austria and 400 % Greece relative uncertainty (expressed in 2•standard_deviation). 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 N₂O emissions are estimated at up to 100 % and 900 % (Spain) for the activity data and emission factor, respectively. Compared to these values, the subcategory of animal production is less uncertain, with a maximum uncertainty estimated by Greece and Spain (112 %).

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 Table 6.33). For other parameters used in the calculation of N₂O emissions from agricultural soils, however, many Member States use country-specific methodologies, linking the N₂O inventory with the Corinair NH₃ inventory or using simulation models. A more specific discussion of emission factors and parameters (see Table 6.34) used is presented below.

A summary of the main methodological issues, as presented in the respective national greenhouse gas inventory reports, is given in Table 6.32. About 80 % of the EU-15 N₂O emissions from 4.D.3 were estimated by the use of higher tier methodologies, whereas less than 10 % were estimated by the use of higher tier methods from 4.D.1 and only about 1 % from 4.D.2.

Table 6.34 Implied emission factors for the Category 4D – N₂O emissions from agricultural soils

Member States	Synthetic Fertilizer	Animal Wastes appl.	N-fixing crops	Crop residue	Cultiv. of Histosols	Animal Production	Atmospheric Deposition	Nitrogen Leaching and run-off	Other a ¹⁾	Other b ¹⁾	Other c ¹⁾
Direct				Indirect				Other			
Austria	1.25 %	1.25 %	1.25 %	1.25 %		2.0 %	1.00 %	2.50 %	1.25 %		
Belgium	1.25 %	1.25 %	0.075 %	0.019 %	5.0	2.0 %	1.02 %	2.50 %	1.25 %		
Denmark	1.25 %	1.25 %	1.25 %	1.25 %	8.0	2.0 %	1.00 %	2.50 %	1.25 %	1.25 %	
Finland	1.25 %	1.25 %	1.25 %	1.25 %	8.0	1.3 %	1.00 %	2.50 %	1.27 %		
France	1.25 %	1.25 %	0.075 %	0.013 %		2.0 %	0.4 %	2.51 %		1.98 %	
Germany	1.25 %	1.25 %	2.9		8.0	2.0 %	1.00 %	2.50 %	NO		
Greece	1.25 %	1.25 %	0.054 %	0.007 %	8.0	2.0 %	1.00 %	2.50 %			
Ireland	1.25 %	1.25 %	1.25 %	1.25 %		2.0 %	1.00 %	2.50 %			
Italy	1.25 %	1.25 %	0.052 %	0.009 %	8.0	2.0 %	1.00 %	2.50 %			
Luxembourg											
Netherlands	1.00 %	1.78 %	1.0 %	1.0 %	4.7	1.5 %	1.00 %	0.75 %			
Portugal	1.25 %	1.25 %	0.106 %	0.008 %		2.0 %	1.00 %	2.50 %			
Spain	1.25 %	1.25 %	1.25 %	1.25 %	NO	2.0 %	1.00 %	2.50 %	1.25 %	1.25 %	
Sweden	0.79 %	2.50 %	0.059 %	0.007 %	8.0	1.6 %	1.00 %	2.50 %	1.17 %	0.5	0.4
United Kingdom ²⁾	1.25 %	1.25 %	0.075 %	0.024 %	8.0	2.0 %	1.00 %	2.50 %	1.25 %		

Information on source: CRF Table 4.D 2003 submitted in 2005

(2) The emission factor used by UK for crop residues has been multiplied by 1 000 000 to obtain a value which can be displayed.

Direct emissions from application of fertiliser. Most Member States use the IPCC default emission factors for the calculation of N₂O emissions from the application of mineral and organic fertiliser. A differentiation between organic and inorganic fertiliser has been made by the Netherlands, Sweden and Portugal. Lower N₂O emission rates resulting from the application of nitrogen with inorganic fertilisers and higher N₂O emission rates when applying organic fertilisers are used by Sweden and the Netherlands. Portugal uses lower than the default emission factors for both fertiliser categories. The Swedish EF of 0.8 % is based on a study on N₂O emissions in Sweden and other countries of northern Europe and in Canada ⁽²⁰⁾, supported by a study in Norway suggesting a lower emission factor for emitted fertiliser N than the IPCC default value ⁽²¹⁾ (SE NIR 2003). 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 N₂O in mineral soils. For organic soils, the same, higher, EF is applied for both application systems (NL NIR 2005). N₂O emissions from the application of organic fertiliser is calculated in the German inventory by applying a mass-flow approach. Emissions are related to the 'total ammoniacal nitrogen' (TAN) in animal wastes and the flow of TAN through the production systems is followed by considering the fate of NH₃, N₂O, NO, and N₂O (DE NIR 2005). In Denmark, emissions from the agricultural sector are calculated in a comprehensive agricultural model complex called DIEMA (Danish integrated emission model for agriculture), which is used to cover both emissions of ammonia, particulate matter and greenhouse gases. In particular, there is a direct link between the ammonia and N₂O emission inventories (DK NIR 2005). In the Austrian inventory the fraction FracGASM relates to N excreted by livestock and not to the excreted nitrogen

⁽²⁰⁾ Kasimir Klemedtsson 2001. Methodology for estimating the emissions of nitrous oxide from agriculture. Swedish Environmental protection Agency. Report 5170

⁽²¹⁾ Laegreid and Aastveit, 2002. Nitrous oxide emissions from field-applied fertilisers. Danish Institute of Agricultural Sciences, Plant Production No 81, October 2002.

left for spreading, as in the inventory submitted in 2004. Also the amount of mineral fertiliser applied is calculated now as the average of two subsequent years in the Austrian GHG inventory, and does not correspond to the amount sold in one calendar year (AT NIR 2005).

Direct emissions from crop residues and nitrogen-fixing crops. The values reported in the columns 'N-fixing crops' and 'Crop residue' are not directly comparable, since the emission factor can be applied either on the amount of dry biomass (pulses and soybeans or other crops, respectively) or on the amount of N input by N-fixing crops or by crop residues. Five Member States are relating the implied emission factor to the amount of nitrogen recycled in crop residues or introduced by nitrogen-fixing crops (Austria, Denmark, Finland, The Netherlands, and Spain). All of them except the Netherlands use the IPCC default emission factor of 1.25 % to estimate N₂O emissions. The Netherlands, which reports in this inventory for the first time N₂O emissions from crop residues as a separate source category, used an EF of 1.0 % kg N₂O-N (kg N)⁻¹. Eight countries (Belgium, France, Greece, Ireland, Italy, Portugal, Sweden, and the UK) relate N₂O emissions to the production of dry biomass. The implied emission factors vary between 0.052 % kg N₂O-N kg (dry biomass)⁻¹ to 0.106 % kg N₂O-N kg (dry biomass)⁻¹ for nitrogen fixing crops and 0.007 % kg N₂O-N kg (dry biomass)⁻¹ to 0.024 % kg N₂O-N kg (dry biomass)⁻¹ for emissions from crop residues⁽²²⁾.

In the German inventory, N₂O emissions from nitrogen fixing crops are reported as an average emission per hectare (2.9) of cultivated crop based on mean nitrogen input factors of 200 kg N ha⁻¹ (grass/clover, clover/alfalfa mixtures) and 250 kg N ha⁻¹ (alfalfa, leguminous crops) and an emission factor of 1.25 % (Daemmgen, 2004⁽²³⁾). No implied emission factor for N₂O emissions from crop residues are reported in the German inventory.

Direct emissions from the cultivation of histosols. N₂O emissions from the cultivation of histosols are 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 (IE NIR 2005).

The cultivation of histosols represents the biggest share of emissions from agricultural soils in the Swedish (19 %) and Finnish (34 %) inventory and a substantial source for N₂O emissions in Germany (15 % — as large as emission from application of manure) and the Netherlands (6 %), where emissions from histosols are for the first time reported as a separate source category. The emission factor proposed in the IPCC GPG of 8 kg N₂O-N per hectare and year (IPCC, 2000) is used in most countries. Only Belgium and the Netherlands use 5 kg N₂O-N ha⁻¹ and 4.7 kg N₂O-N ha⁻¹, respectively.

On absolute terms, the estimated emissions of N₂O from the cultivation of histosols are largest for Germany (17.8 Gg N₂O), followed by Finland (3.6 Gg N₂O) and Sweden (3.0 Gg N₂O).

Direct emissions from animal production.

All countries report N₂O emissions from manure excreted by animals during grazing and the implied EF is the default factor of 2 % N₂O-N per kg N excreted and year, except the emission inventories of the Netherlands and Sweden, which use an EF of 1.5 % and 1.6 %, respectively, and the inventory of Finland using an EF of 1.3 %.

Indirect emissions. Almost all Member States report indirect emissions of nitrous oxide induced by the atmospheric deposition of NH₃ and NO_x volatilised and nitrate leached to the groundwater using the default IPCC emission factors. France uses a smaller emission factor for N₂O from volatilised NH₃ + NO_x (0.4 %) and the Netherlands use a smaller emission factor for N₂O 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 five and three Member States using the IPCC default

⁽²²⁾ Not considering the emission factor from UK, which is not comparable

⁽²³⁾ Ulrich Dämmgen (Hrsg.) (2004). Nationaler Inventarbericht 2004 – Berichterstattung unter der Klimarahmenkonvention der Vereinten Nationen – Teilbericht für die Quellengruppe Landwirtschaft. Lanbauforschung Völknerode FAL Agricultural Research, Sonderheft 260.

Table 6.35 Relevant parameters for the calculation of N₂O emissions from agricultural soils

Member States	FracBURN	FracFUEL	FracGASF	FracGASM	FracGRAS	FracLEACH	FracNCRBF	FracNCRO	FracR
Austria	0.31 %		3.1 %	20 %	16 %	30 %	0.5 %	1.5 %	34 %
Belgium									
Denmark	NO	NO	2.2 %	22 %	12 %	34 %	NE	NE	26 %
Finland	NE		0.6 %	31 %	22 %	15 %	0.8 %	4.2 %	43 %
France	NA	NA	10 %	20 %	28 %	30 %	CS	CS	CS
Germany			5.7 %	29 %	15 %	30 %	NA	NA	NA
Greece	10 %		10 %	20 %	88 %	30 %			
Ireland			3.9 %	17 %	63 %	10 %	as GPG	as GPG	as GPG
Italy ²⁾	10 %		10 %	31 %	25 %	30 %	3.0 %	1.5 %	45 %
Luxembourg									
Netherlands	NO	NO	NE	NE	NE	NE	NE	NE	NE
Portugal	6 %		6 %	16 %	27 %	30 %	1.3 %	2.2 %	72 %
Spain	NA		7.3 %	36 %	NA	15 %	NA	NA	NA
Sweden	NO	NO	1.1 %	33 %	29 %	21 %	1.0 %	2.0 %	20 %
United Kingdom			10 %	20 %	52 %	30 %	3.0 %	1.5 %	45 %

values for the volatilisation fractions of mineral and organic fertiliser (FracGASF and FracGASM), respectively, and six countries using the default IPCC values for the leaching fraction (FracLEACH). Belgium does not report the fractions used, and the Netherlands reports the fractions as NE. No N₂O emissions from agricultural soils are estimated by Luxembourg.

While volatilisation of NH₃ 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 8.0 %), most of the Member States with country-specific volatilisation rates for organic fertiliser estimate larger losses of NH₃ + NO_x than proposed by the IPCC (range 16 to 36 %). The country-specific methodology for the estimation of NH₃ volatilisation is in some cases based on the NH₃ 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. An NH₃ model used in Denmark estimates decreasing levels of NH₃ volatilisation in Denmark for the period 1990–2001 with an average volatilisation rate of 28 % (DK NIR 2003). The German inventory includes indirect emissions from volatilisation of NH₃ and NO_x due to the production of N-fixing crops (DE NIR 2004).

The fraction of nitrogen lost by leaching ranges from 10 to 34 % with most national values being smaller than the IPCC default value. They are in some cases based on a

nitrogen-leaching model (e.g. Denmark, Sweden) and in some cases based on national studies (e.g. Finland, Ireland). The UK estimate of N₂O emissions via leaching includes a correction to avoid double counting N₂O emitted from mineral fertiliser use (UK NIR 2004).

N₂O emissions from other sources. Six countries report emissions of N₂O from the application of sewage sludge, according to the IPCC GPG. The emission factors used are in three cases the IPCC default factor for direct N₂O emissions, an equivalent number of Member States used a different value.

For the EU-15, emissions from all subcategories in the Category 4.D have decreased since 1990 (see Table 6.35). This was most significant for indirect emissions from volatilisation of NH₃ + NO_x (–24 %), followed by indirect emissions from leaching and run-off (–15 %) and application of synthetic fertiliser (–16 %). In the latter two cases, the reduction of emissions can be explained by a reduction of nitrogen input, as the implied emission factor was not changing during the reporting period. For indirect emissions from volatilisation, the decrease in the nitrogen input was further accentuated by a reduced implied emission factor of 0.87 % in 2003 versus 0.99 % in 1990. Here, the decrease is due solely to France, which used for the 1990 inventory the default emission factor of 1 %.

At the aggregated EU-15 level, the implied emission factor for N₂O emissions from

Table 6.36 Total N₂O emissions, Total Nitrogen input into agricultural soils and implied emission factor at EU-15 level in 2003 and 1990 and changes

1990	Synthetic Fertilizer	Animal Wastes appl.	Cultiv. of Histosols	Animal Production	Atmospheric Deposition	Nitrogen Leaching and run-off
Direct			Indirect			
Total Emissions of N ₂ O (Gg N ₂ O-N)	197	84	28	99	50	198
Total Nitrogen input (Gg N)	10 200	4 332	2 365 329	3 204	3 193	5 793
Implied Emission Factor (kg N ₂ O-N/kg N)	1.23 %	1.24 %	0.00 %	1.97 %	0.99 %	2.18 %
2003	Synthetic Fertilizer	Animal Wastes appl.	Cultiv. of Histosols	Animal Production	Atmospheric Deposition	Nitrogen Leaching and run-off
Direct			Indirect			
Total Emissions of N ₂ O (Gg N ₂ O-N)	166	84	27	92	38	170
Total Nitrogen input (Gg N)	8 573	4 078	2 265 598	2 965	2 793	4 841
Implied Emission Factor (kg N ₂ O-N/kg N)	1.23 %	1.31 %	0.00 %	1.98 %	0.87 %	2.23 %
2003 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 ₂ O	84 %	100 %	96 %	93 %	77 %	86 %
Total Nitrogen input	84 %	94 %	96 %	93 %	87 %	84 %
Implied Emission Factor	100 %	106 %	100 %	100 %	87 %	103 %

Source of information: Tables 4.D for 1990 and 2003, submitted in 2005

Table 6.37 CH₄ Emission from agricultural soils

Member States	D. Agricultural Soils (1)	1. Direct Soil Emissions	2. Animal Production	3. Indirect Emissions	4. Other (please specify)
Austria	0.43	NA	NA	NA	0.43
Belgium	4.90	4.73	0.17	NE	
Denmark		NE	IE	NE	
Finland		NE	IE	NE	
France					
Germany	-30.2	IE	NO	NO	-30.17
Greece		NE	NE	NE	
Ireland					
Italy ^a		NO		NO	
Luxembourg					
Netherlands		NO	IE	NO	
Portugal		NE	IE	NE	
Spain					
Sweden	IE	NA	IE	NA	NA
United Kingdom		NE	NE	NE	

NA: Not Applicable - NE: Not Estimated - NO: Not Occurring - IE: Implied Elsewhere

Information on source: CRF Table 4.D 2003 submitted 2005

the application of manure increased by 6 %, caused by a doubling of the implied

emission factor for this source in the Netherlands during 1990 to 2003.

Table 6.38 Member State's background information for the calculation of CH₄ emissions in category 4.D

Member State	
Austria	Based on average carbon content of sewage sludge (300 kg/ton), from which 52 % are volatilised, and 5 % thereof as CH ₄ .
NIR 2005, p. 218-231	
Belgium	CH ₄ fluxes: Flanders: two sources (wetland and surface waters) and one sink (consumption by forest soils, agricultural soils, and grasslands). The same emission (of 20 00) has been used for the entire time-series. In the future efforts will be done to obtain more accurate data for the complete time-series.
NIR 2005, p. 60-64	
Germany	Emissions of CH ₄ fluxes from agricultural soils are calculated on the basis of Boeckx and Van Cleemput (2001) with an uptake of CH ₄ in grassland soils of 2.5 kg ha ⁻¹ a ⁻¹ CH ₄ and in arable soils of 1.5 kg ha ⁻¹ a ⁻¹ CH ₄
NIR 2005, p. 6-23-6-30	

Table 6.39 EU-15 uncertainty estimates for the sector 'Agriculture'

Source category	Gas	Emissions 2003 ¹⁾	Emissions for which MS uncertainty estimates are available ²⁾	Share of emissions for which MS uncertainty estimates are available	Uncertainty estimates based on MS uncertainty estimates
4.A Enteric fermentation	CH ₄	130 748	129 813	99 %	12 %
4.B Manure management	CH ₄	61 967	60 642	98 %	17 %
4.C Rice cultivation	CH ₄	2 205	1 657	75 %	38 %
4.D Agricultural soils	CH ₄	- 521	- 530	102 %	127 %
4.F Field burning	CH ₄	107	42	39 %	54 %
4.B Manure management	N ₂ O	21 873	17 056	78 %	93 %
4.D Agricultural soils	N ₂ O	197 455	194 370	98 %	84 % - 195 %
4.F Field burning	N ₂ O	369	15	4 %	54 %
Total Agriculture	all	414 427	403 063	97 %	41 % - 74 %

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 countries 2002 data and for Belgium 2001 data.

6.3.6 Agricultural soils (CH₄) (CRF Source Category 4.D)

For 2003, CH₄ fluxes have been calculated in three countries (Table 6.36). The methodologies are summarised in Table 6.37.

6.3.7 EU-15 uncertainty estimates

Table 6.39 shows the total EU-15 uncertainty estimates for the sector 'Agriculture' and the uncertainty estimates for the relevant gases of each source category. The highest uncertainty was estimated for N₂O from 4.D and the lowest for CH₄ from 4.A. For a description of the Tier 1 uncertainty analysis carried out for the EU-15, see Chapter 1.7.

6.4 Sector-specific quality assurance and quality control

As a first activity of a project on the comparison of methods used by Member States for emission calculations and emission projections, led by JRC, 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 (CH₄) and nitrous oxide (N₂O) induced by activities in the agricultural sector, not considering changes of carbon stocks in agricultural soils, but including emissions of ammonia (NH₃). The consideration of ammonia emissions allows the validation of the N₂O 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

Table 6.40 Recalculations of total greenhouse gas emissions and recalculations of greenhouse gas emissions in CRF Sector 4: 'Agriculture', for 1990 and 2002 by gas (Gg and %)

1990	CO ₂		CH ₄		N ₂ O		HFCs		PFCs		SF ₆	
	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent
Total emissions and removals	- 122 396	- 3.8 %	- 9 539	- 2.1 %	16 013	4.1 %	200	0.7 %	- 276	- 1.7 %	125	1.2 %
Agriculture	- 3 208	- 100.0 %	- 8 322	- 3.7 %	17 157	7.4 %	NO	NO	NO	NO	NO	NO
2002												
Total emissions and removals	- 165 492	- 5.1 %	- 7 491	- 2.1 %	8 640	2.6 %	- 3 682	- 7.4 %	279	5.2 %	406	4.4 %
Agriculture	- 2 057	- 100.0 %	- 5 646	- 2.8 %	11 140	5.3 %	NO	NO	NO	NO	NO	NO

NO: not occurring

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 4.B), the quality of CH₄ emission estimates from enteric fermentation (Source Category 4.A), and the comprehensive treatment of greenhouse gas emissions from agricultural soils (Source Category 4.D). The workshop recommended, amongst others, 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 4.D' was held in October 2004 at the Joint Research Center in Ispra, Italy with the participation of experts from 14 countries and six international organisations/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 N₂O emissions from agricultural soils.

The workshop's participants formulated general recommendations for the improvement of the quality of greenhouse gas emission inventories for Category 4.D 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. The recommendations of the workshop, the minutes, the presentations and additional information can be found in the Internet at: <http://carbodat.ei.jrc.it/ccu/pweb/leip/home/ExpertMeetingCat4D/index.htm>.

6.5 Sector-specific recalculations

Table 6.40 shows that in the agriculture sector, the largest recalculations in absolute terms were made for N₂O in the years 1990 and 2002, in relative terms, the largest recalculations were made for CO₂. Also, CH₄ emissions were recalculated in both years.

Table 6.41 provides an overview of Member States' contributions to EU-15 recalculations. Germany was mainly responsible for the CH₄ emission recalculations. For N₂O, Germany had the largest recalculations, but France, Greece (for 1990) and the Netherlands also had large recalculations.

Explanations for recalculations of more than 1 000 Gg of CO₂ equivalents are given in Table 6.42. Explanations for most recalculations are provided in Section 10.1.

Table 6.41 Contribution of Member States to EU-15 recalculations in CRF Sector 4: 'Agriculture' for 1990 and 2002 by gas (difference between latest submission and previous submission Gg of CO₂ equivalents)

	1990						2002					
	CO ₂	CH ₄	N ₂ O	HFCs	PFCs	SF ₆	CO ₂	CH ₄	N ₂ O	HFCs	PFCs	SF ₆
Austria	0	10	3	NO	NO	NO	0	19	132	NO	NO	NO
Belgium	0	- 11	- 918	NO	NO	NO	0	- 100	- 304	NO	NO	NO
Denmark	0	10	9	NO	NO	NO	0	10	- 7	NO	NO	NO
Finland	- 3 208	16	21	NO	NO	NO	- 2 057	17	68	NO	NO	NO
France	0	- 1 101	3 568	NO	NO	NO	0	- 787	3 052	NO	NO	NO
Germany	IE	- 6 613	5 766	NO	NO	NO	IE	- 5 377	5 157	NO	NO	NO
Greece	0	- 176	3 239	NO	NO	NO	0	- 129	- 525	NO	NO	NO
Ireland	IE	0	424	NO	NO	NO	IE	0	449	NO	NO	NO
Italy	0	297	- 48	NO	NO	NO	0	603	- 122	NO	NO	NO
Luxembourg	-	0	0	NO	NO	NO	-	0	0	NO	NO	NO
Netherlands	0	- 321	4 759	NO	NO	NO	0	508	2 874	NO	NO	NO
Portugal	0	- 79	288	NO	NO	NO	0	- 63	329	NO	NO	NO
Spain	0	0	- 12	NO	NO	NO	0	- 23	37	NO	NO	NO
Sweden	IE	0	0	NO	NO	NO	0	0	0	NO	NO	NO
UK	0	- 355	57	NO	NO	NO	0	- 324	0	NO	NO	NO
EU-15	- 3 208	- 8 322	17 157	NO	NO	NO	- 2 057	- 5 646	11 140	NO	NO	NO

NO: not occurring; IE: included elsewhere

Table 6.42: Main reasons for recalculations > 1000 Gg of CO₂ equivalents in CRF sector 4

FI	CO ₂	4.D: Removal: CO emissions are included under cropland and grassland in LULUCF sector
FR	CH ₄ , CO ₂	4.B: Method: distribution of manure management systems previously used have been modified according to French data
DE	CH ₄	4.B.1 (Other cattle), 3,6,8: Activity data: figures 2002/03 have been updated due to new information of animals in Hamburg, Bremen, Berlin 4.B.1 (Dairy cows): Activity data: total recalculation from 1990 to 2002 4.B.1: Emission factors have been recalculated from 1990 until 2003 due to wrong factors for pasture range and paddock
DE	N ₂ O	4.D: See tables 10.1 and 10.2
GR	N ₂ O	4.D (1990): Activity data: updated data on fertilisers consumption; addition/removal/replacement: cultivation of histosols
NL	N ₂ O	4.D: Now includes indirect emissions; Methods: new; activity data: improved data; emission factors: improved data; addition (2002): direct emissions from histosols and crop residue

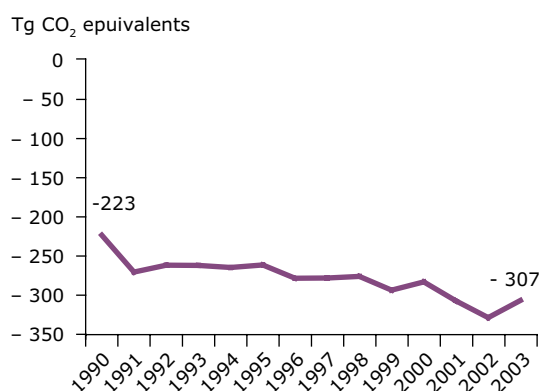
7 LUCF (CRF Sector 5)

This chapter starts with an overview on emission removal trends in CRF Sector 5 'LUCF'. Sections on methodological issues and uncertainty, sector-specific QA/QC and on recalculations are also provided.

7.1 Overview of sector

CRF Sector 5 'LUCF' is both a source and a sink of GHG emissions. In 2003, net GHG emissions from LUCF (emissions minus removals) were – 307 Tg in the EU-15 (Figure 7.1). They decreased by 37 % from 1990 to 2003 and increased by 4 % from 2002 to 2003. Net GHG emissions from LUCF have been below 1990 levels for the past decade.

Figure 7.1 EU-15 net GHG emissions (emissions minus removals) for 1990–2003 from CRF Sector 5: 'LUCF' in CO₂ equivalents (Tg)



Sector 5 is an overall sink of greenhouse gases for all Member States except the Netherlands and Portugal (Table 7.1). Italy, Germany and France account for the largest removals in absolute terms; large changes between 1990 and 2003 occurred in Spain, Italy and France. The United Kingdom and Denmark turned from net emissions in 1990 to net removals in 2003.

Overall, for the EU-15, the Sector 5 removes 7 % of the total emissions (without LUCF). The equivalent shares of the Member States range from – 0.2 % (United Kingdom) to –30.5 % (Sweden) (Table 7.2, column a). In the Netherlands and Portugal, the sector

gives a contribution to the total emissions, respectively, by 8.7 % and 1.3 %.

If only Category 5.A: 'Changes in forests and other wooded land', the largest contributor to Sector 5 inventories and the only one reported by all Member States, is examined (Table 7.2, column b), it is possible to see that the category is a net remover of GHG for all Member States except for Portugal (range 1.5–35.8 %) and for EU-15 as a total (– 8.2 %). When analysing Category 5.A, it should be considered that the proportion of total land area covered by forests is different in the various Member States, ranging from 8–9 % (Ireland and Netherlands) up to 67 % (Finland and Sweden). The EU-15 as a whole has 42 % of its land covered by forests (FAO).

7.2 Methodological issues and uncertainties

As in other sectors, this section of the report is based on data and information from the EU-15 Member States. Therefore, information below is often detailed by countries. It is also important to note that a lot of developments have taken place in the EU-15 countries since the last inventory submission. The improvements include:

- extended use of the new good practice guidance for LULUCF (IPCC 2003)
- more complete category coverage
- estimation of emissions from important pools like soils
- use of improved activity data
- use of improved emission factors
- developments in uncertainty estimation
- improved reporting on methodology.

Due to these improvements, data were recalculated and better estimated in several Member States. The improvements and the current inventory methods are described in the following section, which is followed by an analysis of sources or uncertainties, while recalculations are analysed in Section 7.4.

Table 7.1 Member States' contributions to net GHG emissions from CRF Sector 5: 'Land use change and forestry'

Member State	Greenhouse gas emissions/removals (Gg CO ₂ equivalents)			Change 2002-2003		Change 1990-2003	
	1990	2002	2003	(Gg CO ₂ equivalents)	(%)	(Gg CO ₂ equivalents)	(%)
Austria	- 9 013	- 11 311	- 12 773	- 1 462	13 %	- 3 759	42 %
Belgium	- 3 103	- 3 980	- 3 359	621	- 16 %	- 256	8 %
Denmark	158	- 1 476	- 1 204	271	- 18 %	- 1 363	- 861 %
Finland	- 22 749	- 15 475	- 17 782	- 2 307	15 %	4 967	- 22 %
France	- 33 137	- 54 531	- 52 574	1 957	- 4 %	- 19 437	59 %
Germany	- 73 250	- 76 704	- 77 050	- 345	0 %	- 3 800	5 %
Greece	- 3 193	- 5 456	- 5 529	- 72	1 %	- 2 335	73 %
Ireland	- 407	- 978	- 981	- 3	0 %	- 574	141 %
Italy	- 60 726	- 95 746	- 81 828	13 917	- 15 %	- 21 102	35 %
Luxembourg	- 273	- 273	- 273	0	0 %	0	0 %
Netherlands	2 894	2 759	2 761	2	0 %	- 134	- 5 %
Portugal	6 058	- 1 208	7 076	8 284	- 686 %	1 018	17 %
Spain	- 9 033	- 36 395	- 40 118	- 3 723	10 %	- 31 085	344 %
Sweden	- 20 292	- 26 541	- 21 499	5 042	- 19 %	- 1 207	6 %
United Kingdom	2 662	- 1 470	- 1 522	- 51	3 %	- 4 183	- 157 %
EU- 15	- 223 404	- 328 787	- 306 658	22 129	- 7 %	- 83 254	37 %

Table 7.2 Contribution of Sector 5 (a) and Category 5.A (b) to total emissions (without LUCF) and Member States contribution to EU-15 Sector 5.A(c)

Member State	Sector 5 over total emission excluding LUCF (a) (%)	Category 5.A over total emissions (b) (%)	Member States contribution to EU-15 total for Sector 5.A (c) (%)
Austria	- 13.9 %	- 13.9 %	3.7 %
Belgium ⁽¹⁾	- 2.3 %	- 2.3 %	1.0 %
Denmark	- 1.6 %	- 4.8 %	1.0 %
Finland	- 20.8 %	- 25.0 %	6.2 %
France	- 9.4 %	- 11.8 %	19.1 %
Germany	- 7.6 %	- 7.7 %	22.7 %
Greece	- 4.0 %	- 4.0 %	1.6 %
Ireland	- 1.5 %	- 2.0 %	0.4 %
Italy	- 14.4 %	- 14.0 %	23.3 %
Luxembourg	- 2.4 %	- 2.6 %	0.1 %
Netherlands	1.3 %	- 1.1 %	0.7 %
Portugal	8.7 %	6.6 %	- 1.5 %
Spain	- 10.0 %	- 10.0 %	11.7 %
Sweden	- 30.5 %	- 35.8 %	7.3 %
United Kingdom	- 0.2 %	- 1.5 %	2.8 %
EU-15	- 7.3 %	- 8.2 %	100.0 %

⁽¹⁾ Data only from Wallonia which represents 80 % of the forest area of Belgium.

Source: 1: Member States' submissions 2005, CRF Tables 5, 5.A and Summary 2.

7.2.1 Methodological issues

Pursuant to relevant regulations, emissions and removals from LUCF of the EU-15

are the sum of Member States' emissions and removals as reported either in the 'new' or in the 'old' CRF tables ⁽²⁴⁾. Table 7.3 demonstrates current coverage of

⁽²⁴⁾ The term 'new' refers to CRF tables prepared, based on document UNFCCC/SBSTA/2004/8, and 'old' refers to CRF tables that have been in use for the last years. Note that all MS, except for Germany, submitted data in the old CRF tables, and data in the new CRF tables submitted by Germany were converted to the old tables when calculating the EU estimates.

Table 7.3 Summary of reporting Categories 5.A through 5.E of the 'old' CRF tables by EU-15 Member States

Member State	Reporting category				
	5.A	5.B	5.C	5.D	5.E
Austria	X* (x)	X* (x)			
Belgium	X (x)				(x)
Denmark	X (x)			X (no)	
Finland	X* (x)				
France	X (x)	X (x)	X (x)	X (x)	
Germany	X* (x)			X* (x)	
Greece				X (no)	
Ireland	X (x)				
Italy	(x)		(x)	(x)	(x)
Luxembourg					
Netherlands	X (x)	X (no)	X (no)	X (no)	X (no)
Portugal	(x)				
Spain	(x)				(x)
Sweden	X (x)			X (x)	
United Kingdom	X (x)	X (x)		X (x)	X (x)

Note: X means that the category is estimated; status in the previous year submission is given in brackets. * means that the data are not submitted by the MS in the 'old' tables, rather, in the 'new' ones.

Table 7.4 Summary of methodological issues for Reporting Category 5.A by EU-15 Member States

Member State	Method	Emission factors	Estimate completeness	Quality
	(1)	(2)	(3)	(4)
Austria	T3 (D)	CS (CS)	Partly (Partly)	High (High)
Belgium	D (D)	CS (CS)	NE (Partly)	NE (NE)
Denmark	CS/T2/D (NE; D)	D/CS (NE; CS)	Partially (NE)	NE (NE)
Finland	T3 (CS)	CS (CS)	Partially (All)	Medium (Medium)
France	CS (CS)	CS (CS)	All (All)	Low (Low)
Germany	CS (CS)	CS (CS)	All (All)	Medium (Medium)
Greece	D, CS, T1, T2 (D)	CS, D (D)	Partly (Partly)	NE (NE)
Ireland	CS (CS)	CS (CS)	All (All)	Medium (Medium)
Italy	T1, T2 (D, CS)	D, CS (D, CS)	All (Partly)	High (High)
Luxembourg	(C/D)	(C/D)	(NE)	(NE)
Netherlands	T2, CS (T1)	CS (CS)	All (All)	Medium (Medium)
Portugal	D (D)	D + CS (D+CS)	Partly (Partly)	Medium (Medium)
Spain	CS (CS)	CS (CS)	All (All)	Medium (Medium)
Sweden	T2 (T2, CS)	CS (T2, CS)	All (All)	High (High)
United Kingdom	CS (M)	CS (M)	All (All)	Medium (Medium)

Note: Methodology and emission factor codes: D: default IPCC; CS: country-specific; T1, T2: Tier 1, Tier 2; NE: not estimated; M: model.

Forest type code: TF: temperate forest; (P): plantations; BF: boreal forest; TrF: tropical forest; others: other types, generally under temperate.

Information in brackets indicates the status of the previous year submission.

Sources: columns (1) and (2): CRF Table Summary 3, sheet 2; columns (3) and (4): CRF Table 7, sheet 2 (IPCC Table 8A), and the NIR. If no information in these sources is provided, than either information from the 'new' CRF tables (Sheet Summary 3) or the previous years' information is used.

emission and removal estimation in the various subcategories. Because of their predominance in both emission levels and reporting frequency, only the methodology for subcategories A and D is detailed

below. However, some details for the other categories, and advancements in other respects (including reporting in the new CRF tables) will be discussed in later sections too.

Due to the built-in flexibility of the guidance and the varying conditions within the various countries, different methodologies were used with regard to data collection methods, definitions and conversion factors. Table 7.4 provides a summary of some methodological issues related to reporting of greenhouse gas emissions and removals (limited to CO₂ in current CRFs under Category 5.A). It can be seen from the tables (and also from the fact that some countries developed their estimates in the 'new' CRF tables, see Section 7.3.1) that countries made an increased effort to apply the new GPG for LULUCF.

As can be seen from Table 7.4, most Member States (10 out of 15) are using country-specific or even higher tier approaches, and even more countries use country-specific emission factors. This is needed due to the variety of forest types occurring within the EU-15 (boreal, temperate, Mediterranean, and also tropical) in order to achieve the accuracy as required by IPCC (2003). For Member States that indicate to use IPCC default methods under column 1, the underlying data sources are in many cases based on national surveys and statistics that can be considered as country-specific.

Eight Member States evaluate their reporting for Category 5.A as complete, four Member States as partly complete, while only three Member States do not provide an evaluation of completeness. The Member States which consider their 5.A inventories to be complete represent 88 % of the net EU-

15, 5.A emissions (see Table 7.2, column c) so the EU-15 inventory in this category can be considered as complete.

However, it should be mentioned that Member States are calculating their biomass stocks by considering different components which are additional to tree stems and main branches, such as leaf, roots, dead wood and, in some case, understory vegetation. Although these components are considered by appropriate expansion factors, it should be mentioned that differences are present also in these factors.

The evaluation of quality requires more detailed analysis by country. The quality of the reporting under 5.A is considered high by Austria, Italy and Sweden (Table 7.5, column 4), medium by the majority of Member States (7) and low by France. Belgium, Denmark, Greece and Luxembourg do not provide an evaluation of the quality of their 5.A inventory. Taking into consideration that Member States which contribute to approximately 77 % of the total net EU-15, 5.A emissions (see Table 7.2, column c) assessed the quality of their inventories to be from high to medium, hence medium can be then considered as a conservative estimation of the quality of the aggregated EU-15, 5.A inventory.

An overview of definitions, data sources and methodologies used by the Member States to produce 5.A inventories is presented in Tables 7.5 to 7.6. The data provide a good overview of methodologies and approaches for the Member States.

Table 7.5(a) Overview of methodology used by the Member States: forest definitions

Member State	Definition		
	NFI Forest	Forests and other woody biomass (old tables)	Forest land (new tables)
Austria	All areas covered by woody plants if these criteria are met: a) minimum area 0.05 ha and b) minimum width \geq 10 m and c) minimum crown coverage of 30 %. Below only marginal lands (mountain, not relevant), row of trees (except wind belts), nurseries. Afforestation/Reforestation become 'forest' when 30 % is reached (tree/ha reported).		Forest reserves: area assessed, volume estimated (1990, not reported). Areas taken out of production (growing).
Belgium	All areas covered by woody plants if these criteria are met: a) minimum area 0.5 and 0.3 ha, b) minimum width \geq 25 and 9 m, c) minimum crown coverage of 20 % and 10 %, and d) minimum height 3 m for Flanders and the Wallonia Region, respectively	Same definition is applied as in NFI	Same definition is applied as in NFI
Denmark	The forest is to be or should be planted with tree-species which can develop on the location into high trees with stems, that would say at least, to the height of 6 m; the area should be more than 0.5 ha and wider than 20 m (at least on average)	Areas taken out of production.	

Member State	Definition	Definition	
		Forests and other woody biomass (old tables)	Forest land (new tables)
	NFI Forest		
Finland	Forestry land is grouped into three classes according to site productivity: <i>forest land</i> , where the potential annual increment is at least 1.0 m ³ /ha; <i>scrub land (unproductive forest land)</i> , is mainly exposed bedrock and scree or mires, where the potential annual increment is below 1.0 m ³ /ha but over 0.1 m ³ /ha; <i>waste land</i> , unless naturally treeless, produces less than 0.1 m ³ /ha	Includes forest and other wooded land FAO definition	Includes forest and other wooded land FAO definition
France	Either: measured trees (diameter > 7.5 cm) have a crown cover percentage at least 10 % or there are more than 500 stems per ha that are viable trees (seedlings, plants or shoots, vigorous, well shaped and regularly distributed. Minimum area: 5 acres (2.02 ha) (0.05), minimum average width 15 m. definition by IFN 2004.		
Germany	Forest within the meaning of the FFI is any area of ground covered by forest vegetation, irrespective of the information in the cadastral survey or similar records. The term forest also refers to cutover or thinned areas, forest tracks, firebreaks, openings and clearings, forest glades, feeding grounds for game, landings, rides located in the forest, further areas linked to and serving the forest including areas with recreation facilities, overgrown heaths and moorland, overgrown former pastures, alpine pastures and rough pastures, as well as areas of dwarf pines and green alders. Heaths, moorland, pastures, alpine pastures and rough pastures are considered to be overgrown if the natural forest cover has reached an average age of five years and if at least 50 % of the area is covered by forest. Areas with forest cover in open pasture land or in built-up areas of under 1000 m ² , coppices under 10 m wide and the cultivation of Christmas trees and ornamental brushwood as well as parkland attached to country houses		Same definition is applied as in NFI
Greece	includes: (a) areas larger than 0.5 ha or strips more than 30 m wide with tree crown cover (stand density) of more than 10 % of the area, or areas with 250 trees of reproductive age per hectare, able to produce wood or other products or services and are not used for any other land-use (b) areas where trees are removed to below 10 % of stand density and are not given for other land-use (c) reforested areas and (d) scrublands (areas covered by broadleaved evergreens).		Includes forest and other wooded land FAO definition
Ireland	All areas covered by woody plants if these criteria are met: a) minimum area 0.5 ha and b) minimum width >= 40 m and c) minimum crown coverage of 30 % (20) and d) minimum height 2 m e) minimum potential production of 2 -4 m ³ /ha/yr	Only forest land	Only forest land

Table 7.5(b) Overview of methodology used by the Member States: forest definitions

Member State	Definition	Definition	
		Forests and other woody biomass (old tables)	Forest land (new tables)
	NFI Forest		
Italy	Forest area: a territory with one or more of the following characteristics: -) purpose to wood or non-wood goods production currently regarded as forestal; -) contain tree or bush stands with direct or indirect function of protection; -) contain spontaneous tree or bush stands with naturalist, scenic or recreation function. Included are also areas temporarily without a stand because cutting or exceptional occurrence. Not included: city parks, gardens, botanical gardens and other areas with only aesthetic function. Likewise not considered: forest nurseries, fruit cultivation of walnut and filbert, manna ash stands, carob tree stands and every fruit tree stands. Excluded are also the tree rows and scattered trees in agricultural territory and along the roads. the minimum size is 2000 m ² , the minimum width is 20 m and the minimum crown coverage is 20%.		Includes forest and other wooded land FAO definition
Luxembourg	All areas covered by woody plants if these criteria are met: a) minimum area 0.5 ha and b) minimum crown coverage of 10% and c) minimum height 5 m		
Netherlands	Land with tree crown cover (or equivalent stocking level) of more than 20% and area of more than 0.5 ha. Trees should be able to reach a minimum height of 5 m at maturity in situ. Furthermore, a forest must have a minimum average width of 30 m.	Forest land and non-forest trees: forest, trees outside forests and dead wood	Forest land and non-forest trees and heather
Portugal	Area greater than 0.2 ha and more than 15 m wide. Includes exploitable forest grounds temporarily deprived of vegetation, and grounds related to forestry (forest roads, nurseries, etc).		
Spain	Minimum area 0,25 ha, minimum crown cover 5% and minimum width 20 m		

Member State	Definition		
	NFI Forest	Forests and other woody biomass (old tables)	Forest land (new tables)
Sweden	Forest land is defined as land suitable for forest production, not used for other purposes, and with an average production higher than (or equal to) 1 m ³ per hectare and year during a period of 100 years. The minimum area is 0.25 ha.	About 94 % of the reported carbon uptake increment originates from trees on Forest land. The remaining parts originate from trees on all other land use classes (Mire, Rock surface, Sub-alpine coniferous woodland, Grazing land, Arable land, Other area) except trees from High mountains in the northwest of Sweden, protected areas (Nature reserves and Military wasteland), and Urban and Industrial land	
United Kingdom	The minimum woodland area to be considered as forest area is 2 (0.1) ha. In general the minimum width for a woodland is 50 (16) m. Areas of scattered trees with distinct crowns constitute of woodland if the canopy covers more than 20% of the ground.	Only forest lands that show an increment in carbon stocks	

Table 7.6 Overview of methodology used by the Member States: data sources

Member State	Data sources			
	Forest area	Increment	Harvest	Other loss
Austria	NFI	Applying allometric relationships at two NFI dates results in increment data by difference	NFI, Austrian record of felled wood and Austrian wood balance.	NFI
Belgium	regional forest inventories	Regional forest inventories	Regional forest inventories and model	
Denmark	Currently: Forestry census	Currently: Forestry census	Drain data from thinning statistics and harvesting.	not
Finland	NFI	Measured annually in NFI. Difference in volume of the tallied trees between five years (average sink). Trees with diameter < 2.5 cm, not inventoried may account for 1–2 % of the increment. measured in representative plots	NFI, MTT Agrifood Research Finland, published literature	NFI
France				
Germany	NFI	NFI	NFI	NFI
Greece	NFI	NFI	National statistics	Fire and illegal logging
Ireland	Forest Inventory and Planning System (FIPS)	Irish yield models (Hamilton et al, 1971 and Forest and Wildlife Service, 2000)	Coillte records (Coillte, 2001) compiled through the company's timber sales reporting system.	Not
Italy	NFI	Growth rate based on a dynamic model starting from NFI in 1985.	Harvesting data: national statistics ISTAT.	By fire derived by burned forest surface statistics of CFS
Luxembourg				
Netherlands	national statistics, HOSP & HOSP2 forest project; from 2001 new monitoring network (Meetnet Functievervulling), land use maps	National statistics, HOSP & HOSP2 forest project; from 2001 new monitoring network (Meetnet Functievervulling), land use maps	National statistics, HOSP & HOSP2 forest project; from 2001 new monitoring network (Meetnet Functievervulling)	National statistics, HOSP & HOSP2 forest project; from 2001 new monitoring network (Meetnet Functievervulling)
Portugal				
Spain				
Sweden	NFI. Land use conversions can potentially be traced by permanent sample plots.	Increment obtained as five-year average data from NFI	National Board of Forests (using consumption studies and expert judgement)	National Board of Forests (using consumption studies and expert judgement)
United Kingdom	Planting rate from Forestry Commission.	Net removals: growth, biomass in new plantations, timber.	Net removals: growth, biomass in new plantations, timber.	Not

Table 7.7(a) Overview of methodology used by the Member States: methodological issues

Member State	Growing stock definition in NFI	Fraction of biomass included in "living biomass"	Annual values	Conversion and expansion factors, biomass function	Uncertainties
Austria	Starting from ground: wood volume of the stem over bark until 0 cm of diameter (branch volumes are not included) of all trees with diameter at breast height ≥ 5 cm	Above and belowground woody biomass	Increment 'indices' to weight average increment, calculated from 1200 spruce cores. Average of five years from NFI. No projection of increment (need for relevant recalculation).	Working on stratification of BEFs (age and diameter). Coarse root included	Uncertainties analysis provided for forest biomass changes
Belgium	Wood volume of the stem over bark until 7 cm of diameter (branch volumes are not included) of all trees with diameter at breast height ≥ 7 cm	Above and belowground woody biomass	Models	Average values of neighbouring countries	Not estimated
Denmark	Starting from stump: wood volume of the stem over bark until 5 cm of diameter of all trees with diameter at breast height ≥ 5 cm	Above and belowground woody biomass	From averages of increment reported by forest owners.	BEF changed compared to 1999 communication. BEF based on literature from studies in similar conditions (Germany, Belgium). Stem, no branches, no stump. Starting diameter is 5 cm.	Not estimated
Finland	Starting from stump: wood volume of the stem over bark until 0 cm of diameter (branch volumes are not included) of all trees with diameter at breast height > 0 cm	Above and belowground woody biomass	Average of previous NFI period.	Tendency to work with Biomass functions. Study on BEF ready by 2004–05, including below ground. National conversion factors (currently site and age independent, but will use age and site dependent values later)	Not estimated (but work is under way)
France	Starting from ground: wood volume of the stem over bark until 7 cm of diameter (branch volumes are not included) of all trees with diameter at breast height ≥ 7 cm				
Germany	Starting from ground: wood volume of the stem over bark until 7 cm of diameter (branch volumes are not included) of all trees with diameter at breast height ≥ 7 cm	Above and belowground biomass	Linear interpolation	CS wood density for stem and branches by species; CS tree-level species and age specific volume expansion factor; stand-level D (but verified) root-shoot ratio	Relative standard errors are given for total biomass, but for volume stock, conversion and expansion factors
Greece	Starting from stump: wood volume of the stem over bark until 0 cm of diameter (branch volumes are not included) of all trees with diameter at breast height ≥ 10 cm	Above and belowground biomass	Average of previous NFI	IPCC default	Not estimated
Ireland	Starting from ground: wood volume of the stem over bark until 7 cm of diameter (branch volumes are not included) of all trees with diameter at breast height ≥ 7 cm	Above and belowground woody biomass	Periodic current annual increment by Irish yield models (Hamilton et al, 1971 and Forest and Wildlife Service, 2000)	BEF value was reviewed by COFORD and was revised to a weighted value of 1.64 for all tree species in 2003 (corresponding 2.0 for the young tree category and 1.4 for the mature tree category).	Not estimated

Table 7.7(b) Overview of methodology used by the Member States: methodological issues

Member State	Growing stock definition in NFI	Fraction of biomass included in "living biomass"	Annual values	Conversion and expansion factors, biomass function	Uncertainties
Italy	Starting from stump: wood volume of the stem over bark until 3 cm of diameter of all trees with diameter at breast height \geq 3 cm	Above and belowground woody biomass	From functions based on NFI and volume development.	National BEF's by ISAGA	
Luxembourg					
Netherlands	Starting from ground: wood volume of the stem over bark until 5 cm of diameter (branch volumes are not included) of all trees with diameter at breast height \geq 5 cm	Above and belowground woody biomass	National statistics, HOSP & HOSP2 forest project; from 2001 new monitoring network (Meetnet Functievervulling)	National aspecific value	Not estimated
Portugal	Starting from stump: wood volume of the stem over bark until 7.5 cm of diameter (branch volumes are not included) of all trees with diameter at breast height \geq 7.5 cm				
Spain	Starting from ground: wood volume of the stem over bark until 0 cm of diameter (branch volumes are not included) of all trees with diameter at breast height \geq 5 cm				
Sweden	Starting from stump: wood volume of the stem over bark until 0 cm of diameter (branch volumes are not included) of all trees with diameter at breast height $>$ 0 cm	Above and belowground woody biomass, needles	Annual data from the NFI. The harvest figures are based on consumption studies performed by the National Board of Forestry. Land use conversions can potentially be traced by permanent sample plots	Expansion factors for the conversion of estimates of volume to biomass are based on standing stock data. The biomass per fraction (stem including bark, branches and needles, stump and root system) is estimated by applying Marklunds biomass functions to sample trees of the NFI. The corresponding volume is estimated by functions from Näslund (growth is estimated by functions from Svensson). The developed expansion factors are applied to both estimates of volume growth and harvested volume	Not estimated
United Kingdom	Starting from ground: wood volume of the stem over bark until 7 cm of diameter (branch volumes are not included) of all trees with diameter at breast height \geq 7 cm	Above and belowground woody biomass, leaves	Modelled values.	Model with allocation.	Uncertainty analysis includes more sources than in last year

7.2.2 Source and extent of uncertainties

The above section shows that, to estimate LUCF emissions and removals, EU-15 Member States use different methodologies, in accordance with the IPCC guidelines and the new GPG for LULUCF. Due to lack of data for many elements of the entire estimation procedure, however, it is only possible to give an overview of the sources of uncertainty for the EU-15 LUCF inventory in a few countries. For Category 5.A in particular, Germany estimated a

relative standard deviation of 8.2 % and 12.8 % for the old and new *Bundesländer*, respectively, for 1993, and 7.7 % and 10.1 % for 2002.

Some countries report quantitative estimates of uncertainty in terms of the percentage standard errors with regard to the data sources used in the 5.A inventories. A recent review (Laitat et al, 2000) provides more detailed data on the national forest inventories of 12 Member States. The following ranges were found:

- 0.2–1.2 % (3–15 % for UK) for forest area (nine Member States);
- 0.54–5.1 % (1–15 % for UK) for wood volume (10 Member States);
- 0.4–0.8 % for volume growth (three Member States).

Several countries reported developments in uncertainty estimation. However, until further data are not available, it is important to identify factors that contribute to the overall uncertainty. Below is a more detailed analysis that provides additional information on sources and ranges of uncertainty.

Uncertainties linked to forest area definitions

- Errors in forest area estimation are in the order of 1 to 10 %.
- The forest definitions differ in Member States with regard to threshold of crown cover, area dimension and/or using a productivity index. However, many definitions are compatible with the one by FAO.
- In some countries, different land-cover data sources provide different estimates of total forest area.

Uncertainties linked to activity data

- More countries use updated forest inventory data than in the previous submissions. In several countries, forest inventories are based on representative sampling, where the uncertainty can be and, indeed, is estimated, and is generally low.
- Harvest statistics are usually less certain, however, their quality is improving too. Sweden uses periodic averages instead of annual data to decrease large interannual variation due to turbulent markets, which can also decrease the uncertainty for individual years.

Uncertainties linked to national forest inventories (NFI)

- Errors in volume and growth increment estimates in NFI are generally within 1–5 %.
- Volume calculations may start from different diameter thresholds in different

countries, ranging from 0 to 7 cm. The overall impact of this on the volume estimation is expected to be minor.

- Volume and yield functions may sometimes be old. However, more and more countries try to base their estimates on field measurements. The use of old models may result in an underestimation of current volume/growth, as is the case in Germany where the latest forest inventory revealed that measured increment was more than double the one that had been expected using yield tables. Austria, Sweden and (Italy) also updated their forest inventory estimates, including those of forest area.

Uncertainties linked to calculation of stocks increment

- There are different approaches to calculate the stocks increment, from the IPCC defaults (growth-harvest) to difference from consecutive surveys. As an example, Sweden has estimated the standard error of removals (10 %) and of harvests (5–25 %). Germany estimated the relative standard error or merchantable volume ('Derbholzvorrat', 1.4–40.0 %), depending on species.
- The errors in the estimation of 'removals' values obtained with different approaches are: growth-harvest, error: 20 %; differences in state (e.g. two subsequent NFIs), error: 13 %; combined estimation, error: 11 %; change in estimation aided by remote sensing, error: 10 %.
- Reports to the UNFCCC have to be performed annually, even if most of the Category 5.A data are estimated periodically. Different uncertainty is related to the different approaches (e.g. annual values versus simple or moving averages, use of indicators, etc.). There are indications that the use of simple averages or interpolation between sampling years/periods of inventories may lead to significant errors, making it necessary to perform *ex-post* recalculation when new data became available.

Uncertainties linked to harvest/drain statistics

- The uncertainty linked to different statistical sources is potentially higher than the one of forest inventories, but

mostly unknown. Problematic areas are: reliability of market statistics, fuelwood, local use and export/import of wood. However, several countries directly measure the amount of wood that is removed from the forest, which then produces more reliable estimates.

- Not all annual statistics include the effects of major disturbances on forest stocks. If disturbances occur between two NFIs, there could be inconsistencies in annual reporting when using interpolated/averaged data.

Uncertainties linked to expansion and conversion factors

- Differences in conversion factor from dry weight to carbon may occur, but they are not really relevant (low variability/error).
- Wood density data are mostly based on literature, sometimes they are quite variable for the same species in different places and should be updated. Germany estimated the relative standard error of wood density (between 8.7 and 27.2, depending on species).
- The uncertainty related to biomass expansion factors (BEF), used to expand wood stem volume/biomass to total volume/biomass, is mostly unknown, but potentially relevant. Use of volume/biomass functions, dependent on diameter and age class may reduce

somewhat this uncertainty. Germany reported relative standard error estimates for volume expansion factor by age and species (between 0.9 and 11.3 %, depending on species and age), for root estimation factors (between 19.1 and 59.2 %, depending on species groups).

- Most of the countries use only two expansion factors, one for deciduous and one for conifers. Wood density is generally at species level.
- There are some gaps for BEF, at least in some regions. This may increase uncertainty.
- Not all countries include the same biomass components in their expansion factors.

7.3 Sector-specific quality assurance and quality control

Several MS reported increased efforts of QA/QC. In addition to others, countries with extended forest cover (Finland, Germany, Sweden) reported extended procedures, which ensures the good quality of estimates. These procedures include checking both the forest inventory data, as well as the preparation of the GHG inventory. In addition, several steps were taken with respect to data quality at EU-15 level (see below).

Table 7.8 New CRF tables available from EU-15 Member States by pools reported (DOM = dead organic matter)

Country	New CRF submission	Pools reported		
		Biomass	DOM	Soil
Austria	1990-2003	Y	N	N
Belgium	1990-2003	Y	N	N
Denmark	1990-2003	Y	N	N
Finland	1990-2003	Y	N	N
France	1990-2004	Y	N	N
Germany	1990-2003	Y	N	N
Greece	1990-2003	Y	Y	N
Ireland				
Italy ^a	1990-2003		Y	Y
Luxembourg				
Netherlands	1990-2003	Y	Y	Y
Portugal	1990-2003	Y	N	N
Spain				
Sweden				
United Kingdom	1990-2003	Y	Y	Y

Table 7.9 Recalculations of total greenhouse gas emissions and recalculations of net greenhouse gas emissions in CRF Sector 5: 'LUCF', for 1990 and 2002 by gas (Gg and percentage)

	CO ₂		CH ₄		N ₂ O		HFCs		PFCs		SF ₆	
	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent
1990												
Total emissions and removals	- 122 396	- 3.8 %	- 9 539	- 2.1 %	16 013	4.1 %	200	0.7 %	- 276	- 1.7 %	125	1.2 %
LUCF (net)	- 122 658	121.4 %	- 189	- 51.3 %	- 228	- 63.1 %	NO	NO	NO	NO	NO	NO
2002												
Total emissions and removals	- 165 492	- 5.1 %	- 7 491	- 2.1 %	8 640	2.6 %	- 3 682	- 7.4 %	279	5.2 %	406	4.4 %
LUCF (net)	- 171 106	107.8 %	910	1651.1 %	- 214	- 69.2 %	NO	NO	NO	NO	NO	NO

NO: not occurring

Table 7.10 Contribution of Member States to EU-15 recalculations in CRF Sector 5: 'LUCF' for 1990 and 2002 by gas (difference between latest submission and previous submission Gg of CO₂ equivalents)

	1990						2002					
	CO ₂	CH ₄	N ₂ O	HFCs	PFCs	SF ₆	CO ₂	CH ₄	N ₂ O	HFCs	PFCs	SF ₆
Austria	201	0	0	NO	NO	NO	- 3 678	0	0	NO	NO	NO
Belgium	- 1 210	- 106	- 237	NO	NO	NO	- 2 166	- 102	- 226	NO	NO	NO
Denmark	2 990	0	0	NO	NO	NO	2 337	0	0	NO	NO	NO
Finland	1 004	16	29	NO	NO	NO	2 512	10	13	NO	NO	NO
France	- 1 022	0	0	NO	NO	NO	- 229	1 008	0	NO	NO	NO
Germany	- 80 765	0	0	NO	NO	NO	- 90 611	0	0	NO	NO	NO
Greece	- 4 498	- 70	- 16	NO	NO	NO	- 3 564	- 5	0	NO	NO	NO
Ireland	- 341	0	0	NO	NO	NO	0	0	0	NO	NO	NO
Italy	- 37 351	- 20	- 2	NO	NO	NO	- 75 394	6	1	NO	NO	NO
Luxembourg	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
Netherlands	4 316	0	0	NO	NO	NO	4 172	0	0	NO	NO	NO
Portugal	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
Spain	423	0	0	NO	NO	NO	- 1 094	0	0	NO	NO	NO
Sweden	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
UK	- 6 405	- 9	- 2	NO	NO	NO	- 3 392	- 7	- 1	NO	NO	NO
EU-15	- 122 658	- 189	- 228	NO	NO	NO	- 171 106	910	- 214	NO	NO	NO

NO: not occurring

7.3.1 Experiences with the new CRF tables

COP-9 decided in 2003 that new, more detailed, and restructured CRF tables should be used for reporting in the LULUCF sector. Using these tables is not mandatory this year, rather, countries can try the new tables and gain experience with them. Ten EU-15 Member States submitted the new CRF tables in addition to the old ones (Table 7.8). As the new tables require more detailed reporting, efforts were needed to collect and process necessary data. In some countries, the whole GHG inventory system was restructured, which also ensures higher accuracy. In some cases, however, due to lack of proper data (at least for some

inventory years), emissions and removals from land converted to other land is reported under land remaining the same land.

7.3.2 Other relevant QA/QC activities

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. 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. 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.

7.4. Sector-specific recalculations

Table 7.9 shows the extent of recalculations in the LUCF sector by gas for the EU-15 for 1990 and 2002.

Table 7.10 provides an overview of Member States' contributions to EU-15 recalculations for the years 1990 and 2002. The 2002 data show that the recalculations increased emissions for some countries (Denmark, Finland and the Netherlands), while for other countries the removals increased (Austria, Germany, Ireland, Italy,

UK). The recalculations were done due to the considerable improvements of the estimation methodology in many Member States, as well as new or improved data. In category 5A, new forest inventory data showed larger growth of volume stocks than expected (Austria, Germany). More specifically, recalculation was done due to the following reasons.

- Estimation of new sources (subcategories): Denmark (where emission and removal estimates for soils were included).
- Use of improved activity data: area of recently planted forest (UK), forest growth (Austria, Germany), harvest statistics (Sweden), rates of change of land use (UK), deforestation estimation (UK).
- Use of new or improved emission/removal factors: soil carbon density (UK), net emission due to disturbance of soil for afforestation (UK), estimation of root biomass by applying default (IPCC) root/shoot ratios (Germany), replacement of the former conservative estimate of 1.3 of the biomass expansion factor by a weighted value of 1.64 (Ireland).

8 Waste (CRF Sector 6)

This chapter starts with an overview on emission trends in CRF Sector 6: 'Waste'. For each EU-15 key source, overview tables are presented including the Member States contributions to the key source in terms of level and trend, information on methodologies, emission factors, completeness, and qualitative uncertainty estimates. The quantitative uncertainty estimates for this sector and the sector specific QA/QC activities are summarised in separate sections. Finally, the chapter includes information on recalculations.

8.1 Overview of sector

CRF Sector 6 'Waste' is the fourth largest sector in the EU-15, contributing 2 % to total GHG emissions. Total emissions from 'Waste' have been decreasing by 31 % from 141 Tg in 1990 to 97 Tg in 2003 (Figure 8.1). In 2003, emissions decreased by 2.5 % compared to 2002. The key sources in this sector are:

- 6.A.1: Managed waste disposal on land (CH₄)
- 6.A.2: Unmanaged waste disposal sites (CH₄)
- 6.B.2: Domestic and commercial wastewater (CH₄)
- 6.C: Waste incineration (CO₂)

Figure 8.1. shows that CH₄ emissions from landfills account for about 73 % of waste-related GHG emissions in the EU-15.

Figure 8.2 shows that CH₄ emissions from 'Managed waste disposal on land' had the greatest decrease of all waste-related emissions.

8.2 Source categories

8.2.1 Solid waste disposal on land (CRF Source Category 6.A)

Table 8.1 summarises information by Member State on methodologies, emission factors, completeness and qualitative uncertainty estimates for CH₄ from 6.A: 'Solid waste disposal on land'. CH₄ emissions from 'Solid waste disposal on land' decreased by 35 % between 1990 and 2003 in the EU-15. Nearly all EU-15 Member States reduced their emissions from this source.

This source category includes two key sources: CH₄ from 6.A.1: 'Managed waste disposal on land' and CH₄ from 6.A.2: 'Unmanaged waste disposal on land'.

Table 8.2 provides information on emission trends of the key source CH₄ from 6.A.1 'Managed waste disposal on land' by

Figure 8.1 EU-15 GHG emissions 1990–2003 from CRF Sector 6: 'Waste' in CO₂ equivalents (Tg) and share of largest key source categories in 2003

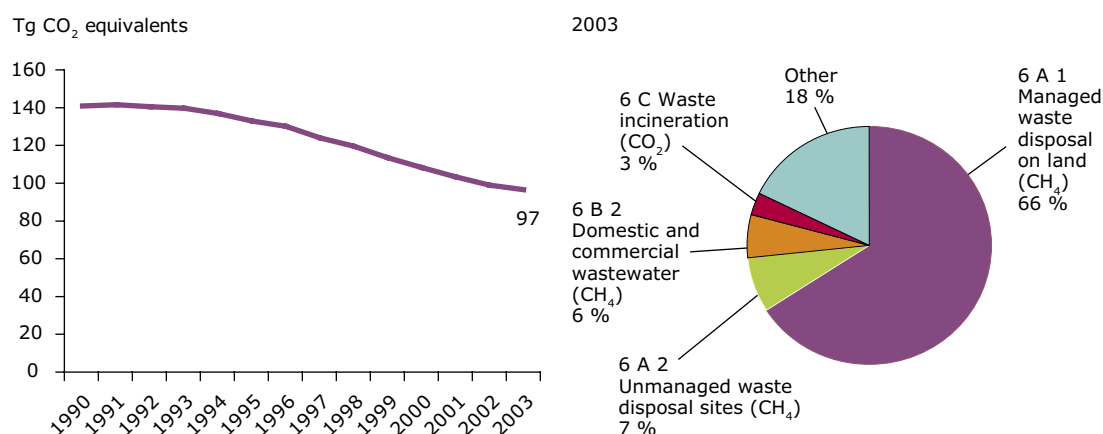
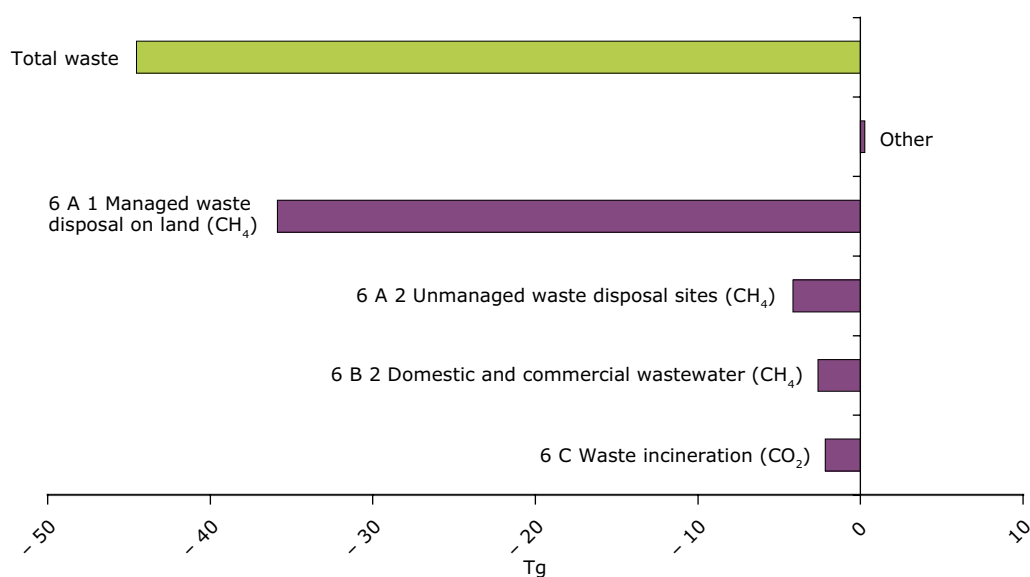


Figure 8.2 Absolute change of GHG emissions by large key source categories 1990–2003 in CO₂ equivalents (Tg) in CRF Sector 6: 'Waste'



Member State. CH₄ emissions from managed waste disposal on land account for 1.5 % of total EU-15 GHG emissions. Between 1990 and 2003, CH₄ emissions from managed landfills declined by 36 % in the EU-15. In 2003, CH₄ emissions from landfills decreased by 2 %. A main driving force of CH₄ emissions from managed waste disposal on

land is the amount of biodegradable waste going to landfills. Total municipal waste disposal on land declined by about 30 % between 1990 and 2003. In addition, CH₄ emissions from landfills are influenced by the amount of CH₄ recovered and utilised or flared. The share of CH₄ recovery increased in several EU-15 Member States.

Table 8.1 Member States' contributions to CH₄ emissions from 6.A: 'Solid waste disposal on land' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO ₂ equivalents)	GHG emissions in 2003 (Gg CO ₂ equivalents)	Methods applied ¹⁾	EF ¹⁾	Estimate ²⁾	Quality ²⁾
Austria	4 144	2 829	CS	CS	ALL	L
Belgium	2 630	917	M	CS		
Denmark	1 334	1 153	CS/M	CS/M	ALL	M
Finland	3 679	2 497	T2	D/CS		
France	11 209	10 311	CS/T2	CS	ALL	M
Germany	31 479	11 655	T2	D, CS	T1	M
Greece	2 652	3 915	T1	D	ALL	
Ireland	1 234	1 931	T2	CS, D	Full	M
Italy	10 348	9 690	T2	D, CS	ALL	M
Luxembourg	64	49	C/D	C/D		
Netherlands	12 011	6 775	CS, T2	CS	ALL	M
Portugal	3 892	4 860	T2	D + CS	All	M
Spain	3 456	7 394	T2	T2, CS		
Sweden	2 554	1 740	T2	D + CS	ALL	M
United Kingdom	23 760	8 064	M	CS	ALL	L
EU-15	114 445	73 779	C, CS, D, M, T1, T2	C, CS, D, M, T2	ALL	M

(¹⁾ Information source: CRF Summary Table 3 for 2002.

(²⁾ Information source: CRF Table 7 for 2002.

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 8.2 Member States' contributions to CH₄ emissions from 6.A.1: 'Managed waste disposal on land'

Member State	Greenhouse gas emissions (Gg CO ₂ equivalents)			Share in EU-15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO ₂ equivalents)	(%)	(Gg CO ₂ equivalents)	(%)			
	Austria	4 144	2 883		2 829	4.4 %	- 54	- 2 %			
Belgium	2 630	1 014	917	1.4 %	- 97	- 10 %	- 1 713	- 65 %	M	RS	CS
Denmark	1 334	1 156	1 153	1.8 %	- 3	0 %	- 181	- 14 %	T2	NS, PS	CS
Finland	2 235	1 620	1 518	2.4 %	- 102	- 6 %	- 717	- 32 %	T2	PS	D, CS
France	6 332	8 093	7 963	12.5 %	- 129	- 2 %	1 631	26 %	CS, T2	NS	CS
Germany	31 479	11 922	11 655	18.3 %	- 267	- 2 %	- 19 824	- 63 %	T2	NS	CS
Greece	1 088	1 887	2 121	3.3 %	235	12 %	1 034	95 %	T1	NS, Q	D
Ireland	908	1 274	1 481	2.3 %	207	16 %	572	63 %	T2	NS	CS
Italy	7 787	9 751	9 294	14.6 %	- 457	- 5 %	1 507	19 %	T2	NS	D, CS
Luxembourg	64	48	49	0.1 %	0	0 %	- 16	- 25 %			
Netherlands	12 011	7 253	6 775	10.6 %	- 478	- 7 %	- 5 236	- 44 %	CS, T2	AS	CS
Portugal	549	1 531	1 706	2.7 %	175	11 %	1 157	211 %	T2	NS	D, S
Spain	2 690	6 178	6 429	10.1 %	251	4 %	3 738	139 %	T2	NS	D
Sweden	2 554	1 845	1 740	2.7 %	- 105	- 6 %	- 814	- 32 %	T3	NS	D, CS
United Kingdom	23 760	8 820	8 064	12.7 %	- 756	- 9 %	- 15 696	- 66 %	M	NS	CS
EU-15	99 564	65 275	63 693	100.0 %	- 1 582	- 2 %	- 35 871	- 36 %			

Table 8.3 Member States' contributions to CH₄ emissions from 6.A.2: 'Unmanaged waste disposal on land'

Member State	Greenhouse gas emissions (Gg CO ₂ equivalents)			Share in EU-15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO ₂ equivalents)	(%)	(Gg CO ₂ equivalents)	(%)			
	Austria	NO	NO		NO	-	-	-			
Belgium	0	0	0	0.0 %	0	-	0	-	NO	NO	NO
Denmark	NO	NO	NO	-	-	-	-	-	NO		
Finland	NO	NO	NO	-	-	-	-	-	(T2)	(PS)	(D, CS)
France	4 876	2 513	2 347	32.5 %	- 166	- 7 %	- 2 529	- 52 %	CS, T2	NS	CS
Germany	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Greece	1 564	1 829	1 794	24.9 %	- 35	- 2 %	230	15 %	T1	NS	D
Ireland	326	427	450	6.2 %	23	5 %	124	38 %	T2	NS	CS
Italy	2 561	515	396	5.5 %	- 119	- 23 %	- 2 165	- 85 %	T2	NS	D, CS
Luxembourg	0	0	0	0.0 %	0	-	0	-			
Netherlands	NO	NO	NO	-	-	-	-	-	NO		
Portugal	1 291	1 366	1 262	17.5 %	- 103	- 8 %	- 28	- 2 %	T2	NS	D, S
Spain	751	1 008	965	13.4 %	- 43	- 4 %	214	28 %	T2	NS	D
Sweden	NO	NO	NO	-	-	-	-	-	NO		
United Kingdom	0	0	0	0.0 %	0	-	0	-	NE	NE	NE
EU-15	11 369	7 657	7 215	100.0 %	- 443	- 6 %	- 4 155	- 37 %			

The Member States with most emissions from this source were Germany, Spain, Italy and the UK. Several Member States reduced their emissions between 1990 and 2003. 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

Table 8.4 Member States' contributions to CH₄ emissions from 6.B: 'Wastewater handling' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990	GHG emissions in 2003	Methods applied ¹⁾	EF ¹⁾	Estimate ²⁾	Quality ²⁾
	(Gg CO ₂ equivalents)	(Gg CO ₂ equivalents)				
Austria	286	303	C	CS	ALL	L
Belgium	81	77	D	D, CS		
Denmark	200	244	NE		NE	
Finland	153	128	D	D/CS	ALL	M
France	714	1 169	CS/T2	CS	ALL	L
Germany	2 226	112	D	D, CS	T1	L
Greece	2 357	655	T1	D	PART	
Ireland	0	0	NA	NA	NE	NE
Italy	1 340	1 432	D	D	ALL	M
Luxembourg	4	5	C	CS	ALL	L
Netherlands	290	207	CS	CS	ALL	M
Portugal	870	835	D	D+CS	All	M/L
Spain	1 250	2 025	D	D, C, CS	0	
Sweden	0	0	NO	NO	IE	
United Kingdom	701	789	M	CS	PART	L
EU-15	10 473	7 981	C, CS, D, M, T1, T2	C, CS, D	ALL, IE, PART	L

(¹⁾ Information source: CRF Summary Table 3 for 2002.

(²⁾ Information source: CRF Table 7 for 2002.

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 8.5 Member States' contributions to CH₄ emissions from 6.B.2: 'Domestic and commercial wastewater'

Member State	Greenhouse gas emissions (Gg CO ₂ equivalents)			Share in EU-15 emissions in 2003	Change 2002-2003		Change 1990-2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO ₂ equivalents)	(%)	(Gg CO ₂ equivalents)	(%)			
	Austria	189	199		200	3.6 %	1	0 %			
Belgium	81	78	77	1.4 %	0	0 %	- 4	- 4 %	D	RS	D, CS
Denmark	200	277	244	4.4 %	- 33	- 12 %	44	22 %	D, CS	NS	D, CS
Finland	131	109	109	1.9 %	- 1	- 1 %	- 22	- 17 %	D	PS	D, CS
France	714	1 163	1 169	20.9 %	6	0 %	455	64 %	CS, T2	NS	CS
Germany	2 226	133	112	2.0 %	- 21	- 16 %	- 2 114	- 95 %	D	NS	D, CS
Greece	2 252	655	538	9.6 %	- 117	- 18 %	- 1 714	- 76 %	D	NS	D
Ireland	NE	NE	NE	-	-	-	-	-			
Italy	83	170	166	3.0 %	- 4	- 2 %	83	100 %	D	NS	D
Luxembourg	2	2	2	0.0 %	0	- 2 %	0	22 %			
Netherlands	190	180	168	3.0 %	- 12	- 7 %	- 23	- 12 %	CS	NS	CS
Portugal	706	623	627	11.2 %	4	1 %	- 79	- 11 %	D	NS, RS	D, CS
Spain	756	1 348	1 404	25.1 %	56	4 %	649	86 %	D	NS	D, CS
Sweden	IE	IE	IE	-	-	-	-	-	IE	IE	IE
United Kingdom	701	784	789	14.1 %	5	1 %	88	13 %	M		CS
EU-15	8 230	5 722	5 605	100.0 %	- 117	- 2 %	- 2 625	- 32 %			

Abbreviations explained in the Chapter 'Units and abbreviations'.

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 8.6 Member States' contributions to CO₂ emissions from 6.C: 'Waste incineration' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO ₂ equivalents)	GHG emissions in 2003 (Gg CO ₂ equivalents)	Methods applied ¹⁾	EF ¹⁾	Estimate ²⁾	Quality ²⁾
Austria	21	11	C	CS	ALL	L
Belgium	339	344	D	PS		
Denmark	0	0	IE			
Finland	IE	0	NO	NO	IE	IE
France	2 300	1 386	C	CS/PS	ALL	M
Germany	NO	NO	NO	NO	NO	
Greece	0	0			NO	
Ireland	NO	NO	NA	NA	NO	NA
Italy	493	168	D	CS	ALL	M
Luxembourg	19	0	C	CS	ALL	L
Netherlands	IE	IE	IE	0	IE	
Portugal	10	350	D	D+C	All	H
Spain	750	178	C	C,CS		
Sweden	44	121	PS	PS	ALL	H
United Kingdom	1 201	460	T2	CS	PART	L
EU-15	5 177	3 016	C,D, PS, T2	C, CS, D, PS	ALL, IE, NE, PART	M

(¹) Information source: CRF Summary Table 3 for 2002.

(²) Information source: CRF Table 7 for 2002.

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 8.7 Member States' contributions to CO₂ emissions from 6.C: 'Waste incineration' and information on methods applied and quality of these emission estimates

Member State	Greenhouse gas emissions (Gg CO ₂ equivalents)			Share in EU-15 emissions in 2003	Change 2002– 2003		Change 1990– 2003		Method applied	Activity data	Emission factor
	1990	2002	2003		(Gg CO ₂ equivalents)	(%)	(Gg CO ₂ equivalents)	(%)			
Austria	21	11	11	0.4 %	0	0 %	- 9	- 46 %	C	AS	CS
Belgium	339	335	344	11.4 %	8	3 %	4	1 %	D	PS	PS
Denmark	IE	IE	IE	-	-	-	-	-	IE		
Finland	IE	IE	IE	-	-	-	-	-	IE		
France	2 300	1 424	1 386	45.9 %	- 38	- 3 %	- 914	- 40 %	C	NS, PS	CS, PS
Germany	NO	NO	NO	-	-	-	-	-	NO		
Greece	NE	NE	NE	-	-	-	-	-	NO		
Ireland	NO	NO	NO	-	-	-	-	-			
Italy	493	185	168	5.6 %	- 17	- 9 %	- 326	- 66 %	D	NS	CS
Luxembourg	19	0	0	0.0 %	0	-	- 19	- 100 %			
Netherlands	IE	IE	IE	-	-	-	-	-	IE		
Portugal	10	359	350	11.6 %	- 9	- 2 %	340	3 372 %	D	PS, NS	PS, C, CS
Spain	750	275	178	5.9 %	- 97	- 35 %	- 573	- 76 %	C	NS, Q	CS, C
Sweden	44	61	121	26.3 %	60	99 %	77	176 %	PS	PS	PS
United Kingdom	1 201	481	460	15.2 %	- 21	- 4 %	- 741	- 62 %	T2	NS, AS	CS
EU-15	5 177	3 130	3 016	100.0 %	- 114	- 4 %	- 2 160	- 42 %			

Abbreviations explained in the Chapter 'Units and abbreviations'.

CH₄ emissions from 6.A.2: 'Unmanaged waste disposal on land' account for 0.2 %

of total EU-15 GHG emissions in 2003. Between 1990 and 2003, CH₄ emissions

from this source decreased by 37 % 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 and Greece are responsible for 57 % of the total EU-15 emissions. France and Italy had large absolute reductions between 1990 and 2003.

8.2.2 Wastewater handling (CRF Source Category 6.B)

Table 8.4 summarises information by Member State on methodologies, emission factors, completeness and qualitative uncertainty estimates for CH₄ from 6.B: 'Wastewater handling'. Between 1990 and 2003, CH₄ emissions from wastewater handling decreased by 24 %. This source category includes one key source: CH₄ from 6.B.2: 'Domestic and commercial wastewater'.

CH₄ from 6.B.2: 'Domestic and commercial wastewater' accounts for 0.1 % of total EU-15 GHG emissions. Between 1990 and 2003, emissions decreased by 32 %. Large decreases in absolute terms are reported from Germany and Greece, whereas Spain had large emission increases (Table 8.5).

8.2.3 Waste incineration (CRF Source Category 6.C)

Tables 8.6 and 8.7 summarise information by Member State on emission trends, methodologies, emission factors, completeness and qualitative uncertainty estimates for CO₂ from 6.C: 'Waste incineration'. This key source accounts for 0.1 % of total EU-15 GHG emissions. Between 1990 and 2003, CO₂ emissions from waste incineration decreased by 42 %; France and the UK had the largest decreases in absolute terms.

8.3 Methodological issues and uncertainties

Detailed information on national methods and circumstances is available in the Member States' national inventory reports.

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 6.A.1 'CH₄ emissions from managed solid waste disposal sites' and 6.A.2 'CH₄ emissions from unmanaged

solid waste disposal sites' since they are EU-15 key sources and contribute 1.5 % and 0.2 % of the GHG emissions from the sector 'Waste', respectively. The Reporting Category 6.B.2 'CH₄ emissions from domestic and commercial wastewater', key source in the EU-15 as well, is also comprehensively analysed. The quality of reporting is assessed to be low in the EU, compare Table 8.4 and a comparative analysis of the Member States' methods and country specific values provide a sound basis for reviews. Source Categories 6.B.1, 6.C and 6.D are only briefly discussed.

8.3.1 Managed solid waste disposal (CRF Source Category 6.A.1)

CH₄ emissions from managed solid waste disposal are key sources in all Member States. For key sources in the Source Category 6.A it is good practice to use the first order decay (FOD) method (Tier 2) to calculate the emissions and to display emission trends over time. All EU-15 Member States apart from Greece and Luxembourg applied — in line with the IPCC good practice guidance — Tier 2 methodologies in order to estimate CH₄ emissions from managed solid waste disposal sites (see Table 8.2). While the method used in Luxembourg is not indicated, Greece applied the Tier 1 methodology due to the lack of detailed data which are required. 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, Austria, France and Finland) applied country-specific methods in accordance with the Tier 2 methodology. The remaining Member States applied the Tier 2 methodology proposed by the IPCC good practice guidance and the IPCC guidelines. Eight Member States assume that the estimates have a medium quality in that source category, two Member States indicate a low quality, while five Member States did not report the results of the quality assessment (compare Table 8.1). Table 8.8 summarises the characteristics of the national methodologies for estimating CH₄ emissions from managed solid waste disposal sites.

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

Table 8.8 Description of national methods used for estimating CH₄ emissions from managed solid waste disposal

Member States	Description of methods
Austria	Country specific method: First the overall amount of generated landfill gas per ton waste was calculated, taking into account the DOC-content of the waste and the average temperature at the landfill. For the calculation the amount of landfill gas produced in the year of disposal and in the 30 years after disposal is taken into account. To determine the total amount of landfill gas emissions for one year, the amounts generated by waste disposed in the last 31 years are summed up. After subtracting the collected gas and multiplying by the CH ₄ constant of landfill gas, the emitted quantity of CH ₄ from residual waste was obtained. The country specific approach is based on the methodology described by Tabasaran and Rettenberger.
Belgium	IPCC Tier 2 method with national model (NIR 2004)
Denmark	Emissions based on a model suited to Danish conditions. The model is based on the IPCC Tier 2 approach (NIR 2004).
Finland	Finland used IPCC Tier 2 method as a basis. However, Equation 5.1 from the GPG (2000) has been slightly modified, so that term MCF (t) has substituted for the term MCF (x) in the calculation of methane generation potential L ₀ (x). Calculation is not made separately for each landfill but the total waste amount and the average common MCF value for each year have been used. It has been thought that the situation in year t defines the MCF to be used for the emissions caused by waste amounts landfilled in the previous year also (NIR 2005).
France	IPCC Tier 2 method
Germany	IPCC Tier 2 method
Greece	IPCC Tier 1 method: According to the IPCC good practice guidance, the Tier 2 methodology should be applied for the estimation of emissions from solid waste disposal on land. However, due to the lack of the detailed data required, its application is not yet feasible (NIR 2004).
Ireland	IPCC Tier 2 method
Italy	IPCC Tier 2 method
Luxembourg	Method is described neither in NIR nor in CRF
Netherlands	IPCC Tier 2 method
Portugal	IPCC Tier 2 method
Spain	IPCC Tier 2 method
Sweden	I□ Comparison between the suggested IPCC gas potentials and Swedish estimates show that the IPCC values tend to be higher, but c□ interval.
United Kingdom	T□ are compatible with Equations 5.1 and 5.2 in the good practice guidance. A slightly different 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 2005 if available, else NIR 2004.

Table 8.9 Data sources used for generating time series of activity data for managed solid waste disposal

Member States	Data sources used for generating time series (6.A.1)
Austria	The quantities of residual waste from 1950 to 1990 were taken from a study (Hackl, Mauschitz; 1999) and from 1990 to 1997 from the current Bundesabfallwirtschaftsplan (Federal Waste Management Plan). However, in both references the amount of waste from administrative facilities of industry is not considered whereas it is included in the Deponiedatenbank, which is used for the activity data from 1998 onwards. Thus to achieve a consistent time series, the share of waste from administrative facilities of industry in the year 1998 was taken and was assumed remained constant over the time series. Activity data for 'residual waste' were not available in the years before 1998, the value for 1998 was used for these years (NIR Austria 2004).
Belgium	In Wallonia, the quantity of waste disposed comes from the statistics of OWD (Walloon Waste Office). It publishes each year the industrial and municipal waste disposed, based on the taxes declaration forms covering 50 solid waste disposal sites of various sizes. Those statistics are available on a yearly basis since 1994. For the years before, the amounts have been estimated using available data and OWD expert judgement assumptions (NIR 2005). 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. 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.
Finland	Activity data for the time series is taken from different sources: 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 for the Landfill Registry of the Finnish 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 and the Technical Research Centre of Finland. Estimated data on waste amounts before the year 1990 are based on the report of VTT (Tukhanen 2002) (NIR 2005).

Member States	Data sources used for generating time series (6.A.1)
France	The amount of waste on SWDS derives from the surveys called 'ITOMA' made by ADEME (NIR 2004). These surveys have been developed since 1985. For the years 1960 to 1984, assumptions made by ADEME are used. ADEME is the French agency for environment and energy management.
Germany	The surveys of waste quantities commenced in 1975 on the basis of the Environmental Statistics Act in 1974. Waste quantities for the period from 1970 to 1975 were extrapolated on the basis of population data. The most recent year for which suitable differentiated data is available is 2000. For 2001 and 2002, quantities were assumed to remain constant in comparison to 2000. These data will be recalculated as soon as the relevant specialised series of the Federal Statistical Office become available. For the period 1970 to 1990, there was no standardised basis for waste-production and waste disposal data throughout all of Germany, as this creates a problem with regard to data on waste quantities and landfilled proportions of waste during that period. Data for the former GDR cannot simply be derived from average data of the old German Länder, since marked differences applied: the average per-capita waste production (municipal waste), at about 175 kg/a was considerably lower than that of the Federal Republic of Germany, where the corresponding figure was about 365 kg/a of household waste. From the former GDR's Ministry for Nature Conservation, Environmental Protection and Water Resources Management, statistical data on settlement-waste production for the territory of the former GDR are available for four different years in the period leading up to reunification (1983, 1985, 1988, 1989); from this data, in connection with population data, the applicable settlement-waste quantities for the former GDR were derived for the period 1970–1990. For the years 1990 and 1993 and for the period since 1996, differentiated data are available on landfilled quantities of individual fractions of municipal waste. For the years prior to 1990, the landfilled proportions from 1990 were used, with no changes. For the years after 1990 for which data were lacking, data from framing years were interpolated.
Greece	Estimates on solid waste quantities generated are contained in various reports, research programmes and studies, but refer to specific points in time rather than to complete time series, while different assumptions are applied in each source for the estimation of generated quantities. Therefore, on the one hand there is a lack of data for some years, while on the other hand the evolution of quantities between years for which official data are available cannot always be considered as reliable. For this reason, a re-estimation of generated quantities of municipal solid wastes for the whole period 1990–2002 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 generated quantities (NIR 2004).
Ireland	The waste material contributing to DOC includes MSW and street cleanings, are given in the national waste database reports. The EPA commenced the development of the national waste database in the early 1990s. National statistics generated from this database and published on a three-year cycle by EPA are the primary basis for establishing the historical time-series of MSW placed in landfills in Ireland. These publications provide detailed descriptions of the methods employed to compile the waste database. The results of other less comprehensive surveys undertaken in previous years (1987, 1993, 1994) have also been used to some extent in compiling the MSW time series.
Italy	The complete database from 1975 of waste production, waste disposal in managed and unmanaged landfills and sludge disposal in landfills has been reconstructed on the basis of available data reported in different sources: studies, national legislation and regression models based on population (NIR 2004).
Netherlands	The amount of waste deposited at disposal sites is collected by the Working Group on Waste Registration. A yearly survey (since 1990) is used therefore. The response to this survey is every year 100 %. (e-mail communication with national waste expert, April 2005).
Portugal	Since 1999 data on MSW are 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 and a research study performed by Quercus (1995). The data were 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 (NIR 2004).
Spain	The data source for characterisation and quantification of the waste has been the annual publication entitled 'Environment in Spain' from the Ministry of the Environment (NIR 2005).
Sweden	Household waste and similar: First national survey by EPA in 1980, similar data in 1985, 1990 and 1994 by Statistics Sweden, since 1994 annual survey on landfilled waste by RVF. For the years in between the surveys, where data are missing, data are imputed. Standard values on fractions of landfilled household waste from 1970 and 1975 available from RVF. Figures on sludge from households and park and garden waste: available since 1990. industrial waste: data from 1980s but no indication on biological fraction. Studies on quantities and treatment of biological waste from industry in 1993 and 1996 by EPA. Landfilled sludge from the pulp industry (important waste fraction): yearly documented from 1994 with high quality from the Swedish EPA. Previously landfilled sludge from the pulp industry had been documented intermittently.
United Kingdom	The estimates of historical waste disposal and composition data are based on various data sources. Estimates for municipal waste are based on population where data are absent. Until 1994, the waste arising data are based on waste surveys in the UK using actual data. After 1994, data are based on a new study carried out by a UK consultancy. Years between 1995 and 1998 inclusive are extrapolated backwards from the 1999 data and years ahead of 1999 are extrapolated based on a projected scenario of waste disposal.

Source: NIR 2005 if available, else NIR 2004. Luxembourg is not considered as their NIR is not available.

the FOD method applied by the Member States is presented. The main factors influencing the quantity of CH₄ 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

Table 8.10 Consistency of time series of activity data

Member States	Consistency of time series
Austria	No detailed description of time series consistency.
Belgium	The time series is expected to be consistent in Belgium.
Denmark	The time series of activity data is consistent in the sense that the source for the data for the whole time-series is the registered amount of waste. A registration has been done since the start of the 1990s in order to measure the effects of action plans. The consistency is the same for the whole time-series and is within the interval recommended for a first order decay model in the IPCC guidelines (NIR 2005).
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 the years 1986–1988, 1990–1992, 1994 and 2001. For the years 1960–1984, consistency between 1984 and 1985 was checked to approve the times series (e-mail communication with national waste expert, April 2005).
Germany	Over the long activity-data period involved, 30 years, time series inconsistencies have to be expected. In Germany, such inconsistencies are expected; furthermore, they must be expected as a result of improvements of laws and statistics for the waste sector (NIR 2005).
Greece	No detailed description of time series consistency.
Ireland	The time-series estimates given in the present submission are fully consistent (NIR 2005).
Italy	No detailed description of time series consistency, Time series refers to different official reports; from 1996 it could be considered fully consistent.
Netherlands	The time series of activity data is consistent in the sense that the source for the data is for the whole time series the same. The amount of waste deposited is registered by a yearly survey since 1990 with a response of 100 %. (e-mail 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 time series in the waste sector is 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 prior to 1995 and after 1995. This has led to some discontinuity between the two sets of estimates (discontinuity in estimated MSW, industrial and commercial waste arising) (NIR 2004).

Source: NIR 2005 if available, else NIR 2004. Luxembourg is not considered as their NIR is not available.

of activity data by the Member States are summarised in Table 8.9.

Some Member States explicitly describe the consistency of their time series (compare Table 8.10).

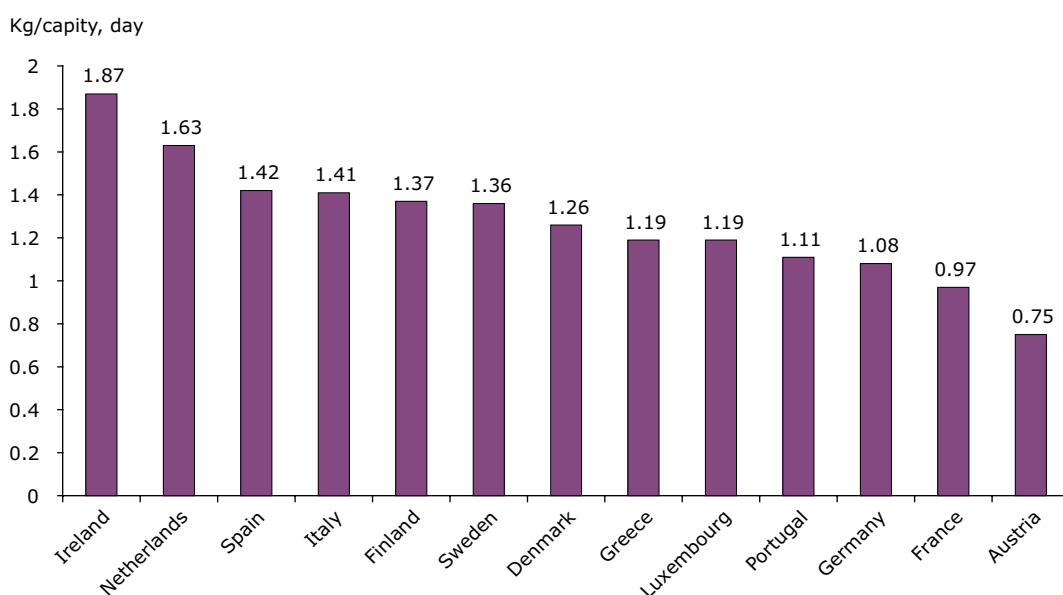
The amount of waste disposed on SWDS depends, on the one hand on the total amount of waste generated, respectively, on the per capita waste generation rate. Figure 8.2 provides an overview.

The waste generation rate per capita varies significantly among the Member States. Austria shows the lowest rate of 0.75 kg/capita/day, while Ireland reports the highest waste generation rate of 1.87 kg/capita/day. The average of all the Member States providing a waste generation rate lies at 1.28 kg/capita/day.

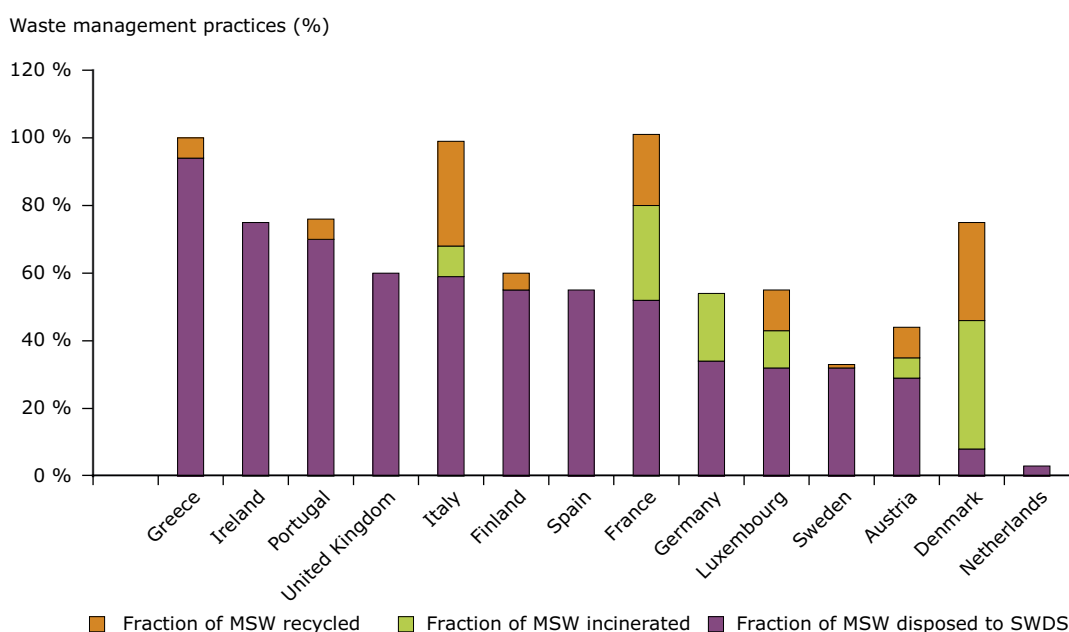
On the other hand, the amount of waste generated on SWDS is strongly influenced by the waste management practices of the individual Member States: by the share of

waste incinerated, recycled and composted, compare Figure 8.3.

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. Landfills in Germany remaining in operation may store only waste that conforms to strict categorisation criteria from 2005 onwards. 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

Figure 8-3 Waste generation rate

Source: CRF 2005, Table 6 A, Additional information; NIR 2005 if available, else NIR 2004; additional information by Luxembourg. For Denmark the waste generation rate is the figure from the NIR, not from the CRF which includes large amounts of industrial waste not relevant for the estimation.

Figure 8-4 Fraction of MSW disposed to SWDS, incinerated and recycled

Source: CRF 2005, Table 6 A, Additional information; NIR 2005 if available, else NIR 2004; additional information by Luxembourg.

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 CH₄ 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 8.4 and Table 8.12) as well as on waste composition of landfilled waste (Table 8.11). The latter parameters are again strongly influenced by waste management practices and policies.

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

Table 8.11 Waste composition of landfilled waste

Member States	Composition of landfilled waste
Austria	Landfilled waste is differentiated in 'residual waste' and 'non-residual waste' (bulk, construction, mixed industrial waste, road sweeping, sewage sludge, rakings, residual matter from waste treatment). The latter is divided into well biodegradable waste (half-life period 1–20 years and hardy biodegradable waste (half life period: 20–100 years) (NIR 2004)
Belgium	There is one model for solid waste disposal on land, using specific parameters (DOC,...)for municipal waste and for industrial waste. Hospital Waste is included in municipal waste.
Denmark	The composition of waste has considerable variation. As waste types are taken into consideration: domestic waste, bulky waste, garden waste, commercial & office waste, industrial waste, building and construction waste, sludge and ash and slag. As material fraction the following are differentiated: waste food, cardboard, paper, wet card board and paper, plastics, other combustibles, glass and metal (NIR 2005).
Finland	Solid municipal, industrial, construction and demolition wastes and municipal and industrial sludges are considered as emissions sources. Different DOC are applied (NIR 2005)
France	Composition of landfilled waste is not mentioned explicitly in the NIR 2004. According to the surveys of ADEME for the 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 %. (e-mail communication with national waste expert, April 2005).
Germany	Composition of solid waste on landfills: household waste, municipal waste of former GDR, bio-degradable waste from 'bio' bins, bulky waste, road sweepings, market waste, garden and park waste, sewage sludge.
Greece	The estimated composition of generated MSW is: putrescible matter, paper, plastics, metals, glass, rest. However, accurate data on the composition of generated municipal solid waste at national level are not available, as a comprehensive analysis at national scale covering a complete time period has not been accomplished yet. The estimated disposed quantities of solid waste do not include sludge from wastewater treatment plants, as well as other kinds of waste (e.g. clinical waste)(NIR 2004).
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 are considered. Explicitly mentioned: completeness with respect to additional sources of organic waste including sludge and industrial waste remains to be addressed (NIR 2005).
Italy	Apart from municipal solid waste, industrial waste which is landfilled and sludge from wastewater handling plants have also been considered (NIR 2004). Landfill waste comprises IPCC categories paper and paperboard, food and garden waste, glass, textiles, other (inert and organic).
Luxembourg	The waste amounts indicated by Luxembourg which are incinerated and disposed of on SWDS comprise all types of waste which have been accepted by the installation, comprising municipal, industrial and bulky waste.
Netherlands	Composition of landfilled waste comprises IPCC categories for municipal waste (paper and paperboard, food and garden waste, plastics, glass, textiles and other: metals, building wastes and ashes, wood and other) (NIR 2005).
Portugal	SWDS include solid municipal or urban waste (household, garden, commercial-services wastes) and industrial wastes (NIR 2004).
Spain	Composition of landfilled waste is not mentioned explicitly in the NIR 2005.
Sweden	Landfilled waste includes household and similar waste, sludge from wastewater handling, park and garden waste, sludge from the pulp industry and other organic industrial wastes.
United Kingdom	The UK method divides the waste stream into four categories of waste: rapidly degrading, moderately degrading, slowly degrading and inert waste. As recommended in the good practice guidance, the estimates of waste disposal quantities include commercial and industrial waste, demolition and construction waste and sewage sludge, as well as municipal waste (NIR 2004). The composition is based on an assumption used in the model, not measured data (CRF, 2005).

Source: NIR 2005 if available, else NIR (2004).

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 8.4, Table 8.13 provides corresponding detailed information on the DOC values extracted from the NIR.

Besides lower quantities of organic carbon deposited into landfills, the major determining factor for the decrease in net CH₄ emissions are increasing methane recovery rates from landfills.

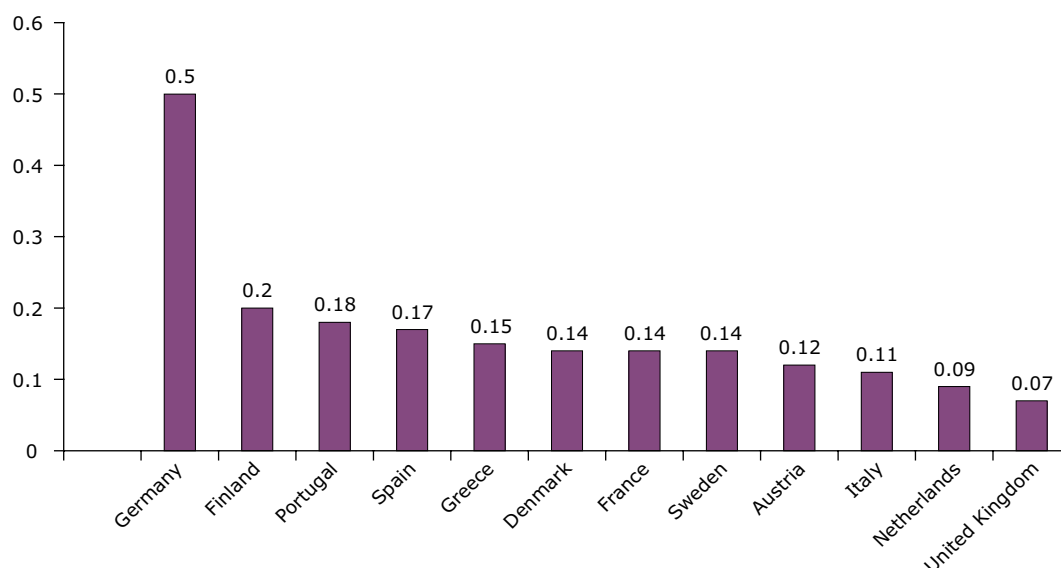
Methane recovery: The recovered CH₄ is the amount of CH₄ that is captured for flaring or energy use and is a country-specific

value which has significant influence on the emission level. The percentage of CH₄ recovered, compare Figure 8.5, varies among the Member States between 8 % in Denmark and 69% in the United Kingdom and depends on the share of solid waste disposal sites that are able to recover CH₄ (see Table 8.13).

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 8.14 illustrates how industrial waste is considered in the individual Member States. Five Member States neither mention nor consider industrial waste in the NIR.

Figure 8.5 Fraction of DOC in MSW

Fraction Gg C/Gg waste



Source: CRF 2003 Table 6A,C Additional information

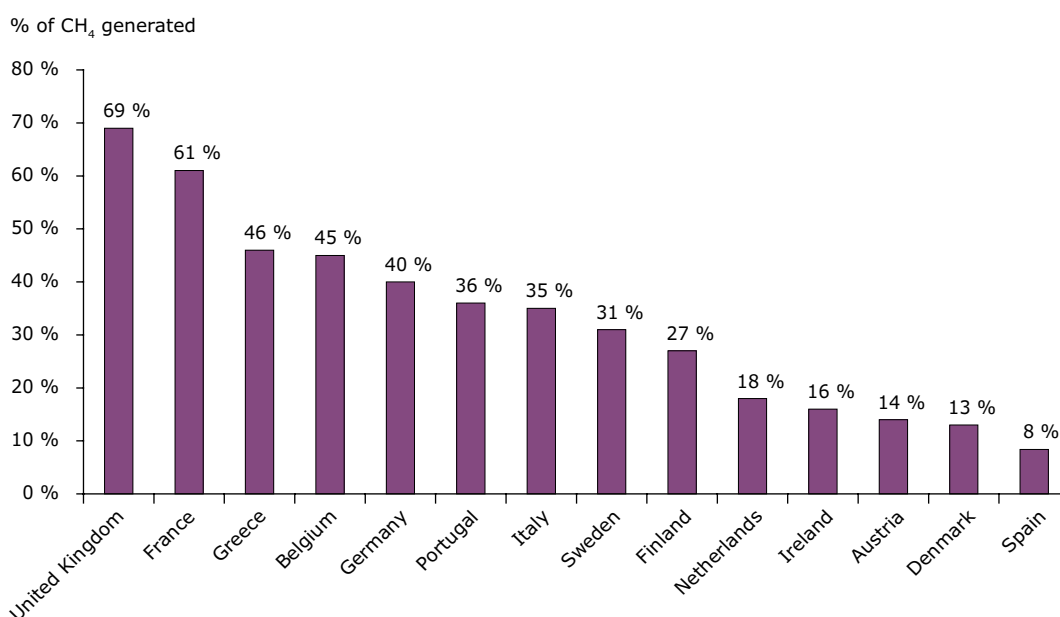
Table 8.12 Further information on DOC values

Member States	Further information on DOC values
Austria	Time series of biodegradable organic carbon content of directly deposited residual waste are indicated for the years 1990 to 2002. In the method for the calculation of emissions from non-residual waste, DOC values are not applied (NIR 2004).
Belgium	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 (10) Equation 5.4, page 5.9), which are used as an input in the model. Those statistics have been available on a yearly basis since 1994. For the years before, the amounts have been estimated using available data and OWD expert judgement assumptions. The DOC value for municipal waste lies in the default value range from IPCC revised 1996 guidelines and was chosen according to national expert judgement (NIR 2005).
Denmark	The value is a calculation of a weighted mean DOC value from individual DOC values for waste fractions used in the FOD model. The calculation is on 2003 data and based on values to be found in the NIR 2005.
Finland	Time series of DOC values are presented for 1990–2003. DOC fractions of different types of solid municipal waste are based on the IPCC default values and national research data. DOC values of subgroups (municipal sludge, industrial sludge, solid industrial waste, construction and demolition waste and industrial inert waste) are indicated (NIR 2005).
France	Country specific data according to the composition of landfilled waste and the DOC for three kinds of waste (high DOC 150 kg/t, □ middle 140–150 kg/t (e-mail communication with national waste expert 2005).
Germany	Both national and IPCC default factors were used for DOC. DOC values are indicated for those fractions for which data on landfilled waste quantities are available via the 1990–2002 time series. While national studies of individual DOC fractions of household waste (paper, glass, textiles, etc) are available, no reliable data on landfilled quantities of these waste fractions are available, and thus DOC values from a more highly aggregated level had to be used. Constant DOC values were assumed for all years, since no data are available for chronological adaptation of DOC values for household waste or bulky waste. Overall, waste-management measures carried out in the 1990s had various, often opposing effects, and experts consider it realistic to assume constancy in the aforementioned terms in the final result (NIR 2005).
Greece	Time series of total amounts of DOC for waste on managed and unmanaged waste disposal sites are provided (NIR 2004) but no further specification of how DOC was determined.
Ireland	IPCC DOC default values are used for organics, paper and textiles. Country specific values for street cleansings and the category 'other' are indicated. Available DOC of MSW is estimated from the given composition and appropriate DOC contents (40 % for paper and textiles, 15 % for putrescibles, 25 % for street cleansings and 15 % for other) (CRF 2005).
Italy	DOC contents for each landfilled waste typology was identified, based on Andreottola and Cossu (1996). In the NIR, one DOC value is indicated for the Italian waste composition. There is a difference to the average DOC in the waste according to IPCC, which depends on the Italian waste composition (NIR 2004). In particular, paper and paperboard DOC value differs from IPCC default figure (CRF 2005).
Netherlands	Time series of DOC values for solid waste are presented for 1990–2003 (NIR 2005). The DOC values are based on the composition of the different landfilled waste streams. The DOC value of 0.09 is the average of all the landfilled waste (not only MSW) (e-mail communication with national waste expert, April 2005).
Portugal	The estimation of DOC was based on information on the waste composition from annual municipal registries, and also from the Quercus survey (NIR 2004). Figures are presented for IPCC Categories A,B, C and D. Furthermore two DOC values for industrial waste are indicated, one for 1960–1999, one for the time after (NIR 2004).

Member States	Further information on DOC values
Spain	The variables A, B, C and D that appear in the calculation of the DOC have been derived from specific country data on waste streams disposed of in landfills (NIR 2005). No further specification is provided.
Sweden	IPCC default values for gas potentials are used for the different fractions of household waste and a weighted average is calculated as suggested in the GPG (e-mail communication with national waste expert, April 2005).
United Kingdom	DOC was estimated assuming that the DOC arises solely from the cellulose and hemicellulose content of waste. The proportion of cellulose and hemicellulose in each waste component and the degradability of these fractions was based on a study by Barlaz et al. 1997. Each waste component (paper, food, etc.) was assigned a DOC value based on the cellulose and hemicellulose 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 assumed to be 25 % moderately degrading and 75 % slowly degrading. The DOC value for both components was assumed to be equal to the percentage by weight of cellulose and hemicellulose multiplied by a factor of 72/162. This was around 22 % for household waste (NIR 2004). The DOC degraded is taken to be the DOC content of the waste disposed of in a given year, including construction and demolition waste. It should be noted that this figure is derived from assumptions used in the model, not from measurement (CRF 2005).

Source: CRF 2003 Table 6A,C Additional information; NIR 2005 if available, else NIR (2004). Luxembourg is not considered as their NIR is not available

Figure 8.6 Methane recovery



CH₄ recovery in % = CH₄ recovery in Gg / (CH₄ recovery in Gg + CH₄ emissions in Gg) * 100

Source: CRF 2005 Table 6.A,C.

Table 8.13 Further information on CH₄ recovery

Member States	No of SWDS recovering CH ₄	Total No of SWDS	Data source for methane recovery
	(¹) (²)	(³)	(⁴)
Austria	54	Excavated-soil landfills: 225 Demolition-waste landfills: 75 Residual-materials landfills: 29 Mass-waste landfills: 58	No specification
Belgium	12 (Wallonia) 20 (Flanders)		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 website (NIR 2005)

Denmark	26	135	Data for landfill gas plants are according to energy statistics from the Danish Energy Agency (NIR 2005).
Finland	26		Finnish Biogas Plant Register (Kuittinen % Huttunen 2004).
France	84 %		82 % of the solid waste disposal are landfilled on SWDS with biogas capturing (NIR 2004).
Germany		330	Methane recovery is applied for 75 % of the waste volume on SWDS (FHG ISI 2003).
Greece	4		Amount of recovered methane is considered to be equal to 0, as no data on the recovered methane from managed disposal sites were available (NIR 2004).
Ireland	5		Annual reports on renewable energy use; top down: the amount of CH ₄ captured for energy use is estimated from the reported electricity production in the national energy balance, assuming 35 % conversion efficiency Bottom-up: estimates on CH ₄ utilised and flared from 53 individual landfills that were producing CH ₄ in any appreciable quantities in that year. Total emission results quite similar top-down and bottom-up.
Italy	420		Amount of methane recovered is estimated on the basis of a survey (De Poli F., Pasqualini S., 1997. Landfill gas: the Italian situation. ENEA, atti del convegno Sardinia 97), and of the amount of energy recovered in landfills (GRTN, 2004. Dati statistici sugli impianti e la produzione di energia elettrica in Italia nel 2002. Gestore Rete Trasmissione Nazionale (also available at website www.grtn.it).
Luxembourg	2		No information provided
Netherlands	51	30 operating, few thousand old sites which are still active	Data based on a yearly survey by the 'Vereniging Afvalbedrijven' (a trade organisation for the waste sector).
Portugal	13		In the absence of metering landfill gas recovered data, estimates on recovered CH ₄ were done based on: the information of NIR 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 %) (NIR 2004).
Spain	9 CRF (2005), 174 NIR (2005)	183	The information on methane recovered is based on specific country data (NIR 2005).
Sweden	72	192	Information on recovered gas (in energy units) is provided by RVF and converted to used quantities by Statistic Sweden (NIR 2005).
United Kingdom	An exact figure is not available (CRF 2005)		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, assuming that flares operate at full capacity except for 15 % downtime. In 2002, the estimates were that 24 % of generated methane was utilised and 45 % was flared. The estimates on generated methane and flaring are not derived from metering data, as recommended by the guidance as such data were not readily available at the time of the study (NIR 2004).

Source: ⁽¹⁾ CRF 2005 Table 6 A,C ⁽²⁾ NIR 2005 if available, else NIR 2004

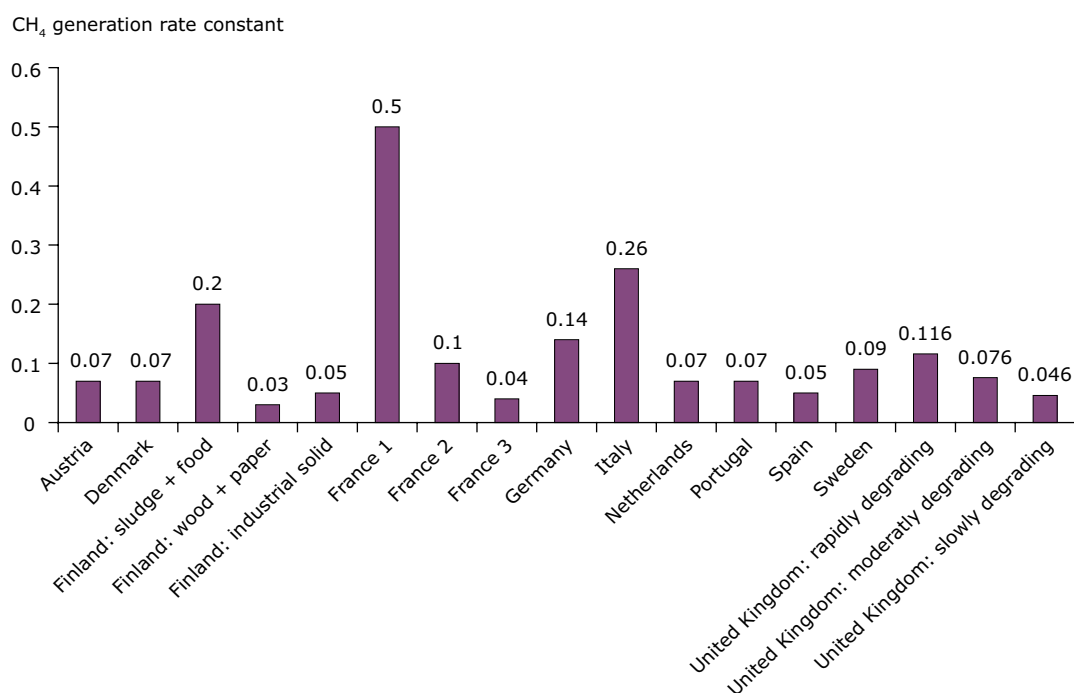
Table 8.14 Methodological issues regarding industrial waste

Member States	Industrial waste
Austria	Mixed industrial waste is considered under 'non residual waste' but not specified in detail (NIR 2004).
Belgium	A country-specific model for industrial waste is applied. 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 was much lower than the default value previously used (NIR 2005).
Denmark	Industrial waste is considered and data on its composition and amount deposited are used in the emission model (NIR 2005).
Finland	Industrial wastes and sludges are considered beside the solid municipal, construction and demolition wastes and municipal sludges as emission source on solid waste disposal sites. Activity data and DOC of industrial sludge and solid industrial waste are indicated.
France	Industrial waste is neither mentioned nor considered explicitly (NIR 2005).
Germany	Industrial waste is neither mentioned nor considered explicitly (NIR 2005).
Greece	Industrial waste is neither mentioned nor considered explicitly (NIR 2004).
Ireland	The food industry is a significant source of wastewater sludge on SWDS. They remain to be quantified (NIR 2005).
Italy	Industrial waste which is landfilled in SWDS and sludge from wastewater handling plants have also been considered (NIR 2004).
Luxembourg	Industrial waste is neither mentioned nor considered explicitly (NIR 2005).
Netherlands	Industrial waste is neither mentioned nor considered explicitly (NIR 2005).
Portugal	The fermentable part of industrial waste is considered. Time series are based on 1999 data which refer to annual registries relating to industrial unit declarations sent to the regional environment directorates. Historical industrial waste disposal data have been estimated on expert judgment. For the period 1960–1989, it was considered to have a growth rate of 1.5 % per year; for the following years (1990–1998) 2 % per year, data for the years 2000 to 2002 are also estimated based on 2 % per year growth rate. All industrial waste generated was considered to be disposed of 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 until 2002 has followed the urban disposal pattern between uncontrolled and controlled SWDS. Except DOC, the same parameters are used for industrial waste as for municipal waste (NIR 2004).

Member States	Industrial waste
Spain	Industrial waste is neither mentioned nor considered explicitly (NIR 2005).
Sweden	Detailed description of how activity data and emissions of relevant industrial waste and sludge are generated.
United Kingdom	The estimates of waste disposal quantities include commercial and industrial waste. For industrial and commercial waste, the data are based on national estimates from a recent study. The data were extrapolated to cover past years based on employment rates in the industries concerned (NIR 2004). In the LQM model, all industrial waste except for blast furnace and steel slag and power station ash is assumed to have some organic content (CRF 2005)

Source: NIR 2005 if available else NIR 2004; CRF 2005 Table 6,C documentation box.

Figure 8.7 Methane generation rate constant



Source: CRF 2003 Table 6 A,C Additional information. Luxembourg is not considered as their NIR is not available

Methane generation rate constant: CH₄ 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 high moisture content and rapidly degradable material can be found, for example in Italy and in part of the waste in Finland and France. Figure 8.6 gives an overview of the CH₄ generation rate constants reported by the Member States, while Table 8.15 summarises information on the applied country specific approach.

8.3.2 Unmanaged solid waste disposal (CRF Source Category 6.A.2)

CH₄ emissions from unmanaged solid waste disposal were reported in only six Member

States in 2003 (France, Greece, Ireland, Italy, Portugal and Spain). All of these Member States apply Tier 2 methods according to the IPCC, except Greece which uses the Tier 1 methodology (compare Table 8.3). Five of these six Member States (France, Portugal, Spain, Greece and Ireland) still dispose MSW to unmanaged SWDS, compare column 'Annual MSW to unmanaged SWDS' in Table 8.16, while in Italy waste disposals from the past still emit (see Table 8.3). The methane correction factor (MCF) reflects the way in which MSW is managed and the effect of management practices on CH₄ generation. According to the revised 1996 IPCC guidelines, the MCF for unmanaged disposal of solid waste depends on the type of site — shallow, deep or uncategorised. Table 8.17 gives an overview of the MCF applied in the relevant Member States.

Further country-specific information on unmanaged solid waste disposal is provided in Table 8.17.

Table 8.15 Further information on methane generation rate constant

Member States	Information on the half-time respectively the methane generation rate constant
Austria	not applicable in the model.
Belgium	No further specification.
Denmark	Assumption is that the half-life of the carbon in the waste is 10 years (NIR 2005).
Finland	Methane generation rate constants are divided into three categories: k1 = 0.2 sludges and food waste in MSW, k2=0.03 wood waste in MSW and in construction and demolition waste, paper waste containing lignin in MSW, k3=0.05 industrial solid waste and other fractions of MSW than above. Country specific k1 and k2 are according to rapid and slow rate constants in good practice guidance (NIR 2005).
France	No further specification.
Germany	A half life of five years was assumed. This yields a value of 0.14 for k. The half-life is considerably less than the IPCC default value of 14 years. The small national half-life figure was derived from various literature sources and from information of national experts. The lower half-life could have to do with the composition of landfilled waste, as well as with specific technologies for placing waste in landfills, technologies that were specially developed early on in Germany and that are designed to create optimal conditions for decomposition (NIR 2005).
Greece	Not applied as Tier 1 method is applied.
Ireland	not applicable.
Italy	The maximum methane generation rate constant of 0.26 per year has been assumed due to the high moisture content in Italian landfill sites (direct communication).
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-times of 7.4 and 10 years, respectively. The change in k-values is caused by a sharp increase in the recycling of vegetable, fruit and garden waste in the early 1990s (NIR 2005).
Portugal	Two different values were considered for the CH4 generation rate constant (k), to take into consideration diverse regional circumstances. A higher k value (0.04) was applied for municipalities above Tagus River, reflecting higher moisture conditions, a lower k figure (0.02) was used for the others (NIR 2004). (In the CRF of 2002 generated in 2004 k=0.03 is indicated, therefore Portugal must have adopted a new methane generation rate constant).
Spain	Methane generation rate constant (k=0.05) has been taken from the IPCC good practice guidance (NIR 2005).
Sweden	National value for half time of 7.5 years (NIR 2005).
United Kingdom	The UK method divides the waste stream into four categories of waste: rapidly degrading, moderately degrading, slowly degrading and inert waste. These categories each have a separate decay rate. The range from 0.046 (slowly degrading waste) to 0.116 (rapidly degrading waste), lies within the range quoted in the good practice guidance (NIR 2005).

Source: NIR 2005 if available, else NIR 2004; CRF 2003 Table 6 A,C Additional information. Luxembourg is not considered as their NIR is not available.

Table 8.16 Selected parameters for calculating emissions from Source Category 6.A.2

Member States	Emissions reported from unmanaged SWDS	Annual MSW to unmanaged SWDS	MCF CH4		
			Unmanaged SWDS	Deep	Shallow
France	X	180.80	0.5	0.00	0.50
Greece	X	1 817.65	0.00	0.60	0.00
Ireland	X	549.79	0.00		0.40
Italy	X	0	0.60	0.00	0.60
Portugal	X	7.36		IE	0.60
Spain	X	189.9440	0.60	0.80	0.40

Source: CRF 2005 Tables 6 and 6.A.

Table 8.17 Further information on unmanaged solid waste disposal

Member States	Unmanaged waste disposal on SWDS
France	The difference between managed and unmanaged MSWD is only if MSWD use compacting or not (e-mail communication with national waste expert April 2005). No further information given in the NIR 2004.
Greece	Out of the existing disposal sites, it is estimated that 25 of them fulfill the criteria set by the IPCC guidelines so as to be considered as 'managed'. The remaining disposal sites are disposed at unmanaged disposal sites. Time series of DOC and MSW quantities disposed on unmanaged SWDS are given for 1990–2002 (NIR 2004).
Ireland	In 1995, 40 % of DOC was assigned an MCF of 0.4, on the assumption that 40 % of MSW are places in unmanaged SWDS of less than five meters in depth: the MSW split between managed and unmanaged sites in 1969 was taken to be the reverse of that adopted for 1995 and appropriate adjustment is made for the intervening years and for the years after 1995 with a gradual increase for managed landfills (NIR 2005).

Member States	Unmanaged waste disposal on SWDS
Italy	The share of waste disposed of into uncontrolled landfills, which was 52.7 % in 1975, gradually decreases thanks to the enforcement of new regulations, and it has been assumed equal to 0 in the year 2000, although emissions are released due to the waste disposed in the past years. The unmanaged sites have been considered 50 % deep and 50 % shallow (NIR 2004). The MCF value for unmanaged landfill results as average of the default IPCC values reported for deep and shallow sites.
Portugal	The share of final disposal destiny (<i>inter alia</i> open dump sites) for the beginning years of the 1960–2002 time series was calculated having as a basis the Quercus survey. Data for recent years 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 two to three years after the beginning of the landfill operation. It was assumed that all estimated industrial waste produced until 2002 has followed the urban disposal pattern between uncontrolled and controlled SWDS (NIR 2004).
Spain	In the case of uncontrolled sites, part of the mass is burnt, in order to reduce the volume, and in this case, apart from the biogas emissions from the unburnt MSW fraction, there are also emissions corresponding to the combustion of the fraction burnt. One percent of MSW is dumped onto unmanaged sites. Different MCF values have been applied to uncontrolled landfill sites (0.8 and 0.4) depending on whether they are deep (more than five meters) or shallow (less than five meters) assuming 50 % of landfills in each category. In case of uncontrolled dumping, the estimation of the emissions from the burnt fraction has been effected by multiplying the activity variable by the corresponding emission factors. Of the total waste burnt in uncontrolled dumpsites, it has been assumed that 85 % is of renewable organic origin and 15 % of fossil origin, a ratio considered country-specific information. Further details are given how the emission factors for the combustion are determined (NIR 2004).

Source: NIR 2005 if available, else NIR 2004.

Table 8.18 CH₄ emission sources in wastewater handling and methods for determining CH₄ emissions from municipal wastewater and sludge handling

Member States	CH ₄ emission sources and description of methods (municipal wastewater and sludge)
Austria	<p>The calculation of CH₄ emissions was taken from a study (STEINLECHNER et al. 1994). First the amount of generated methane per unit of wastewater is determined for each of the three different types of treatments (mechanical/biological/further) separately. These factors were multiplied with the corresponding capacities of the Austrian wastewater treatment plants and then summed up, resulting in total CH₄ emissions for the subsector Commercial and Domestic Wastewater of the Year 1993. Emissions from industrial wastewater were calculated separately, its wastewater was treated like biologically treated wastewater. By dividing the emissions of 1993 by the number of inhabitants of 1993, an implied emission factor for industrial and domestic and commercial wastewater treatment was obtained.</p> <p>The main difference between the Austrian and the IPCC method is that the Austrian method calculates emissions using an implied emission factor per inhabitant and not per kg DOC. To calculate emissions, therefore, the amount of produced biogas was estimated together for industrial and domestic and commercial wastewater, based on the amount of organic waste. It was not calculated on the basis of BOD (biochemical oxygen demand) and COD (chemical oxygen demand) (NIR 2005).</p>
Belgium	In this category, two sources of methane emissions are taken into account: the CH ₄ emissions from municipal wastewater treatment plants and from septic tanks. The methodology for the individual wastewater treatment plant (septic tank) is based on an article (Vasel, 1992) (32), which describes the characteristics and parameters of individual septic tank. In the municipal wastewater treatment plants, the CH ₄ and N ₂ O emissions are estimated by using the methodology described in the EMEP/Corinair guidebook (3). There is a distinction between the emissions from water treatment and sludge treatment.
Denmark	As regards the CRF Source Category 6 B, Wastewater handling, the CH ₄ emission is considered of negligible importance due to aerobic wastewater systems.
Finland	A national methodology that corresponds to the methodology given in the revised (1996) guidelines is used in estimation of the CH ₄ emissions. Emission sources cover municipal and industrial wastewater handling plants and uncollected domestic wastewater for CH ₄ emissions (NIR 2005). For uncollected domestic wastewaters the check method with the 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 (NIR 2004).
Germany	<p>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 □</p> <p>Organic loads from cesspools and septic tanks are calculated pursuant to the IPCC method, in which the relevant population is multiplied by the average organic load per person.</p>
Greece	CH ₄ from wastewater handling were estimated according to the default methodologies suggested by IPCC (NIR 2004).
Hungary	Neither appropriate municipal nor industrial wastewater handling data are available for Hungary. Even where they exist, they cannot be considered as comprehensive. For the above reasons, methane emissions from wastewater handling were calculated from basic data available and with emission factors provided in the revised guidelines, a bit deviating from the IPCC methodology. Data on municipal and industrial wastewater were collected from the Inspectorate for Environmental Protection, which are based on own measurements and those taken by the producers of wastewater. Information on sludge produced during wastewater treatment and the distribution of decomposing matter between water and sludge is not available at all, therefore it was not calculated (NIR 2005).
Ireland	CH ₄ from wastewater handling were not estimated for the CRF 2005.

Member States	CH ₄ emission sources and description of methods (municipal wastewater and sludge)
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 100 % aerobically, whereas industrial wastewaters are treated 85 % aerobically and 15 % anaerobically. Consequently, there are no CH ₄ emissions from the treatment of domestic and commercial wastewaters. The stabilisation of sludge, both in domestic and industrial wastewater treatment plants, occur in aerobic or anaerobic reactors; whereas anaerobic digestion is used, the reactors are of course covered and provided with gas recovery; therefore, emissions from sludge disposal do not occur (NIR 2004). CH ₄ emissions have been estimated from sludge stabilisation occurring in Imhoff tanks (3–5 % of total sludge anaerobically treated).
Netherlands	Country-specific methodology is used for CH ₄ from wastewater handling, which is equivalent to the IPCC Tier 2 method. A full description of the methodology is provided in Oonk et al. (2004). The present Tier 2 methodology complies with the IPCC good practice guidance (IPCC, 2000) (NIR 2005).
Portugal	CH ₄ emissions from domestic wastewater handling were estimated using a methodology adapted from IPCC 1996 revised guidelines (IPCC, 1997) and GPG (IPCC, 2000), which follows three basic steps: 1. determination of the total amount of organic material originated in each wastewater handling system; 2. estimation of emission factors; 3. calculation of emissions. In the national inventory, all calculations have been done at municipal territorial units. National totals result from the summation of estimates performed for each municipality (NIR 2004).
Spain	For the treatment of wastewater in the residential and commercial sectors, the methodology used has been derived from the IPCC reference manual and the EMEP/Corinair guidelines. The activity variable taken has been the organic load in terms of tonnes of BOD ₅ . To calculate this variable, the datum used has been the population effectively served by the residential wastewater treatment plants. For the degradable organic load, a burden of 21.9 kg BOD ₅ /inhabitant equivalent per year and 0.75 as the fraction for the degradable organic load was taken into account. The emissions on the water and sludge lines are obtained as the product of the activity variable by the methane emission factors, discounting from this result the amount of methane recovered (NIR 2005).
Sweden	CH ₄ emissions from wastewater handling do not occur in Sweden.
United Kingdom	The methodology of the UK model differs in some respects from the IPCC default methodology. The main differences are that it considers wastewater and sewage together rather than separately. It also considers domestic, commercial and industrial wastewater together rather than separately. Emissions are based on empirical emission factors derived from the literature expressed in kg CH ₄ /tonne dry solids rather than the BOD default factors used by IPCC. The model, however, complies with the IPCC good practice guidance as a national model (IPCC, 2000). Emissions from sewage are calculated by disaggregating the throughput of sewage into 14 different routes. The routes consist of different treatment processes each with its own emission factor. The allocation of sludge to the treatment routes is reported for each year (NIR 2002).

Source: NIR 2005 if available else NIR 2004; CRF 2005 Table 6 B; Luxembourg is not considered as their NIR is not available.

8.3.3 Wastewater handling (CRF Source Category 6.B)

CH₄ emissions from domestic and commercial wastewater handling (6.B.2) are the most significant emission source in Category 6.B and key source in the EU. CH₄ emissions from wastewater handling are calculated with the help of diverse methods (C, CS, D, M, T1 and T2). The quality of the estimate is low for the EU-15, compare (see Table 8.4). Table 8.18 provides an overview of the CH₄ emission sources in wastewater handling which have been identified by the Member States. Furthermore methods applied to determine CH₄ emission from municipal wastewater and sludge handling are described in detail.

CH₄ emissions from industrial wastewater and sludge handling are not key sources but the reporting of these emissions by Member States is very inhomogeneous and seems to be difficult. Emissions from sludge handling are reported only by one Member State (Spain), other Member States either did not estimate the emissions (seven Member States: Belgium, Denmark, France, Greece, Ireland, Portugal, United Kingdom)

or reported the emissions elsewhere (four Member States: Austria, Finland, Netherlands and Sweden). Emissions from industrial wastewater handling are reported by seven Member States (Austria, Finland, Greece, Italy, Netherlands, Portugal, Spain), but five Member States indicate either that emissions are not estimated (Belgium, Ireland, United Kingdom), or that emissions are reported elsewhere (Denmark) or that this category is not applicable (Sweden). An overview of methodological issues regarding CH₄ emissions from industrial wastewater and sludge handling is provided in Table 8.19.

According to the IPCC good practice guidance, the emission factor for determining CH₄ emissions from wastewater and sludge handling is composed of the maximum methane producing potential (B₀) 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 8.20 provides

Table 8.19 CH₄ emissions from industrial wastewater and sludge handling and methods applied

Member States	CH ₄ from industrial waste		Methods for determining CH ₄ emissions from industrial wastewater and sludge handling
	Waste water	Sludge	
Austria	x	IE	Industrial wastewater is managed like biological treatment, so methane emissions of biological treatment (F2) are multiplied by the delivery rate of industrial treatment plants (IWWT). To calculate emissions, the amount of produced biogas was estimated together for industrial and domestic and commercial wastewater (NIR2005).
Belgium	NE	NE	
Denmark	IE	NE	Data are available for the Danish wastewater treatment systems for centralised municipal WWTPs, where major part of WW is treated. A significant part of industrial WW is treated at those WWTPs and emissions from this part are covered by the methodology used. For industry, only data concerning effluents to surface water are available. No data regarding industrial on-site WW treatment processes or final sludge disposal are available at a level that allows for calculation of on-site industrial WW contribution to CH ₄ emissions. Although some data are available for a separation of WW industrial and domestic and commercial, this separation has not been done in this CRF reporting (CRF 2005).
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. Formula is provided in the NIR 2005.
France	0	NE	For industrial wastewater, emissions from treatments on-site are not estimated (CRF 2005). Due to the major use of aerobic treatment system, CH ₄ emissions are very small. So due to the lack of data, emissions are not estimated (e-mail communication with national waste expert, April 2005).
Germany	NO	0	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 procedures used include aerobic treatment and anaerobic purification; gas formed in the latter procedure is either used for energy recovery or is flared off (NIR 2005).
Greece	x	NE	The methodology for calculating methane emissions from industrial wastewater is similar to the one used for domestic wastewater. In order to estimate the total organic waste produced through anaerobic treatment, the following basic steps were accomplished: Collection of data regarding industrial production of approximately 25 industrial sectors/subsectors for the period 1990–2001. Data on industrial production for 2002 were not available and for this reason production was estimated through linear extrapolation. Calculation of generated wastewater, 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/subsector. The distribution between aerobic and anaerobic treatment of industrial wastewater for each industrial sector was estimated on the basis of data derived from a relevant project. The maximum methane production potential factors and the methane conversion factors for aerobic and anaerobic treatment, which were used for the final estimation of methane emissions, are similar to those used for domestic wastewater handling (NIR 2004).
Ireland	NE	NE	
Italy	x	NO	The methane estimation concerning industrial wastewaters makes use of the IPCC method based on wastewater output and the respective DOC for each major industrial wastewater source. No country specific emission factors of methane per COD are available so the default value of 0.25 kg CH ₄ /kg DC, suggested in the IPCC GPG had been used for the whole time series. As recommended by the GPG for key source categories, data have been collected for several industrial sectors (food and beverage, paper and pulp, organic chemicals, iron and steel, textile, leather industry). National data have been used in the calculation of the total amount of both COD produced and wastewater output for: pulp & paper sector, beer, wine, milk and sugar sectors. The introduction of the leather sector has improved the emission estimation (NIR 2004).
Luxembourg			
Netherlands	x	IE	CH ₄ emission from industrial wastewater refer to anaerobic industrial wastewater treatment plants. The major part of the Dutch industry emit in the sewer system which is connected to municipal wastewater treatment plants. These emissions are included in the category: domestic and commercial waste water (CRF 2005).
Portugal	x	NE	Emissions from industrial wastewater are first rough estimates based on national estimates for industry wastewater organic content, and default emission factors from Corinair guidebook (CH ₄ and N ₂ O) and national data for domestic wastewater (COVNM). Quantities of industrial wastewater organic charge (in millions of inh. eq.) were multiplied by an emission factor for each pollutant considered (NIR 2004).
Spain	x	x	For the treatment of industrial wastewater, the methodology followed has been derived from the IPCC reference manual for the area sources (general statistic information) and the EMEP/Corinair guidebook for the point sources (sectorial questionnaires). The activity variable taken for point sources has been the volume of wastewater purified in the oil refineries and paper pulp works, where the information has been obtained through questionnaires, and for area sources it has been the organic load in terms of chemical oxygen demand in water and sludge, with the basic variables coming from the discharge regulation studies carried out by the Directorate-General for Hydraulic Works and Water Quality at the Ministry of the Environment for the food sectors in 1994 and chemistry sector in 1996. In order to extend the time series homogeneously for the food and chemistry sectors, the corresponding values from the industrial production index produced by the Spanish National Statistics Institute were used (NIR 2005).

Member States	CH ₄ from industrial waste		Methods for determining CH ₄ emissions from industrial wastewater and sludge handling
	Waste water	Sludge	
Sweden	NA	IE	CH ₄ emissions from wastewater handling do not occur.
United Kingdom	NE	NE	Industrial waste is considered together with commercial and domestic wastewater. There is no estimate made of emissions from private wastewater treatment plants operated by companies prior to discharge to the public sewage system or rivers (NIR 2005). They are not estimated but believed to be small (CRF 2005)

Source: NIR 2005 if available, else NIR 2004; CRF 2005 Table 6.B.

Table 8.20 Methane conversion factors

Member States	MCF	Specification of MCF	Further information on MCF
Austria	20°C = 35 %	(67 % of a year)	Apart from temperature sewage, provides ideal conditions for methane production: moisture, pH value and nutrient supply. The temperature is too low, this is taken into account by applying a methane conversion factor (MCF). Calculations are made with an average temperature of 20°C for 8 months and 10°C for the rest of the year.
	10°C = 10 %	(33 % of a year)	
Belgium			
Denmark	0,4	Anaerobic treatment of sludge	
Finland	0.01	Collected domestic wastewater	The estimated methane conversion factors for collected wastewater handling systems (industrial and domestic) are low in Finland because the handling systems included in the inventory are either aerobic or anaerobic with complete methane recovery. The emission factors mainly illustrate exceptional operation conditions. The MCF is based on country specific knowledge.
France	0.23	'Natural' lagoons	Country specific data from experts
	0.35	septic system	
Germany	0.5	Cesspools and septic tanks	The MCF for cesspools and septic tanks has been estimated on the basis of experience gained in other countries (septic tanks in the US, anaerobically treated municipal wastewater in the Czech Republic).
Greece			
Ireland			
Italy			Default IPCC emission factors have been used: g CH ₄ /g BOD = 0.6 for domestic wastewater and sludge treatment and g CH ₄ /g COD=0.25 for industrial wastewater.
Netherlands	0.54	Sludge handling	
	0.035	Aerobic wastewater treatment	
Portugal	1	Anaerobic digestion	Average MCF factors for wastewater treatment systems were weighted by the percentage of each type of treatment for each region, and using the MCF values established by expert judgement for each treatment type. MCF evolution over time was estimated considering an annual average variation rate of: - 2 % for wastewater treatment plants, and + 5 % for sludge.
	0.5	Imhoff tank	
	0.1	Percolation beds	
	0.18	Other treatment	
	0.17	Average	
Spain	0.15	Industrial wastewater	
	0.3	Industrial sludge	
	0.005	Domestic wastewater	
	0.3	Domestic wastewater sludge	
Sweden			
United Kingdom			

Source: NIR 2005 if available, else NIR 2004.

an overview of the MCF applied by the Member States.

All Member States report N₂O emission from wastewater handling. Different methods are applied (C, CS, D, T1 and T2). The quality

of the estimates is considered to be low by eight Member States and medium by three Member States. In Table 8.21, the methods for determining N₂O emissions from wastewater handling applied by the Member States are described in detail.

Table 8.21 Methods for determining N₂O emissions from wastewater handling

Member States	N ₂ O emissions from wastewater (¹)		Description of methods used (N ₂ O)
	Industrial	domestic	
Austria	X	O	N ₂ O emissions from domestic, commercial and industrial wastewater were calculated in accordance with the IPCC methodology with the assumption that industry introduces an additional 30 % of the nitrogen from the human metabolism into the wastewater system (ORTHOFFER et al., 1995). According to this study, about 75 % of the domestic and commercial sewage in Austria is treated in sewage plants. Furthermore, it was estimated in this study that about 10 % of the nitrogen that enters wastewater treatment plants is denitrified and that only 1 % of the total nitrogen in the denitrification process is emitted as N ₂ O (NIR 2005).
Belgium	O	X	In Wallonia and in Brussels, the N ₂ O emissions are estimated by using the methodology described in the IPCC guidelines. In Flanders, N ₂ O emissions are estimated by using the methodology described in the EMEP/Corinair guidebook (NIR 2005).
Denmark	IE	X	Emissions of N ₂ O were divided into direct and indirect emission contributions, i.e. from the wastewater handling and effluents, respectively. Indirect emissions were divided into contributions from industrial discharges, rainwater conditioned effluents, effluents from scattered houses, from mariculture and fish farming and from WWTPs. The methods are described in the Danish NIR 2005.
Finland	NE	NE	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 in-put according to population data. In addition to the IPCC approach, also nitrogen load from industry and fish farming was taken into account. For uncollected wastewaters, the nitrogen load is based on population data. The assessed N ₂ O 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 ₂ O emission calculations are consistent with the IPCC method for discharge of sewage (NIR 2005).
France	0.91	3.22	N ₂ O from industrial sites is estimated according to the total N rejected into water (not collected and treated by domestic systems). N ₂ O from human sewage: approximately 40 % of total N entering into domestic wastewater handling systems are eliminated (CRF 2005).
Germany	NE	NE	IPCC default method.
Greece	O	O	N ₂ O from wastewater handling was estimated according to the default methodologies suggested by IPCC (NIR 2004).
Ireland	NE	NE	Emissions of N ₂ O from human sewage discharges reported under Source Category 6.B wastewater handling have been made following the IPCC methodology (NIR 2005).
Italy	X	IE	N ₂ O emissions from domestic and commercial wastewater are included in human sewage (CRF 2005).
Luxembourg			
Netherlands	NE	X	Country-specific methodology is used for N ₂ O emissions from wastewater handling, which is equivalent to the IPCC Tier 2 method. A full description of the methodology is provided in Oonk et al. (2004) (NIR 2005). Since the N ₂ O emissions from urban wastewater handling are a key source, the present Tier 2 methodology complies with the IPCC good practice guidance (IPCC, 2000) (NIR, 2005). N ₂ O from industrial wastewater is considered as a minor source and no data are available (CRF 2005).
Portugal	X	X	Emissions of N ₂ O from domestic wastewater were estimated following the proposal of IPCC 1996 revised guidelines (IPCC,1997) (NIR 2004).
Spain	O	O	
Sweden	X	X	National activity data on nitrogen in discharged wastewater (industry and domestic 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	NE	Nitrous oxide emissions from the treatment of human sewage are based on the IPCC (1997c) default methodology.

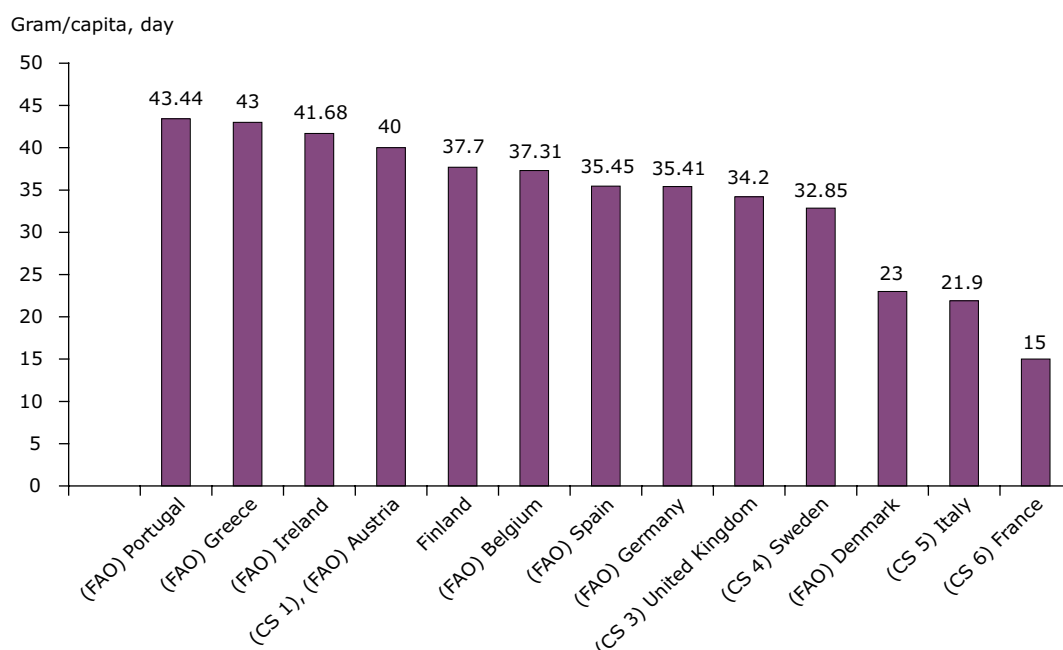
(¹) According to Table 6 B in CRF 2005; X = emissions are reported; NE = not estimated; IE = included elsewhere

Source: NIR 2005 if available, else NIR 2004; CRF 2005 Table 6.B.

One important parameter for the determination of N₂O 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 8.7.

8.3.4 Waste incineration (CRF Source Category 6.C)

Emissions from waste incineration are reported by eight Member States in 2003 (Austria, Belgium, France, Sweden, United Kingdom, Italy, Spain and Portugal). Two of those Member States assume the quality

Figure 8.8 Protein consumption in kg per capita and day

Source: CRF 2005 Table 6 B; NIR 2005 if available, else NIR 2004.

CS = Country specific value; FAO = FAO data basis.

CS 1) Statistik Austria. CS 2) 'Food in Spain (La alimentación en España)' from the Spanish Ministry of Agriculture, Fisheries and Food (Mapa). CS 3) DEFRA, 2002: The National Food Survey, 1990–2002. CS 4) National value, National Food Administration. 2002. www.slv.se CS 5) INRAN — Istituto Nazionale di Ricerca per gli Alimenti e la Nutrizione, 1997. CS 6) No further specification of source.

Table 8.22 Emission reported and methodological issues of CRF Category 6.C

Member States	Emissions reported in CRF	Type of waste incinerated and methods applied
Austria	X	In this category, CO ₂ emissions from incineration of corpses and waste oil are included, as well as CO ₂ , CH ₄ and N ₂ O emissions from municipal waste incineration without energy recovery. There is only one waste incineration plant without energy recovery which was operated until 1991 with a capacity of 22 000 tons of municipal waste per year (NIR 2005).
Belgium	X	N ₂ O emissions from domestic waste incineration are calculated using activity data known from the individual companies involved combined with the emission factor of CITEPA. For CO ₂ emissions, each region applies its own methodology according to the available activity data. In <i>Flanders</i> , only the fraction of organic-synthetic waste is taken into consideration (assuming that organic waste does not give any net CO ₂ emissions). For the municipal waste, the institute responsible for waste management in Flanders (OVAM) is given the analysis of the different fractions in the waste. Based on this information, the amount of non-biogenic waste (excluding the inert fraction) is determined. The carbon emission factor is based on data from literature for the different fractions involved. For industrial waste, the amount of biogenic waste is considered to be the same as in municipal waste. The remaining amount is considered to be the non-biogenic part in which no inert fraction is present. For industrial waste, it is more difficult to determine the content of C and therefore the results of a study carried out by the Vito Debruyne in Van Rensbergen 'Greenhouse gas emissions from municipal and industrial wastes of October 1994' are used. This study gives a content of C of the industrial waste of 65.5 %. In <i>Wallonia</i> , 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 http://www.environment.wallonie.be/data/air/valorisation/index.htm . These results allow a cross-check with the results of measurements directly transmitted by the incinerators to the environmental administration. There is a distinction between the emission from municipal waste incineration and hospital waste incineration. The CO ₂ emissions of municipal waste incineration are reported, assuming that 68 % of the waste is composed of organic material. This is based on the average garbage composition in Wallonia and the use of IPCC equation on organic content of the various materials. The CO ₂ emissions from hospital waste incineration are measured by the Walloon incinerators and are fully reported. Emissions from the incineration of corpses are calculated using the EMEP/Corinair emission factors and statistical data on the number of corpses. In <i>Brussels</i> , the emission factors for the incineration of hospital and municipal waste and corpses are estimated by measurements in situ in connection with EMEP/Corinair emission factors. The emissions of CO ₂ from the flaring in the chemical industry and are reported in Category 6.C according to IPCC guidelines.
Denmark		
Finland		

Member States	Emissions reported in CRF	Type of waste incinerated and methods applied
France	X	Carbon dioxide of biogenic origin was excluded from the emission estimates. Only waste incinerators without energy recovery are considered in this category. The incineration of special industrial waste is partially included according to the information available. Furthermore, the incineration of utilised greenhouse films is included (NIR 2004).
Germany		
Greece		
Hungary	x	<p>Municipal waste is incinerated at only one plant in Hungary, at Budapest Waste Incineration Plant Co., where energy recovery is taking place as well. The incinerator is currently under renovation so it is operated at a lower capacity. The objective of the reconstruction is to decrease emission of pollutants from the incinerator.</p> <p>Information on waste incinerators and joint incinerators is currently being processed. We estimate incinerated industrial waste at 20 to 25 % of municipal waste. In calculating N₂O emissions, we applied the value of 8.33 kg/t as suggested in good practice (NIR 2004).</p>
Ireland		
Italy	x	Existing incinerators in Italy are used for the disposal of municipal waste, together with industrial waste, hospital waste, sewage sludge and waste oil. Emissions from removable residues from agricultural production are included in this IPCC category. They refer mainly to olives and wine residues: the total residues amount and carbon content have been estimated by both IPCC and national factors. In order to improve emission estimations from incinerators, a complete database of these plants has been built; for each plant a lot of information has been included, 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), 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. With regard to municipal waste, on the basis of the IPCC guidelines (IPCC, 1997) and referring to the average content analysis on a national scale, 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 included. Removable residues from agriculture production are estimated for each crop type (cereal, green crop, permanent cultivation) taking into account the amount of crop produced, the ratio of removable residue in the crop, 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. On the basis of these parameters CH ₄ and N ₂ O emissions have been calculated. CO ₂ emissions have been calculated but not included in the inventory as biomass. All these parameters refer both to the IPCC guidelines (IPCC, 1997) and country-specific values, when available (CESTAAT, 1992; Borgioli, 1981). Emissions from olives and wine residues are more than 65 % of the total emissions from removable residues (NIR 2004).
Luxembourg		
Netherlands		<p>The source category waste incineration is included in Source Category 1A1 'Energy industries' since all waste incineration facilities also produce electricity or heat used for energetic purposes and according to the IPCC guidelines (IPCC, 1997), these should be reported under Category 1A1a.</p> <p>Total CO₂ 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 CO₂ emissions from waste incineration (e.g. plastics) are calculated from the total amount of waste incinerated. Per waste stream (residential and several others) the composition of the waste is determined. For each of these types a specific carbon content and fractions of fossil C in total C is assumed, which will yield the CO₂ emissions. The method is described in detail in <i>Joosen and De Jager</i> (2003) and in the monitoring protocol (Ruyssenaars, 2005).</p>
Portugal		
Spain	X	The amount of municipal solid waste entering the incineration process in all the incinerators in operation without energy recovery was obtained from the publication 'The environment in Spain'. The information of the emission factors has been taken assuming that the control technique used is the one for 'control of particles'. For SO ₂ , NO _x , VOC, CO, N ₂ O and NH ₃ the emission factors are taken from EMEP/Corinair guide book. For CO ₂ , a factor of 324 kg/ton has been assumed, calculated assuming 36 % of fossil origin and 64 % of biogenic origin in the waste and considering that the overall factor for CO ₂ per ton of waste is 900 kg (fossil + biogenic)/ton.
Sweden		<p>Emissions from incineration of hazardous waste, and in later years also MSW and industrial waste, from one large plant are reported in CRF 6.C. In earlier submissions, CRF 1.A.1a included emissions from combustion of hazardous waste. These emissions are reallocated and now reported under CRF 6.C for better compliance with the 1996 revised IPCC guidelines.</p> <p>Reported emissions are for the whole time series obtained from the facility's Environmental report or directly from the facility on request. CO₂, SO₂ 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. As a consequence of increased capacity, the emissions in 2003 increased compared to earlier years. Emissions reported are CO₂, NO_x, SO₂ and NMVOC. According to information from the facility, occasional measurements concerning CH₄ and N₂O have been performed. The CH₄ measurement showed very low or non-detectable amounts. CH₄ is therefore reported as NA in the CRF tables. For N₂O, the occasional measurements showed levels giving emissions in the approximate order of 0.2 Mg N₂O/year. N₂O is reported as NE in the CRF tables.</p>
Portugal	X	Until 1999, incineration of solid wastes referred to uncontrolled combustion of industrial solid waste on land and to incineration of hospital hazardous wastes. In 1999, two new incineration units started to operate in an experimental regime. These units are exclusively dedicated to the combustion of MSW which is composed of domestic/commercial waste. The components of fossil origin — plastics, synthetic fibers and synthetic rubber — are to be accounted for in the estimate. The non-biogenic components fractions are considered to be different for MSW, industrial solid waste and clinical waste. In all cases, it was assumed incineration occurring without energy recovery. Non CO ₂ emissions were estimated as the product of the mass of total waste combusted, and an emission factor for the pollutant emitted per unit mass of waste incinerated (NIR 2005).

Member States	Emissions reported in CRF	Type of waste incinerated and methods applied
United Kingdom	X	Incineration of chemical wastes, clinical wastes, sewage sludge and animal carcasses is included here. There are approximately 70 plant incineration chemical or clinical waste or sewage sludge and approximately 2 600 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, data reported by the Environment Agency's pollution inventory.

X = Emissions are reported in Source Category 6.C.

Source: NIR 2005 if available, else NIR 2004.

Table 8.23 Reported emissions under CRF Source Category 6.D

Member States	Specification of 'other waste'	6 D CO ₂	6 D CH ₄	6 D N ₂ O	6 D NO _x
Austria	Compost production	0.00	1.19	0.18	0.00
Belgium	Composting	0.00	15.99	0.00	0.00
Finland	Composting etc.	5.17	0.27	NO	NO
Italy	Compost production	0	0.18	0.00	0.00
Netherlands	Large scale organic waste composting	0.00	3.3	0.1	0.0049
Portugal	Open burning of industrial waste	0.5	0.09	0.65	0.04
Spain	Domestic/Commercial Wastewater sludge spreading		29.35	0.00	0.00
Luxembourg		0.19	0.00	0.00	0.00

Source: CRF 2005 Table 6.

Table 8.24 Description and methodological issues of Source Category CRF 6.D

Member States	Waste – Other
Austria	Emissions were estimated using a country-specific methodology. To estimate the amount of composted waste, it was split up into three fractions of composted waste: 1) mechanical biological treated residual waste, 2) bio waste, loppings, bio composting, 3) sewage sludge. CH ₄ emissions were calculated by multiplying an emission factor (CH ₄ and N ₂ O) based on national references by the quantity waste (NIR 2005).
Belgium	CH ₄ emissions from compost production are estimated in Flanders using regional activity data combined with emission factors of CITEPA.
Finland	No further specification in the NIR 2005.
Italy	Under this source category, CH ₄ emissions from compost production have been reported. The amount of waste treated in composting plants has shown a nearly 15-fold increase in Italy from 363 319 in 1990 to 5 361 471 in 2002. Since no methodology is provided by the IPCC for these emissions, literature data (Hogg, 2001) has been used for the emission factor, 0.029 kgCH ₄ /kg treated waste (NIR 2004).
Netherlands	This source category consists of some CH ₄ and negligible N ₂ O emissions from industrial composting. A country-specific methodology for this source category is used with activity data from <i>WAR (2004)</i> and emission factors from <i>VROM (2002)</i> (see monitoring protocol, Ruysenaars, 2005). Emissions from small-scale composting of garden waste and food waste by households are not estimated as this is assumed to be negligible. Since this source is not considered as a key source, the present methodology level complies with the IPCC good practice guidance (IPCC, 2000). (NIR, 2005) The used emission factors are: * 2.4 kg CH ₄ /ton composted organic waste; * 1.1 kg CH ₄ /ton anaerobic digested organic waste; * 0.096 kg N ₂ O/ton composted organic waste; * 0.046 kg N ₂ O/ton anaerobic digested organic waste; * 0.18 kg NO _x /ton anaerobic digested organic waste.
Portugal	No further specifications in the NIR 2004.
Spain	No further specifications in the NIR 2005.

Source: NIR 2005 if available, else NIR 2004.

of the estimate to be low (Austria, United Kingdom), two Member States describe the quality as high (Sweden, Portugal) and two as medium (France, Italy). In Table 8.22, an overview of category descriptions and methodological issues is provided.

8.3.5 Waste – Other (CRF Source Category 6.D)

Under CRF Source Category 6.D, eight Member States report emissions. Emissions from composting have been reported by five Member States (Austria, Belgium, Finland,

Table 8.25 EU-15 uncertainty estimates for the sector 'Agriculture'

Source category	Gas	Emissions 2003 ¹⁾	Emissions for which MS uncertainty estimates are available ²⁾	Share of emissions for which MS uncertainty estimates are available	Uncertainty estimates based on MS uncertainty estimates
6.C Waste incineration	CO ₂	3 016	2 937	97 %	19 %
6.A Solid waste disposal on land	CH ₄	73 779	70 308	95 %	15 %
6.B Waste water handling	CH ₄	7 981	5 881	74 %	42 %
6.C Waste incineration	CH ₄	539	266	49 %	54 %
6.D Other	CH ₄	986	331	34 %	200 %
6.B Waste water handling	N ₂ O	9 224	7 721	84 %	127 %
6.C Waste incineration	N ₂ O	358	190	53 %	94 %
Total Waste	all	96 728	87 634	91 %	17 %

⁽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 countries 2002 data and for Belgium 2001 data

Table 8.26 Recalculations of total greenhouse gas emissions and recalculations of greenhouse gas emissions in CRF Sector 6: 'Waste', for 1990 and 2002 by gas (Gg and percentage)

	CO ₂		CH ₄		N ₂ O		HFCs		PFCs		SF ₆	
	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent
1990												
Total emissions and removals	- 122 396	- 3.8 %	- 9 539	- 2.1 %	16 013	4.1 %	200	0.7 %	- 276	- 1.7 %	125	1.2 %
Waste	- 352	- 5.2 %	2 431	2.0 %	1 076	13.4 %	NO	NO	NO	NO	NO	NO
2002												
Total emissions and removals	- 165 492	- 5.1 %	- 7 491	- 2.1 %	8 640	2.6 %	- 3 682	- 7.4 %	279	5.2 %	406	4.4 %
Waste	- 653	- 14.3 %	- 690	- 0.8 %	435	4.7 %	NO	NO	NO	NO	NO	NO

NO: Not occurring.

Netherlands and Italy), Portugal indicates emissions from open burning of industrial waste and Spain from domestic and commercial wastewater sludge spreading, compare Table 8.23. Luxembourg does not provide further information from which emissions source the emissions derived in this source category.

In Table 8.24 the source category is described further in detail.

8.3.6 EU-15 uncertainty estimates

Table 8.25 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 uncertainty was estimated for CH₄ from 6.D and the lowest for CH₄ from 6.A. For a description of the Tier 1 uncertainty analysis carried out for the EU-15, see Chapter 1.7.

8.4 Sector-specific quality assurance and quality control

Under the Climate Change Committee, a workshop is being planned for Spring 2005 on inventories and projections of greenhouse gas emissions from waste. The main objectives of the workshop are: (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 will provide an opportunity to discuss potential methodological changes or improvements

Table 8.27 Contribution of Member States to EU-15 recalculations in CRF Sector 6: 'Waste' for 1990 and 2002 by gas (difference between latest submission and previous submission Gg of CO₂ equivalents)

	1990						2002					
	CO ₂	CH ₄	N ₂ O	HFCs	PFCs	SF ₆	CO ₂	CH ₄	N ₂ O	HFCs	PFCs	SF ₆
Austria	0	411	- 5	NO	NO	NO	0	373	177	NO	NO	NO
Belgium	- 580	0	160	NO	NO	NO	- 1 074	- 74	158	NO	NO	NO
Denmark	0	224	88	NO	NO	NO	0	302	58	NO	NO	NO
Finland	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
France	- 133	- 42	143	NO	NO	NO	- 333	181	177	NO	NO	NO
Germany	NE	0	1	NO	NO	NO	NE	0	0	NO	NO	NO
Greece	21	1 261	327	NO	NO	NO	220	- 1 177	- 369	NO	NO	NO
Ireland	0	76	54	NO	NO	NO	0	0	60	NO	NO	NO
Italy	- 52	902	- 2	NO	NO	NO	- 95	1 121	- 8	NO	NO	NO
Luxembourg	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
Netherlands	- 881	153	389	NO	NO	NO	0	281	235	NO	NO	NO
Portugal	0	1 850	- 1	NO	NO	NO	- 21	2 633	- 7	NO	NO	NO
Spain	141	- 2 404	- 80	NO	NO	NO	39	- 4 363	- 41	NO	NO	NO
Sweden	44	0	0	NO	NO	NO	61	29	- 6	NO	NO	NO
UK	1 088	1	1	NO	NO	NO	550	2	2	NO	NO	NO
EU-15	- 352	2 431	1 076	NO	NO	NO	- 653	- 690	435	NO	NO	NO

NO: Not occurring; NE: Not estimated.

Table 8.28 Main reasons for recalculations > 1000 Gg of CO₂ equivalents in CRF Sector 4 'Agriculture'

BE	CO ₂	6.C: Method: adjustment of partition of waste into a biogenic fraction and a non-biogenic fraction was made for Flanders. Removal: municipal waste incineration with energy recuperation was allocated under 1.A.1; only the remaining part (no energy recuperation) is allocated under 6.C (Flanders, Brussels).
UK	CO ₂	6.A: Methods/addition/removal: methodology change to now report CO ₂ emissions in Sector 6.A.1 from the disposal of wood treated with preservatives derived from benzols and tars.
GR	CH ₄	6.B: Emission factors: updated EF according to GPG. 6.A: Activity data: updated data on MSWDS.
PT	CH ₄	6.A: See Tables 10.1 and 10.2.
ES	CH ₄	6.A: See Tables 10.1 and 10.2.

of the draft 2006 IPCC inventory guidelines. The workshop is targeted at experts who have direct experience in compiling and analysing GHG emission projections and inventories from the waste sector.

8.5 Sector-specific recalculations

Table 8.26 shows that in the waste sector large recalculations were made for CH₄ in 1990 and for N₂O in 2002.

Table 8.27 provides an overview of Member States' contributions to EU-15 recalculations.

The United Kingdom and Belgium were responsible for the most recalculations for CO₂, Spain, Portugal and Greece for CH₄ and N₂O.

Explanations for recalculations of more than 1 000 Gg of CO₂ equivalents are given in Table 8.28. Explanations for most recalculations are provided in Section 10.1.

9 Other (CRF Sector 7)

This chapter provides information on emission trends, source allocations of Member States and recalculations in CRF Sector 7: 'Other'. No information on methods, emission factors and uncertainty estimates is included in this chapter because the sector does not contain an EU-15 key source⁽²⁵⁾. Neither is included a section on sector-specific QA/QC as no such activities are performed in this sector.

9.1 Overview of sector

CRF Sector 7 'Other' is the smallest sector contributing 0.02 % to overall EU-15 GHG emissions. CO₂ is the only gas under 'Other'; emissions from 'Other' have increased since 1990 (+ 30 %). In 2003, the emissions increased by 15 % compared to 2002.

Only Finland reports emissions under 'Other'. The Finnish emissions derive from non-energy use of oil products and natural gas.

9.2 Methodological issues and uncertainties

This report does not include more information on methodological issues

because the emissions in this sector are caused by one Member State only.

9.3 Sector-specific quality assurance and quality control

There are no sector-specific QA/QC procedures for this sector.

9.4 Sector-specific recalculations

Table 9.1 shows that in CRF Sector 7: 'Other', recalculations were made mainly for 2002.

Figure 9.1 EU-15 GHG emissions 1990–2003 from CRF Sector 7: 'Other' in CO₂ equivalents (Tg)

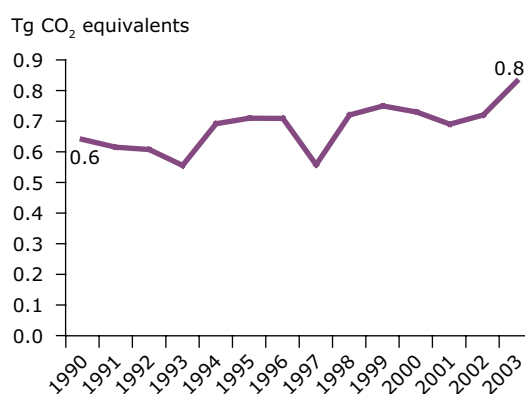


Table 9.1 Recalculations of total greenhouse gas emissions and recalculations of greenhouse gas emissions in CRF Sector 7: 'Other', for 1990 and 2002 by gas (Gg and percentage)

	CO ₂		CH ₄		N ₂ O		HFCs		PFCs		SF ₆	
	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent
1990												
Total emissions and removals	- 122 396	- 3.8 %	- 9 539	- 2.1 %	16 013	4.1 %	200	0.7 %	- 276	- 1.7 %	125	1.2 %
Other	0	0.0 %	- 43	- 100.0 %	- 1 181	- 100.0 %	NO	NO	NO	NO	NO	NO
2002												
Total emissions and removals	- 165 492	- 5.1 %	- 7 491	- 2.1 %	8 640	2.6 %	- 3 682	- 7.4 %	279	5.2 %	406	4.4 %
Other	0	- 0.1 %	- 38	- 100.0 %	- 1 185	- 100.0 %	NO	NO	NO	NO	NO	NO

NO: Not occurring.

⁽²⁵⁾ In this report, overview tables on methodologies and on uncertainties are only presented for the EC key sources as identified in Section 1.5 due to time restrictions (see Section 1.8.5). For information on sector-specific methods used by the Member States, see Member States' submissions.

10 Recalculations and improvements

10.1 Explanations and justifications for recalculations

Tables 10.1 and 10.2 provide an overview of the main reasons for recalculating emissions in the year 1990 and 2002 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 than 1 000 Gg are presented. For more details, see the information provided by the Member States' submissions in Annex 13.

Table 10.1 Main recalculations in the Member States for 1990 and Member States' explanations for recalculations given in the CRF or in the NIR

	Absolute difference between latest and previous submission used for the EU-15 inventory (Gg CO ₂ equivalents)	Member States' explanation for recalculation	Information source of reasons for recalculations
Austria			
Total emissions excluding LUCF	827		
CO ₂ from 1.A.4	577	1.A.4 (stationary): Activity data: energy statistics were revised by Statistik Austria. Details are provided in the NIR. 1.A.4 (mobile): Activity data were updated by a national transport model.	CRF 1990, Table 8(b)
CH ₄ from 6.A	413	6.A.1: Emission factors: as recommended in the centralised review 2004, the IPCC default CH ₄ oxidation factor (0.1) was applied. 6.A.1: Activity data: disposed waste data have been updated on the basis of information from new reporting obligation of disposal site operators.	CRF 1990, Table 8(b)
CO ₂ from 1.A.3	- 354	1.A.3b: Emission factors: have been updated using the new handbook of emission factors (Version 2.1). The handbook is the result of new measurements. Activity data: have been updated using a national transport model.	CRF 1990, Table 8(b)
Belgium			
Total emissions excluding LUCF	- 63		
CO ₂ from 1.A.1	1 692	Emission factors/activity data: use of directly reported emissions for large power plants instead of calculations based on activity data and default IPCC emission factors	NIR 2005, p. 77
N ₂ O from 4.D	- 1 235	Activity data: N content in the non-fixing crops has been changed from IPCC default values to crop specific values	NIR 2005, p. 64
CO ₂ from 6.C	- 580	Method: adjustment of partition of waste into a biogenic fraction and a non-biogenic fraction was made for Flanders. Removal: municipal waste incineration with energy recuperation was allocated under 1.A.1; only the remaining part (no energy recuperation) is allocated under 6.C (Flanders, Brussels)	NIR 2005, p. 75
Denmark			
Total emissions excluding LUCF	578		
CH ₄ from 6.B	200	Emission factors/activity data: emission estimates for wastewater handling have been introduced in this submission.	CRF 1990, Table 8(b)
CO ₂ from 3	193	A survey based on new methodologies results in new NMVOC emission estimates	CRF 1990, Table 8(b)
N ₂ O from 6.B	88	Emission factors/activity data: emission estimates for wastewater handling has been introduced in this submission.	CRF 1990, Table 8(b)
Finland			
Total emissions excluding LUCF	- 6 417		
CO ₂ from 4.D	- 3 208	Addition/removal/replacement: CO ₂ emissions are included under cropland and grassland in LULUCF sector.	CRF 1990, Table 8(b)

	Absolute difference between latest and previous submission used for the EU-15 inventory (Gg CO₂ equivalents)	Member States' explanation for recalculation	Information source of reasons for recalculations
CO ₂ from 1.B.1	- 2 997	Emission factors: Revised EF based on preliminary results of new measurements. Activity data: Improved activity data from surveys. Addition/removal/replacement: emissions from areas previously reported as areas reserved for peat production have been removed due to improved data collection and identified double counting with Agriculture/LULUCF sector (cultivation of organic soils).	CRF 1990, Table 8(b)
CO ₂ from 1.A.4	- 602	Methods: time series consistency has been improved: changes in recent years (incl. 2003) have been applied to the whole time series. Emission factors: consistent use of EFs throughout the time series has been implemented. Activity data: changes in energy statistics (allocation) have been applied consistently to the whole time series.	CRF 1990, Table 8(b)
France			
Total emissions excluding LUCF	3 273		
N ₂ O from 4.B	3 824	Method: distribution of manure management systems previously used have been modified according to French data.	CRF 1990, Table 8(b)
CH ₄ from 4.B	- 1 057	Method: distribution of manure management systems previously used have been modified according to French data.	CRF 1990, Table 8(b)
CO ₂ from 1.A.2	363	No documentation available.	
Germany			
Total emissions excluding LUCF	- 5 019		
CH ₄ from 4.B	- 6 613	4.B.1(Other cattle), 3,6,8: Activity data: figures 2002/03 have been updated due to new information on animals in Hamburg, Bremen, Berlin. 4.B.1(Dairy cows): Activity data: total recalculation from 1990 until 2002. 4.B.1: Emission factors have been recalculated from 1990 until 2003 due to wrong factors for pasture range and paddock.	CRF 1990, Table 8(b)
N ₂ O from 4.D	5 766	Indirect soil emissions: Activity data: number of animals (ewes) for the years 1991–1993 were recalculated for Mecklenburg–Vorpommern, Thüringen, Sachsen, Sachsen–Anhalt, 1990–2003 new information of mineral fertilisers in Bremen, Berlin and Hamburg were considered, recalculation from 1990 until 2003 Method: indirect emissions from atmospheric deposition were calculated by C/CS (Massflow calculation of emissions of reactive nitrogen according to Corinair) Direct soil emissions: Activity data: emissions from the application of nitrogen fertilisers were recalculated from 1990 until 2003 due to recalculated nitrogen fertilisers for Berlin, Bremen, Hamburg. Activity data: new figures for 2002/03 for emissions from agricultural land-use area and legumes. Activity data: updated estimation of area of organic soils for emissions from cultivated histosols. Method for emissions from animal wastes applied to soil: N returned to soil, according to the massflow approach. Activity data (emissions from animal wastes applied to soil): recalculation from 1990 until 2003, number of animals (ewes) for the years 1991–1993 were recalculated for Mecklenburg–Vorpommern, Thüringen, Sachsen, Sachsen–Anhalt; 1990–2003 new information of mineral fertilisers in Bremen, Berlin and Hamburg were considered.	CRF 1990, Table 8(b)
CH ₄ from 1.B.1	- 1 827	1.B.1a: Activity data: information is now based on more detailed and exact statistical data by the 'Statistic coal industries e.V.' from base year onwards.	CRF 1990, Table 8(b)
CH ₄ from 1.B.2	- 1 456	No documentation available.	
Greece			
Total emissions excluding LUCF	4 663		
N ₂ O from 4.D	3 248	Inclusion of indirect emissions from agricultural soils.	NIR 2004
CO ₂ from 1.A.4	2 685	Allocation of emissions from agricultural machinery to agriculture (1.A.4.c) instead of transport (1.A.3).	NIR 2004
CO ₂ from 1.A.3	- 2 684	Allocation of emissions from agricultural machinery to agriculture (1.A.4.c) instead of transport (1.A.3).	NIR 2004
CH ₄ from 6.B	1 419	Inclusion of CH ₄ emissions from industrial waste water handling.	NIR 2004
Ireland			
		No recalculations for the years 1990–2001.	

	Absolute difference between latest and previous submission used for the EU-15 inventory (Gg CO₂ equivalents)	Member States' explanation for recalculation	Information source of reasons for recalculations
Total emissions excluding LUCF	488		
N ₂ O from 4.D	424	4.D.1: Activity data: the activity data for F_{AMF} the manure nitrogen input to soils, is calculated according to GPG Equation 4.23 where previously it was calculated according to the 1996 IPCC guidelines.	CRF 1990, Table 8(b)
CH ₄ from 6.B	76	The activity data for F_{AMF} the manure nitrogen input to soils, is calculated according to GPG Equation 4.23 where previously it was calculated according to the 1996 IPCC guidelines.	CRF 1990, Table 8(b)
N ₂ O from 6.B	54	Activity data: FAO estimate of protein intake of about 114 g/capita/day annually for the population of Ireland now adopted instead of national value of 60 g/capita/day previously used	CRF 1990, Table 8(b)
Italy			
Total emissions excluding LUCF	2 315		
CO ₂ from 1.A.2	- 2 877	No documentation available.	
CO ₂ from 1.A.1	2 140	No documentation available.	
N ₂ O from 2.B	938	No documentation available.	
Luxembourg			
No recalculations.			
Netherlands			
Total emissions excluding LUCF	320		
CO ₂ from 1.A.2	- 9 424	Methods: based on energy statistics. Activity data: improved data. Emission factors: improved data.	CRF 1990, Table 8(b)
N ₂ O from 4.D	4 294	Now includes indirect emissions Methods: new Activity data: improved data Emission factors: improved data	CRF 1990, Table 8(b)
CO ₂ from 2.B	3 538	Method: now partly based on NEU from energy statistics Activity data: improved data Emission factors: improved data	CRF 1990, Table 8(b)
CO ₂ from 1.A.3	- 3 391	Methods: based on energy statistics Activity data: improved data Emission factors: improved data	CRF 1990, Table 8(b)
CO ₂ from 2.C	2 909	Method: now partly based on NEU from energy statistics Activity data: improved data Emission factors: improved data	CRF 1990, Table 8(b)
CO ₂ from 1.A.4	2 519	Methods: based on energy statistics Activity data: improved data Emission factors: improved data	CRF 1990, Table 8(b)
CH ₄ from 1.B.2	- 1 709	Activity data: improved data Emission factors: improved data	CRF 1990, Table 8(b)
CH ₄ from 4.A	- 1 117	Activity data: improved data Emission factors: improved data	CRF 1990, Table 8(b)
Portugal			
Total emissions excluding LUCF	1 499		
CH ₄ from 6.A	1 802	Method: previously used first order decay model — Equation 3 IPCC 1996 — was changed to Equation 4, which is a derivative of Equation 3 and allows a better consideration of variances in annual SW disposed into land. Emission factor: to take account of in-country review recommendations, k parameter (methane generation rate) was changed to 0.07. Activity data: fermentable industrial waste: new data for 2000 and 2002 were used. Municipal waste: updates for 2002 and 2003. According to in-depth review recommendations, new estimates for the composition of municipal wastes were used, which enable the use of different DOC values reflecting the evolution in the composition of solid waste.	CRF 1990, Table 8(b)

	Absolute difference between latest and previous submission used for the EU-15 inventory (Gg CO₂ equivalents)	Member States' explanation for recalculation	Information source of reasons for recalculations
CO ₂ from 1.A.3	- 323	Method: correction of the duplication of CO ₂ emissions estimates from NMVOC evaporative emissions. CO ₂ emissions are estimated now solely from fuel consumption.	CRF 1990, Table 8(b)
N ₂ O from 4.D	292	4.D.1: Activity data: nitrogen added to soil as synthetic fertiliser and manure is now reported after ammonia volatilisation and hence the IEF equals the default IPCC. But this action has caused no change in emission estimates. 4.D.1: Addition/removal/replacement: manure in liquid systems is now assumed to be applied to soils and contributing to N ₂ O emissions. 4.D.2: Method: FracLEACH is applied before ammonia volatilisation in accordance with IPCC GP. Formally it was applied after volatilisation. 4.D.2: Activity data: revision of ammonia volatilisation from synthetic fertilisers after detailed consideration of specific fertilisers (urea, etc)	CRF 1990, Table 8(b)
Spain			
Total emissions excluding LUCF	- 699		
CH ₄ from 6.A	1 935	Method: the following parameters involved in the calculations of the emissions of methane have been revised: i) the oxidation factor for the methane generated and not recovered (OX), given the value of 0.1 recommended in the IPCC good practice guide for industrialised countries with well-monitored landfill sites, instead of the value of 0.05 in the previous edition; ii) the constant rate of methane generation (K) now taken is 0.05, as recommended by the IPCC good practice guide as the default value if no information is available for this, instead of the 0.1 value used in the previous edition. The methane recovered has also been revised, assuming that a maximum of 70 % of the methane generated can be achieved; this restriction was not present in the previous edition. The most relevant of the changes indicated in terms of its (downward) repercussion on the emissions is the parameter 'k' that implies a change in the mean period of 7 to 13 years for degradation of the waste.	CRF 1990, Table 8(b)
CO ₂ from 1.A.2	1 923	1.A.2a: Emission factor: furthermore, with the new information available for the PNA, the historical series for 1990–2002 on the characteristics of the siderurgy gases and other fuels used in the sinter, pig-iron and steel from integrated iron and steel plants in the integrated siderurgy and the fuels used in the electric steel plants have been revised, giving as a result a revision of the associated emission factors. 1.A.2a: Activity data: on the basis of the new information available for the drafting of the PNA, the historical series for 1990–2002 on fuel consumption used in sinterisation plants, blast and steel furnaces in the integrated siderurgy as well as in the steel mills of the electric steel plants have been revised. 1.A.2b: Activity data: the recalculations are derived from the changes implied by subsections 4.1.2; 4.1.4 and by the adjustment in the energy balance sheet for the final fuel consumption in the industry. 1.A.2c: Activity data: the recalculations are derived from the changes implied by subsections 4.1.2; 4.1.4 and by the adjustment in the energy balance sheet for the final fuel consumption in the industry. 1.A.2d: Activity data: on the basis of the new information available for the drafting of the PNA, the historical series for 1990–2002 on fuel consumption used in the paper pulp and paper and cardboard manufacturing plants have been revised, as already indicated in subsection 4.1.2. Another reason for the recalculations in this sector come from the modifications made in connection with co-generation activities as mentioned above in subsection 4.1.4. 1.A.2f: Emission factor: for mobile industrial machinery: revision of the CO ₂ emission factor, derived from the estimated content of carbon in the fuel. 1.A.2f: Activity data: on the basis of the new information available for the drafting of the PNA, the historical series for 1990–2002 on fuel consumption used in the lime, glass and glass fibre manufacturing plants have been revised, as have those for the manufacture of glass-frit, ceramic wall and floor tiles and the manufacture of bricks and roof tiles. With respect to mobile industrial machinery, the fuel consumption series has been revised, indexing it to the changes in the evolution of the 'Building and civil engineering works by companies' indicator indicated in the Ministry of Public Works Yearbook (the consumption data for the years 1993–1996 have been kept the same as in the previous edition, as a direct estimate of fuel consumption was available for these years, provided by the related professional association ATEM COP (Spanish Technical Professional Association of Machinery for Public Works and Mining)	CRF 1990, Table 8(b)

	Absolute difference between latest and previous submission used for the EU-15 inventory (Gg CO₂ equivalents)	Member States' explanation for recalculation	Information source of reasons for recalculations
CO ₂ from 2.A	1 382	<p>2.A.3: Addition/removal: on the basis of the new information available for the drafting of the PNA, the historical series for 1990–2002 on the consumption of this kind of raw materials in the following sectors: i) glass manufacture, ii) glass-frit manufacture, iii) manufacture of bricks and roof tiles.</p> <p>The CO₂ emissions from the decarbonation of the limestone and dolomite consumed in the manufacture of magnesite, included in the previous edition of the inventory in Category 2.A.7 with the emissions of other types of carbonates consumed in this industry, have now been included here.</p> <p>2.A.7: Emission factor: the revisions commented in the preceding paragraph have entailed the assignation of differentiated CO₂ emission factors depending on the type of product (porous vs. non-porous).</p> <p>2.A.7: Activity data: on the basis of the new information available for the drafting of the PNA, the historical series for 1990–2002 on consumption of carbonated materials in the manufacture of ceramic wall and floor tiles, has been revised distinguishing between the types of product (porous vs. non-porous) for the estimation of the CO₂ emissions due to decarbonation.</p> <p>2.A.7: Addition/removal: the CO₂ emissions from only materials other than limestone (calcium carbonate) and dolomite (calcium-magnesium carbonate) consumed in the manufacture of magnesite and in the glass industry have now been included here, whereas in the previous edition of the inventory this category included the emissions from all types of carbonates consumed in these industries except for sodium carbonate, which was placed in its corresponding Category 2.A.4.</p>	CRF 1990, Table 8(b)
CO ₂ from 2.C	1 205	<p>2.C.2: Activity data: revision of ferro-manganese and silicon-manganese production data for 1997 to 2000.</p> <p>2.C.3: Emission factor: revision of the implicit CO₂ emission factor through the realisation at one of the plants of an input/output balance sheet for carbon in the process for manufacturing pre-baked anodes, instead of using a default emission factor.</p> <p>2.C.3: Method: revision of the method for estimating the emissions of PFCs in the three existing aluminium production plants, which now become Tier 2, as the company owning the plants has stopped considering the parameters previously provided for Tier 3b to be representative.</p>	CRF 1990, Table 8(b)
Sweden			
Total emissions excluding LUCF	71		
CO ₂ from 2.C	163	<p>2.C.1 (Steel): Emissions have been reported in CRF 2C1 Other</p> <p>2.C.1 (Blast furnace gas): Activity data: revision of activity data and emission due to former linkage error</p> <p>2.C.1 (Other-steel production): Activity data: new activity data have been added.</p>	CRF 1990, Table 8(b)
CH ₄ from 1.A.3	- 144	<p>Mobile combustion:</p> <p>Methods: diesel used in stationary combustion has been excluded from total delivered amounts.</p> <p>Emission factors: new emission factors for navigation, off-road vehicles and working machinery.</p> <p>Activity data: new activity data for off-road vehicles and working machinery.</p> <p>1.A.3b: Methods: calculations from road traffic have been adjusted.</p>	CRF 1990, Table 8(b)
N ₂ O from 1.A.4	- 104	<p>1.A.4b–c: Mobile combustion:</p> <p>Methods: diesel used in stationary combustion has been excluded from total delivered amounts.</p> <p>Emission factors: new emission factors for navigation, off-road vehicles and working machinery.</p> <p>Activity data: new activity data for off-road vehicles and working machinery.</p>	CRF 1990, Table 8(b)
United Kingdom			
Total emissions excluding LUCF	5 367		

	Absolute difference between latest and previous submission used for the EU-15 inventory (Gg CO₂ equivalents)	Member States' explanation for recalculation	Information source of reasons for recalculations
CO ₂ from 1.A.1	7 697	<p>Method: method improvement as a result of an on-going task to improve the accuracy of fuel use estimates for the cement industry, the lime industry, and the electricity supply industry. This necessarily affects estimates from other industrial combustion. This is a therefore a reallocation of emissions.</p> <p>Emission factors: carbon emission factors for solid, liquid and gaseous fuels have been updated following a review of the CEFs in the UK GHG inventory.</p> <p>1.A.1c: Method: method of estimating emissions from iron and steel production improved. The new method updates the existing approach and is still based on a carbon balance for integrated steelwork processes, including the associated fuel transformation.</p>	CRF 1990, Table 8(b)
CO ₂ from 1.A.2	3 153	<p>Emission factors: carbon emission factors for solid, liquid and gaseous fuels updated following a review of the CEFs in the UK GHG inventory.</p> <p>1.A.2a: Method: method of estimating emissions from iron and steel production improved. The new method updates the existing approach and is still based on a carbon balance for integrated steelwork processes, including the associated fuel transformation. There has been a reallocation of certain fuels which affects the emissions in 1A2a, 1A2f and 2C1.</p> <p>1.A.2f: Method: method of estimating emissions from the use of coke in 'other industrial combustion' in sector 1A2f (1990 to 1994 inclusive) improved.</p> <p>1.A.2f: Method: method improvement as a result of a continuing task to improve the accuracy of fuel-use estimates for the cement industry, the lime industry, and the electricity supply industry. This necessarily affects estimates from other industrial combustion. This is a reallocation of fuel use and therefore emissions.</p> <p>1.A.2f: Addition/removal: a change has been made to reallocate the emissions of coke used in the blast furnace of a primary lead zinc smelter from 2C1_Iron&Steel to 1A2f (as this is a non-ferrous metals process, not an iron and steel process).</p> <p>1.A.2f_{ii}: Method: improvement to model used to estimate emissions from industrial off-road mobile machinery.</p>	CRF 1990, Table 8(b)
CO ₂ from 1.B.2	- 2 374	<p>1.B.2a: Method: methods of estimating emissions from onshore and offshore oil and gas sectors revised. Has affected the sum of emissions in sectors 1B2ai_Oil_Exploration (Offshore oil and gas — well testing), and, 1B2ciii_Flaring (Offshore oil and gas — flaring) for 1990 to 2000 inclusive.</p>	CRF 1990, Table 8(b)
CO ₂ from 1.A.4	- 2 362	<p>Emission factors: carbon emission factors for solid, liquid and gaseous fuels updated following a review of the CEFs in the UK GHG inventory.</p> <p>1.A.4a: Removal: reallocation of emissions from coke in 1A4a_Commercial/Institutional to 1A2f other industrial combustion. Only affects 1990 and 1991.</p> <p>1.A.4b: Addition/removal: reallocation of emissions from sector 1B1b_Solid_Fuel_Transformation to sector 1A4b_Residential. Previously, it was assumed that emissions from the combustion of petroleum coke occurred in the fuel transformation sector. In fact, the emissions from the combustion of this fuel occur when small amounts of petroleum coke are incorporated into some grades of domestic smokeless fuel produced within the fuel transformation process. This fuel is then burnt by householders. Emissions from the consumption of this petroleum coke are now assigned to the IPCC fuel 'Other bituminous coal'.</p>	CRF 1990, Table 8(b)
CO ₂ from 1.B.1	- 2 140	<p>Emission factor: revision to emission factors for coke oven gas (COG) following a review of the CEFs in the UK GHG inventory.</p>	CRF 1990, Table 8(b)
CH ₄ from 1.B.1	1 083	No explanatory information.	
CO ₂ from 6.A	1 019	<p>Methods/addition/removal: methodology change to now report CO₂ emissions in sector 6A1_Managed_Waste_Disposal_on_Land from the disposal of wood treated with preservatives derived from benzols and tars. This change is a consequence of the revision to the method used to estimate emissions from the manufacture of iron & steel. In previous inventories, emissions from the combustion of these compounds were included as part of the emission from coal use in coke ovens — however, these compounds are not burnt in this sector. Emissions from the decomposition of these fossil fuel derived preservatives have now been allocated to sector 6A1.</p>	CRF 1990, Table 8(b)

Table 10.2 Main recalculations in the Member States for 2002 and Member States' explanations for recalculations given in the CRF or in the NIR

	Absolute difference between latest and previous submission used for the EU-15 inventory (Gg CO₂ equivalents)	Member States' explanation for recalculation	Information source of reasons for recalculations
Austria			
Total emissions excluding LUCF	1 813		
CO ₂ from 1.A.2	1 891	Stationary: Activity data: energy statistics are revised for all subcategories by Statistik Austria. Details are provided in the NIR. Mobile: Activity data: updated by national transport model.	CRF 2002, Table 8(b)
CO ₂ from 1.A.1	-1 665	1.A.1a: Emission factors: CO ₂ emissions factor for municipal waste is updated according to information from plant operators. 1.A.1a: Activity data: energy statistics are revised by Statistik Austria. Details are provided in the NIR. Activity data reported due to emission declarations for plants > 50 MWth are completed for the year 2002. 1.A.1b: Method: the methodology is now more transparent and consistent regarding activity data and selection of emission factors. 1.A.1b: Emissions factor: plant specific emission factors are used. In the previous submission, the CO ₂ -emissions were reported by the plant operator and disaggregated to fuels from the energy statistics. 1.A.1b: Activity data: 1990 to 2002: energy statistics are revised by Statistik Austria. 1.A.1c: Activity data: 1990 to 2002: energy statistics are revised by Statistik Austria. Details are provided in the NIR. 1.A.1c: Removal: emissions from LPG used in gasworks were double counted with gasworks gas.	CRF 2002, Table 8(b)
CO ₂ from 2.C	573	2.C.1: Method: process specific CO ₂ emissions from pig iron production have been recalculated as the underlying activity data used for the calculation (non-energy use of coke) have been updated in the national energy balance. 2.C.1: Emission factor: for calculating CO ₂ emissions electric arc furnaces now, a country-specific emission factor is used (previously an emission factor taken from a Swiss publication was applied). 2.C.1: Activity data: Update for 2002. 2.C.2: Addition: addition of CO ₂ emissions. 2.C.3: Activity data: activity data used for calculation of CO ₂ emissions from aluminium production have been harmonised	CRF 2002, Table 8(b)
Belgium			
Total emissions excluding LUCF	- 4 634		
CO ₂ from 1.A.2	- 3 382	1.A.2a: Addition/removal: CO ₂ emissions from electric arc furnaces were recalculated and allocated to 1.A.2a. 1.A.2c: Recalculation of non-energy use and related CO ₂ emissions. 1.A.2f: Activity data: energy consumption in the quarries is taken into account in 1.A.2f. 1.A.2f: Activity data: availability of new detailed activity data on the use of biomass fuels in cement kilns from cement plants.	NIR 2005, p. 40
CO ₂ from 1.A.1	1 244	Addition: municipal waste incineration with energy recuperation was allocated under 1.A.1; only the remaining part (no energy recuperation) is allocated under 6.C (Flanders, Brussels)	NIR 2005, p. 75
CO ₂ from 6.C	- 1 074	Method: adjustment of partition of waste into a biogenic fraction and a non-biogenic fraction was made for Flanders. Removal: municipal waste incineration with energy recuperation was allocated under 1.A.1; only the remaining part (no energy recuperation) is allocated under 6.C (Flanders, Brussels)	NIR 2005, p. 75
Denmark			
Total emissions excluding LUCF	505		
CH ₄ from 6.B	277	Emission factor/activity data: emission estimates for wastewater handling have been introduced in this submission.	CRF 2002, Table 8(b)
N ₂ O from 6.B	58	Emission factor/activity data: emission estimates for wastewater handling have been introduced in this submission.	CRF 2002, Table 8(b)

	Absolute difference between latest and previous submission used for the EU-15 inventory (Gg CO₂ equivalents)	Member States' explanation for recalculation	Information source of reasons for recalculations
CO ₂ from 1.A.4	53	Method/emission factor: in the submission, in 2004 for invent. 1990–2002, the coal fuel cat. included coke and brown coal briquettes. In this submission, individual CO ₂ EFs are applied for these three fuels. The consumption of coke and BCB is very low and so is the change in CO ₂ emission. Emission factor: the CO ₂ emission factor for fish & rape oil has been changed. However, this is a biomass fuel and the cons. is very low.	CRF 2002, Table 8(b)
Finland			
Total emissions excluding LUCF	- 4 782		
CO ₂ from 1.B.1	- 2 906	Emission factor: revised EF based on preliminary results of new measurements. Activity data: improved activity data from surveys. Removal: emissions from areas previously reported as areas reserved for peat production have been removed due to improved data collection and identified double counting with Agriculture/LULUCF sector (cultivation of organic soils)	CRF 2002, Table 8(b)
CO ₂ from 4.D	- 2 057	Removal: CO ₂ emissions are included under cropland and grassland in LULUCF sector.	CRF 2002, Table 8(b)
CO ₂ from 1.A.5	250	Methods: time series consistency has been improved: changes in recent years (incl. 2003) have been applied to the whole time series. Emission factors: consistent use of EFs throughout the time series has been implemented. Activity data: changes in energy statistics (allocation) have been applied consistently to the whole time series.	CRF 2002, Table 8(b)
France			
Total emissions excluding LUCF	- 332		
N ₂ O from 4.B	3544	Method: modification of the distribution of manure management system previously used according to French data.	CRF 2002, Table 8(b)
CO ₂ from 1.A.2	- 2 786	Activity data: energy consumption for manufacturing industries updated.	CRF 2002, Table 8(b)
CO ₂ from 1.A.1	2276	1.A.1a: Emission factor: review of CO ₂ emission factor for domestic waste incineration with energy recovery. 1.A.1a: Activity data: activity updated.	CRF 2002, Table 8(b)
CO ₂ from 1.A.4	- 2 101	1.A.4a: Activity data: energy consumption for commercial and institutional updated. 1.A.4b: Activity data: energy consumption for residential updated.	CRF 2002, Table 8(b)
Germany			
Total emissions excluding LUCF	- 822		
CH ₄ from 4.B	3 544	Activity data: total recalculation from 1990 until 2002 4.B.1: Emission factor: recalculation from 1990 until 2003 (Emission factor pasture range and paddock was wrong).	CRF 2002, Table 8(b)
CH ₄ from 1.B.1	- 1 827	Activity data: information is now based on more detailed and exact statistical data by the 'Statistic coal industries e.V.' from base year onwards	CRF 2002, Table 8(b)
CH ₄ from 4.A	- 1 022	Other cattle, pigs, sheep, horses: Activity data: figures 2002/03 updated, new information of animals in Hamburg, Bremen, Berlin are considered 4.A.1: Dairy cows: method: county-specific; emission factor: recalculation from 1990 until 2002, activity data: total recalculation from 1990 until 2002. 4.A.1: Other cattle: method: T1; activity data: figures 2002/03 updated, new information of animals in Hamburg, Bremen, Berlin are considered	CRF 2002, Table 8(b)
Greece			
Total emissions excluding LUCF	- 1 795		
CH ₄ from 6.A	- 1 559	Activity data: updated data on MSWDS.	CRF 2002, Table 8(b)
N ₂ O from 4.D	- 519	Activity data: updated data on cultivated areas, crop production and fertilisers consumption.	CRF 2002, Table 8(b)
CO ₂ from 2.C	436	Activity data: updated data on steel production.	CRF 2002, Table 8(b)
Ireland			
Total emissions excluding LUCF	509		

	Absolute difference between latest and previous submission used for the EU-15 inventory (Gg CO₂ equivalents)	Member States' explanation for recalculation	Information source of reasons for recalculations
N ₂ O from 4.D	449	4.D.1: Activity data: the activity data for F _{AMF} , the manure nitrogen input to soils, is calculated according to GPG Equation 4.23 where previously it was calculated according to the 1996 IPCC guidelines	CRF 2002, Table 8(b)
N ₂ O from 6.B	60	Activity data: FAO estimate of protein intake of about 114 g/capita/day annually for the population of Ireland now adopted instead of national value of 60 g/capita/day previously used	CRF 2002, Table 8(b)
Italy			
Total emissions excluding LUCF	1 185		
CO ₂ from 1.A.1	6 351	No information	
CO ₂ from 1.A.2	- 5 053	No information	
HFC from 2.F	- 3 541	Emission factor has been corrected	CRF 2002, Table 8(b)
Luxembourg			
No recalculations			
Netherlands			
Total emissions excluding LUCF	- 304		
CO ₂ from 1.A.2	- 9 129	Method: based on energy statistics Emission factor: improved data Activity data: improved data	CRF 2002, Table 8(b)
CO ₂ from 2.B	3 126	Method: now partly based on NEU from energy statistics Emission factor: improved data Activity data: improved data	CRF 2002, Table 8(b)
CO ₂ from 1.A.1	2 843	Method: based on energy statistics Emission factor: improved data Activity data: improved data	CRF 2002, Table 8(b)
CO ₂ from 1.A.3	- 2 670	Method: based on energy statistics Emission factor: improved data Activity data: improved data	CRF 2002, Table 8(b)
N ₂ O from 4.D	2 319	Method: new Emission factor: improved data Activity data: improved data Addition: now includes indirect emissions and direct emissions from histosols and crop residue	CRF 2002, Table 8(b)
CO ₂ from 2.C	1 649	Method: now partly based on NEU from energy statistics Emission factor: improved data Activity data: improved data	CRF 2002, Table 8(b)
CO ₂ from 1.A.4	1 580	Method: based on energy statistics Emission factor: improved data Activity data: improved data	CRF 2002, Table 8(b)
CH ₄ from 1.B.2	- 1 476	Emission factor: improved data Activity data: improved data	CRF 2002, Table 8(b)
CO ₂ from 1.B.2	- 1 231	Emission factor: improved data Activity data: improved data	CRF 2002, Table 8(b)
Portugal			
Total emissions excluding LUCF	4 123		
CH ₄ from 6.A	2 592	Method: previously used first order decay model — Equation 3 IPCC 1996 — was changed to Equation 4, which is a derivative of Equation 3 and allows a better consideration of variances in annual SW disposed into land. Emission factor: to take account of in-country review recommendations, k parameter (methane generation rate) was changed to 0.07. Activity data: fermentable industrial waste: new data for 2000 and 2002 were used. Municipal waste: updates for 2002 and 2003. According to in-depth review recommendations, new estimates for the composition of municipal wastes were used, which enable the use of different DOC values reflecting the evolution in the composition of solid waste.	CRF 2002, Table 8(b)

	Absolute difference between latest and previous submission used for the EU-15 inventory (Gg CO₂ equivalents)	Member States' explanation for recalculation	Information source of reasons for recalculations
CO ₂ from 2.A	1 104	<p>Addition: first time inclusion in the CRF tables of emissions from commercial lime production. Additionally emissions from lime production in paper pulp industry and in integrated iron and steel production that were formerly reported in source categories: limestone and dolomite use (2A3) and fuel combustion (1A2a) were replaced here. First time estimate of emissions from consumption of limestone in fertiliser industry (production of calcium and magnesium nitrate).</p> <p>Emission factor: use of CS EF from glass production (Carbon market allocation plan (PNALE)) based in plant specific data: consumption of limestone and dolomite.</p>	CRF 2002, Table 8(b)
CO ₂ from 1.A.2	1 078	Activity data: correction of detected errors in fuel consumption (LHV) from coke consumption in the cement industry. Use of plant specific LHV for pet. coke;	CRF 2002, Table 8(b)
Spain			
Total emissions excluding LUCF	- 1 144		
CH ₄ from 6.A	3 686	Method: the following parameters involved in the calculations of the emissions of methane have been revised: i) the oxidation factor for the methane generated and not recovered (OX), given the value of 0.1 recommended in the IPCC good practice guide for industrialised countries with well-monitored landfill sites, instead of the value of 0.05 in the previous edition; ii) the constant rate of methane generation (K) now taken is 0.05 as recommended by the IPCC good practice guide as the default value if no information is available for this, instead of the 0.1 value used in the previous edition. The methane recovered has also been revised, assuming that a maximum of 70 % of the methane generated can be achieved; this restriction was not present in the previous edition. The most relevant of the changes indicated in terms of its (downward) repercussion on the emissions is the parameter 'k' that implies a change in the mean period of 7 to 13 years for degradation of the waste.	CRF 2002, Table 8(b)
CO ₂ from 2.A	1 908	<p>2.A.2: Activity data: on the basis of the new information available for the drafting of the PNA, the historical series for 1990–2002 on raw materials giving rise to CO₂ emissions due to decarbonation in the production of lime have been revised.</p> <p>2.A.3: Addition: on the basis of the new information available for the drafting of the PNA, the historical series for 1990–2002 on the consumption of this kind of raw materials in the following sectors: i) glass manufacture, ii) glass-frit manufacture, iii) manufacture of bricks and roof tiles.</p> <p>The CO₂ emissions from the decarbonation of the limestone and dolomite consumed in the manufacture of magnesite, included in the previous edition of the inventory in Category 2.A.7 with the emissions of other types of carbonates consumed in this industry, have now been included here.</p> <p>2.A.7: Emission factor: the revisions commented in the preceding paragraph have entailed the assignation of differentiated CO₂ emission factors depending on the type of product (porous vs. non-porous).</p> <p>2.A.7: Activity data: on the basis of the new information available for the drafting of the PNA, the historical series for 1990–2002 on consumption of carbonated materials in the manufacture of ceramic wall and floor tiles, has been revised distinguishing between the types of product (porous vs. non-porous) for the estimation of the CO₂ emissions due to decarbonation.</p> <p>2.A.7: Addition/removal: the CO₂ emissions from only materials other than limestone (calcium carbonate) and dolomite (calcium-magnesium carbonate) consumed in the manufacture of magnesite and in the glass industry have now been included here, whereas in the previous edition of the inventory this category included the emissions from all types of carbonates consumed in these industries except for sodium carbonate, which was placed in its corresponding Category 2.A.4.</p>	CRF 2002, Table 8(b)
CO ₂ from 1.A.4	1 447	<p>Activity data: for agricultural mobile machinery (tractors), the estimated fuel consumption has been revised, introducing into the calculation a corrective factor to adjust the rated power to the power used, and an additional estimate for consumption during travel off agricultural land.</p> <p>Addition: the motors used in agriculture for irrigation purposes has been added as a distinct activity, as information has become available on the fuel consumption in this activity, as published in the Saving Strategy Report and Energy Efficiency — E4 for the agricultural sector.</p>	CRF 2002, Table 8(b)

	Absolute difference between latest and previous submission used for the EU-15 inventory (Gg CO₂ equivalents)	Member States' explanation for recalculation	Information source of reasons for recalculations
CO ₂ from 1.A.2	1 283	<p>1.A.2a: Emission factor: furthermore, with the new information available for the PNA, the historical series for 1990–2002 on the characteristics of the siderurgy gases and other fuels used in the sinter, pig-iron and steel from integrated iron and steel plants in the integrated siderurgy and the fuels used in the electric steel plants have been revised, giving as a result a revision of the associated emission factors.</p> <p>1.A.2a: Activity data: on the basis of the new information available for the drafting of the PNA, the historical series for 1990–2002 on fuel consumption used in sinterisation plants, blast and steel furnaces in the integrated siderurgy as well as in the steel mills of the electric steel plants have been revised.</p> <p>1.A.2b, c, e: Activity data: the recalculations are derived from the changes implied by subsections 4.1.2; 4.1.4 and by the adjustment in the energy balance sheet for the final fuel consumption in the industry.</p> <p>1.A.2d: On the basis of the new information available for the drafting of the PNA, the historical series for 1990–2002 on fuel consumption used in the paper pulp and paper and cardboard manufacturing plants have been revised, as already indicated in subsection 4.1.2. Another reason for the recalculations in this sector come from the modifications made in connection with co-generation activities as mentioned above in subsection 4.1.4.</p> <p>1.A.2f: Emission factor: for mobile industrial machinery: revision of the CO₂ emission factor, derived from the estimated content of carbon in the fuel.</p> <p>1.A.2f: Activity data: on the basis of the new information available for the drafting of the PNA, the historical series for 1990–2002 on fuel consumption used in the lime, glass and glass fibre manufacturing plants have been revised, as have those for the manufacture of glass-frit, ceramic wall and floor tiles and the manufacture of bricks and roof tiles.</p> <p>With respect to mobile industrial machinery, the fuel consumption series has been revised, indexing it to the changes in the evolution of the 'Building and civil engineering works by companies' indicator indicated in the Ministry of Public Works Yearbook (the consumption data for the years 1993–1996 have been kept the same as in the previous edition, as a direct estimate of fuel consumption was available for these years, provided by the related professional association ATEMCOP (Spanish Technical Professional Association of Machinery for Public Works and Mining)</p>	CRF 2002, Table 8(b)
CO ₂ from 2.C	1 049	<p>2.C.2: Activity data: revision of ferro-manganese and silicon-manganese production data for 1997 to 2000.</p> <p>2.C.3: Method: revision of the method for estimating the emissions of PFCs in the three existing aluminium production plants, which now become Tier 2, as the company owning the plants has stopped considering the parameters previously provided for Tier 3b to be representative.</p> <p>2.C.3: Emission factor: revision of the implicit CO₂ emission factor through the realisation at one of the plants of an input/output balance sheet for carbon in the process for manufacturing pre-baked anodes, instead of using a default emission factor.</p>	CRF 2002, Table 8(b)
Sweden			
Total emissions excluding LUCF	– 117		
CO ₂ from 1.A.3	– 224	<p>Method: ethanol and RME mixed in gasoline and diesel, and diesel used in stationary combustion have been excluded from total delivered amounts of diesel.</p> <p>Emission factor: new emission factors for navigation, off-road vehicles and working machinery.</p> <p>Activity data: new activity data for off-road vehicles and working machinery.</p>	CRF 2002, Table 8(b)
CO ₂ from 1.A.1	– 214	<p>1.A.1a: Removal: combustion of hazardous waste is reallocated to CRF 6C.</p> <p>1.A.1b: Activity data: smaller revisions for the whole time series due to new information about activity data.</p>	CRF 2002, Table 8(b)
CO ₂ from 2.C	173	<p>2.C.1 (steel): Removal: emissions have been reported in CRF 2C1 Other</p> <p>2.C.1 (other): Activity data: new activity data have been added.</p>	CRF 2002, Table 8(b)
United Kingdom			
Total emissions excluding LUCF	8 863		

	Absolute difference between latest and previous submission used for the EU-15 inventory (Gg CO₂ equivalents)	Member States' explanation for recalculation	Information source of reasons for recalculations
CO ₂ from 1.A.1	9 366	<p>Method: method improvement as a result of an on-going task to improve the accuracy of fuel-use estimates for the cement industry, the lime industry, and the electricity supply industry. This necessarily affects estimates from other industrial combustion. This is therefore a reallocation of emissions.</p> <p>Emission factor: carbon emission factors for solid, liquid and gaseous fuels have been updated following a review of the CEFs in the UK GHG inventory.</p> <p>1.A.1a: Emission factor: carbon emission factors for solid, liquid and gaseous fuels have been updated following a review of the CEFs in the UK GHG inventory.</p> <p>1.A.1a: Activity data: revision of activity data for MSW and sour gas.</p> <p>1.A.1b: Emission factor: carbon emission factor changes for fuel oil, natural gas, OPG, petroleum coke, gas oil and naphtha. Emission factors updated following a review of CEFs in the UK GHG inventory.</p> <p>1.A.1b: Activity data: activity data revised for fuel oil, natural gas, OPG, LPG, gas oil, naphtha and petroleum coke.</p> <p>1.A.1ci: Method: method of estimating emissions from iron and steel production improved. The new method updates the existing approach and is still based on a carbon balance for integrated steelwork processes, including the associated fuel transformation.</p> <p>1.A.1ci: Emission factor: update of emissions factors for blast furnace gas, coke oven gas.</p> <p>1.A.1ci: Activity data: revision to activity data.</p> <p>1.A.1cii: Emission factor: revision in carbon emission factors for colliery methane, natural gas, OPG following a review of CEFs in the UK GHG</p> <p>1.A.1cii: Activity data: Revision to activity data.</p>	CRF 2002, Table 8(b)
CO ₂ from 1.A.3	1 914	<p>Emission factor: carbon emission factors for liquid and gaseous fuels updated following a review of the CEFs in the UK GHG inventory.</p> <p>1.A.3aii: Method: major improvement to the method used to estimate GHG emissions from domestic and international aviation — a model based on individual aircraft movements is now used, corresponding to a Tier 3 approach. The split between domestic and international emissions has changed — domestic emissions have declined, with a corresponding increase in emissions allocated to aviation bunkers.</p> <p>1.A.3aii: Emission factor: carbon emission factor for aviation spirit revised.</p> <p>1.A.3aii: Activity data revised.</p> <p>1.A.3b: Method: model to estimate emissions of GHGs from road transport revised. Improvements to the methodology include more detailed information on traffic speeds on different types of roads and information on the composition of the vehicle fleet. Now includes estimate of GHGs released when lubricating oil is burnt inside car engines.</p> <p>1.A.3c: Method: improvement to estimate of emissions from rail transport. Reallocation of emissions associated with freight, intercity and regional rail movements.</p> <p>1.A.3dii: Emission factor: carbon factor for fuel oil and gas oil revised.</p> <p>1.A.3dii: Activity data revised</p> <p>1.A.3e: Emission factor: carbon factor revision to gas oil.</p>	CRF 2002, Table 8(b)
CO ₂ from 1.B.1	- 1 891	<p>1.B.1b: Emission factor: revision to emission factors for coke oven gas (COG) following a review of the CEFs in the UK GHG inventory.</p>	CRF 2002, Table 8(b)
CH ₄ from 1.B.1	1 205	<p>1.B.1b: Method: method of estimating emissions from iron and steel production improved. The new method updates the existing approach and is still based on a carbon balance for integrated steelwork processes, including the associated fuel transformation.</p>	CRF 2002, Table 8(b)
CO ₂ from 1.A.4	- 1 122	<p>Emission factor: carbon emission factors for solid, liquid and gaseous fuels updated following a review of the CEFs in the UK GHG inventory.</p> <p>1.A.4b: Emission factor: carbon emission factor revisions following a review of the UK GHG inventory.</p> <p>1.A.4b: Addition/removal: reallocation of emissions from sector 1B1b_Solid_Fuel_Transformation to sector 1A4b_Residential. Previously, it was assumed that emissions from the combustion of petroleum coke occurred in the fuel transformation sector. In fact, the emissions from the combustion of this fuel occur when small amounts of petcoke are incorporated into some grades of domestic smokeless fuel produced within the fuel transformation process. This fuel is then burnt by householders. Emissions from the consumption of this petroleum coke are now assigned to the IPCC fuel 'Other bituminous coal'.</p> <p>1.A.4a: Activity data revised</p> <p>1.A.4bii: Emission factor: revision to emission factor for diesel following a review of the UK GHG inventory.</p> <p>1.A.4ci: Emission factor: revision to emission factors for natural gas, coal, fuel oil and gas oil following a review of the CEFs in the UK GHG inventory; activity data revised</p> <p>1.A.4cii: Emission factor: emission factor revision for gas oil.</p>	CRF 2002, Table 8(b)

Table 10.3 Overview of recalculations of EU-15 total GHG emissions (difference between latest submission and previous submission in Gg CO₂ equivalents)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Total CO ₂ equivalent emissions including LUCF (absolute)	- 115 873	- 215 715	- 133 864	- 119 881	- 135 772	- 139 515	- 146 646	- 132 429	- 146 023	- 153 223	- 156 760	- 163 469	- 167 340
Total CO ₂ equivalent emissions including LUCF (percent)	- 2.8 %	- 5.1 %	- 3.3 %	- 3.0 %	- 3.4 %	- 3.5 %	- 3.6 %	- 3.3 %	- 3.6 %	- 3.9 %	- 3.9 %	- 4.1 %	- 4.2 %
Total CO ₂ equivalent emissions excluding LUCF (absolute)	7 201	7 076	11 050	10 703	8 247	10 262	7 161	18 034	9 561	8 237	9 785	2 573	3 070
Total CO ₂ equivalent emissions excluding LUCF (percent)	0.2 %	0.2 %	0.3 %	0.3 %	0.2 %	0.2 %	0.2 %	0.4 %	0.2 %	0.2 %	0.2 %	0.1 %	0.1 %

Table 10.4 Recalculations for the EU-15 key source categories 1990 and 2002 (difference between latest submission and previous submission in Gg of CO₂ equivalents and in percentage)

Greenhouse Gas Source Categories	Gas	Recalculations 1990		Recalculations 2002	
		(Gg CO ₂ equivalents)	(%)	(Gg CO ₂ equivalents)	(%)
1.A.1. Energy Industries	CO ₂	12117	1.1 %	19973	1.7 %
1.A.1. Energy Industries	N ₂ O	- 536	- 3.9 %	- 778	- 5.0 %
1.A.2. Manufacturing Industries	CO ₂	- 5985	- 0.9 %	- 16685	- 2.9 %
1.A.3. Transport	CO ₂	- 7401	- 1.1 %	- 1862	- 0.2 %
1.A.3. Transport	CH ₄	- 122	- 2.5 %	- 71	- 2.6 %
1.A.3. Transport	N ₂ O	- 882	- 7.8 %	- 667	- 2.7 %
1.A.4. Other Sectors	CO ₂	2756	0.4 %	- 195	0.0 %
1.A.4. Other Sectors	CH ₄	- 106	- 0.9 %	- 137	- 1.8 %
1.A.5. Other	CO ₂	569	2.8 %	778	11.1 %
1.B.1. Solid Fuels	CH ₄	- 556	- 1.1 %	- 586	- 3.2 %
1.B.2. Oil and Natural Gas	CH ₄	- 3221	- 9.6 %	- 1546	- 5.6 %
2.A. Mineral Products	CO ₂	941	0.9 %	4418	4.1 %
2.B. Chemical Industry	CO ₂	3138	23.4 %	3890	34.1 %
2.B. Chemical Industry	N ₂ O	959	0.9 %	403	0.9 %
2.C. Metal Production	CO ₂	3612	16.9 %	3707	20.6 %
2.C. Metal Production	PFC	- 133	- 1.1 %	- 35	- 1.1 %
2.C. Metal Production	SF ₆	96	4.6 %	7	0.2 %
2.E. Production of Halocarbons and SF ₆	HFC	0	0.0 %	- 65	- 0.7 %
2.F. Consumption of Halocarbons and SF ₆	HFC	200	57.1 %	- 3617	- 9.0 %
2.E. Production of Halocarbons and SF ₆	PFC	30	0.5 %	- 17	- 0.3 %
2.F. Consumption of Halocarbons and SF ₆	SF ₆	30	0.5 %	- 17	- 0.3 %
4.A. Enteric Fermentation	CH ₄	- 1834	- 1.2 %	- 1647	- 1.2 %
4.B. Manure Management	CH ₄	- 6330	- 8.8 %	- 3889	- 5.9 %
4.B. Manure Management	N ₂ O	4418	21.7 %	4143	22.5 %
4.D. Agricultural Soils	N ₂ O	12512	6.0 %	6761	3.5 %
6.A. Solid Waste Disposal on Land	CH ₄	1037	0.9 %	- 1172	- 1.5 %
6.B. Waste- water Handling	CH ₄	1635	18.5 %	605	8.1 %
6.B. Waste incineration	CO ₂	- 511	- 9.0 %	- 1427	- 31.3 %

Note: Many of these source categories are more aggregated than the EU-15 key source categories identified in Section 1.5 because the more detailed data were not estimated in the 2003 inventory.

10.2 Implications for emission levels

Table 10.3 provides the differences in total EU-15 GHG emissions between the latest submission and the previous submission in absolute and relative terms. The table shows that due to recalculations, total EU-15 1990 GHG emissions excluding LUCF have increased in the latest submission compared to the previous submission by 7 201 Gg (+ 0.2 %). EU-15 GHG emissions for 2002 increased 3 070 Gg (+ 0.1 %) due to recalculations.

Table 10.4 provides an overview of recalculations for the EU-15 key source categories for 1990 and 2002 (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 1.A.1: 'Energy industries', (+ 12 117 Gg in 1990 and + 19 973 Gg in 2002).

Tables 10.5 and 10.6 give an overview of absolute and percentage changes of Member States' emissions due to recalculations for 1990 and 2002. Large recalculations in

Table 10.5 Contribution of Member States to EU-15 recalculations of total GHG emissions without LUCF for 1990–2002 (difference between latest submission and previous submission Gg of CO₂ equivalents)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Austria	827	493	927	765	565	803	461	706	514	320	443	473	1 813
Belgium	- 63	- 837	- 1 512	- 1 386	- 1 308	- 2 208	- 2 602	- 1 892	- 2 175	- 1 862	- 1 867	- 2 605	- 4 634
Denmark	578	520	533	548	33	- 255	- 246	- 400	422	348	506	411	505
Finland	- 6 417	- 5 484	- 4 255	- 4 590	- 4 511	- 4 767	- 4 889	- 4 726	- 5 278	- 5 035	- 4 888	- 4 846	- 4 782
France	3 273	3 439	5 561	2 292	3 069	2 832	1 819	3 221	1 693	1 304	2 332	2 076	- 332
Germany	- 5 019	- 5 127	- 3 871	- 4 758	- 389	2 061	2 189	1 576	1 390	1 008	738	450	- 822
Greece	4 663	4 260	3 773	3 727	4 127	4 062	3 687	3 349	3 760	3 727	2 675	- 1 362	- 1 795
Ireland	488	503	520	545	576	598	608	621	641	632	716	723	509
Italy	2 315	1 981	3 053	4 215	3 665	2 993	2 226	1 838	- 151	3 244	7 411	1 874	1 185
Luxembourg	0	0	0	0	0	0	0	0	0	0	0	0	0
Netherlands	320	- 2 012	- 2 262	155	- 1 230	- 468	- 1 481	7 052	2 722	2 083	579	- 647	- 304
Portugal	1 498	1 379	1 608	2 090	2 003	2 250	2 458	2 808	3 221	3 267	2 240	2 884	4 123
Spain	- 699	- 787	- 1 158	- 1 580	- 1 528	- 1 792	- 3 207	- 2 973	- 3 533	- 5 189	- 4 727	- 4 148	- 1 144
Sweden	71	69	- 109	- 80	- 194	- 341	- 20	19	- 196	- 112	- 219	20	- 117
UK	5 367	8 679	8 241	8 762	3 369	4 494	6 160	6 836	6 531	4 502	3 845	7 271	8 863
EU-15	7 201	7 076	11 050	10 703	8 247	10 262	7 161	18 034	9 561	8 237	9 785	2 573	3 070

Table 10.6 Contribution of Member States to EU-15 recalculations of total GHG emissions without LUCF for 1990–2002 (difference between latest submission and previous submission in percentage)

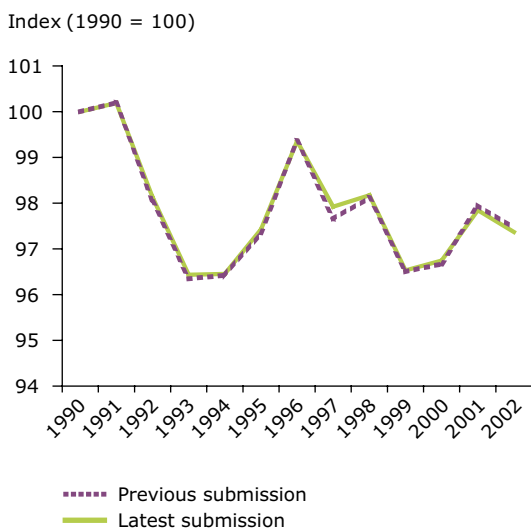
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Austria	1.1	0.6	1.2	1.0	0.7	1.0	0.6	0.9	0.6	0.4	0.5	0.6	2.1
Belgium	0.0	- 0.6	- 1.0	- 0.9	- 0.9	- 1.4	- 1.6	- 1.3	- 1.4	- 1.3	- 1.2	- 1.7	- 3.1
Denmark	0.8	0.7	0.7	0.7	0.0	- 0.3	- 0.3	- 0.5	0.6	0.5	0.7	0.6	0.7
Finland	- 8.4	- 7.3	- 5.9	- 6.3	- 5.7	- 6.3	- 6.0	- 5.9	- 6.8	- 6.5	- 6.5	- 6.0	- 5.8
France	0.6	0.6	1.0	0.4	0.6	0.5	0.3	0.6	0.3	0.2	0.4	0.4	- 0.1
Germany	- 0.4	- 0.4	- 0.3	- 0.4	0.0	0.2	0.2	0.1	0.1	0.1	0.1	0.0	- 0.1
Greece	4.5	4.1	3.6	3.5	3.8	3.7	3.2	2.8	3.0	3.0	2.1	- 1.0	- 1.3
Ireland	0.9	0.9	0.9	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.7
Italy	0.5	0.4	0.6	0.8	0.7	0.6	0.4	0.4	0.0	0.6	1.4	0.3	0.2
Luxembourg	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
Netherlands	0.2	- 0.9	- 1.0	0.1	- 0.6	- 0.2	- 0.6	3.2	1.2	1.0	0.3	- 0.3	- 0.1
Portugal	2.6	2.3	2.5	3.4	3.2	3.3	3.8	4.2	4.5	4.1	2.9	3.7	5.1
Spain	- 0.2	- 0.3	- 0.4	- 0.5	- 0.5	- 0.6	- 1.0	- 0.9	- 1.0	- 1.4	- 1.2	- 1.1	- 0.3
Sweden	0.1	0.1	- 0.2	- 0.1	- 0.3	- 0.5	0.0	0.0	- 0.3	- 0.2	- 0.3	0.0	- 0.2
UK	0.7	1.2	1.1	1.3	0.5	0.7	0.9	1.0	1.0	0.7	0.6	1.1	1.4
EU-15	0.2	0.2	0.3	0.3	0.2	0.2	0.2	0.4	0.2	0.2	0.2	0.1	0.1

absolute terms were made in the UK. In relative terms, the highest recalculations were made by Finland.

10.3 Implications for emission trends, including time series consistency

Figure 10.1 shows that due to the fact that both the 1990 and 2002 emissions have increased, the emission trend in the EU-15 has hardly changed. In the previous submission, the trend of GHG excluding LUCF between 1990 and 2002 was -2.5% . In the latest submission, this trend has changed to -2.6% .

Figure 10.1 Comparison of EU-15 GHG emission trends 1990–2002 (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 2005 in response to UNFCCC reviews:

- More information is provided in the EU-15 CRF tables. Tables 1.C, 2(II), are included for the first time and in several

sectoral background data tables (4.A, 4.B, 4.C, 4.D, 4.E, 4.F, 6.A,C) activity data have been included in order to allow the calculation of implied emission factors at EU-15 level. In addition, overview tables have been included in the inventory report including background information on activity data and implied emission factors by EU-15 Member States.

- The EU-15 reference approach is provided for the latest year (2003) for the first time in this submission.
- QA/QC activities have been further extended on the basis of the EC QA/QC programme adopted in October 2004. Also, a quantitative Tier 1 uncertainty analysis has been performed on the basis of Member States' Tier 1 uncertainty analysis.
- The transparency of the EC inventory was improved by:

providing an analysis of methods used in the sectors 'Industrial processes' and 'Waste';

extending the description of methodologies, uncertainty estimates and sector-specific QA/QC for the agriculture and LUCF sector;

including overview information at subcategory level on methods used, activity data and emission factors used for the EU-15 key sources.

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⁽²⁶⁾. The table shows that a considerable amount of improvements were made compared with the 2004 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

⁽²⁶⁾ Issues related to the NIR are not included in this table as already addressed in Table 1.11.

Table 10.7 Improvements made by Member States in response to the UNFCCC review

Member State	Improvements in response to UNFCCC review as indicated in the NIR
Austria	<p>Energy</p> <p>1 A 2 Manufacturing industries and construction: sectoral division of natural gas consumption is improved by energy statistics.</p> <p>1 A 2 a Iron and steel production: fuel consumption and CO₂ emissions are now corresponding in a more accurate way with pig iron production and process emissions of Category 2 C 1 Iron and steel.</p> <p>1 A 1 c Manufacture of solid fuels and other energy industries: includes now emissions from oil/gas extraction and compressors for storage and liquification of natural gas only.</p> <p>Industrial Processes</p> <p>2 F Consumption of halocarbons and SF₆: emissions from 2001 and 2002 were updated using extrapolation techniques (following recommendations from the ERT) and data from industries, previously the same estimated as for 2000 were used for these years.</p> <p>Agriculture</p> <p>Animal Category 'Other': in Austria, animals of category 'Other' which are mainly deer (but don't include wild living animals) have been counted from 1993 on. As recommended in the centralised review, in this inventory for the years 1990 to 1992 the animal number of 1993 was used.</p> <p>4 A, 4 B, 4 D (Non-dairy cattle): The S&A report 2004 noticed high inter-annual variations in the CH₄ and N₂O IEF values between 1992 and 1993, and 1993 and 1994. An error regarding activity data of non-dairy cattle for the year 1993 was identified and corrected in this submission.</p> <p>4 D 3 Atmospheric nitrogen deposition: following the recommendation of the centralised review (October 2004), in contrast to the last submission, N volatilised in housing, storage and pasture was also taken into account. Now, in accordance with the IPCC good practice, the value FracGASM relates to N excreted by livestock and not to Nex left for spreading.</p> <p>4 F Field burning: as recommended in the centralised review 2003, the IPCC methodology using default values was applied.</p> <p>CRF tables, background data: according to the centralised review 2003, emissions from different animal waste management systems (AWMS) are reported under the appropriate AWMS in the CRF.</p> <p>As recommended in the S&A report 2004 in Table 4 B (b), notation keys instead of '0' have been used.</p> <p>Waste</p> <p>6 A 1 Managed waste disposal on land: as recommended in the centralised review 2004, the IPCC default CH₄ oxidation factor (0.1) was applied. (para. 15) .</p>
Belgium	<p>General improvements</p> <p>The efficiency of the institutional arrangements for the preparation of the inventory has still been improved. On the technical side, all the sectoral tables have been fulfilled in this submission (in the 2003 submission, some regional sectoral tables were included in the annexes to the NIR). In all regions, the emissions were completely updated for the time series 1990–2002 and provisional emissions are calculated for 2001.</p>
Denmark	<p>For the submissions to UNFCCC, 13 April 2004, of inventories 1990–2002 some inconsistencies were pointed out during the consistency phase of the review. The inconsistencies concerned the industrial sector and F-gases and their potential emissions and the agricultural sector and livestock data. The inconsistencies did not affect the actual emissions. Denmark used the possibility to correct the inconsistencies and to resubmit the inventories. The resubmission took place on 19 May 2004 and was sent in parallel to the Commission, with the explanation that no actual emission was affected by the resubmission.</p> <p>Uncertainty analyses have been improved for this submission. Geographical coverage has also been completed as inventories for Greenland and the Faroe Islands, as far as they are available, have been included in a separate version of CRFs. Further improvements have been made in the different sectors. The review report has not been available when preparing the submission for 2005. All suggestions and comments made by the review teams were considered, but due to the late availability of the review report some improvements are still in progress and will be implemented in the next submission.</p>
Finland	<p>Previously, Finland's inventory submission, besides common reporting format tables (CRF), consisted of a national inventory report (NIR) and a more comprehensive additional methodology report (Greenhouse gas emissions and removals in Finland, Pipatti, 2001). The latest centralised review (16 December 2004) urges Finland to provide more precise references and summaries on the methodologies in the NIR. In the current submissions, this request has been taken into account. Finland has made an effort to update descriptions on the methodologies and data sources used. The documentation of methodologies will be further improved up to the inventory submission of 15 April 2005 to the UNFCCC.</p> <p>A quality management system is currently being developed as an integrated part of the national system and annual inventory process. The latest centralised review (16 December 2004) recommends Finland to focus on the further improvement of QA/QC procedures. Finland has established the national system required in the Kyoto Protocol (Article 5.1). The national greenhouse gas inventory system in Finland will be started on a permanent basis on schedule with the government resolution; that is, by the end of 2004.</p> <p>In this submission, Finland reports emissions from forestland and cropland by using the new CRF tables. In addition, emissions from the liming of agricultural soils and direct N₂O fertilisation on forestland (for the year 2003) are reported with the new CRF tables. The whole LULUCF category reporting is under active development and will be more complete in next submissions (para. 147).</p>
France	(NIR not yet provided)
Germany	Several improvements have been made in this submission. More detailed information about applied methods is available and recalculations in response to the review have been made. Many improvements are planned for the next submission in 2006.

Member State	Improvements in response to UNFCCC review as indicated in the NIR
Greece	QA/QC activities since April 2004 were focused on the improvement of the archiving of information and the development of a long-term improvement plan as suggested by the in-country review of the Greek GHG inventory. A number of recalculations have been performed since the previous inventory submission in order to improve consistency with UNFCCC reporting guidelines and IPCC guidelines. The recalculations made are driven by the results of the various review process (e.g. UNFCCC technical review of inventories), while prioritisation is based on the key source analysis and the availability of resources.
Ireland	Major research projects on emissions of CH ₄ from enteric fermentation and direct N ₂ O emissions from soils have been completed and a system is being developed for an efficient application of their findings, which includes reassessment of the values adopted in the past for some of the most important input variables. This reassessment responds to the inventory review process, which has identified large differences between the Irish values of some variables and IPCC default values or those of other parties (para. 56). It has not been possible to fully implement the recommendations for the current reporting cycle but the present NIR mentions some changes and improvements now planned in response to the in-country review report (para. 2). Improvements in order to the good practice guidance have been made.
Italy	(NIR not yet provided)
Luxembourg	(NIR not yet provided)
Netherlands	Response to the issues raised in the UNFCCC reviews is available in Chapter 10.4.6 Inconsistency in time series: for this submission, recalculations for the complete time series were performed for all major sectors, resulting in consistent time series in all sectors. Missing notation keys and other documentation in CRF tables: in this submission, additional notation keys were included. We also improved the explanation of the NE and IE entries in the documentation boxes of the CRF tables. Incompleteness of CRF: Categories 5 B. and 5 D. were not reported in the last submission. These categories are now included in the NIR. Additional information in the NIR: an annex with references to other reports 'that should be considered as part of the NIR' was added in this report, which are also publicly available through the Internet, as are the NIR and the corresponding CRF files. Comparison of activity data with international statistics: because the recalculation for the fossil fuel related emissions is now completely based on national energy statistics, the major part of the abovementioned will be resolved. In the NIR/CRF 2005, the following specific changes were made in the CRF tables (see also Section 10.4.3) partly in response to the reviews and partly as a result of the national improvement programme. <ul style="list-style-type: none"> • CRF tables improved by replacing 0 by notation keys NE, NA, NO, IE, C, where applicable. • Correction of typing/unit errors as observed. • A physical link between the CRF files and the tables of the NIR was further improved to make sure that the data in both are equal.
Portugal	(NIR not yet provided)
Spain	Some recalculations have been made in order to address the recommendations of the in-country review 2003. This largely improved the accuracy and completeness of the inventory series and the emission trends.
Sweden	In response to the UNFCCC review, Tier 2 source analysis has been implemented and uncertainty estimates have been made. The QA/QC management system has been further developed and several recalculations have been made.
United Kingdom	(NIR not yet provided)

too much information and too detailed to be included in this report.

10.4.3 Improvements planned at EC level

Several activities are planned at EC level with a view to improving the EC GHG inventory system.

- The further development of the QA/QC activities in 2005 will include:

organisation of a workshop on inventories and projections in the waste sector (see Section 8.4);

organisation of an expert meeting on improving the quality of GHG inventories and projections for the LUCF sector (see Section 7.3);

further development of the EC QA/QC programme;

preparation of a quality-management manual for the EC based on the current draft for use in 2006.

- During the year 2005, further work will be carried out with the aim of improving the quantitative uncertainty estimate for the EU-15 in accordance with the GPG in the 2005 submission.
- The ETC/ACC will adapt the new UNFCCC software for the purposes of the EC inventory in order to further extend the scope of the EC CRF submission.

11 References

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12 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 ₂ O	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
RIVM	National Institute of Public Health and the Environment (The Netherlands)
SF ₆	sulphur hexafluoride
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 organisations	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				

European Environment Agency

Annual European Community greenhouse gas inventory 1990–2003 and inventory report 2005

Submission to the UNFCCC Secretariat

(EEA Technical report No 4/2005 — ISSN 1725-2237)

Luxembourg: Office for Official Publications of the European Communities

2005 — 244 pp. — 21 x 29.7 cm

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ISBN 92-9167-766-3

