UK Greenhouse Gas Inventory,1990 to 1999

Annual Report for submission under the Framework Convention on Climate Change

A G Salway, TP Murrells, R Milne, S Ellis

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Executive Summary

The United Nations Framework Convention on Climate Change (FCCC) was ratified by the UK in December 1993 and came into force in March 1994. As a Party to the Convention, the UK aims to reduce emissions of greenhouse gases to 1990 levels by 2000 and is committed to monitoring progress towards achieving this target by:

- developing, periodically updating, publishing and making available national inventories of anthropogenic emissions by source and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol;
- using comparable methodologies for inventories of greenhouse gas emissions and removals.

In addition, the Kyoto Protocol will, when ratified, commit the UK to reducing emissions by 12.5 % below 1990 levels in the period 2008 - 2010, taking into account the subsequent redistribution of commitments agreed in June 1998 under the UK Presidency of the European Union. The Government has also adopted a domestic goal of reducing CO_2 emissions by 20% below 1990 levels by 2010.

The UK submits emission inventories of the six direct greenhouse gases under the Kyoto Protocol. These are :

- Carbon dioxide
- Methane
- Nitrous oxide
- Hydrofluorocarbons
- Perfluorocarbons
- Sulphur hexafluoride.

These gases contribute directly to climate change owing to their positive radiative forcing effect. Also reported are four indirect greenhouse gases:

- Nitrogen oxides (reported as NO_2)
- Carbon monoxide
- Non-methane volatile organic compounds (NMVOC)
- Sulphur dioxide.

Of these, nitrogen oxides, carbon monoxide and NMVOC can produce increases in tropospheric ozone concentrations which increase radiative forcing. Sulphur dioxide, however, contributes to aerosol formation in the atmosphere. This is believed to have a negative net radiative forcing effect, tending to cool the surface.

To provide a single, comprehensive source of information on the methodologies and data used in the UK inventory, a technical report has been published annually since 1995, (Salway, 1995, 1996, 1997, 1998, 1999, 2000). The current report extends the data for all gases to 1999 and provides additional information related to the 1999 National Inventory recently submitted to the FCCC

In the UK, emissions of all the major greenhouse gases have declined between 1990 and 1999 with carbon dioxide falling by 9%, methane by 28% and nitrous oxide by 36%. Emissions of nitrogen oxides, carbon monoxide, non-methane volatile organic compounds, perfluorocarbons and hydrofluorocarbons have also declined significantly over the same time period. Releases of sulphur hexafluoride have increased since 1990 but since 1996 are fairly constant. Reasons for the changing emission levels are discussed in the report. Table I summarises the emissions of each greenhouse gas as its equivalent emission of carbon dioxide.

Table I: GWP Weighted Greenhouse Gas Emissions (Tg CO_2 Equivalent)

	1990	1991	1992	1993	1994	1995
Carbon Dioxide (emissions)	602.8	606.7	591.9	576.3	572.4	563.4
Methane	77.1	76.0	74.1	71	64.4	64.1
Nitrous Oxide	66.9	65.0	58.1	54.5	58.9	56.3
HFCs	11.4	11.9	12.3	12.9	13.8	15.2
PFCs	2.3	1.8	1.0	0.8	1.0	1.1
SF_6	0.7	0.8	0.8	0.9	1.1	1.1
Total	761.2	762.2	738.3	716.4	711.6	701.3
Carbon Dioxide (removals)	-10.6	-10.7	-10.8	-11.1	-11.3	-11.5
Carbon Dioxide (net emission)[1]	592.3	596.1	581.1	565.3	561.1	551.9
Total (net emissions)[1]	750.7	751.6	727.4	705.3	700.4	689.7

	1996	1997	1998	1999	% change 1990-99
Carbon Dioxide	583.0	558.0	560.3	547.8	-9.1
Methane	62.7	60.7	58.0	55.3	-28.3
Nitrous Oxide	58.4	60.2	58.2	42.9	-35.9
HFCs	16.3	18.4	20.2	6.2	-45.4
PFCs	0.9	0.7	0.7	0.7	-70.3
SF_6	1.3	1.3	1.3	1.3	81.5
Total	722.5	699.3	698.6	654.2	-14.1%
Carbon Dioxide (removals)	-11.6	-11.6	-11.5	-11.5	9.3%
Carbon Dioxide (net emission)[1]	571.4	546.5	548.7	536.3	-9.5%
Total (net emissions)[1]	710.9	687.7	687.1	642.6	-14.4%

1 Net Emissions are reported in the Common Reporting Format

Weighted by the relevant global warming potentials, total emissions of direct greenhouse gases from the UK have fallen by 14.1% from 1990 to 1999.

The UK Greenhouse Gas Inventory is submitted to the FCCC in the form of the Common Reporting Format. This is attached to this report in the form of a CD ROM containing EXCEL spreadsheets. The Common Reporting Format (CRF) reports net carbon emissions, that is, emissions minus removals. The data in the body of this report quote emissions and removals separately. Hence the National Total Emission quoted is a gross figure, not allowing for removals, and so is higher than the figure quoted on the CRF basis.

Contacts

This work forms part of the Global Atmosphere Research Programme of the Department of the Environment, Transport and the Regions. (Contract EPG/1/1/120). The land use change and forestry estimates were provided by the Centre for Ecology and Hydrology (Edinburgh) (Contract EPG/1/1/106)

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A copy of this report and related data may be found on the website maintained by NETCEN for DETR: www.aeat.co.uk/netcen/airqual/naei

Further copies of this report are available from:

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1 Introduction

The United Nations Framework Convention on Climate Change (FCCC) was ratified by the United Kingdom in December 1993 and came into force in March 1994. Parties to the Convention are committed to develop, publish and regularly update national emission inventories of greenhouse gases (GHG).

National greenhouse gas emission inventories have been submitted to the FCCC for 1990 to 1999. This report includes these annual emission inventories and describes the methodology on which the estimates are based. This report and the attached CRF tables comprise the UK's national inventory report compiled according to Decision 93/CP.5 of the Conference of Parties. The major source for the GHG inventory is the UK National Atmospheric Emissions Inventory (NAEI) compiled by the National Environmental Technology Centre of AEA Technology. The NAEI does not cover all the sources required by the Intergovernmental Panel on Climate Change (IPCC), and it has been necessary to add these sources. Emissions and removals from land use change and forestry are provided by the Centre of Ecology and Hydrology (CEH) and agricultural emissions by the Ministry of Agriculture, Fisheries and Food (MAFF).

The content of the annual report has been expanded this year and there have been some changes in the layout compared to previous inventory reports. This report and the CRF tables have been prepared according to FCCC guidelines (FCCC/CP/1999/7) and are as far as possible consistent with IPCC Good Practice Guidance (IPCC, 2000).

This report is divided into two parts. The main part of the report presents greenhouse gas emissions for the years 1990-1999, and discusses the reasons for the trends and any changes in the estimates due to revisions made since the last inventory. Tables 1-10 give the UK summary data for these years and the IPCC Sectoral Tables are given for 1990 and 1999. The Appendices describe in detail the methodology of the estimates and how the Greenhouse Gas Inventory relates to the IPCC Guidelines and the NAEI. They contain mappings between IPCC, NAEI source categories and fuel types as well as emission factors and references to the technical literature. The scope of the Appendix has been expanded and includes more detail on the methodology and new section on quality assurance and quality control systems. For this reason the Appendix has been divided into nine appendices. The Good Practice Guidance (IPCC, 2000) requires that certain sets of activity data are reported as well as the Common Reporting Format Tables. These datasets are included on a CD ROM attached to this report.

The CRF reports much more detail than the IPCC Sectoral Tables, in that it contains additional tables of activity data as well as updated versions of the IPCC Sectoral Tables. Carbon dioxide is reported as net emissions (=emissions –removals) in the CRF whilst in the main part of this report, emissions and removals are reported separately. This means that the totals reported for CO_2 and total greenhouse gas emissions weighted by global warming potential are reported on a different basis between the CRF and the main report. A copy of the CRF accompanies this report on a CD ROM.

2 Summary Reports of UK Greenhouse Gas Emissions 1990-99

Tables 1-10 give summary data for UK greenhouse gas emissions for the years 1990-1999. These data are updated annually to reflect revisions in the methodology and the availability of new information. These adjustments are applied retrospectively to earlier years, which accounts for any differences in data published in previous reports.

Table 1: SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7A)

Submission 2001

1990

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		CO2 emissions	CO2 removals	CH4	N2O	HFCs		PFCs		SF6		NOx	CO	NMVOC
						P	A	P	A	P	A			
		(Gg)				CO2 equivalent (Gg)						(Gg)		
Total National Emissions and Removals	a	**602826**	**-10556**	**3670.3**	**216**	**41.77**	**11373.84**	**250.18**	**2281.00**	**0.11**	**0.03**	**2759**	**7154**	**2479**
1. Energy		**568692**		**1480.0**	**17.62**							**2732.1**	**6479.1**	**1520.0**
A. Fuel Combustion	Reference Approach	572762												
	Sectoral Approach	556554		119.8	17.31							2726.1	6408.0	1072.7
1. Energy Industries		228089		7.6	7.22							883.4	142.5	10.9
2. Manufacturing Industries and Construction		94578		11.7	3.79							278.7	511.7	30.1
3. Transport		116581		29.8	4.14							1389.1	5254.9	927.9
4. Other Sectors		112041		70.4	1.95							139.4	485.5	101.5
5. Other	b	5265		0.3	0.21							35.5	13.4	2.2
B. Fugitive Emissions from Fuels		12138		1360.2	0.30							6.0	71.1	447.3
1. Solid Fuels		3000		819.2	0.00							0.7	36.6	0.2
2. Oil and Natural Gas		9138		541.0	0.30							5.3	34.5	447.1
2. Industrial Processes		**14123**		**2.7**	**94.46**	**41.77**	**11373.84**	**250.18**	**2281.00**	**0.11**	**0.03**	**12.5**	**405.2**	**228.4**
A. Mineral Products		9555		0.0	0.00							0.0	0.0	9.8
B. Chemical Industry		1358		1.9	94.42	0.00	0.00	0.00	0.00	0.00	0.00	8.1	61.1	145.2
C. Metal Production		3210		0.8	0.04				2031.00		0.02	4.4	344.1	1.8
D. Other Production		IE										0.0	0.0	71.6
E. Production of Halocarbons and SF6							11373.17		0.00		0.00			
F. Consumption of Halocarbons and SF6	c					41.77	0.67	250.18	250.00	0.11	0.01			
G. Other		0		0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0
3. Solvent and Other Product Use	d	**0**			**0.00**									**684.1**
4. Agriculture		0		**1037.2**	**100.43**							9.1	266.0	35.0
A. Enteric Fermentation				913.2	0.00									0.0
B. Manure Management				111.3	5.11									0.0
C. Rice Cultivation				0.0	0.00									0.0
D. Agricultural Soils				0.0	95.07									0.0
E. Prescribed Burning of Savannas				0.0	0.00							0.0	0.0	0.0
F. Field Burning of Agricultural Residues	e			12.7	0.25							9.1	266.0	35.0
G. Other				0.0	0.00							0.0	0.0	0.0
5. Land-Use Change and Forestry	a	**19348**	**-10556**											
A. Changes in Forest and Other Woody Biomass Stocks	f		-9456											
B. Forest and Grassland Conversion		0												
C. Abandonment of Managed Lands		0	0											
D. CO2 Emissions and Removals from Soil	g	15439	0											
E. Other	hi	3908	-1100											
6. Waste		**663**		**1150.4**	**3.47**							**5.1**	**3.3**	**11.3**
A. Solid Waste Disposal on Land		0		1117.0	0.00							0.0	0.0	11.2
B. Wastewater Handling	j	0		33.4	3.33							0.0	0.0	0.0
C. Waste Incineration		663		0.0	0.13							5.1	3.3	0.1
D. Other		0		0.0	0.00							0.0	0.0	0.0
7. Other (please specify)		**0**	**0**	**0.0**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.0**	**0.0**	**0.0**
Memo Items: (7)														
International Bunkers	k	**21349**		**3.5**	**0.87**							**192.4**	**75.6**	**41.3**
Aviation	k	14791		**2.9**	**0.45**							**72.8**	**60.1**	**36.9**
Marine	k	6559		**0.6**	**0.42**							**119.6**	**15.5**	**4.4**
Multilateral Operations		**NO**		**NO**	**NO**							**NO**	**NO**	**NO**
CO2 Emissions from Biomass	kl	**3850**												

Table 2: SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7A)

Submission 2001

1991

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		CO2 emissions	CO2 removals	CH4	N2O	HFCs		PFCs		SF6		NOx	CO	NMVOC
						P	A	P	A	P	A			
		(Gg)				CO2 equivalent (Gg)						(Gg)		
Total National Emissions and Removals	a	**606739**	**-10666**	**3620.9**	**210**	**47.45**	**11858.80**	**233.33**	**1790.25**	**0.11**	**0.03**	**2634**	**6954**	**2414**
1. Energy		**574773**		**1485.5**	**17.89**							**2610.4**	**6332.8**	**1506.9**
A. Fuel Combustion	Reference Approach	589765												
	Sectoral Approach	565039		123.3	17.63							2605.6	6271.4	1055.1
1. Energy Industries		226050		8.4	7.22							788.9	141.1	10.9
2. Manufacturing Industries and Construction		95291		11.8	3.91							271.8	517.7	31.0
3. Transport		116051		29.4	4.28							1363.6	5093.0	906.7
4. Other Sectors		123373		73.6	2.03							147.7	508.9	104.5
5. Other	b	4272		0.2	0.18							33.7	10.8	1.9
B. Fugitive Emissions from Fuels		9734		1362.2	0.26							4.8	61.3	451.8
1. Solid Fuels		2300		838.3	0.00							0.5	33.9	0.2
2. Oil and Natural Gas		7434		523.9	0.26							4.3	27.4	451.6
2. Industrial Processes		**11769**		**2.4**	**88.51**	**47.45**	**11858.80**	**233.33**	**1790.25**	**0.11**	**0.03**	**11.1**	**390.6**	**218.4**
A. Mineral Products		8160		0.0	0.00							0.0	0.0	9.9
B. Chemical Industry		1358		1.9	88.48	0.00	0.00	0.00	0.00	0.00	0.00	7.3	62.8	135.0
C. Metal Production		2250		0.5	0.03				1557.10		0.02	3.8	327.8	1.7
D. Other Production		IE										0.0	0.0	71.8
E. Production of Halocarbons and SF6							11841.18		0.00		0.00			
F. Consumption of Halocarbons and SF6	c					47.45	17.62	233.33	233.15	0.11	0.01			
G. Other		0		0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0
3. Solvent and Other Product Use	d	**0**			**0.00**									**647.8**
4. Agriculture		0		**1021.7**	**99.92**							7.8	227.8	29.9
A. Enteric Fermentation				900.4	0.00									0.0
B. Manure Management				110.5	5.07									0.0
C. Rice Cultivation				0.0	0.00									0.0
D. Agricultural Soils				0.0	94.63									0.0
E. Prescribed Burning of Savannas				0.0	0.00							0.0	0.0	0.0
F. Field Burning of Agricultural Residues	e			10.8	0.21							7.8	227.8	29.9
G. Other				0.0	0.00							0.0	0.0	0.0
5. Land-Use Change and Forestry	a	**19535**	**-10666**											
A. Changes in Forest and Other Woody Biomass Stocks	f		-9566											
B. Forest and Grassland Conversion		0												
C. Abandonment of Managed Lands		0	0											
D. CO2 Emissions and Removals from Soil	g	15653	0											
E. Other	hi	3883	-1100											
6. Waste		**662**		**1111.3**	**3.43**							**5.1**	**3.2**	**10.9**
A. Solid Waste Disposal on Land		0		1080.0	0.00							0.0	0.0	10.8
B. Wastewater Handling	j	0		31.3	3.31							0.0	0.0	0.0
C. Waste Incineration		662		0.0	0.13							5.1	3.2	0.1
D. Other		0		0.0	0.00							0.0	0.0	0.0
7. Other (please specify)		**0**	**0**	**0.0**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.0**	**0.0**	**0.0**
Memo Items: (7)														
International Bunkers	k	**20909**		**3.3**	**0.85**							**187.5**	**73.3**	**40.1**
Aviation	k	14570		**2.7**	**0.45**							**71.9**	**58.3**	**35.8**
Marine	k	6340		**0.6**	**0.41**							**115.6**	**15.0**	**4.3**
Multilateral Operations		**NO**		**NO**	**NO**							**NO**	**NO**	**NO**
CO2 Emissions from Biomass	kl	**4008**												

Table 3: SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7A)

Submission 2001
1992

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		CO2 emissions	CO2 removals	CH4	N2O	HFCs		PFCs		SF6		NOx	CO	NMVOC
						P	A	P	A	P	A			
		(Gg)				CO2 equivalent (Gg)						(Gg)		
Total National Emissions and Removals	a	**591944**	**-10846**	**3528.1**	**187**	**112.23**	**12346.17**	**215.28**	**959.28**	**0.11**	**0.03**	**2555**	**6631**	**2312**
1. Energy		**560979**		**1442.5**	**18.05**							**2534.3**	**6083.6**	**1455.2**
A. Fuel Combustion	Reference Approach	578056												
	Sectoral Approach	551387		117.0	17.80							2529.8	6025.3	1014.0
1. Energy Industries		215977		9.9	6.92							774.5	137.2	10.7
2. Manufacturing Industries and Construction		93761		11.2	4.11							267.5	529.8	31.3
3. Transport		117504		28.5	4.73							1311.7	4875.6	871.4
4. Other Sectors		120077		67.2	1.88							144.6	472.3	98.8
5. Other	b	4068		0.2	0.17							31.5	10.3	1.8
B. Fugitive Emissions from Fuels		9592		1325.5	0.24							4.5	58.4	441.2
1. Solid Fuels		2178		803.9	0.00							0.5	30.9	0.2
2. Oil and Natural Gas		7414		521.7	0.24							4.1	27.5	441.1
2. Industrial Processes		**11159**		**2.3**	**71.61**	**112.23**	**12346.17**	**215.28**	**959.28**	**0.11**	**0.03**	**10.3**	**378.8**	**217.2**
A. Mineral Products		7619		0.0	0.00							0.0	0.0	10.1
B. Chemical Industry		1379		1.9	71.58	0.00	0.00	0.00	0.00	0.00	0.00	6.5	64.8	133.4
C. Metal Production		2161		0.5	0.03				744.70		0.02	3.8	314.1	1.7
D. Other Production		IE										0.0	0.0	72.0
E. Production of Halocarbons and SF6							12309.28		0.00		0.00			
F. Consumption of Halocarbons and SF6	c					112.23	36.88	215.28	214.58	0.11	0.01			
G. Other		0		0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0
3. Solvent and Other Product Use	d	**0**			**0.00**									**608.1**
4. Agriculture		0		**1017.5**	**94.30**							5.6	165.2	21.6
A. Enteric Fermentation				899.5	0.00									0.0
B. Manure Management				110.1	4.97									0.0
C. Rice Cultivation				0.0	0.00									0.0
D. Agricultural Soils				0.0	89.18									0.0
E. Prescribed Burning of Savannas				0.0	0.00							0.0	0.0	0.0
F. Field Burning of Agricultural Residues	e			7.9	0.16							5.6	165.2	21.6
G. Other				0.0	0.00							0.0	0.0	0.0
5. Land-Use Change and Forestry	a	**19173**	**-10846**											
A. Changes in Forest and Other Woody Biomass Stocks	f		-9746											
B. Forest and Grassland Conversion		0												
C. Abandonment of Managed Lands		0	0											
D. CO2 Emissions and Removals from Soil	g	15338	0											
E. Other	hi	3835	-1100											
6. Waste		**632**		**1065.8**	**3.47**							**4.9**	**3.2**	**10.4**
A. Solid Waste Disposal on Land		0		1031.0	0.00							0.0	0.0	10.3
B. Wastewater Handling	j	0		34.8	3.34							0.0	0.0	0.0
C. Waste Incineration		632		0.0	0.13							4.9	3.2	0.1
D. Other		0		0.0	0.00							0.0	0.0	0.0
7. Other (please specify)		**0**	**0**	**0.0**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.0**	**0.0**	**0.0**
Memo Items: (7)														
International Bunkers	k	**22761**		**3.6**	**0.92**							**200.7**	**79.6**	**43.6**
Aviation	k	16121		**3.0**	**0.49**							**79.6**	**63.9**	**39.1**
Marine	k	6640		**0.6**	**0.42**							**121.1**	**15.7**	**4.5**
Multilateral Operations		**NO**		**NO**	**NO**							**NO**	**NO**	**NO**
CO2 Emissions from Biomass	kl	**4295**												

Table 4: SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7A)

Submission 2001
1993

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		CO2 emissions	CO2 removals	CH4	N2O	HFCs		PFCs		SF6		NOx	CO	NMVOC
						P	A	P	A	P	A			
		(Gg)				CO2 equivalent (Gg)						(Gg)		
Total National Emissions and Removals	a	**576349**	**-11073**	**3380.4**	**176**	**446.59**	**12904.59**	**340.61**	**810.59**	**0.11**	**0.04**	**2361**	**6139**	**2208**
1. Energy		**546803**		**1349.0**	**18.64**							**2346.8**	**5746.4**	**1387.9**
A. Fuel Combustion	Reference Approach	561317												
	Sectoral Approach	537695		115.5	18.41							2342.5	5691.1	950.2
1. Energy Industries		199254		11.7	6.59							669.9	126.6	10.7
2. Manufacturing Industries and Construction		92363		11.2	3.84							264.4	513.7	30.4
3. Transport		118683		26.7	5.87							1233.4	4546.0	809.2
4. Other Sectors		123269		65.7	1.94							145.4	494.3	98.1
5. Other	b	4125		0.2	0.17							29.3	10.4	1.7
B. Fugitive Emissions from Fuels		9108		1233.5	0.23							4.4	55.3	437.7
1. Solid Fuels		1940		724.3	0.00							0.5	28.9	0.2
2. Oil and Natural Gas		7169		509.2	0.23							3.9	26.4	437.6
2. Industrial Processes		**11294**		**2.3**	**61.07**	**446.59**	**12904.59**	**340.61**	**810.59**	**0.11**	**0.04**	**9.5**	**385.4**	**212.2**
A. Mineral Products		7664		0.0	0.00							0.0	0.0	10.0
B. Chemical Industry		1379		1.9	61.04	0.00	0.00	0.00	0.00	0.00	0.00	5.6	66.2	127.7
C. Metal Production		2251		0.4	0.03				473.90		0.02	3.9	319.2	1.7
D. Other Production		IE										0.0	0.0	72.9
E. Production of Halocarbons and SF6							12778.30		0.00		0.00			
F. Consumption of Halocarbons and SF6	c					446.59	126.29	340.61	336.69	0.11	0.02			
G. Other		0		0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0
3. Solvent and Other Product Use	d	**0**			**0.00**									**597.5**
4. Agriculture		0		**1010.6**	**92.52**							0.1	3.5	0.5
A. Enteric Fermentation				899.6	0.00									0.0
B. Manure Management				110.8	4.99									0.0
C. Rice Cultivation				0.0	0.00									0.0
D. Agricultural Soils				0.0	87.53									0.0
E. Prescribed Burning of Savannas				0.0	0.00							0.0	0.0	0.0
F. Field Burning of Agricultural Residues	e			0.2	0.00							0.1	3.5	0.5
G. Other				0.0	0.00							0.0	0.0	0.0
5. Land-Use Change and Forestry	a	**17684**	**-11073**											
A. Changes in Forest and Other Woody Biomass Stocks	f		-9973											
B. Forest and Grassland Conversion		0												
C. Abandonment of Managed Lands		0	0											
D. CO2 Emissions and Removals from Soil	g	13897	0											
E. Other	hi	3787	-1100											
6. Waste		**568**		**1018.5**	**3.46**							**4.5**	**3.2**	**10.0**
A. Solid Waste Disposal on Land		0		984.0	0.00							0.0	0.0	9.8
B. Wastewater Handling	j	0		34.5	3.33							0.0	0.0	0.0
C. Waste Incineration		568		0.0	0.13							4.5	3.2	0.1
D. Other		0		0.0	0.00							0.0	0.0	0.0
7. Other (please specify)		**0**	**0**	**0.0**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.0**	**0.0**	**0.0**
Memo Items: (7)														
International Bunkers	k	**23814**		**3.7**	**0.95**							**205.3**	**82.2**	**45.2**
Aviation	k	17241		**3.1**	**0.53**							**85.5**	**66.7**	**40.8**
Marine	k	6573		**0.6**	**0.42**							**119.8**	**15.6**	**4.4**
Multilateral Operations		**NO**		**NO**	**NO**							**NO**	**NO**	**NO**
CO2 Emissions from Biomass	kl	**4447**												

Table 5: SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7A)

Submission 2001

1994

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		CO2 emissions	CO2 removals	CH4	N2O	HFCs		PFCs		SF6		NOx	CO	NMVOC
						P	A	P	A	P	A			
		(Gg)				CO2 equivalent (Gg)						(Gg)		
Total National Emissions and Removals	a	**572422**	**-11286**	**3068.0**	**190**	**2648.06**	**13813.85**	**588.72**	**979.73**	**0.11**	**0.04**	**2263**	**5846**	**2162**
1. Energy		**542850**		**1066.2**	**20.20**							**2249.7**	**5441.0**	**1350.7**
A. Fuel Combustion	Reference Approach	554789												
	Sectoral Approach	531563		102.2	19.89							2244.2	5376.7	885.4
1. Energy Industries		196560		12.9	6.85							637.1	132.8	11.9
2. Manufacturing Industries and Construction		93863		11.5	3.73							272.9	497.7	30.1
3. Transport		119042		25.3	7.39							1165.7	4288.2	756.3
4. Other Sectors		118154		52.3	1.77							141.0	448.1	85.5
5. Other	b	3945		0.2	0.16							27.5	10.0	1.6
B. Fugitive Emissions from Fuels		11286		964.0	0.31							5.6	64.3	465.3
1. Solid Fuels		1787		456.6	0.00							0.4	29.3	0.1
2. Oil and Natural Gas		9499		507.4	0.31							5.1	35.0	465.1
2. Industrial Processes		**12474**		**2.4**	**71.50**	**2648.06**	**13813.85**	**588.72**	**979.73**	**0.11**	**0.04**	**8.8**	**401.8**	**204.8**
A. Mineral Products		8449		0.0	0.00							0.0	0.0	10.2
B. Chemical Industry		1379		1.9	71.47	0.00	0.00	0.00	0.00	0.00	0.00	4.8	69.6	119.3
C. Metal Production		2646		0.6	0.03				406.20		0.03	4.0	332.2	1.7
D. Other Production		IE										0.0	0.0	73.5
E. Production of Halocarbons and SF6							13252.49		0.00		0.00			
F. Consumption of Halocarbons and SF6	c					2648.06	561.36	588.72	573.53	0.11	0.02			
G. Other		0		0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0
3. Solvent and Other Product Use	d	**0**			**0.00**									**596.6**
4. Agriculture		0		**1018.3**	**94.95**							0.0	0.0	0.0
A. Enteric Fermentation				906.6	0.00									0.0
B. Manure Management				111.7	5.06									0.0
C. Rice Cultivation				0.0	0.00									0.0
D. Agricultural Soils				0.0	89.89									0.0
E. Prescribed Burning of Savannas				0.0	0.00							0.0	0.0	0.0
F. Field Burning of Agricultural Residues	e			0.0	0.00							0.0	0.0	0.0
G. Other				0.0	0.00							0.0	0.0	0.0
5. Land-Use Change and Forestry	a	**16670**	**-11286**											
A. Changes in Forest and Other Woody Biomass Stocks	f		-10186											
B. Forest and Grassland Conversion		0												
C. Abandonment of Managed Lands		0	0											
D. CO2 Emissions and Removals from Soil	g	12811	0											
E. Other	hi	3859	-1100											
6. Waste		**428**		**981.0**	**3.45**							**4.2**	**2.7**	**9.6**
A. Solid Waste Disposal on Land		0		945.0	0.00							0.0	0.0	9.5
B. Wastewater Handling	i	0		36.0	3.35							0.0	0.0	0.0
C. Waste Incineration		428		0.0	0.10							4.2	2.7	0.1
D. Other		0		0.0	0.00							0.0	0.0	0.0
7. Other (please specify)		**0**	**0**	**0.0**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.0**	**0.0**	**0.0**
Memo Items: (7)														
International Bunkers	k	**24006**		**3.8**	**0.94**							**200.4**	**84.5**	**47.0**
Aviation	k	17856		**3.2**	**0.55**							**88.4**	**70.0**	**42.8**
Marine	k	6150		**0.6**	**0.39**							**112.1**	**14.5**	**4.2**
Multilateral Operations		**NO**		**NO**	**NO**							**NO**	**NO**	**NO**
CO2 Emissions from Biomass	kl	**4833**												

Table 6: SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7A)

Submission 2001
1995

GREENHOUSE GAS SOURCE AND SINK CATEGORIES			CO2 emissions	CO2 removals	CH4	N2O	HFCs		PFCs		SF6		NOx	CO	NMVOC
							P	A	P	A	P	A			
			(Gg)				CO2 equivalent (Gg)						(Gg)		
Total National Emissions and Removals		a	**563409**	**-11528**	**3053.5**	**182**	**4017.30**	**15205.03**	**753.81**	**1094.10**	**0.11**	**0.05**	**2090**	**5490**	**2037**
1. Energy			**534255**		**1097.9**	**21.41**							**2079.5**	**5077.3**	**1244.3**
A. Fuel Combustion	Reference Approach		553172												
	Sectoral Approach		525044		90.9	21.17							2073.8	5023.1	807.4
1. Energy Industries			197766		15.6	7.01							577.3	133.9	10.1
2. Manufacturing Industries and Construction			91653		11.8	3.61							254.3	473.4	28.8
3. Transport			117939		23.8	8.86							1077.1	4022.8	692.9
4. Other Sectors			113815		39.6	1.54							137.4	383.2	74.0
5. Other		b	3871		0.2	0.16							27.6	9.8	1.6
B. Fugitive Emissions from Fuels			9211		1006.9	0.23							5.8	54.2	436.9
1. Solid Fuels			1987		504.3	0.00							0.4	29.3	0.1
2. Oil and Natural Gas			7224		502.7	0.23							5.3	24.9	436.7
2. Industrial Processes			**12524**		**2.6**	**61.30**	**4017.30**	**15205.03**	**753.81**	**1094.10**	**0.11**	**0.05**	**6.2**	**410.6**	**221.0**
A. Mineral Products			8554		0.0	0.00							0.0	0.0	9.6
B. Chemical Industry			1379		1.9	61.27	0.00	0.00	0.00	0.00	0.00	0.00	1.9	73.2	135.5
C. Metal Production			2591		0.7	0.03				372.35		0.03	4.2	337.4	1.8
D. Other Production			IE										0.0	0.0	74.1
E. Production of Halocarbons and SF6								13959.75		0.00		0.00			
F. Consumption of Halocarbons and SF6		c					4017.30	1245.28	753.81	721.75	0.11	0.02			
G. Other			0		0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0
3. Solvent and Other Product Use		d	**0**			**0.00**									**562.2**
4. Agriculture			0		**1006.6**	**95.44**							0.0	0.0	0.0
A. Enteric Fermentation					896.8	0.00									0.0
B. Manure Management					109.9	5.01									0.0
C. Rice Cultivation					0.0	0.00									0.0
D. Agricultural Soils					0.0	90.43									0.0
E. Prescribed Burning of Savannas					0.0	0.00							NO	NO	NO
F. Field Burning of Agricultural Residues		e			0.0	0.00							0.0	0.0	0.0
G. Other					0.0	0.00							0.0	0.0	0.0
5. Land-Use Change and Forestry		a	**16215**	**-11528**											
A. Changes in Forest and Other Woody Biomass Stocks		f		-10428											
B. Forest and Grassland Conversion			0												
C. Abandonment of Managed Lands			0	0											
D. CO2 Emissions and Removals from Soil		g	12332	0											
E. Other		hi	3883	-1100											
6. Waste			**415**		**946.4**	**3.50**							**4.1**	**2.3**	**9.2**
A. Solid Waste Disposal on Land			0		912.0	0.00							0.0	0.0	9.1
B. Wastewater Handling		j	0		34.3	3.39							0.0	0.0	0.0
C. Waste Incineration			415		0.0	0.11							4.1	2.3	0.1
D. Other			0		0.0	0.00							0.0	0.0	0.0
7. Other (please specify)			**0**	**0**	**0.0**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.0**	**0.0**	**0.0**
Memo Items: (7)															
International Bunkers		k	**25611**		**4.0**	**1.01**							**214.6**	**89.0**	**49.4**
Aviation		k	19012		**3.4**	**0.58**							**94.3**	**73.4**	**44.9**
Marine		k	6599		**0.6**	**0.42**							**120.3**	**15.6**	**4.5**
Multilateral Operations			**NO**		**NO**	**NO**							**NO**	**NO**	**NO**
CO2 Emissions from Biomass		kl	**5223**												

Table 7: SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7A)

Submission 2001

1996

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		CO2 emissions	CO2 removals	CH4	N2O	HFCs		PFCs		SF6		NOx	CO	NMVOC
						P	A	P	A	P	A			
		(Gg)				CO2 equivalent (Gg)						(Gg)		
Total National Emissions and Removals	a	**582965**	**-11612**	**2983.6**	**188**	**5413.15**	**16290.29**	**658.00**	**905.30**	**0.10**	**0.05**	**2014**	**5466**	**1973**
1. Energy		**552636**		**1057.7**	**23.22**							**2004.6**	**5036.7**	**1200.3**
A. Fuel Combustion	Reference Approach	569955												
	Sectoral Approach	543636		94.9	22.98							1999.6	4982.6	763.9
1. Energy Industries		197683		17.5	7.27							530.3	132.1	10.9
2. Manufacturing Industries and Construction		92532		12.2	3.49							248.3	466.8	29.2
3. Transport		122571		22.6	10.39							1041.8	3982.1	644.6
4. Other Sectors		127060		42.4	1.67							151.5	391.9	77.6
5. Other	b	3789		0.2	0.16							27.6	9.6	1.6
B. Fugitive Emissions from Fuels		9000		962.9	0.25							5.1	54.1	436.4
1. Solid Fuels		1628		473.6	0.00							0.4	29.2	0.1
2. Oil and Natural Gas		7372		489.2	0.25							4.6	24.9	436.3
2. Industrial Processes		**13341**		**2.7**	**65.49**	**5413.15**	**16290.29**	**658.00**	**905.30**	**0.10**	**0.05**	**6.0**	**426.2**	**220.7**
A. Mineral Products		8787		0.0	0.00							0.0	0.0	8.5
B. Chemical Industry		1379		1.9	65.45	0.00	0.00	0.00	0.00	0.00	0.00	1.8	73.7	134.7
C. Metal Production		3174		0.8	0.03				297.88		0.03	4.2	352.5	1.8
D. Other Production		IE										0.0	0.0	75.7
E. Production of Halocarbons and SF6							14291.96		0.00		0.00			
F. Consumption of Halocarbons and SF6	c					5413.15	1998.32	658.00	607.42	0.10	0.02			
G. Other		0		0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0
3. Solvent and Other Product Use	d	**0**			**0.00**									**543.0**
4. Agriculture		0		**1015.9**	**95.98**							0.0	0.0	0.0
A. Enteric Fermentation				905.1	0.00									0.0
B. Manure Management				110.9	5.09									0.0
C. Rice Cultivation				0.0	0.00									0.0
D. Agricultural Soils				0.0	90.90									0.0
E. Prescribed Burning of Savannas				0.0	0.00							0.0	0.0	0.0
F. Field Burning of Agricultural Residues	e			0.0	0.00							0.0	0.0	0.0
G. Other				0.0	0.00							0.0	0.0	0.0
5. Land-Use Change and Forestry	a	**16581**	**-11612**											
A. Changes in Forest and Other Woody Biomass Stocks	f		-10512											
B. Forest and Grassland Conversion		0												
C. Abandonment of Managed Lands		0	0											
D. CO2 Emissions and Removals from Soil	g	12816	0											
E. Other	hi	3766	-1100											
6. Waste		**407**		**907.3**	**3.62**							**3.7**	**2.9**	**8.8**
A. Solid Waste Disposal on Land		0		872.0	0.00							0.0	0.0	8.7
B. Wastewater Handling	j	0		35.3	3.51							0.0	0.0	0.0
C. Waste Incineration		407		0.0	0.11							3.7	2.9	0.1
D. Other		0		0.0	0.00							0.0	0.0	0.0
7. Other (please specify)		**0**	**0**	**0.0**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.0**	**0.0**	**0.0**
Memo Items: (7)														
International Bunkers	k	**27447**		**4.2**	**1.08**							**231.9**	**94.7**	**52.3**
Aviation	k	20238		**3.5**	**0.62**							**100.5**	**77.6**	**47.4**
Marine	k	7210		**0.7**	**0.46**							**131.5**	**17.1**	**4.9**
Multilateral Operations		**NO**		**NO**	**NO**							**NO**	**NO**	**NO**
CO2 Emissions from Biomass	kl	**5477**												

Table 8: SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7A)

Submission 2001

1997

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		CO2 emissions	CO2 removals	CH4	N2O	HFCs		PFCs		SF6		NOx	CO	NMVOC
						P	A	P	A	P	A			
		(Gg)				CO2 equivalent (Gg)						(Gg)		
Total National Emissions and Removals	a	**558016**	**-11557**	**2890.9**	**194**	**7272.00**	**18446.80**	**494.74**	**661.24**	**0.10**	**0.05**	**1843**	**5182**	**1871**
1. Energy		**529070**		**1022.4**	**24.56**							**1835.7**	**4746.0**	**1126.9**
A. Fuel Combustion	Reference Approach	539193												
	Sectoral Approach	520790		94.1	24.36							1831.3	4696.1	701.8
1. Energy Industries		183604		20.6	7.33							452.8	101.7	10.2
2. Manufacturing Industries and Construction		92667		12.7	3.42							248.1	468.8	29.1
3. Transport		123631		21.2	11.88							960.6	3746.2	586.4
4. Other Sectors		117276		39.4	1.58							141.6	370.3	74.5
5. Other	b	3613		0.2	0.15							28.2	9.1	1.6
B. Fugitive Emissions from Fuels		8280		928.3	0.21							4.4	49.9	425.1
1. Solid Fuels		1968		445.6	0.00							0.4	29.2	0.1
2. Oil and Natural Gas		6312		482.7	0.21							4.0	20.7	425.0
2. Industrial Processes		**12616**		**2.6**	**67.02**	**7272.00**	**18446.80**	**494.74**	**661.24**	**0.10**	**0.05**	**6.4**	**434.2**	**207.9**
A. Mineral Products		9616		0.0	0.00							0.0	0.0	8.0
B. Chemical Industry		888		1.9	66.99	0.00	0.00	0.00	0.00	0.00	0.00	2.1	75.0	121.2
C. Metal Production		2112		0.7	0.03				236.95		0.03	4.3	359.2	1.9
D. Other Production		IE										0.0	0.0	76.9
E. Production of Halocarbons and SF6							15642.29		0.00		0.00			
F. Consumption of Halocarbons and SF6	c					7272.00	2804.51	494.74	424.29	0.10	0.02			
G. Other		0		0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0
3. Solvent and Other Product Use	d	**0**			**0.00**									**527.7**
4. Agriculture		0		**1003.7**	**98.90**							0.0	0.0	0.0
A. Enteric Fermentation				893.0	0.00									0.0
B. Manure Management				110.7	5.03									0.0
C. Rice Cultivation				0.0	0.00									0.0
D. Agricultural Soils				0.0	93.87									0.0
E. Prescribed Burning of Savannas				0.0	0.00							0.0	0.0	0.0
F. Field Burning of Agricultural Residues	e			0.0	0.00							0.0	0.0	0.0
G. Other				0.0	0.00							0.0	0.0	0.0
5. Land-Use Change and Forestry	a	**16330**	**-11557**											
A. Changes in Forest and Other Woody Biomass Stocks	f		-10457											
B. Forest and Grassland Conversion		0												
C. Abandonment of Managed Lands		0	0											
D. CO2 Emissions and Removals from Soil	g	12655	0											
E. Other	hi	3675	-1100											
6. Waste		**0**		**862.2**	**3.57**							**0.8**	**1.7**	**8.3**
A. Solid Waste Disposal on Land		0		826.0	0.00							0.0	0.0	8.3
B. Wastewater Handling	j	0		36.2	3.50							0.0	0.0	0.0
C. Waste Incineration		0		0.0	0.06							0.8	1.7	0.1
D. Other		0		0.0	0.00							0.0	0.0	0.0
7. Other (please specify)		**0**	**0**	**0.0**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.0**	**0.0**	**0.0**
Memo Items: (7)														
International Bunkers	k	**29617**		**4.5**	**1.18**							**254.1**	**101.6**	**55.9**
Aviation	k	21552		**3.8**	**0.66**							**107.0**	**82.5**	**50.4**
Marine	k	8064		**0.7**	**0.52**							**147.1**	**19.1**	**5.5**
Multilateral Operations		**NO**		**NO**	**NO**							**NO**	**NO**	**NO**
CO2 Emissions from Biomass	kl	**5761**												

Table 9: SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7A)

Submission 2001

1998

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		CO2 emissions	CO2 removals	CH4	N2O	HFCs		PFCs		SF6		NOx	CO	NMVOC
						P	A	P	A	P	A			
		(Gg)				CO2 equivalent (Gg)						(Gg)		
Total National Emissions and Removals	a	**560253**	**-11528**	**2762.7**	**188**	**8607.30**	**20182.62**	**500.64**	**651.74**	**0.11**	**0.05**	**1732**	**4958**	**1738**
1. Energy		**531332**		**942.1**	**26.33**							**1724.7**	**4513.3**	**1027.5**
A. Fuel Combustion	Reference Approach	546626												
	Sectoral Approach	523367		95.5	26.13							1720.5	4464.2	643.4
1. Energy Industries		188985		22.7	7.82							453.8	106.5	8.6
2. Manufacturing Industries and Construction		89806		12.4	3.24							238.7	459.9	28.9
3. Transport		122767		19.7	13.38							862.8	3527.5	528.5
4. Other Sectors		118627		40.5	1.56							143.6	362.3	76.0
5. Other	b	3181		0.2	0.13							21.7	8.1	1.3
B. Fugitive Emissions from Fuels		7966		846.6	0.20							4.3	49.1	384.2
1. Solid Fuels		1688		372.3	0.00							0.5	29.0	0.1
2. Oil and Natural Gas		6277		474.3	0.20							3.8	20.1	384.0
2. Industrial Processes		**12397**		**2.5**	**59.45**	**8607.30**	**20182.62**	**500.64**	**651.74**	**0.11**	**0.05**	**5.9**	**441.0**	**193.0**
A. Mineral Products		9631		0.0	0.00							0.0	0.0	7.8
B. Chemical Industry		1111		1.9	59.42	0.00	0.00	0.00	0.00	0.00	0.00	2.1	76.0	104.7
C. Metal Production		1656		0.6	0.03				223.41		0.03	3.9	365.0	1.8
D. Other Production		IE										0.0	0.0	78.7
E. Production of Halocarbons and SF6							16532.71		0.00		0.00			
F. Consumption of Halocarbons and SF6	c					8607.30	3649.91	500.64	428.33	0.11	0.02			
G. Other		0		0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0
3. Solvent and Other Product Use	d	**0**			**0.00**									**509.9**
4. Agriculture		0		**1006.9**	**98.44**							0.0	0.0	0.0
A. Enteric Fermentation				895.0	0.00									0.0
B. Manure Management				111.8	5.03									0.0
C. Rice Cultivation				0.0	0.00									0.0
D. Agricultural Soils				0.0	93.42									0.0
E. Prescribed Burning of Savannas				0.0	0.00							NO	NO	NO
F. Field Burning of Agricultural Residues	e			0.0	0.00							0.0	0.0	0.0
G. Other				0.0	0.00							0.0	0.0	0.0
5. Land-Use Change and Forestry	a	**16523**	**-11528**											
A. Changes in Forest and Other Woody Biomass Stocks	f		-10428											
B. Forest and Grassland Conversion		0												
C. Abandonment of Managed Lands		0	0											
D. CO2 Emissions and Removals from Soil	g	12997	0											
E. Other	hi	3527	-1100											
6. Waste		**0**		**811.2**	**3.64**							**1.0**	**3.3**	**7.9**
A. Solid Waste Disposal on Land		0		774.0	0.00							0.0	0.0	7.7
B. Wastewater Handling	j	0		37.2	3.50							0.0	0.0	0.0
C. Waste Incineration		0		0.1	0.15							1.0	3.3	0.2
D. Other		0		0.0	0.00							0.0	0.0	0.0
7. Other (please specify)		**0**	**0**	**0.0**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.0**	**0.0**	**0.0**
Memo Items: (7)														
International Bunkers	k	**32910**		**4.8**	**1.30**							**280.4**	**110.9**	**60.9**
Aviation	k	24122		**4.0**	**0.74**							**120.2**	**90.1**	**55.0**
Marine	k	8788		**0.8**	**0.56**							**160.2**	**20.8**	**5.9**
Multilateral Operations		**NO**		**NO**	**NO**							**NO**	**NO**	**NO**
CO2 Emissions from Biomass	kl	**6118**												

Table 10: SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7A)

Submission 2001

1999

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		CO2 emissions	CO2 removals	CH4	N2O	HFCs		PFCs		SF6		NOx	CO	NMVOC
						P	A	P	A	P	A			
		(Gg)				CO2 equivalent (Gg)						(Gg)		
Total National Emissions and Removals	a	**547800**	**-11539**	**2630.8**	**138**	**9653.09**	**6205.55**	**541.23**	**678.19**	**0.11**	**0.05**	**1602**	**4757**	**1565**
1. Energy		**518049**		**874.2**	**27.55**							**1594.5**	**4305.1**	**920.1**
A. Fuel Combustion	Reference Approach	541095												
	Sectoral Approach	509917		108.6	27.35							1590.5	4263.7	598.0
1. Energy Industries		179116		32.8	7.80							422.2	94.4	10.3
2. Manufacturing Industries and Construction		88668		12.0	3.31							225.2	476.0	29.2
3. Transport		121576		18.4	14.68							784.5	3312.4	477.8
4. Other Sectors		117421		45.2	1.43							135.7	373.0	79.4
5. Other	b	3136		0.2	0.13							22.9	7.9	1.3
B. Fugitive Emissions from Fuels		8132		765.6	0.20							4.0	41.4	322.1
1. Solid Fuels		2242		310.9	0.00							0.4	27.4	0.1
2. Oil and Natural Gas		5891		454.7	0.20							3.6	14.0	321.9
2. Industrial Processes		**13480**		**2.6**	**11.79**	**9653.09**	**6205.55**	**541.23**	**678.19**	**0.11**	**0.05**	**6.0**	**448.5**	**165.8**
A. Mineral Products		9136		0.0	0.00							0.0	0.0	7.7
B. Chemical Industry		1108		1.9	11.76	0.00	0.00	0.00	0.00	0.00	0.00	2.3	78.8	77.5
C. Metal Production		3237		0.7	0.03				209.87		0.03	3.7	369.7	1.7
D. Other Production		IE										0.0	0.0	78.9
E. Production of Halocarbons and SF6							1926.51		0.00		0.00			
F. Consumption of Halocarbons and SF6	c					9653.09	4279.04	541.23	468.32	0.11	0.02			
G. Other		0		0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0
3. Solvent and Other Product Use	d	**0**			**0.00**									**471.6**
4. Agriculture		0		**1001.8**	**95.40**							0.0	0.0	0.0
A. Enteric Fermentation				892.4	0.00									0.0
B. Manure Management				109.5	5.15									0.0
C. Rice Cultivation				0.0	0.00									0.0
D. Agricultural Soils				0.0	90.25									0.0
E. Prescribed Burning of Savannas				0.0	0.00							NO	NO	NO
F. Field Burning of Agricultural Residues	e			0.0	0.00							0.0	0.0	0.0
G. Other				0.0	0.00							0.0	0.0	0.0
5. Land-Use Change and Forestry	a	**16271**	**-11539**											
A. Changes in Forest and Other Woody Biomass Stocks	f		-10439											
B. Forest and Grassland Conversion		0												
C. Abandonment of Managed Lands		0	0											
D. CO2 Emissions and Removals from Soil	g	12663	0											
E. Other	hi	3608	-1100											
6. Waste		**0**		**752.1**	**3.62**							**1.1**	**3.7**	**7.3**
A. Solid Waste Disposal on Land		0		716.0	0.00							0.0	0.0	7.2
B. Wastewater Handling	i	0		36.0	3.45							0.0	0.0	0.0
C. Waste Incineration		0		0.1	0.17							1.1	3.7	0.2
D. Other		0		0.0	0.00							0.0	0.0	0.0
7. Other (please specify)		**0**	**0**	**0.0**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.0**	**0.0**	**0.0**
Memo Items: (7)														
International Bunkers	k	**31896**		**4.9**	**1.19**							**243.1**	**110.5**	**62.5**
Aviation	k	25539		**4.3**	**0.79**							**127.3**	**95.4**	**58.2**
Marine	k	6357		**0.6**	**0.41**							**115.9**	**15.0**	**4.3**
Multilateral Operations		**NO**		**NO**	**NO**							**NO**	**NO**	**NO**
CO2 Emissions from Biomass	kl	**7000**												

Footnotes for Tables 1 to 10

a) Net flux may be estimated as the sum of emissions and removals
b) Naval vessels and military aircraft
c) Emissions arise from refrigeration, electronics applications, electrical insulation, foams, aerosols and training shoes
d) The CO_2 equivalent of solvent NMVOC (excluding 3C) is 1644 Gg in 1990 and 1136 Gg in 1999
e) Field burning ceased in 1993
f) 5A Removals include removals to forest litter and to forest products
g) 5D Emissions include removals to soils due to set aside of arable land and emissions due to liming
h) 5E Emissions include emissions from soils due to upland drainage, lowland drainage and peat extraction
i) 5E Removals are increases in crop biomass
j) Emissions from own wastewater treatment by industry are not estimated
k) Emissions are for information only and are not totalled
l) Emissions arise from wood, straw, biogases and poultry litter combustion for energy production

3 UK Emissions of Carbon Dioxide

3.1 INTRODUCTION

The major source of carbon dioxide in the UK is fossil fuel combustion. The UK CO_2 emission estimates use an emission factor for each fuel which were determined by fuel analysis. This is consistent with the IPCC (1997) methodology, though some uncertainty is introduced because the carbon content of some fuels may vary (by a few per cent) over time. Fuel consumption data are from the Digest of UK Energy Statistics (DTI, 2000) which is compatible with the IEA system of international energy statistics (though there are some small differences in reporting conventions), and has a similar level of uncertainty. Some additional imprecision is introduced because of uncertainties in CO_2 emissions from sources other than fuel combustion, though these make up around 4 per cent of the CO_2 inventory. The uncertainty in the 1995 total was estimated by analysing the uncertainties in each main source using a statistical simulation (Eggleston *et al*, 1998). A similar approach was applied to the 1999 inventory giving an overall uncertainty for carbon dioxide emissions of ±2.1-2.6%. (See Appendix 8.)

Some carbon dioxide emissions, however, arise from biological sources that can also act as sinks because of the role of carbon dioxide in photosynthesis. Hence it is necessary to decide whether a source is a net emitter, part of the carbon cycle or indeed a net sink. IPCC (1997) specifies guidelines for the treatment of such sources and sinks. For example the category Land Use Change and Forestry contains both emissions and removals. For transparency, both emissions and removals are reported in the tables in this report. This differs from the format used in the Common Reporting Format where net emissions are reported. Other examples include carbon dioxide emissions from sewage, which are excluded from the inventory since almost all of carbon dioxide from this source comes originally from uptake by plants and is therefore part of the natural carbon cycle. In the case of waste disposal, the issue is complex as the carbon content of waste can be from both fossil and recent sources: plastics are an example of a source of old carbon since they are normally made from fossil fuels, and crop residues are an example of recent carbon. Hence estimates have been made of the amounts of recent carbon in waste and the associated emissions excluded from the inventory.

3.2 DEVELOPMENT OF THE METHODOLOGY

The methodology of these estimates is described in Appendices 1-7. There have been a number of changes in the methodology since the 1998 Inventory was published (Salway, 2000). Overall emissions have been revised downwards by 12649 Gg CO_2. Comparisons between the inventories refer to the year 1998 and the main changes are:

1) Fuel Combustion
   - There has been a significant reduction in emissions of CO_2 (972 Gg) from Petroleum Refining in 1998. The consumption of liquid petroleum gas (LPG) and other petroleum gas (OPG) which was previously classified as petroleum refining (1A1b) has been reclassified as offshore own gas use (1A1c) because it has become clear that the consumption takes place in terminals and not refineries. The emissions data for the

offshore sector already includes the combustion of natural gas liquids as fuel as well as natural gas. Hence this reclassification has resulted in the removal of a double count and a reduction in total UK emissions.

- The emission factor used for LPG has been revised downwards by about 9%. This was because the old factor appeared too high compared with industry data on propane and butane, the major constituents of LPG. The new factor is based on an 80%/20% mixture of propane and butane. The effect of the change will be to reduce emissions by 336 Gg CO_2.
- There have been substantial increases in emissions in the manufacturing and construction sector (1A2) predominantly due to the revisions of consumption of natural gas in the energy statistics (DTI, 2000) by iron and steel, other industry and autogeneration. There have also been minor revisions in the consumption of other fuels, including a small increase in the estimated consumption of petrol by off-road industrial machinery. Overall there has been a net emission increase of 1227 Gg CO_2 in this sector.
- A decrease in emissions of 132 Gg CO_2 in the road transport sector can be attributed to a transfer of petrol and DERV to the off-road vehicle categories in manufacturing and construction (1A2f), residential (1A4a) and agriculture (1A4c). This results from new data on the sales of off-road machinery (Off Highway Research, 2000)
- Emissions in the residential sector have increased by 332 Gg CO_2. This is due largely to revisions in the energy statistics, in particular an increase in residential combustion of anthracite.
- There has been a small decrease in Naval Shipping emissions due to a revision in marine diesel oil combustion.

2) Industrial Processes
   - There has been a small change to the methodology used for cement production. The emission factor has been increased by 2% to account for kiln dust losses (IPCC, 2000). This has resulted in an extra 127 Gg CO_2 in 1998.
   - There has been a significant decrease in CO_2 emissions (495 Gg) from the Iron and Steel Industry due to revisions of the amount of coke used in blast furnaces and the amount of blast furnace gas produced. (DTI, 2000).
3) Land Use and Forestry
   - There has been a large reduction of 9989 Gg CO_2 in emissions from the category 5D CO_2 Emissions and Removals from Soils. This is a consequence of revisions to the size and rate constants used for modelling changes in soil carbon after land use change.

All changes to the methodologies have been applied to all years of the inventory (1990 to 1999).

3.3 DISCUSSION OF THE ESTIMATES

Figure 1 shows emissions of carbon dioxide for the years 1990-1999 broken down by major IPCC source category. Emissions have shown a steady decline since 1990 and are currently lower by around 9% than 1990 levels.

Analysing emissions by source shows that emissions from energy industries contribute to 33% of total CO_2 emissions. This sector has seen a decline in emissions of 22% between 1990 and 1999. The major components of this sector are electricity generation, refineries, offshore gas consumption and manufacture of solid fuel and coke. Since the privatisation of the power

industry in 1990, there has been a move away from coal and oil generation towards nuclear and combined cycle gas turbines (CCGT). Over this period there has been only a modest increase of around 11% in the amount of electricity generated† but a large decrease in CO_2 emissions from power stations of around 30% due to:

(i) The greater efficiency of the CCGT stations compared with conventional stations - around 47% as opposed to 36%.

(ii) The calorific value of natural gas per unit mass carbon being higher than that of coal and oil.

(iii) The proportion of nuclear generated electricity supplied increasing from 21% to 28%.✦

The contribution from other components is much smaller. Emissions from refineries have increased over the period whilst those from the solid fuel transformation industries have declined.

Emissions from industry have also decreased between 1990 and 1999 by around 6%. This compares with a 1% decrease in energy consumption (excluding electricity and non-energy use of fuel) by industry (DTI, 2000) suggesting an overall improvement in emission per unit energy consumption.

Emissions from transport have increased by 4.3% since 1990. Transport emissions are dominated by the contribution from road transport. This rose by 5% over the period. Petrol usage has declined by around 11.5% since 1990, but this was offset by increased use of diesel fuel in cars as well as trucks.

The main components of 1A4 Other Sectors are residential and commercial/institutional. Residential emissions have increased by 8 % since 1990. However they fluctuate from year to year and probably reflect average temperatures. The fuel consumption shows a trend away from coal towards oil and natural gas. Overall emissions from the commercial/institutional sector have decreased throughout the period by approximately 2%. Again gas use has increased with coal and oil usage declining. Overall, emissions from this sector have increased by 4%.

Emissions from military aircraft and naval vessels declined over the period.

Land Use Change and Forestry differ from other categories in that they contain both sources and sinks of carbon dioxide. The removals are plotted as a negative quantity in Figure 1 and are reported separately from emissions in the inventory tables. Emissions from land use change and forestry were around 3% of the UK Total in 1999 and are declining gradually. Removals from land use change have decreased by 9% since 1990 and in magnitude are 2% of the UK Total Emission.

International bunker emissions (international aviation and shipping) are not included in the National Total but are reported separately. For the UK they are around 6% of the National Total. The shipping emission shows little variation up to 1998 but exhibits a marked fall

† Electricity generated by Major Power Producers, DTI (2000)
✦ Electricity supplied (gross) by Major Power Producers, DTI (2000)

between 1998 to 1999 due to reduced fuel oil consumption. It accounts for 20% of bunker emissions in 1999. The remainder is air traffic and this has risen by approximately 73% since 1990.

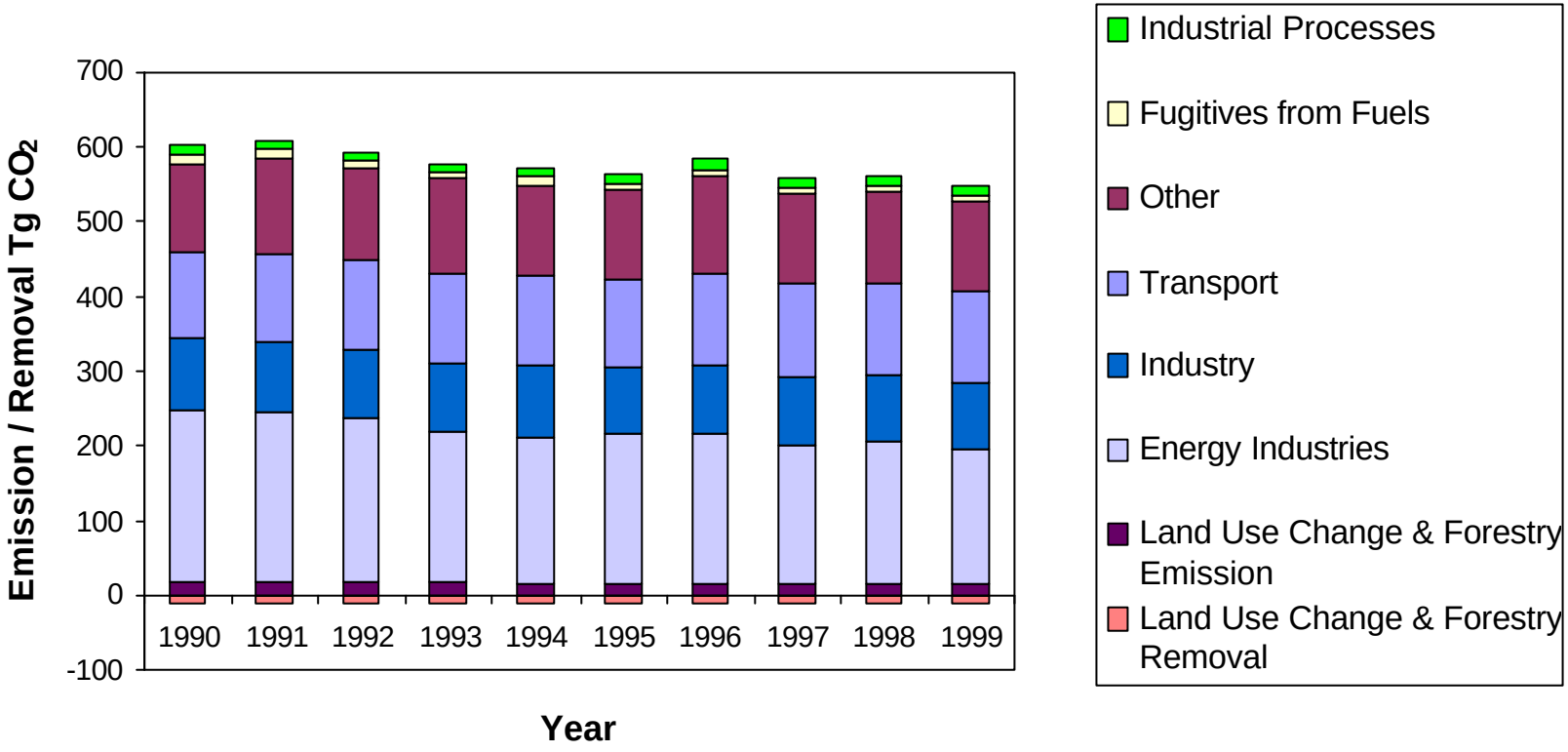
3.4 THE IPCC REFERENCE CARBON DIOXIDE INVENTORY

Summary Table 7B includes the IPCC Reference Inventory total for carbon dioxide. This is a 'top-down' inventory calculated from national statistics on production, imports, exports and stock changes of fossil fuels. All other Sectoral Tables report emissions of pollutants estimated using a 'bottom-up' approach with emissions estimated from activity statistics (mostly fuel consumption) in the various economic sectors and processes.

In principle the IPCC Reference Total is comparable to the Table 1A total plus the fuel consumption emissions in 1B1 Solid Fuel Transformation and 2 Industrial Processes. However, the IPCC Reference approach produces totals that are 2-5% higher than the comparable sources estimated by the 'bottom-up' approach, largely because it is based on a different set of statistics. Reasons for the discrepancies between the two estimates are discussed in Appendix 2. Over the period, emissions estimated by the Reference Approach have fallen by 5.5% compared with 8.4 % for the comparable 'bottom-up' totals.

A detailed comparison between the IPCC Reference Inventory, the UK Greenhouse Gas Inventory and a UK Inventory based on the IPCC Default Methodology is given by Salway (1998a).

Figure 1: UK Emissions and Removals of Carbon Dioxide



4 UK Emissions of Methane

4.1 INTRODUCTION

Methane is the second most important greenhouse gas after carbon dioxide. Unlike most of the other major pollutants in the Greenhouse Gas Inventory, fuel combustion is not the predominant source of methane. The major sources are waste disposal, coal mining, leakage from the gas distribution system and agriculture. Estimation of methane emissions is generally more uncertain than for CO_2 from combustion sources and the methodologies are subject to change as further research is undertaken. An estimate has been made of the overall uncertainty in methane emissions based on the uncertainties in the major sources. This showed that the overall uncertainty was around 20 %. A more detailed discussion of the approach used is given in Appendix 8.

4.2 DEVELOPMENT OF THE METHODOLOGY

A number of changes have been made to the methane estimates since the 1998 Inventory (Salway, 2000). Overall emissions have been revised upwards by 127 Gg CH_4. Comparisons between the inventories refer to the year 1998 and the main changes are:

1) Fuel combustion
   - There has been a small increase in emissions (1 Gg) from residential coal combustion (1A4b) due to revisions in the consumption of coal, anthracite and coke. (DTI, 2000).
2) Fugitive emissions from fuels
   - There has been a significant increase in emissions (101 Gg) from deep mines (1B1). This is due to the use of new emission factors based on measurements carried out by the industry. The new factors have been applied to the years 1993-99.
   - The emissions from coke production (1B1) have decreased by 7 Gg due to a revision of the emission factor used based on advice from British Steel/Corus.
   - There has been a revision to the inventory to include an oil and gas venting category (1B2c). This change does not affect overall emission totals but merely reports more detail.
   - Gas leakage accounts for a small increase (8 Gg) in CH_4 emissions. The increase in emissions is due to a new set of estimates provided by Transco for 1997 to 1999.
3) Industrial Processes
   - A new source has been added to report process emissions from the chemical industry. This accounts for around 2 Gg and is based on data reported in the Pollution Inventory (Environment Agency, 2000)
4) Agriculture
   - An increase in emissions of 12 Gg has arisen predominantly due to enteric fermentation. in cattle. This has resulted from a revision in the population of beef and other non-dairy cattle.
5) Wastewater Handling
   - There has been a small increase in emissions (2 Gg) reported for domestic and commercial wastewater treatment (6B). The revision arises from changes in the assumed

production of sewage sludge per head in the UK. Previous estimates were based on 1995 data, but the new estimates allow for a small increase since 1995.

The methodology of the estimates is discussed in Appendices 1-7. Any methodological changes have been applied where appropriate to all years from 1990.

4.3 DISCUSSION OF THE ESTIMATES

The emissions of methane from the UK are shown in Figure 2. Total emissions are declining and have fallen by 28% since 1990.

The largest source of methane emissions in the UK is agriculture, which includes enteric fermentation emissions from livestock and emissions from their wastes. Dairy cattle are the most significant source in this sector. Since 1990, cattle emissions have fallen by 4%. The decline reflects a reduction in dairy cattle numbers during this period.

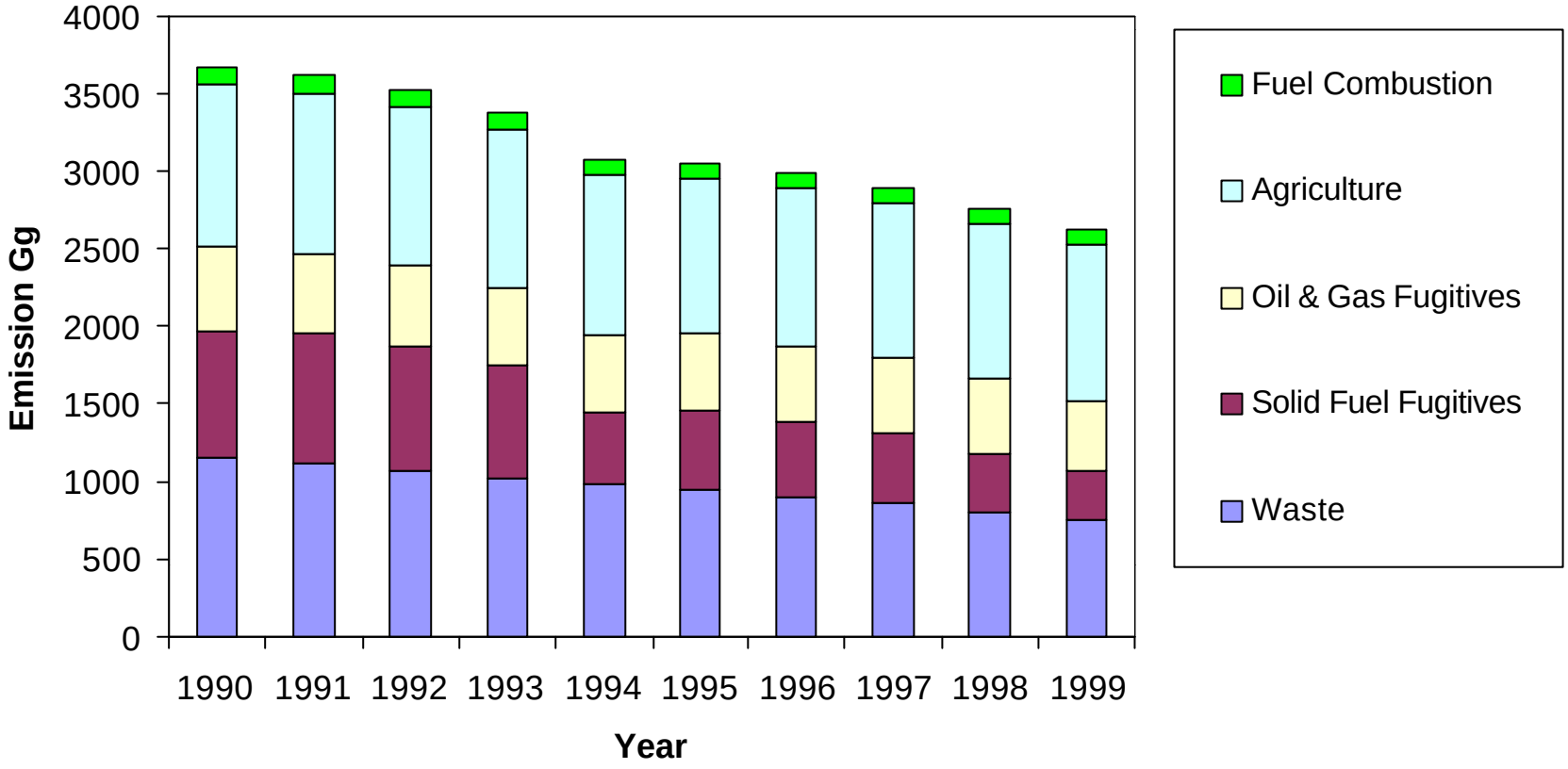
The second largest component of the total methane emission is waste. This comprises landfills, waste water treatment and waste incineration. Waste water treatment emissions are small compared with landfill, and incineration is negligible. Waste water emissions depend on the mode of disposal: sea dumping, land spreading or incineration. The sewage sludge disposed of in landfills is allocated to the landfill estimate. Emissions are likely to rise as a result of the EC Urban Waste Water Treatment Directive but the rate of increase will depend on disposal routes adopted. The UK ceased dumping sewage at sea in 1998.

The largest single source of emissions in the waste category is landfills and it is also the most uncertain. Estimates are derived from the amount of putrescible waste disposed of to landfill, and are based on a model of the kinetics of anaerobic digestion involving four classifications of landfill site. The model accounts for the effects of methane recovery, utilization and flaring. Methane emissions from landfill have declined by 36% since 1990, because of the implementation of methane recovery systems. This trend is likely to continue as all new landfill sites are required to have these systems and many existing sites may have systems retrofitted. However, uncertainties are great and the overall methane estimate from landfill maybe subject to revision as more information becomes available.

Emissions from 1B2 Oil and Natural Gas have fallen by 16% over the period 1990 to 1999. Sources include leakage from the gas transmission and distribution system and offshore emissions. Estimates of leakage from the gas distribution system are based on leakage measurements made by Transco together with data on their gas main replacement programme, and have declined since 1990 as old mains are replaced. The major sources of emissions from the offshore oil and gas industry are venting, fugitive emissions, loading and flaring from offshore platforms. Emissions are estimated on the basis of a survey of operators by SCOPEC (2000). Other emissions in the oil and gas industries arise from fuel oil and gas combustion, but these are reported as energy emissions in category 1A1c.

The emission of methane from coal mining is the fourth largest component of the total UK emission. Emissions have fallen by 62% due to a general decline in coal production.

Figure 2: UK Emissions of Methane



5 UK Emissions of Nitrous Oxide

5.1 INTRODUCTION

Emissions of nitrous oxide are uncertain because there are many small sources, both natural and anthropogenic, and detailed emission factors for some man-made sources, (e.g. combustion) are not yet available. The main anthropogenic sources are agriculture, biomass burning, coal combustion and some industrial processes.

5.2 DEVELOPMENT OF THE METHODOLOGY

A number of changes have been made in the methodology used for the emission estimates since the 1998 Inventory (Salway, 2000). Overall emissions have been revised upwards by 7 Gg N_2O. Comparisons between the inventories refer to the year 1998 and the main changes are:

1) Fuel Combustion
   - There have been small decreases in emissions due to a revision in the emission factor used for MSW based on data in IPCC (2000). The change is not significant.
   - There has been a small increase in N_2O emissions (0.9 Gg) due to a revision in the emission factor used for offshore gas usage. The new factor is based on data provided by SCOPEC (2000).
   - There has been a small increase in N_2Oemissions due to a revision in the emission factor used for offshore flaring. The new factor is based on data provided by SCOPEC (2000).
2) Agriculture
   - There have been increased emissions of 3 Gg from the category 4D Agricultural soils as a result of revisions to the data on the use of synthetic fertilizers.
3) Wastewater handling
   - There has been an increase in emissions (3 Gg) from domestic and commercial wastewater treatment (6B). This arises from a correction to the protein consumption data used in these estimates.

The methodology of the estimates is discussed in Appendices 1 to 7. Any methodological changes have been applied where appropriate to all years from 1990.

5.3 DISCUSSION OF THE ESTIMATES

UK Emissions of nitrous oxide have declined by around 36% over the period 1990 to 1999. Emissions are very uncertain with an estimated mean emission of 138 Gg in 1999 within a range of 33 Gg to 532 Gg. (See Appendix 8). Emissions are dominated by agriculture, which accounted for 69% of the total in 1999. Agricultural emissions arise from a number of sources:

- Cultivation of legumes
- Synthetic fertilizer application
- Crop residues

- Histosols
- Improved grass
- Wastes from grazing animals
- Manure used as fertilizer
- Animal waste management systems
- Leaching
- Atmospheric deposition of NH_3 and NO_x
- Field Burning (Discontinued in 1993)

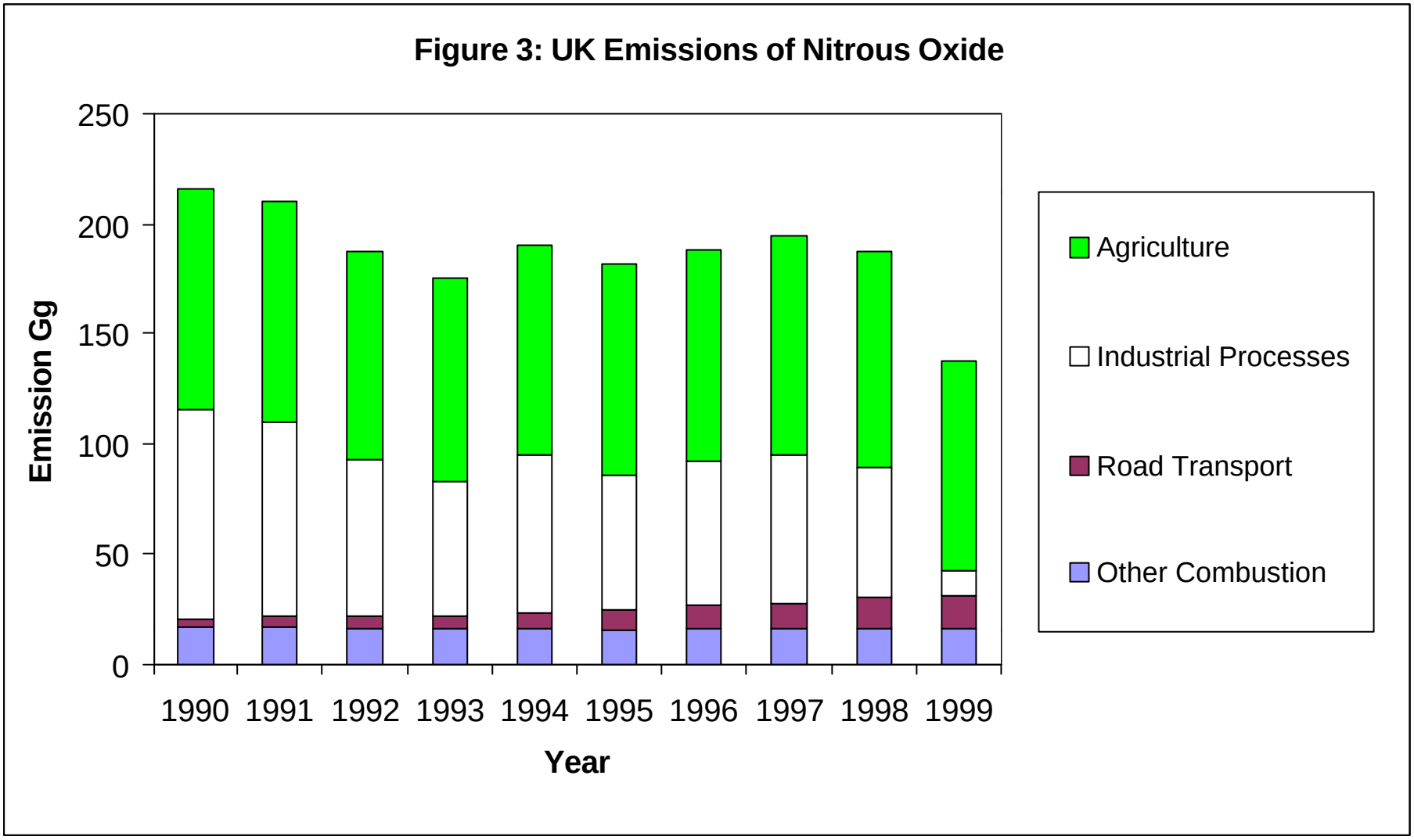
Emissions from agriculture have declined by 5% over the period 1990 to 1999 driven by a slight fall in synthetic fertilizer application over the period. Agricultural stubble burning was discontinued in England and Wales in 1993 resulting in a slight decrease in the agricultural emission.

The next largest source is from fuel combustion (20%). These emissions mainly arise from solid fuel combustion, electricity generation and road traffic. Emissions from road transport are increasing as a result of the increasing numbers of petrol driven cars fitted with three way catalytic converters. The contribution from petrol vehicles has risen by a factor of 4 since 1990, because cars with catalytic converters produce significantly larger emissions of nitrous oxide than uncontrolled cars. Catalytic converters are used to reduce emissions of nitrogen oxides, carbon monoxide and non-methane volatile organic compounds but a by-product is increased nitrous oxide emissions. The contribution of road transport to the total in 1999 was 10%.

There has been a large decline in N_2O emissions from industrial sources. Emissions fell by 88% between the years 1990 and 1999. This is because of reductions in emissions from adipic acid manufacture (a feedstock for nylon) and nitric acid production. The emissions from nitric acid manufacture show a fall in 1995 due to the installation of an abatement system at one of the plants. Emissions from adipic acid manufacture fell notably in 1998 and 1999 as a result of the retrofitting of an emissions abatement system.

Unlike other pollutants, the nitrous oxide emission from public power shows little variation over the period 1990 to 1999 in spite of the trend away from coal towards natural gas combustion. The emission factor for gas combustion is similar to that for coal combustion so no particular trend is apparent. However, these estimates are uncertain because there is very limited data on N_2O emissions from large gas turbines. Public power emissions are around 4.5 % of the total.

Figure 3: UK Emissions of Nitrous Oxide



6 UK Emissions of Hydrofluorocarbons, Perfluorocarbons and Sulphur Hexafluoride

6.1 INTRODUCTION

This chapter discusses the emissions of:

- hydrofluorocarbons (HFCs)
- perfluorocarbons (PFCs)
- sulphur hexafluoride (SF_6)

HFCs and PFCs are used mainly as substitutes for chlorofluorocarbons (CFC) and hydrochlorofluorocarbons (HCFC) which are being phased out under the Montreal Protocol because they deplete the ozone layer. A detailed description of the usage, emission estimates and the methodology used to derive the emissions of these gases is given in MCG (1999).

The UK reports both actual and potential emissions of these gases.

- Actual emissions are estimates of the emission of a gas to atmosphere in a given year.
- Potential emissions are estimated as the apparent consumption of fluid in a given year. (IPCC, 1997). Apparent consumption is based on data on annual production, imports, exports and destruction of fluid. Hence, it is assumed that the entire emission occurs in the year of use and neglects leakage over the lifetime of a piece of equipment.

In this chapter, only actual emissions are discussed. Potential emissions provide a convenient benchmark to compare emissions between countries and are simpler to estimate but do not include emissions arising from metal or halocarbon production. Potential emissions have been revised in the 1999 Inventory. The new estimates include a correction to account for the consumption of fluid required to replace the losses from the fluid bank contained in equipment. Also the new estimates include data on disposals and recycling. The estimation of potential emissions in the UK is discussed in Appendix 4.

Emissions of individual halocarbon species are not reported individually because some of these are considered commercially sensitive data within the industries involved. Consequently, emissions data have been aggregated to protect this information. The total global warming potential of the aggregated emissions is reported based on actual global warming potential of the individual fluids.

6.2 HYDROFLUOROCARBONS

Figure 4 shows the UK emissions of in terms of their global warming potential (GWP). The HFC emissions comprise many species each with its own GWP, hence it is more helpful to express emissions in terms of GWP as CO_2 equivalents. This allows the relative influence of sectors on Global Warming to be compared. This approach differs from previous reports where mass emissions were quoted. Eggleston *et al* (1998) estimated the uncertainty in the emissions as ± 25% in 1990. HFCs had limited usage prior to the phase out of CFCs, in the production of semiconductors and as refrigerants blended with CFCs. They are now being used increasingly as:

- substitutes for CFCs and HCFCs in domestic, commercial and industrial refrigeration and air conditioning
- substitutes for CFCs and HCFCs in plastic foam blowing
- substitutes for CFCs for industrial and specialist aerosols
- substitutes for CFCs for medical dose inhalers (MDI)
- firefighting fluids

Emissions of HFCs, increased between 1990 to 1998 but rapidly declined in 1999 to 45% of 1990 levels. Prior to 1999, halocarbon production was the largest source of HFCs. However, refrigeration is now the largest source of HFCs and contributes 45% of the total. Here emissions arise due to leakage from refrigeration and air conditioning equipment during its manufacture and lifetime. Fugitive emissions from the manufacture of halocarbons accounted for 31% of the total HFC emissions in 1999. Emissions in 1999 from this sector fell dramatically because of an HFC destruction system was fitted to the HCFC plant. Aerosols contribute approximately 23% to the total emission, and here it is assumed that all the fluid is emitted in the year of manufacture. The category aerosols includes mainly industrial aerosols and also medical use in metered dose inhalers. The remaining emission sources, namely, foams and fire fighting are very small and only comprise 1.6% of total emissions.

6.3 PERFLUOROCARBONS

Figure 5 shows the UK emissions of PFCs in terms of their GWP. Eggleston *et al* (1998) estimated the uncertainty in the emissions as ± 19% in 1990. PFCs had limited usage prior to the phase out of CFCs in the electronics and electrical industry in:

- etching processes in the semiconductor industry
- chemical vapour deposition in the electronics industry
- soldering processes
- leak testing of electrical components
- cooling electrical components, for example in super computers and radar systems.

Other significant uses include:
- refrigerant blended with HFC
- fire fighting in specialist applications
- cushioning in the soles of training shoes

Other minor uses were in cosmetics and as a tracer gas.
The main sources of PFCs are from the electronics industry and leakage from the soles of training shoes. Together these accounted for 64% of emissions in 1999.

PFCs also form as a by-product during aluminium smelting and this contributes around 31% of the UK GWP total of PFC emissions in 1999. The emissions are caused by the anode effect which occurs when alumina concentrations become too low in the smelter. This can cause very high electrical current and decomposition of the salt - fluorine bath. The fluorine released then reacts with the carbon anode, creating CF_4 and C_2F_6. Emissions from aluminium production have fallen by 89% since 1990 due to significant improvements in process control and an increase in the rate of aluminium recycling. Emissions from refrigeration, fire fighting and fugitives from PFC production are very small and together account for around 5% of emissions.

6.4 SULPHUR HEXAFLUORIDE

Figure 6 shows the UK emissions of SF_6 in terms of its GWP. One tonne of sulphur hexafluoride is equivalent to 23900 tonnes of carbon dioxide in its effect on global warming. Eggleston *et al* (1998) estimated the uncertainty in the emissions as ± 13% in 1990. It has the following applications:

- insulation medium in high voltage applications such as switch gear and circuit breakers
- cover gas in magnesium foundries to protect the molten magnesium from re-oxidising when it is cast
- degasser in aluminium casting applications, though its use in the UK is rather limited
- insulating gas in double glazing applications, replacing vacuum as an insulation technique
- plasma etching of polysilicon and nitrite surfaces
- atmospheric tracer for scientific studies
- cushioning in the soles of training shoes

Emissions of sulphur hexafluoride have increased by a factor of 1.8 between 1990 and 1999. The largest source is from magnesium manufacture which accounted for 55% of the UK total in 1999. It is not possible to recover the SF_6 so the total annual consumption is emitted to atmosphere. Another main source is electrical insulation accounting for 16% of emissions in 1999. Emissions arise during the manufacture and filling of the circuit breakers and from leakage and maintenance during the equipment lifetime. This application has only been in use for the last 20 to 30 years and little of the equipment has been decommissioned. It is expected that users will take great care over future fluid recovery so that emissions will be minimised. The remaining sources are emissions from applications in the electronics industry and training shoes (30%).

Figure 4: UK Emissions of Hydrofluorocarbons

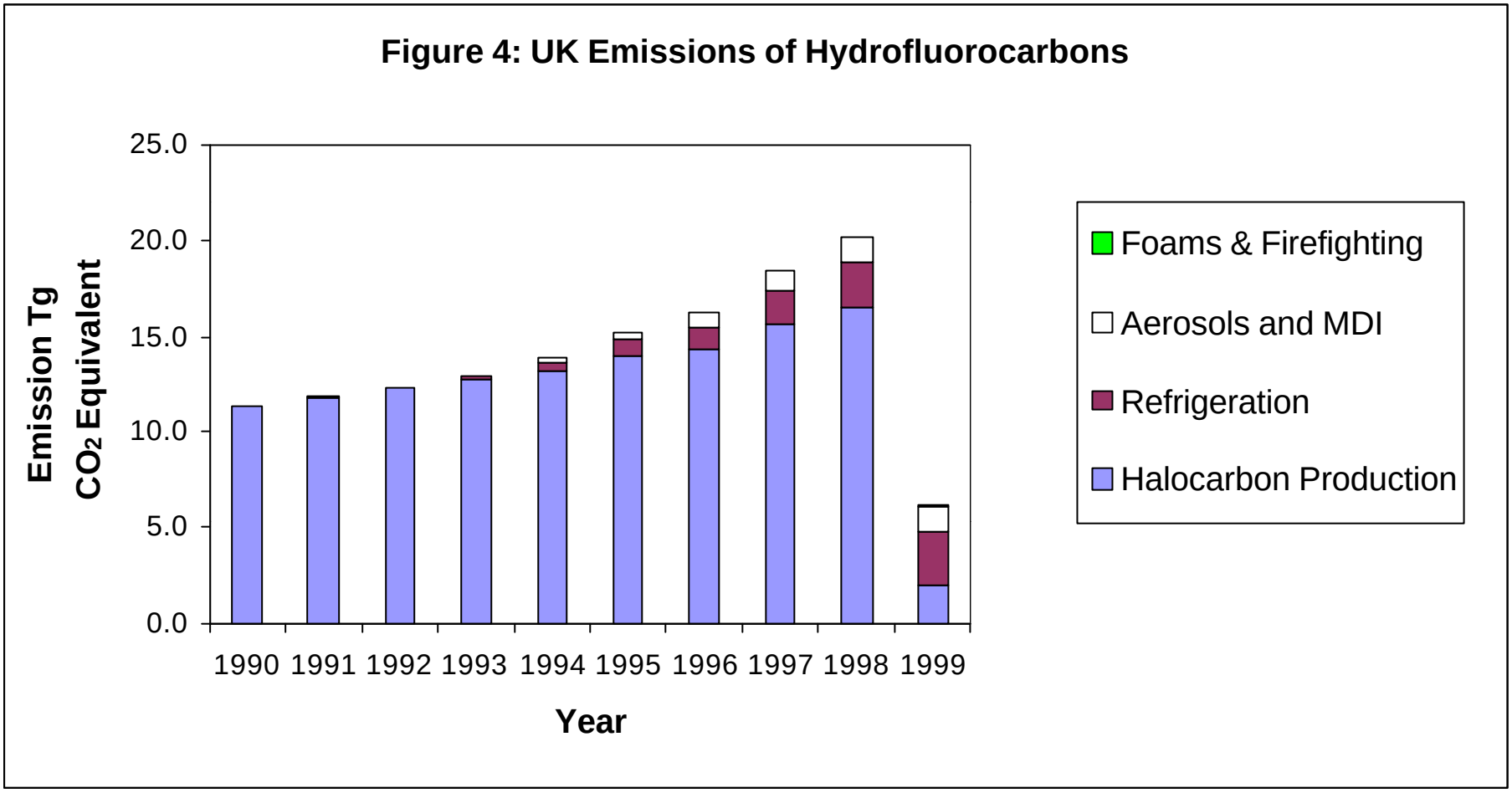


Figure 5: UK Emissions of Perfluorocarbons

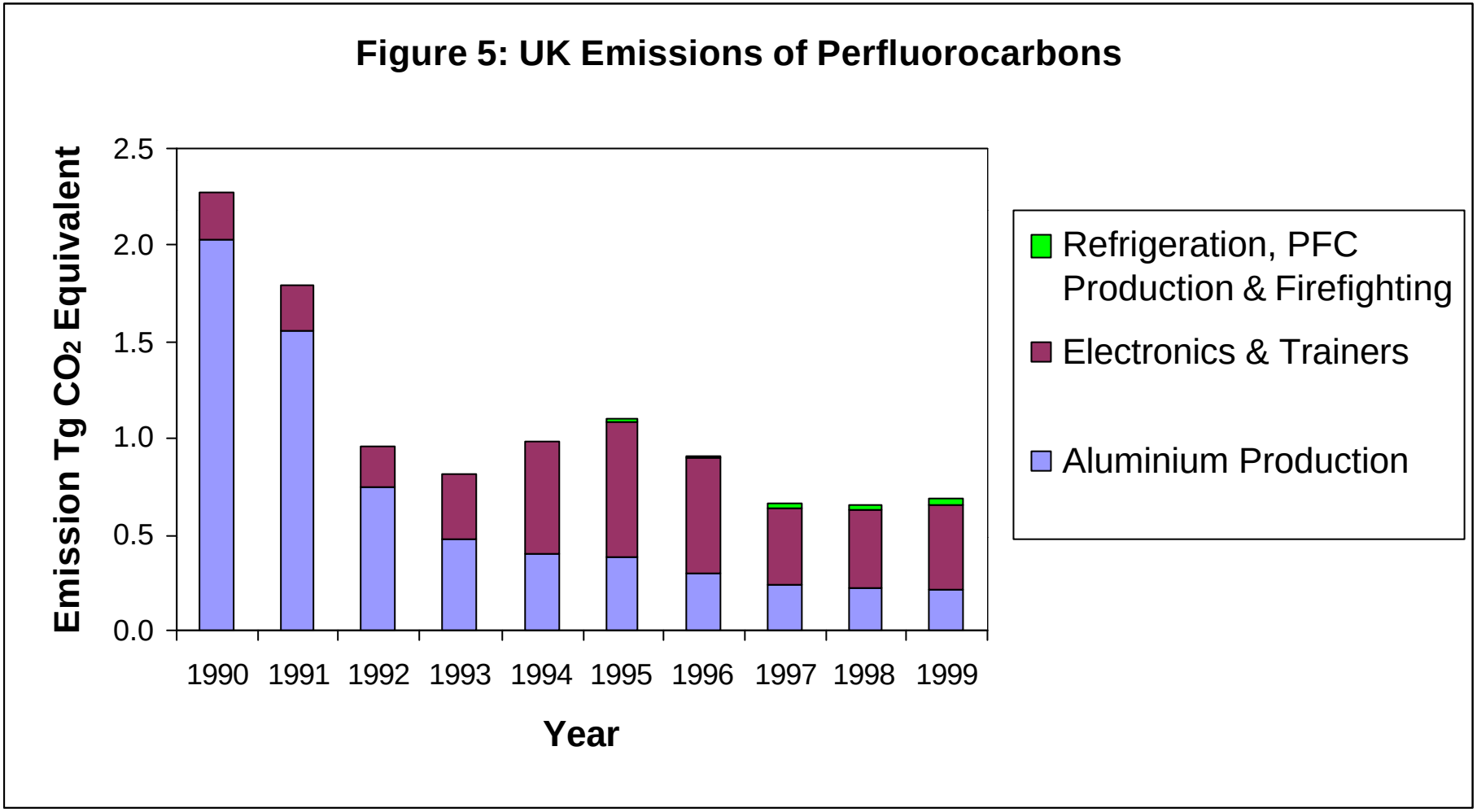
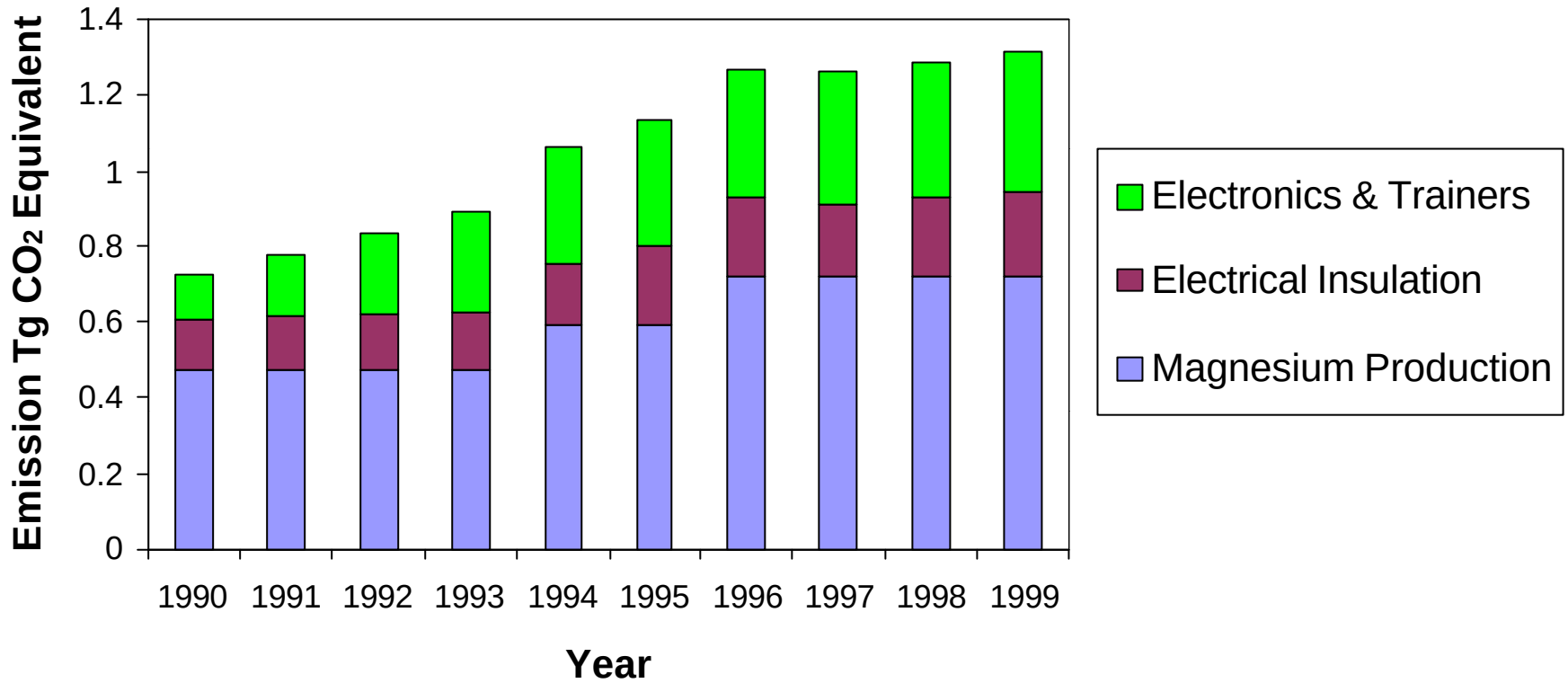


Figure 6: UK Emissions of Sulphur Hexafluoride



7 UK Emissions of Nitrogen Oxides

7.1 INTRODUCTION

The main source of NO_x ($NO + NO_2$) in the UK is fuel combustion. However, such emissions are complex since the nitrogen can be derived from both the fuel and the combustion air. Emissions are also dependent on the conditions of combustion, in particular on the temperature and excess air ratio, which can vary considerably. Thus combustion conditions, load and even state of maintenance are important. The estimation of NO_x emissions is often based on relatively few measurements and, in view of the possible variation in emissions from apparently similar combustion plant, there is greater uncertainty in the estimates than for CO_2. It is estimated that the uncertainty in total NO_x emissions is about ±30%.

7.2 DEVELOPMENT OF THE METHODOLOGY

A number of changes to the methodology have been made since the 1998 Inventory (Salway, 2000). Overall emissions have been revised downward by 19 Gg NO_x in 1998. Comparisons between the inventories refer to the year 1998 and the main changes are:

These are:

1) Fuel Combustion
   - There has been a decrease in emissions of NO_x of 15 Gg from refineries predominantly due to the reclassification of some OPG and LPG to offshore terminals (see Chapter 3) and a revision in the emission factors used for refinery large combustion plant to reflect the use of low NO_x burners.
   - There have also been increases in emissions (16 Gg) in the manufacturing and construction sector (1A2). This is attributed mostly to the revision in the population estimates of off road machinery. This has resulted in a reallocation of petrol from the road transport category (1A3b) and also diesel oil from other manufacturing industry. The emission factors from off-road machinery are higher than those for stationary combustion and road vehicles so there is an overall increase in emissions of around 12 Gg NO_x. The remainder of the increase results from revisions in the energy statistics (DTI, 2000) particularly for coal and natural gas consumption.
   - Emissions due to road transport have decreased by 12 Gg. This decrease can be attributed to revisions in vehicle kilometre data used in these estimates
   - There has also been a small increase in emissions from off-road agricultural power units. This results from a revision in the population data used in these estimates.
   - The decrease in emissions from military aircraft of 12 Gg is due to the revision of the emission factors used. The new factors are appropriate to military jets rather than civilian aircraft as used previously.
2) Industrial Processes
   - There has been a small increase in emissions (1.4 Gg) from metal production. This arises from small revisions in electric arc steel furnaces, nitric acid production and aluminium production based on data provided by the plant operators and the Environment Agency.

3) Waste Incineration
   - There has been a small increase in emissions (1 Gg) from a combination of sources including sewage-sludge combustion, cremation and clinical waste incineration. Cremation and clinical incineration are new sources and account for 0.7 Gg NO_x. The remainder of the increase arises from a revision in the amount of sewage sludge incinerated

7.3 DISCUSSION OF THE ESTIMATES

Figure 7 shows the UK emissions of nitrogen oxides (as nitrogen dioxide) broken down into source categories.

Since 1990, total emissions have fallen by 42% mainly as a result of abatement measures on power stations, three-way catalytic converters fitted to cars and stricter emission regulations on trucks.

The main source of nitrogen oxide emissions is road transport. Other forms of transport are included with road transport in Figure 4 but are small in comparison. From 1970, emissions from road transport increased (especially during the 1980s) and reached a peak in 1989, before falling by around 44% since 1990. The total road vehicle kilometres in 1999 were 14% higher than in 1990. Hence the reduction in emissions is due to the requirement for new cars to be fitted with catalytic converters and stricter regulations on truck emissions.

Emissions from off-road sources are reported in the sectors in which they occur, namely, 1A2 Manufacturing Industry, 1A3 Other Transport, 1A4b Residential and 1A4c Agriculture. Emissions from machinery used in agriculture, construction, industry, gardening and aircraft support have declined over the period but contribute around 5% of the current total.

Over the period 1990 to 1999, emissions from 1A1 Energy Industries fell by approximately 53%. The main reason for this was a fall in emissions from power stations of around 57%. Since 1988, the electricity generators adopted a programme of progressively fitting low NO_x burners to their 500 MWe coal fired units. Since 1990, further changes in the electricity supply industry such as the increased use of nuclear generation and the introduction of CCGT plant (see Section 2.3) have resulted in additional reductions in NO_x emissions.

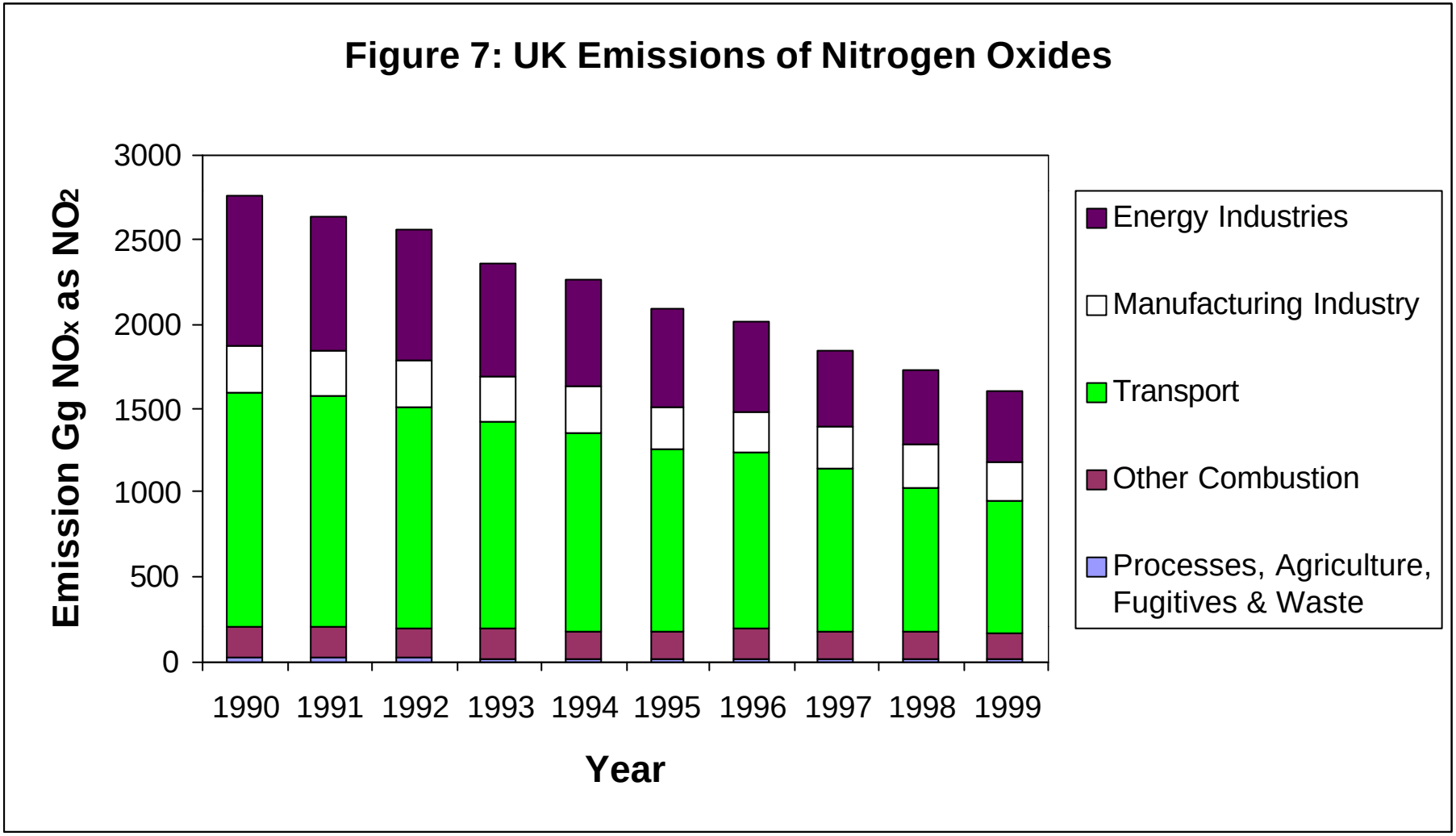
Combustion emissions from industry fell by 19% from 1990 to 1999. This is a result of a slight fall in energy consumption and the switch from coal and oil to natural gas.

Fugitive emissions from 1B2 Oil and Natural Gas have fallen by 31% over the period 1990 to 1999. Most of this is flaring.

Emissions from Other Sectors combustion increased between 1990 and 1998 but declined in 1999 to levels 2.6% below 1990 levels. There is probably little significance in this, since emissions from the main component sectors; residential and commercial/institutional fluctuate from year to year depending on energy consumption. This varies with annual temperature variations. The only discernible trends are a decline in coal use and an increase in natural gas use.

International bunker emissions are not included in the National Total but are reported separately. For the UK they are around 15% of the National Total. Unlike other years, aviation emissions are now the major component of this sector and they accounted for 52% of bunker emissions in 1999. Between 1990 and 1999, emissions of nitrogen oxides from air traffic rose by 75%. However, emissions from marine bunkers increased between 1990 to 1998, but then fell in 1999 to around 3% below 1990 levels. This was due to a decrease in consumption of fuel oil in 1998.

Figure 7: UK Emissions of Nitrogen Oxides



8 UK Emissions of Carbon Monoxide

8.1 INTRODUCTION

Carbon monoxide (CO) arises from incomplete fuel-combustion. In 1999, 64% of emissions came from petrol-engined road vehicles. Many of the comments about the uncertainty of the emission estimates of nitrogen oxides also apply to carbon monoxide and the overall uncertainty in emissions of carbon monoxide is currently estimated to be ±40%.

8.2 DEVELOPMENT OF THE METHODOLOGY

A number of changes have been made to the methodology since the 1998 Inventory (Salway, 2000). Overall emissions have been revised upwards by 202 Gg CO in 1998. Comparisons between the inventories refer to the year 1998 and the main changes are:

1) Fuel Combustion
   - A revision in the population estimates of off-road machinery (1A2f) has resulted in an increase in emissions in manufacturing and construction. The increase in emissions is around 51 Gg.
   - The road transport emissions have increased by 27 Gg due to revisions in the vehicle kilometre statistics used in the road transport model.
   - There has been a significant increase in CO emissions (49 Gg) from the residential sector (1A4b). This is predominantly due to a revision in the population estimates of gardening machinery. Other smaller changes result from revisions in the consumption of solid fuels.
   - There has been a small increase in emissions from military aircraft (3 Gg) due to revisions in the emission factors used. The new factors are appropriate to military jets rather than civilian aircraft as used previously.
2) Industrial Processes
   - There has been a new source added to the inventory to take into account emissions of CO (76 Gg) from the chemical industry. The estimate is based on data reported in the Pollution Inventory (Environment Agency, 2000)
   - A net decrease (20 Gg) in emissions from metal production (2C1) has occurred. This arises from revisions in emissions from electric arc furnaces and basic oxygen furnaces made as a result of revised data on the iron and steel industry. (Environment Agency, 2000). There has also been a small revision (+6 Gg) to sinter plant reported in 1A2a. Emissions from aluminium production have been revised downwards by 4 Gg based on plant operators' data. In addition some new sources are included for other non-ferrous metal processes accounting for an extra 2 Gg. (Environment Agency, 2000)
3) Waste Incineration
   - There has been also been a small increase in emissions (2 Gg) from a combination of sources including sewage-sludge combustion, cremation and clinical waste incineration. Cremation and clinical incineration are new sources and account for 0.4 Gg CO. The remainder of the increase arises from a revision in the amount of sewage sludge incinerated

8.3 DISCUSSION OF THE ESTIMATES

National emissions of carbon monoxide are shown disaggregated into the main IPCC source categories in Figure 8. Since 1990, total emissions of carbon monoxide have fallen by 34%. The most important source is road transport where emissions have fallen by 37% due primarily to the increased use of catalytic converters, although a proportion is a consequence of fuel switching from petrol cars to diesel cars. The other significant reduction is the cessation of agricultural stubble burning in 1993.

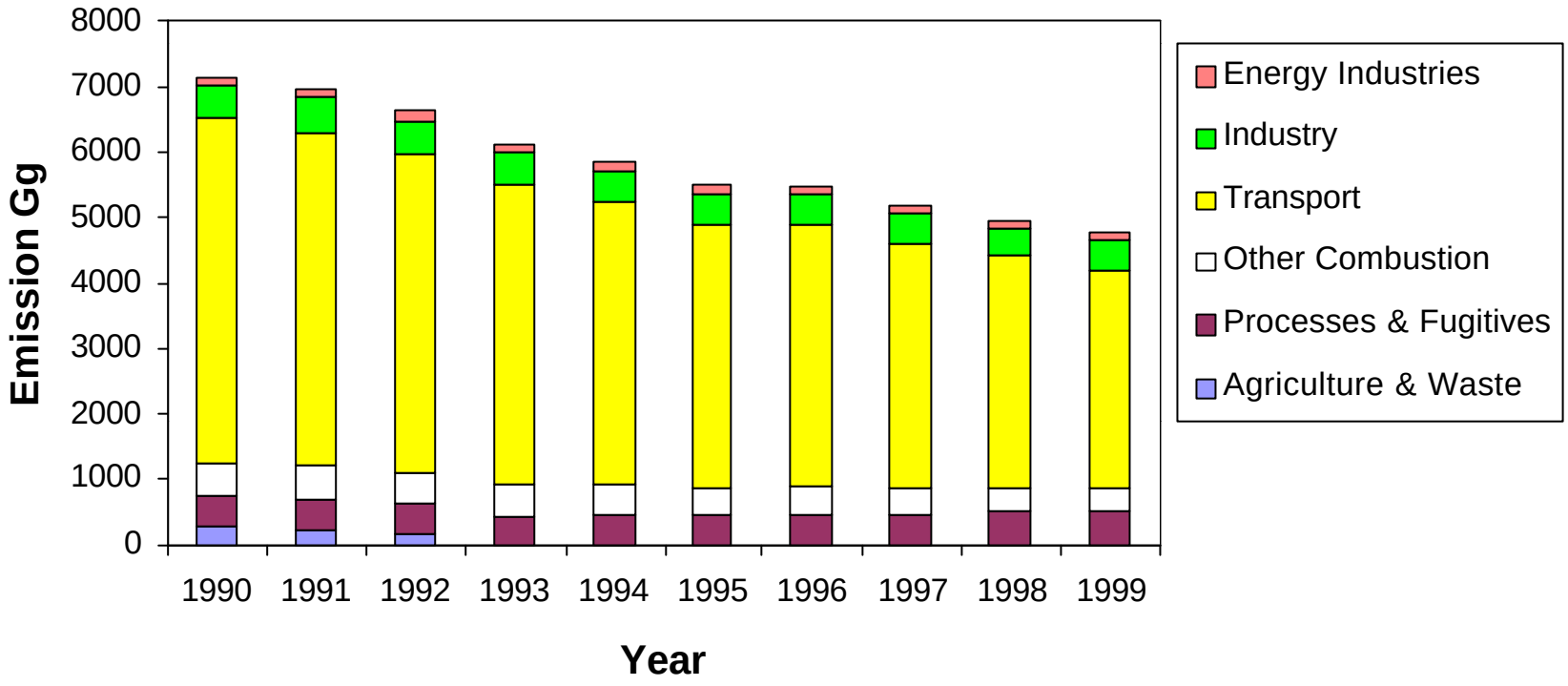
Other emission sources are small compared with transport. Emissions from Other Sectors have decreased by 23% since 1990 almost entirely as a result of decreased residential solid fuel combustion in favour of gas and electricity. This consumption has fluctuated considerably over the period but has fallen markedly since 1993. Emissions from the residential sector were 346 Gg in 1999 accounting for 7% of the total. Around 94 Gg of this arises from house and garden machinery.

Emissions from off-road sources are reported in a number of sectors, namely: 1A2 Industry, 1A3 Other Transport and 1A4 Other Sectors. These include emissions from agricultural and construction equipment such as tractors, combine harvesters, portable generators, forklift trucks, lawnmowers, and cement mixers. The petrol-engined machinery is a particularly important source of CO emissions. These estimates are very uncertain because they are based on estimates of equipment population and annual usage time. New data have been recently collected for a range of construction equipment (Off Highway Research Limited, 2000) resulting in a modest increase in the off-road estimates. Emissions from these sources are now believed to contribute approximately 8.5% of the total emission.

The large emissions from iron and steel processes and the chemical industry are based on data reported in the Pollution Inventory (Environment Agency, 2000). The iron and steel emissions data are fairly approximate and have been allocated to basic oxygen furnaces, electric arc furnaces and sinter plants. Sinter plant emissions are reported in the combustion category 1A2a. The process emissions reported in category 2C account for around 9% of the total in 1999.

Other emission sources are small compared with transport, off-road sources and processes. Power station emissions have decreased since 1990 and are now 47% of 1990 levels. In 1999, this sector accounted for 1.3% of the total.

Figure 8: UK Emissions of Carbon Monoxide



9 UK Emissions of Non-Methane Volatile Organic Compounds

9.1 INTRODUCTION

The development of an accurate emission inventory for Non-Methane Volatile Organic Compounds (NMVOC) is complex. The diversity of processes which emit NMVOC is large, covering not only many branches of industry, but also transport, agriculture and domestic sources. Within a single industry sector such as printing, the variation in the quantity and composition of organic solvents used in the inks, the different printing processes used and the varying extent and types of abatement used on the different presses make it difficult to apply a single, generally valid, emission factor across the industry. Unlike CO_2, CO and NO_x, only about 38% of the UK estimate of NMVOC emissions come from combustion sources.

Often emissions from sources are small individually, but important collectively. A good example of this is leakage from valves, flanges and other connections in petrochemical plants. A typical plant may have many other emission sources, each emitting a very small quantity of NMVOC which are difficult to locate and quantify.

The term NMVOC covers a large range of compounds and this can create difficulties when measuring emission factors. Many commonly employed measurement techniques such as flame ionisation detection do not respond with uniform sensitivity to all compounds. Large errors can therefore occur if emitted compounds are poorly detected by the measurement technique used. Methane is also associated with NMVOC emissions from many sources, for instance, combustion processes, transport, and the oil and gas industries. Methane is removed from the emission factors used so that NMVOC is reported rather than total hydrocarbons (THC).

NMVOC emissions are uncertain since data relating to emission from individual industrial processes and solvent use are incomplete. Therefore, the emission factors are very approximate and the uncertainty in total NMVOC emissions is currently estimated to be around ±50%.

9.2 DEVELOPMENT OF THE METHODOLOGY

A number of changes have been made to the methodology since the 1998 Inventory (Salway, 2000). Overall emissions have been revised downwards by 41 Gg NMVOC in 1998. Comparisons between the inventories refer to the year 1998 and the main changes are:

1. Fuel Combustion
    - The revision in the population estimates of off-road machinery (1a2f) has resulted in an increase in emissions in manufacturing and construction. The increase in emissions has been around 4 Gg.
    - The road transport emissions have decreased by 4 Gg due to revisions in the vehicle kilometre statistics used in the road transport model.

- There has been a significant increase in NMVOC emissions (12 Gg) from the residential sector (1A4b). This is predominantly due to a revision in the population data of gardening machinery.

2. Fugitive emissions from fuels
   - There has been a small increase in emissions from coke production plants due to a revision of the emission factor used based on advice from British Steel/Corus.
   - There is a small increase in emissions from the Oil and Gas industry (6 Gg). This arises from revisions in offshore loading and petrol distribution. In addition a new source of around 5 Gg is reported as gasification processes. These emissions arise from gas production plant downstream of the offshore industry and emissions from onshore oilfields. There has been a minor increase of around 1Gg arising from the revision of leakage from the natural gas transmission system (see Chapter 4)
   - There has been a revision to the inventory to include an oil and gas venting category (1B2c). This change does not affect overall emission totals but merely gives more detail. As a result of this, some emissions have been transferred to this category from the offshore oil and gas category (1B2a).
3. Industrial Processes
   - Ship purging (2B5) has been added to the inventory providing an additional source of NMVOC emissions of approximately 2 Gg.
   - There has been a decrease in emissions from chemical and made fibre production of 9 Gg due to revisions in the methodology and Pollution Inventory.
   - Changes have been made to the emission factors used for bread baking and sugar production leading to a net decrease in NMVOC emissions in 2D2 of 25 Gg.
4. Solvent and other product use
   - There has been a net decrease in emissions of 23 Gg as a result of numerous revisions to the activity data used.

9.3 DISCUSSION OF THE ESTIMATES

Figure 9 shows the UK emissions of NMVOC broken down by source category. The estimates suggest a decline in total emissions of 37% since 1990. The main sources is transport which accounts for 31% of total emissions. Almost all these emissions are from road transport and since 1990, they have fallen by around 49%. This reduction is due mostly to the increasing use of catalytic converters on cars, although a proportion is due to switching from petrol to diesel cars. Solvent use, fugitive emissions from fuels and industrial processes are the next biggest sources and account for 30%, 21% and 11% of emissions respectively.

Emissions from 1B2 Oil and Natural Gas have decreased by 28% since 1990 and constitute 21% of the UK Total. This includes emissions from gas leakage which comprise around 1% of the UK Total at present and are declining as a result of the gas main replacement programme underway since 1990. Emissions from petrol distribution are around 4.2% of the national total and depend on petrol consumption which has fallen recently owing to increased use of diesel oil. Emissions from the offshore industry, refining and storage account for the remainder. This includes a contribution from tanker loading and unloading.

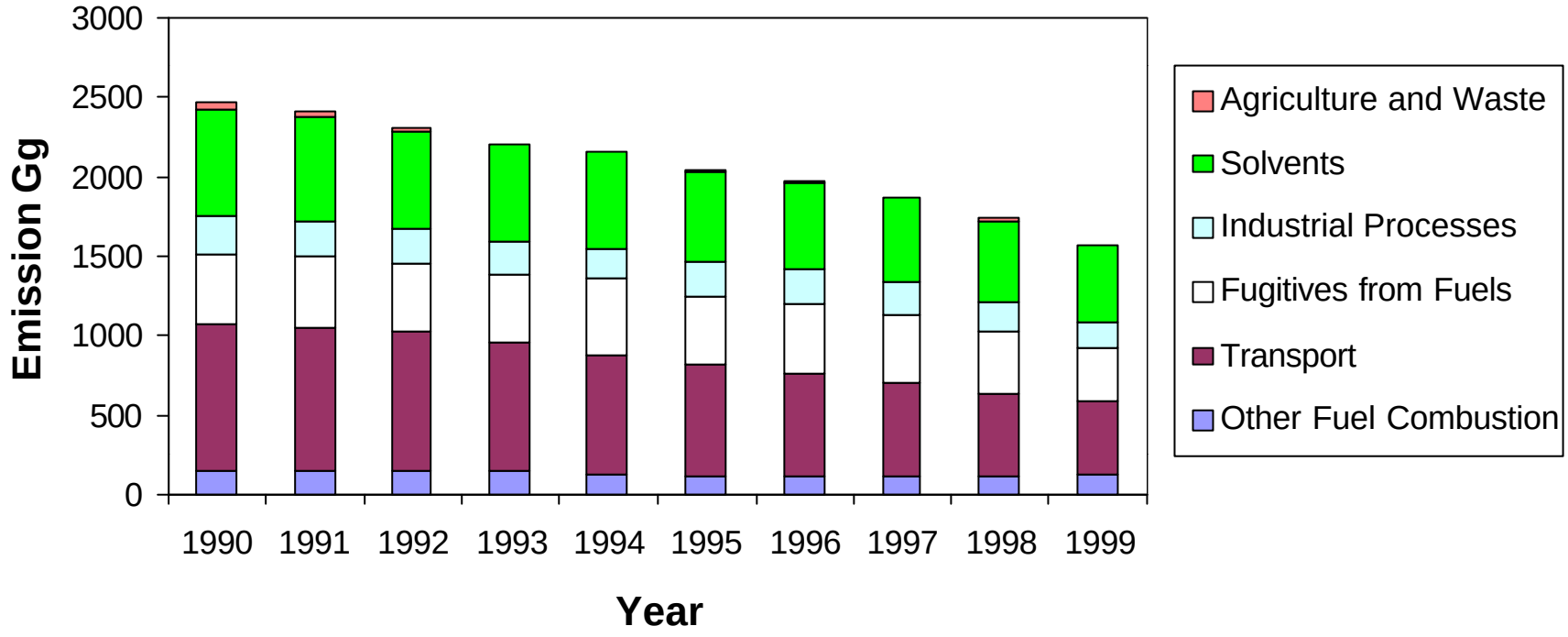
Emissions from off-road sources have been included since the 1995 Inventory. Of particular importance are those from petrol-engined machinery. This includes portable generators, forklift

trucks, lawnmowers and cement mixers. The estimation of emissions from such machinery is very uncertain since it is based on estimates of equipment population and annual usage time. They are believed to contribute around 4% of the total emissions. In the IPCC reporting format these sources are reported under 1A2 Industry, 1A3 Other Transport and 1A4 Other Sectors.

Other combustion emissions are very small compared with the sources discussed above. Emissions from the residential sector contribute approximately 5% to the total and derive from solid fuel combustion in domestic appliances. This source has declined by 23% since 1990 due to fuel switching from solid fuels to gas and electricity.

The other significant reduction in emissions was the cessation of agricultural stubble burning in 1993.

Figure 9: UK Emissions of Non-Methane Volatile Organic Compounds



10 UK Emissions of Sulphur Dioxide

Emissions of sulphur dioxide have been included in the Greenhouse Gas Inventory since the 1996 Inventory. Sulphur dioxide is reported as an indirect greenhouse gas because of its role in aerosol formation. It has however, been reported as part of the NAEI for many years, originally because of its role in smog formation but more recently because of interest in acidification.

Fuel combustion accounts for more than 99% of UK SO_2 emissions with the sulphur deriving from the fuel itself. Hence, SO_2 emissions can be calculated from knowledge of the sulphur content of the fuel and information of the amount of sulphur retained in the ash. The uncertainty in the emissions is estimated as ±10-15%.

10.1 DEVELOPMENT OF THE METHODOLOGY

A number of changes have been made to the methodology since the 1998 Inventory (Salway, 1999). Overall emissions have been revised downwards by 48 Gg SO_2 in 1998. Comparisons between the inventories refer to the year 1998 and the main changes are:

1. Fuel Combustion
   - There has been a significant decrease in SO_2 emissions from petroleum refineries (73 Gg). This is due to a decrease in the sulphur content of fuel oil used in refineries and a downward revision in emissions from the burning off of petroleum coke in catalytic crackers. These revisions are based on advice from UKPIA (2000).
   - There has also been an increase in SO_2 emissions (15 Gg) from coal combustion in other industries. This results from use of a lower estimate of the coal consumed by cement kilns. Coal combustion in cement kiln has a lower SO_2 emission per tonne than in boilers, hence by reallocating coal from kilns to industrial boilers, emissions are increased.
2. Industrial Processes
   - Revisions in the pollution inventory for electric arc furnaces have resulted in a 1 Gg increase in emissions from the iron and steel industry.
   - There has been an increase in emissions (8 Gg) as a result of the addition of new sources from the chemical industry (3 Gg) and pigment production (5 Gg) to the inventory. These estimates are based on data reported in the Pollution Inventory (Environment Agency, 2000).

10.2 DISCUSSION OF THE ESTIMATES

Figure 10 summarizes UK emissions of SO_2 disaggregated by source. Since 1990 there has been an overall decline in SO_2 emissions of around 68%.

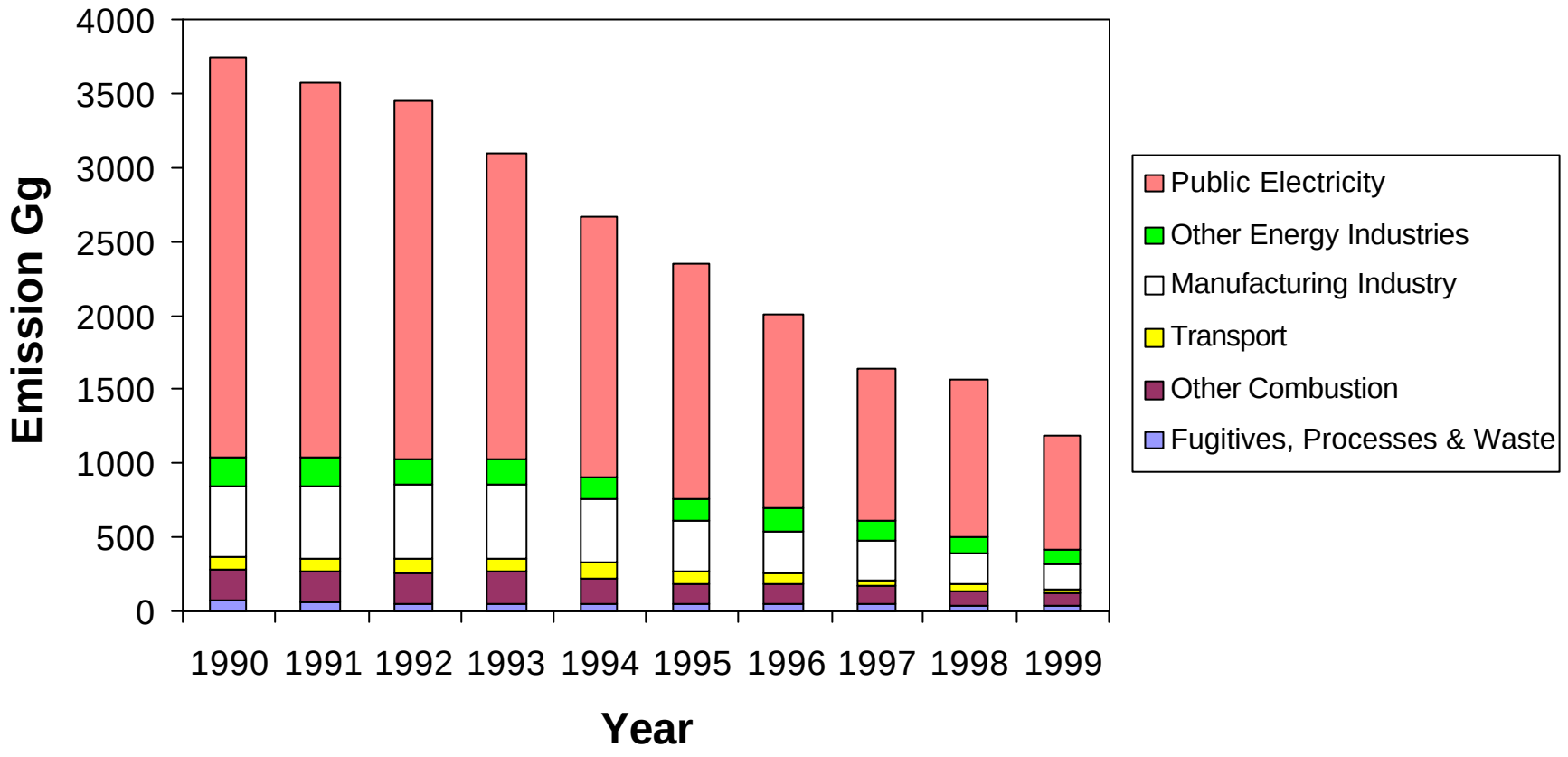
The largest contribution to SO_2 emissions is from power stations which accounts for 65% of the total in 1999. Since 1990 these emissions have declined by 72% because of the increase in the proportion of electricity generated in nuclear plant and the use of Combined Cycle Gas Turbine (CCGT) stations and other gas fired plant. CCGTs run on natural gas and are more efficient than conventional coal and oil stations and have negligible SO_2 emissions. In addition the flue

gas desulphurisation plants, constructed at Drax and Ratcliffe power stations have had a significant effect on emissions since 1994. It is estimated that around 0.285 Mt of SO_2 were removed in 1997 compared with a total emission from coal fired power stations of 0.958 Mt. In 1998, there was a small increase in SO_2 emissions from power stations. This can be attributed to a small increase in coal consumption and a breakdown at the FGD plant at Drax. In 1999, emissions decreased again due to the FGD plant at Drax operating normally again and a decline in coal consumption (DTI, 2000).

SO_2 emissions from manufacturing industry accounted for around 14% of the total in 1999. Since 1994 emissions have fallen by 64% which compares with a 1% decrease in fuel consumption (excluding electricity) by industry (DTI, 2000). Hence, the reduction is due to a decline in the use of coal and oil in favour of natural gas and some improvement in energy efficiency (See Section 3.2).

Other energy industries account for 9% of the total. Emissions from fugitives, processes and waste and other combustion and transport together account for 12% of emissions and are all declining. Emissions from aviation have increased since 1990. SO_2 emissions from marine increased until 1998 but then fell and in 1999 were 19% below 1990 levels. This is due to a decrease in consumption of fuel oil. International aviation bunkers only account for 6.5 Gg of emissions. However, International Marine bunkers are larger at 83 Gg. Emissions from this sector have fluctuated during 1990 to 1999 but in 1999 were 10% below 1990 levels.

Figure 10: UK Emissions of Sulphur Dioxide



11 Global Warming Potential of UK Emissions

11.1 INTRODUCTION

The direct greenhouse gases discussed all have different degrees of effectiveness in global warming. The Global Warming Potential (GWP) is a means of providing a simple measure of the relative radiative effects of the emissions of the various gases. The index is defined as the cumulative radiative forcing between the present and some chosen time horizon caused by a unit mass of gas emitted now, expressed relative to that of CO_2. It is necessary to define a time horizon because the gases have different lifetimes in the atmosphere. Table 11 shows GWPs defined on a 100 year horizon, IPCC (1996).

Table 11: GWP of Greenhouse Gases on 100 Year Horizon

Gas	GWP
Carbon Dioxide	1
Methane	21
Nitrous Oxide	310
HFCs	140-11700
PFCs	6500-7000
SF_6	23900

A range of GWP values is shown for HFCs and PFCs because these refer to a number of species, each with its own GWP. By weighting the emission of a gas with its GWP it is possible to estimate the total contribution to global warming of UK greenhouse gas emissions.

11.2 GWP WEIGHTED EMISSIONS

GWP weighted emissions are shown in Table 12 and Figure 11.

Table 12 GWP Weighted Greenhouse Gas Emissions (Tg CO_2 Equivalent)

	1990	1991	1992	1993	1994	1995
Carbon Dioxide (emissions)	602.8	606.7	591.9	576.3	572.4	563.4
Methane	77.1	76.0	74.1	71	64.4	64.1
Nitrous Oxide	66.9	65.0	58.1	54.5	58.9	56.3
HFCs	11.4	11.9	12.3	12.9	13.8	15.2
PFCs	2.3	1.8	1.0	0.8	1.0	1.1
SF_6	0.7	0.8	0.8	0.9	1.1	1.1
Total	761.2	762.2	738.3	716.4	711.6	701.3
Carbon Dioxide (removals)	-10.6	-10.7	-10.8	-11.1	-11.3	-11.5
Carbon Dioxide (net emission)[1]	592.3	596.1	581.1	565.3	561.1	551.9

Total (net emissions)[1]	750.7	751.6	727.4	705.3	700.4	689.7

Table 12 (Continued)

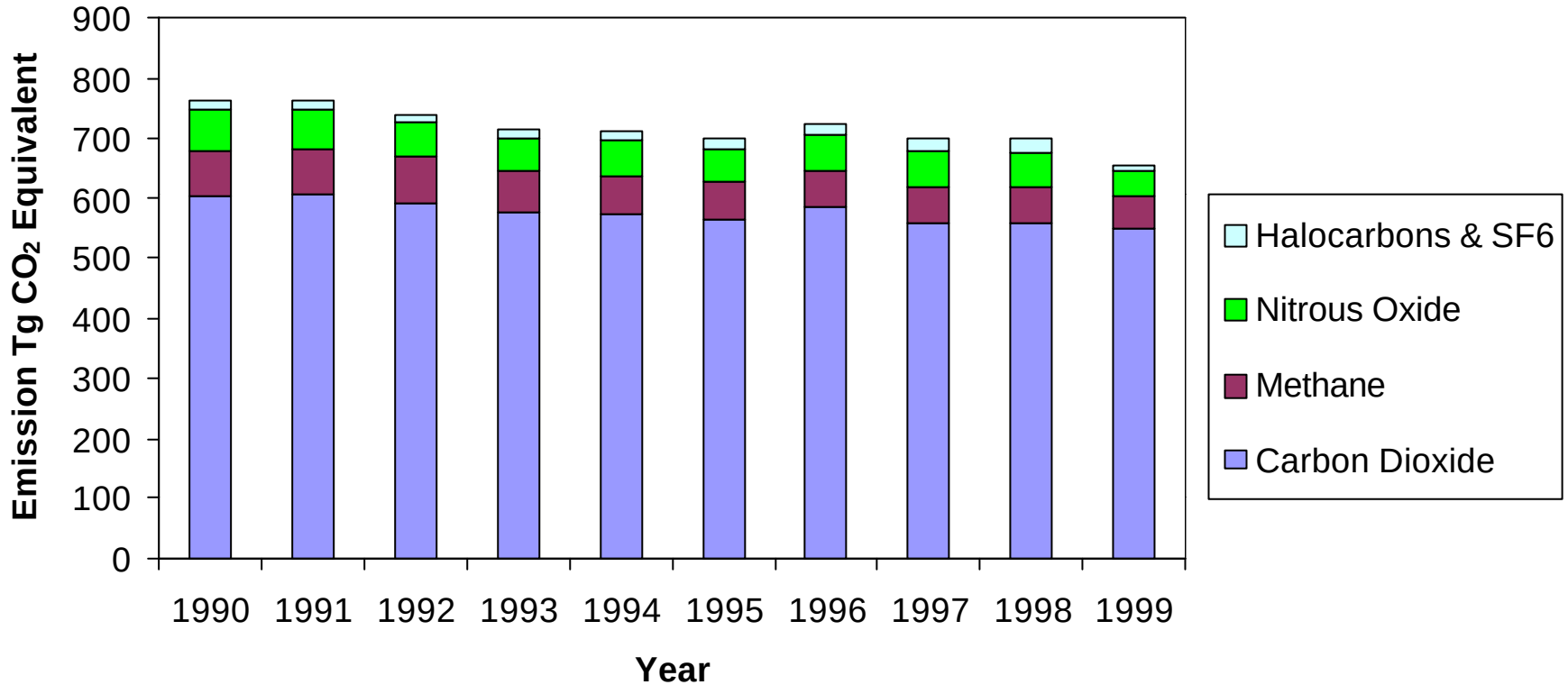
	1996	1997	1998	1999	% change 1990-99
Carbon Dioxide	583.0	558.0	560.3	547.8	-9.1
Methane	62.7	60.7	58.0	55.3	-28.3
Nitrous Oxide	58.4	60.2	58.2	42.9	-35.9
HFCs	16.3	18.4	20.2	6.2	-45.4
PFCs	0.9	0.7	0.7	0.7	-70.3
SF_6	1.3	1.3	1.3	1.3	81.5
Total	722.5	699.3	698.6	654.2	-14.1%
Carbon Dioxide (removals)	-11.6	-11.6	-11.5	-11.5	9.3%
Carbon Dioxide (net emission)[1]	571.4	546.5	548.7	536.3	-9.5%
Total (net emissions)[1]	710.9	687.7	687.1	642.6	-14.4%

1 Net Emissions are reported in the Common Reporting Format

The table shows that the largest contributor to global warming is carbon dioxide at 84% of the weighted emission. Methane and nitrous oxide contribute 8% and 7% respectively. In spite of their high GWPs, the contribution of halocarbons is small at around 1% of the total. This is because their mass emissions are very small. Overall the total weighted emission has fallen by 14.1% since 1990 with all gases declining except SF_6. There has been a marked reduction in the overall uncertainty of the GWP weighted emission. This is explained by abatement measures applied to the adipic acid plant and the HCFC plant resulting in large reductions of nitrous oxide and HFC respectively.

The uncertainty in the combined GWP weighted emission of all the greenhouse gases was estimated as 13.9% in 1990, and 16.5% in 1999. The approach used is discussed in Appendix 8.

Figure 11: UK Emissions of Greenhouse Gases Weighted by GWP



12 Methodological Changes to the Inventory

This section describes the methodological changes made to the inventory since the last 1998 Inventory was released. Where appropriate, emissions from 1990 onwards are recalculated to include the changes and to provide a consistent time series. The effects of the changes on emissions are discussed in the sections dealing with each gas. Sources not listed remain unchanged. Full methodological details are given in Appendix 1 to 7.

12.1 ENERGY (1A)

Electricity Generation (1A1a)
The gross calorific value used for poultry litter combustion has been revised downwards by 11% (DTI, 2000). Since the emissions are based on mass capacities this will result in a very small change in emissions of methane, N_2O, NO_x, CO, NMVOC and SO_2.

Petroleum Refining (1A1b)
In previous inventories the consumption of liquid petroleum gas (LPG) and other petroleum gas (OPG) in gas separation plant was incorrectly allocated to petroleum refining. It is now clear that this should be included under offshore fuel consumption (1A1c). The offshore estimates are based on the SCOPEC (2000) survey, which already includes consumption of natural gas liquids. Hence there was a double count in the inventory. The gas separation plant consumption has now been removed from petroleum refining and the double count removed. This change has resulted in reductions in emissions of CO_2, methane, N_2O, NO_x, CO, NMVOC from petroleum refining.

The NO_x and SO_2 emission factors used for fuel oil combustion in refineries have been revised downwards for the years 1992-99. This is to account for the use of low NO_x burners in refinery large combustion plant. The fuel oil burnt in refineries has a lower sulphur content than that sold outside of refineries. The new factors are based on data supplied by UKPIA (2000).

The carbon emission factor used for LPG has been revised downwards by 9%. This arose from a comparison of the previous factor with those used in the petroleum industry for propane and butane. LPG is a mixture of propane and butane and so a new factor was calculated from physical property data assuming an 80%/20% by weight mixture of propane and butane. This is broadly the ratio of the production of the gases. LPG is also used in industry (1A2) and the residential sector (1A4b).

Manufacturing Industry and Construction (1A2)
Emissions from off-road sources and machinery are calculated from a model based on the population of the various items of equipment. In the 1999 Inventory the equipment population data has been revised based on a new survey (OHRL, 2000). This has resulted in increased estimates of the consumption of gas oil and petrol by these sources. Overall carbon dioxide estimates are unchanged in that fuel has merely been reallocated from other industrial sources and

road transport. However emissions of methane, N_2O, NO_x, CO and NMVOC will increase because of the relatively high emission factors of these sources. A further modification to the methodology is the use of lower emission factors from 1998 onwards to reflect new regulations on emissions from new equipment.

The allocation of coal to cement production has been revised downwards based on data from the British Cement Association. This has resulted in an increase in consumption allocated to other manufacturing industry. Since the emission factors used for kilns differ from those used for boilers, there have been small increases in N_2O and a decrease in methane emissions.

Other Sectors (1A4)
The category other sectors includes emissions from off-road machinery used in the domestic and agricultural sectors. Emissions from off-road sources and machinery are calculated from estimates of the population of the various items of equipment. In the 1999 Inventory the equipment population data has been revised based on a new survey (OHRL, 2000). This has resulted in increased estimates of the consumption of gas oil and petrol by these sources. Overall carbon dioxide estimates are unchanged in that fuel has merely been reallocated road transport. However emissions of methane, N_2O, NO_x, CO and NMVOC will increase because of the relatively high emission factors of these sources. A further modification to the methodology is the use of lower emission factors from 1998 onwards to reflect regulation applied to new equipment.

Military Aircraft (1A5)
The emission factors for NO_x, CO, NMVOC, methane have been revised using factors more appropriate to military aircraft (EMEP/CORINAIR, 1999). The previous inventory used civilian aircraft factors.

12.2 FUGITIVE EMISSIONS (1B)

Deep Mined Coal (1B1a)
There has been a significant increase in emissions from deep mines from 1993-98. The new emission factors are based on measurements taken on mines in 1998 and 1999. The previous emission factors were based on a survey taken in 1993. Specific emissions have increased due to mine closures.

Solid Fuel Fugitive Emissions (1B1b)
The previous inventory used USEPA (1997) emission factors for fugitive emissions arising from coke and patent fuel production. These emissions factors have been revised on the USEPA web site, typically increasing by a factor of two. The new factors are used for CO, NO_x, and SO_2. The emission factors used for CH_4 and NMVOC have also been revised based on industry advice (EIPPCB, 2000). These new factors are lower.

Oil Transport: Onshore Loading (1B2a)
There has been a revision to the emissions of methane and NMVOC from onshore loading. The change is to include emissions from a terminal that is not included in the SCOPEC survey prior to 1998. Thus emissions will have increased slightly in the years prior to 1998.

Distribution of Oil Products (1B2a)
Emissions of NMVOC from gasoline distribution have been revised. The new estimates contain a more detailed model of fugitive emissions from storage and loading at gasoline terminals.

Oil Refining/Storage (1B2a)
The inventory now reports emissions of NMVOC from petroleum processes. This refers to NMVOC emissions from specialist refining, bitumen refining and onshore oil fields which are not dealt with elsewhere. The estimates are derived from the Pollution Inventory. (Environment Agency, 2000)

Natural Gas Transmission/Distribution (1B2b)
Emissions from natural gas transmission have been revised upwards from 1997-98. The new estimates are taken from a new model developed by Transco (2000). The previous estimates were based on their earlier model (British Gas, 1993). The earlier model is still appropriate for the period 1990-96.

Natural Gas Production (1B2b)
The inventory now reports emissions of NMVOC from gasification processes. These refer to processes in the gas industry other than those in terminals. The estimates are derived from the Pollution Inventory (Environment Agency, 2000).

Flaring (1B2c)
Emissions from flaring from onshore oilfields are now included in the total. Emissions of CO_2, methane, N_2O, NO_x, CO, NMVOC, and SO_2 are reported but the contribution is very small.

12.3 INDUSTRIAL PROCESSES (2)

Cement Production (2A1)
The carbon emission factor used for cement production has been increased by 2% to account for cement kiln dust. The increase is based on the IPCC (2000) default factor.

Nitric Acid (2B2)
There have been revisions to the nitric acid time series both of emission factors and of activity data. Most operators now report nitrous oxide emissions and these data were extrapolated back to 1990 based on the respective production capacities of the plant. Only plant closed prior to 1994 are estimated using defaults. For the previous inventory, it was necessary to use a default factor for some operating plant. Emissions of NO_x have also been revised due to the more complete set of activity data.

Iron and Steel Production (2C1)
Emission factors of NO_x, SO_2 and NMVOC from electric arc furnaces have been revised based on data reported in the Pollution Inventory (Environment Agency, 2000). Emissions of NO_x and SO_2 have increased significantly whilst those of NMVOC have reduced.

Aluminium Production (2C3)
The emission factors of SO_2, NO_x and CO from aluminium production have been revised based on advice from the industry. (Alcan, 2000) The new factors are slightly lower.

Chemical Industry (2B5)
Additional process emissions from the chemical industry have been included in the inventory. These are emissions of SO_2 from pigment manufacture and emissions of CO and SO_2 and methane from other chemical processes. The emissions are based on the Pollution Inventory (Environment Agency, 2000).

A new source of NMVOC from ship purging has been added under 2B5.

Non-Ferrous Metals (2C5)
Some new sources of carbon monoxide from non-ferrous metal production have been included in the inventory. These relate specifically to secondary lead and secondary copper production and other non-ferrous metal processes. The estimates are based on the Pollution Inventory (Environment Agency, 2000)

Food and Drink (2D2)
Emissions of NMVOC from the food industry have been reduced slightly. The specific sources are bread baking and sugar production and emission factors have been reduced based on industry advice. The new factors replace CORINAIR defaults and are derived from the Pollution Inventory (Environment Agency, 2000)

Potential Emissions of Halocarbons and Sulphur Hexafluoride (2E)
The new estimates include a correction to account for the consumption of fluid required to replace the losses from the fluid bank contained in equipment. Also the new estimates include data on disposals and recycling.

12.4 LAND USE CHANGE AND FORESTRY (5)

CO_2 Emissions and Removals from Soils (5D)

There have been revisions to the size and rate constants in use after land use change. In particular there has been a reassessment and improvement of estimates of equilibrium soil carbon in Scottish soils. Previous assumptions for rate constants are now considered to have been at extremes of likely range. The new estimates are based on Monte Carlo methods to produce mean change in soil carbon for the likely range of rate constants.

12.5 WASTE (6)

Waste Incineration (6C)
The emissions factors for N_2O from sewage sludge and municipal solid waste incineration have been revised in accordance with IPCC (2000). The emission factor for sewage has increased and that for MSW decreased. Emissions however remain small.

Emissions of NO_x, CO, NMVOC and SO_2 from cremation and clinical incineration are now reported.

Wastewater Treatment (6B1)

Emissions of N_2O have been revised to correct an error in the protein consumption per head data used. The methodology is unchanged but emissions have increased significantly.

There have been minor increases in reported methane emissions from 1996-98. This is due to a revision in the sewage production per head of population over this period.

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Units

The following units are used in this report:

1 Gigagramme (Gg) = 1 thousand tonnes (kt)
1 Teragramme (Tg) = 1 million tonnes (Mt)

SECTORAL TABLES 1990

TABLE 1 SECTORAL REPORT FOR ENERGY
(Sheet 1 of 2)

1990
Submission 2001

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO2	CH4	N2O	NOX	CO	NMVOC	SO2
	(Gg)						
Total Energy	**568,692.17**	**1,479.98**	**17.62**	**2,732.09**	**6,479.07**	**1,519.99**	**3,720.04**
A. Fuel Combustion Activities (Sectoral Approach)	**556,554.16**	**119.77**	**17.31**	**2,726.09**	**6,408.02**	**1,072.68**	**3,683.18**
1. Energy Industries	**228,089.43**	**7.65**	**7.22**	**883.44**	**142.55**	**10.93**	**2,917.31**
a. Public Electricity and Heat Production	198,502.49	5.53	6.20	780.72	113.74	7.35	2,723.06
b. Petroleum Refining	17,605.43	0.70	0.30	39.68	6.46	1.17	152.97
c. Manufacture of Solid Fuels and Other Energy Industries	11,981.52	1.41	0.71	63.03	22.35	2.41	41.29
2. Manufacturing Industries and Construction	**94,577.95**	**11.69**	**3.79**	**278.72**	**511.67**	**30.13**	**463.32**
a. Iron and Steel	22,829.68	7.07	0.40	22.25	107.77	1.15	88.05
b. Non-Ferrous Metals	0.00	0.00	0.00	IE	IE	IE	IE
c. Chemicals	0.00	0.00	0.00	IE	IE	IE	IE
d. Pulp, Paper and Print	0.00	0.00	0.00	IE	IE	IE	IE
e. Food Processing, Beverages and Tobacco	0.00	0.00	0.00	IE	IE	IE	IE
f. Other (please specify)	71,748.28	4.62	3.39	256.47	403.90	28.98	375.27
Other industry				256.47	403.90	28.98	375.27
3. Transport	**116,580.82**	**29.77**	**4.14**	**1,389.09**	**5,254.89**	**927.92**	**90.09**
a. Civil Aviation	2,158.43	0.12	0.07	6.93	7.77	1.38	0.41
b. Road Transportation	109,038.95	29.27	3.11	1,305.72	5,234.90	922.40	62.92
c. Railways	1,888.54	0.07	0.72	13.01	3.93	1.75	2.52
d. Navigation	3,460.90	0.32	0.22	62.81	8.15	2.33	24.19
e. Other Transportation (please specify)	34.00	0.00	0.01	0.61	0.13	0.06	0.05
Aircraft Support Vehicles				0.61	0.13	0.06	0.05

TABLE 1 SECTORAL REPORT FOR ENERGY
(Sheet 2 of 2)

1990
Submission 2001

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO2	CH4	N2O	NOX	CO	NMVOC	SO2
	(Gg)						
4. Other Sectors	**112,040.52**	**70.40**	**1.95**	**139.37**	**485.55**	**101.55**	**203.22**
a. Commercial/Institutional	29,772.86	3.12	0.31	35.67	7.88	1.64	84.27
b. Residential	79,077.51	66.23	0.90	64.51	452.52	93.50	108.00
c. Agriculture/Forestry/Fisheries	3,190.15	1.05	0.75	39.18	25.15	6.41	10.94
5. Other (please specify)	**5,265.43**	**0.26**	**0.21**	**35.48**	**13.37**	**2.15**	**9.24**
a. Stationary	0.00	0.00	0.00	0.00	0.00	0.00	0.00
b. Mobile	0.00	0.00	0.00	35.48	13.37	2.15	9.24
Military Aircraft and Naval Vessels				35.48	13.37	2.15	9.24
B. Fugitive Emissions from Fuels	**12,138.01**	**1,360.21**	**0.30**	**6.00**	**71.06**	**447.31**	**36.85**
1. Solid Fuels	**3,000.36**	**819.20**	**0.00**	**0.72**	**36.55**	**0.22**	**20.61**
a. Coal Mining	0.00	818.46	NO	NO	NO	NO	
b. Solid Fuel Transformation	3,000.36	0.74	NE	0.72	36.55	0.22	20.61
c. Other (please specify)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2. Oil and Natural Gas	**9,137.65**	**541.01**	**0.30**	**5.28**	**34.50**	**447.09**	**16.24**
a. Oil	1,567.13	93.43		1.38	7.08	391.83	15.90
b. Natural Gas	0.00	425.84				23.90	IE
c. Venting and Flaring	7,570.52	21.74	0.25	3.90	27.43	31.36	0.34
Venting	10.30	0.00				IE	IE
Flaring	7,560.22	21.74	0.25	3.90	27.43	31.36	0.34
d. Other (please specify)	0.00	0.00	0.06	0.00	0.00	0.00	0.00
Exploration: Well testing			IE				
Memo Items:							
International Bunkers (k)	**21,349.41**	**3.46**	**0.87**	**192.41**	**75.59**	**41.30**	**95.30**
Aviation (k)	14,790.50	2.85	0.45	72.79	60.06	36.87	2.82
Marine (k)	6,558.91	0.60	0.42	119.63	15.53	4.43	92.48
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO
CO2 Emissions from Biomass (kl)	**3,850.11**						

TABLE 2(I) SECTORAL REPORT FOR INDUSTRIAL PROCESSES
(Sheet 1 of 2)

1990
Submission 2001

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO2	CH4	N2O	HFCs(1)		PFCs(1)		SF6		NOx	CO	NMVOC	SO2
				P	A	P	A	P	A				
	(Gg)			CO2 equivalent (Gg)				(Gg)					
Total Industrial Processes	**14,123.40**	**2.66**	**94.46**	**41.77**	**11,373.84**	**250.18**	**2,281.00**	**0.11146**	**0.03**	**12.54**	**405.20**	**228.38**	**29.73**
A. Mineral Products	**9,554.79**	**0.00**	**0.00**							**0.00**	**0.00**	**9.83**	**0.00**
1. Cement Production	6,828.72												IE
2. Lime Production	1,191.52												
3. Limestone and Dolomite Use	1,369.47												
4. Soda Ash Production and Use	165.07												
5. Asphalt Roofing	NE										NE	NE	
6. Road Paving with Asphalt	NE									NE	NE	9.83	NE
7. Other (please specify)	0.00	0.00	0.00							0.00	0.00	0.00	0.00
B. Chemical Industry	**1,358.31**	**1.88**	**94.42**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**8.10**	**61.09**	**145.15**	**22.97**
1. Ammonia Production	1,358.31	NE								IE	IE	IE	NO
2. Nitric Acid Production			13.33							8.10			
3. Adipic Acid Production			81.09							NE	NE	IE	
4. Carbide Production	0.00	0.00									NO	NO	NO
5. Other (please specify)	0.00	1.88	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	61.09	145.15	22.97
Sulphuric Acid & Pigment Production										NO	NO	NO	22.97
Other Organic Chemicals										NO	61.09	145.15	NO
C. Metal Production	**3,210.31**	**0.78**	**0.04**	**0.00**	**0.00**	**0.00**	**2,031.00**	**0.00**	**0.02**	**4.44**	**344.12**	**1.80**	**6.77**
1. Iron and Steel Production	2,759.99	0.78	0.04							4.10	319.90	1.80	2.48
2. Ferroalloys Production	IE	NE								NE	NE	NE	NE
3. Aluminium Production	450.32	NE					2,031.00			0.34	21.97	NE	4.29
4. SF6 Used in Aluminium and Magnesium Foundries									0.02				
5. Other (please specify)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.24	0.00	0.00
Other Non-Ferrous Metals										NO	2.24	NE	IE

TABLE 2(I) SECTORAL REPORT FOR INDUSTRIAL PROCESSES
(Sheet 2 of 2)

1990
Submission 2001

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO2	CH4	N2O	HFCs(1)		PFCs(1)		SF6		NOx	CO	NMVOC	SO2
				P	A	P	A	P	A				
	(Gg)			CO2 equivalent (Gg)				(Gg)					
D. Other Production	**IE**									**0.00**	**0.00**	**71.60**	**0.00**
1. Pulp and Paper										NE	NE	NE	NE
2. Food and Drink	IE											71.60	
E. Production of Halocarbons and SF6					**11,373.17**		**0.00**		**0.00**				
1. By-product Emissions					11,373.17		0.00		0.00				
Production of HCFC-22					IE								
Other (c)					11,373.17		IE		NO				
2. Fugitive Emissions					IE		IE		NO				
3. Other (please specify)					0.00		0.00		0.00				
F. Consumption of Halocarbons and SF6				**41.77**	**0.67**	**250.18**	**250.00**	**0.11**	**0.01**				
1. Refrigeration and Air Conditioning Equipment				29.49	0.55	0.18	0.00		NO				
2. Foam Blowing				0.00	0.00	0.00	0.00		NO				
3. Fire Extinguishers				0.00	0.00	0.00	0.00		NO				
4. Aerosols/ Metered Dose Inhalers				12.28	0.12	NO	NO		NO				
5. Solvents				0.00	0.00	0.00	0.00		NO				
6. Semiconductor Manufacture				NO	NO	IE	IE		IE				
7. Electrical Equipment				NO	NO	IE	IE		IE				
8. Other (please specify)				0.00	0.00	250.00	250.00	0.11	0.01				
Semiconductors, Electrical and production of trainers				NO	NO	250.00	250.00	0.11	0.01				
G. Other (please specify)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

TABLE 3 SECTORAL REPORT FOR SOLVENT AND OTHER PRODUCT USE
(Sheet 1 of 1)

1990

Submission 2001

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO2 (d)	N2O	NMVOC
	(Gg)		
Total Solvent and Other Product Use	**0.00**	**0.00**	**684.10**
A. Paint Application	**NE**	**NA**	**214.67**
B. Degreasing and Dry Cleaning	**NE**	**NA**	**86.13**
C. Chemical Products, Manufacture and Processing			**45.26**
D. Other (please specify)	0.00	0.00	338.04
(Use of N2O for Anaesthesia)		NE	NA
(N2O from Fire Extinguishers)		NO	NA
(N2O from Aerosol Cans)		NO	NA
(Other Use of N2O)		NO	NA
(NMVOC from Aerosols)	NE	NA	78.61
(Agrochemicals Use)	NE	NA	5.30
(Industrial Adhesives)	NE	NA	57.15
(Non-aerosol consumer products)	NE	NA	63.25
(Paper coating)	NE	NA	12.80
(Printing)	NE	NA	47.15
(Seed oil extraction)	NE	NA	2.43
(Wood preservation)	NE	NA	25.35
(Other Use of Solvent)	NE	NA	46.00

TABLE 4 SECTORAL REPORT FOR AGRICULTURE
(Sheet 1 of 2)

1990
Submission 2001

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CH4	N2O	NOx	CO	NMVOC
	(Gg)				
Total Agriculture	**1,037.20**	**100.43**	**9.07**	**266.04**	**34.96**
A. Enteric Fermentation	**913.20**				
1. Cattle	692.02				
Dairy Cattle	295.94				
Non-Dairy Cattle	396.07				
2. Buffalo	NO				
3. Sheep	205.23				
4. Goats	0.57				
5. Camels and Llamas	NO				
6. Horses	3.64				
7. Mules and Asses	NO				
8. Swine	11.32				
9. Poultry	0.00				
10. Other (please specify)	0.43				
Deer	0.43				
B. Manure Management	**111.335**	**5.11**			**0.00**
1. Cattle	72.80				
Dairy Cattle	33.30				
Non-Dairy Cattle	39.50				
2. Buffalo	NO				
3. Sheep	4.92				
4. Goats	0.01				
5. Camels and Llamas	NO				
6. Horses	0.28				
7. Mules and Asses	NO				
8. Swine	22.64				
9. Poultry	10.67				

TABLE 4 SECTORAL REPORT FOR AGRICULTURE
(Sheet 2 of 2)

1990
Submission 2001

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CH4	N2O	NOx	CO	NMVOC
	(Gg)				
B. Manure Management (continued)					
10. Anaerobic Lagoons		0.00			NO
11. Liquid Systems		0.29			NO
12. Solid Storage and Dry Lot		4.25			NO
13. Other (please specify)		0.57			0.00
Other		0.57			
C. Rice Cultivation	0.00				**0.00**
1. Irrigated	0.00				NO
2. Rainfed	0.00				NO
3. Deep Water	0.00				NO
4. Other (please specify)	0.00				0.00
D. Agricultural Soils	**0.00**	**95.07**			**0.00**
1. Direct Soil Emissions	0.00	46.06			NO
2. Animal Production	0.00	16.61			NO
3. Indirect Emissions	0.00	31.86			NO
4. Other (please specify)	0.00	0.54			0.00
Improved Grass	0.00	0.54			
E. Prescribed Burning of Savannas	**0.00**	**0.00**			
F. Field Burning of Agricultural Residues (e)	**12.67**	**0.25**	**9.07**	**266.04**	**34.96**
1 . Cereals	12.67	0.25	9.07	266.04	34.96
2. Pulse	0.00	0.00	NO	NO	NO
3 . Tuber and Root	0.00	0.00	NO	NO	NO
4 . Sugar Cane	0.00	0.00	NO	NO	NO
5 . Other (please specify)	0.00	0.00	0.00	0.00	0.00
G. Other (please specify)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

TABLE 5 SECTORAL REPORT FOR LAND-USE CHANGE AND FORESTRY
(Sheet 1 of 1)

1990
Submission 2001

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO2 emissions	CO2 removals	Net CO2 emissions/ removals	CH4	N2O	NOx	CO
	(Gg)						
Total Land-Use Change and Forestry (a)	**19,347.54**	**-10,556.33**	**(a)**	**0.00**	**0.00**	**0.00**	**0.00**
A. Changes in Forest and Other Woody Biomass Stocks	**0.00**	**-9,456.33**					
1. Tropical Forests	NO	NO					
2. Temperate Forests (f)	NO	-9,456.33					
3. Boreal Forests	NO	NO					
4. Grasslands/Tundra	NO	NO					
5. Other (please specify)	0.00	0.00					
Harvested Wood	NO	0.00					
B. Forest and Grassland Conversion	**0.00**			**0.00**	**0.00**	**0.00**	**0.00**
1. Tropical Forests	NO						
2. Temperate Forests	NO						
3. Boreal Forests	NO						
4. Grasslands/Tundra	NO						
5. Other (please specify)	0.00			0.00	0.00	0.00	0.00
C. Abandonment of Managed Lands	**0.00**	**0.00**					
1. Tropical Forests	NO	NO					
2. Temperate Forests	NO	NE					
3. Boreal Forests	NO	NO					
4. Grasslands/Tundra	NO	NE					
5. Other (please specify)	0.00	0.00					
D. CO2 Emissions and Removals from Soil (g)	**15,439.30**	**0.00**					
E. Other (please specify) (h) (i)	**3,908.24**	**-1,100.00**		**0.00**	**0.00**	**0.00**	**0.00**

TABLE 6 SECTORAL REPORT FOR WASTE
(Sheet 1 of 1)

1990
Submission 2001

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 (1)	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(Gg)						
Total Waste	**663.33**	**1,150.41**	**3.47**	**5.11**	**3.30**	**11.29**	**4.63**
A. Solid Waste Disposal on Land	**0.00**	**1,117.00**		**0.00**	**0.00**	**11.17**	
1. Managed Waste Disposal on Land	NA	1,117.00		NA	NA	11.17	
2. Unmanaged Waste Disposal Sites	0.00	0.00		NO	NO	NO	
3. Other *(please specify)*	0.00	0.00		0.00	0.00	0.00	
B. Wastewater Handling		**33.38**	**3.33**	**0.00**	**0.00**	**0.00**	
1. Industrial Wastewater		0.00	NE	NA	NA	NE	
2. Domestic and Commercial Wastewater (j)		33.38	3.33	NA	NA	NE	
3. Other *(please specify)*		0.00	0.00	0.00	0.00	0.00	
C. Waste Incineration	**663.33**	**0.03**	**0.13**	**5.11**	**3.30**	**0.12**	**4.63**
D. Other *(please specify)*	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

SUMMARY 1.A SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7A)

(Sheet 1 of 3)

1990

Submission 2001

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		CO2 emissions	CO2 removals	CH4	N2O	HFCs		PFCs		SF6		NOx	CO	NMVOC	SO2
						P	A	P	A	P	A				
		(Gg)				CO2 equivalent (Gg)						(Gg)			
Total National Emissions and Removals (a)		**602,826.44**	**-10,556.33**	**3,670.26**	**215.96**	**41.77**	**11,373.84**	**250.18**	**2,281.00**	**0.11**	**0.03**	**2,758.00**	**7,153.63**	**2,478.73**	**3,754.40**
1. Energy		**560,692.17**		**1,479.98**	**17.62**							**2,732.09**	**6,479.07**	**1,519.99**	**3,720.04**
A. Fuel Combustion	Reference Approach	572,762.39													
	Sectoral Approach	556,554.16		119.77	17.31							2,726.09	6,408.02	1,072.68	3,683.18
1. Energy Industries		228,089.43		9.65	7.22							883.44	142.55	10.99	2,919.31
2. Manufacturing Industries and Construction		94,577.95		11.69	3.79							278.72	511.67	30.13	463.32
3. Transport		116,580.82		29.77	4.14							1,389.09	5,254.89	927.92	90.09
4. Other Sectors		113,040.53		70.40	1.95							139.37	485.55	101.55	303.22
5. Other (b)		5,265.43		0.28	0.21							35.48	13.37	2.15	9.24
B. Fugitive Emissions from Fuels		12,138.01		1,360.21	0.30							6.00	71.06	447.31	36.85
1. Solid Fuels		3,000.36		819.20	0.00							0.72	36.55	0.22	20.61
2. Oil and Natural Gas		9,137.65		541.01	0.30							5.28	34.50	447.09	16.24
2. Industrial Processes		**14,123.40**		**2.66**	**94.46**	**41.77**	**11,373.84**	**250.18**	**2,281.00**	**0.11**	**0.03**	**12.54**	**405.20**	**228.38**	**29.73**
A. Mineral Products		9,554.79		0.00	0.00							0.00	0.00	9.83	0.00
B. Chemical Industry		1,258.31		1.88	94.42	0.00	0.00	0.00	0.00	0.00	0.00	8.10	61.09	145.15	22.97
C. Metal Production		3,210.31		0.78	0.04				2,031.00		0.02	4.44	344.12	1.80	6.77
D. Other Production		0.00										0.00	0.00	71.60	0.00
E. Production of Halocarbons and SF6							11,373.17		0.00		0.00				
F. Consumption of Halocarbons and SF6						41.77	0.67	250.18	250.00	0.11	0.01				
G. Other		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

SUMMARY 1.A SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7A)

(Sheet 2 of 3)

1990

Submission 2001

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO2 emissions	CO2 removals	CH4	N2O	HFCs		PFCs		SF6		NOx	CO	NMVOC	SO2
	(Gg)				P	A	P	A	P	A	(Gg)			
	CO2 equivalent (Gg)													
3. Solvent and Other Product Use (d)	**0.00**		**0.00**	**0.00**									**604.10**	
4. Agriculture	**0.00**	**0.00**	**1,037.204**	**180.43**							9.07	266.04	34.96	0.00
A. Enteric Fermentation			913.201											
B. Manure Management			111.33	5.11									0.00	
C. Rice Cultivation			0.00										0.00	
D. Agricultural Soils			0.00	95.07									0.00	
E. Prescribed Burning of Savannas			0.00	0.00							NO	NO	NO	
F. Field Burning of Agricultural Residues (e)			12.67	0.25							9.07	266.04	34.96	
G. Other			0.00	0.00							0.00	0.00	0.00	
5. Land-Use Change and Forestry (a)	**19,347.54**	**-10,556.33**	**0.00**	**0.00**							**0.00**	**0.00**	**0.00**	**0.00**
A. Changes in Forest and Other Woody Biomass Stocks (f)	0.00	-9,456.33												
B. Forest and Grassland Conversion	0.00		0.00	0.00							0.00	0.00		
C. Abandonment of Managed Lands	0.00	0.00												
D. CO2 Emissions and Removals from Soil (g)	15,439.30	0.00												
E. Other (h)	3,908.24	-1,100.00	0.00	0.00							0.00	0.00		
6. Waste	**663.33**		**1,150.41**	**3.47**							**5.11**	**3.30**	**11.29**	**4.63**
A. Solid Waste Disposal on Land	0.00		1,117.00									0.00	11.17	
B. Wastewater Handling (j)	0.00		33.38	3.33							0.00	0.00	0.00	
C. Waste Incineration	663.33		0.03	0.13							5.11	3.30	0.12	4.63
D. Other	0.00		0.00	0.00							0.00	0.00	0.00	0.00
7. Other (please specify)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

SUMMARY 1.A SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7A)
(Sheet 3 of 3)

1990

Submission 2001

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO2 emissions	CO2 removals	CH4	N2O	HFCs		PFCs		SF6		NOx	CO	NMVOC	SO2
					P	A	P	A	P	A				
	(Gg)				CO2 equivalent (Gg)						(Gg)			
Memo Items:														
International Bunkers (k)	**21,349.41**		**3.46**	**0.87**							**192.41**	**75.59**	**41.30**	**95.30**
Aviation (k)	14,790.50		2.85	0.45							72.79	60.06	36.87	2.82
Marine (k)	6,558.91		0.60	0.42							119.63	15.53	4.43	92.48
Multilateral Operations	**NO**		**NO**	**NO**							**NO**	**NO**	**NO**	**NO**
CO2 Emissions from Biomass (kl)	**3,850.11**													

SECTORAL TABLES 1999

TABLE 1 SECTORAL REPORT FOR ENERGY
(Sheet 1 of 2)

1999
Submission 2001

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO2	CH4	N2O	NOX	CO	NMVOC	SO2
	(Gg)						
Total Energy	**518,049.24**	**874.20**	**27.55**	**1,594.51**	**4,305.10**	**920.10**	**1,165.92**
A. Fuel Combustion Activities (Sectoral Approach)	**509,916.99**	**108.62**	**27.35**	**1,590.48**	**4,263.71**	**598.04**	**1,160.43**
1. Energy Industries	**179,116.20**	**32.82**	**7.80**	**422.21**	**94.42**	**10.34**	**883.40**
a. Public Electricity and Heat Production	141,029.88	24.15	6.20	338.33	60.54	8.03	776.38
b. Petroleum Refining	18,450.25	0.73	0.36	29.42	6.98	1.19	92.59
c. Manufacture of Solid Fuels and Other Energy Industries	19,636.08	7.95	1.24	54.46	26.90	1.12	14.43
2. Manufacturing Industries and Construction	**88,668.35**	**12.01**	**3.31**	**225.17**	**476.00**	**29.17**	**159.12**
a. Iron and Steel	22,797.21	7.10	0.33	24.25	104.97	1.20	42.02
b. Non-Ferrous Metals	0.00	0.00	0.00	IE	IE	IE	IE
c. Chemicals	0.00	0.00	0.00	IE	IE	IE	IE
d. Pulp, Paper and Print	0.00	0.00	0.00	IE	IE	IE	IE
e. Food Processing, Beverages and Tobacco	0.00	0.00	0.00	IE	IE	IE	IE
f. Other (please specify)	65,871.14	4.92	2.98	200.92	371.03	27.96	117.10
Other industry				200.92	371.03	27.96	117.10
3. Transport	**121,575.57**	**18.43**	**14.68**	**784.50**	**3,312.35**	**477.79**	**33.61**
a. Civil Aviation	2,822.12	0.14	0.09	9.12	9.88	1.72	0.72
b. Road Transportation	114,560.29	17.97	13.85	713.62	3,292.63	472.62	12.21
c. Railways	1,436.05	0.06	0.55	11.77	3.27	1.55	1.28
d. Navigation	2,710.01	0.25	0.17	49.19	6.39	1.82	19.37
e. Other Transportation (please specify)	47.10	0.00	0.02	0.80	0.19	0.08	0.04
Aircraft Support Vehicles				0.80	0.19	0.08	0.04

TABLE 1 SECTORAL REPORT FOR ENERGY
(Sheet 2 of 2)

1999
Submission 2001

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO2	CH4	N2O	NOX	CO	NMVOC	SO2
	(Gg)						
4. Other Sectors	**117,421.29**	**45.20**	**1.43**	**135.71**	**373.00**	**79.42**	**77.96**
a. Commercial/Institutional	29,238.49	3.43	0.13	30.85	3.29	1.90	18.52
b. Residential	85,339.24	40.73	0.65	71.84	345.96	71.68	52.91
c. Agriculture/Forestry/Fisheries	2,843.55	1.03	0.65	33.01	23.75	5.85	6.54
5. Other (please specify)	**3,135.58**	**0.16**	**0.13**	**22.90**	**7.93**	**1.32**	**6.33**
a. Stationary	0.00	0.00	0.00	0.00	0.00	0.00	0.00
b. Mobile	0.00	0.00	0.00	22.90	7.93	1.32	6.33
Military Aircraft and Naval Vessels				22.90	7.93	1.32	6.33
B. Fugitive Emissions from Fuels	**8,132.24**	**765.58**	**0.20**	**4.03**	**41.39**	**322.06**	**5.49**
1. Solid Fuels	**2,241.63**	**310.88**	**0.00**	**0.41**	**27.41**	**0.13**	**0.81**
a. Coal Mining	0.00	310.35	NO	NO	NO	NO	
b. Solid Fuel Transformation	2,241.63	0.53	NE	0.41	27.41	0.13	0.81
c. Other (please specify)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2. Oil and Natural Gas	**5,890.61**	**454.70**	**0.20**	**3.62**	**13.98**	**321.93**	**4.68**
a. Oil	872.64	12.03		1.23	1.05	270.09	1.20
b. Natural Gas	0.00	390.43				23.92	IE
c. Venting and Flaring	5,017.97	52.24	0.19	2.39	12.93	27.93	3.48
Venting	10.94	32.03				10.84	IE
Flaring	5,007.03	20.21	0.19	2.39	12.93	17.09	3.48
d. Other (please specify)	0.00	0.00	0.01	0.00	0.00	0.00	0.00
Exploration: Well testing			IE				
Memo Items:							
International Bunkers (k)	**31,895.86**	**4.86**	**1.19**	**243.13**	**110.46**	**62.48**	**89.54**
Aviation (k)	25,539.33	4.28	0.79	127.28	95.42	58.19	6.49
Marine (k)	6,356.53	0.59	0.41	115.85	15.04	4.29	83.05
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO
CO2 Emissions from Biomass (kl)	**7,000.26**						

TABLE 2(I) SECTORAL REPORT FOR INDUSTRIAL PROCESSES
(Sheet 1 of 2)

1999
Submission 2001

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO2	CH4	N2O	HFCs(1)		PFCs(1)		SF6		NOx	CO	NMVOC	SO2
				P	A	P	A	P	A				
	(Gg)			CO2 equivalent (Gg)						(Gg)			
Total Industrial Processes	**13,479.81**	**2.62**	**11.79**	**9,653.09**	**6,205.55**	**541.23**	**678.19**	**0.11421**	**0.05**	**5.99**	**448.54**	**165.79**	**20.32**
A. Mineral Products	**9,135.60**	**0.00**	**0.00**							**0.00**	**0.00**	**7.75**	**0.00**
1. Cement Production	6,113.20												IE
2. Lime Production	1,573.88												
3. Limestone and Dolomite Use	1,325.37												
4. Soda Ash Production and Use	123.14												
5. Asphalt Roofing	NE										NE	NE	
6. Road Paving with Asphalt	NE									NE	NE	7.75	NE
7. Other (please specify)	0.00	0.00	0.00							0.00	0.00	0.00	0.00
B. Chemical Industry	**1,107.50**	**1.88**	**11.76**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**2.31**	**78.81**	**77.50**	**14.41**
1. Ammonia Production	1,107.50	NE								IE	IE	IE	NO
2. Nitric Acid Production			9.63							2.31			
3. Adipic Acid Production			2.13							NE	NE	IE	
4. Carbide Production	0.00	0.00									NO	NO	NO
5. Other (please specify)	0.00	1.88	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	78.81	77.50	14.41
Sulphuric Acid & Pigment Production										NO	NO	NO	14.41
Other Organic Chemicals										NO	78.81	77.50	NO
C. Metal Production	**3,236.71**	**0.74**	**0.03**	**0.00**	**0.00**	**0.00**	**209.87**	**0.00**	**0.03**	**3.68**	**369.73**	**1.68**	**5.91**
1. Iron and Steel Production	2,814.57	0.74	0.03							3.33	346.77	1.68	1.88
2. Ferroalloys Production	IE	NE								NE	NE	NE	NE
3. Aluminium Production	422.14	NE					209.87			0.36	21.06	NE	4.04
4. SF6 Used in Aluminium and Magnesium Foundries									0.03				
5. Other (please specify)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.90	0.00	0.00
Other Non-Ferrous Metals										NO	1.90	NE	IE

TABLE 2(I) SECTORAL REPORT FOR INDUSTRIAL PROCESSES
(Sheet 2 of 2)

1999
Submission 2001

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO2	CH4	N2O	HFCs(1)		PFCs(1)		SF6		NOx	CO	NMVOC	SO2
				P	A	P	A	P	A				
	(Gg)			CO2 equivalent (Gg)				(Gg)					
D. Other Production	**IE**									**0.00**	**0.00**	**78.86**	**0.00**
1. Pulp and Paper										NE	NE	NE	NE
2. Food and Drink	IE											78.86	
E. Production of Halocarbons and SF6					**1,926.51**		**0.00**		**0.00**				
1. By-product Emissions					1,926.51		0.00		0.00				
Production of HCFC-22					IE								
Other (c)					1,926.51		IE		NO				
2. Fugitive Emissions					IE		IE		NO				
3. Other (please specify)					0.00		0.00		0.00				
F. Consumption of Halocarbons and SF6				**9,653.09**	**4,279.04**	**541.23**	**468.32**	**0.11**	**0.02**				
1. Refrigeration and Air Conditioning Equipment				7,999.51	2,843.16	60.55	29.43		NO				
2. Foam Blowing				65.00	42.90	0.00	0.00		NO				
3. Fire Extinguishers				207.26	13.86	45.34	3.55		NO				
4. Aerosols/ Metered Dose Inhalers				1,381.32	1,379.12	NO	NO		NO				
5. Solvents				0.00	0.00	0.00	0.00		NO				
6. Semiconductor Manufacture				NO	NO	IE	IE		IE				
7. Electrical Equipment				NO	NO	IE	IE		IE				
8. Other (please specify)				0.00	0.00	435.33	435.33	0.11	0.02				
Semiconductors, Electrical and production of trainers				NO	NO	435.33	435.33	0.11	0.02				
G. Other (please specify)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

TABLE 3 SECTORAL REPORT FOR SOLVENT AND OTHER PRODUCT USE
(Sheet 1 of 1)

1999

Submission 2001

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO2 (d)	N2O	NMVOC
	(Gg)		
Total Solvent and Other Product Use	**0.00**	**0.00**	**471.59**
A. Paint Application	**NE**	**NA**	**134.98**
B. Degreasing and Dry Cleaning	**NE**	**NA**	**46.70**
C. Chemical Products, Manufacture and Processing			**30.06**
D. Other (please specify)	0.00	0.00	259.84
(Use of N2O for Anaesthesia)		NE	NA
(N2O from Fire Extinguishers)		NO	NA
(N2O from Aerosol Cans)		NO	NA
(Other Use of N2O)		NO	NA
(NMVOC from Aerosols)	NE	NA	50.00
(Agrochemicals Use)	NE	NA	3.58
(Industrial Adhesives)	NE	NA	33.33
(Non-aerosol consumer products)	NE	NA	68.37
(Paper coating)	NE	NA	3.95
(Printing)	NE	NA	31.83
(Seed oil extraction)	NE	NA	2.35
(Wood preservation)	NE	NA	20.42
(Other Use of Solvent)	NE	NA	46.00

TABLE 4 SECTORAL REPORT FOR AGRICULTURE
(Sheet 1 of 2)

1999
Submission 2001

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CH4	N2O	NOx	CO	NMVOC
	(Gg)				
Total Agriculture	**1,001.84**	**95.40**	**0.00**	**0.00**	**0.00**
A. Enteric Fermentation	**892.35**				
1. Cattle	666.07				
Dairy Cattle	280.55				
Non-Dairy Cattle	385.51				
2. Buffalo	NO				
3. Sheep	209.67				
4. Goats	0.39				
5. Camels and Llamas	NO				
6. Horses	4.99				
7. Mules and Asses	NO				
8. Swine	10.93				
9. Poultry	0.00				
10. Other (please specify)	0.33				
Deer	0.33				
B. Manure Management	**109.482**	**5.15**			**0.00**
1. Cattle	69.37				
Dairy Cattle	31.57				
Non-Dairy Cattle	37.80				
2. Buffalo	NO				
3. Sheep	5.02				
4. Goats	0.01				
5. Camels and Llamas	NO				
6. Horses	0.39				
7. Mules and Asses	NO				
8. Swine	21.85				
9. Poultry	12.84				

TABLE 4 SECTORAL REPORT FOR AGRICULTURE
(Sheet 2 of 2)

1999
Submission 2001

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CH4	N2O	NOx	CO	NMVOC
	(Gg)				
B. Manure Management (continued)					
10. Anaerobic Lagoons		0.00			NO
11. Liquid Systems		0.28			NO
12. Solid Storage and Dry Lot		4.21			NO
13. Other (please specify)		0.66			0.00
Other		0.66			NO
					NO
					NO
C. Rice Cultivation	0.00				**0.00**
1. Irrigated	0.00				NO
2. Rainfed	0.00				NO
3. Deep Water	0.00				NO
4. Other (please specify)	0.00				0.00
D. Agricultural Soils	**0.00**	**90.25**			**0.00**
1. Direct Soil Emissions	0.00	43.65			NO
2. Animal Production	0.00	16.82			NO
3. Indirect Emissions	0.00	29.26			NO
4. Other (please specify)	0.00	0.52			0.00
Improved Grass		0.52			NO
E. Prescribed Burning of Savannas	**0.00**	**0.00**	**NO**	**NO**	**NO**
F. Field Burning of Agricultural Residues (e)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
1 . Cereals	0.00	0.00	NO	NO	NO
2. Pulse	0.00	0.00	NO	NO	NO
3 . Tuber and Root	0.00	0.00	NO	NO	NO
4 . Sugar Cane	NO	NO	NO	NO	NO
5 . Other (please specify)	0.00	0.00	0.00	0.00	0.00
G. Other (please specify)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

TABLE 5 SECTORAL REPORT FOR LAND-USE CHANGE AND FORESTRY
(Sheet 1 of 1)

1999
Submission 2001

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO2 emissions	CO2 removals	Net CO2 emissions/ removals	CH4	N2O	NOx	CO
	(Gg)						
Total Land-Use Change and Forestry (a)	**16,271.01**	**-11,539.00**	**(a)**	**0.00**	**0.00**	**0.00**	**0.00**
A. Changes in Forest and Other Woody Biomass Stocks	**0.00**	**-10,439.00**					
1. Tropical Forests	NO	NO					
2. Temperate Forests (f)	NO	-10,439.00					
3. Boreal Forests	NO	NO					
4. Grasslands/Tundra	NO	NO					
5. Other (please specify)	0.00	0.00					
Harvested Wood	NO	0.00					
B. Forest and Grassland Conversion	**0.00**			**0.00**	**0.00**	**0.00**	**0.00**
1. Tropical Forests	NO						
2. Temperate Forests	NO						
3. Boreal Forests	NO						
4. Grasslands/Tundra	NO						
5. Other (please specify)	0.00			0.00	0.00	0.00	0.00
C. Abandonment of Managed Lands	**0.00**	**0.00**					
1. Tropical Forests	NO	NO					
2. Temperate Forests	NO	NE					
3. Boreal Forests	NO	NO					
4. Grasslands/Tundra	NO	NE					
5. Other (please specify)	0.00	0.00					
D. CO2 Emissions and Removals from Soil (g)	**12,663.01**	**0.00**					
E. Other (please specify) (h) (i)	**3,608.00**	**-1,100.00**		**0.00**	**0.00**	**0.00**	**0.00**

TABLE 6 SECTORAL REPORT FOR WASTE
(Sheet 1 of 1)

1999
Submission 2001

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 (1)	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(Gg)						
Total Waste	**0.00**	**752.10**	**3.62**	**1.10**	**3.67**	**7.34**	**0.78**
A. Solid Waste Disposal on Land	**0.00**	**716.00**		**0.00**	**0.00**	**7.16**	
1. Managed Waste Disposal on Land	NA	716.00		NA	NA	7.16	
2. Unmanaged Waste Disposal Sites	0.00	0.00		NO	NO	NO	
3. Other *(please specify)*	0.00	0.00		0.00	0.00	0.00	
B. Wastewater Handling		**36.02**	**3.45**	**0.00**	**0.00**	**0.00**	
1. Industrial Wastewater		0.00	NE	NA	NA	NE	
2. Domestic and Commercial Wastewater (j)		36.02	3.45	NA	NA	NE	
3. Other *(please specify)*		0.00	0.00	0.00	0.00	0.00	
C. Waste Incineration	**0.00**	**0.08**	**0.17**	**1.10**	**3.67**	**0.18**	**0.78**
D. Other *(please specify)*	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

SUMMARY 1.A SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7A)

(Sheet 1 of 3)

1999

Submission 2001

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		CO2 emissions	CO2 removals	CH4	N2O	HFCs		PFCs		SF6		NOx	CO	NMVOC	SO2
						P	A	P	A	P	A				
		(Gg)				CO2 equivalent (Gg)						(Gg)			
Total National Emissions and Removals (a)		**547,800.86**	**-11,589.00**	**2,630.75**	**138.36**	**9,653.09**	**6,205.55**	**541.23**	**678.19**	**0.11**	**0.05**	**1,601.60**	**4,757.31**	**1,564.82**	**1,187.02**
1. Energy		**518,049.24**		**874.20**	**27.55**							**1,594.51**	**4,305.10**	**920.10**	**1,165.92**
A. Fuel Combustion	Reference Approach	541,095.07													
	Sectoral Approach	509,916.99		108.63	27.35							1,390.48	4,263.71	598.04	1,160.48
1. Energy Industries		179,116.20		32.82	7.80							422.21	94.42	10.34	883.40
2. Manufacturing Industries and Construction		88,668.35		12.01	3.31							325.17	476.00	29.17	159.12
3. Transport		121,535.57		18.43	14.68							384.50	3,312.35	497.79	39.61
4. Other Sectors		117,421.29		45.20	1.43							135.71	373.00	78.42	77.96
5. Other (b)		3,135.58		0.16	0.13							22.90	7.93	1.32	6.33
B. Fugitive Emissions from Fuels		8,132.24		765.58	0.20							4.03	41.39	322.06	5.45
1. Solid Fuels		2,241.63		310.88	0.00							0.41	27.41	0.13	0.81
2. Oil and Natural Gas		5,890.61		454.70	0.20							3.62	13.98	321.93	4.68
2. Industrial Processes		**13,479.81**		**2.62**	**11.79**	**9,653.09**	**6,205.55**	**541.23**	**678.19**	**0.11**	**0.05**	**5.99**	**448.54**	**165.79**	**20.32**
A. Mineral Products		9,135.60		0.00	0.00							0.00	0.00	7.75	0.00
B. Chemical Industry		1,107.30		1.88	11.36	0.00	0.00	0.00	0.00	0.00	0.00	2.31	78.81	77.30	14.41
C. Metal Production		3,236.91		0.74	0.03				209.87		0.03	3.68	369.73	1.68	5.91
D. Other Production		0.00										0.00	0.00	78.86	0.00
E. Production of Halocarbons and SF6							1,926.51		0.00		0.00				
F. Consumption of Halocarbons and SF6						9,653.09	4,279.04	541.23	468.32	0.11	0.02				
G. Other		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

SUMMARY 1.A SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7A)
(Sheet 2 of 3)

1999
Submission 2001

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO2 emissions	CO2 removals	CH4	N2O	HFCs		PFCs		SF6		NOx	CO	NMVOC	SO2
					P	A	P	A	P	A				
	(Gg)				CO2 equivalent (Gg)						(Gg)			
3. Solvent and Other Product Use (d)	**0.00**		**0.00**	**0.00**									**471.59**	
4. Agriculture	**0.00**	**0.00**	**1,001.836**	**95.40**							0.00	0.00	0.00	0.00
A. Enteric Fermentation			892.354											
B. Manure Management			109.48	5.15									0.00	
C. Rice Cultivation			0.00										0.00	
D. Agricultural Soils			0.00	90.25									0.00	
E. Prescribed Burning of Savannas			0.00	0.00							NO	NO	NO	
F. Field Burning of Agricultural Residues (e)			0.00	0.00							0.00	0.00	0.00	
G. Other			0.00	0.00							0.00	0.00	0.00	
5. Land-Use Change and Forestry (a)	**16,271.01**	**-11,539.00**	**0.00**	**0.00**							**0.00**	**0.00**	**0.00**	**0.00**
A. Changes in Forest and Other Woody Biomass Stocks (f)	0.00	-10,439.00												
B. Forest and Grassland Conversion	0.00		0.00	0.00							0.00	0.00		
C. Abandonment of Managed Lands	0.00	0.00												
D. CO2 Emissions and Removals from Soil (g)	12,663.01	0.00												
E. Other (h)	3,608.00	-1,100.00	0.00	0.00							0.00	0.00		
6. Waste	**0.00**		**752.10**	**3.62**							**1.10**	**3.67**	**7.34**	**0.78**
A. Solid Waste Disposal on Land	0.00		716.00									0.00	7.16	
B. Wastewater Handling (i)	0.00		36.02	3.45							0.00	0.00	0.00	
C. Waste Incineration	0.00		0.08	0.17							1.10	3.67	0.18	0.78
D. Other	0.00		0.00	0.00							0.00	0.00	0.00	0.00
7. Other (please specify)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

SUMMARY 1.A SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7A)
(Sheet 3 of 3)

1999
Submission 2001

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO2 emissions	CO2 removals	CH4	N2O	HFCs		PFCs		SF6		NOx	CO	NMVOC	SO2
					P	A	P	A	P	A				
	(Gg)				CO2 equivalent (Gg)						(Gg)			
Memo Items:														
International Bunkers (k)	**31,895.86**		**4.86**	**1.19**							**243.13**	**110.46**	**62.48**	**89.54**
Aviation (k)	25,539.33		4.28	0.79							127.28	95.42	58.19	6.49
Marine (k)	6,356.53		0.59	0.41							115.85	15.04	4.29	83.05
Multilateral Operations	**NO**		**NO**	**NO**							**NO**	**NO**	**NO**	**NO**
CO2 Emissions from Biomass (kl)	**7,000.26**													

Footnotes for IPCC Sectoral Tables

(a) Net flux may be estimated as the sum of emissions and removals
(b) Naval vessels and military aircraft
(c) Emissions arise from refrigeration, electronics applications, electrical insulation, foams, aerosols and training shoes
(d) The CO_2 equivalent of solvent NMVOC (excluding 3C) is 1644 Gg in 1990 and 1136 Gg in 1999
(e) Field burning ceased in 1993
(f) 5A Removals include removals to forest litter and to forest products
(g) 5D Emissions include removals to soils due to set aside of arable land and emissions due to liming
(h) 5E Emissions include emissions from soils due to upland drainage, lowland drainage and peat extraction
(i) 5E Removals are increases in crop biomass
(j) Emissions from own wastewater treatment by industry are not estimated
(k) Emissions are for information only and are not totalled
(l) Emissions arise from wood, straw, biogases and poultry litter combustion for energy production