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Annual European Community greenhouse gas inventory 1990–2002 and inventory report 2004

Submission to the UNFCCC Secretariat

European Environment Agency

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Executive summary

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

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

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

The EC GHG inventory is compiled on the basis of the inventories of the 15 Member States. It is the direct sum of the 15 national inventories, except for the reference approach for CO_2 from fossil fuels developed by the Intergovernmental Panel on Climate Change (IPCC), which is based on Eurostat energy data. 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).

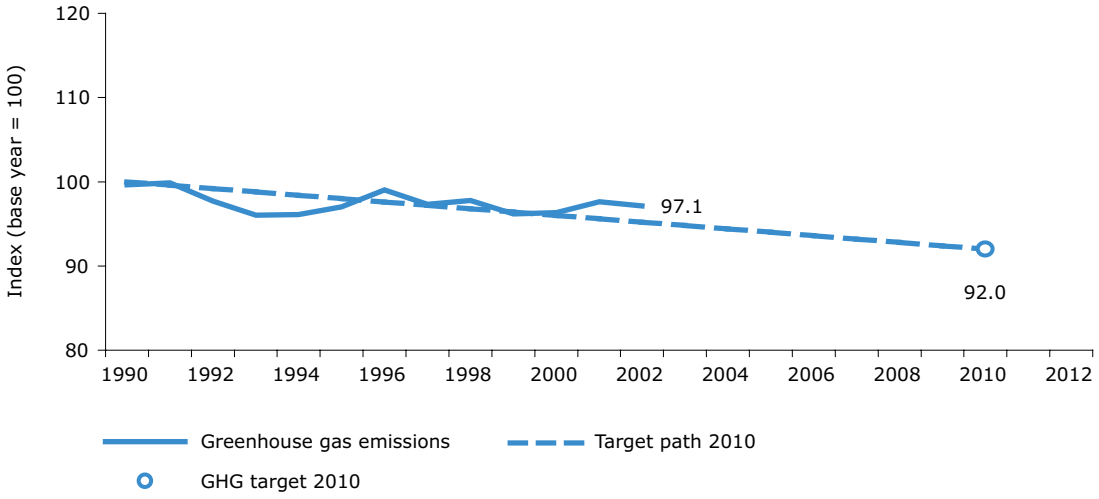
The process of compilation of the EC GHG inventory is as follows: Member States submit their annual GHG inventories by 15 January each year to the European Commission, DG Environment. Then, the EEA's ETC/ACC, Eurostat and JRC perform initial checks on the submitted data. On 28 February, the draft EC 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 EC decreased by 2.9 % between the base year and 2002. 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 EC GHG emissions were 1.9 index points above this target path in 2002 (Figure ES.1).

([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 EC GHG emissions 1990–2002 compared with target for 2008–2012 (excl. LUCF)



Notes: The linear target path is not intended as an approximation of past and future emission trends. It provides a measure of how close the EC emissions in 2002 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 EC with its GHG targets in 2008–2012, but aims at evaluating overall EC GHG emissions in 2002. The unit is index points with base year emissions being 100.

GHG emission data for the EC 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 EC base year emissions is the sum of Member States' emissions in the respective base years. 13 Member States have chosen to select 1995 as base year under the Kyoto Protocol, Finland and France have chosen to use 1990. Therefore, 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.

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 need not be exactly 100.

Table ES.1 gives an overview of the main trends in the EC GHG emissions and removals for 1990–2002. CO_2 is by far the most important GHG, accounting for 82 % of total EC emissions in 2002. In 2002, EC CO_2 emissions without LUCF were 3 382 Tg, which was 1.4 % above 1990 levels. Compared to 2001, CO_2 emissions decreased slightly mainly due to warm outdoor temperatures and low economic activity. The main reason for emission increases between 1990 and 2002 was growing road transport demand. The large increase in road transport-related CO_2 emissions was only partly offset by reductions in energy-related emissions from manufacturing industries.

Table ES.1 Overview of EC GHG emissions and removals from 1990 to 2002 in CO_2 equivalents (Tg)

Greenhouse gas emissions	Base year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Net CO_2 emissions/removals	3 234	3 234	3 310	3 167	3 096	3 111	3 158	3 222	3 153	3 212	3 174	3 211	3 251	3 224
CO_2 emissions (without LUCF)	3 335	3 335	3 358	3 285	3 228	3 232	3 270	3 347	3 281	3 333	3 306	3 328	3 392	3 382
CH_4	451	451	441	433	426	416	410	405	394	385	375	364	356	349
N_2O	392	392	388	378	369	374	375	383	383	361	338	336	335	328
HFCs	41	27	27	28	30	34	40	45	52	53	46	47	46	50
PFCs	12	16	14	12	11	10	9	9	8	8	7	6	6	5
SF_6	15	10	11	12	12	13	15	15	13	12	10	10	9	9
Total (with net CO_2 emissions/ removals)	4 145	4 130	4 191	4 031	3 945	3 959	4 007	4 079	4 004	4 030	3 950	3 974	4 003	3 965
Total (without CO_2 from LUCF)	4 246	4 231	4 240	4 148	4 077	4 080	4 119	4 204	4 132	4 152	4 083	4 091	4 144	4 124
Total (without LUCF)	**4 245**	**4 231**	**4 239**	**4 147**	**4 076**	**4 079**	**4 119**	**4 204**	**4 132**	**4 151**	**4 083**	**4 090**	**4 144**	**4 123**

The increase of CO_2 emissions was compensated by decreases in CH_4 and N_2O in the same period: CH_4 decreased by 102 Tg (CO_2 equivalents) (– 23 %) and N_2O by 64 Tg (CO_2 equivalents) (16.5 %). The main reasons for declining CH_4 emissions were the decline of coal-mining, reductions in solid waste disposal on land and falling cattle population. The main reason for large N_2O 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 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.2 gives an overview of EC GHG emissions in the seven sectors for 1990–2002. The emissions from the largest sector 'Energy', with an 81 % share of the total emissions, increased by 27 Tg CO_2 equivalents (0.8 %). This increase was offset by decreases in all other source categories: emissions from 'Industrial processes' decreased by 56 Tg CO_2 equivalents (– 18.4 %), emissions from 'Agriculture' by 40 Tg CO_2 equivalents (– 8.7 %), emissions from 'Waste' by 38 Tg CO_2 equivalents (– 27.5 %) and emissions from 'Solvent and other product use' by 1 Tg CO_2 equivalents (– 8.5 %).

Tables ES.3 and ES.4 give an overview of Member States' contributions to the EC GHG emissions for 1990–2002. 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 40 % of EC GHG emissions. These two Member States achieved total GHG emission reductions of 348 million tonnes compared to the base year ([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 the German reunification. The reduction of GHG emissions in the United Kingdom was primarily the result of liberalising energy markets and the subsequent fuel switches from oil and coal to gas in electricity production and N_2O emission reduction measures in the adipic acid production.

France and Italy are the third and fourth largest emitters with a share of 13.4 % each. France's emissions were 1.9 % below base year levels in 2002. In France, large reductions were achieved in N_2O emissions from adipic acid production, but CO_2 emissions from road transport increased considerably

Table ES.2 Overview of EC GHG emissions in the main source and sink categories 1990 to 2002 in CO_2 equivalents (Tg)

GHG source and sink	Base year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
1. Energy	3 322	3 322	3 353	3 282	3 227	3 218	3 250	3 331	3 259	3 309	3 278	3 293	3 358	3 349
2. Industrial processes	318	303	294	286	276	290	300	302	308	286	255	256	252	248
3. Solvent and other product use	9	9	9	9	8	8	8	8	8	9	8	9	8	8
4. Agriculture	456	456	443	432	426	428	428	431	432	430	428	424	421	416
5. Land-use change and forestry	– 100	– 100	– 081	– 117	– 131	– 121	– 112	– 125	– 128	– 121	– 132	– 117	– 141	– 158
6. Waste	138	138	138	137	136	133	131	129	122	116	111	106	103	100
7. Other	2	2	2	2	2	2	2	2	2	2	2	2	2	2

([2]) The EC as a whole needs emission reductions of total GHG of 8 %, i.e. 340 million tonnes on the basis of the 2004 inventory in order to meet the Kyoto target.

Table ES.3 Overview of Member States' contributions to EC GHG emissions excluding LUCF from 1990 to 2002 in CO_2 equivalents (Tg)

Member State	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Austria	78	82	75	75	76	79	83	82	82	80	81	84	85
Belgium	146	149	148	147	152	155	159	150	155	148	150	149	150
Denmark	69	79	73	76	80	77	90	81	76	73	68	69	68
Finland	77	75	72	72	79	76	82	81	78	77	75	81	82
France	565	589	579	556	552	560	576	568	583	564	558	562	554
Germany	1 249	1 196	1 146	1 131	1 108	1 101	1 119	1 082	1 056	1 020	1 016	1 027	1 016
Greece	105	105	106	107	109	110	114	120	124	124	130	135	135
Ireland	53	54	55	55	57	58	59	62	64	66	68	70	69
Italy	509	511	506	500	493	525	517	523	535	540	544	554	554
Luxembourg	13	13	13	13	13	10	10	9	8	9	10	10	11
Netherlands	211	218	218	221	222	225	234	218	224	213	213	216	214
Portugal	58	60	64	62	63	67	65	68	72	80	78	78	82
Spain	285	291	300	289	304	316	310	331	341	370	385	383	400
Sweden	72	72	72	72	75	74	77	73	73	70	68	68	70
United Kingdom	743	744	721	701	696	686	708	684	679	648	648	656	635
EU-15	**4 231**	**4 239**	**4 147**	**4 076**	**4 079**	**4 119**	**4 204**	**4 132**	**4 151**	**4 083**	**4 090**	**4 144**	**4 123**

Table ES.4 Greenhouse gas emissions in CO_2 equivalents (excl. LUCF) and Kyoto Protocol targets for 2008–2012

Member State	Base year (1) (million tonnes)	2002 (million tonnes)	Change 2001–2002 (%)	Change base year-2002 (%)	Targets 2008–12 under Kyoto Protocol and 'EU burden sharing' (%)
Austria	78.0	84.6	0.3	8.5	– 13.0
Belgium	146.8	150.0	0.5	2.1	– 7.5
Denmark (2)	69.0	68.5	– 1.2	– 0.8 (– 9.1)	– 21.0
Finland	76.8	82.0	1.7	6.8	0.0
France	564.7	553.9	– 1.4	– 1.9	0.0
Germany	1 253.3	1 016.0	– 1.1	– 18.9	– 21.0
Greece	107.0	135.4	0.3	26.5	25.0
Ireland	53.4	68.9	– 1.6	28.9	13.0
Italy	508.0	553.8	– 0.1	9.0	– 6.5
Luxembourg	12.7	10.8	10.4	– 15.1	– 28.0
Netherlands	212.5	213.8	– 1.1	0.6	– 6.0
Portugal	57.9	81.6	4.1	41.0	27.0
Spain	286.8	399.7	4.2	39.4	15.0
Sweden	72.3	69.6	2.0	– 3.7	4.0
United Kingdom	746.0	634.8	– 3.3	– 14.9	– 12.5
EU-15	**4 245.2**	**4 123.3**	**– 0.5**	**– 2.9**	**– 8.0**

(1) The base year for CO_2, CH_4 and N_2O 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) For Denmark, data that reflect adjustments for electricity trade (import and export) in 1990 are given in brackets. This method is used by Denmark to monitor progress towards its national target under the EC 'burden sharing' agreement. For the EC emissions, total non-adjusted Danish data have been used.

between 1990 and 2002. Italy's GHG emissions were 9.0 % above base year levels in 2002. Italian GHG emissions increased between the base year and 2002 primarily from road transport, electricity and heat production and petrol-refining.

Spain as the fifth largest emitter in the EC accounts for 9.7 % of total EC GHG emissions and increased emissions by 39.4 % between the base year and 2002. This was largely due to emission increases from electricity and heat production, road transport and manufacturing industries.

Table ES.5 Overview of EC indirect GHG and SO_2 emissions for 1990–2002 (Gg)

Greenhouse gas emissions	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
	Gg												
NO_x	13 516	13 363	13 043	12 425	12 079	11 694	11 506	11 026	10 762	10 400	10 462	10 259	10 023
CO	49 871	48 152	46 179	43 796	41 525	39 759	38 517	36 696	35 135	33 105	30 846	29 417	27 598
NMVOC	17 077	16 513	16 023	15 241	15 047	14 570	13 910	13 744	13 226	12 808	12 121	11 714	11 227
SO_2	16 535	15 004	13 863	12 604	11 402	10 242	8 944	8 113	7 597	6 848	6 546	6 375	6 183

Table ES.4 shows that nine Member States were above base year levels in 2002 and six Member States were below. The percentage changes of GHG emissions from the base year to 2002 range from – 19 % (Germany) to + 41 % (Portugal).

ES.4 Information on indirect greenhouse gas emissions

Emissions of CO, NO_x, NMVOC and SO_2 have to be reported to the UNFCCC Secretariat because they influence climate change indirectly: CO, NO_x and NMVOC are precursor substances for ozone which itself is a greenhouse gas. Sulphur emissions produce microscopic particles (aerosols) that can reflect sunlight back out into space and also affect cloud formation. Table ES.5 shows the total indirect GHG and SO_2 emissions in the EC between 1990–2002. All emissions were reduced significantly from 1990 levels: the largest reduction was achieved in SO_2 (– 63 %) followed by CO (– 45 %) NMVOC (– 34 %) and NO_x (– 26 %).

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 2002. 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 11. Note that all Member States' submissions (CRF tables and inventory reports), which are included in Annex 11 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 ([3]). This Council decision came into effect on 18 March 2004. Therefore, for this year, the EC GHG inventory is still based on data delivered by the Member States before 1 April 2004 (as was required under the previous Council Decision 1999/296/EC). The emissions compiled in the EC GHG inventory are the sum of the respective emissions in the respective 15 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 2003 submission by the European Commission to the UNFCCC Secretariat of the Annual European Community greenhouse gas inventory and inventory report 1990–2001 (EEA, 2003a) and in the report entitled Analysis of greenhouse gas emission trends and projections in Europe 2003 (EEA, 2003b).

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 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

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

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 ([4]). The purpose of this decision is to: (1) monitor all anthropogenic GHG emissions covered by the Kyoto Protocol in the Member States; (2) evaluate progress towards meeting GHG reduction commitments under the UNFCCC and the Kyoto Protocol; (3) implement the UNFCCC and the Kyoto Protocol as regards national programmes, greenhouse gas inventories, national systems and registries of the Community and its Member States, and the relevant procedures under the Kyoto Protocol; (4) ensure the timeliness, completeness, accuracy, consistency, comparability and transparency of reporting by the Community and its Member States to the UNFCCC Secretariat.

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

- their anthropogenic emissions of greenhouse gases listed in Annex A to the Kyoto Protocol (carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6)) during the year before last (X – 2);
- provisional data on their emissions of carbon monoxide (CO), sulphur dioxide (SO_2), nitrogen oxides (NO_x) and volatile organic compounds (VOCs) during the year before last (year X – 2), together with final data for the year three-years previous (year X – 3);
- their anthropogenic greenhouse gas emissions by sources and removals of carbon dioxide by sinks resulting from land-use, land-use change and forestry during the year before last (year X – 2);
- information with regard to the accounting of emissions and removals from land-use, land-use change and forestry, in accordance with Article 3(3) and, where a Member State decides to make use of it, Article 3(4) of the Kyoto Protocol, and the relevant decisions thereunder, for the years between 1990 and the year before last (year X – 2);
- any changes to the information referred to in points (1) to (4) relating to the years between 1990 and the year three-years previous (year X – 3);
- the elements of the national inventory report necessary for the preparation of the Community greenhouse gas inventory report, such as information on the Member State's quality assurance/quality control plan, a general uncertainty evaluation, a general assessment of completeness, and information on recalculations performed.

The reporting requirements for the Member States under Council Decision No 280/2004/EC are elaborated in the implementing provisions under Council Decision No 280/2004/EC ([5]). According to the decision and these guidelines 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

([4]) 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.

([5]) The implementing provisions under Council Decision No 280/2004/EC are currently being discussed and will be adopted in 2004. 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 and the guidelines under this decision (European Commission, 2000).

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 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

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 ([6]). 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) ([7]).Table 1.1 shows the main

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
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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 Interprofessionel Technique d'Etudes de la Pollution Atmosphérique (CITEPA) 10 rue de Faubourg Poissonnière, F-75010 Paris
Germany	Michael Strogies Federal Environmental Agency Bismarckplatz 1, D-14193 Berlin
Greece	Dimitra Koutendaki Institute of Environmental Research and Sustainable Development Athens, Greece
Ireland	Michael McGettigan, Paul Duffy Environmental Protection Agency Richview, Clonskeagh Road, Dublin 14, Ireland

([6]) The implementing provisions under Council Decision No 280/2004/EC, which are currently being discussed, include a section on the EC inventory system which specifies in more detail responsibilities, exchange of information, the preparation of the EC inventory, estimates of missing data, identification of key categories, estimation of uncertainties, recalculations, response to the UNFCCC review process, QA/QC, data management and archiving.

([7]) 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.

Member State/EU institution	Contact address
Luxembourg	Frank Thewes Administration de l'Environment, Division Air-Bruit 16 rue Eugène Ruppert, L-2453
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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 Gugele, Kati Huttunen, 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
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), Italy

institutions and persons involved in the compilation and submission of the EC inventory.

1.2.1 The Member States

All Member States are parties to the UNFCCC. Therefore, all Member States have to prepare individual GHG inventories in accordance with UNFCCC reporting guidelines and to submit those inventories to the Commission by 15 January every year.

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 Euopean Commission, DG Environment is assisted by the EEA including its ETC/ACC and by Eurostat and the JRC.

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

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

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

1.2.3 The European Environment Agency

The European Environment Agency assists the 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 2004 work plan for the ETC/ACC and an implementation plan specify the specific tasks of the ETC/ACC partner organisations with regard to the preparation of the EC inventory. Umweltbundesamt Austria is the task leader for the compilation of the EC annual inventory in the ETC/ACC, including all tasks mentioned above.

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

1.2.5 Eurostat

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

1.2.6 Joint Research Centre

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

1.3 A description of the process of inventory preparation

The annual process of compilation of the EC inventory is summarised in Table 1.2. 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 is 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

Table 1.2 Annual process of submission and review of Member States inventories and compilation of the EC inventory ([1])

Element	Who	When	What
1. Submission of annual greenhouse gas inventories (complete CRF submission and elements of the NIR) by Member States under Council Decision No 280/2004/EC	Member States	15 January	Greenhouse gas emissions by sources and removals by sinks, for the year n – 2 And updated time series 1990- year n – 3, depending on recalculations; Core elements of the NIR Steps taken to improve estimates in areas that were previously adjusted under Article 5.2 of the Kyoto Protocol (for reporting under the Kyoto Protocol).
2. 'Initial check' of Member States' submissions	Commission (incl. Eurostat, the JRC), assisted by the EEA	As soon as possible after receipt of Member State data, at the latest by 1 April	Initial checks and consistency checks (by EEA). Comparison of energy data in Member States' IPCC reference approach with Eurostat energy data (by Eurostat and Member States) and check of Member States' LUCF inventories by the 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 and Member States' checking 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. Gap-filling	Commission (DG Environment) assisted by EEA	31 March	The Commission prepares an estimate for any source category for which the required estimate at Member State level is still missing at 15 March.
7. 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.
8. Circulation of initial check results of the EC submission to Member States	Commission (DG Environment) assisted by EEA	As soon as possible after receipt of initial check results	Commission circulates the initial check results of the EC submission as soon as possible after their receipt to those Member States, which are affected by the initial checks.
9. Response of relevant Member States to initial check results of the EC submission	Member States	Within one week from receipt of the findings	The relevant Member States, for which the initial check indicated problems or inconsistencies provide their responses to the initial check to the Commission.
10. Submission of any resubmissions by Member States in response to the UNFCCC initial checks	Member States	For each Member State, same as under the UNFCCC initial checks phase Under the Kyoto Protocol: the resubmission should be provided to the Commission within five weeks of the submission due date.	Member States provide to the Commission the resubmissions which they submit to the UNFCCC Secretariat in response to the UNFCCC initial checks. The Member States should clearly specify which parts have been revised in order to facilitate the use for the EC resubmission. As the EC resubmission also has to comply with the deadlines specified in the guidelines under Article 8 of the Kyoto Protocol, the resubmission has to be sent to the Commission earlier than the period foreseen in the guidelines under Article 8 of the Kyoto Protocol, provided that the resubmission correct data or information that is used for the compilation of the EC inventory.
11. Submission of any other resubmission after the initial check phase	Member States		Member States provide to the Commission any other resubmission (CRF or NIR) which they provide to the UNFCCC Secretariat after the initial check phase.

([1]) As Council Decision No 280/2004/EC entered into force only in March 2004, the compilation of this inventory report 2004 started under the previous Council Decision 1999/296/EC. See EEA (2003a) for an overview of the annual process of submission and review of Member States' inventories and compilation of the EC inventory under Council Decision 1999/296/EC.

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.

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 ([8]). In addition, the *Revised IPCC 1996 guidelines for national greenhouse gas inventories* have been applied as well as the IPCC *Good practice guidance and uncertainty management in national greenhouse gas inventories*, where appropriate and feasible. In addition, for the compilation of the EC GHG inventory, Council Decision No 280/2004/EC and the implementing provisions thereunder have been used.

The EC GHG gas inventory is compiled on the basis of the inventories of the 15 Member States. The emissions of each source category are the sum of the emissions of the respective source and sink categories of the 15 Member States. This is also valid for the base year. Currently, 13 Member States have chosen 1995 as the base year for fluorinated gases while Finland and France have chosen 1990. Therefore, 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. The reference approach is calculated for the EC on the basis of Eurostat energy data (see Section 3.6) and the key source analysis (Section 1.5) is separately performed at EC level ([9]).

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.

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

([9]) 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.

Table 1.3 Inconsistencies between the EC submission 2004 and the sum of the Member States' submissions 2004

	Total CO_2 emissions			CO_2 removals from LUCF		
	EC submission 2004	MS submission 2004	Difference	EC submission 2004	MS submission 2004	Difference
Austria	69 671	69 671	0	– 7 633	– 7 633	0
Belgium	126 585	126 585	0	– 1 814	– 1 814	0
Denmark	54 164	54 164	0	– 3 813	– 3 813	0
Finland	69 500	69 500	0	– 18 010	– 18 010	0
France	406 044	406 044	0	– 54 865	– 54 865	0
Germany	864 117	878 023	– 13 906	13 906	0	13 906
Greece	105 504	105 504	0	– 1 896	– 1 896	0
Ireland	45 808	45 808	0	– 978	– 978	0
Italy	468 961	468 961	0	– 20 385	– 20 385	0
Luxembourg	10 218	10 218	0	– 295	– 295	0
Netherlands	176 654	176 654	0	– 1 413	– 1 413	0
Portugal	67 464	67 464	0	– 1 606	– 1 606	0
Spain	325 448	325 448	0	– 35 301	– 35 301	0
Sweden	54 753	54 753	0	– 26 541	– 26 541	0
United Kingdom	537 380	539 283	– 1 903	1 903	0	1 903
EU-15	**3 382 270**	**3 398 080**	**– 15 810**	**– 158 741**	**– 174 551**	**15 810**

Note: All values are in Gg and for the inventory year 2002.

The EC 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. The sector-specific chapters list the methodologies and emission factors used by the Member States for each EC key source. Annex 11 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 11. Note that all Member States' submissions (CRF tables and national inventory reports), which are included in Annex 11 and made available at the EEA website, are considered to be part of the EC submission.

Differences between EC submissions and Member States' submissions in 2004

Due to the reporting required in Category 5 of CRF Table Summary 1.A., inconsistencies occur between the EC CRF submission 2004 and the sum of the EC Member States' submissions in 2004. Footnote 5 of CRF Table Summary 1.A. requires parties 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 CO_2 emissions or CO_2 removals column, as appropriate. Thirteen Member States reported net removals from LUCF for 2002, two Member States (Germany and the United Kingdom) reported net CO_2 emissions. At EC level, CO_2 removals were larger than CO_2 emissions. Therefore, net removals were reported that resulted from adding the net removals of the 13 Member States and deducting the net emissions of Germany and the UK. This means that total CO_2 emissions at EC level do not include net emissions from LUCF of Germany and the UK. (In turn, net emissions from LUCF of Germany and the UK reduce net removals of the EC.) The sum of CO_2 emissions of the national submissions to the UNFCCC Secretariat includes net emissions of Germany and the UK and therefore is higher (see Table 1.3). In turn, the sum of CO_2 removals in the national submissions to the UNFCCC is also higher.

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. As in 2004 the EC provides GHG emission data at the most detailed level required in the UNFCCC reporting guidelines, also a key source analysis at such a detailed subcategory level is possible this year.

In addition to the key source analysis at EC level, every Member State provides a national key source analysis which is independent from the assessment at EC level. The EC key source analysis is not intended to replace the key source analysis by Member States. The key source analysis at EC 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. 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 EC, the following procedure was applied.

- Starting point for the key source identification for this report were the CRF sectoral report tables, i.e. CRF Tables 1, 2(I), 3, 4, 6 of the EC GHG inventory. All source categories where GHG emissions occur were listed, at the most disaggregated level available at EC 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). Disaggregation by fuel type was not made, because this information is currently not available for all Member States for the complete time series.
- A level assessment was carried out for the base year; for all years starting from 1991 a level and a trend assessment was performed. 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 53 key source categories for the EC. The EC key sources are listed in Table 1.4 and ranked according to their level contribution to total EC GHG emissions in 2002. They cover 97.6 % of total EC GHG emissions in 2002.

In Chapters 3 to 9 for each key source overview tables are presented which include the Member States' contributions to the EC key source in terms of level and trend. Information on methodologies, emission factors, completeness and qualitative uncertainty estimates is provided at more aggregate level, because this information is taken from the CRF Table Summary 3 and Tables 7.

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

A proposal for an EC inventory QA/QC plan is currently being discussed in the

Table 1.4 EC GHG source categories identified as key sources (emissions in Gg of CO_2 equivalents)

Source category gas	Base year	2002	Absolute change	Change (%)	Level assessment (%)	Cumulative total (%)
1.A.1.a: Public electricity and heat production (CO_2)	940 240	964 895	24 656	3	23.4	23.4
1.A.3.b: Road transportation (CO_2)	638 887	784 554	145 667	23	19.0	42.4
1.A.2: Manufacturing industries and construction (CO_2)	651 908	583 070	– 68 838	– 11	14.1	56.6
1.A.4.b: Residential (CO_2)	411 274	415 849	4 575	1	10.1	66.7
1.A.4.a: Commercial/institutional (CO_2)	158 803	153 560	5 243	– 3	3.7	70.4
1.A.1.b: Petroleum refining (CO_2)	102 356	119 515	17 159	17	2.9	73.3
4.A.1: Cattle (CH_4)	126 412	113 520	– 12 892	– 10	2.8	76.0
4.D.1: Direct soil emissions (N_2O)	108 639	97 115	– 11 524	– 11	2.4	78.4
2.A.1: Cement production (CO_2)	80 657	79 359	– 1 298	– 2	1.9	80.3
6.A.1: Managed waste disposal on land (CH_4)	99 663	67 545	– 32 118	– 32	1.6	81.9
4.D.3: Indirect emissions (N_2O)	68 663	64 814	– 3 849	– 6	1.6	83.5
1.A.1.c: Manufacture of solid fuels and other energy industries (CO_2)	96 985	61 773	– 35 212	– 36	1.5	85.0
1.A.4.c: Agriculture/forestry/fisheries (CO_2)	66 920	60 649	– 6 271	– 9	1.5	86.5
2.F: Consumption of halocarbons and SF_6 (HFCs)	5 485	40 340	34 855	635	1.0	87.5
4.B.1: Cattle (CH_4)	42 539	36 062	– 6 477	– 15	0.9	88.3
2.B.2: Nitric acid production (N_2O)	36 048	27 535	– 8 513	– 24	0.7	89.0
4.B.8: Swine (CH_4)	26 191	27 250	1 059	4	0.7	89.7
4.D.2: Animal production (N_2O)	28 194	26 868	– 1 325	– 5	0.7	90.3
1.B.2.b: Natural gas (CH_4)	30 320	26 089	– 4 231	– 14	0.6	91.0
1.A.3.b: Road transportation (N_2O)	9 787	23 799	14 012	143	0.6	91.5
1.A.3.a: Civil aviation (CO_2)	18 921	23 468	4 548	24	0.6	92.1
1.A.3.d: Navigation (CO_2)	19 444	18 758	– 686	– 4	0.5	92.6
2.A.2: Lime production (CO_2)	16 768	16 418	– 350	– 2	0.4	93.0
1.B.1.a: Coal mining (CH_4)	49 220	16 223	– 32 997	– 67	0.4	93.3
4.A.3: Sheep (CH_4)	16 169	14 948	– 1 221	– 8	0.4	93.7
2.B.3: Adipic acid production (N_2O)	63 326	14 591	– 48 735	– 77	0.4	94.1
2.C.1: Iron and steel production (CO_2)	16 722	13 460	– 3 261	– 20	0.3	94.4
1.A.1.a: Public electricity and heat production (N_2O)	11 388	13 337	1 949	17	0.3	94.7
4.B.12: Solid storage and dry lot (N_2O)	12 866	12 243	– 623	– 5	0.3	95.0
2.B.1: Ammonia production (CO_2)	12 395	10 842	– 1 553	– 13	0.3	95.3
2.E: Production of halocarbons and F_6 (HFCs)	35 907	9 247	– 26 660	– 74	0.2	95.5
1.A.3.e: Other (CO_2)	11 410	9 076	– 2 333	– 20	0.2	95.7
6.A.2: Unmanaged waste disposal sites (CH_4)	11 061	7 449	– 3 613	– 33	0.2	95.9
1.A.5: Other (CO_2)	20 278	7 023	– 13 254	– 65	0.2	96.1
1.A.4.b: Residential (CH_4)	10 790	6 961	– 3 829	– 35	0.2	96.2
1.B.2.c: Venting and flaring (CO_2)	9 141	6 027	– 3 115	– 34	0.1	96.4
2.F: Consumption of halocarbons and SF_6 (SF_6)	10 320	5 947	– 4 373	– 42	0.1	96.5
1.A.4.b: Residential (N_2O)	6 418	5 425	– 993	– 15	0.1	96.7
1.A.3.c: Railways (CO_2)	8 290	5 373	– 2 917	– 35	0.1	96.8
6.B.2: Domestic and commercial wastewater (CH_4)	6 664	5 152	– 1 512	– 23	0.1	96.9
6.C: Waste incineration (CO_2)	5 687	4 557	– 1 131	– 20	0.1	97.0
4.B.13: Other (N_2O)	5 643	4 456	– 1 187	– 21	0.1	97.1
4.D.4: Other (N_2O)	4 292	3 853	– 439	– 10	0.1	97.2
2.C: Metal production (PFCs)	7 323	3 416	– 3 907	– 53	0.1	97.3
1.A.3.b: Road transportation (CH_4)	4 687	2 593	– 2 093	– 45	0.1	97.4
4.D: Agricultural soils (CO_2)	3 208	2 057	– 1 152	– 36	0.0	97.4
1.B.1.b: Solid fuel transformation (CO_2)	3 018	2 018	– 1 000	– 33	0.0	97.5
2.B.5: Other (N_2O)	4 394	1 707	– 2 687	– 61	0.0	97.5
2.G: Other (CO_2)	1 111	1 396	286	26	0.0	97.5
1.B.2.a: Oil (CH_4)	2 501	619	– 1 882	– 75	0.0	97.6
2.E: Production of halocarbons and SF_6 (PFCs)	3 354	258	– 3 095	– 92	0.0	97.6
2.E: Production of halocarbons and (SF_6)	2 389	0	– 2 389	– 100	0.0	97.6
6.D: Other waste (CO_2)	881	0	– 881	– 100	0.0	97.6

Climate Change Committee and the relevant working groups and is expected to be adopted in 2004 as annex to the implementing provisions under the new monitoring mechanism decision. The QA/QC plan will describe the annual procedures for QA/QC of the EC inventory, the responsibilities for their

performance and the time schedules when they are performed. The plan will be reviewed annually and modified or updated as appropriate.

Based on the discussions on the proposed QA/QC plan and based on the experience made in 2003, QA/QC activities were further extended for the 2004 submission. Table 1.5 shows that in 2004 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 : 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 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 of this report.

The consistency checks of Member States data primarily aim at identifying main problems in time series or subcategory sums. 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.

After the initial checks of the emission data, the ETC/ACC transfers the national data from the CRF tables into spreadsheets and into the ETC/ACC database on emissions of GHG and air pollutants. The version of the data received by ETC/ACC are numbered, in order to be traced back to their source. The ETC/ACC database is a relational database (MS Access) and maintained and managed by Umweltbundesamt Austria. 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 1.5).

Sector-specific QA/QC activities to improve the quality of the EC inventory are performed by Eurostat in the energy sector (see also Sections 3.4 and 3.7) and by the JRC in the sectors agriculture and LUCF (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, also the detailed analysis of GHG emission trends of the EC and each EC Member State after the submission of the EC inventory to the UNFCCC also contributes to improving the quality of the EC GHG inventory. This analysis is carried out in the annual

Table 1.5 QA/QC activities related to the EC inventory for the 2004 submission

Quality control activity	Check report/area	Checks
Initial checks of the submissions	Status report	Complete status report form for each Member State's submission
	Consistency and completeness report ([1])	1. Import checking routines in relation to completeness and consistency to check Member States' 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:
		(a) annual deviation in time series of ± 10 %;
		(b) deviations of time series of ± 50 % over the whole period;
		(c) check time series against previous submissions (document deviations ± 5 %);
		(d) check if previous year values are used.
		2. Check correctness of summing of subcategories.
		3. Check completeness of information in those CRF tables that are necessary for the compilation of the EC inventory.
		4. Check consistency between NIR and CRF in those parts that are necessary for the compilation of the EC inventory report.
		5. Check whether methodological and data changes resulting in recalculations of Member State data are documented appropriately in the CRF.
		6. Check consistency between Table 1.A and Table 10
		7. Document any further findings and procedures applied.
Checks during the preparation of the EC inventory	Preparation report (CRF and inventory report)	1. Check for transcription errors in data input from Member States' inventory data to EC inventory database and check of correctness of transcriptions between different intermediate data sheets.
		2. Check of correct calculations of summing of Member States' inventory data for all source categories and gases.
		3. Check whether emissions data are correctly aggregated from lower reporting levels to higher reporting levels when preparing summaries.
		4. Check whether units and conversion factors are correctly used at EC level and compared with Member States' inventories. 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.
		5. Check whether updates of inventory data from Member States are correctly included in the EC inventory and correctly documented and registered.
		6. Confirm that estimates are reported for all source categories and for all years from the appropriate base year to the period of the current inventory.
		7. Check that known data gaps that result in incomplete source category emission estimates are documented.
		8. Check that exact data sources are specified (e.g. are data taken from Table 1.A or Table 10).
		9. Check that any further findings and procedures applied are documented.
		10. Check the inventory report (layout, consistency, tables and figures, references, general format).
	Data file integrity	1. Use cell protection so that fixed data cannot accidentally be changed.
		2. If identical data are used by different source categories, the same electronic data file (whether obtained electronically or transcribed) should be used by both source categories.
		3. Build in computerised checks to highlight possible problems.
Documentation and archiving	Procedures documentation and archiving	The archives should be sufficiently complete that an informed analyst could obtain relevant data sources and spreadsheets, reproduce the inventory and review all decisions about assumptions and methodology that were made. It should also be possible to track changes in data and methodology over time.
		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:
		(a) an electronic and paper copy of the list of the full content of the documentation file for that year;
		(b) 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;
		(c) 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;

Quality control activity	Check report/area	Checks
		(d) 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;
		(e) all information and data received in the project file from each Member State should be placed in the documentation file;
		(f) all additional materials received and included in the project file should be placed in the documentation file;
		(g) copies of all checklist, reports, and forms that were completed as part of QC procedures.
		Adequate back-up routines should be in place for all electronic data.
	Checks documentation and archiving	1. Check whether all inventory data, supporting data, and inventory records are archived and stored appropriately in the database.
		2. Check whether internal documentation is consistent and complete, e.g. check that spreadsheets and references are consistently documented and procedures are consistently applied.
		3. Check whether bibliographical data references are properly cited and registered in the internal documentation.
Sector-specific QA/QC	Energy	1. Check that all formulas in the spreadsheet of the Eurostat reference approach are correct.
		2. Compare trend of Eurostat reference approach with latest Member States' reference approach.
		3. Compare trend of Eurostat reference approach with latest EC GHG inventory sectoral approach.
		4. Check that any further findings and procedures applied are documented.
	Agriculture	1. Check on the calculation of emissions in Table 4.D. 2. Checks on the consistency of total amount of nitrogen produced by livestock, distributed over the animal waste management systems, and used for documented purposes. 3. Check on the calculation of nitrogen used for estimating indirect emissions from atmospheric deposition.
	LUCF	1. General check of CRF Tables 5 and 5.A to 5.E for completeness and correctness. 2. Comparison of Table 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. Reporting of the results of the pilot project on harmonisation. 6. 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.

EC GHG trend and projections report (see EEA, 2003b); 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 1.6 gives an overview of QA/QC procedures in place at Member State level. The information is taken from the Member State national inventory reports 2003 and 2004.

1.6.3 Further improvement of the QA/QC procedures

The current QA/QC activities will be further developed in 2004. The EC inventory QA/QC plan is currently being discussed along with the preparation of the implementing provisions under the new monitoring

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

Member State	Description of the national QA/QC activities	Source
Austria	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 2004. The QMS contains all relevant features of the European Standard 45004:1995 General Criteria for the operation of various types of bodies performing inspections. The QMS ensures that all requirements of a Type A inspection body as stipulated in EN 45004 are met, including strict independence, impartiality and integrity of accredited bodies. During the year 2003 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 EN 45004 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. 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.	Austria's comment to final draft
Belgium	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. 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.	NIR 2004, p. 12
Denmark	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: • 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. Apart from the UNFCCC's in-depth-reviews, quality assurance (QA) with independent review of the inventories has not yet been carried out. A strategy for implementing a formal QA/QC plan is presented in the NIR 2004 (p. 18–25).	NIR 2004, p. 18
Finland	Development of quality systems: Statistics Finland as the designated single national entity will coordinate the QA/QC activities of the national greenhouse gas inventory from here onwards. The formal QA/QC plan was not prepared for the 2002 inventory, but it will be in use in the 2003 inventory as a part of the quality management system of the national greenhouse gas inventory. The quality management system under development will also include the QA/QC plans for the sectoral inventories of the expert institutes, documentation, archiving, review, verification and improvement procedures of the inventory. Statistics Finland will coordinate the project. Archiving of the inventory: At the moment the annually reported CRF tables are archived both at the Finnish Environment Institute and Statistics Finland. The method descriptions together with documents of the original data sources are archived at the Finnish Environment Institute. Verification: The inventory project in Statistics Finland develops inventory review methods and verification procedures in the context of general QA/QC functions.	NIR 2004, p. 14
France	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.	NIR 2004, p. 29
Germany	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). The QA/QC plan in the future will consist of the following elements: • 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. Each QA/QC plan will be valid for one year. 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.	NIR 2004, p. 31, and Appendix 6

Member State	Description of the national QA/QC activities	Source
Greece	An integrated quality assurance (QA) and quality control (QC) plan is not yet in place. However, the formulation of such a plan is under development and its implementation is expected to start in the 2005 submission. However, during the inventory preparation process, certain relevant procedures are followed, which concern: • the reliability check of the data used, through the comparison of relative information from different data sources; • the archiving of the emission factors used; • the comparison of CO_2 emission estimates from the energy sector calculated by the reference and the sectoral approach; • the assessment of the observed trends. Finally, the commenting of the national inventory report from the involved governmental agencies represents an additional quality control procedure.	NIR 2004, p. 14
Ireland	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.	NIR 2004, p. 8
Italy	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. Data entries are checked several times during the compilation of the inventory; special attention is paid to sources which show significant changes from a 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. 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. 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.	NIR 2003, p. 8
Luxem-bourg	—	-
Nether-lands	In 2001, a three-phase project was started to adapt the QA/QC system for use in the Netherlands greenhouse gas monitoring and NIR/CRF process. The first phase (finished in early 2002) included an assessment of the present situation as compared to the UNFCCC/IPCC requirements. The second phase involves the elaboration and description of relevant processes and procedures, including adaptation of the present situation. This work is interrelated with the elaboration of the protocols and is coordinated by NOVEM with involvement from the Ministry of VROM and the PER. The third phase comprises the formal and legal arrangements, needed for the structural embedding of the QA/QC procedures. This will be done in 2003/04, together with the legal embedding of the protocols in the PER.	NIR 2004, p.1–21
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
Spain	—	
Sweden	Sweden is currently working with the development of the quality-assurance procedures. These procedures are due to be fully implemented in 2005 at the earliest.	NIR 2004, p. 13

Member State	Description of the national QA/QC activities	Source
United Kingdom	The national atmospheric emissions inventory and the UK greenhouse gas inventory are compiled and maintained by the National Environmental Technology Centre 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. 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. 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. UK DEFRA is 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. 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.	NIR 2004, p. 12

mechanism decision and will be adopted in 2004. The activities in 2004 include:

- continuation of the comparison of national inventories for the sectors energy, LUCF and agriculture, with inventories prepared at EC level by Eurostat and the JRC;
- extension of the current and the development of new QC procedures according to the IPCC Tier 1 requirements (explore the further use of UNFCCC review results);
- development of a QA/QC-plan for the EC;
- preparation of a draft quality-management manual for the EC;
- organisation of a workshop on 'Quality control and quality assurance of greenhouse gas inventories and the establishment of national inventory systems'; the purpose of this workshop is to exchange experience between the Member States and the EC as many Member States are currently establishing their QA/QC procedures and inventory systems at national level and as the quality of the EC inventory crucially depends on the quality of Member States' inventories. In addition, the links between national and EC-wide QA/QC procedures and inventory systems will be discussed.
- organisation of a workshop on methodologies for estimating GHG emissions from international bunkers (see Section 3.7).

1.7 Uncertainty evaluation

Table 1.7 shows the results of a first, very simple approach to estimate the quality of the EC key sources ([10]). The approach is based on the quality estimates (high, medium, low) provided by the Member States in their CRF Table 7. The overview tables in Chapters 3 to 9 provide the qualitative uncertainty estimates of the Member States for each EC key source.

In order to obtain a single quality estimate for each EC key source, the quality estimates of the Member States were assigned quantitative values (1 for 'high', 2 for 'medium', 3 for 'low'). Then these values were multiplied by Member States' emissions, added up and divided by total EC emissions of the key source. Finally, the quantitative result of the EC

([10]) Note that several of these source categories are more aggregated than the EC key source categories identified in Section 1.5 because the qualitative uncertainty estimates in CRF Table 7 refer to more aggregated source categories.

Table 1.7 Uncertainty of GHG key source categories

Source category gas	2002	Quality estimate
1.A.1: Energy industries (CO_2)	1 146 183	H
1.A.3: Transport (CO_2)	841 230	H
1.A.4: Other sectors (CO_2)	630 058	H
2.G: Other (CO_2)	1 396	H
1.A.2: Manufacturing industries and construction (CO_2)	583 070	H
2.B: Chemical industry (CO_2)	11 394	H
2.C: Metal production (PFC)	3 416	H
2.A: Mineral products (CO_2)	107 570	H
2.C: Metal production (CO_2)	18 034	H
1.B.2: Oil and natural gas (CO_2)	16 791	H
1.A.5: Other (CO_2)	7 023	H
2.F: Consumption of halocarbons and SF6 (SF_6)	5 947	H
4.B: Manure management (CH_4)	66 371	M
2.E: Production of halocarbons and SF_6 (HFCs)	9 247	M
4.B: Manure management (N_2O)	18 433	M
4.A: Enteric fermentation (CH_4)	134 638	M
2.F: Consumption of halocarbons and SF_6 (HFCs)	40 340	M
1.B.2: Oil and natural gas (CH_4)	27 564	M
2.E: Production of halocarbons and SF_6 (PFCs)	258	M
2.E: Production of halocarbons and SF_6 (SF_6)	0	M
6.D: Other (CO_2)	0	M
2.B: Chemical industry (N_2O)	43 833	M
4.D: Agricultural soils (N_2O)	192 651	M
6.A: Solid waste disposal on land (CH_4)	77 105	M
1.B.1: Solid fuels (CO_2)	6 558	M
1.A.3: Transport (CH_4)	2 702	M
1.A.4: Other sectors (N_2O)	9 513	M
1.A.3: Transport (N_2O)	24 799	L
1.B.1: Solid fuels (CH_4)	18 389	L
6.B: Wastewater handling (CH_4)	7 476	L
1.A.4: Other sectors (CH_4)	7 685	L
6.C: Waste incineration (CO_2)	8 710	L
1.A.1: Energy industries (N_2O)	15 644	L
4.D: Agricultural soils (CO_2)	2 057	L

Note: Many of these source categories are more aggregated than the EC key source categories identified in Section 1.5 because the qualitative uncertainty estimates in CRF Table 7 refer to more aggregated source categories.

key source was assigned a qualitative estimate again (high: less than 1.5; medium: 1.5 to 2.5; low: more than 2.5).

It has to be noted that this approach assumes that Member States use the quality estimates 'high', 'medium' and 'low' in a consistent way both within their inventories and across Member States' inventories. This is not very likely, because there are no IPCC definitions for using these quality characterisations. Nevertheless the approach is believed to provide a first indication on quality of the EC key sources.

Table 1.7 shows that according to this approach 82 % of total EC GHG key source emission estimates in 2002 can be classified as being of high quality, 15 % of medium and 2 % of low quality. The key sources are ranked according to the quality estimates.

The good practice guidance requires parties to provide quantitative uncertainty estimates. Although several of the Member States already provide quantitative uncertainty analysis, the possibility of estimating uncertainty at EC level is limited for two reasons. Firstly, not all EC Member States provide uncertainty estimates for all source categories so that these uncertainties could be combined by using the Tier 1 or Tier 2 methods. Secondly, the EC Member States

Table 1.8 Overview of uncertainty estimates available from Member States (from Member States' national inventory reports 2003 and 2004)

Member State	Austria		Belgium		Denmark		Finland		France		Germany	
Citation	Austrian NIR 2004, p. 28–30		Belgian NIR 2004, p. 13		Danish NIR 2004 p. 25–27		Finnish NIR 2004 p. 16, Annex 3 (Tables A–D)		French NIR 2003 p. 30–31		German NIR 2004, p. 1, 32–35, Annex 7	
Method used	Tier 2		Tier 1		Tier 1		Tier 1, Tier 2		Tier 1		Tier 1	
Detailed documentation available in NIR (e.g. expert judgments according to Table 6.1 of GPG)	No		No		Yes: Table 1.2 (no reference to source information)		Yes: Annex 3		Yes: Annex 2 (no reference source information)		Yes: Annex [Anhang] 7 (no source information)	
Years and sectors included	1990, 1997 (from year 1999) — all sectors		Some attempts have been made at determining the uncertainty of CO_2 emissions from fossil fuel combustion in the Flemish region (Tier 1) and Wallonia (Tier 1).		1990, 2002 (from year 2004) — the uncertainty estimates include stationary combustion plants, mobile combustion, agriculture and fugitive emissions from fuels (93 % of total Danish GHG emissions)		1990, 2002 (from year 2004) — all sectors except agricultural soils and LULUCF		1990, 2002 (from year 2004) — all sources (key sources and 'others')		1990, 2002 (from 2004) — nearly complete estimation for Sources 1.A, 1.B.2, 2.A.1, 2.A.2, 2.C.1, 2.C.3	
Uncertainty (%)	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2
CO_2	—	2.3 %	—	—	2.0	—	—	– 4 to + 6 %	—	—	—	—
CH_4	—	48.3 %	—	—	15	—	—	± 25 %	—	—	—	—
N_2O	—	89.6 %	—	—	407	—	—	– 32 to + 45 %	—	—	—	—
F-gases	—	—	—	—	—	—	—	– 7 to + 18 %	—	—	—	—
Total	—	8.9 %	—	—	46	—	± 7 %	– 5 to + 6 %	22.1	—	—	—
Uncertainty in trend (%)	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2
CO_2	—	—	—	—	1.7	—	—	—	—	—	—	—
CH_4	—	—	—	—	6.3	—	—	—	—	—	—	—
N_2O	—	—	—	—	32	—	—	—	—	—	—	—
F-gases	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	19	—	± 6 %	± 5 %	3.5	—	—	—

Member State	**Greece**		**Ireland**		**Italy**		**Netherlands**		**Spain**		**Sweden**		**United Kingdom**	
Citation	Greek NIR 2004, p. 15–15, Table VI.I		Irish NIR 2004, p. 8–9, 14–15		Italian NIR 2003, Annex 1		Dutch NIR 2004, p. 1–24 to 1–29 and A-6		Spanish NIR 2004, p.44–53		Swedish NIR 2004, p. 14–15		UK NIR 2004 (draft) Annex 7, Table A7.4	
Method used	Tier 1		Tier 1		Tier 1		Tier 1		Tier 1		Tier 1		Tier 1, Tier 2	
Detailed documentation available in NIR (e.g. expert judgments according to Table 6.1 of GPG)	No		Yes: Table 1.4 (no reference source information)		Partially (Table A1.2): 'IPCC GHG and expert judgement has been used, standard deviations have also been considered whenever measurements were available'		Partially p. 1-26		Partially, p. 44-48		No		Yes: Annex 7 (no composite table on references included)	
Years and sectors included	1990, 2002 (from year 2004) — all sources		1990, 2002 (from year 2004) — all sources (key sources and 'others')		1990, 2001 (from year 2003) — all sources		1990, 2002 (from year 2004) — key sources and 'other' sources		1990. 2000, 2001 (from year 2004) — all sources (key sources and 'other emission sources')		1990, 2002 (from year 2004) — 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	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2
CO_2	3.7%	—	1.35	—	—	—	± 3 %	—	—	—	3.2	—	—	2.1
CH_4	34.5 %	—	3.39	—	—	—	± 25 %	—	—	—	1.8	—	—	13
N_2O	182.9 %	—	10.94	—	—	—	± 50 %	—	—	—	6.2	—	—	231
F-gases	67.9 %	—	0.16	—	—	—	HFCs ± 50 % PFCs ± 50 % SF_6 ± 50 %	—	—	—	0.3	—	—	HFC 25 PFCs 19 SF_6 13
Total	19.1 %	—	11.53	—	2.50 %	—	5 %	—	2000 ± 17.5 % 2001 ± 16.6 %	—	7.2	—	17.9	15
Uncertainty in trend (%)	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2
CO_2	—	—	2.19	—	—	—	3 %	—	—	—	—	—	—	—
CH_4	—	—	2.31	—	—	—	6 %	—	—	—	—	—	—	—
N_2O	—	—	6.83	—	—	—	11 %	—	—	—	—	—	—	—
F-gases	—	—	0.18	—	—	—	9 %	—	—	—	—	—	—	—
Total	—	—	7.53	—	2.30 %	—	4 %	—	2000 ± 2.2 % 2001 ± 2.5 %	—	—	—	2	—

provide their uncertainty estimates for different source categories at different levels of detail so that combining the uncertainties is difficult. However, the EC plans to provide quantitative uncertainty estimates in its 2005 submission. Table 1.8 gives an overview of information provided by Member States on uncertainty estimates in their national inventory reports 2003 or 2004 and presents summarised results of these estimates. The table includes information from 13 Member States. From the remaining two Member States, either a national inventory report was available, which did not include quantitative uncertainty analysis (Portugal), or no national inventory report was available at all (Luxembourg).

1.8 General assessment of the completeness

1.1.1 Completeness of Member States' submissions

The EC GHG inventory is compiled on the basis of the inventories of the 15 Member States. Therefore, the completeness of the EC inventory depends on the completeness of the Member States' submissions.

Table 1.9 summarises timeliness and completeness of the Member States' submissions on 30 April 2004. It shows that GHG inventories were submitted by all Member States. Thirteen Member States submitted all or almost all tables (i.e. more than 90 %) of the CRF tables for 1990–2002. The completeness of national submissions with regard

Table 1.9 Date of submissions (updates submitted), years covered and CRF tables available from Member States at 30 April 2004

Member State	Submission dates	Latest data available	Years covered	CRF tables (1)
Austria	30 Dec. 2003	2002	1990–2002	All
Austria	15 Mar. 2004	2002	1990–2002	All
Belgium	23 Dec. 2003	2002	1990–2002	All
Belgium	31 Mar. 2004	2002	1990–2002	All
Belgium	15 Apr. 2004	2002	1990–2002	All
Denmark	15 Jan. 2004	2002	1990–2002	All
Denmark	15 Mar. 2004	2002	1990–2002	All
Finland	17 Dec. 2003	2002	1990–2002	All
Finland	15 Mar. 2004	2002	1990–2002	All
France	22 Dec. 2003	2002	1990–2002	All
Germany	15 Jan. 2004	2002	1990–2002	Full CRF for 90–01; Trend Table 10 for 2002
Germany	30 Apr. 2004	2002	1990–2002	All
Greece	28 Jan. 2004	2002	2001–2002	All
Ireland	31 Dec. 2003	2002	1990–2002	Full CRF only for 2002
Ireland	27 Apr. 2004	2002	1990–2002	All
Italy	1 Apr. 2004	2002	1990–2002	Full CRF only for 2002
Italy	8 Apr. 2004	2002	1990–2002	All
Luxembourg	1 Apr. 2004	2002	1998, 2000, 2002	Sectoral report tables, Table 1A(a), Summary 1.A, Summary 3
Netherlands	16 Dec. 2003	2002	1990–2002	All
Netherlands	15 Mar. 2004	2002	1990–2002	All
Netherlands	31 Mar. 2004	2002	1990–2002	All
Portugal	31 Mar. 2004	2002	1990–2002	All
Portugal	6 Apr. 2004	2002	1990–2002	All
Portugal		2002	1990–2002	All
Spain	10 Feb. 2004	2002	1990–2002	All
Sweden	19 Dec. 2003	2002	1990–2002	All
Sweden	31 Mar. 2004	2002	1990–2002	All
United Kingdom	24 Dec. 2003	2002	1990–2002	All
United Kingdom	15 Jan. 2004	2002	1990–2002	All
United Kingdom	17 Mar. 2004	2002	1990–2002	All

(1) All = all or almost all (approx. more than 90 %) of the CRF tables (see Annex 3 for more details).

to individual CRF tables in the 2004 submission can be found in the status reports in Annex 3. In addition, Member State information on the completeness of their emission estimates at source level can be seen from Table 1.12 and Table 1.13 below and in the overview tables in Chapters 3 to 8 which are based on the CRF Table 7 of the Member States.

Table 1.10 shows the availability of Member States' national inventory reports or additional inventory information and a short characterisation of the 2004 report. The column 'Report structure 2004' indicates whether the Member States used the UNFCCC structure of national inventory report ([11]).

Table 1.11 compiles the characterisation of the 2003 NIRs of Member States as well as the findings from the individual review of Member States' inventories conducted by the UNFCCC Secretariat in 2003 and compares those findings with the NIRs submitted in 2004 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 1.10 National inventory reports or additional information available from Member States as by 15 May 2004

Member State	2003	2004	Report structure 2004 as in the revised UNFCCC reporting guidelines adopted by Decision 18/CP.8.2	Characterisation of the 2004 report
Austria	Umweltbundesamt (2003b)	Umweltbundesamt (2004a)	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 Health Protection (2003)	Directorate-General of the Environment (2004)	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, recalculations and inventory improvements.
Denmark	National Environmental Research Institute (2003)	National Environmental Research Institute (2004)	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, recalculations and inventory improvements. Uncertainty evaluation partly included.
Finland	Ministry of the Environment (2003a)	Ministry of the Environment (2004a)	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	Citepa (2002)	Citepa (2003)	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.

([11]) FCCC/CP/2002/8.

Member State	2003	2004	Report structure 2004 as in the revised UNFCCC reporting guidelines adopted by Decision 18/CP.8.2	Characterisation of the 2004 report
Germany	Federal Environmental Agency (2003)	Umweltbundesamt (2004b)	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, recalculations and inventory improvements.
Greece	—	National Observatory of Athens (2004)	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.
Ireland	Environmental Protection Agency (2003)	Environmental Protection Agency (2004)	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.
Italy	Romano, D., Contaldi, M., De Lauretis, R., Gaudioso, D. (2003)	—		
Luxembourg	—	—		
Netherlands	Olivier, J.G.J., Brandes, L.J., Peters, J.A.H.W., Coenen, P.W.H.G. and Vreuls H.H.J. (2003)	Klein Goldewijk, K., Olivier, J.G.J., Brandes, L.J., Peters, J.A.H.W., Coenen, P.W.H.G. and Vreuls H.H.J. (2004)	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.
Portugal	Ministerio das Cidades, Ordenamento do Territorio e Ambiente (2003)	—		
Spain	Ministry of the Environment (2003b)	Ministry of the Environment (2004b)	No	National inventory report including general information on the inventory, emission trends, sector and source-specific methodological information and data sources, key source analysis, uncertainty evaluation and recalculations.
Sweden	Swedish Environmental Protection Agency (2003)	Swedish Environmental Protection Agency (2004)	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	National Environmental Technology Centre (2003)	National Environmental Technology Centre (2004)	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.

Table 1.11 Characterisation of Member States' national inventory reports 2003 and changes in 2004

Member State	Characterisation of the report in the 2003 UNFCCC inventory review	Changes to report in 2004 in response to the review
Austria	**UNFCCC review report 2003:** The NIR provides very detailed descriptions of all methodologies used for inventory preparation as well as full and transparent descriptions of the overall national system of data collection and inventory preparation. In general, the quality of the Austrian inventory (both the CRF and the NIR) can be rated as very high. (FCCC/WEB/IRI(3)/2003/AUT, para. 6)	NIR continues with very detailed and transparent descriptions. Additions were included in areas where requested by the UNFCCC inventory review in 2003 and are transparently documented in Table 209.
Belgium	**UNFCCC status report 2003:** The NIR's structure follows the outline of the revised UNFCCC reporting guidelines adopted by Decision 18/CP.8. The report provides information on methodologies, activity data sources and emission factors for all source categories as well as information on recalculations, uncertainties, verification and QA/QC procedures, and a detailed analysis of the trends in emissions. A key source analysis is also included, as well as an assessment of the completeness of the inventory and information on planned improvements. **UNFCCC review report 2003:** The NIR is lacking in details about the activity data (AD) underlying the estimates, links to national statistical data and some national emission factors (EFs) used to calculate emissions (e.g. HFCs, PFCs and SF_6). Also it lacks details on which default IPCC EFs have been used. Moreover in many cases the methodological descriptions are not detailed enough. (FCCC/WEB/IRI(2)/2003/BEL para. 17)	Information about methodologies and emission factors improved and more detailed than in the previous NIR.
Denmark	**UNFCCC status report 2003:** The NIR provides summary information on methodologies used, recalculations, uncertainty and QA/QC. The appendices to the report contain emission factors for fuel combustion, a key source analysis, information on Greenland and the Faeroe Islands, emission trends for the years 1990–2001 adjusted for electricity exchange and inter-annual temperature variations, including a description of the methodology used for the adjustments. The NIR further provides a reference to a report that includes descriptions of the methodologies, and was provided as part of Denmark's 2000 inventory submission. **UNFCCC review report 2003:** The documentation in the NIR is not detailed enough to allow the ERT to fully assess the underlying assumptions and rationale for choices of activity data (AD), methods of estimation of emission factors (EFs) and other inventory parameters required to be reported in the CRF. The party's comments on the draft report clarified many of the aspects raised, and the ERT recommends that these explanations be included in the next NIR. A more detailed description of country-specific methods as well as the systematic use of notation keys would enhance the transparency of the inventory submission greatly. (FCCC/WEB/IRI(3)/2003/DNK, para. 8)	Description of methods considerably improved and clearer and more consistent structure of methodological descriptions. Methods, activity data and emission factors reported for source categories. Use of notation key improved.
Finland	**UNFCCC status report 2003:** The NIR's structure follows the outline of the revised UNFCCC reporting guidelines adopted by Decision 18/CP.8. The report provides information on methodologies, activity data sources and emission factors for all source categories as well as information on recalculations, uncertainties, verification and QA/QC procedures, and a detailed analysis of the trends in emissions. A key source analysis is also included, as well as an assessment of the completeness of the inventory and information on planned improvements. The NIR further provides a reference to a report entitled 'Greenhouse gas emissions and removals in Finland', which was part of Finland's 2001 submission, where the methodologies and calculation models, including information on uncertainty estimation and key sources (for 1999), are described in more detail. **UNFCCC review report 2003:** Transparency would be improved if the methodologies described in the separate report were integrated into the latest NIR. Specifically, a means of clarifying where new elements of a methodology have been implemented, EFs have changed, activity data (AD) have changed, recalculations have been performed, or where the methodology has remained unchanged would be helpful (e.g. a table listing each source and whether the methodology is included in the NIR, the previous methodology document, or both). The NIR (Section 1.4) provides some of this type of information but it is not always sufficiently transparent to make it possible readily to piece together the new and old aspects. (FCCC/WEB/IRI(3)/2003/FIN, para. 10)	Few structural changes as previous structure was already adequate. Some additions to previous NIR. Information on methodology, AD and EF of cement production was added. The report 'Greenhouse gas emissions and removals in Finland' from 2001 was not incorporated in NIR or updated.
France	**UNFCCC status report 2003:** The NIR provides summary information on the methodologies used for all sectors. It also includes information on uncertainties and key sources. **UNFCCC review report 2003:** The submission of CRF tables for 1990–2001 together with the NIR provides an acceptable level of transparency, although this could be improved in future submissions. Specifically, the use of notation keys in all CRF tables would improve transparency. The choice of methodology, the extent of the documentation, and the uncertainty analyses performed and documented in the NIR make the French submission transparent. (FCCC/WEB/IRI(3)/2003/FRA, para. 8)	Notation keys in CRF generally used in the same limited number of tables as in previous submissions with exception of Table 2(II).F where additional notation keys are used. New sections provided on completeness, QA/QC.

Member State	Characterisation of the report in the 2003 UNFCCC inventory review	Changes to report in 2004 in response to the review
Germany	**UNFCCC review report 2003:** The submission of an NIR for the first time has added greatly to the transparency of Germany's inventory reporting, but efforts to make the inventory more transparent where methods, recalculations and time-series consistency are concerned should continue. Documentation is essential to explain the methodological approaches and also to track changes made in response to findings from the review process. The ERT noted that the present NIR provides explanations of some of the issues raised in previous review reports, although more improvements are still needed. The party reports that priority for 2004 improvements will be given to efforts to make the inventory more transparent in the methods used in the energy sector and continuous improvement is in progress as part of the QC. (FCCC/WEB/IRI(3)/2003/DEU, para. 8)	Further improvements on description of methods, recalculations and time series consistency were achieved, however methodological descriptions in the NIR still do not in all parts clearly document methods or EF used. A number of CRF tables such as Table 9 on completeness or Table 8(b) explanations of recalculations have not been provided.
Greece	UNFCCC review not conducted as no NIR submitted.	First NIR provided.
Ireland	**UNFCCC status report 2003:** The NIR includes information on methods, activity data, emission factors for all source categories, as well as information on key sources, recalculations, QA/QC, trends, completeness and planned improvements. Calculations sheets are provided. The structure of the NIR is similar to the outline of the revised UNFCCC reporting guidelines adopted by Decision 18/CP.8. **UNFCCC review report 2003:** Overall, the level of transparency of Ireland's greenhouse gas (GHG) inventory is good and has shown significant improvement with the publication of the 2002 and 2003 NIRs. In line with the reporting guidelines, the NIR contains a general description of institutional arrangements, QA/QC procedures, uncertainty assessments, estimation methods, key source analysis, references to key source estimation methods, a summary of trends in emissions by gas, recalculations, and explanations of the differences between the reference and the sectoral approaches. In addition, the methodology, EFs, AD and measurements used in the Irish inventory are described in the report and calculation sheets for each sector and the energy balance sheets for 2001 are included in appendices to the NIR. The ERT notes that one area of particular importance that could be improved is that of documentation, especially with respect to the information that could be added to the NIR that would provide a more complete explanation, for example, for the choice of an EF, data source or model. (FCCC/WEB/IRI(2)/2003/IRL, para. 15 and para. 16)	Documentation of choice of an EF, data source or model are provided in the NIR. In general very transparent information on different parameters used in the estimation. More detailed information on some models is provided in appendices.
Italy	**UNFCCC review report 2003:** There have been some improvements over the previous year's submission, such as the inclusion of quantitative key source and uncertainty analyses in conformity with the IPCC good practice guidance. However, further work is needed to improve the transparency of the NIR as regards methods and emission factors (EFs) in some sectors. It is also important that in future CRF tables are provided for all years back to 1990 and that recalculations are documented in CRF Table 8 and in the NIR (para. 6). In general, the NIR is complete and transparent for the energy sector. Data sources for the key sources and choice of methodology tier are supplied in the NIR and are consistent with the IPCC good practice guidance. Complete CRF tables are lacking for the years 1990–2000 (para. 17). There is no additional information in the NIR as to the relationship between the energy sector and the industrial processes, solvent and other product use, and Waste sectors. The ERT recommends that more documentation be provided on this issue (para. 25). For the agriculture sector the NIR does not provide sufficient information on the methodologies and EFs to allow replication of the inventory or to assist the review. Significant improvements are required to the documentation of the methods in the NIR, and the additional information boxes should be completed (para. 46). The transparency of the country-specific methods in the waste sector could be improved in the NIR (para. 62). (FCCC/WEB/IRI(3)/2003/ITA)	Not yet provided.
Luxembourg	UNFCCC review not conducted as no NIR submitted.	Not yet provided.

Member State	Characterisation of the report in the 2003 UNFCCC inventory review	Changes to report in 2004 in response to the review
Netherlands	**UNFCCC status report 2003:** The NIR's structure follows the outline of the revised UNFCCC reporting guidelines adopted by Decision 18/CP.8. The report provides information on methodologies, activity data sources and emission factors for all source categories as well as information on recalculations, uncertainties, verification and QA/QC procedures, and a detailed analysis of the trends in emissions. A key source analysis is also included, as well as assessment of the completeness of the inventory and information on planned improvements. **UNFCCC review report 2003:** The information provided in the NIR is generally complete and well documented, usually with a high level of transparency; however, the sectoral sections of this report identify a number of areas where transparency needs to be further improved. The NIR includes appendices with additional information, as well as clearly noted website references for key supporting materials (para. 10) a Tier 2 bottom-up approach. Although the NIR provides a large amount of detail and analysis of the inventory, there are numerous gaps in the descriptions of methodology and data sources. Most notably, AD have not been provided at a disaggregated level. The Netherlands does not generally report emissions and fuel consumption at the subsector level. The ERT recommends to correct this (para. 27). The NIR contains information on different emissions reported under the category 'Other' in the CRF. The ERT recommends the Netherlands to present the information according to the CRF categories and in line with the IPCC good practice guidance (para. 73). References and online documentation on methodologies and country-specific EFs, as well as additional information in the CRF tables, are provided, enhancing transparency (para. 74). (FCCC/WEB/IRI(3)/2003/NLD)	In the 2004 NIR, all the items have been included which were observed as missing in the 2003 NIR submission (as far as they are available at the moment). The review reports make recommendations on the inclusion in the NIR of information provided in other Dutch reports cited. In general, this raises the question on how extensive the explanations in the NIR should be, given that the report needs to be submitted annually. In the 2004 NIR the Netherlands have added an annex with references to other reports 'that should be considered as part of the NIR', which are also publicly available through the Internet, as are the NIR and the corresponding CRF files. Use of category 'Other' to group existing IPCC categories: Some of the emissions figures in the Dutch inventory can not be allocated to the specific (industrial) activities as asked for in the CRF. This is especially the case for those figures not reported by individual firms. Furthermore some of the requested data originate in the Netherlands from one or two individual companies. In those cases the Netherlands prefer to include the emission under the category 'other' rather than to mark the emission as 'C' and provide no data. It is planned to improve the specific allocation of fuel combustion emissions in the next submission based on a total recalculation based on fuel statistics for the total time series. (NIR 2004, Section 10.4.6)
Portugal	UNFCCC review report 2003: The NIR and CRF are transparent and internally consistent. The information in the NIR is detailed enough and the choice of methodology sufficiently well documented to allow the ERT to reconstruct the inventory (para. 8). (FCCC/WEB/IRI(3)/2003/PRT)	Not yet provided.
Spain	**UNFCCC status report 2003:** The NIR provides information on general methodology, the inventory principles followed, recalculations, results and key source analysis, trends and comparison of the current inventory submission to the submission in the year 2002. UNFCCC review report 2003: The information received for this review, especially that contained in the methodological supplement, represents a notable improvement compared with previous years. Assumptions, methodologies, data sources, AD and EFs are mostly explained clearly in the methodological supplement (para. 25). The structure of the methodological supplement is based on SNAP codes. Although all underlying information has generally been provided with a great level of detail, together with relevant information on the SNAP nomenclature, this structure affects the transparency of the submission for the purposes of the UNFCCC review. The transparency and comprehensiveness of the NIR would be significantly improved if part of the information currently included in the methodological supplement were included in the actual NIR. It is expected that this problem will be overcome once Spain follows the structure for the NIR that is outlined in the revised UNFCCC reporting guidelines and once the NIR incorporates the methodological information that is currently in the supplement (para. 26). Although in general the information submitted facilitates replication and assessment of the inventory, in some categories more detailed explanations or additional information are necessary, for example, in relation to the sources of factors used in country-specific methods in the LUCF sector, or livestock characterisation in the agriculture sector. The ERT encourages Spain to further improve the transparency of its inventory (para. 27). During the presentations of the inventory, Spain provided additional explanations which are not included in the NIR. The ERT recommends Spain to incorporate some of those explanations in the NIR and its annexes for the benefit of future reviews, as indicated in the sectoral sections of this report (para. 30). (FCCC/WEB/IRI(2)/2003/ESP)	More methodological information provided in NIR 2004 than in previous year. Further review has to assess if the level of detail is appropriate. Structure of NIR as outlined in revised UNFCCC reporting guidelines not implemented (e.g. QA/QC not addressed).

Member State	Characterisation of the report in the 2003 UNFCCC inventory review	Changes to report in 2004 in response to the review
Sweden	**UNFCCC status report 2003:** The NIR contains a description of the methodologies used, activity data and emission factors, as well as information on uncertainties, QA/QC, differences to previous submissions, upcoming improvements and a key source analysis (level and trend assessment). UNFCCC review report 2003: The NIR includes descriptions of methodologies, underlying assumptions and EFs in a coherent manner for each sector. References to sources of data, however, are provided mostly in Swedish. The information provided in the CRF and the NIR is transparent with some exceptions as regards the methodologies used in the energy and industrial processes sectors (para. 10). The ERT recognises the continued improvement in the transparency and documentation of Sweden's NIR as compared to previous reviews. Continued attention should be given to documenting verification of country-specific values, particularly for key source categories (e.g. for industrial plant data). Inserting additional background information into the NIR source category sections would improve the transparency of the estimation methodologies, particularly where country-specific methods or factors are used (para. 11). The NIR states that a consortium, Swedish Environmental Emission Data (SMED), has developed an emissions database that stores emissions data and underlying data (see Section B of the introduction to the NIR). It is not clear to what extent this database is being used currently or how it is used. Additional documentation regarding the database would help to explain its use more transparently (para. 12). Because of the significant level of difference in the energy sector emission estimates between the reference and sectoral approaches (the reference approach was up to 10.6 % higher than the sectoral approach), additional explanatory information should be provided in the NIR to provide a more transparent accounting of the differences (para. 13). (FCCC/WEB/IRI(3)/2003/SWE)	Methodological information and background information in the NIR was expanded. More information on differences between reference approach and sectoral approach is provided. Information on the emissions database and its use was added to the NIR.
United Kingdom	**UNFCCC status report 2003:** The NIR contains information on the methodologies and emission factors used, including methodological changes to the inventory for each IPCC sector. It further provides information on emission trends, uncertainty and key source analysis, description of the QA/QC system and verification activities and references to the sources of information. **UNFCCC review report 2003:** Overall, the information provided in the CRF and NIR is transparent. The use of notation keys is appropriate and the information provided in the documentation boxes of the CRF increases the transparency of the inventory. The exceptions are that descriptions for the key source and uncertainty analysis could be improved and clearer documentation could be provided (para. 11). (FCCC/WEB/IRI(3)/2003/UK)	Detailed description of uncertainty assessment provided in the annex to NIR. Values for level and trend assessment of key sources not included as requested (however partly included in uncertainty assessment).

Table 1.12 provides an overview regarding incomplete estimation of source categories and completeness of geographical coverage 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 1.12 Overview of completeness as reported by Member States in CRF Table 9 and in the 2004 NIR

Member State	Summary of information on completeness in Member States' NIRs and CRF Table 9 (NE)
Austria	**Completeness by emission sources:** CRF 1.B.2a: CO_2 and CH_4 emissions assumed to be negligible. CRF 1.B.4: Carbide production: CH_4 emissions not estimated as neither default EF nor CS EF exists. CRF 2.B.5: CH_4 emissions from carbon black, methanol, ethylene included in the NMVOC estimate. CRF 5.A.2c: C stock changes of plantations not included as considered negligible. CRF 5.A.2d, 5.B.5: Emissions/removals from other wooded lands not estimated as not data available. CRF 5.A.4, 5.B.4: Emissions from grassland not estimated as not data available. CRF 5.C.4: Emissions/removals from abandonment of managed lands and re-growth by grasslands not estimated and considered as minor. CRF 5.D: No measured data available for C stock changes in soils. Compared to the 2003 submission, where 90 subcategories were indicated as 'not estimated', the number of 'not estimated' categories decreased to 75 in the 2004 submission. The number of emissions estimates 'included elsewhere' decreased from 61 to 48. Subcategories were considered at the most disaggregated level available. Overall transparency increased from 93 % to 95 %, overall completeness from 93 to 95 %. This was accomplished by both advanced completeness of the inventory and the proper use of notation keys. **Completeness by geographical coverage:** Complete territory covered.
Belgium	**Completeness by geographical coverage:** For some sectors, the emissions are calculated for one region only. Work is going on (i.e. sectoral meetings described in Section 1.5) to identify the areas where the completeness of the inventory should be improved, taking into account the specific socioeconomic conditions of the three regions. **Completeness by emission sources:** The CO_2 emissions and removals from soils (LUCF or agriculture) has not been estimated so far. In Belgium, the ongoing research projects bring together a multidisciplinary team of researchers to develop a modelling framework capable of calculating greenhouse gas inventories for terrestrial ecosystems in Belgium, by addressing these fluxes for individual landscape units or areas. The results of these projects will eventually be used to assess the CO_2 emissions and removals from soils, taking into account the IPCC good practice guidance (10) on LULUCF which is being drawn up.
Denmark	**Completeness by emission sources:** The Danish greenhouse gas emission inventory due 15 April 2004 includes all sources identified by the revised IPPC guidelines except the following (see Table A5.1): CRF 6.B: Wastewater handling systems are considered to produce only minor emissions of CO_2, CH_4 and N_2O but it will be investigated further. Industrial processes: CO_2 emission from sugar production and production of expanded clay will be included in the next submission. Also CO_2 emissions from use of coke in iron foundries will be included in the next submission. Agriculture: The methane conversion factor for poultry and fur farming is not estimated. There is no default value recommended in IPCC (Table A-4 in GPG). The CH_4 emissions from manure storage in the field and from cultivation of organic soil are not estimated.
Finland	**Completeness by emission sources:** CRF 1.B.2: Fugitive emissions from oil and natural gas: emissions of CO_2, CH_4 and N_2O are estimated to be nearly zero (negligible). This has to be rechecked in the future inventories. CRF 1: International bunkers/lubricants: emissions of CO_2, CH_4 and N_2O are estimated to be nearly zero (negligible). This has to be rechecked in the future inventories. CRF 2.A, B, D: Emissions from industrial processes: CO_2 emissions from some source categories are estimated to be nearly zero (negligible). This has to be rechecked in the future inventories. CRF 3.A,B,D: No compound specific data of NMVOC emissions available for conversion to CO_2. CRF 4: Field burning of agricultural residues is occasional and small scale, thus these emissions are estimated negligible and not reported. Nitrogen fraction of certain vegetable and fruit crops will be estimated and included in the calculations in future together with the improved evaluation of the areas of mineral and organic soils. CRF 6: Other (composting): emissions of CH_4 and N_2O are estimated to be nearly zero (negligible). **Completeness by geographical coverage:** 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.ymparisto.fi/eng/environ/state/air/emis/ghg/ghg.htm by the end of March 2004.
France	**Completeness by emission sources:** CRF 1.A.3a: Civil aviation CH_4 and N_2O emissions not estimated as considered negligible. CRF 1.A.3d: Civil aviation CH_4 emissions not estimated as considered negligible. **Completeness by geographical coverage:** France's main territory and overseas departments included (Guadeloupe, Martinique, Guyana, Réunion) as well as Saint-Pierre and Miquelon, Mayotte and overseas territories (New Caledonia, French Polynesia, Wallis and Futuna). Some French territories that have almost no inhabitants were excluded (Southern Lands, French Antarctiques).

Member State	Summary of information on completeness in Member States' NIRs and CRF Table 9 (NE)
Germany	**Completeness by emission sources:** CRF Table 9 completeness not provided. According to information from CRF Table 7 the following source categories were **not estimated**. CRF 1.B.1.2: Oil and natural gas: CO_2 and N_2O emissions not estimated. CRF 2.C: Metal production: N_2O emissions not estimated, CH_4 only partly estimated. CRF 3: Solvent and other product use: CO_2 emissions not estimated. CRF 4.D: Agricultural soils: CO_2 emissions not estimated, CH_4 emissions only partly estimated. CRF 5.B: Forest and grassland conversion: CO_2 emissions not estimated, CH_4 and N_2O reported as not occurring. CRF 5.C: Abandonment of managed lands: CO_2 emissions not estimated. CRF 6.D: Other waste: Emissions not estimated. Memo items: Multilateral operations and CO_2 from biomass not estimated. Industrial processes: CRF 2.A.3 limestone and dolomite use; 2.A.4 soda ash production and use; 2.A.5 asphalt and 2.C.2 ferroalloys production are not estimated. No data are available and the emissions are considered as negligible. Further assessment is needed regarding the complete coverage of blast-furnace gas, refinery gas as well as the energy use of CH_4 from coal mines.
Greece	**Completeness by emission sources:** CRF 1.A.3.b: Road transport — natural gas: CH_4 and N_2O emissions due to lack of background information and EF. CRF 1.B.1.a (ii): Surface mines: CO_2 emissions not estimated due to insufficient data. CRF 1.B.1.b: Solid fuel transformation: CO_2 and CH_4 emissions not estimated due to lack of background information and methodological approach. CRF 1.B.2.a (iii): Oil transport: CO_2 emissions not estimated due to lack of activity data. CRF 1.B.2.b (i): Gas production processing: CO_2 emissions not estimated due to methodological consistency within source category. CRF 1.B.2.b (ii): Gas transmission/distribution: CO_2 emissions not estimated due to lack of activity data. CRF 1.B.2.c (i),(ii): Flaring: CO_2 emissions not estimated due to insufficient data, CH_4 emissions not estimated for gas flaring. CRF 1.B.2.d: Other: CO_2, CH_4 and N_2O emissions not estimated due to lack of background information and methodological approach. CRF 2.A.5, 2.A.6: Asphalt roofing, road-paving: CO_2 emissions not estimated due to lack of activity data. CRF 2.B.1: Ammonia production: CO_2 emissions not estimated due to lack of activity data. CRF 2.C.2: Ferroalloys production: CO_2 emissions not estimated due to lack of activity data. CRF 2.C.4: SF_6 emissions from aluminium foundries: SF_6 emissions not estimated due to lack of activity data. CRF 2.F(a): Consumption of halocarbons and SF_6: HFC and PFC emissions not estimated except for refrigeration due to lack of activity data. CRF 3 A,B,C: N_2O emissions not estimated due to lack of data. CRF 4.A.9: Poultry: CH_4 emissions not estimated due to lack of EF. CRF 4.D: Agricultural soils: CH_4 emissions not estimated due to lack of method. CRF 5.A: Temperate plantation: CO_2 removals not estimated due to lack of activity data. CRF 5.B: Grasslands: CO_2 emissions/removals not estimated due to lack of activity data. CRF 5.C: Abandonment of managed lands: CO_2 emissions/removals not estimated due to lack of activity data. CRF 5.D: Cultivation of mineral soils: CO_2 emissions/removals not estimated due to insufficient data. CRF 6.B: Wastewater handling: CH_4 emissions not estimated and industrial sludge due to insufficient data. CRF 6.C: Waste incineration: CO_2 and CH_4 emissions not estimated due to insufficient data. No estimates of potential emissions have been calculated for fluorinated gases (HFCs, PFCs, SF_6).
Ireland	CRF 5.B., 5.C, 5.D: The inventory time-series for 1990–2002 extends the updated and improved estimates of the carbon emissions and removals under 5.A: Changes in forest and other woody biomass stocks. No other estimates of emissions or removals are reported under land-use change and forestry, except the CO_2 emissions arising from the liming of agricultural lands. The CO_2 fluxes involved may be very large and any estimates based on the current simplified IPCC methodologies and default input values for these source categories could add significantly to the overall uncertainty in the inventory. For this reason, Ireland has deferred the inclusion of estimates for these source categories until the results of major national research in this area become available for inventory purposes. The research should establish the crucial items of background data, such as the national carbon stocks in soil and biomass and the factors affecting these stocks over time, to allow for a reasonably robust application of the IPCC methods under Irish circumstances. CRF 6.B: Wastewater handling: The inclusion of an estimate of the N_2O emissions arising from 6.B: Wastewater handling is one element of the recalculations completed for the 2002 submission. The emissions of CH_4 from this source and the emissions of greenhouse gases associated with 6.C Waste incineration are considered to be negligible in Ireland.
Italy	CRF 6: Waste incineration: Emissions from biogenic, plastics and other non-biogenic waste not estimated. CRF 3.D: Other: Not estimated.
Luxembourg	Not yet provided.
Netherlands	The Netherlands greenhouse gas emission inventory presently includes all sources identified by the revised IPCC guidelines except for the following. CRF 4.D: Agricultural soils: CO_2 emissions not estimated are not estimated/reported due to historical reasons, CH_4 emissions from soils deceased in last 40 years due to drainage and lowering of water tables; these emissions have been included in the natural total; thus no net (i.e. positive) anthropogenic emissions, on the contrary, this acts in fact a methane sink; indirect N_2O emissions from atmospheric deposition are not estimated/reported due to historical reasons. CRF 4.B: Manure management: CH_4 and N_2O from manure of horses is missing because no manure production estimates from horses have been made to date and no emission factors for this source category have been defined. CRF 5.A to 5.E: Emissions/sinks for LUCF subcategories not estimated, except for the CO_2 sink in Category 5.A.2. New data sets are being compiled but are still under discussion, so no data for these subcategories have been included in this submission. CRF 6B: CH_4 and N_2O emissions from industrial wastewater treatment. CRF 6.D: Other: CH_4 and N_2O emissions from large-scale compost production from organic waste are not estimated.
Portugal	Not yet provided.

Member State	Summary of information on completeness in Member States' NIRs and CRF Table 9 (NE)
Spain	CRF 5.B, 5.C, 5.D: Emissions/removals not estimated, only CO_2 removals by sinks from 5.A 'Changes in forests and other woody biomass stocks' were estimated due to lack of reliable basic data. No estimates of potential emissions have been calculated for fluorinated gases (HFCs, PFCs, SF_6).
Sweden	**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. Emissions from industries with less than 10 employees are not covered. These emissions are small, approximately 0.2 % of all emissions from fuel combustion in Sweden. CRF 1.A.5: Other: for biomass CH_4 and N_2O emissions not estimated due to lack of data. CRF 1.A.3b: Road transport: for biomass and natural gas CH_4 and N_2O emissions not estimated due to lack of EF. CRF 1.C: Emissions from multilateral operations not estimated due to lack of data. CRF 1.B.2: CO_2 emissions not estimated due to lack of data. **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 usually small emissions. The possible incompleteness from these sectors concerns NMVOC emissions. The completeness is considered to be good for all greenhouse gases, possibly with the exception of CH_4, for a few sources. CRF 2.B.1: Ammonia production: CO_2 and CH_4 emissions not estimated due to lack of data. CRF 2.C: Metal production: N_2O emissions not estimated due to lack of data. CRF 2.C.2: Ferroalloys production: CH_4 emissions not estimated due to lack of data. CRF 2.C.3: Aluminium production: CH_4 emissions not estimated due to lack of data. CRF 2.C.5: Other metal production: CH_4 emissions not estimated due to lack of data. CRF 2.D.2: Food and drink: CO_2 emissions not estimated due to lack of data. CRF 2.F: Consumption of halocarbons and SF_6: destroyed amounts of HFCs and PFCs not estimated. **Solvent and product use:** 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. **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. 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. CRF 4.A.9: Poultry: CH_4 emissions not estimated due to lack of data, considered as negligible. **Land use change and forestry:** Carbon from all relevant land use classes except trees in urban areas are 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. CH_4 emissions not estimated due to lack of data. **Waste:** The completeness of data on construction and demolition waste cannot be estimated objectively. There are parts of the generated construction and demolition waste that we currently know little about.
United Kingdom	CRF 1.B.1: Fugitive emissions energy: CH_4 from closed coal mines not estimated because IPCC methodology not available; research under way to enable inclusion. CRF 2.A.5, 2.A.6: Asphalt roofing/road-paving: CO_2 emissions not estimated as no methodology available. CRF 2.B.1: Ammonia production: CH_4 emissions not estimated as manufacturers do not report emission and considered as negligible. CRF 2.C.1: Iron and steel: CH_4 emissions only estimated for EAF and flaring, as no methodology available for other sources. CRF 2.C.2: Ferroalloys production: CH_4 emissions not estimated as no methodology available. CRF 2.C.3: Aluminium production: CH_4 emissions not estimated as no methodology available. CRF 3: CO_2 equivalent of solvent use not included in total, but provided for information. CRF 3.D: Other: Anaesthesia: N_2O emissions not estimated as no activity data available and considered negligible. CRF 5.C: Abandonment of managed lands: CO_2 emissions/removals not estimated as considered as negligible. CRF 6.B.1: Wastewater handling: CH_4 emissions from industrial wastewater not estimated as no activity data available and considered negligible.

Table 1.13 gives a very broad indication of incomplete source categories. However, a large number of the source categories 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 1.13). 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 1.13 indicates if Member States introduced changes to their NIRs regarding the completeness issues addressed during the review in 2003.

1.1.2 Data gaps and gap-filling

The EC GHG inventory is compiled by using the inventory submissions of

Table 1.13 Completeness of Member States' inventories as indicated in UNFCCC review reports and responses in 2004

Member State, type and year of UNFCCC review	Findings related to completeness from UNFCCC review report	Response in 2004 submission
Austria, centralised review 2003	Austria submitted GHG inventories for the years 1990–2001 using the CRF, accompanied by a very comprehensive NIR, which includes all information prescribed by the UNFCCC guidelines. The geographic coverage is complete. All major sources and sinks are covered; no other sources specific to Austria have been identified. Where emissions or removals are not reported, explanations are provided in the NIR and the CRF (para. 7). **Industrial processes:** Regarding completeness, Austria reports that not all sources are reported yet. Apart from the studies the party has announced on CO_2 from limestone and dolomite use, from production and use of soda ash and from carbide production, the ERT encourages the party also to conduct a survey of CO_2 from ferroalloys, CH_4 from iron and steel production (including coke production) and SF_6 from manufacture of electrical equipment (para. 30). **Agriculture:** The reporting of emissions in the CRF for the agriculture sector is complete (para. 42). **LUCF:** The CRF tables report 2 000 hectares of plantations but no growth rate or removals are estimated. The ERT recommends that the party estimate removals from this source for the sake of completeness (para. 55). **Waste:** The reporting of the waste sector is complete and covers emissions from all source categories (para. 60). FCCC/WEB/IRI(3)/2003/AUT	**Industrial processes:** Addition of source categories: 2.A.3: CO_2 emissions from limestone and dolomite use. 2.A.4: CO_2 emissions from soda ash use. 2.B.4: CO_2 emissions from calcium carbide production. 2.A.7: CO_2 emissions from bricks production. 2.C.3: CO_2 emissions from aluminium production. 2.C.1: CO_2 emissions from electric arc furnaces. 2.B.5: CH_4 emissions from production of fertilisers. **LUCF**: Growth rates and removals for plantations are provided in CRF Table 5.A, the issue is considered in the improvement plan.
Belgium, in-country review 2003	The inventory for the years 2000 and 2001 are fairly complete, with the exception of a few sources (asphalt-roofing, road-paving and food industries) in the industrial processes, land-use change and forestry (LUCF) and waste sectors. Some sectoral background data tables have not been provided (1.B.1, 1.B.2, 1.C, 2(I).A–G, 2(II).C,E, 2(II).F, 3.A–D, 4.B(b), 4.D, 4.E, 4.F, 5.B, 5.C, 6.A, 6.B and 6.C); and Summary 3, 7 (incomplete), 8 (b) and Table 9, which essentially provide transparency and completeness of the inventory, are not filled in. Notation keys are used, but in some sectoral background data tables they are used in a limited way. For previous years (1990–99) sectoral background data tables are not filled in. Biomass consumption is reported only partially from 1990 to 2000. **Energy:** In Table 1.A(a), emissions of CH_4 and N_2O from some manufacturing industries and construction subsectors are missing. In Tables 1.B.1 and 1.B.2 data on fugitive emissions are also missing. In Table 1.C background data for international bunkers and multilateral operations are also missing (para. 36). **Industrial processes:** The CRF includes all gases, except PFCs. CO_2 emissions from limestone and dolomite use, soda ash production and use, asphalt-roofing, road-paving with asphalt and food and drink were reported as '0.00' (para. 73). **Agriculture:** In the category manure management, CH_4 emissions from cattle are not reported at disaggregated level. N_2O emissions from manure management are not reported at disaggregated level. CH_4 and N_2O emissions from agricultural soils are not reported at disaggregated level (para. 103). FCCC/WEB/IRI(2)/2003/BEL	The following sectoral background data tables have been provided in the 2004 submission: 1.B.1, 1.B.2, 1.C, 2(I).A–G, 4.B(b), 4.D, 4.E, 4.F, 6.A, 6.B and 6.C. Sectoral background data tables for previous years were provided. PFC emissions from 2.E.1 estimated. CH_4 emissions from cattle are reported at disaggregated level. N_2O emissions from manure management are reported at disaggregated level. N_2O emissions from agricultural soils are reported at disaggregated level
Denmark, centralised review 2003	All years 1990–2001, all gases, all sectors and all source/sink categories are covered in the 2003 inventory submission. Denmark has included initial GHG inventory data for Greenland and the Faeroe Islands in its NIR, but these data are not yet included in the CRFs. There are no significant gaps identified in the CRF and the time series (para. 7). Some sectoral background tables are not filled in (para. 3). **Industrial processes:** To improve the completeness and transparency of the inventory the ERT recommends that some emission sources that are not as yet covered should be covered (e.g. ammonia production — CO_2 and nitric acid production —N_2O). The ERT encourages Denmark to indicate clearly whether some emission sources are occurring or not (e.g. iron and steel production, aluminium production) using the appropriate notation keys and to provide the data for those emission sources that do occur in Denmark (para. 38). **Agriculture:** The submission is almost complete in terms of gases, sources and years covered. Goats will be included for the next submission. CRF Tables 4.C, 4.E and 4.F were not filled in as they are not applicable for the party (para. 46). **LUCF:** The CRF tables for the LUCF sector are not filled in completely; in many cases cells are left blank. The ERT recommends that for future reporting Denmark fill in the CRF tables more comprehensively and use the notation keys not estimated ('NE') or not occurring ('NO') as necessary. The party could also provide data for emissions that most likely do occur in Denmark although they are not reported, for example, emissions of CO_2 from soils due to agricultural practices (para. 61). **Waste:** The inventory is practically complete in terms of gases, sources and years covered. CH_4 and N_2O emissions from wastewater handling are not estimated (para. 57). FCCC/WEB/IRI(3)/2003/DNK	General improvement of the use of notation keys. Emissions from nitric acid production provided, ammonia production NO estimates for goats provided, notation keys used in Tables 5.A and 5.B. For the further plans in the agriculture sector one of the highest priority plans is to include CO_2 from agricultural soils. The review team had to question wastewater-handling system as regards CH_4 and N_2O emissions. The plan is to analyse this in order to estimate and document the CH_4 and N_2O emissions, which especially for CH_4 is believed to be of only minor importance.
Finland, centralised review 2003	The NIR and the CRF recognise categories that are not estimated, with the statement that future work will look at whether the missing categories are responsible for any emissions and thus would need to be included in the inventory. Notable among the missing sources are fugitive venting emissions (CH_4, CO_2) and fugitive flaring emissions (CH_4, CO_2 and N_2O) from the oil and natural gas category in the energy sector. This category typically can be a relatively significant CH_4 source where gas is produced in substantial quantities; however, this is not the case in Finland. Other sources stated as not estimated include: CO_2, CH_4 and N_2O from lubricants used in international marine bunkers; CO_2 from the industrial processes categories for limestone usage (2.A.3), soda ash production (2.A.4), and asphalt-roofing and paving (2.A.5); and CH_4 and N_2O emissions from waste-composting. In all these cases, Finland estimates that emissions are nearly zero but that further studies are needed. Overall, the inventory is generally complete and the missing categories do not suggest any major gaps in coverage at this point (para. 11). FCCC/WEB/IRI(3)/2003/FIN	Omissions remain in 2004 inventory submission as before but were regarded as minor by the 2003 inventory review.

Member State, type and year of UNFCCC review	Findings related to completeness from UNFCCC review report	Response in 2004 submission
France, centralised review 2003	France's inventory is by and large complete, covering all major source and sink categories. However, some sectoral background data in Table 4.E: Prescribed burning of savannas and Table 5.C are not provided. Tables 1.A(b) and 1.A(d) (reference approach) are only provided for the years 1990 and 1999–2001, Tables 5.A and 5.B are not provided for the years 1998–99, and Table 5.D is not provided for the years 1991–99. Notation keys are used in a limited way in the tables (para. 7). FCCC/WEB/IRI(3)/2003/FRA	Tables 1.A(b) and 1.A.(d) provided for 1998. Tables 5.A, 5.B. and 5.D provided for entire time series.
Germany, centralised review 2003	The ERT noted that the inventory is complete in terms of coverage of gases and source/sink categories. However, there are some gaps in the CRF: data for Table 8 (recalculations) and Table 9 (completeness) are missing for the whole time series, and Tables 1.A(b) and 1.A(d) are missing for the years 2000 and 2001. With regard to the latter tables, the NIR explains that there is a two-year backlog (para. 7) of work on the German energy balance. The party reports that this issue will be addressed in the 2004 NIR (para. 7). **Energy:** Fugitive emissions from venting and flaring have not been estimated (para. 25 and para. 29). CO_2 and N_2O emission estimates from fugitive emissions are incomplete and reported as 'not estimated' ('NE'). **Industrial processes:** The ERT observed that reporting in this sector is not complete. There are gaps in the CRF; and notation keys are often not used and sometimes have been used incorrectly. Germany does not estimate CO_2 emissions from iron and steel production in the industrial processes sector of the inventory, and has used the notation key 'NE' in the CRF (para. 31). **LUCF:** Changes in forest and other woody biomass stocks: Non-CO_2 gases are not reported for this category (para. 53). 5B, 5C, 5D: No numerical estimates are provided for any of these categories (para. 54). FCCC/WEB/IRI(3)/2003/DEU	Estimates for 5.D provided, other issues remain to be addressed.
Greece	Not reviewed in 2003 as no NIR was provided.	
Ireland, in-country review 2003	The NIR provides a general assessment of completeness and notes a few sources for which estimates of emissions are not included, for instance, in the land-use change and forestry (LUCF) sector, where estimates of emissions and removals are reported only for Category 5.A and the liming of soils in Category 5.D. In addition, the ERT noted a few other areas for which information was lacking or estimates had not been made. These included estimates of emissions from wastewater handling, which were not available, and estimates of emissions of SF_6, HFCs and PFCs for the period 1990–94, which were not provided in the NIR or the CRF. However, the ERT was informed that emissions for those years and sources were assumed to be negligible. Table 9 of the CRF, completeness, had not been filled in. With these exceptions, the inventory covered all major sources and sinks, as well as all direct and indirect gases, identified in the IPCC and UNFCCC reporting guidelines (para. 14). **Energy:** With a few exceptions, the CRF includes estimates of most gases and sources of emissions from the energy sector, as recommended by the IPCC guidelines. In the fugitive emissions subsector, emissions of CO_2 and CH_4 from natural gas distribution are estimated, but emissions from oil and from natural gas exploration, leakage, venting and flaring are reported as 'NO'. Emissions of N_2O are also not reported (para. 37). Non-CO_2 emissions from marine bunkers are not reported in the CRF (para. 45). No information on some fuels (i.e., bitumen, lubricants, white spirit, refinery feedstocks) has been provided in Table 1.A(d). It is unclear in the inventory whether these fuels have been used for non-energy purposes but have not been accounted for in the inventory. The IEA data indicate non-energy use of these fuels in Ireland. In the comments to the draft version of this report, Ireland confirmed that these products are not produced in the country. Nevertheless, Ireland agreed that it may be reasonably assumed that these fuels are used in Ireland and the problem therefore lies in the lack of completeness with respect to the energy balance (para. 46).	CRF Table 9 is provided. CH_4 emission from manure management from poultry and swine estimated for 2002. N_2O emissions from wastewater are included in the 2004 inventory. NIR states that although very few of the report's recommendations could be implemented in reporting for 2002, a recalculation exercise soon to be undertaken will take account of as many specific inventory issues as possible.
	Industrial processes: It should be noted that Ireland reports several sources within the sector as 'NE'. These include CO_2 emissions from steel production, limestone and dolomite use, soda ash production and use, asphalt-roofing and road-paving with asphalt (para. 67). **Agriculture:** The CRF includes estimates of most gases and sources of emissions from the agriculture sector, as identified by the IPCC guidelines. Not included are: CH_4 emissions from manure management from non-cattle livestock species, and N_2O emissions from organic soils (para. 89). **LUCF:** Estimates of emissions and removals have not been made for categories 5.B: Forest and grassland conversion or 5.C Abandonment of managed lands, and have only been partially made for 5.D CO_2 emissions and removals from soil. The CRF only includes estimates of emissions and removals of CO_2. The other gases were not estimated. In the CRF, Ireland has used notation keys that indicate that a number of sources and sinks are 'NE', while other cells contain values of zero (para. 111). FCCC/WEB/IRI(2)/2003/IRL	
Italy, centralised review 2003	The inventory covers the major source and sink categories for both direct and indirect GHGs included in the IPCC guidelines. However, Italy has not provided potential emissions for PFCs. Tables 5.B and 8(a) are also not filled in. CH_4 emissions from waste incineration and N_2O emissions from solvent and other product use are not estimated (NE). Italy has not estimated emissions from limestone and dolomite use, and has not submitted complete CRF tables for the years 1990–2000 (para. 7). Recalculation tables have not been completed even though there are a number of changes to data and methods, for example: the revision of preliminary figures in the national energy (para. 20). **Agriculture:** Emissions for 2001 are reported in the CRF tables and are mostly complete. There are some gaps in Table 4.B (b) where no notation keys are used (para. 45). **LUCF:** Reporting in the 2001 CRF is not complete since some tables have not been filled in and notation keys have generally not been used. Non-CO_2 emissions, which may be of a significant magnitude, are also not reported (para. 55). FCCC/WEB/IRI(3)/2003/ITA	Table 8(a) provided emissions from limestone and dolomite use estimated. Non-CO_2 emissions from forest fires estimated.
Luxembourg	Not reviewed in 2003 as not NIR provided.	

Member State, type and year of UNFCCC review	Findings related to completeness from UNFCCC review report	Response in 2004 submission
Netherlands, centralised review 2003	The majority of the major source/sink categories and direct and indirect GHGs are reported in the inventory. The exceptions are two potentially significant subcategories in the agricultural soils category (N_2O emissions from crop residues and indirect N_2O from atmospheric deposition) and Categories 5.B to 5.D of the LUCF sector. The Netherlands informed the ERT about its plans to improve and expand its methodology for N_2O from 4.D agricultural soils to include those not reported sources (para. 9). **Energy:** No CH_4 or N_2O emissions are reported for solid fuels from 1.A.1.a: Energy industries — Public electricity and heat production in some years (para. 34). **LUCF:** Emissions and/or removals from Categories 5.B to 5.E have not been estimated ('NE' is reported) because the available data sets are inadequate (para. 67). Emissions of non-CO_2 gases for this sector (LUCF) have not been estimated ('NE' is reported) but no explanation is provided in Table 9 of the CRF (para. 68). **Waste:** However, the sources are not standardised, the time series for CO_2 is incomplete (in particular data for 1991–94 are missing) and data for 2001 are provisional. Plans to include CH_4 and N_2O emissions from large-scale composting are included (para. 72). N_2O emissions from industrial wastewater have not been estimated (reported as 'NE'), while emissions from domestic and commercial wastewater are stated to be included under the category 'Other' (reported as 'included elsewhere' ('IE')) (para. 77). FCCC/WEB/IRI(3)/2003/NLD	Not (yet) addressed.
Portugal, centralised review 2003	The inventory covers the major emission sources. Portugal provides inventory data from 1990 to 2001. Tables 5.B (Forest and grassland conversion), 5.C (Abandonment of managed lands) and 5.D (CO_2 emissions and removals from soils) have not been completed. Emissions of N_2O from Solvent and Other Product Use and fluorinated gases from use in fire extinguishers and semiconductor industries are not estimated (para. 7). **Industrial processes:** CO_2 emissions from asphalt-roofing are not estimated (para. 34). **LUCF:** Within subcategory 5.A, only removals due to forest growth and emissions due to wood harvest are reported; Non-CO_2 emissions, which may be of a significant magnitude, are not reported at all in the LUCF sector; emissions and removals occurring in the autonomous territories of Madeira and the Azores are not reported (para. 56). FCCC/WEB/IRI(3)/2003/PRT	Not (yet) addressed.
Spain, in-country review 2003	In general, the inventory covers all years, gases and sectors, and most of the source categories, and is complete with regard to geographical coverage. However, the estimation of emissions and removals in the LUCF sector is incomplete, and Categories 5.B: Forest and grassland conversion, 5.C: Abandonment of managed lands, and 5.D: CO_2 emissions and removals from soil have not been estimated. The inclusion of Categories 5.B and 5.D in particular could have a significant impact on the inventory total (including LUCF). Non-CO_2 emissions from anthropogenic forest fires are also not reported. In the energy sector, emissions from military energy use are not estimated and it is unclear if military fuel consumption is included in the AD used. In the industrial processes sector, potential emissions for fluorinated gases (F-gases) are not estimated (because the required data are lacking), nor are emissions from limestone and dolomite use (only partial information is available), asphalt-roofing and road-paving (no CO_2 EF is available), or methane (CH_4) emissions from ethylene and styrene production. In addition, some minor subcategories are not estimated ('NE'), as explained in the sectoral sections of this report. The ERT recommends Spain to estimate emissions from the source categories that are not yet estimated as soon as possible, in particular those categories that contribute to the total emissions and that may not be negligible (para. 23). **Energy:** It is not clear if the volume of combustion of waste fuels included in the energy sector is complete as waste fuels are not included in the energy balance and emissions from industrial waste were not included in the waste sector. The inventory does not estimate emissions from some source categories, for example, CO_2 emissions from 1.B.1.a: Coal mining and handling, and in Category 1.B.2: Emissions from venting and exploration, and part of gas flaring (exploration and production), because of a lack of data for some sub-sources and because emissions are considered as minor (para. 58). The inventory agency receives responses to questionnaires with plant-specific energy and emissions data from large point sources. Coverage is not, however, complete for some industrial sectors, including the chemical and iron and steel industries (only integrated steel plants are covered). The inventory agency should try to achieve more complete coverage also in those sectors where it is incomplete (para. 59). **Industrial processes:** Moreover, CRF Table 9 has not been filled in with information on sources not estimated. Spain is encouraged to provide emissions for the sources not estimated, to complete Table 9, and to make use of notation keys, as appropriate. In particular, Spain is encouraged to develop a country-specific approach to collecting AD for the estimation of potential emissions of HFCs, PFCs and SF_6, to estimate emissions from semiconductor manufacture, and to improve the estimation of HFCs, PFCs and SF_6 from refrigeration (para. 104). **LUCF:** Spain indicated that the non-reporting under 5.B and 5.C is due to the fact that the relevant estimates are included in Category 5.A. Spain does not report emissions of non-CO_2 greenhouse gases, except nitrogen oxide (NO_x) emissions from soils (para. 140). **Waste:** However, estimates for N_2O from wastewater handling only include emissions from human sewage; emissions from industrial and commercial wastewater are not included because IPCC methodologies for these sources are not available (para. 153). FCCC/WEB/IRI(2)/2003/ESP	Not (yet) addressed.

Member State, type and year of UNFCCC review	Findings related to completeness from UNFCCC review report	Response in 2004 submission
Sweden, centralised review 2003	Sweden has provided a complete CRF for the period 1990–2001 with all required tables, which appear to have been completed in a comparable and complete manner. All major source/sink categories and direct and indirect GHGs are reported in the inventory. Mainly because of limited availability of data (CRF Table 9), emissions from the following source/sink categories are not reported in the 2003 submission: CO_2 emissions from some categories in industrial processes (chemical industry, asphalt-roofing, road-paving with asphalt) and LUCF (abandonment of managed land, emissions and removals from soil, forest and grassland conversion); CH_4 emissions from some categories in industrial processes (metal production) and solvent and other product use (N_2O from aerosol cans); and potential HFC, PFC and SF_6 emissions from industrial processes (para. 8). **Agriculture**: CH_4 emissions from poultry are reported as 'NE', although AD (17 850 000 heads) are provided. For purposes of completeness, Sweden is encouraged to estimate CH_4 emissions from poultry (para. 63). FCCC/WEB/IRI(3)/2003/SWE	Potential emissions estimated at aggregate level.
United Kingdom, centralised review 2003	All major source/sink categories and direct and indirect GHGs are reported in the inventory. The UK's NIR generally adheres to the UNFCCC reporting guidelines. The annexes to the NIR include detailed descriptions of methodologies, underlying assumptions and EFs in a coherent manner for each sector. References to sources of the underlying activity data (AD) are sufficiently provided. A file on the fuel combustion data used in the inventory is also included (para. 10). The emissions estimates for the sector are complete with the exception of CO_2 emissions from 2.A.5: Asphalt-roofing and 2.A.6: Road-paving with asphalt. CH_4 emissions from 2.B.1: Ammonia production, 2.C.2: Ferroalloys production and 2.C.3: Aluminium production are also not reported. Different reasons are given for these gaps, ranging from the fact that the emission sources are negligible to lack of methodology (para. 47). FCCC/WEB/IRI(3)/2003/UK	Not required.

the 15 Member States. For data gaps in Member States' inventory submissions (CRF Table Summary 1.A or sectoral emission tables), the following procedure is applied by the ETC/ACC in accordance with the implementing provisions under Council Decision No 280/2004/EC for missing emission data.

- If a consistent time series of reported estimates for the relevant source category is available from the Member State for previous years that has not been subject to adjustments under Article 5.2 of the Kyoto Protocol, extrapolation of this time series is used to obtain the emission estimate. As far as CO_2 emissions from the energy sector are concerned, extrapolation of emissions should be based on the percentage change of Eurostat CO_2 emission estimates if appropriate.
- If the estimate for the relevant source category was subject to adjustments under Article 5.2 of the Kyoto Protocol in previous years and the Member State has not submitted a revised estimate, the basic adjustment method used by the expert review team as provided in the 'Technical guidance on methodologies for adjustments under Article 5.2 of the Kyoto Protocol' ([12]) 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.

Table 1.14 shows that data gaps exist for Greece, Ireland and Luxembourg.

For Greece, the SF_6 gaps were not filled, because emission data was not available for any of the years 1990–2002. For Ireland, for fluorinated gases 1995 emissions were used for 1990–94.

For Luxembourg the following gap-filling procedures have been applied.

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

Table 1.14 Overview of data gaps

Member State	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
Greece						1990–2002
Ireland				1990–94	1990–94	1990–94
Luxem-bourg	Summary 1.A for 1991–93 ([1]); Tables 1, 2(I), 3, 4, 5, 6 for 1990–97; 1999; 2001	Summary 1.A for 1991–93; Tables 1, 2(I), 3, 4, 5, 6 for 1990–97; 1999; 2001	Summary 1.A for 1991–93; Tables 1, 2(I), 3, 4, 5, 6 for 1990–97; 1999; 2001	1990–97; 1999	1990–97; 1999	1990–97; 1999

([1]) Total CO_2 emissions for 1991–93 are available for Luxembourg but without sector and category split.

- Table Summary 1.A for 1991–93 were estimated on the basis of the 1990 table. For CH_4 and N_2O 1990 emissions were used for 1991–93, for CO_2 the 1990 sector and category split was extrapolated by the percentage change of total CO_2 emissions for 1991–93, which is available from Luxembourg.
- The Sectoral Tables 1, 2(I), 3, 4, 5, 6 for the years 1990–97, 1999, 2001 were estimated by applying the detailed category split (percentage shares) of 1998 (reported by Luxembourg) to the years 1990–97 and 1999, and the detailed category split (percentage shares) of 2000 to the year 2001.
- For fluorinated gases 1998 emissions were used for 1990–97 and 1999.

Table 1.15 shows the data gap-filling for Ireland and Luxembourg at national total. For more details see Annexes 4–10, which include the Summary 1.A and sectoral emissions tables with the gap-filled data in red.

In addition for Luxembourg, CO_2 emissions from fuels sold in Luxembourg but burned abroad (fuel tourism) were added to the Source Category 1.A.3.b 'Road transport' for the years 1990–97, 1999 and 2001 in order to obtain a consistent time series. Luxembourg's 2004 submission

Table 1.15 Data gap-filling for Ireland and Luxembourg at national total level (Gg of CO_2 equivalents)

Ireland						
	1990	**1991**	**1992**	**1993**	**1994**	**1995**
HFC	21	21	21	21	21	21
PFC	75	75	75	75	75	75
SF_6	83	83	83	83	83	83

Luxembourg				
	Most recent previous year reported	**Data-gap filling for years:**		
	1990	**1991**	**1992**	**1993**
CH_4	498	498	498	498
N_2O	208	208	208	208
Total CO_2 emissions without LUCF as reported by Luxembourg	12 007	12 160	11 953	12 303
Percentage change applied to CO_2 emissions at sectoral and source category level		– 4.2 %	– 5.7 %	– 2.8 %

	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
HFC	43	43	43	43	43	43	43	43	43	43
PFC	0	0	0	0	0	0	0	0	0	0
SF_6	4	4	4	4	4	4	4	4	4	4

Note: Values are shaded for emission estimates derived by gap-filling.

(covering the years 1998, 2000, 2002) includes these emissions in national totals for the first time; until 2003, these emissions were not included in the national totals, but reported separately.

1.8.3 Data basis of the European Community greenhouse gas inventory

The 2004 EC GHG inventory data consist of:

- the GHG submissions of the Member States to the Commission in 2004;
- 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.

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
Austria	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04
Belgium	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04
Denmark	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04
Finland	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04
France	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04
Germany	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04
Greece	Inv03	Inv03	Inv03	Inv03	Inv03	Inv03	Inv03	Inv03	Inv03	Inv03	Inv03	Inv04	Inv04
Ireland	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04
Italy	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04
Luxembourg	Inv00	Gap-filling	Gap-filling	Gap-filling	Inv97	Inv98	Inv98	Inv00	Inv04	Inv01	Inv04	Inv03	Inv04
Netherlands	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04
Portugal	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04
Spain	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04
Sweden	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04
United Kingdom	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04	Inv04

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.

Table 1.17 Data basis of CO_2 emissions excluding LUCF (Tg)

EC Member State	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Austria	60.9	64.5	59.1	59.3	59.7	62.5	66.1	65.7	65.8	64.3	65.1	69.0	69.7
Belgium	118.3	122.2	121.1	119.8	123.7	125.1	129.6	123.3	128.7	123.8	125.6	125.5	126.6
Denmark	52.7	63.4	57.5	59.9	63.9	61.1	74.5	65.2	60.2	57.4	52.8	54.5	54.2
Finland	62.5	61.1	58.7	59.2	65.5	62.7	68.1	66.8	64.6	64.1	62.3	67.7	69.5
France	396.1	420.4	412.7	392.7	388.2	394.8	408.7	402.7	423.9	411.2	406.8	411.5	406.0
Germany	1 015.6	977.5	929.9	920.2	906.1	901.5	923.8	892.4	884.5	857.3	860.3	874.3	864.1
Greece	84.3	84.2	85.8	85.8	87.5	87.6	90.2	94.7	99.4	98.6	103.7	105.5	105.5
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
Italy	431.2	431.3	429.8	424.0	416.6	446.6	439.6	444.2	455.8	460.1	462.1	469.5	469.0
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
Netherlands	160.6	167.7	166.4	168.5	169.5	173.2	181.6	166.2	172.4	167.3	170.7	177.1	176.7
Portugal	44.1	46.0	50.1	48.5	49.8	53.5	50.6	53.5	57.9	64.4	63.8	64.4	67.5
Spain	224.8	231.3	239.4	230.2	241.3	251.9	240.6	260.1	268.8	295.3	306.8	308.3	325.4
Sweden	55.8	56.3	56.1	55.7	58.4	57.5	60.8	56.4	57.3	54.5	52.4	53.2	54.8
United Kingdom	584.0	587.6	573.2	559.4	556.0	547.6	567.4	543.1	545.9	537.6	542.6	556.0	537.4
EU-15	**3 334.7**	**3 358.1**	**3 284.8**	**3 228.2**	**3 232.2**	**3 269.7**	**3 347.1**	**3 281.2**	**3 333.1**	**3 306.4**	**3 328.2**	**3 392.2**	**3 382.3**

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 has been taken from Member States' submissions in previous years. Shaded values derive from gap-filling. 'NE' ('not estimated') indicates that data is not available and that no gap-filling has been made.

Table 1.18 Data basis of CH_4 emissions in CO_2 equivalents (Tg)

EC Member State	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Austria	9.4	9.3	9.1	9.0	8.9	8.8	8.6	8.3	8.2	8.0	7.8	7.7	7.5
Belgium	10.9	10.9	10.8	10.7	10.8	10.9	10.7	10.6	10.5	10.2	9.8	9.4	9.1
Denmark	5.4	5.5	5.6	5.7	5.8	5.9	6.0	5.9	5.9	5.8	5.7	5.8	5.6
Finland	6.3	6.3	6.2	6.2	6.1	6.1	6.1	6.0	5.8	5.7	5.4	5.4	5.1
France	69.4	69.8	69.5	69.7	69.4	69.9	69.4	66.1	65.6	64.6	64.4	63.3	61.8
Germany	141.6	130.5	125.8	122.3	117.5	111.0	106.5	103.0	97.6	94.1	88.4	84.8	83.3
Greece	8.7	8.7	9.0	9.1	9.4	9.5	9.8	9.9	10.4	10.4	10.9	11.2	11.4
Ireland	11.9	12.2	12.3	12.4	12.5	12.6	12.8	13.0	13.0	12.9	12.8	12.6	12.8
Italy	37.2	37.7	36.1	35.8	36.3	36.7	36.5	36.6	36.0	35.5	35.5	35.4	34.3
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
Netherlands	27.3	27.8	26.9	26.5	25.9	25.0	24.8	23.2	22.4	21.4	20.3	19.9	18.7
Portugal	8.4	8.8	8.3	8.0	8.2	8.6	8.4	8.4	8.8	9.0	8.6	8.2	8.4
Spain	30.2	30.5	31.6	32.0	33.0	33.7	35.4	36.4	37.7	38.1	39.3	40.3	41.1
Sweden	6.7	6.6	6.7	6.8	6.7	6.6	6.6	6.5	6.3	6.1	5.9	5.9	5.7
United Kingdom	76.9	75.9	74.3	71.3	64.9	64.3	62.8	59.6	56.4	52.6	48.8	46.0	44.1
EU-15	**451.0**	**441.2**	**432.7**	**426.0**	**416.0**	**410.1**	**404.9**	**394.0**	**385.1**	**374.8**	**364.1**	**356.3**	**349.4**

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 has been taken from Member States' submissions in previous years. Shaded values derive from gap-filling. 'NE' ('not estimated') indicates that data is not available and that no gap-filling has been made.

Table 1.19 Data basis of N_2O emissions in CO_2 equivalents (Tg)

EC Member State	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Austria	6.0	6.6	5.7	6.2	6.8	6.4	6.1	6.4	6.2	6.1	6.1	6.0	5.7
Belgium	13.2	13.2	12.8	13.1	13.6	14.0	14.4	14.1	14.4	13.2	13.0	13.0	12.9
Denmark	10.6	10.5	10.0	9.8	9.7	9.6	9.3	9.2	9.1	8.8	8.5	8.3	8.0
Finland	7.9	7.4	6.9	7.0	7.1	7.4	7.4	7.6	7.5	7.3	6.8	6.8	6.8
France	89.4	89.3	88.0	86.5	87.7	89.4	90.8	91.3	84.2	78.5	76.2	75.2	72.5
Germany	81.4	77.9	79.1	75.9	72.2	73.5	75.1	72.6	59.4	55.7	55.8	56.1	55.8
Greece	10.6	10.5	10.5	10.1	10.3	9.9	10.3	10.6	10.6	10.4	11.0	14.4	14.3
Ireland	9.5	9.6	9.6	9.7	9.9	10.1	10.3	10.4	10.6	10.8	10.8	10.4	9.7
Italy	38.2	39.6	39.0	39.3	38.6	39.7	39.3	40.5	40.3	41.2	41.5	42.6	42.2
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
Netherlands	16.4	16.7	17.6	18.4	18.0	18.1	17.8	17.7	17.5	17.3	16.6	15.8	15.3
Portugal	5.8	5.8	5.5	5.3	5.5	5.7	5.8	5.7	5.8	6.2	5.9	6.0	6.1
Spain	26.3	26.0	25.3	23.4	25.6	25.3	27.6	27.0	27.7	29.0	30.3	29.1	28.8
Sweden	9.1	9.0	8.9	9.0	9.2	9.0	9.1	9.1	9.1	8.6	8.5	8.4	8.4
United Kingdom	67.9	65.9	59.1	55.4	59.7	57.0	59.1	60.8	58.1	45.0	44.8	42.5	41.0
EU-15	**392.5**	**388.2**	**378.3**	**369.4**	**374.2**	**375.2**	**382.8**	**383.4**	**360.6**	**338.3**	**335.8**	**334.8**	**327.6**

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 has been taken from Member States' submissions in previous years. Shaded values derive from gap-filling. 'NE' ('not estimated') indicates that data is not available and that no gap-filling has been made.

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 has been taken from Member States' submissions in previous years. Shaded values derive from gap-filling. 'NE' ('not estimated') indicates that data is not available and that no gap-filling has been made.

1.8.4 Geographical coverage of the European Community inventory

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

Table 1.20 Data basis of actual HFCs, PFCs and SF_6 emissions in CO_2 equivalents (Gg)

Member State		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Austria	HFCs	4	6	9	12	17	546	625	718	816	870	1 033	1 033	1 033
	PFCs	963	974	576	48	54	16	15	18	21	25	25	25	25
	SF_6	518	683	725	823	1 033	1 175	1 246	1 148	955	730	677	677	677
Belgium	HFCs	255	255	255	255	255	255	387	550	703	796	979	1 209	1 505
	PFCs	1 753	1 678	1 830	1 759	2 113	2 335	2 217	1 211	669	348	361	228	108
	SF_6	1 663	1 576	1 744	1 677	2 035	2 205	2 120	531	270	120	109	105	94
Denmark	HFCs	0	0	3	94	135	218	329	324	411	503	605	647	672
	PFCs	0	0	0	0	0	1	2	4	9	12	18	22	22
	SF_6	44	64	89	101	122	107	61	73	59	65	59	30	22
Finland	HFCs	0	0	0	0	7	29	77	168	245	319	502	657	463
	PFCs	0	0	0	0	0	0	0	0	0	28	22	20	13
	SF_6	94	67	37	34	35	69	72	76	53	52	51	55	51
France	HFCs	3 628	4 189	3 611	2 253	1 547	1 995	3 324	4 287	4 674	5 866	6 774	8 210	9 944
	PFCs	3 458	2 811	2 527	2 328	2 037	1 275	1 303	1 399	1 578	1 830	1 545	1 249	1 614
	SF_6	2 195	2 220	2 247	2 274	2 301	2 329	2 353	2 267	2 160	1 880	1 858	1 725	1 567
Germany	HFCs	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
	PFCs	2 696	2 356	2 138	2 012	1 627	1 759	1 723	1 377	1 481	1 247	790	723	786
	SF_6	3 896	4 350	4 876	5 401	5 808	6 633	6 359	6 274	6 038	4 414	4 018	3 325	3 781
Greece	HFCs	935	1 107	908	1 638	2 209	3 369	3 916	4 194	4 053	4 156	4 281	3 845	3 999
	PFCs	258	258	252	153	94	83	72	165	204	132	148	91	88
	SF_6	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Ireland	HFCs	21	21	21	21	21	21	58	79	104	152	190	231	253
	PFCs	75	75	75	75	75	75	103	131	62	196	305	297	207
	SF_6	83	83	83	83	83	83	101	132	91	63	52	67	71
Italy	HFCs	351	355	359	355	482	671	605	1 218	2 351	3 049	4 098	5 560	7 106
	PFCs	1 808	1 423	799	631	355	337	243	252	270	258	346	452	414
	SF_6	333	356	358	370	416	601	683	729	605	405	493	795	760
Luxem-bourg	HFCs	43	43	43	43	43	43	43	43	43	43	43	43	43
	PFCs	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
Nether-lands	HFCs	4 432	3 452	4 447	4 998	6 487	6 018	7 676	8 307	9 360	4 922	3 879	1 507	1 572
	PFCs	2 416	2 419	2 079	2 095	1 864	1 836	2 014	2 164	1 738	1 471	1 578	1 482	1 200
	SF_6	217	134	143	150	191	301	312	345	329	317	335	356	344
Portugal	HFCs	0	0	0	0	0	0	0	1	6	12	24	37	49
	PFCs	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
Spain	HFCs	2 403	2 179	2 763	2 258	3 458	4 645	5 197	6 126	5 809	7 164	8 171	5 288	3 896
	PFCs	828	787	782	794	785	790	759	784	750	696	405	229	257
	SF_6	56	61	64	67	76	94	101	122	141	185	211	212	239
Sweden	HFCs	4	7	10	31	72	127	178	271	302	351	373	372	386
	PFCs	440	427	414	402	390	391	351	324	309	329	270	267	301
	SF_6	83	86	85	91	101	121	110	155	91	92	78	100	94
United Kingdom	HFCs	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
	PFCs	1 394	1 164	571	485	481	457	496	450	441	446	541	438	384
	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
Total	**HFCs**	**26 960**	**27 015**	**28 428**	**29 909**	**33 918**	**39 789**	**44 903**	**51 822**	**53 125**	**46 315**	**46 663**	**46 495**	**49 587**
	PFCs	**16 090**	**14 373**	**12 042**	**10 782**	**9 874**	**9 355**	**9 299**	**8 280**	**7 532**	**7 018**	**6 355**	**5 523**	**5 420**
	SF_6	**10 268**	**10 815**	**11 630**	**12 294**	**13 440**	**15 018**	**14 845**	**13 135**	**12 111**	**9 805**	**9 804**	**8 916**	**9 304**

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 has been taken from Member States' submissions in previous years. Shaded values derive from gap-filling. 'NE' ('not estimated') indicates that data is not available and that no gap-filling has been made.

the EC inventory covers the same geographical area as the inventories of the Member States.

1.8.5 Completeness of the European Community submission

CRF tables

This year the EC CRF inventory includes all sectoral emission tables, i.e. Tables 1, 2(I), 3, 4, 5 and 6 for 1990–2002. It also includes the energy background data Table 1.A(a) for 1998, 2000 and 2002. The reason for the limited number of years for Table 1.A(a) is that data for the missing years are not available for all Member States. From 2005 onwards the EC intends to report the activity data for Table 1A(a) for the complete time series.

Apart from Table 1.A(a) the sectoral background data tables are not filled in at EU level because the availability and the type of activity data used by the

Table 1.21 Geographical coverage of the EC inventory

Member State	Geographical coverage
Austria	Austria
Belgium	Belgium
Denmark	Denmark (excluding Greenland and the Faeroe Islands)
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
Ireland	Ireland
Italy	Italy
Luxembourg	Luxembourg
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
Portugal	Portugal, Madeira, Azores
Spain	Spanish part of Iberian mainland, Canary Islands, Balearic Islands, Ceuta and Melilla
Sweden	Sweden
United Kingdom	England, Scotland, Wales, Northern Ireland

Member States may vary. The reason for this is that the purpose of these tables is to document the background activity data used to calculate the emissions at Member States level and the actual background activity data used to compile the emission estimates might be country-specific, as the methods applied might be country-specific. For example some Member States document 'clinker production' in Table 2(I).A-G, because they use this data for the calculation of the emissions from cement production; other Member States use 'cement production'. Therefore, the EC currently does not see the possibility of providing the sectoral background activity data tables except for Table 1.A(a), where the CRF defines the energy activity data to be reported more strictly (fuel consumption in TJ). Note that sectoral activity data are available 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 11, which is available at the EEA website http://www.eea.eu.int). In addition, the EC explores the possibility for providing those activity data in future inventory reports, which are crucial for understanding the emission trends.

This submission includes the reference approach tables for 1990–2001, but not for 2002. The reason for this is that the Eurostat NewCronos database does not have the relevant data available for the previous year but one before 15 April.

Inventory report 2004

In the review report of the EC greenhouse gas inventory submitted in 2003 (FCCC/WEB/IRI(3)/2003/EUC), the expert review team recommends that the EC increases the transparency of its submission by, *inter alia*, including more trend analysis in the report. In the 2004 inventory report, the EC tries to improve on this, but the scope of this analysis is still limited because the EC receives several Member States' inventory submissions rather late, after the inventory submission due date of 15 April. Therefore, this report focuses on trend analysis of gases and sectors and of large EC key sources. More detailed analysis on the EC GHG emission trends will be provided in the EEA report 'Analysis of greenhouse gas emission trends and projections in Europe 2004'. The focus of providing overview information with regard to methodologies, emission factors, completeness and qualitative uncertainty for the EC key sources only, is also due to these time restrictions.

2 European Community greenhouse gas emission trends

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

2.1 Aggregated greenhouse gas emissions

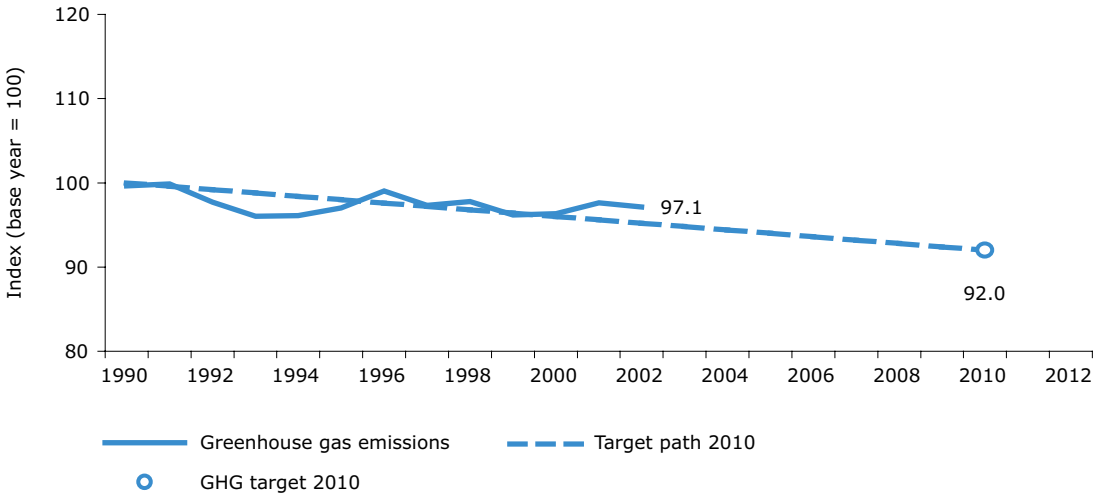
Total GHG emissions without LUCF in the EC decreased by 2.9 % between the base year and 2002. In the Kyoto Protocol, the EC agreed to reduce its GHG emissions by 8 % by 2008–12, from base year levels. Assuming a linear target path from 1990 to 2010, total EC GHG emissions were 1.9 index points above this target path in 2002 (Figure 2.1).

2.2 Emission trends by gas

Table 2.1 gives an overview of the main trends in EC GHG emissions and removals for 1990–2002.

The most important GHG by far is CO_2, accounting for 82 % of total EC emissions in 2002. In 2002, EC CO_2 emissions without LUCF were 3 382 Tg, which was 1.4 % above 1990 levels (Figure 2.2). Compared to 2001, CO_2 emissions decreased slightly mainly due to warm outdoor temperatures and low economic activity. The largest four key sources account for 67 % of total CO_2 emissions

Figure 2.1 EC GHG emissions 1990–2002 compared with target for 2008–12 (excl. LUCF)



Notes: The linear target path is not intended as an approximation of past and future emission trends. It provides a measure of how close the EC emissions in 2002 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 EC with its GHG targets in 2008–12, but aims at evaluating overall EC GHG emissions in 2002. The unit is index points with base year emissions being 100.

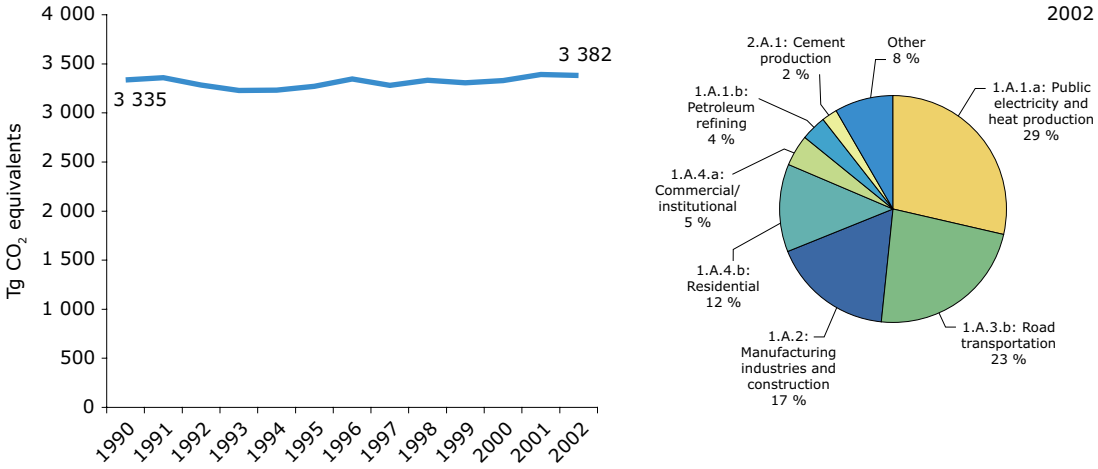
GHG emission data for the EC as a whole do not include emissions and removals from LUCF. In addition, no adjustments for temperature variations or electricity trade are considered.
For the fluorinated gases the EC base year is the sum of Member States base years. Thirteen Member States have chosen to select 1995 as the base year under the Kyoto Protocol, Finland and France have chosen to use 1990. Therefore, the 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.

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 needs not to be exactly 100.

Table 2.1 Overview of EC GHG emissions and removals from 1990 to 2002 in CO_2 equivalents (Tg)

Greenhouse gas emissions	Base year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Net CO_2 emissions/removals	3 234	3 234	3 310	3 167	3 096	3 111	3 158	3 222	3 153	3 212	3 174	3 211	3 251	3 224
CO_2 emissions (without LUCF)	3 335	3 335	3 358	3 285	3 228	3 232	3 270	3 347	3 281	3 333	3 306	3 328	3 392	3 382
CH_4	451	451	441	433	426	416	410	405	394	385	375	364	356	349
N_2O	392	392	388	378	369	374	375	383	383	361	338	336	335	328
HFCs	41	27	27	28	30	34	40	45	52	53	46	47	46	50
PFCs	12	16	14	12	11	10	9	9	8	8	7	6	6	5
SF_6	15	10	11	12	12	13	15	15	13	12	10	10	9	9
Total (with net CO_2 emissions/ removals)	4 145	4 130	4 191	4 031	3 945	3 959	4 007	4 079	4 004	4 030	3 950	3 974	4 003	3 965
Total (without CO_2 from LUCF)	4 246	4 231	4 240	4 148	4 077	4 080	4 119	4 204	4 132	4 152	4 083	4 091	4 144	4 124
Total (without LUCF)	**4 245**	**4 231**	**4 239**	**4 147**	**4 076**	**4 079**	**4 119**	**4 204**	**4 132**	**4 151**	**4 083**	**4 090**	**4 144**	**4 123**

Figure 2.2 CO_2 emissions without LUCF 1990 to 2002 in CO_2 equivalents (Tg) and share of largest key source categories in 2002



in 2002. Figure 2.3 shows that the main reason for increases between 1990 and 2002 was growing road transport demand. The large increase in road transport-related CO_2 emissions was only partly offset by reductions in energy-related emissions from manufacturing industries and from 'Other'. The largest reductions of 'Other' as shown in Figure 2.3 occurred in 1.A.1.c 'Manufacture of solid fuels and other energy industries' and in 1.A.5 'Other'.

CH_4 emissions account for 8.5 % of total EC GHG emissions and decreased by 23 % to 349 Tg (CO_2 equivalents) in 2002 (Figure 2.4). The two largest key sources account for about 50 % of CH_4 emissions in 2002. Figure 2.5 shows that the main reasons for declining CH_4 emissions were the decline of coal-mining, reductions in solid waste disposal on land and falling cattle population.

N_2O emissions are responsible for 8 % of total GHG emissions and decreased by 16.5 % to 328 Tg (CO_2 equivalents) in 2002 (Figure 2.6). The two largest key sources account for about 50 % of N_2O emissions in 2002. Figure 2.7 shows that the main reason for large N_2O emission cuts were reduction measures in the adipic acid production.

Fluorinated gas emissions account for 1.6 % of total GHG emissions. In 2002, emissions were 64 Tg (CO_2 equivalents), which was 21 % above 1990 levels, but 5 % below base year level (Figure 2.8). The two largest key sources account for 75 % of fluorinated gas emissions in 2002. Figure 2.9 shows that HFCs from consumption of halocarbons showed large increases between 1990 and 2002. The main reason for this is the phase-out of ozone-depleting substances such as chlorofluorocarbons under the

Figure 2.3 Absolute change of CO_2 emissions by large key source categories 1990 to 2002 in CO_2 equivalents (Tg)

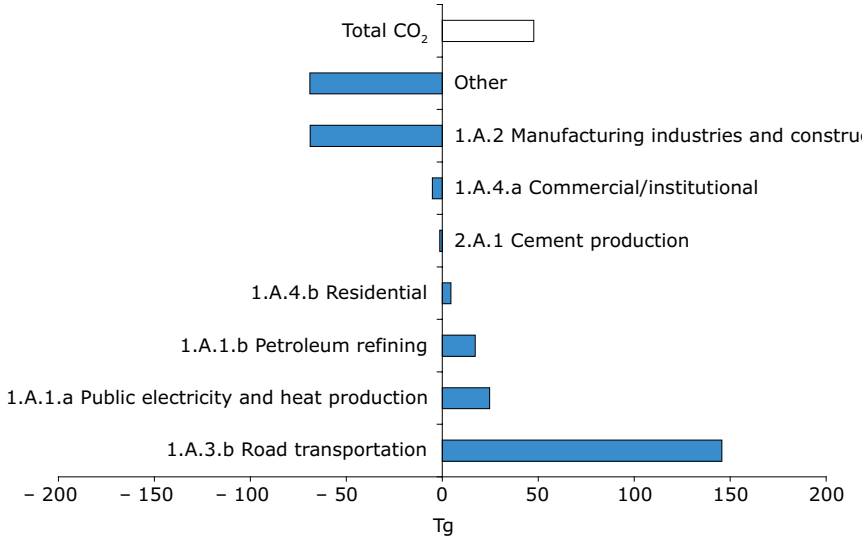


Figure 2.4 CH_4 emissions 1990 to 2002 in CO_2 equivalents (Tg) and share of largest source categories in 2002

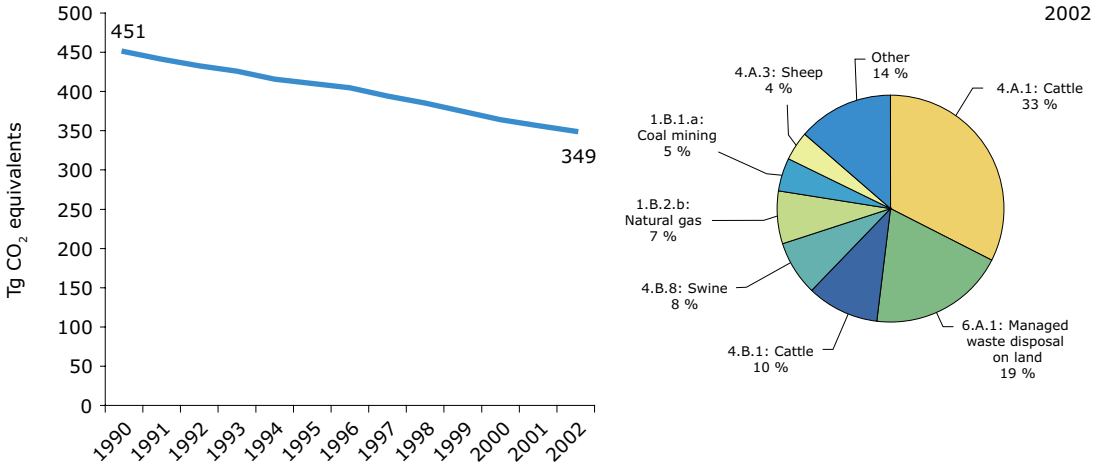


Figure 2.5 Absolute change of CH_4 emissions by large key source categories 1990 to 2002 in CO_2 equivalents (Tg)

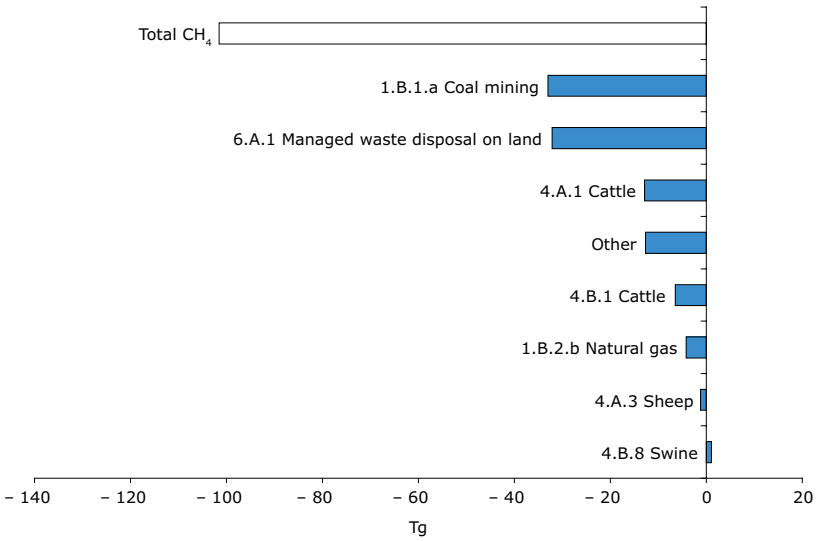


Figure 2.6 N_2O emissions 1990 to 2002 in CO_2 equivalents (Tg) and share of largest source categories in 2002

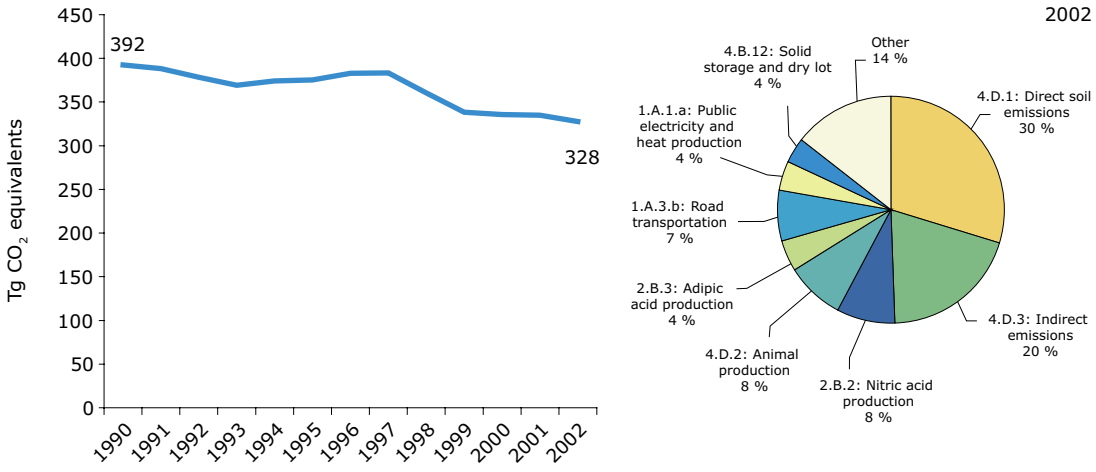


Figure 2.7 Absolute change of N_2O emissions by large key source categories 1990 to 2002 in CO_2 equivalents (Tg)

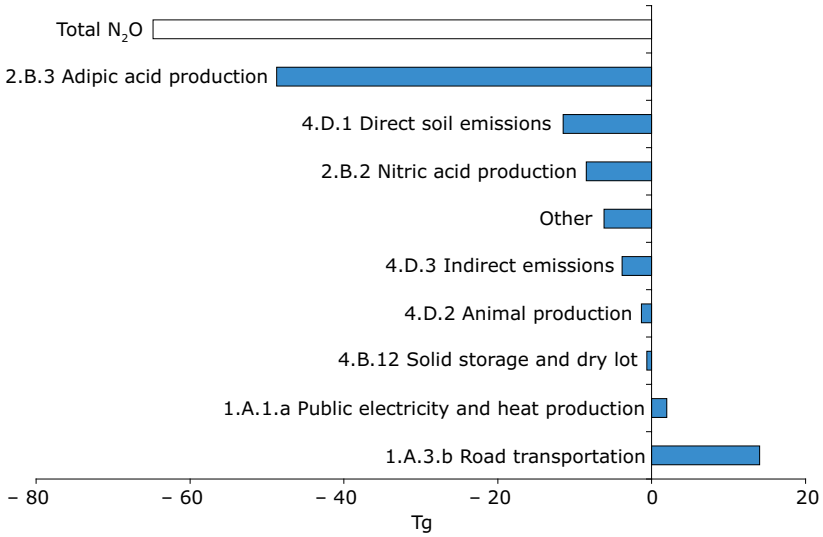


Figure 2.8 Fluorinated gas emissions 1990 to 2002 in CO_2 equivalents (Tg) and share of largest source categories in 2002

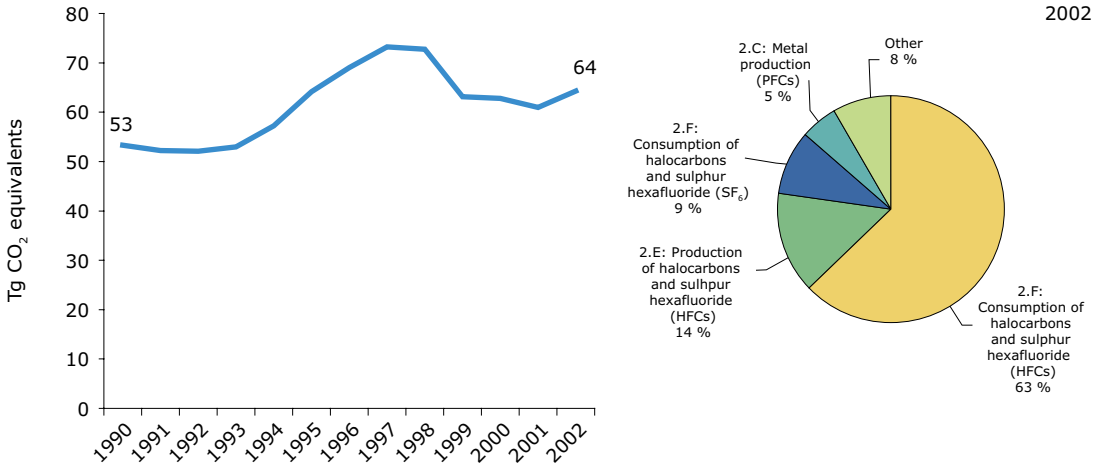


Figure 2.9 Absolute change of fluorinated gas emissions by large key source categories 1990 to 2002 in CO_2 equivalents (Tg)

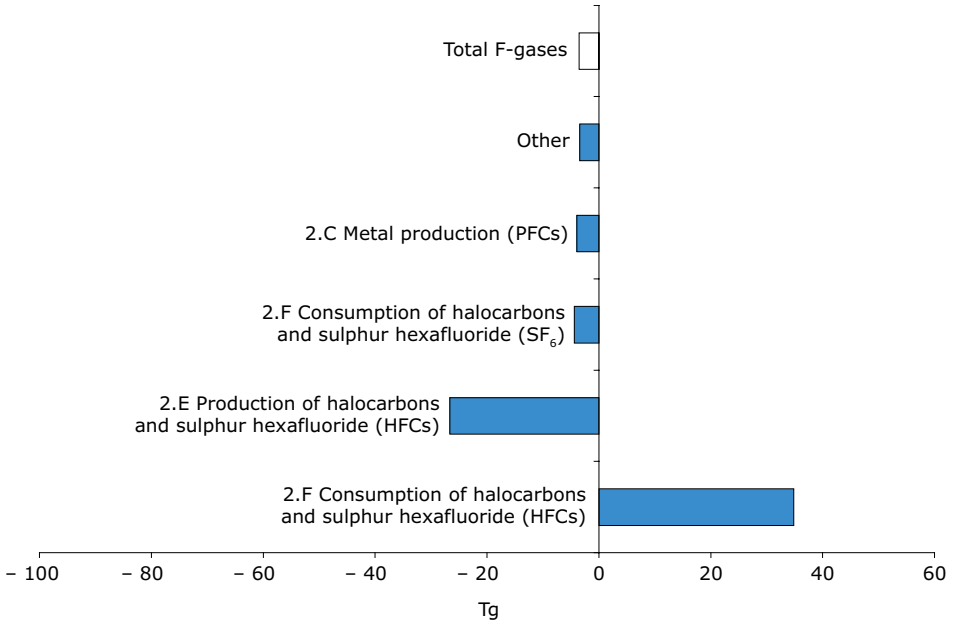


Table 2.2 Overview of EC GHG emissions in the main source and sink categories 1990 to 2002 in CO_2 equivalents (Tg)

GHG source and sink	Base year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
1. Energy	3 322	3 322	3 353	3 282	3 227	3 218	3 250	3 331	3 259	3 309	3 278	3 293	3 358	3 349
2. Industrial processes	318	303	294	286	276	290	300	302	308	286	255	256	252	248
3. Solvent and other product use	9	9	9	9	8	8	8	8	8	9	8	9	8	8
4. Agriculture	456	456	443	432	426	428	428	431	432	430	428	424	421	416
5. Land-use change and forestry	– 100	– 100	– 081	– 117	– 131	– 121	– 112	– 125	– 128	– 121	– 132	– 117	– 141	– 158
6. Waste	138	138	138	137	136	133	131	129	122	116	111	106	103	100
7. Other	2	2	2	2	2	2	2	2	2	2	2	2	2	2

Montreal Protocol and the replacement of these substances with HFCs (mainly in refrigeration, air conditioning, foam production and as aerosol propellants). On the other hand, HFC emissions from production of halocarbons decreased substantially. The decrease started in 1998 and was strongest in 1999.

2.3 Emission trends by source

Table 2.2 gives an overview of EC GHG emissions in the main source categories for 1990–2002. More detailed trend descriptions are included in Chapters 3 to 9.

2.4 Emission trends by Member State

Tables 2.3 and 2.4 give an overview of Member States' contributions to the EC GHG emissions for 1990–2002. 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 40 % of EC GHG emissions. These two Member States achieved total GHG emission reductions of 348 million tonnes compared to the base year ([13]).

([13]) The EC as a whole needs emission reductions of total GHG of 8 %, i.e. 340 million tonnes on the basis of the 2004 inventory in order to meet the Kyoto target.

Table 2.3 Overview of Member States' contributions to EC GHG emissions excluding LUCF from 1990 to 2002 in CO_2 equivalents (Tg)

Member State	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Austria	78	82	75	75	76	79	83	82	82	80	81	84	85
Belgium	146	149	148	147	152	155	159	150	155	148	150	149	150
Denmark	69	79	73	76	80	77	90	81	76	73	68	69	68
Finland	77	75	72	72	79	76	82	81	78	77	75	81	82
France	565	589	579	556	552	560	576	568	583	564	558	562	554
Germany	1 249	1 196	1 146	1 131	1 108	1 101	1 119	1 082	1 056	1 020	1 016	1 027	1 016
Greece	105	105	106	107	109	110	114	120	124	124	130	135	135
Ireland	53	54	55	55	57	58	59	62	64	66	68	70	69
Italy	509	511	506	500	493	525	517	523	535	540	544	554	554
Luxembourg	13	13	13	13	13	10	10	9	8	9	10	10	11
Netherlands	211	218	218	221	222	225	234	218	224	213	213	216	214
Portugal	58	60	64	62	63	67	65	68	72	80	78	78	82
Spain	285	291	300	289	304	316	310	331	341	370	385	383	400
Sweden	72	72	72	72	75	74	77	73	73	70	68	68	70
United Kingdom	743	744	721	701	696	686	708	684	679	648	648	656	635
EU-15	**4 231**	**4 239**	**4 147**	**4 076**	**4 079**	**4 119**	**4 204**	**4 132**	**4 151**	**4 083**	**4 090**	**4 144**	**4 123**

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

France and Italy are the third and fourth largest emitters with a share of 13.4 % each. France's emissions were 1.9 % below base year levels in 2002. In France, large reductions were achieved in N_2O emissions from the adipic acid production, but CO_2 emissions from road transport increased considerably between 1990 and 2002. Italy's GHG emissions were 9.0 % above base year levels in 2002. Italian GHG emissions increased between the base year and 2002 primarily from road transport, electricity and heat production and petrol-refining.

Spain as the fifth largest emitter in the EC accounts for 9.7 % of total EC GHG emissions and increased emissions by 39.4 % between base year and 2002. This was largely due to emission increases from electricity and heat production, from road transport and manufacturing industries.

Table 2.4 shows that nine Member States were above base year levels in 2002, six Member States were below. The percentage changes of GHG emissions from the base year to 2002 range from – 19 % (Germany) to + 41 % (Portugal).

2.5 Emission trends for indirect greenhouse gases and sulphur dioxide

Emissions of CO, NO_x, NMVOC and SO_2 have to be reported to the UNFCCC Secretariat because they influence climate change indirectly: CO, NO_x and NMVOC are precursor substances for ozone which itself is a greenhouse gas. Sulphur emissions produce microscopic particles (aerosols) that can reflect sunlight back out into space and also affect cloud formation. Table 2.5 shows the total indirect GHG and SO_2 emissions in the EC between 1990–2002. All emissions were reduced significantly from 1990 levels: the largest reduction was achieved in SO_2 (– 63 %) followed by CO (– 45 %) NMVOC (– 34 %) and NO_x (– 26 %).

Table 2.6 shows the NO_x emissions of the Member States between 1990–2002. The largest emitters, Spain, the United

Table 2.4 Greenhouse gas emissions in CO_2 equivalents (excl. LUCF) and Kyoto Protocol targets for 2008–12

Member State	Base year (1) (million tonnes)	2002 (million tonnes)	Change 2001–2002 (%)	Change base year-2002 (%)	Targets 2008–12 under Kyoto Protocol and 'EU burden sharing' (%)
Austria	78.0	84.6	0.3	8.5	– 13.0
Belgium	146.8	150.0	0.5	2.1	– 7.5
Denmark (2)	69.0	68.5	– 1.2	– 0.8 (– 9.1)	– 21.0
Finland	76.8	82.0	1.7	6.8	0.0
France	564.7	553.9	– 1.4	– 1.9	0.0
Germany	1 253.3	1 016.0	– 1.1	– 18.9	– 21.0
Greece	107.0	135.4	0.3	26.5	25.0
Ireland	53.4	68.9	– 1.6	28.9	13.0
Italy	508.0	553.8	– 0.1	9.0	– 6.5
Luxembourg	12.7	10.8	10.4	– 15.1	– 28.0
Netherlands	212.5	213.8	– 1.1	0.6	– 6.0
Portugal	57.9	81.6	4.1	41.0	27.0
Spain	286.8	399.7	4.2	39.4	15.0
Sweden	72.3	69.6	2.0	– 3.7	4.0
United Kingdom	746.0	634.8	– 3.3	– 14.9	– 12.5
EU-15	**4 245.2**	**4 123.3**	**– 0.5**	**– 2.9**	**– 8.0**

(1) Base year for CO_2, CH_4 and N_2O 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) For Denmark, data that reflect adjustments for electricity trade (import and export) in 1990 are given in brackets. This method is used by Denmark to monitor progress towards its national target under the EC 'burden sharing' agreement. For the EC emissions, total non-adjusted Danish data have been used.

Table 2.5 Overview of EC indirect GHG and SO_2 emissions for 1990–2002 (Gg)

Greenhouse gas emissions	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
	Gg												
NO_x	13 516	13 363	13 043	12 425	12 079	11 694	11 506	11 026	10 762	10 400	10 462	10 259	10 023
CO	49 871	48 152	46 179	43 796	41 525	39 759	38 517	36 696	35 135	33 105	30 846	29 417	27 598
NMVOC	17 077	16 513	16 023	15 241	15 047	14 570	13 910	13 744	13 226	12 808	12 121	11 714	11 227
SO_2	16 535	15 004	13 863	12 604	11 402	10 242	8 944	8 113	7 597	6 848	6 546	6 375	6 183

Kingdom and Germany made up 50 % of total NO_x emissions in 2002. The United Kingdom and Germany reduced their emissions from 1990 levels. This was partly counterbalanced by increases from Spain, Portugal, Greece and Ireland. All other Member States reduced emissions.

Table 2.7 shows the CO emissions of the Member States between 1990–2002. The largest emitters, France, Italy and Germany that made up 54 % of the total CO emissions in 2002, reduced their emissions from 1990 levels. Also all other Member States except for Finland reduced emissions.

Table 2.8 shows the NMVOC emissions of the Member States between 1990–2002. The largest emitters France, Spain and Germany that made up 61 % of the total NMVOC emissions in 2002, reduced their emissions from 1990 levels. All Member States except for Greece and Portugal reduced emissions.

Table 2.9 shows the SO_2 emissions of the Member States between 1990–2002. The largest emitters, Spain, the United Kingdom and Italy, that made up 59 % of the total SO_2 emissions in 2002, reduced their emissions from 1990 levels. All other Member States except for Greece reduced emissions.

Table 2.6 Overview of Member States' contributions to EC NO_x emissions for 1990–2002 (Gg)

Member State	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Austria	212	217	207	199	194	189	194	190	194	190	190	196	204
Belgium	365	354	350	343	367	354	342	330	329	304	307	298	290
Denmark	283	332	290	289	292	274	312	266	243	226	208	203	200
Finland	311	290	283	282	282	259	268	260	253	248	236	210	211
France	1 958	2 033	1 986	1 863	1 817	1 779	1 747	1 684	1 662	1 589	1 507	1 477	1 434
Germany	2 815	2 584	2 391	2 273	2 108	1 979	1 896	1 801	1 744	1 697	1 620	1 545	1 479
Greece	290	298	297	292	299	296	306	310	334	326	317	321	318
Ireland	116	118	129	117	114	114	118	117	120	117	123	132	121
Italy	1 929	1 983	2 002	1 904	1 823	1 789	1 730	1 652	1 551	1 451	1 374	1 359	1 267
Luxembourg	22	22	22	22	22	20	22	18	19	16	17	17	17
Netherlands	599	586	579	555	530	518	502	471	461	464	447	436	430
Portugal	260	276	289	280	280	293	279	280	294	293	294	288	293
Spain	1 257	1 301	1 332	1 306	1 329	1 340	1 306	1 343	1 341	1 401	1 848	1 877	1 929
Sweden	324	321	317	305	308	298	291	279	274	262	250	247	243
United Kingdom	2 775	2 649	2 570	2 396	2 315	2 193	2 195	2 026	1 943	1 815	1 723	1 653	1 587
EU-15	**13 516**	**13 363**	**13 043**	**12 425**	**12 079**	**11 694**	**11 506**	**11 026**	**10 762**	**10 400**	**10 462**	**10 259**	**10 023**

Table 2.7 Overview of Member States' contributions to EC CO emissions for 1990–2002 (Gg)

Member State	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Austria	1 249	1 253	1 209	1 171	1 118	1 031	1 038	978	938	891	833	837	812
Belgium	1 470	1 441	1 446	1 328	1 236	1 197	1 202	1 072	1 041	1 030	1 054	1 011	1 024
Denmark	745	788	778	786	758	742	747	695	634	609	602	603	577
Finland	549	495	467	447	433	424	463	460	452	545	535	603	592
France	11 092	10 977	10 501	9 915	9 208	9 043	8 438	7 971	7 748	7 219	6 698	6 335	6 027
Germany	11 212	9 528	8 351	7 701	7 080	6 580	6 166	5 993	5 536	5 200	4 906	4 573	4 318
Greece	1 298	1 290	1 320	1 285	1 264	1 254	1 354	1 356	1 489	1 386	1 395	1 205	1 169
Ireland	397	391	391	347	326	301	303	308	313	281	275	270	251
Italy	7 117	7 408	7 608	7 550	7 343	7 111	6 809	6 667	6 148	5 869	5 179	5 090	4 486
Luxembourg	172	172	172	172	145	104	102	80	58	49	49	53	48
Netherlands	1 130	1 039	985	964	925	851	835	759	747	728	702	676	656
Portugal	1 018	1 135	966	919	882	1050	905	838	945	867	948	849	879
Spain	3 798	3 868	3 933	3 713	3 674	3 301	3 424	3 266	3 250	2 997	2 898	2 873	2 748
Sweden	1 202	1 178	1 174	1 134	1 119	1 113	1 081	996	957	897	838	796	767
United Kingdom	7 421	7 191	6 877	6 366	6 014	5 656	5 649	5 256	4 880	4 536	3 934	3 643	3 244
EU-15	**49 871**	**48 152**	**46 179**	**43 796**	**41 525**	**39 759**	**38 517**	**36 696**	**35 135**	**33 105**	**30 846**	**29 417**	**27 598**

Table 2.8 Overview of Member States' contributions to EC NMVOC emissions for 1990–2002 (Gg)

Member State	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Austria	298	286	257	250	233	232	226	213	201	190	190	195	193
Belgium	357	352	351	336	325	312	295	284	272	255	245	238	216
Denmark	164	166	165	165	162	158	157	149	143	138	132	126	124
Finland	236	213	206	196	191	182	207	204	160	178	162	156	151
France	3 830	3 814	3 743	3 603	3 567	3 520	3 278	3 374	3 193	3 227	3 049	3 033	2 908
Germany	3 534	3 082	2 808	2 582	2 404	2 249	2 110	2 042	1 966	1 842	1 699	1 594	1 477
Greece	255	253	261	270	274	273	284	285	290	291	305	270	268
Ireland	106	107	110	101	103	101	107	111	113	94	85	83	78
Italy	2 038	2 097	2 146	2 102	2 045	2 021	1 974	1 908	1 802	1 710	1 541	1 442	1 340
Luxembourg	19	19	19	19	18	17	17	17	14	12	13	12	11
Netherlands	490	462	437	404	389	362	308	281	298	287	267	251	244
Portugal	292	314	343	319	326	331	335	339	344	339	333	328	332
Spain	2 534	2 526	2 455	2 324	2 501	2 444	2 347	2 373	2 430	2 447	2 428	2 422	2 404
Sweden	503	483	470	438	418	410	395	365	341	318	306	297	295
United Kingdom	2 420	2 338	2 253	2 131	2 091	1 959	1 870	1 800	1 659	1 480	1 365	1 266	1 187
EU-15	**17 077**	**16 513**	**16 023**	**15 241**	**15 047**	**14 570**	**13 910**	**13 744**	**13 226**	**12 808**	**12 121**	**11 714**	**11 227**

Table 2.9 Overview of Member States' contributions to EC SO_2 emissions for 1990–2002 (Gg)

Member State	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Austria	80	77	61	59	53	52	49	45	41	38	35	38	36
Belgium	355	353	347	321	281	256	254	226	214	176	169	159	151
Denmark	177	236	181	147	147	138	174	101	75	55	29	26	25
Finland	237	194	141	122	115	97	105	99	89	85	76	87	85
France	1 368	1 491	1 310	1 146	1 102	1 038	1 013	867	882	763	686	629	596
Germany	5 322	3 991	3 303	2 941	2 469	1 934	1 335	1 036	833	733	631	640	608
Greece	493	532	546	545	517	541	525	521	528	540	483	498	509
Ireland	183	180	170	161	175	161	147	166	176	157	131	126	96
Italy	1 774	1 656	1 557	1 455	1 359	1 287	1 228	1 151	1 017	922	772	737	665
Luxembourg	15	15	15	15	15	15	15	6	4	4	3	3	2
Netherlands	204	173	167	160	146	142	136	118	110	105	91	90	85
Portugal	322	307	373	320	298	333	272	293	342	343	312	295	295
Spain	2 177	2 163	2 133	2 008	1 963	1 807	1 580	1 739	1 607	1 639	1 885	1 876	1 968
Sweden	106	99	93	87	87	77	81	76	73	59	55	57	59
United Kingdom	3 722	3 537	3 464	3 117	2 676	2 364	2 029	1 670	1 608	1 230	1 190	1 116	1 003
EU-15	**16 535**	**15 004**	**13 863**	**12 604**	**11 402**	**10 242**	**8 944**	**8 113**	**7 597**	**6 848**	**6 546**	**6 375**	**6 183**

3 Energy (CRF Sector 1)

This chapter starts with an overview on emission trends in CRF Sector 1: 'Energy'. For each EC 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 EC. Total GHG emissions from this sector increased by 0.8 % from 3 322 Tg in 1990 to 3 349 Tg in 2002 (Figure). In 2002, emissions decreased by 0.3 % compared to 2001.

The most important energy-related gas is CO_2 that makes up 78 % of the total GHG emissions. CH_4 and N_2O are both 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 (CO_2)
1.A.1.a: Public electricity and heat production (N_2O)
1.A.1.b: Petroleum-refining (CO_2)
1.A.1.c: Manufacture of solid fuels and other energy industries (CO_2)
1.A.2: Manufacturing industries and construction (CO_2)
1.A.3.a: Civil aviation (CO_2)
1.A.3.b: Road transportation (CH_4)
1.A.3.b: Road transportation (CO_2)
1.A.3.b: Road transportation (N_2O)
1.A.3.c: Railways (CO_2)
1.A.3.d: Navigation (CO_2)
1.A.3.e: Other (CO_2)
1.A.4.a: Commercial/institutional (CO_2)
1.A.4.b: Residential (CH_4)
1.A.4.b: Residential (CO_2)
1.A.4.b: Residential (N_2O)
1.A.4.c: Agriculture/forestry/fisheries (CO_2)
1.A.5: Other (CO_2)
1.B.1.a: Coal-mining (CH_4)
1.B.1.b: Solid fuel transformation (CO_2)
1.B.2.a: Oil (CH_4)
1.B.2.b: Natural gas (CH_4)
1.B.2.c: Venting and flaring (CO_2)

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

Figure 3.1 EC GHG emissions for 1990–2002 from CRF Sector 1: 'Energy' in CO_2 equivalents (Tg) and share of largest key source categories in 2002

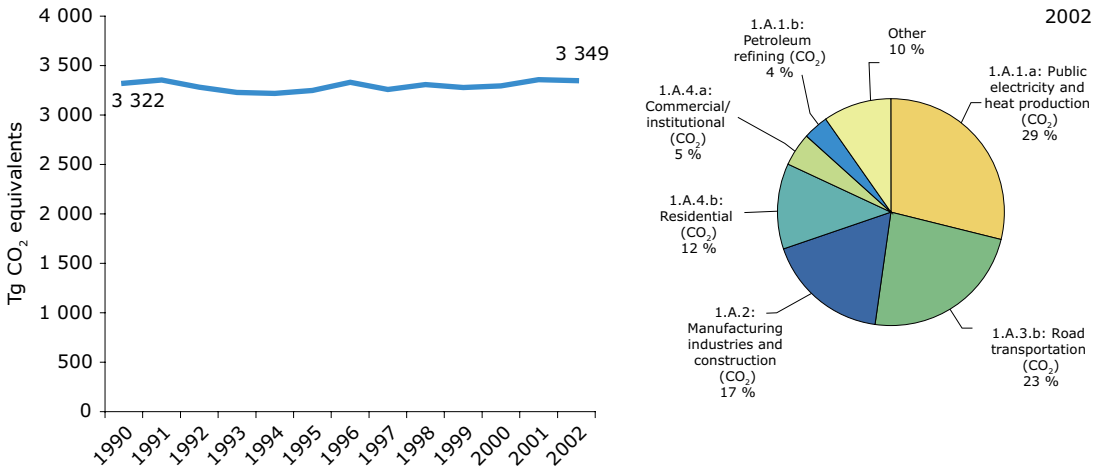


Figure 3.2 Absolute change of GHG emissions by large key source categories 1990–2002 in CO_2 equivalents (Tg) in CRF Sector 1: 'Energy'

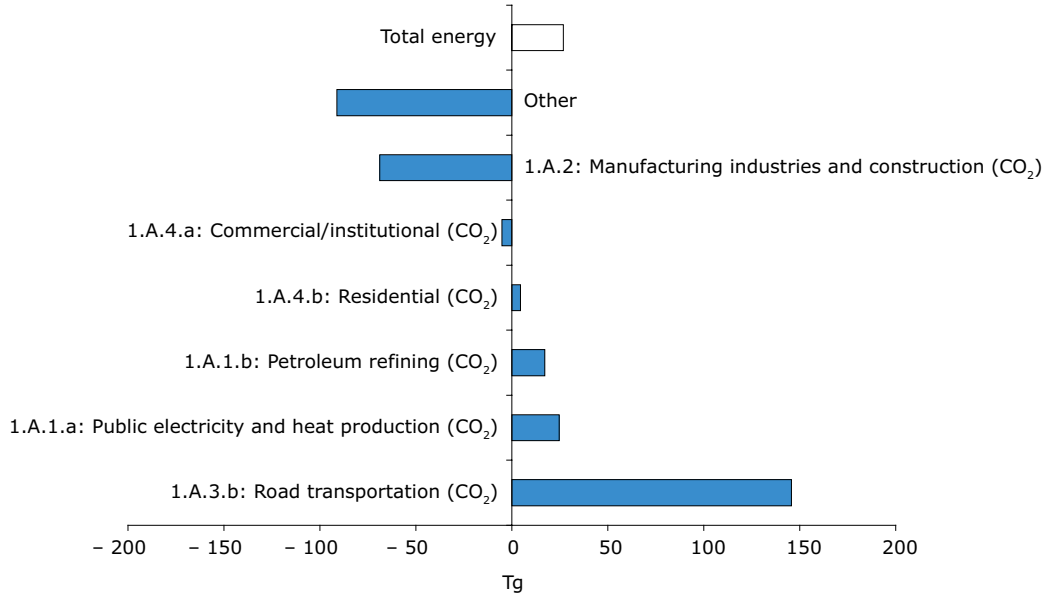


Figure 3.2 shows that CO_2 emissions from road transport had the highest increase in absolute terms of all energy-related emissions, while CO_2 emissions from manufacturing industries decreased substantially between 1990 and 2002. The increases in road transport occurred in almost all Member States, whereas the emission reductions from manufacturing industries mainly occurred in Germany after the reunification. The decline of coal-mining (CH_4) and decreasing CO_2 emissions from 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 CO_2 from 1.A.1: 'Energy industries'. CO_2 emissions from energy industries increased by 0.6 % between 1990 and 2002. Most Member States had increases in this source during this time, but the large Member States Germany and the United Kingdom, that are responsible for 48 % of the total emissions from this source, reduced their emissions by 14 % and 15 %, respectively.

This source category includes three key sources: CO_2 from 1.A.1.a: 'Electricity and heat production' and CO_2 from 1.A.1.b: 'Petroleum-refining', and CO_2 from 1.A.1.c: 'Manufacture of solid fuels and other energy industries'.

CO_2 emissions from 1.A.1.a: 'Electricity and heat production' is the largest key source in the EC accounting for 23.4 % of total GHG emissions in 2002. Between 1990 and 2002, CO_2 emissions from electricity and heat production increased by 3 % in the EC (Table 3.2). The emissions from this key source are due to fossil fuel consumption in public electricity and heat plants, which increased by 13 % between 1990 and 2002. 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 12 % between 1990 and 2002, whereas gas consumption almost tripled.

Table 3.1 Member States' contributions to CO_2 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 2002 (Gg CO_2 equivalents)	Methods applied (1)	EF (1)	Estimate (2)	Quality (2)
Austria	13 475	15 013	C	CS	ALL	H
Belgium	28 215	26 513	CS	CS	F	
Denmark	26 177	26 548	C	CS	ALL	H
Finland	18 517	28 947	CS (T2)	CS, PS, D	ALL	H
France	67 686	59 416	C	CS	ALL	H
Germany	413 945	356 788	CS	CS	ALL	H
Greece	43 302	55 109	C	C, CS	ALL	
Ireland	11 057	16 201	T1	PS, CS	FULL	H
Italy	132 812	153 151	D, T2	CS	ALL	H
Luxembourg	1277	266	C/D	C/D	ALL	
Netherlands	51 305	63 780	CS/T2	PS, CS	ALL/IE	H
Portugal	16 187	24 788	T2	D,C	ALL	H
Spain	77 326	113 135	CS, C	PS, C	ALL	H
Sweden	10 210	12 326	T2/T3, T1, CS	CS, PS, D	ALL	H
United Kingdom	228 090	194 202	T2	CS	ALL	H
EU-15	**1 139 581**	**1 146 183**	**C, CS, D, T1, T2, T3**	**C, CS, D, PS**	**ALL, IE**	**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 CO_2 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 2002 (%)	Change 2001–2002		Change 1990–2002	
	1990	2001	2002		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	11 091	11 263	11 877	1.2	614	5	786	7
Belgium	21 797	20 379	21 287	2.2	908	4	510	– 2
Denmark	24 760	23 971	24 083	2.5	113	0	677	– 3
Finland	16 248	24 169	26 149	2.7	1 979	8	9 900	61
France	47 801	36 807	39 887	4.1	3 080	8	7 914	– 17
Germany	334 619	309 577	317 060	32.9	7 483	2	17 558	– 5
Greece	41 202	52 157	51 561	5.3	596	– 1	10 359	25
Ireland	10 876	16 800	15 830	1.6	969	– 6	4 954	46
Italy	105 576	110 542	117 012	12.1	6 470	6	11 437	11
Luxembourg	1 277	266	266	0.0	0	0	1 011	– 79
Netherlands	40 305	51 685	51 867	5.4	183	0	11 563	29
Portugal	14 180	18 970	22 267	2.3	3 296	17	8 087	57
Spain	64 341	84 252	98 901	10.2	14 650	17	34 560	54
Sweden	7 663	8 077	9 221	1.0	1 143	14	1 557	20
United Kingdom	198 503	162 434	157 626	16.3	4 808	– 3	40 877	– 21
EU-15	**940 240**	**931 349**	**964 895**	**100.0**	**33 546**	**4**	**24 656**	**3**

Between 1990 and 2002, large emission decreases in absolute and relative terms had been achieved by the United Kingdom and Germany, whereas emissions increased considerably in Spain. The most important reason for German CO_2 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 61 % between 1990 and 2002, affecting also emissions from this source.

CO_2 emissions from 1.A.1.b: 'Petroleum-refining' is the sixth largest key source in the EC accounting for 2.9 % of total GHG emissions in 2002. Between 1990

Table 3.3 Member States' contributions to CO_2 emissions from 1.A.1.b: 'Petroleum-refining'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU-15 emissions in 2002 (%)	Change 2001–2002		Change 1990–2002	
	1990	2001	2002		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	2 019	2 482	2 565	2.1	83	3	546	27
Belgium	4 299	4 646	4 767	4.0	121	3	468	11
Denmark	897	996	948	0.8	48	– 5	51	6
Finland	2 225	2 504	2 708	2.3	205	8	483	22
France	13 239	14 671	14 635	12.2	36	0	1 396	11
Germany	19 419	19 940	19 675	16.5	265	– 1	256	1
Greece	2 045	3 338	3 449	2.9	111	3	1 404	69
Ireland	181	345	371	0.3	26	7	190	105
Italy	15 788	26 201	26 034	21.8	168	– 1	10 245	65
Luxembourg	0	0	0	0.0	0	—	0	—
Netherlands	9 670	11 183	10 262	8.6	921	– 8	592	6
Portugal	1 929	2 404	2 517	2.1	113	5	588	30
Spain	10 907	12 936	12 738	10.7	198	– 2	1 831	17
Sweden	2 133	2 548	2 780	2.3	232	9	647	30
United Kingdom	17 605	16 426	16 067	13.4	359	– 2	1 538	– 9
EU-15	**102 356**	**120 621**	**119 515**	**100.0**	**1.106**	**– 1**	**17 159**	**17**

Table 3.4 Member States' contributions to CO_2 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 2002 (%)	Change 2001–2002		Change 1990–2002	
	1990	2001	2002		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	366	767	571	0.9	196	– 26	205	56
Belgium	2 118	473	460	0.7	13	– 3	1 659	– 78
Denmark	520	1 410	1 517	2.5	107	8	997	192
Finland	44	88	90	0.1	1	1	46	104
France	6 647	5 452	4 894	7.9	558	– 10	1 752	– 26
Germany	59 907	19 884	20 053	32.5	169	1	39 854	– 67
Greece	55	75	99	0.2	24	32	44	81
Ireland	NO	NO	NO	—	—	—	—	—
Italy	11 447	10 005	10 105	16.4	100	1	1 343	– 12
Luxembourg	0	0	0	0.0	0	—	0	—
Netherlands	1 330	1 782	1 650	2.7	131	– 7	320	24
Portugal	78	29	4	0.0	25	– 86	74	– 95
Spain	2 078	1 615	1 496	2.4	119	– 7	582	– 28
Sweden	413	336	325	0.5	10	– 3	88	– 21
United Kingdom	11 982	20 280	20 509	33.2	228	1	8 527	71
EU-15	**96 985**	**62 195**	**61 773**	**100.0**	**423**	**– 1**	**35 212**	**– 36**

and 2002, CO_2 emissions from this source increased by 17 % in the EC (Table 3.3).

Between 1990 and 2002, emission decreases in absolute and relative terms had been achieved by the United Kingdom, whereas all other Member States reported increases. Italy had the largest increases in absolute terms.

CO_2 emissions from 1.A.1.c: 'Manufacture of solid fuels and other energy industries' account for 1.5 % of total EC GHG emissions in 2002. Between 1990 and 2002, CO_2 emissions from this source decreased by 36 % in the EC (Table 3.4). Between 1990 and 2002, 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

Table 3.5 Member States' contributions to N_2O 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 2002 (Gg CO_2 equivalents)	Methods applied (1)	EF (1)	Estimate (2)	Quality (2)
Austria	47	62	C	CS	ALL	L
Belgium	274	353	C	D	F	
Denmark	275	264	C	C	ALL	L
Finland	279	488	CS(T2)	CS/PS	ALL	L
France	736	976	C	CS	ALL	L
Germany	4 494	3 869	CS	CS	ALL	
Greece	1 779	2 206	C	C	ALL	
Ireland	431	612	T1	C	FULL	L
Italy	1 672	1 898	D/T2	D/CS		
Luxembourg	0	1	C/D	C/D		
Netherlands	145	156	CS/T1	PS, D	ALL/IE	L
Portugal	61	110	T2	D, C	ALL	L
Spain	921	1 520	C	C	ALL	L
Sweden	338	386	T2/T3+T1	CS	ALL	M
United Kingdom	2 270	2 741	T2	CS/D/C	ALL	L
EU-15	**13 722**	**15 644**	**C, CS, D, T1, T2, T3**	**C, CS, D, PS**	**ALL/IE**	**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 3.6 Member States' contributions to N_2O 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 2002 (%)	Change 2001–2002		Change 1990–2002	
	1990	2001	2002		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	43	57	58	0	0	1	15	35
Belgium	69	36	36	0	0	0	33	– 48
Denmark	263	242	246	2	4	2	17	– 6
Finland	259	408	464	3	56	14	205	79
France	592	817	838	6	21	3	246	42
Germany	3 651	3 501	3 550	27	50	1	101	– 3
Greece	1 703	2 102	2 076	16	27	– 1	373	22
Ireland	427	670	604	5	66	– 10	177	41
Italy	1 530	1 530	1 708	13	179	12	179	12
Luxembourg	0	1	1	0	0	0	1	—
Netherlands	121	96	137	1	41	43	16	13
Portugal	52	85	100	1	15	17	49	94
Spain	454	864	1 010	8	147	17	557	123
Sweden	304	313	347	3	33	11	43	14
United Kingdom	1 922	2 178	2 162	16	16	– 1	240	12
EU-15	**11 388**	**12 900**	**13 337**	**100**	**437**	**3**	**1 949**	**17**

qualitative uncertainty estimates for the N_2O emissions from 1.A.1: 'Energy industries'. N_2O emissions from this source increased by 14 % between 1990 and 2002. Most Member States had increases in this source during this time. In absolute terms, Germany had the highest decrease in these emissions. The countries contributing the most to the increasing trend were Spain, the United Kingdom and Greece.

This source category includes one key source: N_2O from 1.A.1.a: 'Electricity and heat production'.

N_2O emissions from 1.A.1.a: 'Electricity and heat production' account for 0.3 % of total EC GHG emissions in 2002. Between 1990 and 2002, N_2O emissions from this source increased by 17 % in the EC (Table 3.6). Most Member States had increases in this source during this

Table 3.7 Member States' contributions to CO_2 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 2002 (Gg CO_2 equivalents)	Methods applied (1)	EF (1)	Estimate (2)	Quality (2)
Austria	13 033	12 504	C	CS	ALL	H
Belgium	33 194	33 976	C	C, CS	F	
Denmark	5 383	5 557	C	CS	ALL	H
Finland	14 358	13 228	CS (T2)	CS/PS/D	ALL	H
France	82 893	81 366	C	CS	ALL	H
Germany	196 315	132 033	CS	CS	ALL	H
Greece	9 792	10 143	C	C	ALL	
Ireland	3 833	4 892	T1	PS, CS	FULL	H
Italy	87 846	84 943	D, T2	CS	ALL	H
Luxembourg	5 258	2 341	C/D	C/D	ALL	
Netherlands	42 192	35 791	CS/T2	PS, CS	ALL	M
Portugal	9 158	9 971	T2	D, C	ALL	H
Spain	43 839	61 903	CS, C	PS, C	ALL	H
Sweden	10 677	10 380	T2/T3, T1	CS	ALL	H
United Kingdom	94 138	84 044	T2	CS	ALL	H
EU-15	**651 908**	**583 070**	**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'.

time. The countries contributing the most to the increasing trend were Spain, Greece and France. In absolute terms, Germany had the highest decrease in these emissions.

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

Table 3.7 and Table 3.8 summarise information by Member State on emission trends, methodologies, emission factors, completeness and qualitative uncertainty estimates for the CO_2 from 1.A.2: 'Manufacturing industries and construction'.

CO_2 emissions from 1.A.2: 'Manufacturing industries and construction' is the third largest key source in the EC accounting for 14 % of total GHG emissions in 2002. Between 1990 and 2002, CO_2 emissions from manufacturing industries declined by 11 % in the EC. The emissions from this key source are due to fossil fuel consumption in manufacturing industries and construction, which decreased by 3 % between 1990 and 2002. Also in industry a shift from solid fuels to gas took place.

Between 1990 and 2002, Germany shows by far the largest emission reductions in absolute terms. Also Italy, 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 the 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, completeness and qualitative uncertainty estimates for the CO_2 emissions from 1.A.3: 'Transport'. CO_2 emissions from 'Transport' increased by 21 % between 1990 and 2002. Most Member States had increases in this source during this time. The growth was less than 10 % only in

Table 3.8 Member States' contributions to CO_2 emissions from 1.A.2: 'Manufacturing industries and construction'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU-15 emissions in 2002 (%)	Change 2001–2002		Change 1990–2002	
	1990	2001	2002		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	13 033	12 920	12 504	2.1	– 416	– 3	– 529	– 4
Belgium	33 194	32 994	33 976	5.8	981	3	781	2
Denmark	5 383	5 760	5 557	1.0	– 203	– 4	174	3
Finland	14 358	13 855	13 228	2.3	– 627	– 5	– 1 130	– 8
France	82 893	81 706	81 366	14.0	– 340	0	– 1 527	– 2
Germany	196 315	132 869	132 033	22.6	– 836	– 1	– 64 282	– 33
Greece	9 792	10 436	10 143	1.7	– 293	– 3	351	4
Ireland	3 833	4 726	4 892	0.8	166	4	1059	28
Italy	87 846	89 865	84 943	14.6	– 4 922	– 5	-2903	– 3
Luxembourg	5 258	1 651	2 341	0.4	690	42	– 2 917	– 55
Netherlands	42 192	36 444	35 791	6.1	– 653	– 2	– 6 401	– 15
Portugal	9 158	10 562	9 971	1.7	– 591	– 6	813	9
Spain	43 839	61 332	61 903	10.6	570	1	18064	41
Sweden	10 677	10 117	10 380	1.8	262	3	– 297	– 3
United Kingdom	94 138	89 805	84 044	14.4	– 5 761	– 6	– 10 094	– 11
EU-15	**651 908**	**595 042**	**583 070**	**100.0**	**– 11 972**	**– 2**	**– 68 838**	**– 11**

Table 3.9 Member States' contributions to CO_2 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 2002 (Gg CO_2 equivalents)	Methods applied (1)	EF (1)	Estimate (2)	Quality (2)
Austria	12 759	20 606	M, CS	CS	ALL	H
Belgium	19 941	24 977	C, M	C, M	F	
Denmark	10 415	12 300	M/C	CS	ALL	H
Finland	12 475	12 784	CS (M)	CS	ALL	H
France	119 123	141 953	C/CS	C/M/CS	ALL	H
Germany	162 360	176 388	CS	CS	ALL	H
Greece	18 039	20 299	C	C	ALL	
Ireland	5 020	11 231	T1	CS	FULL	H
Italy	101 857	124 944	D, T2	CS	ALL	H
Luxembourg	2 724	5 422	C/D	C/D	ALL	
Netherlands	29 399	36 251	CS/T2	CS	ALL	H
Portugal	10 460	19 831	M	D, C	ALL	H
Spain	57 497	91 427	C	C	ALL	H
Sweden	18 302	20 025	T1, T2	CS	ALL	H
United Kingdom	116 581	122 792	T2	CS	ALL	H
EU-15	**696 951**	**841 230**	**C, CS, D, M, T1, T2**	**C, CS, D, M**	**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'.

Finland, the United Kingdom, Sweden and Germany.

This source category includes five key sources: CO_2 from 1.A.3.a: 'Civil Aviation', 1.A.3.b: 'Road transportation', 1.A.3.c: 'Railways', 1.A.3.d: 'Navigation', and 1.A.3.e: 'Other transportation'.

CO_2 emissions from 1.A.3.a 'Civil aviation' account for 0.6 % of total GHG emissions in 2002. Between 1990 and 2002, CO_2 emissions from civil aviation increased by 24 % in the EC (Table 3.10). The emissions from this source are due to fossil fuel consumption in aviation, which increased by 25 % between 1990 and 2002.

The Member States France, Spain and Germany contributed the most to the emissions from this source (63 %). Most

Table 3.10 Member States' contributions to CO_2 emissions from 1.A.3.a: 'Civil aviation'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU-15 emissions in 2002 (%)	Change 2001–2002		Change 1990–2002	
	1990	2001	2002		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	32	79	75	0.3	– 5	– 6	43	134
Belgium	12	12	12	0.1	0	0	0	1
Denmark	216	167	146	0.6	– 21	– 12	– 71	– 33
Finland	403	360	313	1.3	– 47	– 13	– 90	– 22
France	4 541	5 673	5 522	23.5	– 150	– 3	982	22
Germany	2 897	4 292	4 248	18.1	– 44	– 1	1 350	47
Greece	1 458	1 273	1 162	5.0	– 110	– 9	– 296	– 20
Ireland	59	109	105	0.4	– 4	– 4	46	78
Italy	1 596	2 604	2 677	11.4	73	3	1 081	68
Luxembourg	0	0	0	0.0	0	—	0	—
Netherlands	492	197	225	1.0	29	15	– 267	– 54
Portugal	246	375	377	1.6	2	1	131	53
Spain	4 135	5 618	5 084	21.7	– 534	– 10	949	23
Sweden	673	625	601	2.6	– 25	– 4	– 73	– 11
United Kingdom	2 158	2 938	2 921	12.4	– 17	– 1	763	35
EU-15	**18 921**	**24 321**	**23 468**	**100.0**	**– 853**	**– 4**	**4 548**	**24**

Table 3.11 Member States' contributions to CO_2 emissions from 1.A.3.b: 'Road transportation'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU-15 emissions in 2002 (%)	Change 2001–2002		Change 1990–2002	
	1990	2001	2002		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	12 278	17 893	19 939	2.5	2 046	11	7 660	62
Belgium	19 270	23 963	24 279	3.1	316	1	5 009	26
Denmark	9 351	11 273	11 389	1.5	117	1	2 039	22
Finland	11 111	10 905	11 133	1.4	229	2	23	0
France	111 403	131 969	132 672	16.9	703	1	21 269	19
Germany	150 262	167 712	166 002	21.2	– 1 710	– 1	15 740	10
Greece	11 873	16 421	17 071	2.2	649	4	5 198	44
Ireland	4 680	10 300	10 833	1.4	533	5	6 153	131
Italy	93 994	113 022	115 125	14.7	2 103	2	21 131	22
Luxembourg	2 708	5 198	5 396	0.7	198	4	2 688	99
Netherlands	25 374	31 984	32 747	4.2	763	2	7 373	29
Portugal	9 562	18 652	19 117	2.4	465	2	9 555	100
Spain	51 390	81 072	83 418	10.6	2 346	3	32 028	62
Sweden	16 592	17 855	18 406	2.3	552	3	1 814	11
United Kingdom	109 039	116 747	117 026	14.9	279	0	7 987	7
EU-15	**638 887**	**774 965**	**784 554**	**100.0**	**9 588**	**1**	**145 667**	**23**

Member States increased emissions from civil aviation between 1990 and 2002. The Member States with the highest increases in absolute terms were Germany, Italy and France. The countries with the most reductions were Greece and the Netherlands.

CO_2 emissions from 1.A.3.b: 'Road transportation' is the second largest key source in the EC accounting for 19 % of total GHG emissions in 2002. Between 1990 and 2002, CO_2 emissions from road transportation increased by 23 % in the EC (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 2002.

The Member States Germany, France and the United Kingdom contributed the most to the emissions from this source (53 %). Nearly all Member States increased emissions from road transportation between 1990 and 2002, only in Finland these emissions remained stable. The Member States

Table 3.12 Member States' contributions to CO_2 emissions from 1.A.3.c: 'Railways'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU-15 emissions in 2002 (%)S	Change 2001–2002		Change 1990–2002	
	1990	2001	2002		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	174	170	168	3.1	– 2	– 1	– 6	– 4
Belgium	202	141	142	2.6	1	1	– 60	– 30
Denmark	297	211	210	3.9	– 1	0	– 86	– 29
Finland	192	136	132	2.5	– 4	– 3	– 60	– 31
France	1 070	721	743	13.8	21	3	– 327	– 31
Germany	2 879	1 790	1 675	31.2	– 114	– 6	– 1 204	– 42
Greece	203	129	129	2.4	0	0	– 74	– 37
Ireland	147	420	124	2.3	– 296	– 70	– 23	– 15
Italy	441	381	383	7.1	1	0	– 58	– 13
Luxembourg	13	19	21	0.4	1	7	8	64
Netherlands	89	113	113	2.1	0	0	23	26
Portugal	175	119	111	2.1	– 8	– 7	– 64	– 36
Spain	414	313	304	5.7	– 10	– 3	– 111	– 27
Sweden	105	78	70	1.3	– 8	– 10	– 35	– 33
United Kingdom	1 889	1 279	1 050	19.5	– 229	– 18	– 839	– 44
EU-15	**8 290**	**6 020**	**5 373**	**100.0**	**– 647**	**– 11**	**– 2 917**	**– 35**

with the highest increases in absolute terms were Spain, France and Italy. The country with the lowest increase — apart from Finland — was Sweden.

CO_2 emissions from 1.A.3.c: 'Railways' account for 0.1 % of total EC GHG emissions in 2002. Between 1990 and 2002, CO_2 emissions from rail transportation decreased by 35 % in the EC (Table 3.12). The emissions from this key source are due to fossil fuel consumption in rail transport, which decreased by 35 % between 1990 and 2002.

The Member States Germany and the United Kingdom contributed the most to the emissions from this source (51 %). Nearly all Member States decreased emissions from rail transportation between 1990 and 2002, only Luxembourg and the Netherlands increased their emissions. The Member States with the highest decreases in absolute terms were Germany and the United Kingdom.

CO_2 emissions from 1.A.3.d: 'Navigation' account for 0.5 % of total EC GHG emissions in 2002. Between 1990 and 2002, CO_2 emissions from navigation decreased by 4 % in the EC (Table 3.13). The emissions from this key source are due to fossil fuel consumption in navigation, which decreased by 4 % between 1990 and 2002.

Four Member States (Italy, France, Spain and Greece) contributed the most to the emissions from this source (68 %). Nearly all Member States increased emissions from navigation between 1990 and 2002, 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.

CO_2 emissions from 1.A.3.e: 'Other' account for 0.2 % of total EC GHG emissions in 2002. Between 1990 and 2002, CO_2 emissions from 'Other' sources decreased by 20 % in the EC (Table 3.14). The emissions from this key source are due to fossil fuel consumption in other transportation, which decreased by 17 % between 1990 and 2002. A fuel shift occurred from oil to gas.

Two Member States (Germany and the Netherlands) contributed the most to the emissions from this source (66 %). Several Member States increased emissions from other sources between

Table 3.13 Member States' contributions to CO_2 emissions from 1.A.3.d: 'Navigation'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU-15 emissions in 2002 (%)	Change 2001–2002		Change 1990–2002	
	1990	2001	2002		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	52	64	64	0.3	0	1	12	23
Belgium	340	450	459	2.4	9	2	119	35
Denmark	551	498	554	3.0	56	11	3	1
Finland	227	464	503	2.7	39	8	276	122
France	1 896	2 149	2 433	13.0	284	13	537	28
Germany	2 050	846	738	3.9	– 108	– 13	– 1 312	– 64
Greece	1 825	2 145	1 937	10.3	– 208	– 10	112	6
Ireland	85	125	59	0.3	– 66	– 53	– 26	– 30
Italy	5 419	6 215	6 117	32.6	– 98	– 2	698	13
Luxembourg	4	6	6	0.0	0	– 5	2	46
Netherlands	877	969	923	4.9	– 47	– 5	45	5
Portugal	477	235	225	1.2	– 10	– 4	– 252	– 53
Spain	1 536	2 098	2 338	12.5	240	11	802	52
Sweden	643	664	657	3.5	– 7	– 1	13	2
United Kingdom	3 461	2 133	1 747	9.3	– 387	– 18	– 1 714	– 50
EU-15	**19 444**	**19 060**	**18 758**	**100.0**	**– 302**	**– 2**	**– 686**	**– 4**

Table 3.14 Member States' contributions to CO_2 emissions from 1.A.3.e: 'Other'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU-15 emissions in 2002 (%)	Change 2001–2002		Change 1990–2002	
	1990	2001	2002		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	223	500	361	4.0	– 139	-28	138	62
Belgium	116	85	85	0.9	0	0	– 31	– 26
Denmark	0	0	0	0.0	0	—	0	—
Finland	543	705	704	7.8	– 1	0	161	30
France	213	451	583	6.4	132	29	370	174
Germany	4 272	3 585	3 725	41.0	140	4	– 546	– 13
Greece	2 681	0	0	0.0	0	—	– 2 681	– 100
Ireland	48	108	109	1.2	1	1	61	125
Italy	406	599	643	7.1	44	7	236	58
Luxembourg	0	0	0	0.0	0	—	0	—
Netherlands	2 566	2 243	2 243	24.7	0	0	– 323	– 13
Portugal	0	0	0	0.0	0	—	0	—
Spain	20	240	283	3.1	43	18	263	1 298
Sweden	288	284	292	3.2	8	3	4	1
United Kingdom	34	49	49	0.5	0	0	15	43
EU-15	**11 410**	**8 850**	**9 076**	**100.0**	**227**	**3**	**– 2 333**	**– 20**

1990 and 2002. The decrease in Greece's emissions seems to be due to a time series inconsistency.

Table 3.15 summarises information by Member State on methodologies, emission factors, completeness and qualitative uncertainty estimates for CH_4 emissions from 1.A.3: 'Transport'. CH_4 emissions from transport decreased by 44 % between 1990 and 2002. Most Member States had decreases in this source during this time.

This source category includes one key source: CH_4 from 1.A.3.b: 'Road transportation'.

CH_4 emissions from 1.A.3.b: 'Road transportation' account for 0.1 % of total EC GHG emissions in 2002. Between 1990 and 2002, CH_4 emissions from 'Road transportation' sources decreased by 45 % in the EC (Table 3.16). Three Member States (Italy, France and Germany) contributed the most to the emissions from this source (53 %). Most Member States reduced CH_4 emissions

Table 3.15 Member States' contributions to CH_4 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 2002 (Gg CO_2 equivalents)	Methods applied (1)	EF (1)	Estimate (2)	Quality (2)
Austria	60	33	M, T1	CS	ALL	M
Belgium	99	80	C, M	C, M	F	
Denmark	57	66	C	CS/C	ALL	M
Finland	70	67	CS(M)	CS/M	ALL	M
France	765	483	C/CS	C/M/CS	ALL	L
Germany	1 334	281	CS	CS	ALL	M
Greece	114	160	C	C	ALL	
Ireland	37	52	T1	C	FULL	L
Italy	775	649	D, T3	D, C	ALL	M
Luxembourg	7	9	C/D	C/D		
Netherlands	161	84	CS/T3 (road); T1 (non-road)	CS (road)	ALL	M
Portugal	58	68	M	D+C+CS	ALL	H
Spain	232	208	C	C	ALL	L
Sweden	413	213	T1, T2	CS, C	PART	M
United Kingdom	619	249	T2/T3	D/C	ALL	L
EU-15	**4 800**	**2 702**	**C, CS, D, M, T1, T2, T3**	**C, CS, D, M**	**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 CH_4 emissions from 1.A.3.b: 'Road transportation'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU-15 emissions in 2002 (%)	Change 2001–2002		Change 1990–2002	
	1990	2001	2002		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	59	32	32	1.2	0	1		– 46
Belgium	95	79	77	3.0	– 3	– 4	– 19	– 20
Denmark	55	68	63	2.4	– 5	– 8	8	15
Finland	59	52	50	1.9	– 2	– 4	– 9	– 15
France	763	538	481	18.5	– 57	– 11	– 282	– 37
Germany	1 317	308	269	10.4	– 38	– 13	– 1 048	– 80
Greece	101	152	154	5.9	2	2	53	53
Ireland	37	53	52	2.0	– 2	– 3	15	41
Italy	744	677	612	23.6	– 65	– 10	– 132	– 18
Luxembourg	7	9	9	0.3	– 1	– 5	2	35
Netherlands	153	80	77	3.0	– 3	– 3	– 76	– 49
Portugal	57	67	67	2.6	0	1	10	18
Spain	228	212	204	7.9	– 8	– 4	– 25	– 11
Sweden	404	220	205	7.9	– 16	– 7	– 199	– 49
United Kingdom	607	272	242	9.3	– 29	– 11	– 365	– 60
EU-15	**4 687**	**2 820**	**2 593**	**100.0**	**– 226**	**– 8**	**– 2 093**	**– 45**

from 'Road transportation' between 1990 and 2002. 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 N_2O emissions from 1.A.3: 'Transport'.

N_2O emissions from 'Transport' increased by 119 % between 1990 and 2002. All Member States except Greece had decreases in this source during this time. This source category includes one key source: N_2O from 1.A.3.b: 'Road transportation'.

N_2O emissions from 1.A.3.b: 'Road transportation' account for 0.6 % of total

Table 3.17 Member States' contributions to N_2O 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 2002 (Gg CO_2 equivalents)	Methods applied (1)	EF (1)	Estimate (2)	Quality (2)
Austria	486	694	M, T1	CS	ALL	M
Belgium	358	885	C, M	C, M	F	
Denmark	147	407	M/C	M/C	ALL	L
Finland	368	590	CS (M)	CS/M	ALL	L
France	1 625	4 147	C/CS	C/M/CS	ALL	L
Germany	3 079	4 590	CS	CS	ALL	M
Greece	515	476	C	C	ALL	
Ireland	87	395	T1	C	FULL	L
Italy	1 720	3 656	D, T3	D, C	ALL	M
Luxembourg	12	55	C/D	C/D	ALL	
Netherlands	309	504	CS/T3(road); T1(rest)	CS(road)/ D(rest)	ALL	L
Portugal	150	566	M	D, C, CS	ALL	H
Spain	778	2 322	C	C	ALL	L
Sweden	352	734	T1, T2	CS, C	ALL	M
United Kingdom	1 346	4 778	T2/T3	D	ALL	L
EU-15	**11 331**	**24 799**	**C, CS, D, M, T1, T2, 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 N_2O emissions from 1.A.3.b: 'Road transportation'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU-15 emissions in 2002 (%)	Change 2001–2002		Change 1990–2002	
	1990	2001	2002		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	475	634	683	2.9	49	8	209	44
Belgium	293	790	813	3.4	23	3	519	177
Denmark	131	381	394	1.7	12	3	263	200
Finland	182	446	481	2.0	35	8	299	164
France	1 592	3 945	4 106	17.3	162	4	2 514	158
Germany	2 932	4 741	4 481	18.8	– 260	– 5	1 549	53
Greece	143	392	434	1.8	42	11	291	204
Ireland	56	342	369	1.6	27	8	313	558
Italy	1 608	3 206	3 534	14.8	328	10	1 926	120
Luxembourg	12	51	53	0.2	2	5	41	349
Netherlands	276	477	476	2.0	– 1	0	200	72
Portugal	133	522	554	2.3	32	6	421	316
Spain	673	2 039	2 197	9.2	159	8	1 524	227
Sweden	253	611	640	2.7	29	5	387	153
United Kingdom	1 028	4 265	4 584	19.3	319	7	3 556	346
EU-15	**9 787**	**22 841**	**23 799**	**100.0**	**958**	**4**	**14 012**	**143**

EC GHG emissions in 2002. Between 1990 and 2002, N_2O emissions from 'Road transportation' increased by 143 % in the EC (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.

Three Member States (the United Kingdom, Germany and France) contributed the most to the emissions from this source (55 %). All Member States increased N_2O emissions from 'Road transportation' between 1990 and 2002. The Member States with the highest increases in absolute terms were the United Kingdom, France and Italy.

Table 3.19 Member States' contributions to CO_2 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 2002 (Gg CO_2 equivalents)	Methods applied (1)	EF (1)	Estimate (2)	Quality (2)
Austria	13 815	13 651	C	CS	ALL	H
Belgium	27 230	29 624	C	C	F	
Denmark	9 152	7 428	C	CS	ALL	H
Finland	7 571	6 078	CS (T2, T1)	CS/D	ALL	H
France	94 381	97 806	C	CS	ALL	H
Germany	204 414	174 262	CS	CS	ALL	H
Greece	5 341	12 261	C	C	ALL	
Ireland	9 726	10 296	T1	CS	FULL	H
Italy	76 121	77 759	D, T2	CS	ALL	H
Luxembourg	1 277	1 390	C/D	C/D	ALL	
Netherlands	34 912	37 203	CS/T2	CS	ALL	H
Portugal	4 055	6 481	T2	D, C	ALL	H
Spain	25 953	34 300	C	C	ALL	H
Sweden	10 512	6 444	T2/T3, T1	CS	ALL	H
United Kingdom	112 538	115 076	T2	CS	ALL	H
EU-15	**636 997**	**630 058**	**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'.

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'. CO_2 emissions from 'Other sectors' decreased by 1 % between 1990 and 2002. Most Member States had increases in this source during this time. The relative growth was highest in Greece (130 %).

This source category includes three key sources: CO_2 from 1.A.4.a: 'Commercial/ Institutional', CO_2 from 1.A.4.b: 'Residential' and CO_2 from 1.A.4.c: 'Agriculture/forestry/fisheries'.

CO_2 emissions from 1.A.4.a: 'Commercial/institutional' are the fifth largest key source of GHG emissions in the EC and account for 3.7 % of total GHG emissions in 2002. Between 1990 and 2002, CO_2 emissions from services decreased by 3 % in the EC (Table 3.20). Main factors influencing CO_2 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 7 % between 1990 and 2002, with a fuel shift from coal and oil to gas. The decline in 2002, compared to 2001, was mainly due to warmer outdoor temperatures in most EC Member States.

The Member States Germany, France and the United Kingdom contributed the most to the emissions from this source (66 %). The Member States with the highest increases in absolute terms were Spain and Portugal. The Member State with the highest reduction was Germany.

CO_2 emissions from 1.A.4.b: 'Residential' are the fourth largest key source of GHG emissions in the EC and account for 10 % of total GHG emissions in 2002. Between 1990 and 2002, CO_2 emissions from households increased by 1 % in the EC (Table 3.21). Main factors influencing CO_2 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

Table 3.20 Member States' contributions to CO_2 emissions from 1.A.4.a: 'Commercial/ institutional'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU-15 emissions in 2002 (%)	Change 2001–2002		Change 1990–2002	
	1990	2001	2002		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	1 767	1 904	1 207	0.8	– 697	– 37	– 560	– 32
Belgium	4 278	6 320	6 047	3.9	– 273	– 4	1 769	41
Denmark	1401	820	800	0.5	– 21	– 3	– 601	– 43
Finland	201	1 317	1 318	0.9	0	0	1 117	557
France	26 529	32 458	28 321	18.4	– 4137	– 13	1 793	7
Germany	61 816	49 551	47 429	30.9	– 2122	– 4	– 14 386	– 23
Greece	523	1 002	1 030	0.7	28	3	507	97
Ireland	2 314	3 082	2 999	2.0	– 83	– 3	685	30
Italy	15 528	18 128	17 267	11.2	– 862	– 5	1 738	11
Luxembourg	607	669	656	0.4	– 13	– 2	49	8
Netherlands	6604	10 075	10 175	6.6	101	1	3 571	54
Portugal	751	2 628	2 830	1.8	201	8	2 079	277
Spain	3 684	7 350	6 704	4.4	– 646	– 9	3 020	82
Sweden	2 532	1 303	1 220	0.8	– 82	– 6	– 1 312	– 52
United Kingdom	30 270	29 446	25 558	16.6	– 3888	– 13	– 4 712	– 16
EU-15	**158 803**	**166 052**	**153 560**	**100.0**	**– 12 492**	**– 8**	**– 5 243**	**– 3**

Table 3.21 Member States' contributions to CO_2 emissions from 1.A.4.b 'Residential'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU-15 emissions in 2002 (%)	Change 2001–2002		Change 1990–2002	
	1990	2001	2002		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	10 156	10 919	10 448	2.5	– 471	– 4	291	3
Belgium	20 222	22 407	21 296	5.1	– 1 111	– 5	1 074	5
Denmark	5 061	4 312	4 061	1.0	– 251	– 6	– 1 000	– 20
Finland	5 190	2 658	2 686	0.6	29	1	– 2 503	– 48
France	57 147	63 375	59 017	14.2	– 4 358	– 7	1 871	3
Germany	129 279	131 237	120 090	28.9	– 11 147	– 8	– 9 190	– 7
Greece	4 684	8 170	8 518	2.0	349	4	3 834	82
Ireland	6 752	6 479	6 461	1.6	– 18	0	– 291	– 4
Italy	52 254	54 750	52 233	12.6	– 2 517	– 5	– 21	0
Luxembourg	609	672	658	0.2	– 13	– 2	49	8
Netherlands	19 881	20 448	20 196	4.9	– 252	– 1	315	2
Portugal	1 630	2 244	2 305	0.6	60	3	675	41
Spain	12 982	16 813	16 505	4.0	– 308	– 2	3 524	27
Sweden	6 350	4 127	3 736	0.9	– 391	– 9	– 2 614	– 41
United Kingdom	79 078	89 250	87 638	21.1	– 1 611	– 2	8 561	11
EU-15	**411 274**	**437 859**	**415 849**	**100.0**	**– 22 010**	**– 5**	**4 575**	**1**

warm water. Fossil fuel consumption in households increased by 9 % between 1990 and 2002, with a fuel shift from coal and oil to gas. The decline in 2002, compared to 2001, was mainly due to warmer outdoor temperatures in most EC Member States.

Between 1990 and 2002, the largest reduction in absolute terms was reported by Germany reducing emissions by 9 million tonnes. Also the Nordic countries show emission reductions of more than 1 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 CO_2 emissions from households (but increases emissions from energy industries if fossil fuels are used). In Germany, efficiency improvements and the fuel switch in eastern German households are two reasons for the emission reductions.

Table 3.22 Member States' contributions to CO_2 emissions from 1.A.4.c: 'Agriculture/ forestry/fisheries'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU-15 emissions in 2002 (%)	Change 2001–2002		Change 1990–2002	
	1990	2001	2002		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	1 892	2 002	1 997	3.3	– 6	0	105	6
Belgium	2 730	2 313	2 281	3.8	– 32	– 1	– 449	– 16
Denmark	2 691	2 639	2 567	4.2	– 72	– 3	– 124	– 5
Finland	2 181	2 047	2 074	3.4	27	1	– 107	– 5
France	10 705	10 246	10 468	17.3	221	2	– 38	– 2
Germany	13 319	7 411	6 743	11.1	– 669	– 9	– 6 576	– 9
Greece	134	2 717	2 713	4.5	– 5	0	2 579	1 924
Ireland	660	853	836	1.4	– 17	– 2	177	27
Italy	8 339	8 310	8 260	13.6	– 51	– 1	– 79	– 1
Luxembourg	61	84	75	0.1	– 9	– 11	14	23
Netherlands	8 427	6 892	6 832	11.3	– 61	– 1	– 1 595	– 19
Portugal	1 675	1 381	1 346	2.2	– 35	– 3	– 329	– 20
Spain	9 287	10 694	11 091	18.3	397	4	1 803	19
Sweden	1 630	1 494	1 488	2.5	– 7	0	– 142	– 9
United Kingdom	3 190	2 106	1 880	3.1	– 226	– 11	– 1 310	– 41
EU-15	**66 920**	**61 192**	**60 649**	**100.0**	**– 542**	**– 1**	**– 6 271**	**– 9**

Table 2.23 Member States' contributions to CH_4 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 2002 (Gg CO_2 equivalents)	Methods applied (1)	EF (1)	Estimate (2)	Quality (2)
Austria	395	274	C	CS	ALL	L
Belgium	129	108	C	D	F	
Denmark	88	164	C	CS/C	ALL	M
Finland	268	328	CS (T2, T1)	CS/PS	ALL	L
France	3 986	3 088	C	CS	ALL	L
Germany	2 684	645	CS	CS	ALL	M
Greece	163	217	C	C	ALL	
Ireland	89	50	T1	C	FULL	L
Italy	323	489	D, T2	D, C	ALL	M
Luxembourg	12	7	C/D	C/D	ALL	
Netherlands	428	428	CS/T2	CS	ALL	M
Portugal	348	309	T2	D, C	ALL	M
Spain	838	650	C	C	ALL	L
Sweden	228	234	T2/T3, T1	CS	ALL	M
United Kingdom	1 468	695	T2	CS/C/D	ALL	L
EU-15	**11 447**	**7 685**	**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'.

CO_2 emissions from 1.A.4.c: 'Agriculture/forestry/fisheries' account for 1.5 % of total EC GHG emissions in 2002. Between 1990 and 2002, CO_2 emissions from 'Agriculture/forestry/ fisheries' decreased by 9 % in the EC (Table 3.22).

Three Member States (Spain, France and Italy) contributed the most to the emissions from this source (49 %). The Member States with the highest increases in absolute terms were Greece and Spain, the highest decreases were in Germany and in the Netherlands. In the Netherlands, this decrease was due to significant energy conservation measures in the greenhouse horticulture which account for approximately 85 % of the primary energy use of the Dutch agricultural sector.

Table 3.23 summarises information by Member State on methodologies,

Table 3.24 Member States' contributions to CH_4 emissions from 1.A.4.b: 'Residential'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU-15 emissions in 2002 (%)	Change 2001–2002		Change 1990–2002	
	1990	2001	2002		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	385	258	247	3.5	– 11	– 4	– 138	– 36
Belgium	122	102	99	1.4	– 2	– 2	– 22	– 18
Denmark	67	100	97	1.4	– 3	– 3	30	45
Finland	234	270	274	3.9	4	1	39	17
France	3 908	3 385	3 022	43.4	– 363	– 11	– 886	– 23
Germany	2 507	582	553	7.9	– 29	– 5	– 1 954	– 78
Greece	147	206	207	3.0	1	0	60	41
Ireland	84	45	44	0.6	– 1	– 1	– 39	– 47
Italy	260	399	344	4.9	– 54	– 14	84	32
Luxembourg	6	4	3	0.0	– 1	– 29	-3	– 45
Netherlands	352	359	356	5.1	– 3	– 1	3	1
Portugal	344	303	303	4.4	0	0	-41	– 12
Spain	775	603	589	8.5	– 14	– 2	– 186	– 24
Sweden	218	205	217	3.1	12	6	-1	– 1
United Kingdom	1 381	682	606	8.7	– 77	– 11	– 775	– 56
EU-15	**10 790**	**7 503**	**6 961**	**100.0**	**– 542**	**– 7**	**– 3 829**	**– 35**

Table 3.25 Member States' contributions to N_2O 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 2002 (Gg CO_2 equivalents)	Methods applied (1)	EF (1)	Estimate (2)	Quality (2)
Austria	275	318	C	CS	ALL	L
Belgium	784	768	C	D	F	
Denmark	111	94	C	C	ALL	L
Finland	227	247	CS (T2, T1)	CS/PS	ALL	L
France	1 293	1 338	C	CS	ALL	L
Germany	1 748	565	CS	CS	ALL	M
Greece	290	774	C	C	ALL	
Ireland	328	401	T1	C	FULL	L
Italy	3 438	3 177	D, T2	D, C	ALL	M
Luxembourg	6	6	C/D	C/D	ALL	
Netherlands	29	26	CS/T1	D	ALL	L
Portugal	237	195	T2	D, C	ALL	L
Spain	727	894	C	C	ALL	L
Sweden	424	381	T2/T3, T1	CS	PART	M
United Kingdom	613	329	T2	CS/D	ALL	L
EU-15	**10 529**	**9 513**	**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'.

emission factors, completeness and qualitative uncertainty estimates for CH_4 from 1.A.4: 'Other sectors'. CH_4 emissions from 'Other sectors' decreased by 33 % between 1990 and 2002. Most Member States had decreases in this source during this time. The relative growth was highest in Denmark (86 %), the decrease was highest in Germany (76 %).

This source category includes one key source: CH_4 from 1.A.4.a: 'Residential'.

CH_4 emissions from 1.A.4.b: 'Residential' account for 0.2 % of total GHG emissions in 2002. Between 1990 and 2002, CH_4 emissions from households decreased by 35 % in the EC. France contributed by 43 % to this source. Between 1990 and 2002, the

Table 3.26 Member States' contributions to N_2O emissions from 1.A.4.b: 'Residential'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU-15 emissions in 2002 (%)	Change 2001–2002		Change 1990–2002	
	1990	2001	2002		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	138	143	137	2.5	– 5	– 4	0	0
Belgium	517	550	502	9.3	– 48	– 9	– 15	– 3
Denmark	57	54	51	0.9	– 2	– 5	– 6	– 11
Finland	64	74	75	1.4	1	1	11	16
France	976	1 055	973	17.9	– 82	– 8	-3	0
Germany	1 113	425	385	7.1	– 40	– 9	– 728	– 65
Greece	253	409	422	7.8	13	3	169	67
Ireland	184	200	200	3.7	0	0	16	9
Italy	2 122	1 841	1 772	32.7	– 68	– 4	– 350	– 16
Luxembourg	3	3	3	0.1	0	– 5	0	– 1
Netherlands	18	16	16	0.3	0	– 1	– 2	– 10
Portugal	84	77	77	1.4	0	0	– 7	– 8
Spain	491	583	546	10.1	– 37	– 6	55	11
Sweden	120	96	96	1.8	0	0	– 25	– 21
United Kingdom	277	189	170	3.1	– 19	– 10	– 108	– 39
EU-15	**6 418**	**5 713**	**5 425**	**100.0**	**– 288**	**– 5**	**– 993**	**– 15**

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	Stationary: Not directly attributable to Sectors 1 to 4	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

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'. N_2O emissions from 'Other sectors' decreased by 10 % between 1990 and 2002. Most Member States had decreases in this source during this time. The relative growth was highest in Greece (166 %), the decrease was highest in Germany (68 %).

This source category includes one key source: N_2O from 1.A.4.b: 'Residential'. N_2O emissions from 1.A.4.b: 'Residential' account for 0.1 % of total GHG emissions in 2002. Between 1990 and 2002, N_2O emissions from households decreased by 15 % in the EC (Table 3.26). Italy and France contributed the most to this source (51 %). Between 1990 and 2002, the largest reductions in absolute terms was reported by Germany and Italy. Greece had the largest emission increases in absolute terms.

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'.

Table 3.28 Member States' contributions to CO_2 emissions from 1.A.5: 'Other' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2002 (Gg CO_2 equivalents)	Methods applied (1)	EF (1)	Estimate (2)	Quality (2)
Austria	35	41	M, CS	CS	ALL	H
Belgium	166	98	C	C	NE	
Denmark	119	89				
Finland	972	1 174	CS (T2, T1)	CS/D	ALL	H
France	0	0	C	CS	NO	
Germany	11 826	1 947	CS	CS	ALL	H
Greece	0	0				
Ireland	NO	NO	NA	NA	NE	NE
Italy	1 041	314	D, T2	CS	ALL	H
Luxembourg	0	0	C/D	C/D	ALL	
Netherlands	1	0	CS/T2	CS	ALL/IE	M
Portugal	8	0	T2	D, C		
Spain	0	0	NE		IE	
Sweden	844	316	T2/T3, T1	CS	ALL	H
United Kingdom	5 265	3 045	T2	CS	ALL	M
EU-15	**20 278**	**7 023**	**C, CS, D, M, T1, T2, T3**	**C, CS, D**	**ALL, IE, 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 3.29 Member States' contributions to CO_2 emissions from 1.A.5: 'Other'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU-15 emissions in 2002 (%)	Change 2001–2002		Change 1990–2002	
	1990	2001	2002		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	35	43	41	0.6	– 3	– 6	6	16
Belgium	166	98	98	1.4	0	0	– 69	– 41
Denmark	119	97	89	1.3	– 8	– 8	– 30	– 25
Finland	972	1 284	1 174	16.7	– 110	– 9	202	21
France	0	0	0	0.0	0	—	0	—
Germany	11 826	1 923	1 947	27.7	25	1	– 9 879	– 84
Greece	0	0	0	0.0	0	—	0	—
Ireland	NO	NO	NO	—	—	—	—	—
Italy	1 041	354	314	4.5	– 40	– 11	– 727	– 70
Luxembourg	0	0	0	0.0	0	—	0	—
Netherlands	1	0	0	0.0	0	– 100	– 1	– 100
Portugal	8	0	0	0.0	0	—	-8	– 100
Spain	0	0	0	0.0	0	—	0	—
Sweden	844	268	316	4.5	49	18	– 527	– 62
United Kingdom	5 265	2 909	3 045	43.4	136	5	– 2 220	– 42
EU-15	**20 278**	**6 976**	**7 023**	**100.0**	**48**	**1**	**– 13 254**	**– 65**

Table 3.28 and Table 3.29 summarise information by Member State on emission trends, methodologies, emission factors, completeness and qualitative uncertainty estimates for the key source CO_2 from 1.A.5: 'Other'.

CO_2 emissions from 1.A.5: 'Other' account for 0.2 % of total GHG emissions in 2002. Between 1990 and 2002, CO_2 emissions from this source decreased by 65 % in the EC. The United Kingdom contributed by 43 % to these emissions. Between 1990 and 2002, the largest reduction in absolute terms was reported by Germany, which was partly due to reduced military operations after German reunification.

Table 3.30 Member States' contributions to 1.B.1: 'Fugitive CO_2 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 2002 (Gg CO_2 equivalents)	Methods applied (1)	EF (1)	Estimate (2)	Quality (2)
Austria	0	0			NA	NA
Belgium	0	0	NA	NA	P	
Denmark	0	0	NO		NO	
Finland	3 500	3 500	CS	CS	ALL	L
France	0	0	C	CS	IE	H
Germany	NE	NE	NO	NO	NO	
Greece	0	0			PART	
Ireland	NO	0	NA	NA	NO	NA
Italy	0	0			NO	
Luxembourg	0	0	C/D	C/D	ALL	
Netherlands	0	0	IE		IE	
Portugal	9	0	MB	C	ALL	H
Spain	18	14	CS, C	PS, C	ALL	H
Sweden	947	1041	T2/T3	CS	ALL	H
United Kingdom	3 000	2 003	T2/T3	CS	ALL	M
EU-15	**7 474**	**6 558**	**C, CS, D, MB, T2, T3**	**C, CS, PS**	**ALL, IE, 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 CO_2 emissions from solid fuel transformation'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU-15 emissions in 2002 (%)	Change 2001–2002		Change 1990–2002	
	1990	2001	2002		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	IE	IE	IE	—	—	—	—	—
Belgium	0	NA	NA	—	—	—	—	—
Denmark	NO	NO	NO	—	—	—	—	—
Finland	0	0	0	0.0	0	—	0	—
France	0	0	0	0.0	0	—	0	—
Germany	NE	NE	NE	—	—	—	—	—
Greece	0	NE	NE	—	—	—	—	—
Ireland	NO	NO	NO	—	—	—	—	—
Italy	NO	NO	NO	—	—	—	—	—
Luxembourg	0	0	0	0.0	0	—	0	—
Netherlands	IE	IE	IE	—	—	—	—	—
Portugal	0	0	0	0.0	0	—	0	—
Spain	18	15	14	0.7	0	– 1	– 3	– 18
Sweden	NO	NO	NO	—	—	—	—	—
United Kingdom	3 000	2 218	2 003	99.3	– 215	– 10	– 997	– 33
EU-15	**3 018**	**2 233**	**2 018**	**100.0**	**– 215**	**– 10**	**– 1 000**	**– 33**

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 CO_2 emissions from 1.B.1: 'Fugitive emissions from solid fuels'. CO_2 emissions from 'Fugitive emissions from solid fuels' decreased by 12 % between 1990 and 2002. Most Member States did not report any emissions from this source.

This source category includes one key source: CO_2 from 1.B.1.b: 'Fugitive emissions from solid fuel transformation'.

Table 3.32 Member States' contributions to 1.B.1: 'Fugitive CH_4 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 2002 (Gg CO_2 equivalents)	Methods applied (1)	EF (1)	Estimate (2)	Quality (2)
Austria	11	6	T1	D	ALL	L
Belgium	44	24	C	C	P	
Denmark	72	62	D	D	ALL	L
Finland	21	21	CS	CS	ALL	L
France	4 331	1 459	C	CS	ALL	M
Germany	27 599	9 110	CS	CS	ALL	L
Greece	926	1 487	T1	D	PART	
Ireland	0	0	NA	NA	NO	NA
Italy	117	66	D, C	D, CS	ALL	M
Luxembourg	0	0	C/D	C/D	ALL	
Netherlands	0	0	IE		IE	
Portugal	66	0	T2	D, C	ALL	M
Spain	1 789	1 019	T1	CS	ALL	M
Sweden	0	0	T2/T3	CS	ALL	M
United Kingdom	17 203	5 135	T2	CS	ALL	M
EU-15	**52 180**	**18 389**	**C, CS, D, T1, T2, T3**	**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 3.33 Member States' contributions to a 1.B.1.a: 'Fugitive CH_4 emissions from coal-mining'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU-15 emissions in 2002 (%)	Change 2001–2002		Change 1990–2002	
	1990	2001	2002		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	11	6	6	0.0	0	0	– 5	– 50
Belgium	0	0	0	0.0	0	—	0	—
Denmark	0	0	0	0.0	0	—	0	—
Finland	0	0	0	0.0	0	—	0	—
France	3 569	1 484	1 320	8.1	– 164	– 11	– 2 248	– 63
Germany	25 644	7 657	7 260	44.8	– 396	– 5	– 18 384	– 72
Greece	926	1 400	1 487	9.2	87	6	561	61
Ireland	0	0	0	0.0	0	—	0	—
Italy	50	20	23	0.1	3	17	– 27	– 54
Luxembourg	0	0	0	0.0	0	—	0	—
Netherlands	0	0	0	0.0	0	—	0	—
Portugal	66	0	0	0.0	0	—	– 66	– 100
Spain	1 766	1 038	1 000	6.2	-38	– 4	– 766	– 43
Sweden	0	0	0	0.0	0	—	0	—
United Kingdom	17 188	5 099	5 127	31.6	27	1	– 12 061	– 70
EU-15	**49 220**	**16 703**	**16 223**	**100.0**	**– 481**	**– 3**	**– 32 997**	**– 67**

CO_2 emissions from 1.B.1.b: 'Fugitive CO_2 emissions from solid fuel transformation' account for 0.05 % of total GHG emissions in 2002. Between 1990 and 2002, CO_2 emissions from this source decreased by 33 % in the EC (Table 3.31). Most Member States did not report emissions from this source. Between 1990 and 2002, both reporting Member States, the United Kingdom and Spain, had emission reductions.

Table 3.32 summarises information by Member State on methodologies, emission factors, completeness and qualitative uncertainty estimates for the CH_2 emissions from the source 1.B.1: 'Fugitive emissions from solid

Table 3.34 Member States' contributions to 1.B.2: 'Fugitive CO_2 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 2002 (Gg CO_2 equivalents)	Methods applied (1)	EF (1)	Estimate (2)	Quality (2)
Austria	102	167	T1, CS	D, CS, PS	PART	L
Belgium	84	145	CS	CS	P	
Denmark	240	535	C	C	ALL	L
Finland	42	23	CS	PS	PART	M
France	4 306	3 912	C	CS	ALL	H
Germany	NE	NE	NE	NE	NE	
Greece	0	0			PART	
Ireland	139	65	T1	CS	FULL	M
Italy	3 048	1 924	C, CS	CS	ALL	M
Luxembourg	0	0	C/D	C/D	ALL	
Netherlands	308	1 640	CS/T3 (>97 T1)	CS	PART	L
Portugal	118	708	MB	C, PS	ALL	H
Spain	1 743	2 149			ALL	H
Sweden	22	3	CS	CS	PART	L
United Kingdom	9 138	5 519	T3	CS	ALL	H
EU-15	**19 289**	**16 791**	**C, CS, MB, T1, T3**	**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'.

fuels'. CH_4 emissions from 'Fugitive emissions from solid fuels' decreased by 65 % between 1990 and 2002. In relative terms, the United Kingdom had the highest reductions, while Greece had the highest increases in emissions from this source.

This source category includes one key source: CH_4 from 1.B.1.a: 'Fugitive emissions from coal-mining'.

CH_4 emissions from 1.B.1.a: 'Fugitive CH_4 emissions from coal-mining' account for less than 0.04 % of total GHG emissions in 2002. Between 1990 and 2002, CO_2 emissions from this source decreased by 67 % in the EC (Table 3.33). Several Member States did not report emissions from this source. In 2002, the largest share on total emissions from this source had Germany and the United Kingdom (76 %). Both Member States reduced their emissions between 1990 and 2002 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 CO_2 emissions from the source 1.B.2: 'Fugitive emissions from oil and natural gas'. CO_2 emissions from 'Fugitive emissions from oil and natural gas' decreased by 13 % between 1990 and 2002.

This source category includes one key source: CO_2 from 1.B.2.c: 'Venting and flaring'.

Fugitive CO_2 emissions from 1.B.2.c: 'Venting and flaring' account for 0.1 % of total GHG emissions in 2002. Between 1990 and 2002, CO_2 emissions from this source decreased by 34 % in the EC (Table 3.35). The United Kingdom was responsible for 76 % of the emissions from this source. The reductions in the United Kingdom (40 %) contributed

Table 3.35 Member States' contributions to a 1.B.2.c: 'CO_2 emissions from venting and flaring'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU-15 emissions in 2002 (%)	Change 2001–2002		Change 1990–2002	
	1990	2001	2002		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	0	0	0	0.0	0	—	0	—
Belgium	84	144	145	2.4	1	1	61	73
Denmark	240	633	535	8.9	– 98	– 15	295	123
Finland	42	23	23	0.4	0	0	– 19	– 46
France	297	341	277	4.6	– 64	– 19	– 19	– 7
Germany	NE	NE	NE	—	—	—	—	—
Greece	0	0	0	0.0	0	—	0	—
Ireland	NO	56	0	0.0	– 56	– 100	—	—
Italy	681	218	202	3.4	– 16	– 7	– 478	– 70
Luxembourg	0	0	0	0.0	0	—	0	—
Netherlands	0	0	0	0.0	0	—	0	—
Portugal	49	52	53	0.9	1	2	5	10
Spain	179	202	218	3.6	16	8	39	22
Sweden	0	0	0	0.0	0	—	0	—
United Kingdom	7 571	4 961	4 573	75.9	– 388	– 8	– 2 998	– 40
EU-15	**9 141**	**6 630**	**6 027**	**100.0**	**– 603**	**– 9**	**– 3 115**	**– 34**

Table 3.36 Member States' contributions to 1.B.2: 'Fugitive CH_4 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 2002 (Gg CO_2 equivalents)	Methods applied (1)	EF (1)	Estimate (2)	Quality (2)
Austria	267	298	T1, CS	D	ALL	L
Belgium	480	404	CS	CS	P	
Denmark	21	70	C	C	ALL	L
Finland	4	8	CS	PS	PART	M
France	2 471	1 893	C	CS	ALL	M
Germany	8 465	7 302	CS	CS	ALL	M
Greece	5	191	T1, C	D, C	PART	
Ireland	151	82	T1	CS	FULL	M
Italy	6 666	5 100	C, CS	CS	ALL	H
Luxembourg	28	58	C/D	C/D	ALL	
Netherlands	3 754	2 523	CS/T1	CS	ALL	L
Portugal	35	299	C, T2	D, C	PART	M
Spain	584	1 167	CS, C	PS, C	ALL	M
Sweden	0	0	T2, CS	CS	PART	M
United Kingdom	10 779	8 171	T3	CS	ALL	M
EU-15	**33 707**	**27 564**	**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'.

mainly to the reduction trend in the EC between 1990 and 2002.

Table 3.36 summarises information by Member State on methodologies, emission factors, completeness and qualitative uncertainty estimates for the CH_4 emissions from the source 1.B.2: 'Fugitive emissions from oil and natural gas'. CH_4 emissions from 'Fugitive emissions from oil and natural gas' decreased by 18 % between 1990 and 2002.

This source category includes one key source: CH_4 from 1.B.2.a: 'CH_4 emissions from oil'.

Table 3.37 Member States' contributions to a 1.B.2.a: 'CH_4 emissions from oil'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2002	Change 2001–2002		Change 1990–2002	
	1990	2001	2002		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	101	92	94	15.2	2	2	– 7	– 7
Belgium	3	4	5	0.8	1	15	2	56
Denmark	1	1	1	0.1	0	– 2	0	16
Finland	0	0	0	0.0	0	—	0	—
France	6	3	4	0.6	0	7	– 3	– 46
Germany	227	133	86	13.8	– 48	– 36	– 141	– 62
Greece	2	28	28	4.5	0	– 1	26	1 310
Ireland	0	0	0	0.0	0	—	0	—
Italy	127	67	77	12.5	11	16	– 50	– 39
Luxembourg	0	0	0	0.0	0	—	0	—
Netherlands	6	0	0	0.0	0	– 8	– 1	– 100
Portugal	35	42	44	7.2	3	6	9	26
Spain	30	34	33	5.4	0	– 1	3	11
Sweden	0	0	0	0.0	0	1	0	– 88
United Kingdom	1 962	262	247	39.9	– 15	– 6	– 1 715	– 87
EU-15	**2 501**	**666**	**619**	**100.0**	**– 47**	**– 7**	**– 1 882**	**– 75**

Table 3.38 Uncertainty of the key source categories in the CRF Sector 1: 'Energy'

Source category gas	2002	Quality estimate
1.A.1: Energy industries (CO_2)	1 146 183	H
1.A.3: Transport (CO_2)	841 230	H
1.A.4: Other sectors (CO_2)	630 058	H
1.A.2: Manufacturing industries and construction (CO_2)	583 070	H
1.B.2: Oil and natural gas (CO_2)	16 791	H
1.A.5: Other (CO_2)	7 023	H
1.B.2: Oil and natural gas (CH_4)	27 564	M
1.B.1: Solid fuels (CO_2)	6 558	M
1.A.3: Transport (CH_4)	2 702	M
1.A.4: Other sectors (N_2O)	9 513	M
1.A.3: Transport (N_2O)	24 799	L
1.B.1: Solid fuels (CH_4)	18 389	L
1.A.4: Other sectors (CH_4)	7 685	L
1.A.1: Energy industries (N_2O)	15 644	L

Note: Many of these source categories are more aggregated than the EC key source categories identified in Section 1.5 because the qualitative uncertainty estimates in CRF Table 7 refer to more aggregated source categories.

CH_4 emissions from 1.B.2.a 'Fugitive CH_4 emissions from oil' account for 0.02 % of total GHG emissions in 2002. Between 1990 and 2002, CH_4 emissions from this source decreased by 75 % in the EC (Table 3.37). The United Kingdom was responsible for 40 % of the emissions from this source. The decreases in the United Kingdom (– 87 %) contributed largely to the reduction trend in the EC between 1990 and 2002.

3.3 Methodological issues and uncertainties

The previous section presented for each EC 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.

The qualitative uncertainty estimation for the key sources in Table 3.38 are based on the quality estimates (high, medium and low) provided by the Member States in the CRF Table 7. The quality estimates were weighted according to Member States' share on the total emissions (see Section 1.7). The table shows that 97 % of energy-related key source emission estimates can be classified as being of high quality.

3.4 Sector-specific quality assurance and quality control

The main sector-specific QA/QC activity is the project lead by Eurostat on the harmonisation of the energy data used for energy balances and CO_2 inventories. The work programme for this project foresees that Member States perform the following tasks:

- examine the energy data used by the two submissions (CRF to UNFCCC and the European Commission's DG Environment, and joint questionnaires to Eurostat and the IEA) for 1990, 1995 and 2000 and identify and explain the differences;
- establish a procedure at national level that will eliminate discrepancies in the two reporting mechanisms in future; this procedure will be agreed with Eurostat;
- provide the updated energy data in the form of annual questionnaires for the period 1990–2000 ensuring comparable data under the two reporting mechanisms.

At the end of year 2000 the first countries co-financed to carry out this work were Denmark, Sweden, the Netherlands and Norway. In 2001 Eurostat continued this project with the provision of grants to Austria, Germany, France and the United Kingdom. In 2002 grants were issued for Ireland, Italy and Portugal and in 2003 a grant was issued for Greece. Denmark, Sweden, Austria, the Netherlands, the United Kingdom, Germany, Portugal and France have already submitted the final report to Eurostat, while Italy, Ireland and Greece will submit their final reports in 2004.

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 CO_2 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 EC 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 EC Member States and accession and candidate countries, the European Commission (DG Environment, Eurostat), the EEA and ETC/ACC. Representatives from the IEA, the UNFCCC Secretariat and the European non-energy use research network, attended as observers. The workshop report with the recommendations can be downloaded from the ETC/ACC website: http://air-climate.eionet.eu.int/. The most important recommendations of the workshop are as follows.

Fuel categorisation

- Countries should transparently report the mapping of fuel categories in their national inventory reports and in the joint questionnaires.

Emissions from domestic and international aviation and shipping navigation
- International organisations are encouraged to assist countries with data.
- More advanced countries are encouraged to share their approaches.
- Inventory experts are encouraged to share methods with energy experts.
- Countries should transparently report how they separate international from domestic aviation and navigation in both their greenhouse gas inventories and their energy statistics.

Non-energy use of fuels
- Countries should transparently report methodologies, definitions and assumptions used in the reporting of non-energy fuel use.
- Activities by the European non-energy use (NEU) network should be further developed in the direction of a simple model and a realistic approach for an improved estimation methodology of non-energy fuel use and updated default storage factors.

Calorific values
- Countries and international organisations should transparently report the calorific values.
- Countries should strive for consistent reporting of calorific values in all energy questionnaires as well as for GHG inventories.

Emission factors
- Transparency of emission factors used at country and international level should be increased (Eurostat/IEA).
- Country-specific emission factors should be used to the extent possible by international organisations (Eurostat/IEA).
- Changes (e.g. fuel quality) over time should be reflected in emission factors.

Uncertainties
- Statistical institutes are encouraged to provide quantitative uncertainty estimates at the relevant reporting levels.
- Further work on approaches and methods to estimate uncertainties of energy data should be carried out.

Autoproduction of electricity and heat
- Countries are encouraged to strengthen their efforts to gather data that allows a further disaggregation of autoproduction and allocate the emissions in a transparent way.

Non-commercial fuels (biomass, waste, peat)
- Countries should strive to achieve complete reporting of biomass fuels and peat.
- Further exchange of information is needed on methods and approaches how such data can be collected (e.g. surveys of end users).
- Countries are encouraged to collect data on fossil and biogenic carbon fractions as well as on emission factors in waste fuels and biomass fuels (e.g. for municipal solid wastes)

Statistical differences
- Countries with significant statistical differences should start more in-depth analysis to find explanations for these differences in order to eliminate statistical differences if possible.
- Countries should transparently report what they include in statistical differences.

Sectoral breakdown of final energy use
- Countries should try to organise surveys for an improved breakdown.
- Exchange of countries' experiences and transparency of reporting should be strengthened.
- Eurostat is encouraged to repeat surveys on households and services addressing the EC and the country level.
- Harmonisation of IPCC and IEA sectoral split during revision IPCC guidelines should be further discussed.

Facility/plant source data
- Countries should check consistencies of data collected under different systems, in particular for non-energy use of fuels.
- Countries should consider facility/plant level data for improving energy statistics.

Separation of process (non-combustion) emissions in industry sector from combustion emissions in energy sector in iron and steel industry
- Countries should strive to have separate surveys and improve data used in models and estimation methodologies.
- Countries should enhance exchange of experiences on models and methodologies used.
- To the extent possible countries should try to exclude coke production from the iron and steel industry sector.
- Countries should strive for consistent use of calorific value and carbon content of coke oven gas and blast-furnace gas if this is (partially) sold outside the iron and steel industry.

Legal basis for reporting of energy balances and energy parts of the inventory
- Countries are encouraged to allocate more resources to energy data collection.
- Countries are encouraged to strengthen their legal basis of energy statistics and energy-related emissions where appropriate.
- Further discussion on the legal basis at EC level on energy statistics is necessary.

Timeliness
- Further cooperation is needed between GHG inventory and energy balance compilers.
- Countries are encouraged to use short-term methods on the basis of preliminary energy data.
- Countries are strongly encouraged to keep the IEA/Eurostat deadline of 1 November.

Confidentiality
- Improve access, where relevant, to confidential data for GHG inventory compilers when this information is available to energy statistics institutes, in order to provide aggregated estimates for the inventories and to check for data consistencies.

Dataflow
- Countries should continue to implement a consistent dataflow from national organisations to international organisations (IEA/Eurostat and the UNFCCC). Revisions of time series should be transparently reported.
- International organisations (IEA/Eurostat) should assist consistent dataflow by providing clear methodological guidance how the annual energy questionnaires should be filled in.
- An energy statistics manual from Eurostat/IEA is needed before the next annual energy data collection.

Consistent time series
- As part of the national inventory systems, energy statistical institutes should also improve and document time series consistency of energy data.
- Reporting of time series to international organisations (IEA/Eurostat) should be further facilitated (harmonisation of five energy questionnaires).

Documentation
- National and international organisations (IEA/Eurostat) responsible for energy data collection and reporting should consider improving the transparency/documentation.
- Subsequent versions of the comprehensive set of extended national energy balances (set for all years since 1990) and description of changes between them should be identified.

Exports and imports of fuels, consistency of trade and energy statistics

- Countries should aim at improving the collection and reporting of data on small exports of fuels and oil products.
- Countries should aim at improving the consistency between data on foreign trades and energy statistics, also aiming at reducing statistical differences.

As a follow-up of this workshop, in May 2004 a workshop on international bunker fuels will be organised (see Section 3.7).

3.5 Sector-specific recalculations

Table 3.39 shows that in the energy sector the largest recalculations in absolute terms were made for CO_2 both in 1990 and 2001. However, in relative terms the recalculations of CO_2 emissions in the energy sector were below 1 %.

Table 3.40 provides an overview of Member States' contributions to EC recalculations. In absolute terms, Austria had the most influence on CO_2 recalculations in the EC. For CH_4 it was Germany and for N_2O there were several Member States contributing an equal amount to the recalculations. Explanations for the largest recalculations by Member State are provided in Section 10.1.

3.6 Comparison between the sectoral approach and the reference approach

The IPCC reference approach for CO_2 from fossil fuels for the EC is based on Eurostat energy data (NewCronos database, October 2003 version). This

Table 3.39 Recalculations of total greenhouse gas emissions and recalculations of greenhouse gas emissions in CRF Sector 1: 'Energy' for the years 1990 and 2001 by gas in Gg and percentage

1990	CO_2		CH_4		N_2O		HFCs		PFCs		SF_6	
	Gg	(%)	Gg	(%)	Gg	(%)	Gg	(%)	Gg	(%)	Gg	(%)
Total emissions and removals	96 422	3.1	36 845	8.9	– 16 489	– 4.0	1 293	5.0	2 687	20.1	1 957	23.5
Energy	8 989	0.3	5 384	5.4	– 1 875	– 4.0	NO	NO	NO	NO	NO	NO
2001												
Total emissions and removals	70 582	2.2	26 684	8.1	– 9 674	– 2.8	3 112	7.2	– 4	– 0.1	– 620	– 6.5
Energy	13 007	0.4	3 946	6.8	– 2 738	– 4.6	NO	NO	NO	NO	NO	NO

Table 3.40 Contribution of Member States to EC recalculations in CRF Sector 1: 'Energy' for 1990 by gas (difference between latest submission and previous submission Gg of CO_2 equivalents)

	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
Austria	6 570	189	22	NO	NO	NO
Belgium	– 163	– 206	– 576	NO	NO	NO
Denmark	– 43	4	6	NO	NO	NO
Finland	0	0	– 463	NO	NO	NO
France	312	905	– 1	NO	NO	NO
Germany	2 027	4 487	20	NO	NO	NO
Greece	0	0	0	NO	NO	NO
Ireland	0	0	0	NO	NO	NO
Italy	6	4	– 440	NO	NO	NO
Luxembourg	1 854	0	0	NO	NO	NO
Netherlands	1 308	0	– 62	NO	NO	NO
Portugal	560	55	15	NO	NO	NO
Spain	– 2 936	– 42	– 369	NO	NO	NO
Sweden	– 341	3	– 27	NO	NO	NO
United Kingdom	– 166	– 14	– 2	NO	NO	NO
EU-15	**8 989**	**5 384**	**– 1 875**	**NO**	**NO**	**NO**

submission includes the reference approach tables for 1990–2001, but not for 2002. The reason for this is that the Eurostat NewCronos database does not have available the relevant data for the previous year but one before 15 April.

Energy statistics are submitted to Eurostat by Member States on an annual basis with the five joint Eurostat/IEA/UNECE questionnaires on solid fuels, oil, natural gas, electricity and heat, and renewables and wastes. On the basis of this information Eurostat compiles the annual energy balances which are used for the estimation of CO_2 emissions from fossil fuels by Member State and for the EC as a whole.

The Eurostat data for the EC IPCC reference approach includes activity data, net calorific values and carbon emission factors as available in the Eurostat NewCronos database. In the CRF Table 1.A(b) some fuel categories are grouped and average net calorific values are used: 'Orimulsion' is included in 'Residual fuel oil'. 'Natural gas liquids' is included in 'Crude oil'. 'Other kerosene' is included in 'Total kerosene'. 'Anthracite', 'Coking coal' and 'Other bituminous coal' are referred to in the Eurostat NewCronos database as 'Hard coal' and are included in CRF Table 1.A(b) under 'Other bituminous coal'. 'Sub-bitumenous coal' and 'Peat' are included in 'Lignite'. 'Solid biomass', 'Liquid biomass' and 'Gas biomass' is included in 'Total biomass'. For international bunkers, only fuel consumption for international navigation is available in the NewCronos database; data on international aviation is added to the reference approach separately from the joint (Eurostat/IEA/UNECE) oil questionnaire. For the calculation of CO_2 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 EC 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 EC CRF Table 1.A(b) are calculated by adding the relevant Member State activity and emission data, as calculated under Step 1. The

Table 3.41 Apparent EC energy consumption (PJ) and EC CO_2 emissions from fossil fuel combustion (Tg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Liquid fuels	21 811	22 431	23 286	22 429	22 748	22 808	23 337	23 260	24 159	23 367	22 887	23 772
Solid fuels	12 605	11 861	11 080	10 271	10 130	9 862	9 782	9 312	9 301	8 626	8 960	9 030
Gaseous fuels	9 296	10 036	9 952	10 563	10 623	11 451	12 780	12 670	13 211	13 800	14 205	14 548
Total energy consumption	43 712	44 328	44 317	43 263	43 500	44 121	45 899	45 242	46 671	45 793	46 052	47 351
CO_2 emissions	3 121	3 126	3 102	3 012	3 014	3 036	3 144	3 073	3 162	3 075	3 088	3 184

Table 3.42 Percentage difference between IPCC reference approach (Eurostat data) and sectoral approach (Member State data)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Percentage	– 0.78	– 1.66	– 0.28	– 1.56	– 1.35	– 1.81	– 0.94	– 1.04	– 0.40	– 1.71	– 1.69	– 0.93

net calorific values provided for the EC 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 EC level.

Step 3: Fuel consumption from international aviation is included in Tables 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 Tables 1.A(d), Eurostat data on non-energy use of fuels are used, as reported by Member States in the joint questionnaire. For the fraction of carbon stored and carbon emission factors IPCC default values are taken (IPCC, 1997).

Table 3.41 shows the apparent energy consumption and CO_2 emissions from fossil fuel combustion from 1990 to 2001 as provided in Tables 1.A(b) ([14]). Total fossil fuel energy consumption increased by 8 % between 1990 and 2001, whereas CO_2 emissions from fossil fuel combustion increased by 2 %. Table 3.42 summarises the percentage deviation of CO_2 emissions between the IPCC reference approach applied to the EC based on Eurostat data and the sectoral approach available from the Member States. It shows that the percentage differences are smaller than 2 %.

Differences are also observed when comparing the estimates for CO_2 emissions from fossil fuels from the IPCC reference approach of the Member States with the estimates from the reference approach calculated using Eurostat energy balance data. Table 3.43 provides an overview by Member State on differences between the Eurostat and national reference approach for 1990 and 2001, as far as available. The differences can occur due to differences in the basic energy data or due to differences when calculating CO_2 emissions from the basic energy data. The main reasons for diverging energy data are:

- the use of different calorific values (CV) mainly for oil products, BKB (lignite briquettes) and patent fuels. For BKB and patent fuels, Eurostat is using the same CV for all countries which differs from the calorific values used by the Member States;
- small differences in the basic energy balance data reported by Member States to Eurostat (in the joint questionnaires) and to the Commission and the UNFCCC (in the CRF tables).

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 CO_2 emissions are:

- differences in the treatment of non-energy use of fossil fuels and carbon stored;
- the use of country-specific emission factors. The Eurostat reference approach uses the IPCC default emission factors.

Table 3.43 shows that the differences are larger for the year 2001 than for 1990. The reason for this is that more recent years are more frequently recalculated than earlier years. Differences are larger for CO_2 emissions than for apparent consumption indicating that the use of non-energy fuels is treated differently in the two approaches. If 1990 is taken, apparent consumption of the two approaches is within 2 % for several Member States (Denmark, France, Germany, Greece, Italy, Netherlands, Spain and the UK). Differences of more than 5 % can be observed for Belgium, Finland, Portugal and Sweden. The differences of CO_2 emissions for 1990

([14]) This submission includes the reference approach tables for 1990–2001, but not for 2002. The reason for this is that the Eurostat NewCronos database does not have available the relevant data for the previous year but one before 15 April.

range from – 4.7 % (Austria) to 10.5 % (Greece).

A direct comparison of these tables with the tables provided in the 2003 submission is not possible, because in the 2003 submission the Eurostat-based estimates included emissions from international aviation, where in the 2004 submission these emissions are excluded.

Table 3.43 Comparison between Eurostat and national reference approach for CO_2 from fuel combustion (CRF 1.A) ([15])

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	413 432	27 511	432 688	28 106	4.7 %	2.2 %
Solid fossil fuels	169 442	16 326	168 733	13 509	– 0.4 %	– 17.3 %
Gaseous fossil fuels	217 360	11 809	219 239	11 405	0.9 %	– 3.4 %
Total	**800 234**	**55 646**	**820 661**	**53 020**	**2.6 %**	**– 4.7 %**

2001	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	515 345	34 789	530 520	34 300	2.9 %	– 1.4 %
Solid fossil fuels	163 848	15 899	163 023	12 195	– 0.5 %	– 23.3 %
Gaseous fossil fuels	290 137	15 989	293 067	15 804	1.0 %	– 1.2 %
Total	**969 329**	**66 677**	**986 610**	**62 298**	**1.8 %**	**– 6.6 %**

Belgium

1990	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	692 836	45 243	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	**1 443 713**	**102 466**	**1 533 717**	**109 149**	**6.2 %**	**6.5 %**

2001	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	839 714	49 530	972 488	60 466	15.8 %	22.1 %
Solid fossil fuels	291 499	27 744	323 101	29 989	10.8 %	8.1 %
Gaseous fossil fuels	551 811	30 184	553 316	30 313	0.3 %	0.4 %
Total	**1 683 024**	**107 458**	**1 848 904**	**120 768**	**9.9 %**	**12.4 %**

Denmark

1990	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	314 962	22 014	317 229	22 355	0.7 %	1.5 %
Solid fossil fuels	255 380	24 078	254 879	24 129	– 0.2 %	0.2 %
Gaseous fossil fuels	76 099	4 241	76 098	4 269	0.0 %	0.7 %
Total	**646 441**	**50 334**	**648 206**	**50 753**	**0.3 %**	**0.8 %**

2001	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	341 967	24 567	337 180	24 468	– 1.4 %	– 0.4 %
Solid fossil fuels	175 939	16 592	176 494	16 711	0.3 %	0.7 %
Gaseous fossil fuels	193 890	10 806	193 890	10 877	0.0 %	0.7 %
Total	**711 795**	**51 965**	**707 564**	**52 057**	**– 0.6 %**	**0.2 %**

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

Finland

1990	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	403 746	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	91620	5 121	– 3.2%	– 2.6%
Total	**710 788**	**51 895**	**756 596**	**56 500**	**6.4 %**	**8.9 %**

2001	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	405 332	27 262	372 703	25 101	– 8.0%	– 7.9%
Solid fossil fuels	255 254	24 622	260 604	25 100	2.1 %	1.9 %
Gaseous fossil fuels	155 201	8 625	155 590	8 659	0.3 %	0.4 %
Total	**815 787**	**60 509**	**788 897**	**58 860**	**– 3.3%**	**– 2.7%**

France

1990	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	3 523 645	227 303	3 533 651	220 991	0.3 %	– 2.8%
Solid fossil fuels	824 313	78 009	754 302	70 353	– 8.5%	– 9.8%
Gaseous fossil fuels	1 030 510	55 965	1 089 913	59 174	5.8 %	5.7 %
Total	**5 378 469**	**361 277**	**5 377 866**	**350 517**	**0.0 %**	**– 3.0%**

2001	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	3 788 457	240 968	3 720 824	230 339	– 1.8%	– 4.4%
Solid fossil fuels	519 706	49 186	500 046	46 603	– 3.8%	– 5.3%
Gaseous fossil fuels	1 572 062	85 991	1 535 998	84 048	– 2.3%	– 2.3%
Total	**5 880 225**	**376 145**	**5 756 868**	**360 990**	**– 2.1%**	**– 4.0%**

Germany

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	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 %**

Greece

1990	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	499 503	35 301	514 426	36 256	3.0 %	2.7 %
Solid fossil fuels	338 766	33 462	337 773	39 718	– 0.3 %	18.7 %
Gaseous fossil fuels	5 764	259	6426	284	11.5 %	9.9 %
Total	**844 032**	**69022**	**858 624**	**76 258**	**1.7 %**	**10.5 %**

2001	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	646 120	45 441	667 871	47 312	3.4 %	4.1 %
Solid fossil fuels	389 698	38 552	389 704	46 624	0.0 %	20.9 %
Gaseous fossil fuels	70 466	3 882	70 466	3 888	0.0 %	0.2 %
Total	**1 106 283**	**87 875**	**1 128 041**	**97 823**	**2.0 %**	**11.3 %**

Ireland

1990	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	181 212	12 706	165 588	12 323	– 8.6 %	– 3.0 %
Solid fossil fuels	148 001	14 249	147 417	14 334	– 0.4 %	0.6 %
Gaseous fossil fuels	79 289	4 086	78 586	4 318	– 0.9 %	5.7 %
Total	**408 502**	**31 041**	**391 591**	**30 975**	**– 4.1 %**	**– 0.2 %**

2001	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	305 219	22 090	333 666	23 724	9.3 %	7.4 %
Solid fossil fuels	109 294	10 477	114 300	11 328	4.6 %	8.1 %
Gaseous fossil fuels	150 045	8 015	150 348	8 260	0.2 %	3.1 %
Total	**564 559**	**40 581**	**598 314**	**43 312**	**6.0 %**	**6.7 %**

Italy

1990	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	3 687 152	245 827	3 755 112	251 788	1.8 %	2.4 %
Solid fossil fuels	613 080	57 813	614 758	57 389	0.3 %	– 0.7 %
Gaseous fossil fuels	1 632 907	89 716	1 644 135	87 066	0.7 %	– 3.0 %
Total	**5 933 139**	**393 356**	**6 014 005**	**396 243**	**1.4 %**	**0.7 %**

2001	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	3 486 713	230 529	3 752 385	242 004	7.6 %	5.0 %
Solid fossil fuels	564 707	53 360	557 496	52 155	– 1.3 %	– 2.3 %
Gaseous fossil fuels	2 432 498	134 806	2 448 661	133 625	0.7 %	– 0.9 %
Total	**6 483 917**	**418 695**	**6 758 542**	**427 784**	**4.2 %**	**2.2 %**

Netherlands

1990	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	932 744	51 323	943 000	52 284	1.1 %	1.9 %
Solid fossil fuels	384 249	36 081	367 000	34 741	– 4.5 %	– 3.7 %
Gaseous fossil fuels	1 289 950	70 140	1 305 000	72 533	1.2 %	3.4 %
Total	**2 606 943**	**157 544**	**2 615 000**	**159 558**	**0.3 %**	**1.3 %**

2001	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	1 121 966	65 764	1 112 000	58 355	– 0.9 %	– 11.3 %
Solid fossil fuels	348 939	32 842	352 000	33 690	0.9 %	2.6 %
Gaseous fossil fuels	1 488 288	81 244	1 507 000	83 859	1.3 %	3.2 %
Total	**2 959 192**	**179 851**	**2 971 000**	**175 904**	**0.4 %**	**– 2.2 %**

Portugal

1990	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	465 808	29 073	491 139	30 430	5.4 %	4.7 %
Solid fossil fuels	108 009	10 181	115 571	10 463	7.0 %	2.8 %
Gaseous fossil fuels	0	0	0	0	—	—
Total	**573 817**	**39 254**	**606 709**	**40 892**	**5.7 %**	**4.2 %**

2001	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	637 266	41 917	661 492	42 795	3.8 %	2.1 %
Solid fossil fuels	133 650	12 599	134 017	12 089	0.3 %	– 4.0%
Gaseous fossil fuels	94 415	5 262	104 968	5 859	11.2 %	11.3 %
Total	**865 332**	**59 778**	**900 477**	**60 744**	**4.1 %**	**1.6 %**

Spain

1990	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	1 838 371	119 009	1 867 535	119 333	1.6 %	0.3 %
Solid fossil fuels	790 770	75 139	795 344	78 376	0.6 %	4.3 %
Gaseous fossil fuels	208 105	11 310	212 036	11 376	1.9 %	0.6 %
Total	**2 837 246**	**205 459**	**2 874 915**	**209 085**	**1.3 %**	**1.8 %**

2001	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	2 646 515	173 627	2 652 269	169 976	0.2 %	– 2.1%
Solid fossil fuels	772 705	72 896	796 311	78 321	3.1 %	7.4 %
Gaseous fossil fuels	686 632	37 906	690 875	33 326	0.6 %	– 12.1%
Total	**4 105 852**	**284 428**	**4 139 455**	**281 623**	**0.8 %**	**– 1.0%**

Sweden

1990	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	590 330	36 411	628 365	39 904	6.4 %	9.6 %
Solid fossil fuels	112 065	10 719	121 965	11 170	8.8 %	4.2 %
Gaseous fossil fuels	22 124	1 233	21 536	1 217	– 2.7%	– 1.3%
Total	**724 519**	**48 363**	**771 865**	**52 291**	**6.5 %**	**8.1 %**

2001	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)	Apparent consumption (TJ)	CO_2 emissions (Gg)
Liquid fossil fuels	609 539	36 170	607 240	39 477	– 0.4%	9.1 %
Solid fossil fuels	115 247	11 028	111 681	10 365	– 3.1%	– 6.0%
Gaseous fossil fuels	32 117	1 790	32 202	1 820	0.3 %	1.7 %
Total	**756 902**	**48988**	**751 123**	**51 661**	**– 0.8%**	**5.5 %**

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	3 263 134	214 244	1.7 %	1.7 %
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	113 483	0.0 %	4.4 %
Total	**7 840 640**	**569 694**	**7 865 994**	**569 238**	**0.3 %**	**– 0.1%**

2001	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	3 031 933	194 258	3 080 951	201 745	1.6 %	3.9 %
Solid fossil fuels	1 625 001	153 118	1 634 492	149 873	0.6 %	– 2.1%
Gaseous fossil fuels	3 636 893	202 047	3 636 553	210 081	0.0 %	4.0 %
Total	**8 293 827**	**549 423**	**8 351 997**	**561 699**	**0.7 %**	**2.2 %**

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 CO_2 emissions from international aviation. In a first phase of the project, Eurocontrol, the European Organisation for the Safety of Air Navigation and responsible for the coordination of the European air traffic management system, provided Eurostat with aggregated air traffic data covering 1996–2000. Eurostat has used these data to produce estimates of fuel consumption and emissions of CO, CO_2, hydrocarbons, NO_x and SO_2, split between domestic and international flights. Estimated fuel consumption has been compared with the figures provided in national inventories and with energy statistics for a number of European countries. The main results of these first investigations are as follows: estimations of fuel consumption based on European air traffic data are largely compatible with statistics on fuel sold. Similarly, the split between domestic and international fuel consumption as reported in European inventories is largely compatible with traffic-based estimates. The reasons for remaining discrepancies need to be further investigated and may include: (1) the fact that an aircraft often does not refuel during every landing and take-off cycle; (2) the inclusion or non-inclusion of overseas territories for some Member States in the compared data sets.

In May 2004, a workshop on bunker fuels will be organised as a follow-up to the workshop on 'Energy balances and energy-related greenhouse gas emission inventories' (see Section 3.4). The workshop is targeted at energy-statistics- and environmental experts and will address the following issues on bunker fuels:

- reporting of domestic and international bunker fuels from Member States and the disaggregation of domestic from international aviation and navigation;
- improvement activities on the level of international organisations and the EC for reporting of bunker fuels;
- cooperation of EC experts in international organisations concerning bunker fuels;
- recommendations for improvement activities and their follow-up.

([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.

4 Industrial processes (CRF Sector 2)

This chapter starts with an overview on emission trends in CRF Sector 2 'Industrial processes'. Then for each EC 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 qualitative uncertainty estimates for the EC key sources of this sector 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 EC GHG emissions. The most important GHGs from 'Industrial processes' are CO_2 (3 % of total GHG emissions), HCFs (1.2 %) and N_2O (1.1 %). The emissions from this sector decreased by 22 % from 303 Tg in 1990 to 248 Tg in 2002 (Figure 4.1). In 2002, the emissions decreased by 2 % compared to 2001. 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 key sources in this sector are:

2.A.1: Cement production (CO_2)
2.A.2: Lime production (CO_2)
2.B.1: Ammonia production (CO_2)
2.B.2: Nitric acid production (N_2O)
2.B.3: Adipic acid production (N_2O)
2.B.5: Other (N_2O)
2.C.1: Iron and steel production (CO_2)
2.C: Metal production (PFCs)
2.E: Production of halocarbons and sulphur hexafluoride (HFCs)
2.E: Production of halocarbons and sulphur hexafluoride (PFCs)
2.E: Production of halocarbons and sulphur hexafluoride (SF_6)
2.F: Consumption of halocarbons and sulphur hexafluoride (HFCs)
2.F: Consumption of halocarbons and sulphur hexafluoride (SF_6)
2.G: Other (CO_2)

Figure 4.1 EC GHG emissions for 1990–2002 from CRF Sector 2: 'Industrial processes' in CO_2 equivalents (Tg) and share of largest key source categories in 2002

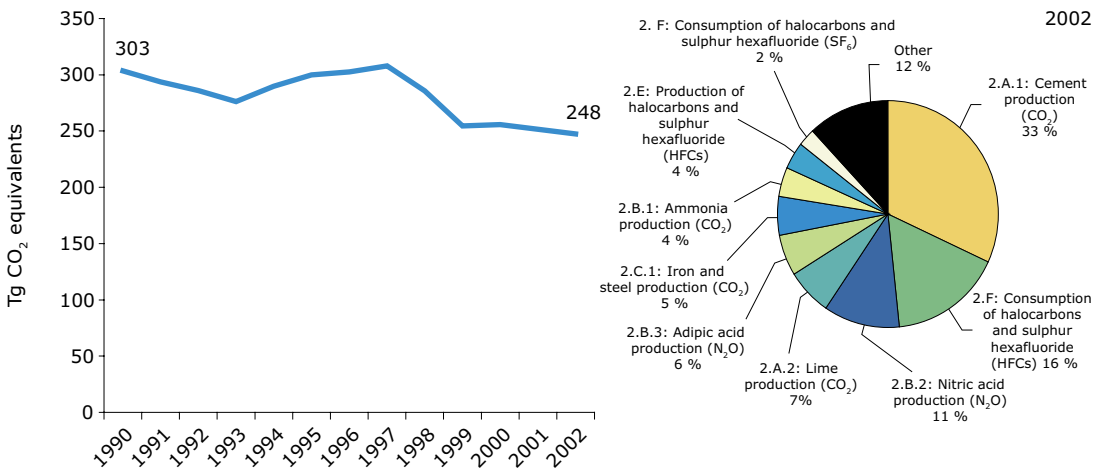


Figure 4.2 Absolute change of GHG emissions by large key source categories 1990–2002 in CO_2 equivalents (Tg) in CRF Sector 2: 'Industrial processes'

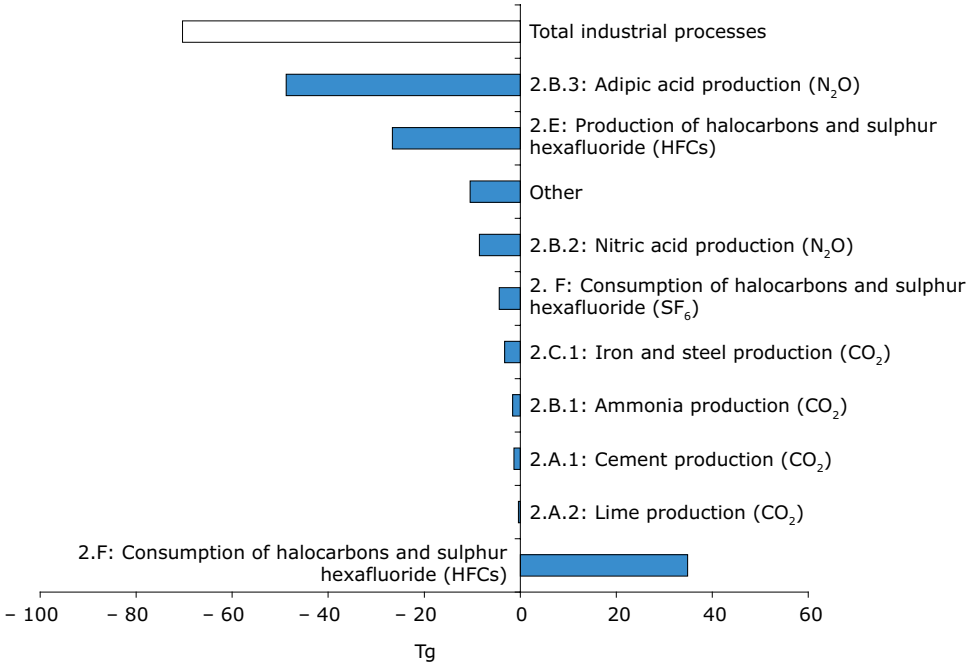


Figure 4.1 shows that the two largest key sources account for almost 50 % of total process-related GHG emissions in the EC.

Figure 4.2 shows that large emission reductions occurred in adipic acid production (N_2O) mainly due to reduction measures in Germany, France and the UK and in production of halocarbons and SF_6 (HFCs). Large emission increases can be observed of HFCs from consumption of halocarbons and SF_6.

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 CO_2 from 2.A: 'Mineral products'. Between 1990 and 2002, CO_2 emission from 'Mineral products' decreased by 1.4 %. The relative decrease was largest in the United Kingdom, the relative growth was largest in Ireland.

This source category includes two key sources: CO_2 from 2.A.1: 'Cement production' and CO_2 from 2.A.2:'Lime production'.

Table 4.2 provides information on emission trends of the key source CO_2 from 2.A.1: 'Cement production' by Member State. CO_2 emissions from cement production account for 1.9 % of total EC GHG emissions in 2002. In 2002, CO_2 emissions from cement production were 2 % below 1990 levels in the EC.

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 EC 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.

CO_2 emissions from 2.A.2: 'Lime production' account for 0.4 % of total GHG emissions in 2002. Between 1990 and 2002, CO_2 emissions from this source decreased by 2 % in the EC (Table 4.3). Germany was responsible for 34 % of the emissions from this source.

Table 4.1 Member States' contributions to CO_2 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 2002 (Gg CO_2 equivalents)	Methods applied (1)	EF (1)	Estimate (2)	Quality (2)
Austria	3 243	2 911	D, CS	CS, D	PART	M
Belgium	5 234	5 142	CS	CS	F	
Denmark	1 021	1 592	CS	CS	ALL	M
Finland	1 175	990	D	PS/D	PART	H
France	14 667	12 177	C	CS	ALL	H
Germany	23 511	19 961	CS	CS	ALL	H
Greece	6 984	7 277	T1, T2	D	PART	
Ireland	941	2 203	D	D	PART	M
Italy	21 713	22 077	D	D	ALL	M
Luxembourg	585	516	C/D	C/D	ALL	
Netherlands	1 124	1 431	CS/T2 (clinker)	PS, CS	ALL	M
Portugal	3 220	3 347	D	D, C	ALL	H
Spain	14 287	18 477	CS, C, D, T2	CS, C, D, T2	PART	H
Sweden	1 840	1 945	T2, D	CS, D	PART	H
United Kingdom	9 629	7 524	T2	D	PART	H
EU-15	**109 174**	**107 570**	**C, CS, D, 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'.

Table 4.2 Member States' contributions to CO_2 emissions from 2.A.1: 'Cement production'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU-15 emissions in 2002 (%)	Change 2001–2002		Change 1990–2002	
	1990	2001	2002		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	2 033	1 588	1 588	2.0	0	0	– 446	– 22
Belgium	2 824	2 908	2 908	3.7	0	0	84	3
Denmark	882	1 432	1 452	1.8	20	1	569	65
Finland	777	625	565	0.7	– 60	– 10	– 213	– 27
France	10 948	8 664	8 651	10.9	– 13	0	– 2 297	– 21
Germany	15 146	12 997	12 352	15.6	– 645	– 5	– 2 794	– 18
Greece	6 760	6 876	6 920	8.7	45	1	160	2
Ireland	750	1 650	2 021	2.5	371	23	1271	170
Italy	16 052	16 401	16 347	20.6	– 54	0	294	2
Luxembourg	538	448	460	0.6	12	3	– 78	– 15
Netherlands	400	478	489	0.6	11	2	89	22
Portugal	3 107	3 545	3 033	3.8	– 511	– 14	– 73	– 2
Spain	12 534	15 327	15 853	20.0	527	3	3319	26
Sweden	1 245	1 303	1 253	1.6	– 50	– 4	8	1
United Kingdom	6 659	5 334	5 466	6.9	132	2	– 1 193	– 18
EU-15	**80 657**	**79 574**	**79 359**	**100.0**	**– 216**	**0**	**– 1 298**	**– 2**

The decreases in Germany (– 13 %) contributed largely to the reduction trend in the EC between 1990 and 2002.

4.2.2 Chemical industry (CRF Source Category 2.B)

Table 4.4 summarises information by Member State on methodologies, emission factors, completeness and qualitative uncertainty estimates for CO_2 from 2.B: 'Chemical industry'. Between 1990 and 2002, CO_2 emission from 'Chemical industry' decreased by 15 %. The relative decrease was largest in Italy, the relative growth was largest in Portugal.

This source category includes one key source: CO_2 from 2.B.1: 'Ammonia production'.

Table 4.3 Member States' contributions to CO_2 emissions from 2.A.2: 'Lime production'

Member State	Greenhouse gas emissions ($Gg\ CO_2$ equivalents)			Share in EU-15 emissions in 2002 (%)	Change 2001–2002		Change 1990–2002	
	1990	2001	2002		($Gg\ CO_2$ equivalents)	(%)	($Gg\ CO_2$ equivalents)	(%)
Austria	396	507	547	3.3	40	8	150	38
Belgium	2 197	2 118	2 118	12.9	0	0	– 79	– 4
Denmark	123	104	124	0.8	20	19	1	1
Finland	398	417	425	2.6	7	2	27	7
France	2 576	2 450	2 445	14.9	– 5	0	– 131	– 5
Germany	6 417	5 895	5 551	33.8	– 344	– 6	– 866	– 13
Greece	222	356	356	2.2	0	0	134	60
Ireland	191	183	182	1.1	– 1	0	– 10	– 5
Italy	1 640	1 862	1 877	11.4	15	1	237	14
Luxembourg	0	0	0	0.0	0	—	0	—
Netherlands	IE	IE	IE	—	—	—	—	—
Portugal	IE	IE	IE	—	—	—	—	—
Spain	917	1 335	1 433	8.7	98	7	517	56
Sweden	500	525	549	3.3	24	4	49	10
United Kingdom	1 192	1 015	0 811	4.9	– 203	– 20	– 380	– 32
EU-15	**16 768**	**16 767**	**16 418**	**100.0**	**– 349**	**– 2**	**– 350**	**– 2**

Table 4.4 Member States' contributions to CO_2 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 2002 ($Gg\ CO_2$ equivalents)	Methods applied (1)	EF (1)	Estimate (2)	Quality (2)
Austria	461	510	PS	PS	ALL	H
Belgium	815	1 874	CS	CS	F	
Denmark	2	3				
Finland	0	0	NO	NO	NE	NE
France	3 537	2 288	C	CS/PS	ALL	H
Germany	2 190	1 846	CS	CS	ALL	H
Greece	470	0			PART	
Ireland	989	810	D, T1a	D	PART	M
Italy	2 237	551	D	D, C, CS	ALL	M
Luxembourg	0	0	C/D	C/D	ALL	
Netherlands	0	0	CS/IE	PS/CS	ALL	M
Portugal	633	1 638	MB, D	D, C	ALL	H
Spain	673	590	C, D	C, D	ALL	H
Sweden	69	50	D	PS	PART	H
United Kingdom	1 358	1 233	T1	CS	ALL	H
EU-15	**13 434**	**11 394**	**C, CS, D, MB, PS, T1, T1a**	**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'.

CO_2 emissions from 2.B.1: 'Ammonia production' account for 0.3 % of total EC GHG emissions in 2002. Between 1990 and 2002, CO_2 emissions from this source decreased by 13 % (Table 4.5). France, Germany, Belgium and Portugal are responsible for 68 % of these emissions in the EC. The greatest reductions in absolute terms between 1990 and 2002 had Italy. The largest growth had Belgium.

Table 4.6 summarises information by Member State on methodologies, emission factors, completeness and qualitative uncertainty estimates for N_2O from 2.B: 'Chemical industry'. Between 1990 and 2002, N_2O emission from 'Chemical industry' decreased by 58 %. The relative decrease was largest in the United Kingdom, the relative growth was largest in Italy.

Table 4.5 Member States' contributions to CO_2 emissions from 2.B.1: 'Ammonia production'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU-15 emissions in 2002 (%)	Change 2001–2002		Change 1990–2002	
	1990	2001	2002		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	396	442	445	4.1	3	1	49	12
Belgium	776	1 819	1 819	16.8	0	0	1 043	134
Denmark	NO	NO	NO	—	—	—	—	—
Finland	NO	NO	NO	—	—	—	—	—
France	3 357	2 504	2 198	20.3	– 306	– 12	– 1 160	– 35
Germany	1 747	1 796	1 831	16.9	35	2	83	5
Greece	470	NE	NE	—	—	—	—	—
Ireland	989	1 037	810	7.5	– 228	– 22	– 179	– 18
Italy	2 183	645	501	4.6	– 144	– 22	– 1 681	– 77
Luxembourg	0	0	0	0.0	0	—	0	—
Netherlands	IE	IE	IE	—	—	—	—	—
Portugal	569	1 434	1 528	14.1	94	7	959	168
Spain	550	494	477	4.4	– 18	– 4	– 73	– 13
Sweden	NE	NE	NE	—	—	—	—	—
United Kingdom	1 358	1 373	1 233	11.4	– 140	– 10	– 125	– 9
EU-15	**12 395**	**11 545**	**10 842**	**100.0**	**– 703**	**– 6**	**– 1 553**	**– 13**

Table 4.6 Member States' contributions to N_2O 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 2002 (Gg CO_2 equivalents)	Methods applied (1)	EF (1)	Estimate (2)	Quality (2)
Austria	912	807	PS	PS	ALL	H
Belgium	3 934	4 199	CS	CS	F	
Denmark	1043	774				
Finland	1 595	1 310	D	PS	ALL	L
France	24 143	9 028	C	CS/PS	ALL	M
Germany	23 478	7 081	CS	CS	ALL	M
Greece	713	566	T1	D	PART	
Ireland	1 035	292	D	CS	PART	L
Italy	5 811	7 467	D	D, CS	ALL	M
Luxembourg	0	0	C/D	C/D	ALL	
Netherlands	7 554	6 258	CS/T2	PS	ALL	L
Portugal	567	590	D	D, C	ALL	M
Spain	2 884	1 945	C	CS, C	ALL	M
Sweden	829	455	T2, CS	PS	ALL	H
United Kingdom	29 270	3 061	PS	CS	ALL	M
EU-15	**103 768**	**43 833**	**C, CS, D, PS, 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'.

This source category includes three key sources: N_2O from 2.B.2: 'Nitric acid production', N_2O from 2.B.3: 'Adipic acid production', and N_2O from 2.B.5: 'Other'.

N_2O emissions from 2.B.2: 'Nitric acid production' account for 0.7 % of total EC GHG emissions in 2002. Between 1990 and 2002, N_2O emissions from this source decreased by 24 % (Table 4.7). The Netherlands, France, Germany and Belgium are responsible for 65 % of these emissions in the EC. Nearly all Member States had reductions from this source between 1990 and 2002. France had the greatest reductions. The largest growth was in Belgium.

Table 4.7 Member States' contributions to N_2O emissions from 2.B.2: 'Nitric acid production'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU-15 emissions in 2002 (%)	Change 2001–2002		Change 1990–2002	
	1990	2001	2002		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	912	786	807	2.9	21	3	– 105	– 11
Belgium	3 562	4 031	3 912	14.2	– 119	– 3	350	10
Denmark	1 043	885	774	2.8	– 111	– 13	– 269	– 26
Finland	1 595	1 260	1 310	4.8	51	4	– 285	– 18
France	6 570	4 968	4 403	16.0	– 565	– 11	– 2 167	– 33
Germany	4 673	3 646	4 007	14.6	361	10	– 666	– 14
Greece	713	566	566	2.1	0	0	– 147	– 21
Ireland	1 035	584	292	1.1	– 292	– 50	– 743	– 72
Italy	1 232	626	585	2.1	– 41	– 7	– 647	– 53
Luxembourg	0	0	0	0.0	0	—	0	—
Netherlands	6 314	5 323	5 498	20.0	175	3	– 816	– 13
Portugal	567	582	590	2.1	7	1	23	4
Spain	2 884	2 044	1 945	7.1	– 99	– 5	– 939	– 33
Sweden	814	479	441	1.6	– 38	– 8	– 373	– 46
United Kingdom	4 134	3 603	2 405	8.7	– 1 198	– 33	– 1 729	– 42
EU-15	**36 048**	**29 385**	**27 535**	**100.0**	**– 1 850**	**– 6**	**– 8 513**	**– 24**

Table 4.8 Member States' contributions to N_2O emissions from 2.B.3: 'Adipic acid production'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU-15 emissions in 2002 (%)	Change 2001–2002		Change 1990–2002	
	1990	2001	2002		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	0	0	0	0.0	0	—	0	—
Belgium	0	0	0	0.0	0	—	0	—
Denmark	0	0	0	0.0	0	—	0	—
Finland	0	0	0	0.0	0	—	0	—
France	14 806	4 838	3 979	27.3	– 859	– 18	– 10 827	– 73
Germany	18 805	2 987	3 074	21.1	87	3	– 15 731	– 84
Greece	0	0	0	0.0	0	—	0	—
Ireland	0	0	0	0.0	0	—	0	—
Italy	4 579	7 002	6 882	47.2	– 120	– 2	2 303	50
Luxembourg	0	0	0	0.0	0	—	0	—
Netherlands	0	0	0	0.0	0	—	0	—
Portugal	0	0	0	0.0	0	—	0	—
Spain	0	0	0	0.0	0	—	0	—
Sweden	0	0	0	0.0	0	—	0	—
United Kingdom	25 136	1 783	656	4.5	– 1 127	– 63	– 24 480	– 97
EU-15	**63 326**	**16 609**	**14 591**	**100.0**	**– 2 018**	**– 12**	**– 48 735**	**– 77**

N_2O emissions from 2.B.3: 'Adipic acid production' account for 0.4 % of total EC GHG emissions in 2002. Between 1990 and 2002, N_2O emissions from this source decreased by 77 % (Table 4.8). Italy is responsible for 47 % of these emissions in the EC and it had increases in emissions from this source between 1990 and 2002. All other Member States that reported emissions from this source had large emissions reductions between 1990 and 2002 due to reduction measures in adipic acid production.

N_2O emissions from 2.B.5: 'Other' account for 0.04 % of total EC GHG emissions in 2002. Between 1990 and 2002, N_2O emissions from this source decreased by 61 % (Table 4.9). The Netherlands and France are responsible for 82 % of these emissions in the EC and both of them had increases in emissions from this source between 1990 and 2002. Their decreases had the most influence on the reductions in the EC.

Table 4.9 Member States' contributions to N_2O emissions from 2.B.5: 'Other'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU-15 emissions in 2002 (%)	Change 2001–2002		Change 1990–2002	
	1990	2001	2002		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	0	0	0	0.0	0	—	0	—
Belgium	372	358	287	16.8	– 71	– 20	– 85	– 23
Denmark	0	0	0	0.0	0	—	0	—
Finland	0	0	0	0.0	0	—	0	—
France	2 767	1 629	646	37.8	– 983	– 60	– 2 121	– 77
Germany	0	0	0	0.0	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	760	44.5	– 480	– 39	– 480	– 39
Portugal	0	0	0	0.0	0	5	0	92
Spain	0	0	0	0.0	0	—	0	—
Sweden	16	16	15	0.9	– 1	– 9	-1	– 6
United Kingdom	0	0	0	0.0	0	—	0	—
EU-15	**4 394**	**3 243**	**1 707**	**100.0**	**– 1 536**	**– 47**	**– 2 687**	**– 61**

Table 4.10 Member States' contributions to CO_2 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 2002 (Gg CO_2 equivalents)	Methods applied (1)	EF (1)	Estimate (2)	Quality (2)
Austria	3 673	4 064	T2	CS, PS	PART	M
Belgium	1 873	1 816	CS	CS	F	
Denmark	28	0				
Finland	0	0	NO	NO	IE	IE
France	4 559	3 335	C	CS	ALL	H
Germany	1 012	893	CS	CS	ALL	H
Greece	232	260	T1	D	PART	
Ireland	0	0	NA	NA	NO	NA
Italy	2 205	1 777	D, C	D, C, CS	ALL	M
Luxembourg	850	270	C/D	C/D	ALL	
Netherlands	0	172	CS/IE	PS, CS	ALL	M
Portugal	51	8	D	D, C	ALL	H
Spain	1 579	1 948	C	C	ALL	H
Sweden	2 103	2 037	CS, D, T1	CS, PS	ALL	H
United Kingdom	3 161	1 456	T2	CS	ALL	H
EU-15	**21 327**	**18 034**	**C, CS, D, T1, T2**	**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'.

4.2.3 Metal production (CRF Source Category 2.C)

Table 4.10 summarises information by Member State on methodologies, emission factors, completeness and qualitative uncertainty estimates for CO_2 from 2.C: 'Metal production'. Between 1990 and 2002, CO_2 emission from 'Metal production' decreased by 15 %. The relative decrease was largest in Denmark, the relative growth was largest in Spain.

This source category includes one key source: CO_2 from 2.C.1: 'Iron and steel production'.

CO_2 emissions from 2.C.1: 'Iron and steel production' account for 0.3 % of total EC GHG emissions in 2002. Between 1990 and 2002, CO_2 emissions

Table 4.11 Member States' contributions to CO_2 emissions from 2.C.1: 'Iron and steel production'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU-15 emissions in 2002 (%)	Change 2001–2002		Change 1990–2002	
	1990	2001	2002		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	3 514	4 321	4 064	30.2	– 257	– 6	549	16
Belgium	1 873	1 682	1 816	13.5	134	8	– 7	– 3
Denmark	28	47	0	0.0	– 47	– 100	– 28	– 100
Finland	IE	IE	IE	—	—	—	—	—
France	4 047	2 254	2 659	19.8	405	18	– 1 388	– 34
Germany	0	NE	NE	—	—	—	—	—
Greece	0	6	6	0.0	0	0	6	—
Ireland	NE	0	0	0.0	0	—	—	—
Italy	1 346	1 379	1 353	10.0	– 26	– 2	6	0
Luxembourg	850	139	270	2.0	131	94	– 580	– 68
Netherlands	0	0	0	0.0	0	—	0	—
Portugal	48	32	5	0.0	– 27	– 85	– 43	– 90
Spain	690	858	852	6.3	– 6	– 1	163	24
Sweden	1 613	1 678	1 510	11.2	– 168	– 10	– 103	– 6
United Kingdom	2 711	2 213	925	6.9	– 1 288	– 58	– 1 786	– 66
EU-15	**16 722**	**14 608**	**13 460**	**100.0**	**– 1 148**	**– 8**	**– 3 261**	**– 20**

Table 4.12 Energy and process-related CO_2 emissions reported in IPCC Categories 1.A.2.a and 2.C.1: Iron and steel industry

	Member State reporting	Member State explanation	Information source
Austria	Member State reports emissions from 1.A.2.a and 2.C.1.	In this submission only CO_2 process emissions from iron and steel production (both from steel production in basic oxygen furnaces and from electric furnaces) as well as CH_4 emissions from rolling mills are reported in 2.C.1.	CRF 2004 and Umwelt-bundesamt (2003a, p. 12)
Belgium	Member State reports emissions from 1.A.2.a. and 2.C.1.	—	CRF 2004
Denmark	Member State reports that emissions from 1.A.2.a and 2.C.1 are zero.	—	CRF 2004
Finland	Member State reports emissions from 1.A.2.a and that CO_2 emissions from 2.C.1 are included elsewhere (IE).	CO_2 emissions from metal production 2.C.1 and 2 are included in 1.A.2.a. This calculation method gives more accurate total CO_2 emissions (no double counting, completeness) compared to more or less arbitrary allocation of coke and BF gases between energy use and process use.	CRF 2004
France	Member State reports emissions from 1.A.2.a and 2.C.1.	—	CRF 2004
Germany	Member State reports emissions from 1.A.2.a as included elsewhere (IE) and that CO_2 emissions from 2.C.1 are not estimated (NE)	No specific explanation available in the CRF. Additional information is included in the NIR.	CRF 2004, NIR 2004, p. 3-56ff; 4-15f
Greece	Member State reports emissions from 1.A.2.a and 2.C.1.	—	CRF 2004
Ireland	Member State reports emissions from 1.A.2.a and that CO_2 emissions from 2.C.1 are not occurring (NO).	No specific information available.	CRF 2004
Italy	Member State reports emissions from 1.A.2.a and 2.C.1.	—	CRF 2004
Luxembourg	Member State reports emissions from 1.A.2.a and 2.C.1.	—	CRF 2004
Netherlands	Member State reports emissions from 1.A.2.a and that CO_2 emissions from 2.C.1 are included elsewhere (IE).	CO_2 emissions from 2.C.1 are included in 1.A.2.a.	CRF 2004, NIR 2004, p. 1–16
Portugal	Member State reports emissions from 1.A.2.a and 2.C.1.	—	CRF 2004
Spain	Member State reports emissions from 1.A.2.a and 2.C.1.	—	CRF 2004
Sweden	Member State reports emissions from 1.A.2.a. and 2.C.1.	—	CRF 2004
United Kingdom	Member State reports emissions from 1.A.2.a and 2.C.1.	—	CRF 2004

Table 4.13 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 2002 (Gg CO_2 equivalents)	Methods applied (1)	EF (1)	Estimate (2)	Quality (2)
Austria	937	0			NA	NA
Belgium	0	0				
Denmark	0	0				
Finland	0	0	NO	NO	NO	NO
France	2 290	973	C	PS	ALL	H
Germany	2 486	431	T3a	T3a	ALL	H
Greece	258	88			ALL	
Ireland	0	0	NA	NA	NO	NA
Italy	1 673	199	D, T1, T2	CS	ALL	M
Luxembourg	0	0	C/D	C/D		
Netherlands	2 398	1 041	CS/T2/T3b	PS	NO	
Portugal	0	0			NO	
Spain	828	192	NO		ALL	H
Sweden	440	283	T2	CS	ALL	H
United Kingdom	1 327	209	T2/PS	CS	ALL	M
EU-15	**12 637**	**3 416**	**C, CS, D, PS, T1, T2, T3a, T3b**	**C, CS, D, PS, T3a**	**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'.

from this source decreased by 20 % (Table 4.11). Austria and France are responsible for 50 % of these emissions in the EC. The United Kingdom had the largest decreases in absolute terms between 1990 and 2002 while the largest increases were in Austria.

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 4.12 provides an overview of emission allocations from iron and steel production for those Member States which provided the relevant information. The table shows that most Member States report energy and process-related CO_2 emissions from iron and steel production in both Source Categories 1.A.2 and 2.C.1. Finland and the Netherlands report energy and process-related emissions under 1.A.2.

Table 4.13 and Table 3.14 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: 'Metal production' account for 0.1 % of total EC GHG emissions in 2002. Between 1990 and 2002, PFC emissions from this source decreased by 73 %. The Netherlands and France are responsible for 59 % of these emissions in the EC. All Member States reduced their emissions from this source between 1990 and 2002. Germany had the largest decreases in absolute terms.

4.2.4 Production of halocarbons and SF_6 (CRF Source Category 2.E)

Table 4.15 and Table 4.16 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 SF_6'.

HFC emissions from 2.E: 'Production of halocarbons and SF_6' account for 0.2 % of total EC GHG emissions in 2002. Between 1990 and 2002, HFC emissions

Table 4.14 Member States' contributions to PFC emissions from 2.C: 'Metal production'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU-15 emissions in 2002 (%)	Change 2001–2002		Change 1990–2002	
	1990	2001	2002		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	937	0	0	0.0	0	—	– 937	– 100
Belgium	0	0	0	0.0	0	—	0	—
Denmark	0	0	0	0.0	0	—	0	—
Finland	0	0	0	0.0	0	—	0	—
France	2 290	584	973	28.5	389	67	– 1 317	– 58
Germany	2 486	372	431	12.6	59	16	– 2 055	– 83
Greece	258	91	88	2.6	– 3	– 3	– 169	– 66
Ireland	0	0	0	0.0	0	—	0	—
Italy	1 673	234	199	5.8	– 36	– 15	– 1 475	– 88
Luxembourg	0	—	0	0.0	—	—	0	—
Netherlands	2 398	1 323	1 041	30.5	– 282	– 21	– 1 357	– 57
Portugal	0	0	0	0.0	0	—	0	—
Spain	828	176	192	5.6	16	9	– 637	– 77
Sweden	440	259	283	8.3	24	9	– 157	– 36
United Kingdom	1 327	222	209	6.1	– 13	– 6	– 1 118	– 84
EU-15	**12 637**	**3 261**	**3 416**	**100.0**	**155**	**5**	**– 9 222**	**– 73**

Table 4.15 Member States' contributions to HFC emissions from 2.E: 'Production of halocarbons and SF_6' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2002 (Gg CO_2 equivalents)	Methods applied (1)	EF (1)	Estimate (2)	Quality (2)
Austria	NO	NO			NO	NO
Belgium	0	0			F	
Denmark	0	0	NO		NO	
Finland	0	0	NO	NO	NO	NO
France	3 605	571	CS	CS/PS	ALL	M
Germany	3 510	1 212	T1	T1	ALL	H
Greece	935	3 195	CS	CS	NO	
Ireland	0	0	NA	NA	NO	NA
Italy	351	25	CS	CS	ALL	M
Luxembourg	0	0	C/D	C/D		
Netherlands	4 432	782	CS/T2	PS	ALL	M
Portugal	0	0			NE	
Spain	2 403	1 171	D, CS, T2	D, PS, T2	ALL	H
Sweden	NO	NO	NO	NO	NO	
United Kingdom	11 374	2 292	T2/PS	CS	ALL	M
EU-15	**26 610**	**9 247**	**CS, D, PS, T1, T2**	**C, CS, D, PS, 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'.

from this source decreased by 65 %. Greece and the United Kingdom are responsible for 59 % of these emissions in the EC. Greece was the only Member State with emission increases from this source between 1990 and 2002.

Table 4.17 and Table 4.18 summarise information by Member State on emission trends, methodologies, emission factors, completeness and qualitative uncertainty estimates for the key source PFCs from 2.E.

PFC emissions from 2.E: 'Production of halocarbons and SF_6' account for 0.01 % of total EC GHG emissions in 2002. Only four Member States reported emissions from this source. Between 1990 and 2002, PFC emissions decreased by 91 %. The United Kingdom was the only

Table 4.16 Member States' contributions to HFC emissions from 2.E: 'Production of halocarbons and SF_6'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU-15 emissions in 2002 (%)	Change 2001–2002		Change 1990–2002	
	1990	2001	2002		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	NO	NO	NO	—	—	—	—	—
Belgium	0	0	0	0.0	0	—	0	—
Denmark	0	0	0	0.0	0	—	0	—
Finland	0	0	0	0.0	0	—	0	—
France	3 605	519	571	6.2	52	10	– 3 034	– 84
Germany	3 510	1 098	1 212	13.1	114	10	– 2 298	– 65
Greece	935	3 181	3 195	34.5	13	0	2 260	242
Ireland	0	0	0	0.0	0	—	0	—
Italy	351	25	25	0.3	0	0	– 326	– 93
Luxembourg	0	—	0	0.0	—	—	0	—
Netherlands	4 432	641	782	8.5	141	22	– 3 649	– 82
Portugal	0	0	0	0.0	0	—	0	—
Spain	2 403	2 993	1 171	12.7	– 1 822	– 61	– 1 233	– 51
Sweden	NO	NO	NO	—	—	—	—	—
United Kingdom	11 374	2 452	2 292	24.8	– 160	– 7	– 9 082	– 80
EU-15	**26 610**	**10 910**	**9 247**	**100.0**	**– 1 663**	**– 15**	**– 17 363**	**– 65**

Table 4.17 Member States' contributions to PFC emissions from 2.E: 'Production of halocarbons and SF_6' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2002 (Gg CO_2 equivalents)	Methods applied (1)	EF (1)	Estimate (2)	Quality (2)
Austria	NO	NO			NO	NO
Belgium	1 753	108			F	
Denmark	0	0	NO		NO	
Finland	0	0	NO	NO	NO	NO
France	826	83	CS	CS/PS	ALL	M
Germany	70	NO	NO	NO	NO	
Greece	0	0	CS	CS	NO	
Ireland	0	0	NA	NA	NO	NA
Italy	134	0	CS	CS	ALL	M
Luxembourg	0	0				
Netherlands	0	0	NO		NO	
Portugal	0	0			NE	
Spain	0	0	CS/T3	PS/T3	NO	
Sweden	NO	NO	NO	NO	NO	
United Kingdom	9	68	T2/PS	CS	ALL	M
EU-15	**2 793**	**258**	**CS, PS, T2, T3**	**CS, PS, T3**	**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'.

Member State with emission increases between 1990 and 2002.

Table 4.19 and Table 4.20 summarise information by Member State on emission trends, methodologies, emission factors, completeness and qualitative uncertainty estimates for the key source SF_6 from 2.E.: 'Production of halocarbons and SF_6'.

No SF_6 emissions from 2.E: 'Production of halocarbons and SF_6' have been reported by EC Member States for 2002.

4.2.5 Consumption of halocarbons and SF_6 (CRF Source Category 2.F)

Table 4.21 and Table 4.22 summarise information by Member State on emission trends, methodologies,

Table 4.18 Member States' contributions to PFC emissions from 2.E: 'Production of halocarbons and SF_6'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU-15 emissions in 2002 (%)	Change 2001–2002		Change 1990–2002	
	1990	2001	2002		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	NO	NO	NO	-	-	-	-	-
Belgium	1 753	228	108	41.8	– 120	– 53	– 1 645	– 94
Denmark	0	0	0	0.0	0	-	0	-
Finland	0	0	0	0.0	0	-	0	-
France	826	125	83	32.0	– 42	– 34	– 743	– 90
Germany	70	NO	NO	-	-	-	-	-
Greece	0	0	0	0.0	0	-	0	-
Ireland	0	0	0	0.0	0	-	0	-
Italy	134	0	0	0.0	0	-	– 134	– 100
Luxembourg	0	-	0	0.0	-	-	0	-
Netherlands	0	0	0	0.0	0	-	0	-
Portugal	0	0	0	0.0	0	-	0	-
Spain	0	0	0	0.0	0	-	0	-
Sweden	NO	NO	NO	-	-	-	-	-
United Kingdom	9	68	68	26.1	0	0	58	649
EU-15	**2 793**	**421**	**258**	**100.0**	**– 162**	**– 39**	**– 2 534**	**– 91**

Table 4.19 Member States' contributions to SF_6 emissions from 2.E: 'Production of halocarbons and SF_6' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2002 (Gg CO_2 equivalents)	Methods applied (1)	EF (1)	Estimate (2)	Quality (2)
Austria	0	0			NO	NO
Belgium	1 559	0			F	
Denmark	0	0	NO		NO	
Finland	0	0	NO	NO	NO	NO
France	0	0			NO	
Germany	0	0	T1	T1	ALL	H
Greece	0	0			NO	
Ireland	0	0	NA	NA	NO	NA
Italy	120	0	CS	CS	ALL	M
Luxembourg	0	0				
Netherlands	0	0	T2/T3b	PS/CS/D	NO	
Portugal	0	0			NE	
Spain	0	0	NO	NO	NO	
Sweden	0	0	NO	NO	NO	
United Kingdom	0	0	NO	NO	NO	
EU-15	**1 679**	**0**	**CS, T1, T2, T3b**	**CS, D, PS, T1**	**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'.

emission factors, completeness and qualitative uncertainty estimates for the key source HFCs from 2.F: 'Consumption of halocarbons and SF_6'.

HFC emissions from 2.F: 'Consumption of halocarbons and SF_6' account for 1.0 % of total EC GHG emissions in 2002. Between 1990 and 2002, HFC emissions from this source increased by 11 411 %. 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

Table 4.20 Member States' contributions to SF_6 emissions from 2.E: 'Production of halocarbons and SF_6'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU-15 emissions in 2002 (%)	Change 2001–2002		Change 1990–2002	
	1990	2001	2002		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	0	0	0	—	0	—	0	—
Belgium	1 559	0	0	—	0	—	– 1 559	– 100
Denmark	0	0	0	—	0	—	0	—
Finland	0	0	0	—	0	—	0	—
France	0	0	0	—	0	—	0	—
Germany	0	239	0	—	– 239	– 100	0	—
Greece	0	0	0	—	0	—	0	—
Ireland	0	0	0	—	0	—	0	—
Italy	120	0	0	—	0	—	– 120	– 100
Luxembourg	0	0	0	—	0	—	0	—
Netherlands	0	0	0	—	0	—	0	—
Portugal	0	0	0	—	0	—	0	—
Spain	0	0	0	—	0	—	0	—
Sweden	0	0	0	—	0	—	0	—
United Kingdom	0	0	0	—	0	—	0	—
EU-15	**1 679**	**239**	**0**	**—**	**– 239**	**– 100**	**– 1 679**	**– 100**

Table 4.21 Member States' contributions to HFC emissions from 2.F: 'Consumption of halocarbons and SF_6' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2002 (Gg CO_2 equivalents)	Methods applied (1)	EF (1)	Estimate (2)	Quality (2)
Austria	4	1 033	CS	CS	ALL	M
Belgium	255	1 505			F	
Denmark	0	672	M/CS	CS	ALL	M
Finland	0	463	T2, T1a & T1b	D	ALL	H
France	23	9 373	CS/T2	CS	ALL	M
Germany	NE	7 035	T2	T2	ALL	H
Greece	0	804	T2a	D	PART	
Ireland	21	253	T2	D, CS	FULL	M
Italy	0	7 081	D, T2	CS	PART	M
Luxembourg	43	43	C/D	C/D		
Netherlands	0	790	M, CS/T2	CS	ALL	M
Portugal	0	49	D	D, CS	PART	L
Spain	0	2 725	D, CS, T2	D, PS, T2	ALL	L
Sweden	4	386	T2, D	CS, D, PS	ALL	M
United Kingdom	2	8 127	T2	D/CS	ALL	H
EU-15	**350**	**40 340**	**C, CS, D, M, T1a, T1b, T2, T2a**	**C, CS, D, 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'.

significant absolute increases from this source between 1990 and 2002.

Table 4.23 and Table 4.24 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 SF_6'.

SF_6 emissions from 2.F: 'Consumption of halocarbons and SF_6' account for 0.1 % of total EC GHG emissions in 2002. Between 1990 and 2002, SF_6 emissions from this source decreased by 9 %. Germany and France are responsible

Table 4.22 Member States' contributions to HFC emissions from 2.F: 'Consumption of halocarbons and SF_6'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU-15 emissions in 2002 (%)	Change 2001–2002		Change 1990–2002	
	1990	2001	2002		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	4	1 033	1 033	2.6	0	0	1 030	27 900
Belgium	255	1 209	1 505	3.7	296	25	1 250	490
Denmark	0	647	672	1.7	25	4	672	—
Finland	0	657	463	1.1	– 193	– 29	463	2 618 206
France	23	7 690	9 373	23.2	1 682	22	9 350	41 437
Germany	NE	7 032	7 035	17.4	4	0	—	—
Greece	0	663	804	2.0	141	21	804	—
Ireland	21	231	253	0.6	22	10	232	1 122
Italy	0	5 535	7 081	17.6	1 546	28	7 081	—
Luxembourg	43	43	43	0.1	0	0	0	0
Netherlands	0	865	790	2.0	– 75	– 9	790	—
Portugal	0	37	49	0.1	12	34	49	—
Spain	0	2 295	2 725	6.8	430	19	2 725	—
Sweden	4	372	386	1.0	14	4	382	9 937
United Kingdom	2	7 276	8 127	20.1	851	12	8 125	488 564
EU-15	**350**	**35 585**	**40 340**	**100.0**	**4 755**	**13**	**39 990**	**11 411**

Table 4.23 Member States' contributions to SF_6 emissions from 2.F: 'Consumption of halocarbons and SF_6' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2002 (Gg CO_2 equivalents)	Methods applied (1)	EF (1)	Estimate (2)	Quality (2)
Austria	264	669	CS	CS	ALL	M
Belgium	103	94			F	
Denmark	13	22	M/CS	CS	ALL	M
Finland	94	51	T2, T1a & T1b	D	ALL	H
France	1 060	828	CS/T2	CS	ALL	M
Germany	3 728	2 564	CS/T2/T1	CS/T2/T1	ALL	H
Greece	0	0			NE	
Ireland	83	71	T2	D, CS	FULL	M
Italy	213	360	D, T3c	CS	ALL	M
Luxembourg	4	4	C/D	C/D		
Netherlands	217	344	T2/T3b	PS/CS/D	PART	L
Portugal	0	7	D	CS	ALL	H
Spain	56	239	CS, T2	CS, T2	All	M
Sweden	83	33	T2, CS	CS, D, PS	ALL	M
United Kingdom	604	662	T2	CS	ALL	H
EU-15	**6 524**	**5 947**	**C, CS, D, M, T1, T1a, T1b, T2, T3b, T3c**	**C, CS, D, PS, T1, T2**	**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'.

for 57 % of total EC emissions from this source. In absolute terms, Germany had also the most significant decreases from this source between 1990 and 2002.

Table 4.24 Member States' contributions to SF_6 emissions from 2.F: 'Consumption of halocarbons and SF_6'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU-15 emissions in 2002 (%)	Change 2001–2002		Change 1990–2002	
	1990	2001	2002		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	264	669	669	11.3	0	0	405	153
Belgium	103	105	94	1.6	– 11	– 10	– 9	– 9
Denmark	13	30	22	0.4	– 9	– 29	8	62
Finland	94	55	51	0.9	– 4	– 7	– 43	– 46
France	1 060	848	828	13.9	– 20	– 2	– 232	– 22
Germany	3 728	2 741	2 564	43.1	– 177	– 6	– 1 164	– 31
Greece	0	0	0	0.0	0	—	0	—
Ireland	83	67	71	1.2	5	7	– 12	– 14
Italy	213	345	360	6.1	15	4	147	69
Luxembourg	4	4	4	0.1	0	0	0	0
Netherlands	217	356	344	5.8	– 13	– 4	126	58
Portugal	0	7	7	0.1	0	7	7	—
Spain	56	212	239	4.0	26	12	183	328
Sweden	83	53	33	0.5	– 20	– 38	– 51	– 1
United Kingdom	604	669	662	11.1	– 7	– 1	58	10
EU-15	**6 524**	**6 161**	**5 947**	**100.0**	**– 214**	**– 3**	**– 577**	**– 9**

Table 4.25 Member States' contributions to CO_2 emissions from 2.G: 'Other' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2002 (Gg CO_2 equivalents)	Methods applied (1)	EF (1)	Estimate (2)	Quality (2)
Austria	NO	NO			NO	NO
Belgium	654	1 011			P	
Denmark	0	0				
Finland	0	0			NO	NO
France	0	0			NO	
Germany	NO	0	NO	NO	NO	
Greece	0	0				
Ireland	NO	NO	NA	NA	NE	NE
Italy	0	0			NO	
Luxembourg	0	0	C/D	C/D	ALL	
Netherlands	457	386	CS	PS/CS	ALL	H
Portugal	0	0				
Spain	0	0	NO		NO	
Sweden	IE	IE	CS	CS	IE	
United Kingdom	0	0				
EU-15	**1 111**	**1 396**	**C, CS, D**	**C, CS, D, PS**	**ALL, IE, 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'.

4.2.6 Other (CRF Source Category 2.G)

Table 4.25 and Table 4.26 summarise information by Member State on emission trends, methodologies, emission factors, completeness and qualitative uncertainty estimates for the key source CO_2 from 2.G: 'Other'.

CO_2 emissions from 2.G: 'Other' account for 0.03 % of total EC GHG emissions in 2002. Only two Member States reported emissions from this source. Between 1990 and 2002, CO_2 emissions increased by 26 %. Belgium reports emissions of feedstocks in the Flemish region under this source, the Netherlands reports emissions from flue gas desulphurisation and other sources.

Table 4.26 Member States' contributions to CO_2 emissions from 2.G: 'Other'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU-15 emissions in 2002 (%)	Change 2001–2002		Change 1990–2002	
	1990	2001	2002		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	NO	NO	NO	—	—	—	—	—
Belgium	654	1 011	1 011	72.4	0	0	357	55
Denmark	0	0	0	0.0	0	—	0	—
Finland	0	0	0	0.0	0	—	0	—
France	0	0	0	0.0	0	—	0	—
Germany	NO	0	0	0.0	0	—	—	—
Greece	0	0	0	0.0	0	—	0	—
Ireland	NO	NO	NO	—	—	—	—	—
Italy	0	0	0	0.0	0	—	0	—
Luxembourg	0	0	0	0.0	0	—	0	—
Netherlands	457	396	386	27.6	– 11	– 3	– 71	– 16
Portugal	0	0	0	0.0	0	—	0	—
Spain	0	0	0	0.0	0	—	0	—
Sweden	IE	IE	IE	—	—	—	—	—
United Kingdom	0	0	0	0.0	0	—	0	—
EU-15	**1 111**	**1 407**	**1 396**	**100.0**	**– 11**	**– 1**	**286**	**26**

Table 4.27 Uncertainty of the key source categories in the CRF Sector 2: 'Industrial processes'

Source category gas	2002	Quality estimate
2.G: Other (CO_2)	1 396	H
2.B: Chemical industry (CO_2)	11 394	H
2.C: Metal production (PFC)	3 416	H
2.A: Mineral products (CO_2)	107 570	H
2.C: Metal production (CO_2)	18 034	H
2.F: Consumption of halocarbons and SF_6 (SF_6)	5 947	H
2.E: Production of halocarbons and SF_6 (HFCs)	9 247	M
2.F: Consumption of halocarbons and SF_6 (HFCs)	40 340	M
2.E: Production of halocarbons and SF_6 (PFCs)	258	M
2.E: Production of halocarbons and SF_6 (SF_6)	0	M
2.B: Chemical industry (N_2O)	43 833	M

Note: Many of these source categories are more aggregated than the EC key source categories identified in Section 1.5 because the qualitative uncertainty estimates in CRF Table 7 refer to more aggregated source categories.

4.3 Methodological issues and uncertainties

The previous section presented for each EC 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.

The qualitative uncertainty estimation for the key sources in Table 4.27 is based on the quality estimates (high, medium and low) provided by the Member States in CRF Table 7. The quality estimates were weighted according to Member States' share of the total emissions (see Section 1.7). The table shows that 61 % of process-related key source emission estimates can be classified as being of a high quality, 39 % as of a medium quality.

4.4 Sector-specific quality assurance and quality control

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

Table 4.28 Recalculations of total greenhouse gas emissions and recalculations of greenhouse gas emissions in CRF Sector 2: 'Industrial processes', for 1990 and 2001 by gas (Gg and percentage)

1990	CO_2		CH_4		N_2O		HFCs		PFCs		SF_6	
	Gg	(%)	Gg	(%)	Gg	(%)	Gg	(%)	Gg	(%)	Gg	(%)
Total emissions and removals	96 422	3.1	36 845	8.9	– 16 489	– 4.0	1 293	5.0	2 687	20.1	1 957	23.5
Industrial processes	– 2 199	– 1.5	3	0.5	– 2 324	– 2.2	1 293	5.0	2 687	20.1	1 957	23.5
2001												
Total emissions and removals	70 582	2.2	26 684	8.1	– 9 674	– 2.8	3 112	7.2	– 4	– 0.1	– 620	– 6.5
Industrial processes	– 2 194	– 1.5	17	4.3	112	0.2	3 112	7.2	– 4	– 0.1	– 620	– 6.5

Table 4.29 Contribution of Member States to EC recalculations in CRF Sector 2: 'Industrial processes' for 1990 by gas (difference between latest submission and previous submission Gg of CO_2 equivalents)

	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
Austria	– 5 544	4	5	0	0	0
Belgium	904	– 2	375	– 84	1 753	1 567
Denmark	46	0	1 043	0	0	1
Finland	0	0	0	0	0	0
France	230	0	– 205	1 375	266	0
Germany	– 893	0	– 2 069	0	0	0
Greece	0	0	0	0	0	0
Ireland	0	0	0	0	0	0
Italy	3 339	0	– 1 441	0	1 570	0
Luxembourg	0	0	0	0	0	0
Netherlands	0	0	0	0	– 15	30
Portugal	– 190	1	– 36	0	0	0
Spain	211	0	0	0	0	0
Sweden	– 302	0	0	0	0	0
United Kingdom	0	0	4	2	– 887	358
EU-15	**– 2 199**	**3**	**– 2 324**	**1 293**	**2 687**	**1 957**

4.5 Sector-specific recalculations

Table 4.28 shows that in the industrial processes sector the largest recalculations in absolute terms were made for CO_2. In both absolute and relative terms, the largest recalculations were made for HFC emissions in 2001 and PFC emissions in 1990.

Table 4.29 provides an overview of Member States' contributions to EC recalculations. Austria had the most influence on the CO_2 and CH_4 recalculations while Germany was responsible for the largest N_2O recalculations. For HFCs, France made the largest contribution to recalculations, for PFCs Belgium and Italy together contributed the most and for SF_6 it was Belgium alone. Explanations for some of these 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 EC key source ([17]). Neither is included 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 EC GHG emissions. The most important GHG from 'Solvent and other product use' is CO_2 (0.12 % of the total GHG emissions). The emissions from this sector decreased by 8.5 % from 9 Tg to 8 Tg in 2002 (Figure 5.1). In 2002, the emissions decreased by 0.1 compared to 2001.

This sector does not contain any key source. The Member States Germany, Spain and France are responsible for 63 % of the total emissions in this sector (Table 5.1). Germany's inventory consists of a rough estimation of N_2O emissions from medical use (anaesthesia). Spain and France report CO_2 emissions from paint application (3.A), degreasing and dry cleaning (3.B), and other solvent and product use (3.D), and N_2O emissions from anaesthesia (see Annex 7).

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.

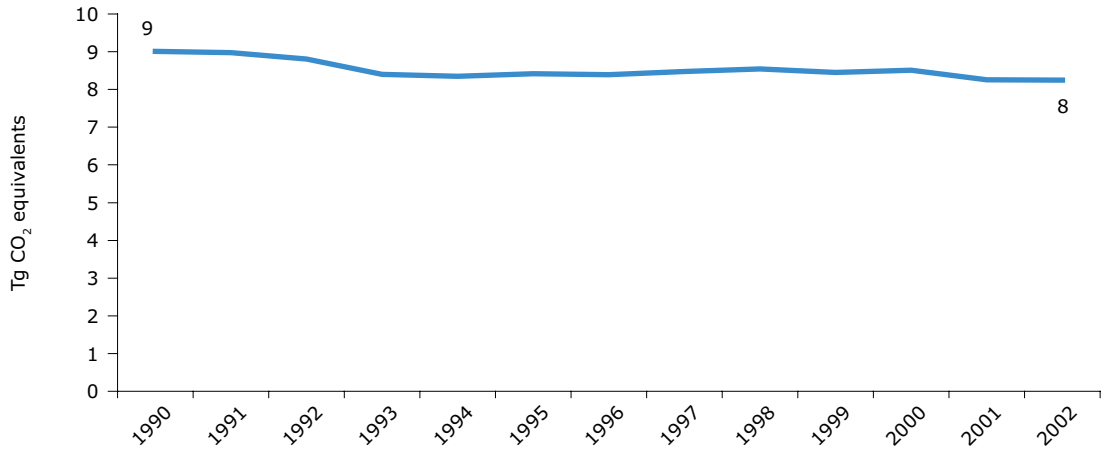
5.3 Sector-specific quality assurance and quality control

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

5.4 Sector-specific recalculations

Table 5.2 shows that in the solvent sector only minor recalculations were made (in particular in absolute terms). In relative terms, the highest recalculation was made for N_2O.

Figure 5.1 EC GHG emissions for 1990–2002 from CRF Sector 3: 'Solvent and other product use' in CO_2 equivalents (Tg) and share of largest source categories in 2002



([17]) 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.

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 2002 (%)	Change 2001–2002		Change 1990–2002	
	1990	2001	2002		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	515	426	426	5.2	0	0	– 89	– 17
Belgium	253	256	256	3.1	0	0	2	1
Denmark	124	112	112	1.4	0	0	– 12	– 10
Finland	62	49	44	0.5	– 5	– 10	– 18	– 30
France	1 937	1 613	1 561	18.9	– 52	– 3	– 376	– 19
Germany	1 922	1 922	1 922	23.3	0	0	0	0
Greece	177	155	155	1.9	1	0	– 21	– 12
Ireland	92	109	109	1.3	1	1	18	19
Italy	1 733	1 263	1 241	15.1	– 22	– 2	– 493	– 28
Luxembourg	12	10	9	0.1	0	– 4	-2	– 21
Netherlands	225	115	90	1.1	– 25	– 22	– 135	– 60
Portugal	222	305	313	3.8	8	3	91	41
Spain	1 330	1 616	1 694	20.5	77	5	364	27
Sweden	411	305	313	3.8	8	3	– 98	– 24
United Kingdom	0	0	0	0.0	0	-	0	-
EU-15	**9 014**	**8 254**	**8 244**	**100.0**	**– 10**	**0**	**– 769**	**– 9**

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 2001 by gas (Gg and %)

1990	CO_2		CH_4		N_2O		HFCs		PFCs		SF_6	
	Gg	(%)	Gg	(%)	Gg	(%)	Gg	(%)	Gg	(%)	Gg	(%)
Total emissions and removals	96 422	3.1	36 845	8.9	– 16 489	– 4.0	1 293	5.0	2 687	20.1	1 957	23.5
Solvent and other product use	– 280	– 4.6	0	0.0	– 266	– 7.6	NO	NO	NO	NO	NO	NO
2001												
Total emissions and removals	70 582	2.2	26 684	8.1	– 9 674	– 2.8	3 112	7.2	– 4	– 0.1	– 620	– 6.5
Solvent and other product use	– 307	– 5.7	0	0.0	– 210	– 6.2	NO	NO	NO	NO	NO	NO

Table 5.3 Contribution of Member States to EC recalculations in CRF Sector 3: 'Solvent and other product use' for 1990 by gas (difference between latest submission and previous submission Gg of CO_2 equivalents)

	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
Austria	– 240	0	0	NO	NO	NO
Belgium	NE	0	253	NO	NO	NO
Denmark	0	0	0	NO	NO	NO
Finland	0	0	0	NO	NO	NO
France	9	0	– 519	NO	NO	NO
Germany	NE	0	0	NO	NO	NO
Greece	0	0	0	NO	NO	NO
Ireland	0	0	0	NO	NO	NO
Italy	0	0	0	NO	NO	NO
Luxembourg	0	0	0	NO	NO	NO
Netherlands	0	0	0	NO	NO	NO
Portugal	– 49	0	0	NO	NO	NO
Spain	0	0	0	NO	NO	NO
Sweden	0	0	0	NO	NO	NO
United Kingdom	0	0	0	NO	NO	NO
EU-15	**– 280**	**0**	**– 266**	**NO**	**NO**	**NO**

Table 5.3 provides an overview of Member States' contributions to EC recalculations. Austria contributed the most to CO_2 and France to N_2O recalculations.

6 Agriculture (CRF Sector 4)

This chapter starts with an overview on emission trends in CRF Sector 4 'Agriculture'. Then for each EC 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 qualitative uncertainty estimates, sector-specific QA/QC, and recalculations.

6.1 Overview of the sector

CRF Sector 4 'Agriculture' contributes 10 % to total EC 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 8.7 % from 456 Tg to 416 Tg in 2002 (Figure 6.1). In 2002, the emissions decreased by 1 % compared to 2001. 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.13: Other (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)
4.D.4: Other (N_2O)
4.D: Agricultural soils (CO_2)

Figure 6.1 shows that the four largest key sources account for about 75 % of agricultural GHG emissions of the EC.

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 2002, CH_4 emission

Figure 6.1 EC GHG emissions for 1990–2002 from CRF Sector 4: 'Agriculture' in CO_2 equivalents (Tg) and share of largest key source categories in 2002

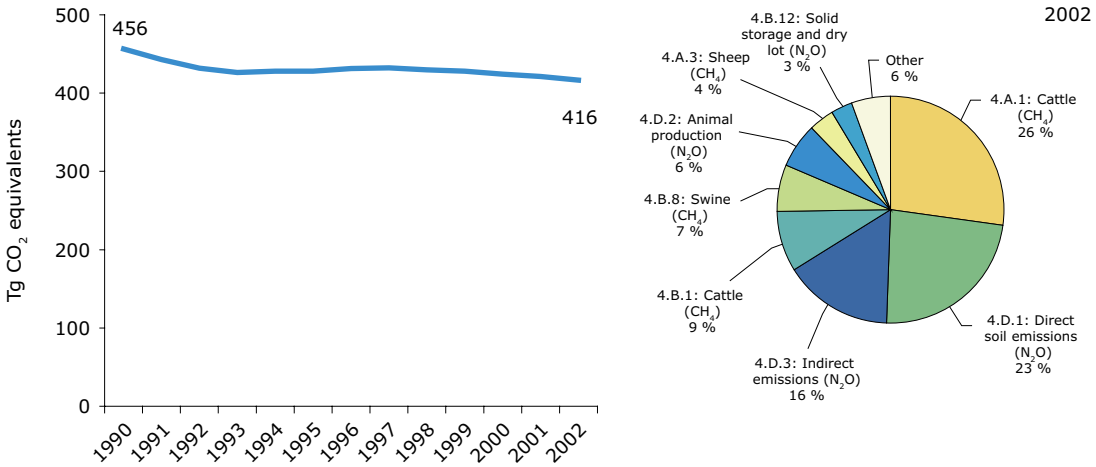


Figure 6.2 Absolute change of GHG emissions by large key source categories 1990–2002 in CO_2 equivalents (Tg) in CRF Sector 4: 'Agriculture'

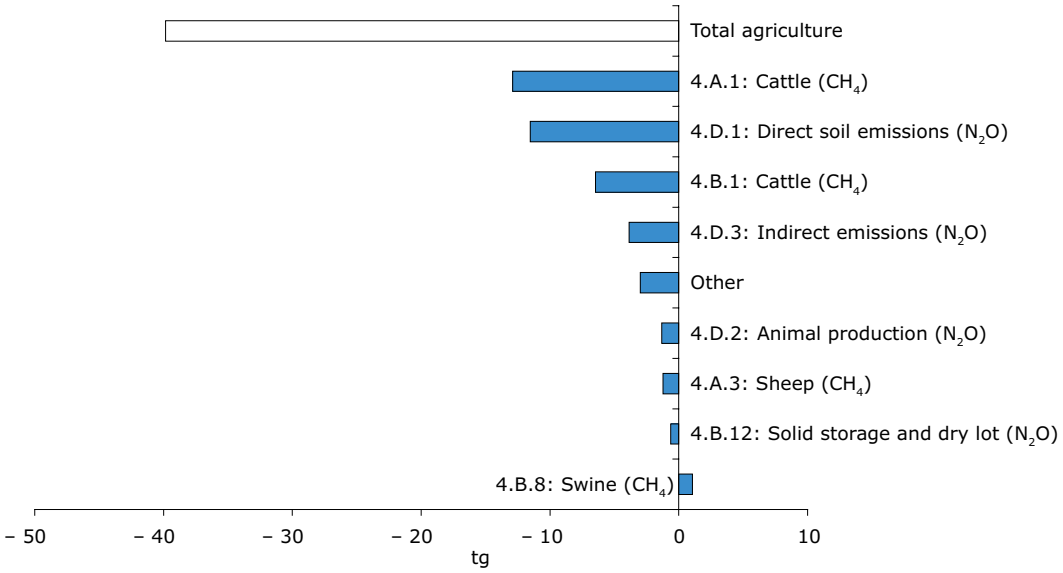


Table 6.1 Member States' contributions to CH_4 emissions from 4.A: 'Enteric fermentation' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2002 (Gg CO_2 equivalents)	Methods applied (1)	EF (1)	Estimate (2)	Quality (2)
Austria	3 563	3 104	T1, T2	D, CS	ALL	M
Belgium	4 488	4 161	M	CS	F	
Denmark	3 100	2 798	T1/T2	CS	ALL	H
Finland	1 868	1 562	T1, T2	CS/D	ALL	M
France	30 854	28 886	C	CS	ALL	M
Germany	34 294	26 796	C/D	C/D	ALL	H
Greece	2 976	3 004	T1	D	ALL	
Ireland	9 180	9 524	D	CS, D	FULL	M
Italy	12 044	11 042	D, T2	D, CS	ALL	H
Luxembourg	346	317	C/D	C/D	ALL	
Netherlands	8 439	6 421	cattle 90: T2; rest: T1	cattle: CS; rest: D	ALL	M
Portugal	2 606	2 515	T1	D	ALL	M
Spain	12 651	14 720	CS, T1, T2	T1, T2	ALL	M
Sweden	3 027	2 858	T1, CS	D, CS	ALL	H
United Kingdom	19 122	16 928	T2	D/CS	ALL	M
EU-15	**148 558**	**134 638**	**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'.

from 'Enteric fermentation' decreased by 9 %. The relative decrease was largest in the Netherlands, 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 EC accounting for 2.8 % of total GHG emissions in 2002. Between 1990 and 2002, CH_4 emissions from enteric fermentation from cattle declined by 10 % in the EC (Table 6.2). In 2002, the emissions were 1 % lower compared to 2001. The main driving force of CH_4 emissions from enteric fermentation is

Table 6.2 Member States' contributions to CH_4 emissions from 4.A.1: 'Cattle'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU-15 emissions in 2002 (%)	Change 2001–2002		Change 1990–2002	
	1990	2001	2002		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	3 372	2 967	2 911	2.6	– 56	– 2	– 461	– 14
Belgium	4 301	4 067	3 973	3.5	– 94	– 2	– 327	– 8
Denmark	2 784	2 493	2 402	2.1	– 92	– 4	– 382	– 14
Finland	1 745	1 452	1 444	1.3	– 8	– 1	– 301	– 17
France	28 382	27 115	26 666	23.5	– 449	– 2	– 1 716	– 6
Germany	32 593	25 327	25 327	22.3	0	0	– 7 266	– 22
Greece	867	828	825	0.7	– 3	0	– 42	– 5
Ireland	8 020	8 517	8 398	7.4	– 120	– 1	378	5
Italy	9 928	8 967	8 950	7.9	– 17	0	– 977	– 10
Luxembourg	341	323	311	0.3	– 11	– 3	– 30	– 9
Netherlands	7 678	6 043	5 766	5.1	– 276	– 5	– 1 912	– 25
Portugal	1 826	1 784	1 779	1.6	– 6	0	– 48	– 3
Spain	7 411	9 068	9 195	8.1	127	1	1784	24
Sweden	2 729	2 581	2 570	2.3	– 11	0	– 159	– 6
United Kingdom	14 433	13 072	13 001	11.5	– 72	– 1	– 1 433	– 10
EU-15	**126 412**	**114 606**	**113 520**	**100.0**	**– 1 087**	**– 1**	**– 12 892**	**– 10**

Table 6.3 Member States' contributions to CH_4 emissions from 4.A.3: 'Sheep'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU-15 emissions in 2002 (%)	Change 2001–2002		Change 1990–2002	
	1990	2001	2002		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	52	54	51	0.3	– 3	– 5	– 1	– 2
Belgium	28	22	21	0.1	– 1	– 4	– 6	– 23
Denmark	33	33	27	0.2	– 7	– 20	– 7	– 20
Finland	17	16	16	0.1	0	0	– 1	– 7
France	1 923	1 591	1 575	10.5	– 16	– 1	– 348	– 18
Germany	544	466	466	3.1	0	0	– 79	– 14
Greece	1 460	1 515	1 520	10.2	6	0	60	4
Ireland	1 103	1 073	1 042	7.0	– 31	– 3	– 61	– 5
Italy	1 468	1 840	1 367	9.1	– 473	– 26	– 101	– 7
Luxembourg	1	1	2	0.0	0	14	0	6
Netherlands	286	217	199	1.3	– 17	– 8	– 87	– 30
Portugal	564	581	581	3.9	0	0	16	3
Spain	4 267	4 391	4 391	29.4	0	0	124	3
Sweden	68	76	72	0.5	– 4	– 6	3	5
United Kingdom	4 354	3 694	3 619	24.2	– 75	– 2	– 735	– 17
EU-15	**16 169**	**15 570**	**14 948**	**100.0**	**– 622**	**– 4**	**– 1 221**	**– 8**

the number of cattle, which was 10 % below 1990 levels in 2002. The Member States with most emissions from this source were France and Germany (46 %). All Member States except Ireland and Spain reduced CH_4 emissions from enteric fermentation of cattle.

Enteric fermentation from sheep is the sixth largest single source of CH_4 emissions in the EC and accounts for 0.4 % of total GHG emissions in 2002. Between 1990 and 2002, CH_4 emissions from enteric fermentation of sheep declined by 8 % in the EC (Table 6.3). In 2002, the emissions were 4 % lower compared to 2001. The main driving force of CH_4 emissions from enteric fermentation is the number of sheep, which was 10 % below 1990 levels in 2002. The Member States with most emissions from this source were Spain and the United Kingdom (54 %). Nearly all Member States reduced CH_4 emissions from enteric fermentation of sheep.

Table 6.4 Member States' contributions to CH_4 emissions from 4.B: 'Manure management' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2002 (Gg CO_2 equivalents)	Methods applied (1)	EF (1)	Estimate (2)	Quality (2)
Austria	1 020	882	T1, T2	D, CS	ALL	M
Belgium	2 565	2 541	M	CS	F	
Denmark	742	966	T2	CS	ALL	M
Finland	199	202	T2	CS/D	ALL	M
France	14 851	14 133	C	D	ALL	M
Germany	33 711	27 479	C/D	C/D	ALL	H
Greece	497	490	T1	D	ALL	
Ireland	1 261	1 380	D	CS, D	FULL	M
Italy	4 026	3 921	D, T1, T2	D, CS	ALL	H
Luxembourg	24	22	C/D	C/D	ALL	
Netherlands	2 173	1 749	CS/T2	CS (=D, corrected)	ALL	L
Portugal	1 626	1 457	T2	D (CS)	ALL	M
Spain	6 221	8 627	CS, T1, T2	T1, T2	ALL	M
Sweden	361	442	T1, CS	D, CS	ALL	H
United Kingdom	2 329	2 079	T2	D/CS	ALL	M
EU-15	**71 605**	**66 371**	**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 CH_4 emissions from 4.B.1: 'Cattle'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU-15 emissions in 2002 (%)	Change 2001–2002		Change 1990–2002	
	1990	2001	2002		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	547	465	455	1.3	– 10	– 2	– 93	– 17
Belgium	1 128	1 015	977	2.7	– 37	– 4	– 150	– 13
Denmark	282	263	261	0.7	– 1	0	– 20	– 7
Finland	101	95	94	0.3	– 1	– 1	– 7	– 7
France	12 305	11 358	11 155	30.9	– 204	– 2	– 1 150	– 9
Germany	21 222	16 448	16 448	45.6	0	0	– 4 774	– 22
Greece	202	193	193	0.5	– 1	0	– 10	– 5
Ireland	1 115	1 170	1 153	3.2	– 16	– 1	39	3
Italy	2 217	2 044	2 054	5.7	9	0	– 163	– 7
Luxembourg	23	21	21	0.1	– 1	– 3	– 2	– 10
Netherlands	905	807	774	2.1	– 34	– 4	– 131	– 14
Portugal	68	67	66	0.2	0	0		– 2
Spain	670	756	767	2.1	11	1	96	14
Sweden	236	288	285	0.8	– 3	– 1	50	21
United Kingdom	1 520	1 368	1 359	3.8	– 8	– 1	– 160	– 11
EU-15	**42 539**	**36 357**	**36 062**	**100.0**	**– 295**	**– 1**	**– 6 477**	**– 15**

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 CH_4 from 4.B: 'Manure management'. Between 1990 and 2002, CH_4 emission from 'Manure management' decreased by 7 %. The relative decrease was largest in the Netherlands, the relative increase was largest in Spain.

This source category includes two key sources: CH_4 from 4.B.1: 'Cattle' and CH_4 from 4.B.8: 'Swine'.

CH_4 emissions from 4.B.1: 'Cattle' account for 0.9 % of total EC GHG

Table 6.6 Member States' contributions to CH_4 emissions from 4.B.8: 'Swine'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU-15 emissions in 2002 (%)	Change 2001–2002		Change 1990–2002	
	1990	2001	2002		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	448	423	403	1.5	– 19	– 5	– 4	– 10
Belgium	1 315	1 449	1 422	5.2	– 27	– 2	108	8
Denmark	448	681	692	2.5	12	2	244	54
Finland	81	89	93	0.3	4	4	12	14
France	1 790	2 176	2 181	8.0	6	0	392	22
Germany	12 262	10 791	10 791	39.6	0	0	– 1 471	– 12
Greece	146	142	142	0.5	0	0	– 4	– 3
Ireland	124	198	199	0.7	0	0	75	60
Italy	1 413	1 413	1 386	5.1	– 27	– 2	– 27	– 2
Luxembourg	1	1	1	0.0	0	3	0	0
Netherlands	1 033	846	775	2.8	– 71	– 8	– 258	– 25
Portugal	1 489	1 341	1 315	4.8	– 26	– 2	– 173	– 12
Spain	5 076	7 344	7 377	27.1	33	0	2 301	45
Sweden	90	117	119	0.4	2	2	29	32
United Kingdom	476	368	352	1.3	– 16	– 4	– 123	– 6
EU-15	**26 191**	**27 380**	**27 250**	**100.0**	**– 129**	**0**	**1 059**	**4**

Table 6.7 Member States' contributions to N_2O emissions from 4.B: 'Manure management' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2002 (Gg CO_2 equivalents)	Methods applied (1)	EF (1)	Estimate (2)	Quality (2)
Austria	786	701			ALL	M
Belgium	894	899	D	D	F	
Denmark	686	605			ALL	M
Finland	554	378	D	D/CS	ALL	L
France	3 074	2 903	C/T2	D/CS	ALL	M
Germany	4 475	3 032	D	D	ALL	H
Greece	301	290	D	D, CS		
Ireland	627	674	D	CS, D	FULL	M
Italy	3 846	4 168	D	D, CS	ALL	H
Luxembourg	0	0	C/D	C/D	ALL	
Netherlands	205	183	CS	CS	ALL	L
Portugal	946	1 039	T2	D (CS)	ALL	M
Spain	1 632	1 633	CS, D	D	ALL	M
Sweden	799	591	T1, T2	D, CS	ALL	M
United Kingdom	1 514	1 337	T1	D/CS	ALL	M
EU-15	**20 339**	**18 433**	**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'.

emissions in 2002. Between 1990 and 2002, CH_4 emissions from this source decreased by 15 % (Table 6.5). Germany and France are responsible for 77 % of the total EC emissions from this source. All Member States except Ireland and Spain had reductions between 1990 and 2002. In absolute and relative terms, Germany had the most significant decreases from this source.

CH_4 emissions from 4.B.8: 'Swine' account for 0.7 % of total EC GHG emissions in 2002. Between 1990 and 2002, CH_4 emissions from this source increased by 4 % (Table 6.6). Germany and Spain are responsible for 67 % of the total EC emissions from this source. In absolute terms, Spain had the most significant increases from this

Table 6.8 Member States' contributions to N_2O 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 2002 (%)	Change 2001–2002		Change 1990–2002	
	1990	2001	2002		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	0	0	0	0.0	0	—	0	—
Belgium	782	794	785	6.4	– 9	– 1	4	0
Denmark	590	528	512	4.2	– 16	– 3	– 78	– 13
Finland	542	390	367	3.0	– 23	– 6	– 175	– 32
France	1 917	1 767	1 751	14.3	– 16	– 1	– 165	– 9
Germany	0	0	0	0.0	0	—	0	—
Greece	282	270	269	2.2	– 1	0	-- 12	– 4
Ireland	578	629	620	5.1	– 9	– 1	42	7
Italy	3 705	3 873	3 796	31.0	– 77	– 2	91	2
Luxembourg	0	0	0	0.0	0	—	0	—
Netherlands	0	0	0	0.0	0	—	0	—
Portugal	917	1 005	1 013	8.3	9	1	97	11
Spain	1 564	1 523	1 541	12.6	18	1	– 23	– 1
Sweden	709	474	475	3.9	1	0	– 234	– 33
United Kingdom	1 280	1 144	1 112	9.1	– 32	– 3	– 168	– 13
EU-15	**12 866**	**12 397**	**12 243**	**100.0**	**– 154**	**– 1**	**– 623**	**– 5**

Table 6.9 Member States' contributions to N_2O emissions from 4.B.13: 'Other'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU-15 emissions in 2002 (%)	Change 2001–2002		Change 1990–2002	
	1990	2001	2002		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	0	0	0	0.0	0	—	0	—
Belgium	47	53	51	1.2	– 1	– 3	5	10
Denmark	0	0	0	0.0	0	—	0	—
Finland	0	0	0	0.0	0	—	0	—
France	653	678	661	14.8	– 16	– 2	8	1
Germany	4 475	3 032	3 032	68.0	0	0	– 1 442	– 32
Greece	13	14	14	0.3	0	0	1	7
Ireland	0	0	0	0.0	0	—	0	—
Italy	0	240	244	5.5	4	2	244	—
Luxembourg	0	0	0	0.0	0	-	0	—
Netherlands	205	195	183	4.1	– 12	– 6	– 22	– 11
Portugal	0	0	0	0.0	0	—	0	—
Spain	3	2	2	0.0	0	2	– 1	– 27
Sweden	74	95	94	2.1	– 1	– 1	21	28
United Kingdom	175	183	174	3.9	– 9	– 5	– 1	– 1
EU-15	**5 643**	**4 492**	**4 456**	**100.0**	**– 36**	**– 1**	**– 1 187**	**– 21**

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 N_2O from 4.B: 'Manure management'. Between 1990 and 2002, N_2O emission from 'Manure management' decreased by 9 %. The relative decrease was largest in Germany and Finland, the relative increase was largest in Portugal.

This source category includes two key sources: N_2O from 4.B.12: 'Solid storage and dry lot' and N_2O from 4.B.13: 'Other'.

N_2O emissions from 4.B.12: 'Solid storage and dry lot' account for 0.3 % of total EC GHG emissions in 2002. Between 1990 and 2002, N_2O emissions from this source decreased by 5 % (Table 6.8). Italy, France and Spain are responsible for 58 % of the total EC emissions from this source. In absolute

Table 6.10 Member States' contributions to CO_2 emissions from 4.D: 'Agricultural soils' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2002 (Gg CO_2 equivalents)	Methods applied (1)	EF (1)	Estimate (2)	Quality (2)
Austria	0	0			NE	NE
Belgium	0	0	NE	NE	P	
Denmark	0	0	NE		NE	
Finland	3 208	2 057	D	D/CS	ALL	L
France	0	0			NO	
Germany	IE	IE	IE	IE	NE	
Greece	0	0				
Ireland	IE	IE	NA	NA	IE	NA
Italy	0	0			NO	
Luxembourg	0	0	C/D	C/D	ALL	
Netherlands	NE	NE	NE		NE	
Portugal	NE	NE			NE	
Spain	0	0	NO		NO	
Sweden	IE	IE	IE	IE	IE	
United Kingdom	IE	IE	IE	IE		
EU-15	**3 208**	**2 057**	**C, D**	**C, D, CS**	**ALL, IE, NE, 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 6.11 Member States' contributions to N_2O emissions from 4.D: 'Agricultural soils' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2002 (Gg CO_2 equivalents)	Methods applied (1)	EF (1)	Estimate (2)	Quality (2)
Austria	3 064	2 702	T1	D	ALL	M
Belgium	5 640	4 595	D	CS	F	
Denmark	8 297	5 765	CS/M	CS/M	ALL	M
Finland	4 269	3 276	D	D/CS	ALL	L
France	56 307	51 977	C/T2	D/CS	ALL	L
Germany	38 110	31 621	C/CS	C/D	ALL	H
Greece	6 501	8 799	D, T1b	D	PART	
Ireland	6 870	7 146	D	CS, D	FULL	M
Italy	18 897	18 985	D	D, CS	ALL	H
Luxembourg	146	0	C/D	C/D	ALL	
Netherlands	6 584	6 619	CS/T1b (D&I)	CS	ALL	L
Portugal	3 224	2 842	D	D	ALL	M
Spain	16 277	17 008	CS, D	CS, D	ALL	L
Sweden	5 395	4 896	D, C	CS	ALL	M
United Kingdom	30 353	26 419	T1a/T1b	D	ALL	L
EU-15	**209 933**	**192 651**	**C, CS, D, M, T1, T1a, T1b, T2**	**C, CS, D, M**	**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'.

and relative terms, Sweden had the most significant decreases from this source while Portugal had the largest increases.

N_2O emissions from 4.B.13: 'Other' account for 0.1 % of total EC GHG emissions in 2002. Between 1990 and 2002, N_2O emissions from this source decreased by 21 % (Table 6.9). Germany is responsible for 68 % of the total EC 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 the key source CO_2 from 4.D: 'Agricultural soils'. CO_2 emissions from 4.D: 'Agricultural soils' were reported only by Finland. The Finnish emissions derive from organic soils (peat soils and other organic soils) and liming, the emissions are caused by agricultural activities. This key source accounts for 0.05 % of EC GHG emissions.

Table 6.11 summarises information by Member State on methodologies, emission factors, completeness and qualitative uncertainty estimates for N_2O from 4.D: 'Agricultural soils'. N_2O emissions from 4.D: 'Agricultural soils' decreased by 8 % between 1990 and 2002. Most EC Member States decreased emissions.

This source category includes four key sources: N_2O from 4.D.1:'Direct soil emissions', N_2O from 4.D.2:' Animal production', N_2O from 4.D.3: 'Indirect emissions', and N_2O from 4.D.4: 'Other'.

Table 6.12 provides information on emission trends of the key source from 4.D.1: 'Direct soil emissions' by Member State. Direct N_2O emissions from agricultural soils is the largest source category of N_2O emissions and accounts for 2.4 % of total EC GHG emissions in 2002. Direct N_2O emissions from agricultural soils occur from the application of mineral nitrogen fertilisers and organic nitrogen from animal manure. Between 1990 and 2002, emissions declined by 11 % in the EC, compared to 2001 they decreased by 1 %. The Member States with most emissions from this source were France and Germany. All Member States except Ireland and the Netherlands reduced N_2O emissions from agricultural soils.

The main driving force of direct N_2O emissions from agricultural soils is the use of nitrogen fertiliser and animal manure, which were 15 % and 6 % respectively below 1990 levels in 2002. N_2O emissions from agricultural land can be decreased by overall efficiency improvements of nitrogen uptake by crops, which should lead to lower fertiliser consumption on agricultural land. The decrease of fertiliser use is partly due to the effects of the 1992 reform of the common agricultural policy and the resulting shift from production-based support mechanisms to direct area payments in arable production. This has tended to lead to an optimisation and overall reduction in fertiliser use. In addition, reduction

Table 6.12 Member States' contributions to N_2O emissions from 4.D.1: 'Direct soil emissions'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU-15 emissions in 2002 (%)	Change 2001–2002		Change 1990–2002	
	1990	2001	2002		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	1 693	1 637	1 488	1.5	– 149	– 9	– 205	– 12
Belgium	2 799	2 741	2 749	2.8	8	0	– 50	– 2
Denmark	4 170	3 105	2 962	3.0	– 143	– 5	– 1 208	– 29
Finland	3 285	2 588	2 549	2.6	– 39	– 2	– 736	– 22
France	28 426	25 879	25 657	26.4	– 223	– 1	– 2 770	– 10
Germany	21 972	18 595	18 293	18.8	– 302	– 2	– 3 678	– 17
Greece	3 119	2 116	2 088	2.1	– 28	– 1	– 1 031	– 33
Ireland	2 659	2 935	2 768	2.9	– 167	– 6	109	4
Italy	9 133	8 989	9 055	9.3	66	1	– 78	– 1
Luxembourg	0	0	0	0.0	0	—	0	—
Netherlands	3 962	4 573	4 377	4.5	– 195	– 4	415	10
Portugal	1 451	1 195	1 195	1.2	1	0	– 256	– 18
Spain	8 535	8 789	8 357	8.6	– 432	– 5	– 178	– 2
Sweden	3 227	2 976	2 889	3.0	– 87	– 3	– 338	– 10
United Kingdom	14 208	12 039	12 687	13.1	648	5	– 1 521	– 11
EU-15	**108 639**	**98 157**	**97 115**	**100.0**	**– 1 041**	**– 1**	**– 11 524**	**– 11**

Table 6.13 Member States' contributions to N_2O emissions from 4.D.2: 'Animal production'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU-15 emissions in 2002 (%)	Change 2001–2002		Change 1990–2002	
	1990	2001	2002		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	200	217	213	0.8	– 5	– 2	13	6
Belgium	703	669	659	2.5	– 10	– 1	– 44	– 6
Denmark	312	312	299	1.1	– 14	– 4	– 14	– 4
Finland	207	168	166	0.6	– 2	– 1	– 41	– 20
France	6 270	5 920	5 817	21.6	– 103	– 2	– 453	– 7
Germany	2 519	2 045	2 045	7.6	0	0	– 473	– 19
Greece	3 382	3 515	3 531	13.1	16	0	149	4
Ireland	2 780	2 932	2 883	10.7	– 49	– 2	103	4
Italy	1 869	2 192	1 743	6.5	– 449	– 20	– 127	– 7
Luxembourg	0	0	0	0.0	0	—	0	—
Netherlands	1 163	775	781	2.9	6	1	– 381	– 33
Portugal	544	523	519	1.9	– 4	– 1	– 24	– 4
Spain	2 794	3 290	3 306	12.3	15	0	512	18
Sweden	228	306	304	1.1	– 2	– 1	76	33
United Kingdom	5 223	4 685	4 604	17.1	– 81	– 2	– 619	– 12
EU-15	**28 194**	**27 549**	**26 868**	**100.0**	**– 681**	**– 2**	**– 1 325**	**– 5**

Table 6.14 Member States' contributions to N_2O emissions from 4.D.3: 'Indirect emissions'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU-15 emissions in 2002 (%)	Change 2001–2002		Change 1990–2002	
	1990	2001	2002		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	1 171	1 102	1 001	1.5	– 101	– 9	– 170	– 15
Belgium	1 112	1 015	1 010	1.6	– 5	– 1	– 102	– 9
Denmark	3 787	2 525	2 436	3.8	– 89	– 4	– 1 352	– 36
Finland	764	575	557	0.9	– 18	– 3	– 207	– 27
France	20 918	19 439	19 421	30.0	– 19	0	– 1 497	– 7
Germany	13 619	11 430	11 282	17.4	– 148	– 1	– 2 337	– 17
Greece	0	3 196	3 181	4.9	– 16	0	3 181	—
Ireland	1 431	1 548	1 495	2.3	– 52	– 3	65	5
Italy	7 894	8 396	8 187	12.6	– 209	– 2	293	4
Luxembourg	0	0	0	0.0	0	—	0	—
Netherlands	0	0	0	0.0	0	—	0	—
Portugal	1 229	1 125	1 127	1.7	2	0	– 102	– 8
Spain	4 836	5 318	5 205	8.0	– 114	– 2	368	8
Sweden	1 148	948	947	1.5	– 1	0	– 202	– 18
United Kingdom	10 754	8918	8966	13.8	48	1	– 1 787	– 17
EU-15	**68 663**	**65 535**	**64 814**	**100.0**	**– 721**	**– 1**	**– 3 849**	**– 6**

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).

N_2O emissions from 4.D.2: 'Animal production' account for 0.7 % of total EC GHG emissions in 2002. Between 1990 and 2002, N_2O emissions from this source decreased by 5 % (Table 6.13). France, the United Kingdom and Greece are responsible for 52 % of the total EC emissions from this source. The United Kingdom had the greatest reduction in absolute terms while Spain had the largest increases.

N_2O emissions from 4.D.3: 'Indirect emissions' account for 1.6 % of total EC GHG emissions in 2002. Between 1990 and 2002, N_2O emissions from this source decreased by 6 % (Table 6.14). France, Germany and the United Kingdom are responsible for 61 % of the total EC emissions from this source.

Table 6.15 Member States' contributions to N_2O emissions from 4.D.4: 'Other'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU-15 emissions in 2002 (%)	Change 2001–2002		Change 1990–2002	
	1990	2001	2002		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	0	0	0	0.0	0	—	0	—
Belgium	1 026	177	177	4.6	1	0	– 849	– 83
Denmark	28	64	69	1.8	4	7	41	148
Finland	13	5	5	0.1	0	0	– 9	– 66
France	693	1 090	1 083	28.1	– 7	– 1	390	56
Germany	0	0	0	0.0	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	1 460	1 460	1 460	37.9	0	0	0	0
Portugal	0	0	0	0.0	0	—	0	—
Spain	111	133	140	3.6	7	6	29	26
Sweden	792	751	757	19.7	6	1	– 34	– 4
United Kingdom	169	165	162	4.2	– 3	– 2	– 7	– 4
EU-15	**4 292**	**3 844**	**3 853**	**100.0**	**9**	**0**	**– 439**	**– 10**

Each of these Member States had large absolute reductions between 1990 and 2002.

N_2O emissions from 4.D.4: 'Other' account for 0.1 % of total EC GHG emissions in 2002. Between 1990 and 2002, N_2O emissions from this source decreased by 10 % (Table 6.15). The Netherlands and France are responsible for 66 % of the total EC emissions from this source. Between 1990 and 2002, Belgium had the largest absolute reductions from this source, while the French emissions increased.

6.3 Methodological issues and uncertainties

The previous section presents for each EC key source in CRF Sector 4 an overview on 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.

The following considerations are focussed on the reporting categories 4.A: 'Enteric fermentation' and 4.D: 'Agricultural soils' as they contribute 32.3 % and 46.6 % of the GHG emissions from the sector 'Agriculture', respectively. Preliminary checks have been carried out including Source Category 4.B: 'Manure management' (20.4 %). The importance of the agricultural sector — especially Category 4.D — to the inventory uncertainty is considerable, as the quantitative analysis by Member State using Tier 1 or Tier 2 methodology shows (Table 6.16).

6.3.1 Enteric fermentation (CRF Source Category 4.A)

CH_4 emissions in the source category 'Enteric fermentation' stem for 10 Member States to over 85 % from the subcategory 'Cattle'. Substantial emissions from the subcategory 'Sheep' (11–51 % 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' (20 %) and Denmark for the subcategory 'Swine' (10 %).

Accordingly, higher tier methodologies and country-specific methodologies are used for the estimation of CH_4 emissions from cattle (see Table 6.17 for methodologies and emission factors

Table 6.16 Member State's uncertainty estimates using Tier 1 or Tier 2 methodology. Results for the Source Categories 4.A and 4.D: (a) Uncertainties expressed as percentage of total reported national GHG emissions and (b) uncertainties expressed relative to the emissions in the respective category

(a)		Total uncertainty of GHG inventory	Agricultural soils (4.D)				Enteric fermentation (4.A)	
			Total N_2O	Direct N_2O	Indirect N_2O	Animal prod. N_2O	CH_4	
Member State	Year analysed	% of total emissions	Uncertainties expressed as % of total GHG emissions					Source
Denmark (T1)	2002	46.2	45.5				0.9	NIR 2004 Annex 7, p. 255
Finland (T1)	2002	6.5		1.9	2.5		0.6	NIR 2004 Annex 3, p. 86
Finland (T2)	2002			1.9	2.4		0.6	NIR 2004 Annex 3, p. 86
France (T1)	2002	22.1	20.9				2.3	NIR 2004 p. 32
Greece (T1)	2002	19.1		16.8	1.2		1.1	NIR 2004 Annex IV, p. 166f
Ireland (T1)	2002	11.5	10.9				2.8 (1)	NIR 2004 p.15
Italy (T1)	2001	2.5		0.5	0.7	0.4	0.7	NIR 2003 p. 81
Spain (T1)	2001	17.5		8.7	12.6	1.0	0.8	NIR 2004 p. 52/53
Sweden (T1)	2002	7.2	6.1				1.2	NIR 2004 p. 15
Netherlands (T1)	2002	5		1.5	1.4 (2)		0.6 (3)	NIR 2004 page A-7, I-23 ff
United Kingdom (T1)	2002	17.9	17.6 0.5					NIR 2004 A7.270
(b)		% of total emissions	Relative uncertainties (%)					
Austria (T2)	1997	8.9	24.0				8–62 (4)	NIR 2003 p. 157, 190
United Kingdom (T2)	2002	15.0	Total: Lognormal distribution; 97.5 percentile 100 times the 2.5 percentile.				20.0	NIR 2004 A7.258ff

T1: Tier 1 methodology, T2: Tier 2 methodology.
(1) Dairy: 0.73 %; Non-dairy: 2.56 %; Other livestock: 0.83 %.
(2) N_2O emissions from polluted surface water: 1.1 %.
(3) Cattle: 0.6 %; Swine: 0.1 %.
(4) Cattle: ± 8 %; Horses: ± 10 %; Swine: ± 42 %; Sheep, goats: ± 62 %.

used). An overview of the emission factors and the methane conversion rates used is given in Table 6.18.

The uncertainty of the emission value in Category 4.A is reported to range between 0.5 % (UK) and 2.8 % (Ireland) of the total national GHG emissions (see Table 6.16). All Member States consider the emission inventory for Category 4.A as complete. Eight countries consider the quality of the emission estimate in Category 4.A as medium and four countries assign high quality to the emission estimate. At EU level, the quality has to be considered as medium (see Table 6.21).

Table 6.17 Member State's background information for the calculation of CH_4 emissions in Category 4.A

Member State	Methods ([1])	EF ([1])	Comments
Austria NIR 2004, p. 175ff Gebetsroither et al., 2002, p. 3	T1, T2	D, CS	Cattle: Tier 2. Other animal categories: Tier 1. Emissions from organic and conventional farming practices have been calculated separately. Gross energy intake for dairy cows in dependency of annual milk yield has been taken from values modelled by Gruber and Steinwidder (1996) ([2]).
Belgium NIR 2004, p. 54.	M	CS	Tier 1 for all animal categories. Default emission factors are used unless country-specific data are available. Further harmonisation of the emission factors between the regions is foreseen. The emission factors presented in the CRF tables are a weighted average of the emission factors used at the regional level.
Denmark DK NIR 2004, p. 97f	T1/T2	CS	All animal categories: Tier 2. Feeding consumption for all animal categories is based on the Danish norm figures (Poulsen *et al., 2001* ([3])). Changes in fodder conditions and stable systems are accounted for in each year.
Finland NIR 2004, p. 45	T1/T2	CS/D	Cattle: Tier 2. Other animal categories: Tier 1. Reindeer: emissions are calculated on the basis of Finnish literature (Nieminen *et al. 1998* ([4])). The average daily feed intake has been calculated from data on animal weight, daily weight gain, etc. as in previous inventories (estimating the live weight using a time series developed on the basis of milk recording and applying a scaling factor for mature weight, NIR 2002).
France NIR 2004, p. 77	C	CS	Dairy cattle: Country-specific method. Other animal categories: Tier 1.
Germany NIR 2004, pp. 6-3/6-4	C/D	C/D	Dairy cattle: a regression approach is applied based on the animal feed, the milk production and the animal weight. Other animal categories: Tier 1. The milk productivity is taken from regional statistics ('Kreise') and is used to calculated live weight. Feeding characteristics are taken from an agricultural sector model (Raumis).
Greece NIR 2004, p. 90	T1	D	All animal categories: Tier 1. Due to limited information on detailed data about animal feeding Tier 2 methodology can not be used for sheep, which constitute 50 % of total methane emissions from enteric fermentation.
Ireland NIR 2004, pp. 49/50	D	CS, D	All animal categories: Tier 1. Much of the required information for applying Tier 2 methodology does exist in the country, but could not be acquired to date. 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 (McGettigan, 1993 ([5])). A weighted emission factor of 50 kg CH_4/head/year was adopted for the category 'other cattle' in 2000 during the preparation of Ireland's climate change strategy.
Italy CRF Table 4.D for 2002	D, T2	D, CS	Cattle: Tier 2. Other animal categories: Tier 1.
Luxembourg	0.00	0.00	
Netherlands NIR 2004, pp. 1-14/15 and 6-2	cattle 90: T2; rest: T1	cattle: CS; rest: D	Cattle: emission factor from country-specific Tier 2 analysis in 1990. The emission factors did not change for subsequent years. Specific factors are applied to 4 and 3 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 CRF Table 4.A for 2002	T1	D+CS	All animal categories: Tier 1 level. Data on average daily feed intake, CH_4 conversion, percentage of weight, feeding situation, milk yield, work, pregnant, digestibility of feed are not available.
Spain NIR 2004, p. 126	CS,T1,T2	T1,T2	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).
Sweden NIR 2004, pp. 112,129	T1 + CS	D+CS	Significant cattle subgroups: national. Reindeer: according to IPCC 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. 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. 91	T2	D/CS	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. 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.

T1, T2, D: IPCC Tier 1, Tier 2, and default methodology/emission factor. C: Corinair. CS: country-specific methodology/emission factor, M: model.

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

([2]) Gruber & Steinwidder, (1996): 'Einfluß der Fütterung auf die Stickstoff- und Phosphorausscheidung landwirtschaftlicher Nutztiere — Modellkalkulationen auf Basis einer Literaturübersicht in: Die Bodenkultur' — *Austrian Journal of Agricultural Research,* 47. Band/Heft 4/Dezember 1996/ISBN 0006-5471, WUV-Universitätsverlag, Vienna.

([3]) Poulsen, H.D., Børsting, C.F., Rom, H.B., Sommer, S.G. (2001). *Kvælstof, fosfor og kalium i husdyrgødning — normtal 2000.* DJF rapport nr. 36 — husdyrbrug, Danmarks Jordbrugsforskning. (In Danish).

([4]) Nieminen, M., Maijala, V. & Soveri, T. (1998). *Reindeer feeding.* (Poron ruokinta). Finnish Game and Fisheries Research Institute. (In Finnish.)

([5]) McGettigan, M. (1993). Corinair 1990 emissions inventory for Ireland. Contract B92/B4-3200-11/3208. Environmental Research Unit, Dublin.

Table 6.18 Member State's implied emission factors and CH_4 conversion rates for the calculation of CH_4 emissions in Category 4.A

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	103	53	8.0	5.0	1.5	6.0	6.0	NE	NE	NE
Belgium	105	48	6.8	8.8	1.1	NE	NE	NE	NE	NE
Denmark	118	36	17.2	13.2	1.1	6.0	6.0	6.0	5.0	0.6
Finland	115	42	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	1.5	NE	NE	NE	NE	NE
Greece	81	56	8.0	5.0	1.5	0.0	0.0	0.0	0.0	0.0
Ireland	100	50	8.0	5.0	1.5	0.0	0.0	0.0	0.0	0.0
Italy	84	49	8.0	5.0	1.5	5.0	4.4	0.0	0.0	0.0
Luxembourg	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Netherlands	82	43	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 (2)	104	59	8.6	4.9	1.3	6.0	6.0	6.5	N.A	N.A
Sweden	128	57	8.0	5.0	1.7	6.7	7.0	6.0	5.0	0.6
United Kingdom	121	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 4.A.
(2) Spanish numbers for CH_4 conversion rates multiplied by 100.

Source: CRF Table 4.A for 2002.

6.3.2 Agricultural soils (CRF Source Category 4.D)

N_2O emissions from agricultural soils contribute a significant part of the total estimated uncertainty in national GHG inventories and are believed to be mainly affected by the emission factors for direct and indirect emissions. The uncertainty of the emission value in Category 4.D. is reported to range between 0.4 % of the total national GHG emissions for the subcategory animal production (Italy) to 45.5 % of the total national GHG emissions for total N_2O emissions in Category 4.D (Denmark). The significance of this category for the national GHG inventories appears by comparison of these values with the total estimated uncertainty (see Table 6.16). Five countries consider the quality of the emission estimate in Category 4.D as medium and five countries assign low quality to the emission estimate. Two countries consider the estimate in Category 4.D of high quality. At EU level, the quality has therefore to be considered as medium (see Table 6.21).

Due to the large uncertainty associated with this category and the lack of well-established alternatives, most Member States rely on the IPCC default emission factors. For other parameters used in the calculation of N_2O emissions from agricultural soils, however, many Member States use country-specific methodologies, linking the N_2O inventory with the Corinair NH_3 inventory or using simulation models. A more specific discussion of emission factors (Table 6.19) and parameters (Table 6.20) used is presented below.

All Member States consider the emission inventory for Category 4.D as complete.

Direct emissions from application of fertiliser. Most Member States use the IPCC default emission factors for the calculation of N_2O emissions from the application of mineral and organic fertiliser. A differentiation between organic and inorganic fertiliser has been made by the Netherlands, Sweden and Portugal. Lower N_2O emission rates resulting from the application of nitrogen with inorganic fertilisers and higher N_2O 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 N_2O emission factor for

Table 6.19 Emission factors used for the calculation of N_2O emissions from agricultural soils

Member States	Synthetic fertiliser	Animal wastes appl.	N-fixing crops	Crop residue	Cultiv. of histo-sols	Animal produc'n	Atmosph. 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	0.00	2.0	1.00	2.5	0.00	0.00	0.00
Belgium	1.25	1.25	0.08	0.029	5.0	2.0	1.00	2.5	1.00	0.00	0.00
Denmark	1.25	1.25	1.25	1.25	8.0	2.0	1.00	2.5	1.25	1.25	0.00
Finland	1.25	1.25	1.25	1.25	8.0	2.0	1.00	2.5	1.25	0.00	0.00
France	1.25	1.25	0.075	0.013	0.0	2.0	1.00	2.5	0.00	2.31	0.00
Germany	1.25	1.25 (2)	2.9 (3)	NE	0.0	2.0	1.00	2.50			
Greece	1.25	1.25	0.06	0.007	NE	2.0	1.00	2.5 (4)	0.00	0.00	0.00
Ireland	1.25	1.25	1.25	1.25	0.0	2.0	1.00	2.5	0.00	0.00	0.00
Italy	1.25	1.25	0.04	0.01	8.0	2.0	1.00	2.5	0.00	0.00	0.00
Luxembourg	0.00	0.00	0.00	0.00	0.0	0.0	0.00	0.00	0.00	0.00	0.00
Netherlands	1.10	2.00	0.98	NE	IE	1.6	NE	IE	0.00	0.00	0.00
Portugal	1.13	1.06	0.11	0.005	0.0	1.9	1.00	2.5	0.00	0.00	0.00
Spain	1.25	1.25	1.25	1.25	NO	2.0	1.00	2.5	1.25	1.25	0.00
Sweden	0.79	2.50	0.06	0.007	8.0	1.6	1.00	2.5	1.18	0.5	0.4
United Kingdom	1.25	1.25	0.07	0.028	8.0	2.0	1.00	2.5	0.00	0.00	0.00

NE: not estimated — IE: included elsewhere.

(1) Belgium: Sludge spreading — Denmark (a) Industrial waste used as fertiliser and (b) Sewage sludge used as fertiliser — Finland (a) Sludge spreading — France (a) Overseas territories; (b) Sewage sludge spreading and (c) Cultures without fertilisers — Netherlands (a) Background agricultural soils — Spain (a) Municipal solid wastes compost and (b) Domestic wastewater sludges; Sweden (a) Sewage sludge, (b) Cultivation of mineral soils and (c) N-fixation in hayfields.
(2) The German CRF shows the value of 0.44 % — the EF of 1.25 %, however, is consistent with the NIR and activity data and emissions given in Table 4.D.
(3) The German CRF reports the emission factor for N_2O emissions from N-fixing in the units of kg N_2O-N ha^{-1}.
(4) Due to a transcription error, the CRF table shows 100 %. Calculation has been done with the EF for Nitrogen leaching and runoff used of 2.5 %.

Source: CRF Table 4.D 2002.

Table 6.20 Parameters used for the calculation of N_2O emissions from agricultural soils

Member States	$Frac_{BURN}$	$Frac_{FUEL}$	$Frac_{GASF}$	$Frac_{GASM}$	$Frac_{GRAS}$	$Frac_{LEACH}$	$Frac_{NCRBF}$	$Frac_{NCRO}$	$Frac_{R}$
Austria	0.74 %	0.00 %	2.9 %	18 %	16.1 %	30 %	0.5 %	1.5 %	34.1 %
Belgium	0.00 %	0.00 %	0.0 %	0 %	0.0 %	0 %	0.0 %	0.0 %	0.0 %
Denmark	NO	NO	2.0 %	23 %	12.0 %	34 %	NE	NE	NE
Finland	NA	0.00 %	0.6 %	31 %	22.2 %	15 %	0.8 %	4.2 %	43.2 %
France	NA	NA	10 %	20 %	28.0 %	30 %	CS	CS	CS
Germany			6 %	29 %	16.0 %	30 %	NE	NE	NE
Greece	10 %	0.00 %	10 %	20 %	0.0 %	30 %	0.0 %	0.0 %	0.0 %
Ireland	0.00 %	0.00 %	3.9 %	17 %	63.0 %	10 %	as GPG (1)	as GPG	as GPG
Italy	10 %	0.00 %	10 %	39 %	25.0 %	30 %	3.0 %	1.5 %	45.0 %
Luxembourg	0.00 %	0.00 %	0.0 %	0 %	0.0 %	0 %	0.0 %	0.0 %	0.0 %
Netherlands	NO	NO	NE	NE	NE	NE	NE	NE	NE
Portugal	10 %	0.00 %	10 %	16 %	26.8 %	27 %	1.3 %	2.3 %	79.9 %
Spain	NA	0.00 %	8.0 %	36 %	NA	15 %	NA	NA	NA
Sweden	NO	NO	1.4 %	33 %	29.0 %	22 %	1.0 %	2.0 %	19.3 %
United Kingdom	0.00 %	0.00 %	10 %	20 %	54.4 %	30 %	3.0 %	1.5 %	45.0 %

NO: not occurring — NA: not applicable — NE: not estimated.

(1) 'as GPG' refers to the fraction of nitrogen in N-fixing crops ($Frac_{NCRBF}$) and non-N-fixing crops ($Frac_{NCRO}$) and to the amount of total above-ground crop biomass that is removed from the field as product ($Frac_{R}$) as given in the good practice guidance for different crops.

Source: CRF Table 4.D 2002.

synthetic fertiliser in the submission of the Netherlands is composed of the application of 90 % of the fertiliser-nitrogen applied on mineral soils (EF: 1 %) and 10 % of the nitrogen applied on organic soils (EF: 2 %) (Spakmann *et*

al., 2003 ([18])). The Swedish EF of 0.8 % is based on a study on N_2O emissions in Sweden and other countries of northern Europe and in Canada ([19]), supported by a study in Norway suggesting a lower emission factor for emitted fertiliser N than the IPCC default value ([20]) (SE NIR 2003). N_2O 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 NH_3, N_2O, NO, and N_2 (DE NIR 2004). The Austrian inventory calculates the nitrogen left for spreading by subtracting the nitrogen excreted during grazing, NH_3-N losses during housing and manure storage, and N_2O-N losses during manure management. The N_2O emissions are calculated by correcting the remaining nitrogen with the volatilisation rate for $NH_3 + NO_x$ ($Frac_{GASM}$) (AT NIR 2004).

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.

N_2O emissions from crop residues have not been reported in the inventory from the Netherlands, because the emissions from this subcategory and the emissions from the cultivation of histosols have been determined using a country-specific methodology and reported under 'Other' as a fixed value of 4.7 Gg N_2O representing the (enhanced) background emissions from previous applications of manure and fertilisers on agricultural soils and from lowering the groundwater tables in the last century (NL NIR 2004).

Direct emissions from the cultivation of histosols. N_2O emissions from the cultivation of histosols are thus reported as 'Included Elsewhere' in the CRF table by the Netherlands. 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 2003). The cultivation of histosols represents the biggest share of emissions from agricultural soils in the Swedish (19 %) and Finnish (35 %) inventory. The emission factor proposed in the IPCC GPG of 8 kg N_2O-N per hectare and year (IPCC, 2000) is used. Only Belgium uses 5 kg N_2O-N per hectare as given in the IPCC guidelines.

Direct emissions from animal production. All countries are reporting N_2O emissions from manure excreted by animals during grazing and the implied EF is the default factor of 2 % N_2O-N per kg N excreted and year, except for the emission inventories of the Netherlands and Sweden, which use an EF of 1.6 %, and the inventory of Portugal which uses an EF of 1.9 %.

Indirect emissions. All Member States save for the Netherlands report indirect emissions of nitrous oxide induced by the atmospheric deposition of NH_3 and NO_x volatilised and nitrate-leached to the groundwater using the default IPCC emission factors. 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

([18]) Spakman *et al.*, 2003, 'Method for calculating greenhouse gas emissions', *Emission Registration Series/ Environmental Monitor* No 37b, March 2003: electronic update of No 37, July 1997.
([19]) Kasimir Klemedtsson, 2001, *Methodology for estimating the emissions of nitrous oxide from agriculture*, Swedish Environmental Protection Agency, Report 5170.
([20]) Laegreid and Aastveit, 2002, 'Nitrous oxide emissions from field-applied fertilisers', *Plant Production*, No 81, Danish Institute of Agricultural Sciences, October 2002.

values for the volatilisation fractions of mineral and organic fertiliser ($Frac_{GASF}$ and $Frac_{GASM}$), respectively, and six countries using the default IPCC values for the leaching fraction ($Frac_{LEACH}$). While volatilisation of NH_3 and NO_x from the application of mineral fertiliser is considered by all Member States as lower than the IPCC default values (range of national factors 0.6 to 8 %), most of the Member States with country-specific volatilisation rates for organic fertiliser are estimating larger losses of NH_3 + NO_x than proposed by the IPCC (range 16 to 39 %). The country-specific methodology for the estimation of NH_3 volatilisation is in some cases based on the NH_3 inventory using the Corinair methodology thus differentiating between different kinds of synthetic fertilisers. Also, model-based estimations for the fraction of nitrogen volatilised from applied animal wastes have been used. An NH_3 model used in Denmark estimates decreasing levels of NH_3 volatilisation in Denmark for the period 1990–2001 with an average volatilisation rate of 28 % (DK NIR 2003). Indirect N_2O emissions from atmospheric deposition are not estimated in the inventory from the Netherlands. The German inventory includes indirect emissions from volatilisaton of NH_3 and NO_x due to the production of N-fixing crops (DE NIR 2004). In the Austrian inventory, the sum of gaseous losses was calculated on the basis of the amount of nitrogen left for spreading, excluding the nitrogen produced during grazing (AT NIR 2004). In the UK, the amount of mineral fertiliser available for indirect emissions by deposition are corrected by the emissions of N_2O (UK 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 and Sweden) and in some cases based on national studies (e.g. Finland and Ireland). Nitrogen lost by leaching from agricultural soils are reported in the Dutch inventory as a fixed value of 3.8 Gg N_2O under IPCC Sector 7 'Other sources', as 'polluted surface water', since this value is regarded to include nitrogen from non-agricultural sources. Three quarters of these emissions, however, stem from agricultural sources. The UK estimate of N_2O emissions via leaching includes a correction to avoid double counting N_2O emitted from mineral fertiliser use (UK NIR 2004).

N_2O emissions from other sources. Five countries report emissions of N_2O from the application of sewage sludge, according to the IPCC GPG. The emission factors used in three cases are the IPCC default factor for direct N_2O emissions and an equivalent number of Member States used a different value.

6.3.3 Uncertainty

The qualitative uncertainty estimation for the key sources in Table is based on the quality estimates (high, medium and low) provided by the Member States in the CRF Table 7. The quality estimates were weighted according to Member States' share of the total emissions (see Section 1.7). The table shows that almost all agricultural key source emission estimates can be classified as being of medium quality.

Table 6.21 Uncertainty of the key source categories in the CRF Sector 4: 'Agriculture'

Source category gas	2002	Quality estimate
4.B: Manure management (CH_4)	66 371	M
4.B: Manure management (N_2O)	18 433	M
4.A: Enteric fermentation (CH_4)	134 638	M
4.D: Agricultural soils (N_2O)	192 651	M
4.D: Agricultural soils (CO_2)	2 057	L

Note: These source categories are more aggregated than the EC key source categories identified in Section 1.5 because the qualitative uncertainty estimates in CRF Table 7 refer to more aggregated source categories.

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 emissions projections, led by the 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 (CH_4) and nitrous oxide (N_2O) induced by activities in the agricultural sector, not considering changes of carbon stocks in agricultural soils, but including emissions of ammonia (NH_3). The consideration of ammonia emissions allows the validation of the N_2O emission sources and it further strengthens the link between greenhouse gas and air pollutant emission inventories reported under the UNFCCC, the EC Climate Change Committee, the UNECE Long-Range Transboundary Air Pollution Convention, and the EU national emission ceiling directive.

Objectives of the workshop were to compare the Member States' methodologies and to identify and explain the main differences. The longer term objective is to further improve the methods used for inventories and projections in the different Member States and to identify how national and common agricultural policies could be integrated in EU-wide emission scenarios. The workshop concluded with a set of recommendations concerning *inter alia*:

- the consistent assessment of the nitrogen balance in agricultural livestock production systems, including the lack of statistical data (Category 4.B);
- the quality of CH_4 emissions from enteric fermentation (Category 4.A);
- the comprehensive treatment of greenhouse gas emissions from agricultural soils (Category 4.D).

Moreover, the experts participating at the workshop expressed their interest in research projects on the simulation of direct and indirect emissions of N_2O using process models, including their potential use for improvements in the inventories.

As the next step, an expert meeting of the working group on annual inventories under the Climate Change Committee is foreseen for the end of 2004 at the JRC. The expected outcome is a review of national methodologies and emission factors used to estimate GHG emissions from agricultural soils and a suggestion for improved national emission inventories in the category of agricultural soils. Different approaches for the calculation of the fate of nitrogen in agriculture will be discussed and, where possible, suggestions for improved comparability of the approaches will be made. It is foreseen to feed the outcome of the expert meeting into the revision of the revised 1996 IPCC guidelines starting early 2004. Items to be covered are:

- availability and requirements of activity data/input data to estimate GHG emissions from agricultural soils;
- possible improvements in reporting direct and indirect GHG emissions from agricultural soils, including topics relevant for future reporting obligations under the Kyoto Protocol;
- process-based simulation of nutrient cycling and GHG emissions from agricultural soils.

The final agenda of the expert meeting will be based on the results of a questionnaire that has been distributed to the Member States. The questionnaire was considered as necessary due to several gaps in the currently available information on actual reporting practices and possible improvements of reporting in IPCC CRF Category 4.D.

The purpose of the questionnaire ([21]) is:

- to understand the source (sub)categories where improvement in EC Member States is most needed because of inadequacy of the suggested IPCC methodologies for the country, incomplete description of the source category, or insufficient consideration of mitigation measures;
- to understand the need for Tier 3 methodologies (process models) in order to encompass the complexity of controlling factors for emissions (e.g. N_2O emissions from soils);
- to understand the availability of data required for higher tier methodologies;
- to collect complete information on national emission factors and methodologies.

Preliminary calculations were performed to compare national submissions of CH_4 emissions from cattle-enteric fermentations with European-wide application of IPCC Tier 2 methodology (Table 6.22). For EU-15, the emissions reported for 2001 are 16 % lower for dairy cattle and 7 % higher for non-dairy cattle than the values derived with the harmonised data sets. For single Member States, however, the deviation can be as high as 41 %. These deviations are partly explained by national methodologies and country-specific parameters (see Section 6.3.1).

6.5 Sector-specific recalculations

Table 6.23 shows that in the agriculture sector the largest recalculations in absolute and relative terms were made for CH_4 in years 1990 and 2001. Also N_2O emissions were recalculated in both years.

Table 6.24 provides an overview of Member States' contributions to EC recalculations. Germany was mainly responsible for the CH_4 emission recalculations. For N_2O Germany had

Table 6.22 CH_4 emissions (Gg CH_4) from cattle-enteric fermentation for EU-15 in 2001 calculated with IPCC Tier 2 methodology and deviation from submitted emissions data

Member States	Dairy cattle	Non-dairy cattle	Dairy cattle	Non-dairy cattle
	Calculation using IPCC Tier 2 methodology ([1])		Deviation from submitted emissions data (2001) (%) ([2])	
Austria	69	72	88	111
Belgium	73	90	119	119
Denmark	90	58	72	82
Finland	49	30	82	94
France	539	769	81	111
Germany	580	473	78	102
Greece	27	17	71	119
Ireland	130	286	93	99
Italy	258	226	92	108
Luxembourg	6	7	NR	NR
Netherlands	397	50	59	106
Portugal	52	47	68	108
Spain	131	234	93	133
Sweden	60	60	88	116
United Kingdom	290	412	91	87
EU-15	**2 648**	**2 783**	**84**	**107**

NR: not reported.

([1]) Livestock populations from Member States' submissions and redistributed for the calculations over the subcategories: mature female, mature male, growing female, growing male, calves females, calves male using FSS2000 data. Milk characteristics are taken from Eurostat (NewCronos, Theme 5 — agricultural products), Animal performance data are IPCC default values. A value of 50 % was used for the average time spent grazing.

([2]) Values > 100 % indicate larger emissions being reported to UNFCCC.

([21]) The questionnaire is available at http://carbodat.ei.jrc.it/ccu/pweb/leip/home/GHG_questionnaire.html.

Table 6.23 Recalculations of total greenhouse gas emissions and recalculations of greenhouse gas emissions in CRF Sector 4: 'Agriculture', for 1990 and 2001 by gas (Gg and %)

1990	CO_2		CH_4		N_2O		HFCs		PFCs		SF_6	
	Gg	(%)	Gg	(%)	Gg	(%)	Gg	(%)	Gg	(%)	Gg	(%)
Total emissions and removals	96 422	3.1	36 845	8.9	– 16 489	– 4.0	1 293	5.0	2 687	20.1	1 957	23.5
Agriculture	0	0.0	30 206	15.7	– 7 713	– 3.2	NO	NO	NO	NO	NO	NO
2001												
Total emissions and removals	70 582	2.2	26 684	8.1	– 9 674	– 2.8	3 112	7.2	– 4	– 0.1	– 620	– 6.5
Agriculture	0	0.0	25 643	14.3	– 4 657	– 2.1	NO	NO	NO	NO	NO	NO

Table 6.24 Contribution of Member States to EC recalculations in CRF Sector 4: 'Agriculture' for 1990 by gas (difference between latest submission and previous submission Gg of CO_2 equivalents)

	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
Austria	0	169	133	NO	NO	NO
Belgium	0	22	986	NO	NO	NO
Denmark	0	– 247	– 1 276	NO	NO	NO
Finland	0	0	0	NO	NO	NO
France	0	0	505	NO	NO	NO
Germany	IE	33642	– 5 406	NO	NO	NO
Greece	0	0	0	NO	NO	NO
Ireland	IE	0	0	NO	NO	NO
Italy	0	– 1 567	– 839	NO	NO	NO
Luxembourg	-	0	0	NO	NO	NO
Netherlands	0	0	– 90	NO	NO	NO
Portugal	0	– 1 838	– 1 749	NO	NO	NO
Spain	0	0	0	NO	NO	NO
Sweden	IE	25	24	NO	NO	NO
United Kingdom	0	0	0	NO	NO	NO
EU-15	**0**	**30 206**	**– 7 713**	**NO**	**NO**	**NO**

the largest recalculations, but Portugal, Denmark and Italy also had large recalculations. Explanations for some of these recalculations are provided in Section 10.1.

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 2002, net GHG emissions from LUCF (emissions minus removals) were – 159 Tg in the EC (Figure 7.1). They decreased by 57 % from 1990 to 2002 and by 12 % from 2001 to 2002. Net GHG emissions from LUCF have been below 1990 levels for the past decade except in 1991.

Sector 5 is an overall sink of greenhouse gases for all Member States except Germany and the United Kingdom (Table 7.1). For the latter, this is a confirmation of previous years inventories, while, for Germany, the estimation of emissions in Category 5.D (cultivation of organic soils and liming of agricultural and forest soils), previously not estimated, has shifted

Figure 7.1 EC net GHG emissions (emissions minus removals) for 1990–2002 from CRF Sector 5: 'LUCF' in CO_2 equivalents (Tg)

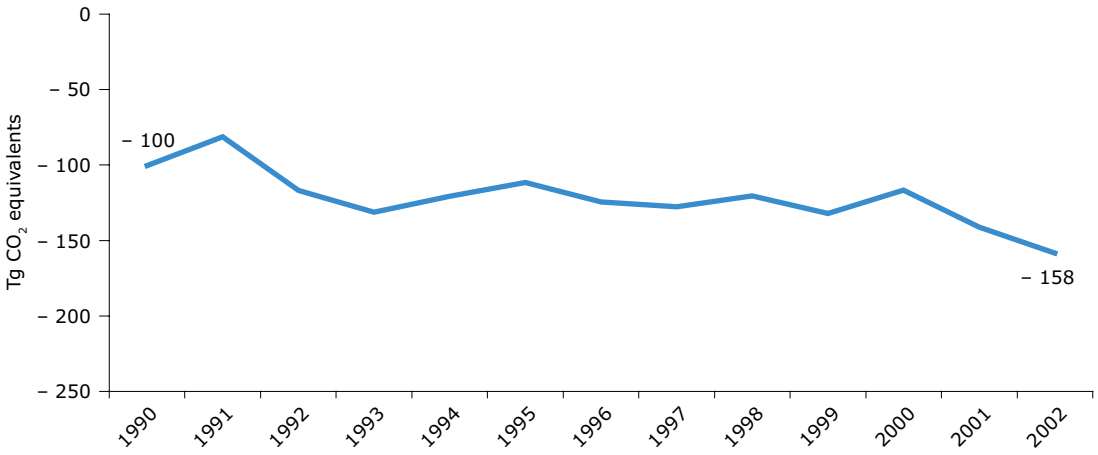


Table 7.1 Member States' contributions to net GHG emissions from CRF Sector 5: 'Land use change and forestry'

Member State	Greenhouse gas emissions/removals (Gg CO_2 equivalents)			Change 2001–2002		Change 1990–2002	
	1990	2001	2002	(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	– 9 215	– 7 633	– 7 633	0	0	1 581	– 17
Belgium	– 1 550	– 1 486	– 1 486	0	0	64	– 4
Denmark	– 2 832	– 3 539	– 3 813	– 274	8	– 981	35
Finland	– 23 798	– 16 851	– 18 010	– 1 159	7	5 788	– 24
France	– 32 115	– 50 303	– 55 310	– 5 007	10	– 23 195	72
Germany	7 515	13 809	13 906	98	1	6391	85
Greece	1 391	– 1 270	– 1 887	– 617	49	– 3 278	– 236
Ireland	– 66	– 629	– 978	– 349	56	– 912	1 389
Italy	– 23 353	– 18 240	– 20 358	– 2 118	12	2 995	– 13
Luxembourg	– 273	– 273	– 273	0	0	0	0
Netherlands	– 1 422	– 1 413	– 1 413	0	0	9	– 1
Portugal	6058	– 604	– 1 208	– 604	100	– 7 267	– 120
Spain	– 9 456	– 31 477	– 35 301	– 3 825	12	– 25 845	273
Sweden	– 20 292	– 24 811	– 26 541	– 1 730	7	– 6 249	31
United Kingdom	9 077	3 501	1 930	– 1 571	– 45	– 7 147	– 79
EU-15	**– 100 330**	**– 141 219**	**– 158 376**	**– 17 157**	**12**	**– 58 046**	**58**

Table 7.2 Contribution of Sector 5 (a) and Category 5.A (b) to total emissions (without LUCF) and Member States contribution to EU 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 total for Sector 5.A (c) (%)
Austria	– 9.0	– 9.0	3.3
Belgium (1)	– 1.0	– 1.2	0.8
Denmark	– 5.6	– 5.4	1.6
Finland	– 22.0	– 22.0	7.8
France	– 10.0	– 12.2	29.2
Germany	1.4	– 2.5	11.0
Greece	– 1.4	– 1.3	0.7
Ireland	– 1.4	– 1.9	0.6
Italy	– 3.7	– 5.0	11.9
Luxembourg	– 2.5	– 2.7	0.1
Netherlands	– 0.7	– 0.7	0.6
Portugal	– 1.9	– 1.9	0.7
Spain	– 8.8	– 8.8	15.3
Sweden	– 38.1	– 43.5	13.1
United Kingdom	0.3	– 1.2	3.3
EU-15	**– 3.9**	**– 5.6**	**100.0**

(1) Data only from Wallonia which represents 80 % of the forest area of Belgium.

Source: 1: Member States' submissions 2004, CRF Table 5, 5.A and Summary 2.

Table 7.3 Percentage of total land area covered by forest (a) and of forest growth increment removed by harvest (resulting in CO_2 emissions, (b) in Member States and EU

Member State	Forest and other wooded land over total land area a (%)	Member States forest sector emissions over removals b (%)
Austria	47	74.4
Belgium	22	70.7
Denmark	12	38.8
Finland	67	83.2
France	31	56.1
Germany	30	68.0
Greece	49	56.7
Ireland	8	69.8
Italy	36	21.2
Luxembourg	34	No sectoral data reported
Netherlands	9	60.7
Portugal	38	91.4
Spain	51	30.4
Sweden	67	78.2
United Kingdom	10	Model provides net results
EU-15	**42**	**65.0**

Sources: (a) FAO TBFRA 2000; (b) CRF Sectoral Table 5.A. Values in column b have been calculated from Sectoral Table 5.A as total biomass consumption from stocks over total annual growth increment * 100.

the sector to be a source. Germany has performed the recalculations for the period 1990 to 2001 (as a result, Sector 5 is now a source of GHG for all years from 1990 to 2002). These changes affected mainly the level and not the dynamic of the overall EU trend from 1990 to 2002. France, Spain and Sweden account for the largest removals in absolute terms while large increases of removals between 1990 and 2002 occurred in France and Spain.

Sector 5 removes an average of 7 % of the total emissions of Member States (without LUCF), ranging from – 0.7 % (Netherlands) to – 38 % (Sweden) (Table 7.2, column a). In Germany and the United Kingdom, the sector gives a minor contribution to the total emission

respectively by 1.4 % and 0.3 %. Overall, for the EU, the sector removes 3.9 % of the total emissions (without LUCF).

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 (range 0.7–43.5 %, average 8 %) and for EU as a total (– 5.6 %).

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 (Table 7.3, column a), ranging from 8–9 % (Ireland and Netherlands) up to 67 % (Finland and Sweden). EU as a whole has 42 % of its land covered by forests.

The intensity and sustainability of forest management can be measured by dividing CO_2 equivalents of the total biomass consumptions from stocks (including total biomass removed in commercial harvest and consumption of fuelwood) by CO_2 removed by total growth increment (as derived from Sectoral Table 5.A) (Table 7.3, column b). In 2002, in the EU, only two thirds of total growth increment was removed by forest stands (65 %), indicating that forest management is sustainable. EU Member States can be roughly grouped under 'intensive forestry' countries, that harvest about 70 % or more of their growth increment (Austria, Belgium, Finland, Germany, Ireland, Portugal and Sweden), and 'less forestry-intensive' countries (Denmark, France, Greece, Italy, Netherlands and Spain). In all cases, biomass consumptions from harvest and fuelwood use is always below 100 %, the harvest threshold above which forest management is generally defined as unsustainable.

7.2 Methodological issues and uncertainties

The following considerations are focused on the reporting Category 5.A: 'Changes in forest and other woody biomass stocks' for a number of reasons.

- Within Sector 5, LUCF, Category 5.A is by far the category that contributes most to the sector's inventory.
- Category 5.A is the only category in sector LUCF which is reported by all EC Member States (see Table 7.4).

Table 7.4 Summary of methodological issues for Reporting Category 5.A by EC Member State

Member State	Method (1)	Emission factors (2)	Forest type occurring (3)	Estimate completeness (4)	Quality (5)	Other sector in Category 5 (6)
Austria	D	CS	TF	Partly	High	5.B, 5.C (incl. in 5.A)
Belgium (Wallonia)	D	CS	TF	Partly	NE	5.E
Denmark	NE (D)	NE (CS)	TF(P)	NE	NE	None
Finland	CS	CS	BF	All	Medium	5.D (Agriculture)
France	CS	CS	TF, TrF	All	Low	5.B, 5.C, 5.D
Germany	CS	CS	TF	All	Medium	5.D
Greece	D	D	TF	Partly	NE	5.B, 5.D
Ireland	CS	CS	TF(P)	All	Medium	5.D
Italy	D, CS	D, CS	TF (others)	All	High	5.C, 5.D, 5.E
Luxembourg	C/D	C/D		NE	NE	None
Netherlands	T1	CS	TF (others)	All	Medium	None
Portugal	D	D+CS	TF (others)	Partly	Medium	None
Spain	CS	CS	TF	All	Medium	5.E (None)
Sweden	T2, CS	T2, CS	TF, BF (others)	All	High	5.D (5.B, 5.C)
United Kingdom	M	M	TF	All	Medium	5.B, 5.D, 5.E

Note: Methodology and emission factors 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.

Sources: (1) and (2): CRF Table Summary 3, sheet 2; (3): CRF Sectoral Table 5.A; (4) and (5): CRF Table 7, sheet 2 (IPCC Table 8A); (6): CRF Table 5.

- In the recent years (2001–03), joint efforts of Member States, the JRC and EC research have been devoted to improving the comparability of 5.A inventories, including harmonisation to a certain extent (see Section 7.3).

7.2.1 Methodological issues

Emissions and removals from LUCF of the EC are the sum of Member States' emissions and removals. In accordance with IPCC guidelines, Member States use different methodologies, with regard to data collection methods and frequencies, 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 CO_2 in current CRFs) under Category 5.A.

The EC Member States generally apply a variety of methods, both for activity data and emission factors (Table 7.4, column 1 and 2). Most of the Member States (12 out of 15) are using country-specific approaches, particularly for emission factors. This is justified by the variety of forest types occurring within the EC in order to achieve the accuracy as required by IPCC (2000).

Also for the Member States that indicate to use IPCC default methods under column 1, in many cases, the underlying data sources are based on national surveys and statistics that can be considered close to 'country-specific'.

Nine Member States evaluate their reporting for Category 5.A as complete, four Member States as partly complete, while only two Member States do not provide an evaluation of completeness (Luxembourg estimated the reporting as partly complete in 2003). The Member States which consider their 5.A inventories to be complete represent 92.8 % of the net EC 5.A emissions (see Table 7.2, column c) so the EC inventory in this category can be considered as complete.

However, it should be mentioned that not all Member States are calculating their biomass stocks by considering all the components which are additional to tree stems and main branches, such as leaf, roots, dead wood and, in some case, understory vegetation. Although, in principle, these components could be considered by appropriate expansion factors, it should be mentioned that differences are present also in these factors (see Table 7.6, column 4 for some examples).

The picture for the evaluation of quality is more diverse. The quality of the reporting under 5.A is considered high by Austria, Italy and Sweden (Table 7.4, column 5), 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 65 % of the total net EC 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 EC 5.A inventory.

In terms of the percentage standard errors that are linked to the data sources generally used by Member States to put together 5.A inventories, a recent review on the national forest inventories of 12 Member States provided the following ranges (Laitat et al, 2000):

- 0.2–1.2 % (3–15 % for UK) for forest area (Member States = 9);
- 0.54–5.1 % (1–15 % for UK) for wood volume (Member States = 10);
- 0.4–0.8 % for volume growth (Member States = 3).

Table 7.5 provides a general overview of the more recent national forest inventory (NFI) or other data sources available for EC Member States. For what concerns forest area, all Member States are using national statistics, data from national inventories and, sometimes, assessment

Table 7.5 Overview of national forest inventory or other data sources for EC Member States

	More recent national forest inventories (NFI)	Periodicity (yrs)
Austria	1992–96, new results expected 2003-04	5
Belgium	1997 (Wallonia), 2000 (Flanders)	10
Denmark	None so far. First one under development (2003). Data from Forestry Census (2000)	5 (planned)
Finland	1992–99	< 10
France	1985–2000 (1993)	10–12, continuous
Germany	1986–90	15
Greece	1992 (survey 1963–67 and 1973–85)	> 20
Ireland	Volume/increment NFI under development. Area data inventoried	
Italy	1985, new one under development	irregular, 5 (planned)
Luxembourg	None	
Netherlands	1995–99	5
Portugal	1999	10
Spain	1986–96, new one almost completed	20–10
Sweden	1995–99	1(5), continuous
United Kingdom	Various data sources, no proper NFI	

based on remote sensing and aerial photographs.

An overview of the methodologies and background information used by the Member States participating in the pilot project to produce 5.A inventories (described in Section 7.3.1) are presented in Table 7.6. The data provide a good overview of methodologies and approaches for some Member States. It is expected to expand the results of the pilot project to other Member States by using the information which will be provided in 2004 NIRs and during the follow-up of the project.

7.2.2 Source of uncertainties

To estimate LUCF data, specifically under Category 5.A, EC Member States, in accordance with IPCC guidelines, use different methodologies. However, most of the methodologies make use of forestry data from national forest inventories, annual forestry statistics (mainly for forest area and harvested stocks) and land-cover databases. It is then possible to give an overview of the sources of uncertainty for the EC LUCF inventory (5.A in particular).

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 on the volume estimation is expected to be minor.
- Volume and yield functions are sometimes too old (see Table 7.7). The literature reports unreliability of some of those functions to predict current growth. This may result in an underestimation of current volume/growth.
- In some Member States, the data currently used are coming from relatively old inventories, applied to updated estimate of forest area.

Table 7.6 Overview of meth□

MS	Forest definitions	Specificity of forests and other wooded land	Data sources	Biomass expansion factors (BEF), biomass function	Increment	Annual values	National forest inventory (NFI), planned changes
AT	> 30 % cover; 500 m^2 minimum area, 10 m^2 minimum width. 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).	NFI, national statistics. Possible to estimate forest area with different crown coverage threshold.	Working on stratification of BEFs (age and diameter). Coarse root included.	National statistics, Austrian record of felled wood, Austrian wood balance. Applying allometric relationships at two NFI dates results in increment data by difference).	Increment 'indices' to weigh average increment, calculated from 1 200 spruce cores. Average of five years from NFI. No projection of increment (need for relevant recalculation).	No concrete plans, question of cost, remote sensing (non-managed lands, high mountains). Moving from a 'classic' NFI to a forest ecosystem information tool. GPS coordinates taken. New NFI available 2003.
DK	FAO definition from 2002 (year of the first NFI) (0.5 ha minimum area, tree height > 5 m, crown cover > 10 %).	Areas taken out of production.	Currently: Forestry census. Future: NFI, Christmas trees included when not on arable lands. Drain data from thinning statistics and harvesting.	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.	From values reported by forest owners in the forestry census.	From averages of increment reported by forest owners.	NFI 2002–03. Plot based. Continuous FI with partial replacement, 1/5 of the plots sampled annually.
FI	Productivity. > 1 m^3. Reporting of C stock/changes: FAO. Crown cover is inventoried, 0.5 % sampling error.	Vegetation below 5 m included in other wooded land.	NFI and annual updates/ check.	Tendency to work with Biomass functions. Study on BEF ready by 2004–05, including below ground. Stump considered with coarse roots, starting diameter 0 cm.	Annual, 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.	Average of previous NFI period.	Ninth inventory started 1996, 70 000 plots over the country. Height increment and diameter at 1.3 and 6 m inventoried. Geo-referenced data. Multisource NFI. ICP and NFI on separate grids.
IT	> 20 % cover in NFI1, >10 % cover in NFI2, two forest types (> 5 m; >2-5m), sparse woodland, macchia, shrubland. FAO compatible. Forest area is coming from national statistical office.	Shrublands (5 % of total, sometimes managed). 5.C is quite relevant.	Forest area and harvesting data: national statistics. Growth rate data consider also info from regional forest inventories. Wood density from NFI, carbon content: IPCC defaults. Drain data are coming from the statistical office.	Volume function based only on diameter at breast height (DBH). Only stem, basically. Some branches included for deciduous, not for conifers. Coarse root not included.	Growth rate based on a dynamic model starting from NFI in 1985.	From functions based on NFI and volume development.	NFI 1985. New planned for 2005–07, then every five years. In future NFI threshold 2.5 cm for forest, for low forest is zero. Five carbon pools will be estimated.
SE	Managed forests: Productivity > 1m^3 ha^{-1} yr^{-1} Protected areas are not reported to UNFCCC.	All areas where harvest is allowed are reported to the UNFCCC. About 6 % of the reported growth originate from other land than 'Managed forests'. High mountain area and urban-industrial land not inventoried/reported. Protected forests inventoried, not reported.	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.	Tendency to work with biomass functions. Actions on below-ground biomass. Working on BEF for deadwood and other vegetation. Both stump and coarse root included, starting diameter 0 cm.	Estimated by functions and increment cores. Increment obtained as five-year average.	Today IPCC default annual 'growth minus removals'. Alternative possibility: to study actual changes in the forest stock. (Possibility of close-to-unbiased estimates).	Annual data for the entire country. 10 000 plots clustered. Deadwood currently inventoried but not included in UNFCCC reporting.
UK	FAO		1984 (400 sites) and 1990 (500 sites) information on vegetation carbon. Planting rate from Forestry Commission.	Model with allocation.	Removals: growth, biomass in new plantations, timber.	Modelled values.	Carbon flow model. Model results include biomass, litter, soils and products.

Table 7.7 Year of literature reference for some yield or volume tables in EC Member States

Member State	Years of literature references for yield or volume tables
Austria	1975
Belgium	1988, 1999
Denmark	1905, 1908, 1912, 1914, 1928, 1950, 1955, 1958, 1974, 1980, 1988
Finland	1959
France	1969, 1982, 1987, 1995
Germany	1903, 1919, 1936, 1943, 1946, 1951, 1953, 1954, 1955, 1956, 1958, 1967, 1969, 1972, 1975, 1988, 1990
Greece	
Ireland	1987
Italy	1889, 1915, 1935, 1938, 1949, 1950, 1955, 1962, 1963, 1965, 1969, 1970, 1978, 1980, 1985
Luxembourg	
Netherlands	1967, 1975, 1986, 1987, 1988, 1996
Portugal	1991
Spain	1975, 1977, 1981, 1985, 1992, 1994, 1996, 1997
Sweden	1955, 1961, 1976
United Kingdom	1971, 1974, 1991

Note: Often the most recent tables generally refer to plantations of fast-growing or introduced species. The table is not to be considered as complete of all available tables.

Uncertainties linked to forest area and definitions

- Errors in forest area estimation are in the order 1 to 10 %.
- There are differences in how Member States determine if a land cover is a forest, namely different threshold of crown cover, area dimension and/or using a productivity index. However, many definitions are compatible to the one by FAO.
- In some countries, different land-cover data sources provide different estimates of total forest area.

Uncertainties linked to expansion and conversion factors

- Differences in conversion factor from dry weight to carbon 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.
- 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.
- Most of the countries are using only two values, 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.

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 calculated the errors in the estimation of 'removals' values obtained with different approaches: growth-harvest, error: 20 %; differences in state (e.g. two subsequent NFIs), error: 13 %; combined estimation, error: 11 %; Change 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 forest statistical sources is potentially high but mostly unknown. Problematic areas are: reliability of market statistics, fuelwood, local use and export/import of wood.
- Not all annual statistics include the effects of major disturbances on forest stocks. If disturbances are occurring between two NFIs, there could be inconsistencies in annual reporting when using interpolated/averaged data.

7.3 Sector-specific quality assurance and quality control

7.3.1 Pilot project of LUCF reporting

In the last two years, the JRC has been working with the Member States to facilitate the comparability and, to the extent possible, the subsequent harmonisation of LUCF estimates within EC Member States. The main activity performed was the setting-up of a pilot project to identify differences in reporting of land-use, land-use change and forestry to the UNFCCC, and to propose and test possibilities to improve the comparability and quality of inventory data. The main focus of this pilot project was on reporting in IPCC Category 5.A (changes in forest and other woody biomass stocks). The following Member States participated in the pilot project: Austria, Denmark, Finland, Italy, Sweden and the United Kingdom, while Spain and Ireland participated as 'observers'.

The activities performed by the JRC with the Member States in the past two years, together with the extensive exchange at scientific and technical levels (e.g. COST actions, EC projects), have already resulted in important improvements of the current EC LUCF inventory for Category 5.A.

- The specific information provided in the NIR on Category 5.A has already significantly improved and will allow a better assessment of the comparability of the reports.
- Many Member States are considering, in the next round of forest inventories, to assess/include some of the parameters discussed during the projects.
- Some Member States have started national and local projects on biomass expansion factors and functions, soil carbon, peat lands.
- Denmark changed its biomass expansion factors after recognition of inconsistencies with neighbouring countries and reference to better data sources.

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 will complete its work in 2004. At the end of 2003, under the same framework, a new action has been proposed 'Harmonisation of national forest inventories in Europe: Techniques for common reporting', with the objective to improve and harmonise the existing national forest resource inventories in Europe and to promote the use of scientifically sound and validated methods in forest inventory designs, data collection and data analysis. The action is currently under review by the European Science Foundation.

Table 7.8 Recalculations of total greenhouse gas emissions and recalculations of net greenhouse gas emissions in CRF Sector 5: 'LUCF', for 1990 and 2001 by gas (Gg and percentage)

1990	CO_2		CH_4		N_2O		HFCs		PFCs		SF_6	
	Gg	(%)	Gg	(%)	Gg	(%)	Gg	(%)	Gg	(%)	Gg	(%)
Total emissions and removals	96 422	3.1	36 845	8.9	– 16 489	– 4.0	1 293	5.0	2 687	20.1	1 957	23.5
LUCF (net)	90 885	– 47.3	– 1 845	– 83.4	– 5 309	– 93.6	NO	NO	NO	NO	NO	NO
2001												
Total emissions and removals	70 582	2.2	26 684	8.1	– 9 674	– 2.8	3 112	7.2	– 4	– 0.1	– 620	– 6.5
LUCF (net)	61 935	– 30.4	– 2 145	– 99.0	– 5 358	– 94.6	NO	NO	NO	NO	NO	NO

Table 7.9 Contribution of Member States to EC recalculations in CRF Sector 5: 'LUCF' for 1990 by gas (difference between latest submission and previous submission Gg of CO_2 equivalents)

	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
Austria	0	0	0	NO	NO	NO
Belgium	– 293	0	0	NO	NO	NO
Denmark	286	0	0	NO	NO	NO
Finland	0	0	0	NO	NO	NO
France	24 057	– 2 473	– 5 373	NO	NO	NO
Germany	41 204	0	0	NO	NO	NO
Greece	0	0	0	NO	NO	NO
Ireland	0	0	0	NO	NO	NO
Italy	0	163	17	NO	NO	NO
Luxembourg	0	0	0	NO	NO	NO
Netherlands	0	0	0	NO	NO	NO
Portugal	5 576	441	45	NO	NO	NO
Spain	19 796	0	0	NO	NO	NO
Sweden	0	0	0	NO	NO	NO
United Kingdom	259	24	3	NO	NO	NO
EU-15	**90 885**	**– 1 845**	**– 5 309**	**NO**	**NO**	**NO**

Recently, following a proposal of Scandinavian countries, a network of European national forest inventories has been initiated (ENFIN, European national forest inventory network). Its main objective is harmonisation of forest information throughout Europe based on NFIs, in accordance with national and international demands. At the moment, a steering group was set up including representatives of the NFIs agencies of Austria, Belgium, Denmark, Finland, Italy, Lithuania, Sweden, UK and of European Forest Institute.

7.4. Sector-specific recalculations

Table 7.8 shows that in the LUCF sector the large recalculations in absolute terms were made for CO_2, CH_4 and N_2O for both 1990 and 2001. The largest absolute change was in CO_2.

Table 7.9 provides an overview of Member States' contributions to EC recalculations. Germany, France and Spain contributed most to the CO_2 recalculations. For CH_4 and N_2O it was France.

8 Waste (CRF Sector 6)

This chapter starts with an overview on emission trends in CRF Sector 6: 'Waste'. For each EC 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 qualitative uncertainty estimates for the EC key sources of this sector are summarised in a separate section. Finally, the chapter includes information on recalculations. A section on sector-specific QA/QC is not included as such activities have not yet started in this sector.

8.1 Overview of sector

CRF Sector 6 'Waste' is the fourth largest sector in the EC, contributing 2 % to total GHG emissions. Total emissions from 'Waste' have been decreasing by 27 % from 138 Tg in 1990 to 100 Tg in 2002 (Figure 8.1). In 2002, emissions decreased by 3 % compared to 2001. The key sources in this sector are:

6.A.1: Managed waste disposal on land (CH_4)
6.A.2: Unmanaged waste disposal sites (CH_4)
6.B.2: Domestic and commercial wastewater (CH_4)
6.C: Waste incineration (CO_2)
6.D: Other waste (CO_2)

Figure 8.1 shows that CH_4 emissions from landfills account for about 75 % of waste-related GHG emissions in the EC.

Figure 8.2 shows that CH_4 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 CH_4 from 6.A: 'Solid waste disposal on land'. CH_4 emissions from 'Solid waste disposal on land' decreased by 32 % between 1990 and 2002 in the EC. Nearly all EC Member States reduced their emissions from this source.

Figure 8.1 EC GHG emissions 1990–2001 from CRF Sector 6: 'Waste' in CO_2 equivalents (Tg) and share of largest key source categories in 2002

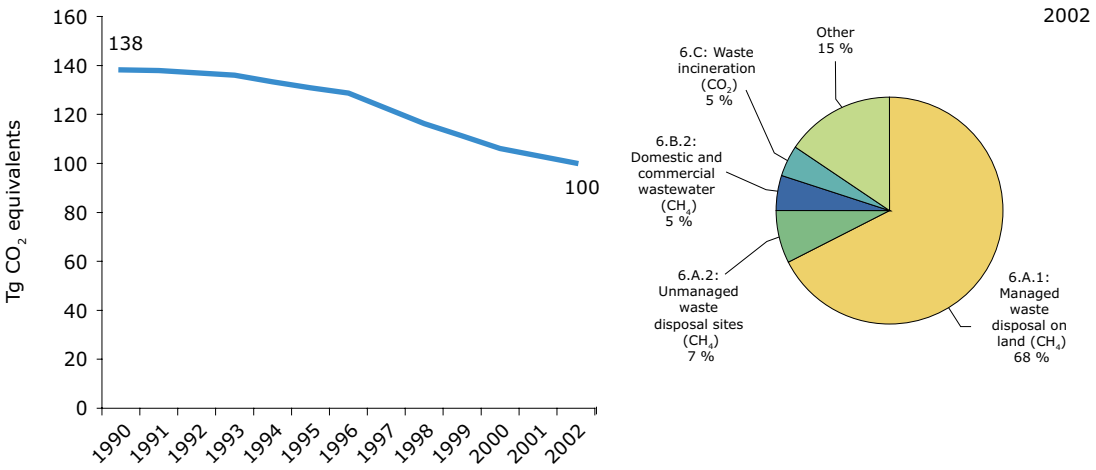


Figure 8.2 Absolute change of GHG emissions by large key source categories 1990–2002 in CO_2 equivalents (Tg) in CRF Sector 6: 'Waste'

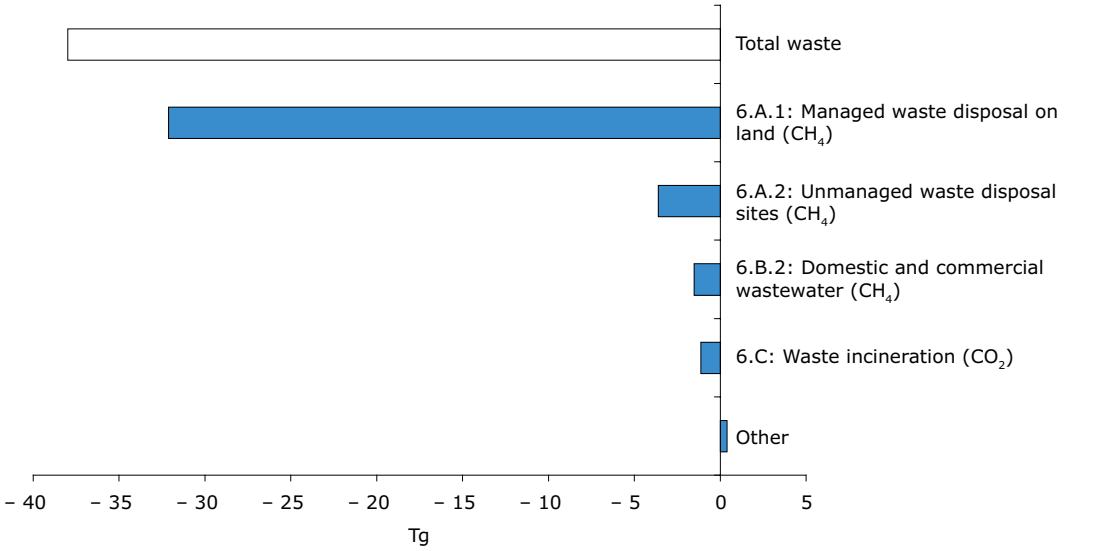


Table 8.1 Member States' contributions to CH_4 emissions from 6.A: 'Solid waste disposal on land' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2002 (Gg CO_2 equivalents)	Methods applied (1)	EF (1)	Estimate (2)	Quality (2)
Austria	3 731	2 515	CS	CS	ALL	L
Belgium	2 630	1 096	M	CS	P	
Denmark	1 310	1 131	CS/M	CS/M	ALL	M
Finland	3 679	2 684	T2	D/CS	ALL	M
France	11 209	10 413	CS/T2	CS	ALL	M
Germany	31 479	11 922	T2	D/CS	NE	L
Greece	2 811	5 275	T1	D	ALL	
Ireland	1 158	1 701	T2	CS, D	FULL	M
Italy	9 533	9 318	D, T2	D, CS	ALL	M
Luxembourg	64	48	C/D	C/D	ALL	
Netherlands	12 011	7 253	M, CS/T2	CS	ALL	M
Portugal	2 089	2 241	T2	D, CS	ALL	M
Spain	5 391	10 873	T2	CS, T2	ALL	M
Sweden	2 554	1 816	T2	D, CS	ALL	M
United Kingdom	23 760	8 820	M	CS	ALL	L
EU-15	**113 409**	**77 105**	**C, CS, D, M, T1, T2**	**C, CS, D, M, 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'.

This source category includes two key sources: CH_4 from 6.A.1: 'Managed waste disposal on land' and CH_4 from 6.A.2: 'Unmanaged waste disposal on land'.

Table 8.2 provides information on emission trends of the key source CH_4 from 6.A.1 'Managed waste disposal on land' by Member State. CH_4 emissions from managed waste disposal on land account for 1.6 % of total EC GHG emissions. Between 1990 and 2002, CH_4 emissions from managed landfills declined by 32 % in the EC. In 2002, CH_4 emissions from landfills decreased by 3 %. A main driving force of CH_4 emissions from managed waste disposal on land is the amount of biodegradable waste going to landfills. Total municipal waste disposal on land declined by about 20 % between 1990 and 2002. In

Table 8.2 Member States' contributions to CH_4 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 2002 (%)	Change 2001–2002		Change 1990–2002	
	1990	2001	2002		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	3 731	2 597	2 515	3.7	– 82	– 3	– 1 217	– 33
Belgium	2 630	1 204	1 096	1.6	– 108	– 9	– 1 534	– 58
Denmark	1 310	1 188	1 131	1.7	– 57	– 5	– 178	– 14
Finland	2 235	1 759	1 620	2.4	– 140	– 8	– 615	– 28
France	6 332	7 928	7 908	11.7	– 21	0	1 575	25
Germany	31 479	12 806	11 922	17.6	– 884	– 7	– 19 557	– 62
Greece	1 247	3 146	3 338	4.9	192	6	2 091	168
Ireland	849	895	1274	1.9	379	42	424	50
Italy	7 130	9 104	8 980	13.3	– 124	– 1	1 850	26
Luxembourg	64	48	48	0.1	1	1	– 16	– 25
Netherlands	12 011	7 716	7 253	10.7	– 463	– 6	– 4 758	– 40
Portugal	103	249	275	0.4	26	10	173	168
Spain	4 228	9 081	9 550	14.1	469	5	5 322	126
Sweden	2 554	1 972	1 816	2.7	– 156	– 8	– 738	– 29
United Kingdom	23 760	10 231	8 820	13.1	– 1 411	– 14	– 14 940	– 63
EU-15	**99 663**	**69 925**	**67 545**	**100.0**	**– 2 380**	**– 3**	**– 32 118**	**– 32**

Table 8.3 Member States' contributions to CH_4 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 2002 (%)	Change 2001–2002		Change 1990–2002	
	1990	2001	2002		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	0	0	0	0.0	0	—	0	—
Belgium	0	0	0	0.0	0	—	0	—
Denmark	0	0	0	0.0	0	—	0	—
Finland	0	0	0	0.0	0	—	0	—
France	4 876	2 685	2 505	33.6	– 180	– 7	– 2 372	– 49
Germany	0	0	0	0.0	0	—	0	—
Greece	1 564	1 903	1 937	26.0	34	2	373	24
Ireland	309	381	427	5.7	46	12	118	38
Italy	2 403	505	338	4.5	– 166	– 33	– 2 065	– 86
Luxembourg	0	0	0	0.0	0	—	0	—
Netherlands	0	0	0	0.0	0	—	0	—
Portugal	761	952	920	12.3	– 32	– 3	159	21
Spain	1 148	1 402	1 322	17.8	– 80	– 6	174	15
Sweden	0	0	0	0.0	0	—	0	—
United Kingdom	0	0	0	0.0	0	—	0	—
EU-15	**11 061**	**7 827**	**7 449**	**100.0**	**– 378**	**– 5**	**– 3 613**	**– 33**

addition, CH_4 emissions from landfills are influenced by the amount of CH_4 recovered and utilised or flared. The share of CH_4 recovery increased in several EC Member States.

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 2002. The largest reductions in absolute terms were reported by Germany and the UK. The emission reductions are partly due to the (early) implementation of the landfill waste directive or similar legislation of the Member States. The landfill waste directive was adopted in 1999 and requires the Member States to reduce the amount of biodegradable waste disposed untreated to landfills and to install landfill gas recovery at all new sites.

CH_4 emissions from 6.A.2: 'Unmanaged waste disposal on land' account for

Table 8.4 Member States' contributions to CH_4 emissions from 6.B: 'Wastewater handling' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2002 (Gg CO_2 equivalents)	Methods applied (1)	EF (1)	Estimate (2)	Quality (2)
Austria	288	300	C	CS	ALL	L
Belgium	81	81	D	D/CS	P	
Denmark	0	0	NE		NE	
Finland	153	128	D	D/CS	ALL	M
France	713	1 163	CS/T2	CS	ALL	L
Germany	2 226	133	D	D/CS	CS	L
Greece	938	390	D	D	PART	
Ireland	0	0	NA	NA	NE	NE
Italy	1 255	1 260	D	D, CS	ALL	M
Luxembourg	4	5	C/D	C/D		
Netherlands	138	15	CS/T2	CS	ALL	M
Portugal	822	789	D	D + CS	ALL	M
Spain	1 518	2 428	D	CS, D	PART	L
Sweden	0	0	IE	IE	IE	
United Kingdom	701	784	T2	CS	PART	L
EU-15	**8 837**	**7 476**	**C, CS, D, T2**	**C, CS, D**	**ALL, IE, NE, 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 CH_4 emissions from 6.B.2: 'Domestic and commercial wastewater'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU-15 emissions in 2002 (%)	Change 2001–2002		Change 1990–2002	
	1990	2001	2002		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	190	198	198	3.8	0	0	7	4
Belgium	81	82	81	1.6	– 1	– 1	1	1
Denmark	0	0	0	0.0	0	—	0	—
Finland	131	111	109	2.1	– 1	– 1	– 21	– 16
France	713	1 158	1 163	22.6	6	0	450	63
Germany	2 226	154	133	2.6	– 21	– 14	– 2 093	– 94
Greece	938	319	273	5.3	– 46	– 14	– 665	– 71
Ireland	0	0	0	0.0	0	—	0	—
Italy	0	0	0	0.0	0	—	0	—
Luxembourg	2	2	2	0.0	0	1	0	24
Netherlands	0	0	0	0.0	0	—	0	—
Portugal	659	578	581	11.3	4	1	– 77	– 12
Spain	1 023	1 747	1 826	35.4	80	5	803	78
Sweden	0	0	0	0.0	0	—	0	—
United Kingdom	701	780	784	15.2	5	1	83	12
EU-15	**6 664**	**5 128**	**5 152**	**100.0**	**24**	**0**	**– 1 512**	**– 23**

0.2 % of total EC GHG emissions in 2002. Between 1990 and 2002, CH_4 emissions from this source decreased by 33 % (Table 8.3). Not all Member States reported emissions from this source. France and Greece are responsible for 60 % of the total EC emissions. France and Italy had large absolute reductions between 1990 and 2002.

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 CH_4 from 6.B: 'Wastewater handling'. Between 1990 and 2002, CH_4 emissions from wastewater handling decreased by

Table 8.6 Member States' contributions to CO_2 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 2002 (Gg CO_2 equivalents)	Methods applied (1)	EF (1)	Estimate (2)	Quality (2)
Austria	21	11	C	CS	ALL	L
Belgium	919	1 410	D	PS	F	
Denmark	0	0	IE			
Finland	IE	IE	NO	NO	IE	IE
France	2 433	1 757	C	CS/PS	ALL	M
Germany	NO	NO	NO	NO	NO	
Greece	0	0	NE	NE		
Ireland	NO	NO	NA	NA	NO	NA
Italy	545	280	D	CS	ALL	M
Luxembourg	19	0	C/D	C/D		
Netherlands	IE	IE	NO(IE)		NO	
Portugal	10	380	D	D+C	ALL	H
Spain	609	233	C	CS, C	ALL	M
Sweden	IE	IE	IE	IE	IE	
United Kingdom	1 132	486	T2	CS	PART	L
EU-15	**5 687**	**4 557**	**C, D, 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 CO_2 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 2002 (%)	Change 2001–2002		Change 1990–2002	
	1990	2001	2002		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	21	11	11	0.2	0	0	– 9	– 46
Belgium	919	1 409	1 410	30.9	0	0	490	53
Denmark	0	0	0	0.0	0	—	0	—
Finland	IE	IE	IE	—	—	—	—	—
France	2 433	1 863	1 757	38.6	– 106	– 6	– 676	– 28
Germany	NO	NO	NO	—	—	—	—	—
Greece	0	0	0	0.0	0	—	0	—
Ireland	NO	NO	NO	—	—	—	—	—
Italy	545	298	280	6.1	– 19	– 6	– 265	– 49
Luxembourg	19	0	0	0.0	0	—	– 19	– 100
Netherlands	IE	IE	IE	—	—	—	—	—
Portugal	10	350	380	8.3	30	8	370	3 659
Spain	609	260	233	5.1	– 27	– 10	– 376	– 62
Sweden	IE	IE	IE	—	—	—	—	—
United Kingdom	1 132	496	486	10.7	– 9	– 2	– 645	– 57
EU-15	**5 687**	**4 688**	**4 557**	**100.0**	**– 131**	**– 3**	**– 1 131**	**– 20**

15 %. This source category includes one key source: CH_4 from 6.B.2: 'Domestic and commercial wastewater'.

CH_4 from 6.B.2: 'Domestic and commercial wastewater' accounts for 0.1 % of total EC GHG emissions. Between 1990 and 2002 emissions decreased by 23 %. 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)

Table 8.6 and Table 8.7 summarise information by Member State on emission trends, methodologies, emission factors, completeness and qualitative uncertainty estimates for CO_2 from 6.C: 'Waste incineration'. This key source accounts for 0.1 % of total EC GHG emissions. Between 1990 and 2002, CO_2 emissions from waste incineration

Table 8.8 Member States' contributions to CO_2 emissions from 6.D: 'Other' and information on methods applied and quality of these emission estimates

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2002 (Gg CO_2 equivalents)	Methods applied (1)	EF (1)	Estimate (2)	Quality (2)
Austria	0	0			NE	NE
Belgium	0	0	NE	NE	P	
Denmark	0	0				
Finland	0	0			NO	NO
France	0	0			ALL	L
Germany	NO	NO	NE	NE	NE	L
Greece	0	0				
Ireland	NO	0	NA	NA	NE	NE
Italy	0	0			NO	
Luxembourg	0	0	C/D	C/D	ALL	
Netherlands	881	0	CS	CS	ALL	M
Portugal	0	0			ALL	M
Spain	0	0	NO		NO	
Sweden	NO	NO	NO	NO	NO	
United Kingdom	0	0			NO	
EU-15	**881**	**0**	**C, D, CS**	**C, D, CS**	**ALL, 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 8.9 Uncertainty of the key source categories in the CRF Sector 6: 'Waste'

Source category gas	2002	Quality estimate
6.D: Other (CO_2)	0	M
6.A: Solid waste disposal on land (CH_4)	77 105	M
6.B: Wastewater handling (CH_4)	7 476	L
6.C: Waste incineration (CO_2)	8 710	L

Note: Some of these source categories are more aggregated than the EC key source categories identified in Section 1.5 because the qualitative uncertainty estimates in CRF Table 7 refer to more aggregated source categories.

decreased by 20 %; France and the UK had the largest decreases in absolute terms.

8.2.4 Other (CRF Source Category 6.D)

Table 8.8 shows that CO_2 emissions from 6.D: 'Other' are only reported by the Netherlands. The Netherlands includes in this source process emissions from waste recycling and handling, which show annual fluctuation according to environmental reporting from individual companies.

8.3 Methodological issues and uncertainties

The previous section presents for each EC key source in CRF Sector 6 an overview on 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.

The qualitative uncertainty estimation for the key sources in Table 8.9 is based on the quality estimates (high, medium and low) provided by the Member States in the CRF Table 7. The quality estimates were weighted according to Member States' share on the total emissions (see Section 1.7). The table shows that 83 % of waste-related key source emission estimates can be classified as being of medium quality.

Table 8.10 Recalculations of total greenhouse gas emissions and recalculations of greenhouse gas emissions in CRF Sector 6: 'Waste', for 1990 and 2001 by gas (Gg and percentage)

1990	CO_2		CH_4		N_2O		HFCs		PFCs		SF_6	
	Gg	(%)	Gg	(%)	Gg	(%)	Gg	(%)	Gg	(%)	Gg	(%)
Total emissions and removals	96 422	3.1	36 845	8.9	– 16 489	– 4.0	1 293	5.0	2 687	20.1	1 957	23.5
Waste	– 973	– 12.5	3 098	2.6	998	14.2	NO	NO	NO	NO	NO	NO
2001												
Total emissions and removals	70 582	2.2	26 684	8.1	– 9 674	– 2.8	3 112	7.2	– 4	– 0.1	– 620	– 6.5
Waste	– 1 859	– 28.3	-777	– 0.9	3 177	52.0	NO	NO	NO	NO	NO	NO

Table 8.11 Contribution of Member States to EC recalculations in CRF Sector 6: 'Waste' for 1990 by gas (difference between latest submission and previous submission Gg of CO_2 equivalents)

	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
Austria	0	– 1 659	24	NO	NO	NO
Belgium	– 165	– 133	– 25	NO	NO	NO
Denmark	0	– 1	0	NO	NO	NO
Finland	0	0	0	NO	NO	NO
France	302	747	0	NO	NO	NO
Germany	NE	4 330	923	NO	NO	NO
Greece	0	0	0	NO	NO	NO
Ireland	0	0	0	NO	NO	NO
Italy	– 367	– 63	68	NO	NO	NO
Luxembourg	0	0	0	NO	NO	NO
Netherlands	0	209	0	NO	NO	NO
Portugal	0	– 333	0	NO	NO	NO
Spain	77	0	7	NO	NO	NO
Sweden	IE	0	0	NO	NO	NO
United Kingdom	– 820	0	0	NO	NO	NO
EU-15	**– 973**	**3 098**	**998**	**NO**	**NO**	**NO**

8.4 Sector-specific quality assurance and quality control

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

8.5 Sector-specific recalculations

Table 8.10 shows that in the waste sector large recalculations were made for CH_4 in 1990 and for N_2O in 2001.

Table 8.11 provides an overview of Member States' contributions to EC recalculations. The United Kingdom was responsible for the most recalculations for CO_2, Germany for CH_4 and N_2O. Explanations for some of the 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 EC key source ([22]). 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 0.05 % to overall EC GHG emissions. The most important gases from the CRF Sector 7: 'Other' are N_2O (0.03 % of the total GHG emissions) and CO_2 (0.02 %). Total emissions from 'Other' have slightly increased since 1990 (+ 4.2 %). In 2002, the emissions increased by 1.5 compared to 2001.

Figure 9.1 EC GHG emissions 1990–2002 from CRF Sector 7: 'Other' in CO_2 equivalents (Tg)

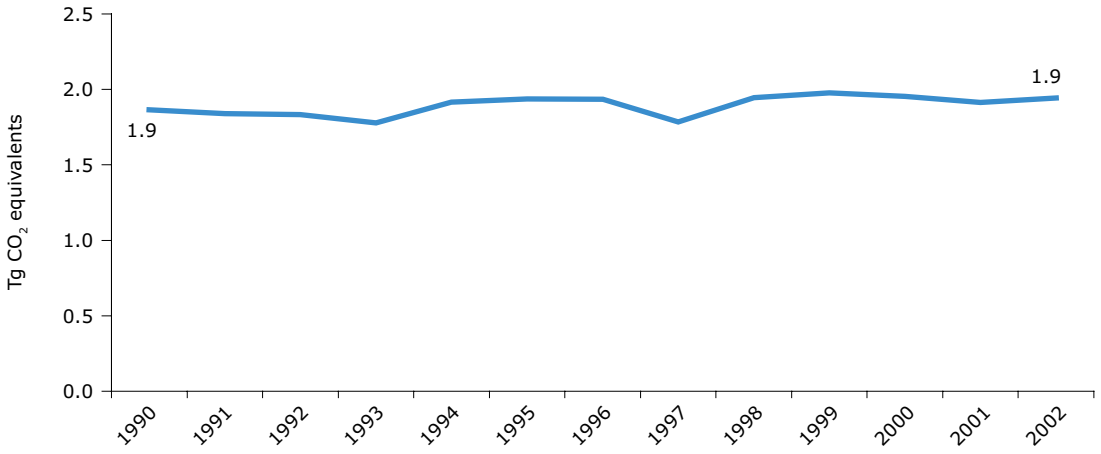


Table 9.1 Member States' contributions to GHG emissions from CRF Sector 7: 'Other'

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU-15 emissions in 2002 (%)	Change 2001–2002		Change 1990–2002	
	1990	2001	2002		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	0	0	0	0.0	0	—	0	—
Belgium	0	0	0	0.0	0	—	0	—
Denmark	0	0	0	0.0	0	—	0	—
Finland	640	690	720	37.1	30	4	80	12
France	0	0	0	0.0	0	—	0	—
Germany	0	0	0	0.0	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	1 224	1 224	1 223	62.9	– 1	0	– 1	0
Portugal	0	0	0	0.0	0	—	0	—
Spain	0	0	0	0.0	0	—	0	—
Sweden	0	0	0	0.0	0	—	0	—
United Kingdom	0	0	0	0.0	0	—	0	—
EU-15	**1 865**	**1 914**	**1 943**	**100.0**	**29**	**2**	**79**	**4**

([22]) 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.

Table 9.2 Member States' allocation of sources to Sector 7: 'Other'

Member State	Source allocation to Sector 7: 'Other'	Source
Austria	No 'Other' emissions	CRF Table 10.S.1-3
Belgium	No 'Other' emissions	CRF Table 10.S.1-3
Denmark	No 'Other' emissions	CRF Table 10.S.1-3
Finland	CO_2: Emissions from fuels used as feedstock	CRF Table 10.S.1-3
France	No 'Other' emissions	CRF Table 10.S.1-3
Germany	No 'Other' emissions	CRF Table 10.S.1-3
Greece	No 'Other' emissions	CRF Table 10.S.1-3
Ireland	No 'Other' emissions	CRF Table 10.S.1-3
Italy	No 'Other' emissions	CRF Table 10.S.1-3
Luxembourg	No 'Other' emissions	CRF Table 10.S.1-3
Netherlands	CO_2: Solvent and other product use, polluted surface water CH_4: Solvents and other product use, polluted surface water, degassing drinkwater from groundwater N_2O: Solvent and other product use, polluted surface water	CRF Table 10.S.1-3
Portugal	No 'Other' emissions	CRF Table 10.S.1-3
Spain	No 'Other' emissions	CRF Table 10.S.1-3
Sweden	No 'Other' emissions	CRF Table 10.S.1-3
United Kingdom	No 'Other' emissions	CRF Table 10.S.1-3

Table 9.3 Recalculations of total greenhouse gas emissions and recalculations of greenhouse gas emissions in CRF Sector 7: 'Other', for 1990 and 2001 by gas (Gg and percentage)

1990	CO_2		CH_4		N_2O		HFCs		PFCs		SF_6	
	Gg	(%)	Gg	(%)	Gg	(%)	Gg	(%)	Gg	(%)	Gg	(%)
Total emissions and removals	96 422	3.1	36 845	8.9	– 16 489	– 4.0	1 293	5.0	2 687	20.1	1 957	23.5
Other	0	0.0	0	0.0	0	0.0	NO	NO	NO	NO	NO	NO
2001												
Total emissions and removals	70 582	2.2	26 684	8.1	– 9 674	– 2.8	3 112	7.2	– 4	– 0.1	– 620	– 6.5
Other	0	0.0	0	0.0	0	0.0	NO	NO	NO	NO	NO	NO

Only Finland and the Netherlands report emissions under 'Other'. The Netherlands allocate CO_2, CH_4 and N_2O emissions to this sector, Finland only CO_2 emissions. The Netherlands reports emissions from solvent and other product use, polluted surface water, and degassing drinkwater from groundwater. The Finnish emissions derive from non-energy use of oil products and natural gas. Whereas the Netherlands had small reductions between 1990 and 2002, Finland had increases in this source.

9.2 Methodological issues and uncertainties

Table 9.2 shows the allocation of Member States to this sector. Only Finland and the Netherlands reported emissions under sector 'Other'.

There are no uncertainty estimates because this sector does not contain an EC key source.

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 9.3 shows that in CRF Sector 7: 'Other', no recalculations were made for 1990 and 2001.

10 Recalculations and improvements

10.1 Explanations and justifications for recalculations

Table 10.1 provides an overview of the main reasons for recalculating emissions in the year 1990 for each Member State, which provided the relevant information. For each Member State, those three sources have been identified which had the largest recalculations in absolute terms. In addition, all recalculations of more that 1 000 Gg are presented. For more details see the information provided by the Member States' submissions in Annex 11.

Table 10.1 Main recalculations in the Member States for 1990 and Member States' explanations for recalculations given in the CRF or in the NIR

	Absolute difference between latest and previous submission used for the EC inventory (Gg CO_2 equivalents)	Member States' explanation for recalculation	Information source of reasons for recalculations
Austria			
Total emissions excluding LUCF	– 327		
CO_2 from 1.A.2	6 106	1.A.2.a: Emissions from fuel combustion of two iron and steel plants so far reported under Category 2.C.1 are now reported under this category. Additionally emissions due to combustion of cement industry so far reported under 2.A.1 are now reported under 1.A.2 f.	Umweltbundesamt (2003a), p. 11
CO_2 from 2.C	– 4 788	2.C.1: Only CO_2 emissions from iron and steel production (both from steel production in basic oxygen furnaces and from electric furnaces) are reported in this category. In the previous submission CO_2 emissions reported in this category also included emissions due to combustion from the two integrated steel plants operating blast furnaces in Austria.	Umweltbundesamt (2003a), p. 12
CH_4 from 6.A	– 1 197	6.A.1: Residual waste: activity data from 1998 to 2002 have been updated on the basis of the Austrian database for solid waste disposals. In the previous submission the amount of waste from administrative facilities of industry was included in the years from 1998 to 2002 but not included in the years before 1998. Therefore the activity data for the time series 1990 to 1997 have been recalculated. Non-residual waste: previously the amount of non-residual waste has been estimated based on expert judgment, now activity data for the years from 1998 to 2002 is taken from the Austrian database for solid waste disposal sites. No data was available for the years before 1998 from this database, therefore the values of 1998 was also used for the years 1990–97. The operators of landfill sites reported their annual collected landfill gas in the context of an investigation of the Umweltbundesamt. Emissions have been recalculated on the basis of these data. The biodegradable organic carbon content (DOC) has been corrected according to a new study of the Umweltbundesamt.	Umweltbundesamt (2003a), p. 14
Belgium			
Total emissions excluding LUCF	4 507		
PFCs from 2.E	1 753	Not estimated in previous submission.	
SF_6 from 2.E	1 559	Not estimated in previous submission.	
CO_2 from 2.A	665	The CO_2 emission factor in the glass sector has been changed in the Walloon region. Also CO_2 from lime and cement have been recalculated.	NIR 2004, p. 48
Denmark			
Total emissions excluding LUCF	– 467		
N_2O from 4.D	– 1 500	Changes in methods, emission factors and activity data. The most important changes in the N_2O emission from agriculture is due to recalculation made by the Danish Institute of Agricultural Sciences of N-leaching and recalculation from crop residue.	CRF 1990, Table 8(b)
N_2O from 2.B	1 043	Addition of N_2O from production of nitric acid.	CRF 1990, Table 8(b)
N_2O from 4.B	224	No explanation provided.	

	Absolute difference between latest and previous submission used for the EC inventory (Gg CO_2 equivalents)	Member States' explanation for recalculation	Information source of reasons for recalculations
Finland			
Total emissions excluding LUCF	– 463		
N_2O from 1.A.3	– 263	Indirect N_2O emission caused by nitrogen deposition due to NO_x emissions in the energy sector have been excluded as recommended by the ERT.	CRF 1990, Table 8(b)
N_2O from 1.A.1	– 90	Indirect N_2O emission caused by nitrogen deposition due to NO_x emissions in the energy sector have been excluded as recommended by the ERT.	CRF 1990, Table 8(b)
N_2O from 1.A.2	– 64	Indirect N_2O emission caused by nitrogen deposition due to NO_x emissions in the energy sector have been excluded as recommended by the ERT.	CRF 1990, Table 8(b)
France			
Total emissions excluding LUCF	3 928		
CH_4 from 1.A.4	942	For residential sector: review of wood emission factor since 1960 based on a study conducted by Citepa for the French administration in 2003; energy consumption has been revised by the French energy statistics body since 1998.	CRF 2002, Table 8(b)
CH_4 from 6.A	747	For solid waste disposal on land degradable organic carbon was updated since 1960.	CRF 2002, Table 8(b)
CO_2 from 2.B	508	CO_2 emission factor was updated for ammonia production; carbide production has been added to the French inventory and CO_2 emissions have been calculated since 1960.	CRF 2002, Table 8(b)
Germany			
Total emissions excluding LUCF	37 062		
CH_4 from 4.B	28 058	Country-specific emission factor used instead of IPCC default. The emissions from Bremen, Hamburg and Berlin are included.	NIR 2004, p. 6-17
CH_4 from 4.A	6 257	Country-specific emission factor used for dairy cattle. The emissions from Bremen, Hamburg and Berlin are included.	NIR 2004, p. 6-6
N_2O from 4.B	– 3 716	New method applied. The emissions from Bremen, Hamburg and Berlin are included.	NIR 2004, p. 6-17
CH_4 from 1.B.1	3 654	No documentation available.	NIR 2004, p. 3-111 and 3-313
CH_4 from 6.A	3 194	The whole time series for CH_4 was recalculated for 6.A.1 by using the Tier 2 method.	NIR 2004, p. 8-7
N_2O from 2.B	– 2 069	No documentation available.	NIR 2004, p. 4-11, 4-14
N_2O from 4.D	– 1 690	New method of estimating the CH_4 consumption was used.	NIR 2004, p. 6-24
CH_4 from 6.B	1 136	The allocation between domestic and industrial wastewater was changed.	NIR 2004, 8-11 and 8-13
CO_2 from 1.A.1	1 049	Recalculations due to changes in methods and in energy balance data. A more detailed documentation of recalculations will be given in the NIR 2005.	NIR 2004, p. 3-46
CO_2 from 2.A	– 1 000	The time series consistency for emission factors has not been completed.	NIR 2004, p. 4-5
Greece		No recalculation for the years 1990–2001.	
Ireland		No recalculations for the years 1990–2001.	
Italy			
Total emissions excluding LUCF	270		
CO_2 from 1.A.1	– 6 145	No explanation provided.	
CO_2 from 1.A.2	3 812	No explanation provided.	
CO_2 from 2.A	3 490	Emissions from limestone and dolomite use as well as soda ash production and use have been added. Emissions from food and beverage have been removed since they are originated from sources of carbon that are from a closed cycle.	CRF 2002, Table 8(b)
CO_2 from 1.B.2	2 049	No explanation provided.	CRF 2002, Table 8(b)
CH_4 from 4.A	– 1 580	Emissions for the whole time series and pollutants have been revised using the Tier 2 IPCC GPG approach.	CRF 2002, Table 8(b)
PFCs total	1 570	The Tier 2 approach has been used from 2000. Emission factors have been revised from 1990 to 2000 onwards on the basis of new information available by industry.	CRF 2002, Table 8(b)
N_2O from 2.B	– 1 441	For 2.B.2 (nitric acid production) the emission factor has been revised from 1995 onwards on the basis of new information available by industry. For 2.B.3 (adipic acid production) the previous emission factor of 0.333 has been checked again with industry and corrected with the default IPCC value equal to 0.30.	CRF 2002, Table 8(b)
Luxembourg			
Total emissions excluding LUCF	1 854		

	Absolute difference between latest and previous submission used for the EC inventory (Gg CO_2 equivalents)	Member States' explanation for recalculation	Information source of reasons for recalculations
CO_2 from 1.A.3	1 854	CO_2 emissions from fuel sold in Luxembourg and burned abroad (fuel tourism) was included.	Direct communication
Netherlands			
Total emissions excluding LUCF	1 380		
CO_2 from 1.A.4	727	Recalculations due to improved accuracy by using adjusted activity data.	CRF 1990, Table 8(b)
CO_2 from 1.A.2	304	Recalculations due to improved accuracy by using adjusted activity data.	CRF 1990, Table 8(b)
CO_2 from 1.A.3	277	Recalculations due to improved accuracy by using adjusted activity data.	CRF 1990, Table 8(b)
Portugal			
Total emissions excluding LUCF	– 3 592		
CH_4 from 4.B	– 1 838	Quantity of manure produced by sheep and goats was revised downward toward values more similar to other parties and IPCC defaults. A doubling of manure produced per animal was probably affecting earlier estimates; MCF values now use the new default values proposed in GP.	CRF 1990, Table 8(b)
N_2O from 4.D	– 1 568	No explanation provided for this specific source category.	
CO_2 from 1.A.2	962	Methods: Methodology used to estimate emissions in combustion processes with contact (cement, ceramic and glass) was improved and now EF are based on production and not fuel consumption. For CO_2 emission estimates include and distinguish now clearly both decarbonising and oxidation of carbon in fuel. Emission factors: CO_2 EF for combustion of coke gas and blast-furnace gas in iron and steel industrial plant were revised according to information from the only plant operating in Portugal (nowadays closed). Activity data: Consumption of fuel-coke and used tyres were added as fuels in the cement industry improving emission estimates. Propylene is now clarified as being used as feedstock. A minor error that resulted in subtraction of part of the feedstocks from fuel combustion in chemical industry was corrected. Small corrections were made in fuel consumption (biomass) in paper pulp industry, following cross-check with information collected from General-Directorate of Energy. Addition/removal/replacement of source categories: It was detected that emissions formerly attributed to non-ferrous metals (1.A.2.b) were including in fact both ferrous and non-ferrous metallurgy, and no statistical data allowed separation, and were therefore transferred to 1.A.2.f (Other) category; First time inclusion of 'Other fuels' (Hydrogen) in the chemical industry.	CRF 1990, Table 8(b)
Spain			
Total emissions excluding LUCF	– 3 053		
CO_2 from 1.B.1	– 2 504	Amount of fuel produced: AR. Revision of the mass units in which the production of fuel were expressed. In the previous submission it was mistakenly expressed in thousand of tonnes instead of million of tonnes. This error has been fixed in the present submission. This revision only affects IEF, not the emissions themselves.	CRF 1990, Table 8(b)
CO_2 from 1.A.2	– 693	Petroleum coke fuel characteristics: EF. As a consequence of the revision of petroleum coke carbon content (t C/TJ), the CO_2 EF has been changed for the whole period 1990–2001 in the following industrial sectors categories: cement, lime and plaster production, chemical industry, machinery industries, and other non-metallic minerals industries Petroleum coke fuel characteristics: AR. As a consequence of the revision of petroleum coke LHV, the activity rate expressed in terms of energy (TJ) for the whole period 1990–2001 has been changed in the following industrial sectors categories: cement, lime and plaster production, chemical industry, machinery industries, and other non-metallic minerals industries. Combustion in manufacturing industries: RA. This reference to recalculation is motivated by the reallocation for the whole period 1990–2001 of a set of activities related to combustion in a miscellaneous subset of industrial activities that were assigned in the previous submission to Category 1.A.2.f: (1) Lime productions in iron and paper pulp industries have been reallocated to categories 1.A.2.a and 1.A.2.d respectively; (2) Galvanising furnace in iron industry has been reallocated to Category 1.A.2.a; (3) Anode-baking furnaces in aluminium industry have been reallocated to Category 1.A.2.b.	CRF 1990, Table 8(b)

	Absolute difference between latest and previous submission used for the EC inventory (Gg CO_2 equivalents)	Member States' explanation for recalculation	Information source of reasons for recalculations
N_2O from 1.A.2	– 362	Petroleum coke fuel characteristics: AR. As a consequence of the revision of petroleum coke LHV, the activity rate expressed in terms of energy (TJ) for the whole period 1990–2001 has been changed in the following industrial sectors categories: cement, lime and plaster production, chemical industry, machinery industries, and other non-metallic minerals industries Combustion in manufacturing industries: RA. This reference to recalculation is motivated by the reallocation for the whole period 1990–2001 of a set of activities related to combustion in a miscellaneous subset of industrial activities that were assigned in the previous submission to Category 1.A.2.f: (1) Lime productions in iron and paper pulp industries have been reallocated to categories 1.A.2.a and 1.A.2.d respectively; (2) Galvanising furnace in iron industry has been reallocated to Category 1.A.2.a; (3) Anode-baking furnaces in aluminium industry have been reallocated to Category 1.A.2.b.	CRF 1990, Table 8(b)
Sweden			
Total emissions excluding LUCF	– 617		
CO_2 from 1.A.2	– 890	1.A.2.a: The whole time series for iron and steel production has been recalculated due to new activity data, new emission factors on coke oven gas, blast-furnace gas and steel converter gas and due to the new allocation of emissions from the iron and steel industry. 1.A.2.c: Due to new activity data from about ten of the largest companies within the chemical industry, emissions from this sector have been recalculated for all years.	NIR 2004, Section 3.6
CO_2 from 1.B.1	695	Emissions from flaring of gases are reported as Other fugitive emissions from solid fuels, 1.B.1.c, for all years, instead of reporting this within iron and steel production and fugitive emissions from solid fuel transformation in CRF 1.B.1.b.	NIR 2004, Section 3.6
CO_2 from 2.C	– 342	CRF 2.C.1: Emissions of CO_2 from the use of dolomite and limestone in the production of ore-based iron sinter are reported, in this submission, in CRF 2.A.3 instead of 2.C.1 for the whole time series, in line with the GPG. Emissions of CO_2 from the production of pig iron in blast furnaces have been recalculated, for all years, based on the use of blast-furnace gas in the blast-furnace cowpers. Emissions of CO_2 from the use of coke within pig iron production in blast furnaces have been excluded from CRF 2.C.1 in this submission to avoid double counting. CO_2 emissions from the use of limestone in the iron sinter industry have been reallocated to CRF 2.A.3 in this submission. CRF 2.C.2: Emission factors for the calculation of emissions of CO_2 from ferroalloys production have changed and emissions from coal electrodes have been included for all years. CRF 2.C.3: Emissions of CO_2 from aluminium production have been recalculated due to new information on carbon that is bound in soot instead of being emitted as CO_2.	NIR 2004, Section 4.3.3
United Kingdom			
Total emissions excluding LUCF	– 1 572		
CO_2 from 6.C	– 820	Updated whole time series of emission factors for chemical waste; activity for clinical waste revised.	CRF 1990, Table 8(b)
PFCs from 2.C.3	– 704	New model used to estimate potential and actual emissions	CRF 1990, Table 8(b)
SF_6 from 2.F	358	New model used to estimate potential and actual emissions for 2.F.6: 'Other' (electronics, electrical insulation and trainers).	CRF 1990, Table 8(b)

10.2 Implications for emission levels

Table 10.2 provides the differences in total EC GHG emissions between the latest submission and the previous submission in absolute and relative terms. The table shows that due to recalculations, total EC 1990 GHG emissions excluding LUCF have increased in the latest submission compared to the previous submission by 38 985 Gg (+ 0.9 %). EC GHG emissions for 2001 increased 35.646 Gg (+ 0.9 %) due to recalculations.

Table 10.3 provides an overview of recalculations for the EC key source categories for 1990 and 2001 (see Section 1.5 for information on identification of EC key sources). The table shows that the largest recalculations in absolute terms were made in the Key Source 4.B: 'CH_4 from manure management',

Table 10.2 Overview of recalculations of EC total GHG emissions (difference between latest submission and previous submission in Gg CO_2 equivalents)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Total CO_2 equivalent emissions including LUCF (absolute)	122 715	200 633	119 486	121 016	116 660	116 013	112 831	103 270	95 372	88 436	79 258	90 079
Total CO_2 equivalent emissions including LUCF (%)	3.1 %	5.0 %	3.1 %	3.2 %	3.0 %	3.0 %	2.8 %	2.6 %	2.4 %	2.3 %	2.0 %	2.3 %
Total CO_2 equivalent emissions excluding LUCF (absolute)	38 985	39 569	42 113	47 255	44 619	43 848	44 890	38 469	32 964	29 012	23 406	35 646
Total CO_2 equivalent emissions excluding LUCF (%)	0.9 %	0.9 %	1.0 %	1.2 %	1.1 %	1.1 %	1.1 %	0.9 %	0.8 %	0.7 %	0.6 %	0.9 %

Table 10.3 Recalculations for the EC key source categories 1990 and 2001 (difference between latest submission and previous submission in Gg of CO_2 equivalents and in percentage)

Greenhouse gas source categories	Gas	Recalculations 1990		Recalculations 2001	
		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
1.A.1. Energy industries	CO_2	– 4 853	– 0.4	– 5 136	– 0.5
1.A.1. Energy industries	N_2O	– 885	– 6.1	– 939	– 5.9
1.A.2. Manufacturing industries	CO_2	9 559	1.5	9 883	1.7
1.A.3. Transport	CO_2	1 948	0.3	– 708	– 0.1
1.A.3. Transport	CH_4	18	0.4	– 120	– 3.9
1.A.3. Transport	N_2O	– 329	– 2.8	– 2 439	– 9.3
1.A.4. Other sectors	CO_2	1 901	0.3	9 340	1.4
1.A.4. Other sectors	CH_4	994	9.5	487	6.3
1.A.5. Other	CO_2	201	1.0	– 331	– 4.5
1.B.1. Solid fuels	CO_2	– 1 809	– 19.5	– 1 282	– 15.9
1.B.1. Solid fuels	CH_4	3 671	7.6	3 650	23.9
1.B.2. Oil and natural gas	CO_2	2 042	11.8	1 240	7.6
1.B.2. Oil and natural gas	CH_4	738	2.2	– 49	– 0.2
2.A. Mineral products	CO_2	2 241	2.1	1 718	1.6
2.B. Chemical industry	CO_2	550	4.3	1 342	12.5
2.B. Chemical industry	N_2O	– 2 328	– 2.2	70	0.1
2.C. Metal production	CO_2	– 4 376	– 17.0	– 4 791	– 20.1
2.C. Metal production	PFC	969	8.3	161	5.2
2.E. Production of halocarbons and SF_6	HFC	1 727	6.9	– 1 047	– 8.8
2.F. Consumption of halocarbons and SF_6	HFC	– 40	– 10.2	4 202	13.4
2.E. Production of halocarbons and SF_6	PFC	614	10.4	– 382	– 5.8
2.E. Production of halocarbons and SF_6	SF_6	0	0.0	112	8.7
2.F. Consumption of halocarbons and SF_6	SF_6	614	10.4	– 382	– 5.8
2.G. Other	CO_2	0	0.0	112	8.7
4.A. Enteric fermentation	CH_4	4 466	3.1	4 814	3.7
4.B. Manure management	CH_4	26 434	58.5	21 571	47.7
4.B. Manure management	N_2O	– 3 157	– 13.4	– 2 915	– 13.5
4.D. Agricultural soils	CO_2	0	0.0	0	0.0
4.D. Agricultural soils	N_2O	– 4 556	– 2.1	– 1 733	– 0.9
6.A. Solid waste disposal on land	CH_4	2 426	2.2	– 377	– 0.5
6.B. Wastewater handling	CH_4	1 142	14.8	62	0.8
6.B. Waste incineration	CO_2	– 972	– 14.6	– 1 378	– 22.7
6.D. Other	CO_2	0	0.0	– 420	– 100.0

Note: Many of these source categories are more aggregated than the EC key source categories identified in Section 1.5 because the more detailed data was not estimated in the 2003 inventory.

Table 10.4 Contribution of Member States to EC recalculations of total GHG emissions without LUCF for 1990–2001 (difference between latest submission and previous submission Gg of CO_2 equivalents)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Austria	– 327	– 87	– 156	– 1 167	– 1 287	– 1 441	– 1 848	– 1 806	– 1 819	– 2 040	– 1 311	– 1 482
Belgium	4 507	2 322	2 521	2 908	4 497	2 740	4 959	705	1 450	– 1 874	– 381	– 995
Denmark	– 467	– 438	– 200	– 584	– 366	– 380	– 500	– 272	– 140	– 197	– 373	– 97
Finland	– 463	– 432	– 422	– 420	– 419	– 385	– 399	– 387	– 376	– 369	– 351	– 313
France	3 928	5 443	5 159	3 914	2 785	2 008	2 447	1 888	455	224	157	897
Germany	37 062	37 831	40 568	44 158	43 093	41 840	41 625	41 995	40 016	37 073	34 429	33 875
Greece	0	0	0	0	0	0	0	0	0	0	0	2 774
Ireland	0	0	0	0	0	0	0	0	0	0	68	0
Italy	270	537	– 1 133	2 256	474	4 187	2 308	1 822	2 673	1 827	181	8 867
Luxembourg	1 854	2 436	2 381	2 439	2 451	2 241	2 313	2 553	2 371	3 008	3 525	3 719
Netherlands	1 380	418	1 035	979	995	1 186	1 292	– 2 334	– 1 334	– 3 773	– 3 417	– 3 545
Portugal	– 3 565	– 3 441	– 3 695	– 3 900	– 2 831	– 2 612	– 2 853	– 2 038	– 2 445	– 3 378	– 4 348	– 5 453
Spain	– 3 053	– 3 307	– 3 157	– 2 644	– 1 766	– 2 892	– 1 622	– 2 034	– 2 258	– 679	– 1 902	670
Sweden	– 617	– 447	252	203	– 1 800	– 1 319	– 1 516	– 1 048	– 1 461	– 2 197	– 1 447	– 2 221
United Kingdom	– 1 527	– 1 265	– 1 040	– 887	– 1 207	– 1 325	– 1 317	– 575	– 4 169	1 388	– 1 425	– 1 050
EU-15	**38 985**	**39 569**	**42 113**	**47 255**	**44 619**	**43 848**	**44 890**	**38 469**	**32 964**	**29 012**	**23 406**	**35 646**

Table 10.5 Contribution of Member States to EC recalculations of total GHG emissions without LUCF for 1990–2001 (difference between latest submission and previous submission in percentage)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Austria	– 0.4	– 0.1	– 0.2	– 1.5	– 1.7	– 1.8	– 2.2	– 2.1	– 2.2	– 2.5	– 1.6	– 1.7
Belgium	3.2	1.6	1.7	2.0	3.0	– 1.8	3.2	– 0.5	0.9	– 1.2	– 0.3	– 0.7
Denmark	– 0.7	– 0.5	– 0.3	– 0.8	– 0.5	– 0.5	– 0.6	– 0.3	– 0.2	– 0.3	– 0.5	– 0.1
Finland	– 0.6	– 0.6	– 0.6	– 0.6	– 0.5	– 0.5	– 0.5	– 0.5	– 0.5	– 0.5	– 0.5	– 0.4
France	0.7	0.9	0.9	0.7	0.5	0.4	0.4	0.3	0.1	0.0	0.0	0.2
Germany	3.1	3.3	3.7	4.1	4.0	4.0	3.9	4.0	3.9	3.8	3.5	3.4
Greece	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1
Ireland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Italy	0.1	0.1	– 0.2	0.5	0.1	0.8	0.4	0.3	0.5	0.3	0.0	1.6
Luxembourg	17.0	23.3	23.1	23.0	23.9	28.8	29.5	37.3	40.1	49.9	58.8	61.2
Netherlands	0.7	0.2	0.5	0.4	0.5	0.5	0.6	– 1.1	– 0.6	– 1.7	– 1.6	– 1.6
Portugal	– 5.8	– 5.4	– 5.5	– 5.9	– 4.3	– 3.7	– 4.2	– 2.9	– 3.3	– 4.1	– 5.3	– 6.5
Spain	– 1.1	– 1.1	– 1.0	– 0.9	– 0.6	– 0.9	– 0.5	– 0.6	– 0.7	– 0.2	– 0.5	0.2
Sweden	– 0.8	– 0.6	0.3	0.3	– 2.3	– 1.8	– 1.9	– 1.4	– 2.0	– 3.0	– 2.1	– 3.2
Unied Kingdom	– 0.2	– 0.2	– 0.1	– 0.1	– 0.2	– 0.2	– 0.2	– 0.1	– 0.6	0.2	– 0.2	– 0.2
EU-15	**0.9**	**0.9**	**1.0**	**1.2**	**1.1**	**1.1**	**1.1**	**0.9**	**0.8**	**0.7**	**0.6**	**0.9**

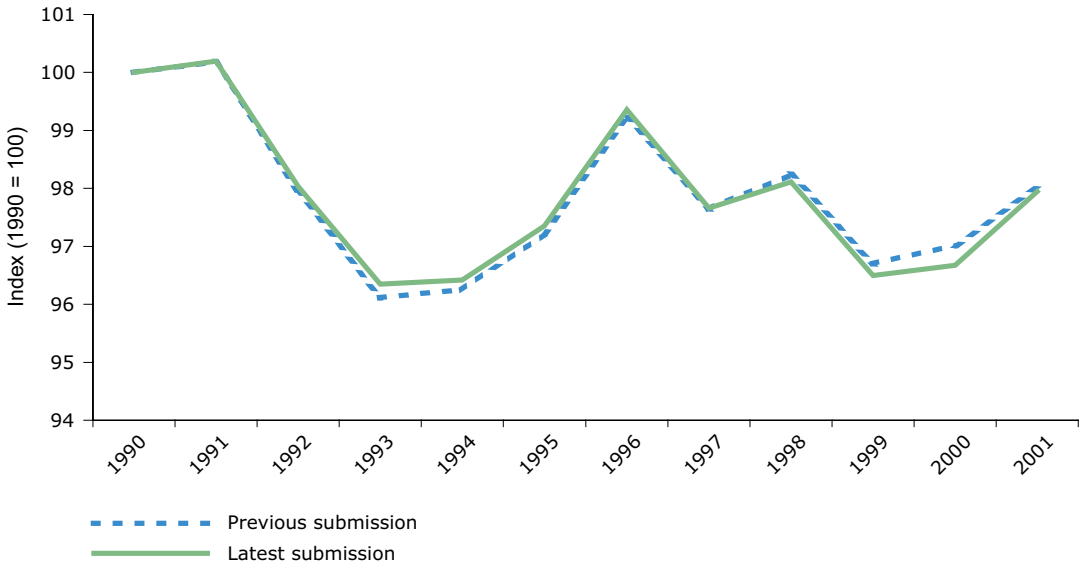
(+ 26 434 Gg in 1990 and + 21 571 Gg) in 2001).

Table 10.4 and Table 10.5 give an overview of absolute and percentage changes of Member States' emissions due to recalculations for 1990 and 2001. Large recalculations in absolute terms were made especially in Germany. In relative terms, the highest recalculations were made by Luxembourg.

10.3 Implications for emission trends, including time series consistency

Figure 10.1 shows that due to the fact that both the 1990 and 2001 emissions have increased, the emission trend in the EC has hardly changed. In the previous submission the trend of GHG excluding LUCF between 1990 and 2001 was – 2 %. In the latest submission this trend has changed to – 2.1 %.

Figure 10.1 Comparison of EC GHG emission trends 1990–2001 (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 2004 in response to the UNFCCC review process 2003.

- In 2004, the EC provides CRF emission data at subcategory level (Table 1, Table 2(I), Table 3, Table 4, Table 5 and Table 6) for 1990–2002. In previous years the EC could not provide these tables, because not all Member States provided CRF emission data at subcategory level and because a gap-filling procedure for this case was not in place. The new implementing provisions provide such a gap-filling procedure. Also a key source analysis was made on this more detailed level in 2004. In addition, Tables 1.A(a) are provided for 1998, 2000 and 2002.
- QA/QC activities have been further extended on the basis of the discussions on the proposed QA/QC plan and on the basis of experience made in 2003. Also the qualitative uncertainty estimates have been improved by developing a simple approach on the basis of the Member States' qualitative estimates. This resulted in a list of key sources ranked according to their contribution to EC uncertainty. This is a first step towards a more comprehensive uncertainty analysis which will be included in the 2005 submission.
- The transparency of the EC inventory was improved by:
  - — including more trend analysis in Chapters 2 to 9; however, due to the fact that the EC receives several Member States' submissions rather late, the scope of this trend analysis is still limited; in the current submission there is a focus on providing overview information on emission trends at gas and sector level and for large key sources;
  - — providing overview tables for the completeness of Member States' submissions by referring to the Member States' NIRs, Member States CRF Table 9 and Member States' UNFCCC review reports;
  - — extending the description of methodologies, uncertainty estimates and sector-specific QA/QC for the agriculture and LUCF sector;

— including new overview tables on allocation of Member States' emissions to Category 1.A.5 'Other' and Sector 7: 'Other';
— providing an overview table on improvements made by Member States in response to the UNFCCC review;
— providing for each sector the Member States' contributions to recalculations.

10.4.2 Member States' responses to UNFCCC review

Since the improvement of the EC inventory depends on Member States' efforts regarding completeness of estimation and improvement of methods and parameters used, Table 10.6 provides an overview of Member States' responses to the UNFCCC review ([23]). The table shows that a considerable amount of improvements were made compared with the 2003 submissions of Member States. In addition to the response to the UNFCCC review, a large number of additional improvements were implemented by Member States. However, an aggregation of all improvements conducted in all Member States would be too much information and too detailed to be included in this report.

Table 10.6 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	**Energy/industry** Emissions due to combustion from the cement industry and the iron and steel industry that have been reported together with process-specific emissions in the industry sector until last submission are now reported in the energy sector. **Fugitive emissions** In response to the comments of the ERT, a default EF for coal-mining is now used. **Industry** CO_2 emissions from limestone and dolomite use, from soda ash use, carbide production, electric arc furnaces and aluminium production have been added to the inventory. Data for 2.A.7 magnesia sinter plants have been updated according to plant-specific information. Potential emissions for fluorinated compounds have been corrected. **Agriculture** The age class split for swine categories for the years 1990–92 was adjusted because there is an inconsistency in the time series in the statistical data set resulting from a changing methodology of the statistical survey in 1992/93. The time series has been adjusted using the split from 1993, resulting in higher emissions for the years 1990–92. Data of the background tables for agriculture (N-excretion for the different waste management systems by animal category) have been corrected. Table 209 on page 241 transparently reports all detailed issues raised during the UNFCCC inventory review 2003 and whether the issue was already addressed in the inventory submission 2004 or whether the issue was included in the improvement plan.
Belgium	**Energy** For road transport, the emissions of CO_2 reported in this submission are based on the amounts of fuel sold in Belgium. This adjustment was made based on the methodology described in the IPCC good practice guidance (10) and the comments of the UNFCCC review team during the in-country review of the Belgian emission inventory of greenhouse gases in September 2003. In previous submissions, the emissions of road transport were calculated as the sum of the three regions that are using the transport model Copert to calculate the emissions of road transport.
Denmark	The insertion of notation keys has for this submission been considerable improved for all sectors. **Energy** Stationary combustion: no recalculation has taken place as a result of the comments made by the reviewers, but the documentation has been improved to clarify subjects questioned by the reviewers. The plans for future improvements are given in Section 3.2.6, where the most important plans are a disaggregation of the fuel consumption in the industrial sector and updating of energy statistics. For the energy sector as regards transport a response to the review team is given in the energy chapter, Section 3.3.5 (last paragraph) and an outline of plans is given in Sector 3.3.6. For 'energy, fugitive emissions' the recalculations carried out are noted in Section 3.5.5. In connection to the energy sector the review team notes that the inventories for Greenland and Faeroe Islands are not disaggregated. This note has been discussed and the plan is now to include those emissions under 'other' in the relevant CRF source categories. **Industrial processes** The resources in the sector have been strengthened. N_2O emission from nitric acid production has been estimated for 1990–2002. For more details on the response to the recommendation by the review team refer to Section 4.1. For F-gases a full introduction of recalculated emission estimates as a result of a revision of the model used was announced to the reviewers. This has now been done and the changes were minor. Refer to the table in Section 10.3. Furthermore, the reviewers noted inconsistencies as regards background information on the potential emission of F-gases in the CRF tables. These emissions have been changed.

([23]) Issues related to the NIR are not included in this table as already addressed in Table 1.11.

Member State	Improvements in response to UNFCCC review as indicated in the NIR
	Agriculture Details on the response and implementation can be seen in Section 6.8. In general the inconsistencies pointed out by the reviewers have been removed and the plans for improvements announced to the reviewers have been implemented. For the further plans in the sector one of the highest priority plans is to include CO_2 from agricultural soils. **LULUCF** Chapter 7 regarding the methodological description has been revised. This chapter also includes some considerations on uncertainty. Furthermore, notation keys have been inserted in the CRF tables. **Waste** The inconsistencies for CH_4 from solid disposal on land (between activities and emission factors in the CRF and in FOD model used) are now removed. As a part of the general improvement of the use of notation keys, this has also been done in this sector, including that the review team point on the use of 'IE' in Table 6.A. The review team suggested comparing the model used with IPCC default methodology. It is the plan, depending on resources, to do so. As regards the recommendation made by the review team to conduct uncertainty analysis it is also planned to do so. The review team had to question wastewater handling systems as regards CH_4 and N_2O emissions. The plan is to analyse this in order to estimate and document the CH_4 — and N_2O-emissions, which especially for CH_4 is believed to be of only minor importance. For items pointed out by the reviewers and not reflected in the NIR 2004, NIR has put remarks, extended explanations and announcement of plans for improvements. **Institutional arrangements** A strengthening on timely delivery of data from other institutions will be carried out and considerations will be made to have data delivered data for some missing sources.
Finland	Recalculation of Source Category 1.A: In the previous inventories the indirect N_2O emissions caused by nitrogen deposition due to NO_x emissions in the energy sector were included in the emission estimates for the relevant sectors. That was reported as an exception to the IPCC guidelines. Now these emissions have been removed from the inventory to increase transparency and comparability with other countries' inventories (NIR 2004, p. 63).
France	The recommendations from the review report were incorporated in the 2004 submission. Most of the remarks from the UNFCCC review deal with transparency issues. Improvements in this field have already been planned for a couple of years and actions are progressively implemented especially in the framework of the new NIR structure. The NIR will include from the 2004 submission a report dedicated to methodology (so called Ominea) which is covering all national inventories among them the UNFCCC one. Other improvements concern the use of notation keys in the 2004 CRF submission, the reporting of N_2O from fertiliser to avoid misunderstanding in the use of the emission factor, the consumption of SF_6 is now estimated according to the IPCC Tier 2, the implementation of a ISO 9001/2000 standard for quality management. Moreover, several improvements have been introduced in emission calculation according to the national improvement plan established in agreement with the National Committee on Inventories lead by the Ministry of Ecology and Sustainable Development (NIR 2004, p. 89 and direct communication).
Germany	A number of methodological improvements occurred. Except for methodological documentation in the energy sector (NIR, p. 3-46) no explicit information in the NIR whether and which changes address issues indicated during the UNFCCC inventory review. The NIR mentions that the improvement process is ongoing and not yet completed and that a number of recommendations from the UNFCCC review will only be addressed with the next inventory submission.
Greece	UNFCCC review not conducted as no NIR submitted in 2003.
Ireland	Improvement of completeness in some areas (see Table 13). The review report recorded no major problems or shortcomings in the Irish inventories but nevertheless made recommendations that the inventory agency could pursue in order to increase transparency and achieve better compliance with UNFCCC reporting requirements in general. It has not been possible to implement the recommendations for the 2004 reporting cycle but the present NIR mentions some changes and improvements now planned in response to the in-country review report. No important recalculations have been performed for the 2004 submission. Planned recalculations, that will account for revised energy balances, the application of high-tier methods and more complete country-specific data for some key source categories in agriculture and the inclusion of some potentially important sources of emissions and removals under land-use change and forestry, have been deferred to the next reporting cycle (NIR 2004, p. 2). The 2003 in-country review report for Ireland concluded that the input values of uncertainty chosen for activity data or emission factors for some sources in the 2001 inventory may not have been entirely appropriate. The uncertainty analysis for 2002 therefore incorporates changes that have been made following further investigation to determine the most conceptually meaningful values that can be used at the level of source disaggregation being used for the analysis (NIR 2004, p. 9).
Italy	**Cross-cutting topics:** A full CRF time series from 1990 to 2002 has been submitted. Recalculation for the last year submitted has been provided. Improvement in accuracy and more detailed estimations have regarded all the sectors. **Energy:** CH_4 and N_2O emissions from natural gas road transport have been estimated and reported. **Industrial processes:** CO_2 emissions from limestone and dolomite use and soda ash production have been estimated and reported. PFCs emissions from aluminium production have been verified and checked with industry and modified according to the IPCC Tier 2 methodology. **LUCF:** Non CO_2 emissions from forest fires have been reported. (Direct communication.)
Luxem-bourg	NIR not yet available.

Member State	Improvements in response to UNFCCC review as indicated in the NIR
Nether-lands	**Inconsistency in time series:** Some of the apparent inconsistencies in time series are due to (a) limited recalculations (only for 1990, 1995 and the last three years) because of the limitation in the annual PER project of the years considered in the update; and (b) to different source allocations used for different years (in particular 1991–94) because of a different national source coding system for these years. Therefore, with the current PER practices, consistency over the complete time period can not be guaranteed for all sources. However, as explained in Section 10.4.7, this aspect is part of the improvement programme. **Missing notation keys and other documentation in CRF tables:** Additional notation keys were included. **Incompleteness of CRF:** Two potentially significant subcategories in the agricultural soils category (N_2O emissions from crop residues and indirect N_2O from atmospheric deposition) and Categories 5.B. ad 5.D of the LUCF sector are not reported in the inventory. Section 6.4.4 of the NIR addresses the actions planned to resolve this issue. **Additional information in the NIR:** In the NIR an annex with references to other reports 'that should be considered as part of the NIR' was added which are publicly available on the Internet. **Comparison of activity data with international statistics:** In comparing Netherlands' activity data with international data, we stress that, in general, statistical data published by international organisations like the UN, the IEA and the FAO, though essentially officially submitted national data, are ultimately the responsibility of these organisations. Any discrepancies found could be due to various reasons, e.g. (a) apparent errors in one of the national submissions; (b) errors in data-processing by the international statistical agency; (c) errors arising from data conversions prior or after submission; (d) differences in activity definitions; (e) differences in data sets compared due to revisions in subsequent editions; and (f) modifications or estimates made by the international statistical agency, when inconsistencies or omissions were found in the dataset and national agencies did not conclusively respond to requests for clarifications. However, it is still important to check discrepancies found to see if errors have been made in the emission compilation or reporting process. In the NIR/CRF 2004 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: • CRF tables improved by replacing 0 by notation keys NE, NA, NO, IE, C, where applicable; • Correction of typing/unit errors as observed; • in the 2003 submission the fuel split was made uniform for the years 1990, 1995 to 2002; • a physical link between the CRF files and the tables of the NIR was established to make sure that the data in both are equal. (NIR 2004, Section 10.4.6)
Portugal	NIR not yet available.
Spain	A number of changes and recalculations occurred, no explicit information in the NIR on whether and which changes address issues indicated during the UNFCCC inventory review.
Sweden	Since the last submission, recalculations has been carried out for all sectors except for waste. The recalculations are responses on suggestions from the expert review team that carried out an in-country review in Sweden in November 2001 and due to comments in the centralised review and synthesis and assessment report in 2003 Parts I and II. Some recalculations are also made due to new emission factors, thermal values and activity data and due to discovered errors during the work with the inventory in 2002 and 2003 (NIR 2004, p. 162).
United Kingdom	**Further explanation requested about emissions from aviation bunkers:** Extra information will be given in the next NIR, as a complete revision of the methodology used to estimate emissions from aviation is being implemented this year. **Further explanation requested about feedstocks and non-energy use of fuels:** Further information is being prepared, and will be included in the 2005 NIR. **Negative emissions used in iron and steel production:** To remove these would need a major change to the UK method of estimating and presenting emissions — UK is considering this, although the UK believes that the current method provides accurate estimates of emissions from the iron and steel sector. **Various comments on estimation and presentation of emissions from LUCF:** Further clarification has been added to the 2004 NIR about the UK reporting of emissions from LUCF. **Various comments on estimation and presentation of emissions from waste:** Further clarification has been added to the 2004 NIR of the UK reporting of emissions from waste. **Comments made about inconsistencies between the NIR and the CRF, especially for emissions of F-gas:** There has been a complete revision of method to estimate F-gases; changes have been made to data entered in the CRF to we hope ensure a complete match between emissions presented in the 2004 CRF and the 2004 NIR. **A few errors identified in data entry in 2003 CRF:** Errors identified by the ERT have been corrected in the 2004 CRF submission. Main actions currently under way are: • scientific research to enable inclusion of methane emissions from closed coal mines • incorporation of an improved method for estimating aviation emissions, currently being reviewed • adoption of the IPCC good practice guidance in the LUCF sector. (NIR 2004, p. 128)

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 new legal basis of the compilation of the EC inventory (new Council decision and implementing provisions) are expected to improve the preparation process of the EC inventory ([24]). For example, under the new decision Member States' inventories be available by 15 March at the latest. This will facilitate the provision of more overview information including trend analysis from 2005 onwards.
- The new Council decision and the implementing provisions thereunder are also expected to bring forward the establishment of the EC inventory system. In addition, the workshop organised in September 2004 (see Section 1.6.3), will facilitate the exchange of experience on the development of national systems in the Member States and the relation between the national systems and the EC inventory system.
- The current QA/QC activities will be further developed in 2004. The EC inventory QA/QC plan is currently being discussed as part of the implementing provisions under the new monitoring mechanism decision which came into force in March 2004. The QA/QC activities in 2004 will include:
  - — continuation of the comparison of national inventories for the sectors energy, LUCF and agriculture, with inventories prepared at EC level by Eurostat and the JRC;
  - — extension of the current and the development of new QC procedures according to the IPCC Tier 1 requirements (explore the further use of UNFCCC review results);
  - — development of a QA/QC plan for the EC;
  - — preparation of a draft quality management manual for the EC;
  - — organisation of a workshop on QA/QC (see Section 1.6.3);
  - — organisation of a workshop on methodologies for estimating GHG emissions from international bunkers (see Section 3.7).
- During the year 2004 further work will be carried out with the aim of providing a quantitative uncertainty estimate for the EC 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. The EC plans to provide the sectoral background data tables for energy (Table 1.A(a)) in the 2005 submission for the complete time series. In addition, the EC explores the possibility for providing those activity data in the inventory report, which are crucial for understanding the emission trends.

([24]) 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 and the guidelines under this decision (European Commission, 2000).

References

Citepa 2002, *Inventaire des émissions de gaz à effet de serre en France au titre de la convention cadre des Nations Unies sur le changement climatique*, December 2002. (FR NIR 2003)

Citepa 2003, *Inventaire des émissions de gaz à effet de serre en France au titre de la convention cadre des Nations Unies sur le changement climatique*, December 2003. (FR NIR 2004)

Directorate-General for Health Protection 2003, *Belgium's greenhouse gas inventory (1990–2001). National inventory report submitted under the United Nations Framework Convention on Climate Change*, Federal Public Service 'Health, Food Chain Safety and Environment'. Directorate General for Health Protection: Environment, Climate Change Unit, April 2003. (BE NIR 2003)

Directorate-General of the Environment 2004, *Belgium's greenhouse gas inventory (1990–2002). National inventory report submitted under the United Nations Framework Convention on Climate Change*, Federal Public Service 'Public Health, Food Chain Safety and Environment', Directorate-General of the Environment, Climate Change Section, April 2004. (BE NIR 2004)

EC 2001, *Third communication from the European Community under the UN Framework Convention on Climate Change*, Commission staff working paper, SEC(2001) 2053, European Commission, Brussels, 20.12.2001.

EEA 2003a, *Annual European Community greenhouse gas inventory 1990–2001 and inventory report 2003. Submission to the UNFCCC Secretariat*, Technical report No 95, European Environment Agency, Copenhagen. (EC IR 2003)

EEA 2003b, *Analysis of greenhouse gas emission trends and projections in Europe 2003*, Technical report, European Environment Agency, Copenhagen (forthcoming).

Environmental Protection Agency 2003, *Ireland: National inventory report 2003. Greenhouse gas emissions 1990–2001 reported to the United Nations Framework Convention on Climate Change*, Wexford, Ireland. (IE NIR 2003)

Environmental Protection Agency 2004, *Ireland: National inventory report 2004. Greenhouse gas emissions 1990–2002 reported to the United Nations Framework Convention on Climate Change*, Wexford, Ireland. (IE NIR 2004)

European Commission 2000, *Guidelines under Council Decision 1999/296/EC for a monitoring mechanism of Community CO_2 and other greenhouse gas emissions. Part I: Guidelines for Member States and EC annual inventories*, 1 September 2000.

Federal Environmental Agency 2003, *German greenhouse gas inventory 1990–2001. National inventory report 2003*, submission under the United Nations Framework Convention on Climate Change, Berlin, June 2003. (DE NIR 2003)

IPCC 1997, *Revised 1996 IPCC guidelines for national greenhouse gas inventories*, Intergovernmental Panel on Climate Change.

IPCC 2000, *Good practice guidance and uncertainty management in national greenhouse gas inventories*, Intergovernmental Panel on Climate Change.

Klein Goldewijk, K.; Olivier, J.G.J.; Brandes, L.J.; Peters, J.A.H.W.; Coenen, P.W.H.G. and Vreuls H.H.J. 2004, *Greenhouse gas emissions in the Netherlands 1990–2002. National inventory report 2004*, RIVM Report 773201 008/2004. (NL NIR 2004)

Laitat, E.; Karjalainen, T.; Loustau, D. and Lindner, M. (2000), 'Introduction: towards an integrated scientific approach for carbon accounting in forestry', *Biotechnol. Agron. Soc. Environ*. 4:241–51.

Ministerio das Cidades, Ordenamento do Territorio e Ambiente 2003, *Portuguese national inventory report on greenhouse gases, 1990–2001*, submitted under the United Framework Convention on Climate Change, Instituto do Ambiente, August 2003. (PT NIR 2003)

Ministry of the Environment 2003a, *Greenhouse gas emissions in Finland 1990–2001. National inventory report to the UNFCCC Secretariat' common reporting formats (CRF) 1990–2001*, Helsinki, 28 March 2003. (FI NIR 2003)

Ministry of the Environment 2003b, *Greenhouse gas emissions inventories report from Spain 1990–2001*, communication to the European Commission (Decision 1999/296/EC), Ministry of the Environment, Directorate-General for Environmental Quality and Assessment, Madrid, March 2003. (ES NIR 2003)

Ministry of the Environment 2004a, *Greenhouse gas emissions in Finland 1990–2002. National inventory report to the UNFCCC Secretariat*, common reporting formats (CRF) 1990–2002. 15 March 2004. (FI NIR 2004)

Ministry of the Environment 2004b, *Greenhouse gas emissions inventories report from Spain 1990–2002* communication to the European Commission (Decision 2004/280/EC), Ministry of the Environment, Directorate-General for Environmental Quality and Assessment, Madrid, March 2004. (ES NIR 2004)

National Environmental Research Institute 2003, *Denmark's national inventory report*, submitted under the United Nations Framework Convention on Climate Change 1990–2001, Ministry of Environment and Energy, April 2003. (DK NIR 2003)

National Environmental Research Institute 2004, *Denmark's national inventory report 2004*, submitted under the United Nations Framework Convention on Climate Change 1990–2001, Ministry of Environment and Energy, April 2004. (DK NIR 2004)

National Environmental Technology Centre 2003, *UK greenhouse gas inventory, 1990 to 2001*, annual report for submission under the Framework Convention on Climate Change, March 2003. (UK NIR 2003)

National Environmental Technology Centre 2004, *UK greenhouse gas inventory, 1990 to 2002*, annual report for submission under the Framework Convention on Climate Change, April 2004. (UK NIR 2004)

National Observatory of Athens 2004, *Climate change emissions inventory. National inventory for greenhouse and other gases for the years 1990–2002*, Ministry for the Environment, Physical Planning and Public Works, Athens, February 2004. (GR NIR 2004)

Olivier, J.G.J.; Brandes, L.J.; Peters, J.A.H.W.; Coenen, P.W.H.G. and Vreuls H.H.J. 2003, *Greenhouse gas emissions in the Netherlands 1990–2001. National inventory report 2003*, RIVM Report 773201 007/2003. (NL NIR 2003)

Romano, D.; Contaldi, M.; De Lauretis, R.; Gaudioso, D. 2003, *Italian greenhouse gas inventory 1990–2001. National inventory report 2003*. (IT NIR 2003)

Swedish Environmental Protection Agency 2003, *Sweden's national inventory report 2003*, submitted under the United Nations Convention on Climate Change, April 2003. (SE NIR 2003)

Swedish Environmental Protection Agency 2004, *Sweden's national inventory report 2004*, submitted under the United Nations Convention on Climate Change, April 2004. (SE NIR 2004)

Umweltbundesamt 2003a, *Austria's annual national greenhouse gas inventory*

1990–2002, submission under the monitoring mechanism of Community CO_2 and other greenhouse gas emissions (1999/296/EC), BE-234, Vienna, December 2003.

Umweltbundesamt 2003b, *Austria's national inventory report 2003*, submission under the United Nations Framework Convention on Climate Change 2003, BE-225, Vienna, May 2003. (AT NIR 2003)

Umweltbundesamt 2004a, *Austria's national inventory report 2004*, submission under the United Nations Framework Convention on Climate Change, BE-244, Vienna, 2004. (AT NIR 2004)

Umweltbundesamt 2004b, *Deutsches Treibhausgasinventar 1990–2002. Nationaler Inventarbericht 2004*, Berichterstattung unter der Klimarahmenkonvention der Vereinten Nationen, Berlin, March 2004. (DE NIR 2004)

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
CCC	Climate Change Committee (established under Council Decision No 280/2004/EC)
CH_4	methane
CO_2	carbon dioxide
COP	conference of the parties
CRF	common reporting format
CV	calorific value
EC	European Community
EEA	European Environment Agency
EF	emission factor
Eionet	European environmental information and observation network
ETC/ACC	European Topic Centre on Air and Climate Change
EU	European Union
FAO	Food and Agriculture Organisation of the United Nations
GHG	greenhouse gas
GPG	good practice guidance and uncertainty management in national greenhouse gas inventories (IPCC, 2000)
GWP	global warming potential
HFCs	hydrofluorocarbons
JRC	Joint Research Centre
F-gases	fluorinated gases (HFCs, PFCs, SF_6)
IE	included elsewhere
IPCC	Intergovernmental Panel on Climate Change
KP	Kyoto Protocol
LUCF	land-use change and forestry
LULUCF	land-use, land-use change and forestry
N	nitrogen
NH_3	ammonia
N_2O	nitrous oxide
NA	not applicable
NE	not estimated
NFI	national forest inventory
NIR	national inventory report
NO	not occurring
PFCs	perfluorocarbons
QA/QC	quality assurance/quality control
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	Estimate: assessment of completeness	Quality: assessment of the uncertainty of the estimates
C — Corinair	C — Corinair	All — full	H — high
CS — country-specific	CS — country-specific	F — full	M — medium
D — default	D — default	Full — full	L — low
M — model	M — model	IE — included elsewhere	
NA — not applicable	MB — mass balance	NE — not estimated	
T1 — IPCC Tier 1	PS — plant-specific	NO — not occurring	
T2 — IPCC Tier 2		P — partial	
T3 — IPCC Tier 3		Part — partial	

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