UK Greenhouse Gas Inventory,1990 to 2000

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, 2001). The current report extends the data for all gases to 2000 and provides additional information related to the 2000 National Inventory recently submitted to the FCCC

Total GWP weighted emissions declined by 12.8% between 1990 and 2000. Carbon dioxide fell by 7.5%, methane by 33.4% and nitrous oxide by 35.4%. Fluorinated compounds included in the Kyoto basket fell by 19.9% over this period. For the base year, which is comprised of 1990 data for carbon dioxide, methane and nitrous oxide, and 1995 data for the fluorinated compounds, then the corresponding falls in emissions to 2000 are: carbon dioxide, 7.5%; methane, 33.4%; nitrous oxide, 35.4%; fluorinated compounds, 33.9%; total GWP weighted emissions, 13.2%. 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[1])

	Base Year[2]	1990	1991	1992	1993	1994	1995
Carbon Dioxide (emissions)	603.1	603.1	606.8	592.1	576.6	572.6	563.6
Methane	76.5	76.5	75.4	73.6	70.4	63.9	63.6
Nitrous Oxide	67.9	67.9	66.0	59.1	55.4	59.8	57.1
HFCs	15.2	11.4	11.9	12.3	12.9	13.8	15.2
PFCs	1.1	2.3	1.8	1.0	0.8	1.0	1.1
SF_6	1.1	0.7	0.8	0.8	0.9	1.1	1.1
Total	764.9	761.8	762.6	738.9	717.1	712.2	701.7
Carbon Dioxide (removals)	-10.6	-10.6	-10.7	-10.8	-11.1	-11.3	-11.5
Carbon Dioxide (net emission)[3]	592.5	592.5	596.2	581.3	565.6	561.3	552.1
Total (net emissions)[3]	754.3	751.3	751.9	728.1	706.0	700.9	690.2

	1996	1997	1998	1999	2000	% change 1990-00
Carbon Dioxide	583.5	559.0	561.6	552.9	557.7	-7.5
Methane	62.2	59.9	57.2	54.4	51.0	-33.4
Nitrous Oxide	59.1	60.8	58.0	44.9	43.8	-35.4
HFCs	16.3	18.4	20.2	8.6	9.3	-18.1
PFCs	0.9	0.7	0.7	0.7	0.7	-70.7
SF_6	1.3	1.3	1.5	1.5	1.5	113
Total	723.3	700.1	699.1	662.9	664.1	-12.8
Carbon Dioxide (removals)	-11.6	-11.6	-11.5	-11.5	-11.7	-10.4
Carbon Dioxide (net emission)[3]	571.9	547.5	550.1	541.3	546.1	-7.8
Total (net emissions)[3]	711.7	688.5	687.6	651.3	652.4	-13.2

1 One Tg is equal to 10^{12} g or one million tonnes.
2 The 1990 base year is the sum of 1990 totals for CO_2 ,CH_4 and N_2O and 1995 totals for HFC, PFC and SF_6
3 Net Emissions are reported in the Common Reporting Format.

Emissions of nitrogen oxides, carbon monoxide, non-methane volatile organic compounds, and sulphur dioxide have also declined significantly over the same time period.

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. It should be noted that in this report, carbon dioxide emissions and removals are reported separately and that carbon dioxide removals are reported with a negative

sign. However, in the CRF, carbon dioxide is reported as net emissions (=emissions +removals). 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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Email: defra@iforcegroup.com

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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 2000. 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 Institute of Grassland and Environmental Research. (IGER)

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 1990-2000, and discusses the reasons for the trends and any changes in the estimates due to revisions made since the last inventory. Tables 1-11 give the UK summary data for these years and the IPCC Sectoral Tables are given for 1990 and 2000. 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 Appendices also include sections on the estimation of uncertainties, quality assurance and quality control systems. They have been expanded to include a new section on verification. 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. It should be noted that in this report, carbon dioxide emissions and removals are reported separately and that carbon dioxide removals are reported with a negative sign. However, in the CRF, carbon dioxide is reported as net emissions (=emissions +removals). 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. Land Use Change and Forestry Data in both formats are discussed in Appendix 6. A copy of the CRF accompanies this report on a CD ROM.

2 Summary Reports of UK Greenhouse Gas Emissions 1990-2000

Tables 1-11 give summary data for UK greenhouse gas emissions for the years 1990-2000. 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 2002

1990

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	**603052**	**-10556**	**3644.5**	**219**	**41.77**	**11373.84**	**250.18**	**2201.00**	**0.11**	**0.03**	**2767**	**7219**	**2509**	**3721**
1. Energy		**568745**		**1453.4**	**17.98**							**2742.7**	**6751.8**	**1554.7**	**3661.8**
A. Fuel Combustion	Reference Approach	572763													
	Sectoral Approach	556600		121.0	17.67							2736.9	6689.4	1088.8	3623.4
1. Energy Industries		228089		7.7	7.32							880.8	143.0	10.9	2884.1
2. Manufacturing Industries and Construction		94133		13.0	3.82							284.1	797.8	30.2	433.6
3. Transport		116581		30.3	4.34							1396.2	5262.2	944.7	90.1
4. Other Sectors		112538		69.9	1.98							140.3	473.1	100.8	206.4
5. Other	b	5265		0.3	0.21							35.5	13.4	2.2	9.2
B. Fugitive Emissions from Fuels		12138		1332.5	0.31							5.8	61.6	465.9	38.4
1. Solid Fuels		3000		819.2	0.01							0.5	27.1	0.3	22.1
2. Oil and Natural Gas		9138		513.3	0.30							5.3	34.5	465.6	16.2
2. Industrial Processes		**14140**		**8.6**	**94.46**	**41.77**	**11373.84**	**250.18**	**2201.00**	**0.11**	**0.03**	**10.5**	**198.6**	**242.4**	**54.9**
A. Mineral Products		9629		1.1	0.00							0.0	5.2	13.0	14.1
B. Chemical Industry		1358		6.7	94.42	0.00	0.00	0.00	0.00	0.00	0.00	8.4	24.5	148.2	32.5
C. Metal Production		3161		0.8	0.04				2031.00		0.03	2.1	168.8	2.1	8.2
D. Other Production		IE										0.0	0.0	79.1	0.0
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	0.0
3. Solvent and Other Product Use	d	**0**			**0.00**									**665.7**	
4. Agriculture		0		**1032.1**	**103.05**							9.1	266.0	35.0	
A. Enteric Fermentation				908.5	0.00									0.0	
B. Manure Management				110.9	4.88									0.0	
C. Rice Cultivation				0.0	0.00									0.0	
D. Agricultural Soils				0.0	97.91									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	**19349**	**-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	IE												
E. Other	h	3908	-1100												
6. Waste		**812**		**1150.4**	**3.47**							**4.7**	**3.1**	**11.3**	**4.3**
A. Solid Waste Disposal on Land		0		1117.0	0.00							0.0	0.0	11.2	0.0
B. Wastewater Handling	i	0		33.4	3.33							0.0	0.0	0.0	0.0
C. Waste Incineration		812		0.0	0.13							4.7	3.1	0.1	4.3
D. Other		0		0.0	0.00							0.0	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**	**0.0**
Memo Items: (7)															
International Bunkers	k	**21349**		**3.5**	**0.87**							**192.4**	**75.6**	**41.3**	**95.3**
Aviation	k	14791		**2.9**	**0.45**							**72.8**	**60.1**	**36.9**	**2.8**
Marine	k	6559		**0.6**	**0.42**							**119.6**	**15.5**	**4.4**	**92.5**
Multilateral Operations		**NO**		**NO**	**NO**							**NO**	**NO**	**NO**	**NO**
CO2 Emissions from Biomass	h	**2979**													

Table 2: SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7A)												Submission 2002			
												1991			
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	**606834**	**-10666**	**3500.7**	**213**	**47.45**	**11050.80**	**233.33**	**1790.25**	**0.11**	**0.03**	**2641**	**7012**	**2430**	**3534**
1. Energy		**574722**		**1453.1**	**18.23**							**2619.7**	**6587.5**	**1538.4**	**3478.9**
A. Fuel Combustion	Reference Approach	589965													
	Sectoral Approach	564980		124.2	17.97							2615.2	6535.0	1070.6	3454.0
1. Energy Industries		226050		8.4	7.32							786.5	141.5	11.0	2703.6
2. Manufacturing Industries and Construction		94819		13.0	3.93							276.3	787.5	31.0	444.8
3. Transport		116058		29.5	4.49							1370.2	5098.9	923.0	88.1
4. Other Sectors		123780		73.1	2.03							148.5	496.3	103.8	207.9
5. Other	b	4272		0.2	0.18							33.7	10.8	1.9	9.6
B. Fugitive Emissions from Fuels		9734		1338.9	0.26							4.6	52.5	467.7	24.9
1. Solid Fuels		2300		838.3	0.00							0.3	25.1	0.3	18.8
2. Oil and Natural Gas		7434		490.6	0.26							4.3	27.4	467.5	6.1
2. Industrial Processes		**11772**		**8.1**	**88.51**	**47.45**	**11050.80**	**233.33**	**1790.25**	**0.11**	**0.03**	**9.3**	**193.9**	**231.3**	**51.2**
A. Mineral Products		8224		0.9	0.00							0.0	4.3	12.6	11.5
B. Chemical Industry		1338		6.7	88.48	0.00	0.00	0.00	0.00	0.00	0.00	7.6	25.2	138.1	31.6
C. Metal Production		2189		0.5	0.03				1557.10		0.02	1.8	164.5	1.9	8.1
D. Other Production		IE										0.0	0.0	78.7	0.0
E. Production of Halocarbons and SF6							11041.18		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	0.0
3. Solvent and Other Product Use	d	**0**			**0.00**									**627.9**	
4. Agriculture		0		**1016.2**	**102.58**							7.8	227.8	29.9	
A. Enteric Fermentation				895.3	0.00									0.0	
B. Manure Management				110.0	4.87									0.0	
C. Rice Cultivation				0.0	0.00									0.0	
D. Agricultural Soils				0.0	97.40									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		-9688												
B. Forest and Grassland Conversion		0													
C. Abandonment of Managed Lands		0	0												
D. CO2 Emissions and Removals from Soil	g	15853	IE												
E. Other	hi	3883	-1100												
6. Waste		**806**		**1111.3**	**3.43**							**4.7**	**3.0**	**10.9**	**4.2**
A. Solid Waste Disposal on Land		0		1080.0	0.00							0.0	0.0	10.8	0.0
B. Wastewater Handling	j	0		31.3	3.31							0.0	0.0	0.0	0.0
C. Waste Incineration		806		0.0	0.13							4.7	3.0	0.1	4.2
D. Other		0		0.0	0.00							0.0	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**	**0.0**
Memo Items: (7)															
International Bunkers	k	**20909**		**3.3**	**0.85**							**107.5**	**73.3**	**40.1**	**90.8**
Aviation	k	14570		**2.7**	**0.45**							**71.9**	**58.3**	**35.0**	**3.7**
Marine	k	6340		**0.6**	**0.41**							**115.6**	**15.0**	**4.3**	**87.1**
Multilateral Operations		NO		NO	NO							NO	NO	NO	NO
CO2 Emissions from Biomass	hl	**3130**													

Table 3: SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7A) Submission 2002

1992

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	**592148**	**-10046**	**3502.6**	**191**	**112.23**	**12346.17**	**215.28**	**959.20**	**0.11**	**0.03**	**2562**	**6716**	**2339**	**3463**
1. Energy		**561038**		**1410.6**	**18.35**							**2543.8**	**6360.1**	**1486.0**	**3412.0**
A. Fuel Combustion	Reference Approach	578056													
	Sectoral Approach	551445		118.0	18.11							2539.5	6309.8	1029.3	3387.1
1. Energy Industries		313977		9.9	7.01							374.4	137.7	10.7	2386.1
2. Manufacturing Industries and Construction		99761		12.5	4.18							273.4	809.4	31.3	503.2
3. Transport		117503		28.2	4.86							1315.2	4879.9	886.7	91.5
4. Other Sectors		120136		67.2	1.89							145.0	472.5	98.8	197.3
5. Other	b	4068		0.2	0.17							31.5	10.3	1.8	9.1
B. Fugitive Emissions from Fuels		9592		1292.6	0.24							4.4	50.4	456.6	24.9
1. Solid Fuels		2178		803.9	0.00							0.3	22.8	0.2	17.2
2. Oil and Natural Gas		7414		488.8	0.24							4.1	27.5	456.4	7.7
2. Industrial Processes		**11156**		**9.0**	**71.61**	**112.23**	**12346.17**	**215.28**	**959.20**	**0.11**	**0.03**	**0.4**	**107.3**	**229.0**	**46.5**
A. Mineral Products		7676		0.8	0.00							0.0	3.8	12.5	10.3
B. Chemical Industry		1379		7.3	71.58	0.00	0.00	0.00	0.00	0.00	0.00	0.7	23.9	136.5	28.8
C. Metal Production		2101		0.5	0.03				744.20		0.02	1.3	159.6	1.9	7.5
D. Other Production		IE										0.0	0.0	78.9	0.0
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	0.0
3. Solvent and Other Product Use	d	**0**			**0.00**									**591.4**	
4. Agriculture		0		**1017.5**	**97.22**							5.6	165.2	21.6	
A. Enteric Fermentation				899.5	0.00									0.0	
B. Manure Management				110.1	4.79									0.0	
C. Rice Cultivation				0.0	0.00									0.0	
D. Agricultural Soils				0.0	92.27									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	g	**19173**	**-10046**												
A. Changes in Forest and Other Woody Biomass Stocks	f		-9748												
B. Forest and Grassland Conversion		0													
C. Abandonment of Managed Lands		0	0												
D. CO2 Emissions and Removals from Soil	g	16338	IE												
E. Other	hi	3835	-1100												
6. Waste		**781**		**1065.8**	**3.47**							**4.5**	**3.0**	**10.4**	**4.1**
A. Solid Waste Disposal on Land		0		1031.0	0.00							0.0	0.0	10.3	0.0
B. Wastewater Handling	j	0		34.8	3.34							0.0	0.0	0.0	0.0
C. Waste Incineration		781		0.0	0.13							4.5	3.0	0.1	4.1
D. Other		0		0.0	0.00							0.0	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**	**0.0**
Memo Items: (7)															
International Bunkers	k	**22761**		**3.6**	**0.92**							**200.7**	**79.6**	**43.6**	**94.7**
Aviation	k	16121		**3.0**	**0.49**							**79.6**	**63.9**	**39.1**	**5.1**
Marine	k	6640		**0.6**	**0.42**							**121.1**	**15.7**	**4.5**	**89.6**
Multilateral Operations		**NO**		**NO**	**NO**							**NO**	**NO**	**NO**	**NO**
CO2 Emissions from Biomass	kl	**3653**													

Table 4: SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7A)													Submission 2002		
													1993		
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	**576628**	**-11073**	**3354.2**	**179**	**446.59**	**12984.59**	**340.61**	**810.59**	**0.11**	**0.04**	**2365**	**6218**	**2234**	**3115**
1. Energy		**546937**		**1317.8**	**18.66**							**2354.8**	**6021.4**	**1417.2**	**3069.2**
A. Fuel Combustion	Reference Approach	561317													
	Sectoral Approach	537838		116.8	18.42							2350.6	5973.5	964.6	3047.3
1. Energy Industries		199254		11.3	6.69							669.2	126.8	10.8	2236.0
2. Manufacturing Industries and Construction		92486		12.5	3.89							269.4	791.6	30.4	501.5
3. Transport		118690		26.7	5.73							1237.1	4550.4	823.6	89.2
4. Other Sectors		123333		65.7	1.94							140.6	494.4	98.1	212.5
5. Other	b	4125		0.2	0.19							29.3	10.4	1.9	8.0
B. Fugitive Emissions from Fuels		9108		1201.0	0.24							4.2	47.8	452.5	21.9
1. Solid Fuels		1940		724.3	0.00							0.3	21.4	0.2	16.5
2. Oil and Natural Gas		7169		476.7	0.23							3.9	26.4	452.3	5.4
2. Industrial Processes		**11286**		**7.3**	**61.07**	**446.59**	**12984.59**	**340.61**	**810.59**	**0.11**	**0.04**	**7.6**	**191.1**	**224.5**	**42.9**
A. Mineral Products		9691		0.7	0.00							0.0	3.2	12.0	8.6
B. Chemical Industry		1339		6.2	61.04	0.00	0.00	0.00	0.00	0.00	0.00	5.9	26.5	130.7	26.8
C. Metal Production		2216		0.4	0.03				473.90		0.02	1.7	161.5	1.9	7.5
D. Other Production		IE										0.0	0.0	79.9	0.0
E. Production of Halocarbons and SF6							12978.30		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	0.0
3. Solvent and Other Product Use	d	**0**			**0.00**									**581.8**	
4. Agriculture		0		**1010.6**	**95.52**							0.1	3.5	0.5	
A. Enteric Fermentation				899.6	0.00									0.0	
B. Manure Management				110.8	4.82									0.0	
C. Rice Cultivation				0.0	0.00									0.0	
D. Agricultural Soils				0.0	90.69									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		-9873												
B. Forest and Grassland Conversion		0													
C. Abandonment of Managed Lands		0	0												
D. CO2 Emissions and Removals from Soil	g	13897	IE												
E. Other	hi	3787	-1100												
6. Waste		**722**		**1018.5**	**3.46**							**2.6**	**2.4**	**10.8**	**2.8**
A. Solid Waste Disposal on Land		0		984.0	0.00							0.0	0.0	9.8	0.0
B. Wastewater Handling	j	0		34.5	3.33							0.0	0.0	0.0	0.0
C. Waste Incineration		722		0.0	0.13							2.6	2.4	0.1	2.8
D. Other		0		0.0	0.00							0.0	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**	**0.0**
Memo Items: (7)															
International Bunkers	k	**23814**		**3.7**	**0.95**							**205.3**	**82.2**	**45.2**	**94.1**
Aviation	k	17241		**3.1**	**0.53**							**85.5**	**66.7**	**40.8**	**4.4**
Marine	k	6573		**0.6**	**0.42**							**119.8**	**15.6**	**4.4**	**89.7**
Multilateral Operations		**NO**		**NO**	**NO**							**NO**	**NO**	**NO**	**NO**
CO2 Emissions from Biomass	hl	**3705**													

Table 5: SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7A)												Submission 2002			
												1994			
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	**572603**	**-11286**	**3044.1**	**193**	**2648.06**	**13013.85**	**588.72**	**979.73**	**0.11**	**0.04**	**2268**	**5085**	**2185**	**2677**
1. Energy		**542893**		**1035.8**	**19.94**							**2257.0**	**5689.4**	**1378.2**	**2631.2**
A. Fuel Combustion	Reference Approach	554789													
	Sectoral Approach	531608		103.8	19.63							2251.6	5632.8	898.8	2610.5
1. Energy Industries		196560		13.0	6.93							698.3	133.3	12.0	1900.9
2. Manufacturing Industries and Construction		93858		12.9	3.82							278.7	750.4	30.4	432.1
3. Transport		119035		25.5	6.94							1165.7	4290.8	769.3	93.1
4. Other Sectors		118211		52.3	1.77							141.5	448.3	85.5	176.7
5. Other	b	3945		0.2	0.16							20.5	10.0	1.6	7.7
B. Fugitive Emissions from Fuels		11285		931.9	0.31							5.4	56.7	479.4	20.7
1. Solid Fuels		1785		456.6	0.00							0.3	21.7	0.2	14.1
2. Oil and Natural Gas		9499		475.3	0.31							5.1	35.0	479.1	6.6
2. Industrial Processes		**12461**		**8.9**	**71.50**	**2648.06**	**13013.85**	**588.72**	**979.73**	**0.11**	**0.04**	**6.9**	**193.3**	**217.8**	**43.1**
A. Mineral Products		8476		0.8	0.00							0.0	3.6	12.5	0.1
B. Chemical Industry		1339		7.6	71.47	0.00	0.00	0.00	0.00	0.00	0.00	5.1	27.8	122.4	26.6
C. Metal Production		2605		0.6	0.03				406.20		0.03	1.8	161.9	2.0	7.4
D. Other Production		IE										0.0	0.0	80.9	0.0
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	0.0
3. Solvent and Other Product Use	d	**0**			**0.00**									**579.5**	
4. Agriculture		0		**1018.4**	**97.95**							0.0	0.0	0.0	
A. Enteric Fermentation				906.3	0.00									0.0	
B. Manure Management				111.7	4.89									0.0	
C. Rice Cultivation				0.0	0.00									0.0	
D. Agricultural Soils				0.0	93.06									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	IE												
E. Other	hi	3859	-1100												
6. Waste		**580**		**981.0**	**3.46**							**3.7**	**2.6**	**9.6**	**2.3**
A. Solid Waste Disposal on Land		0		945.0	0.00							0.0	0.0	9.5	0.0
B. Wastewater Handling	j	0		36.0	3.35							0.0	0.0	0.0	0.0
C. Waste Incineration		580		0.0	0.11							3.7	2.6	0.1	2.3
D. Other		0		0.0	0.00							0.0	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**	**0.0**
Memo Items: (7)															
International Bunkers	k	**24006**		**3.8**	**0.94**							**200.4**	**84.5**	**47.0**	**85.1**
Aviation	k	17856		3.2	0.55							88.4	70.0	42.0	5.7
Marine	k	6150		0.6	0.39							112.1	14.5	4.2	79.4
Multilateral Operations		NO		NO	NO							NO	NO	NO	NO
CO2 Emissions from Biomass	hl	**4033**													

Table 6: SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7A)													Submission 2002		
													1995		
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	**563590**	**-11528**	**3027.7**	**184**	**4017.30**	**15205.03**	**753.81**	**1094.10**	**0.11**	**0.05**	**2093**	**5531**	**2055**	**2363**
1. Energy		**534301**		**1067.7**	**20.90**							**2084.7**	**5328.5**	**1270.0**	**2312.4**
A. Fuel Combustion	Reference Approach	551806													
	Sectoral Approach	525091		93.4	20.67							2079.2	5281.8	819.9	2295.7
1. Energy Industries		197766		15.6	7.10							576.9	134.4	10.1	1726.3
2. Manufacturing Industries and Construction		91653		13.2	3.77							280.5	730.8	29.1	340.8
3. Transport		117928		23.8	8.09							1076.5	4023.5	705.0	80.1
4. Other Sectors		113874		39.6	1.54							137.9	383.3	74.0	130.9
5. Other	b	3871		0.2	0.16							27.6	9.8	1.8	7.6
B. Fugitive Emissions from Fuels		9210		975.3	0.23							5.6	46.6	450.1	16.7
1. Solid Fuels		1986		504.3	0.00							0.3	21.7	0.2	10.5
2. Oil and Natural Gas		7224		471.0	0.23							5.3	24.9	449.9	6.2
2. Industrial Processes		**12504**		**7.0**	**61.30**	**4017.30**	**15205.03**	**753.81**	**1094.10**	**0.11**	**0.05**	**4.2**	**199.9**	**235.3**	**48.5**
A. Mineral Products		8525		0.2	0.00							0.0	3.6	11.7	12.2
B. Chemical Industry		1379		5.5	61.27	0.00	0.00	0.00	0.00	0.00	0.00	2.3	29.2	140.5	28.9
C. Metal Production		2540		0.7	0.03				372.35		0.03	1.9	167.1	2.0	7.4
D. Other Production		IE										0.0	0.0	81.2	0.0
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	0.0
3. Solvent and Other Product Use	d	**0**			**0.00**									**540.7**	
4. Agriculture		0		**1006.7**	**98.44**							0.0	0.0	0.0	
A. Enteric Fermentation				896.8	0.00									0.0	
B. Manure Management				109.9	4.82									0.0	
C. Rice Cultivation				0.0	0.00									0.0	
D. Agricultural Soils				0.0	93.62									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	s	**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	IE												
E. Other	hi	3883	-1100												
6. Waste		**569**		**946.4**	**3.50**							**3.6**	**2.2**	**9.2**	**2.3**
A. Solid Waste Disposal on Land		0		912.0	0.00							0.0	0.0	9.1	0.0
B. Wastewater Handling	j	0		34.3	3.39							0.0	0.0	0.0	0.0
C. Waste Incineration		569		0.0	0.11							3.6	2.2	0.1	2.3
D. Other		0		0.0	0.00							0.0	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**	**0.0**
Memo Items: (7)															
International Bunkers	k	**25611**		**4.0**	**1.01**							**214.6**	**89.0**	**40.4**	**95.9**
Aviation	k	19012		**3.4**	**0.50**							**94.3**	**73.4**	**44.9**	**4.8**
Marine	k	6599		**0.6**	**0.42**							**120.3**	**15.6**	**4.5**	**91.1**
Multilateral Operations		NO		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 2002

1996

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	**503543**	**-11612**	**2959.7**	**191**	**5413.15**	**16290.29**	**650.00**	**905.30**	**0.10**	**0.05**	**2019**	**5496**	**1992**	**2026**
1. Energy		**553093**		**1028.3**	**22.56**							**2011.4**	**5291.6**	**1225.1**	**1974.8**
A. Fuel Combustion	Reference Approach	564946													
	Sectoral Approach	543678		96.6	22.31							2006.5	5245.0	776.1	1957.0
1. Energy Industries		197680		17.5	7.37							330.9	133.6	10.9	1467.2
2. Manufacturing Industries and Construction		92534		13.6	3.67							254.5	723.4	29.5	282.3
3. Transport		122554		22.9	9.44							1041.5	3987.3	656.4	67.0
4. Other Sectors		127121		42.4	1.68							152.0	392.1	77.7	132.8
5. Other	b	3789		0.2	0.16							27.6	9.6	1.6	7.6
B. Fugitive Emissions from Fuels		9414		931.7	0.25							4.9	46.6	449.0	17.8
1. Solid Fuels		2043		473.6	0.00							0.3	21.7	0.2	11.1
2. Oil and Natural Gas		7372		458.0	0.25							4.6	24.9	448.8	6.7
2. Industrial Processes		**13314**		**0.1**	**65.49**	**5413.15**	**16290.29**	**650.00**	**905.30**	**0.10**	**0.05**	**4.0**	**201.4**	**234.5**	**49.4**
A. Mineral Products		8804		0.7	0.00							0.0	3.4	10.5	14.4
B. Chemical Industry		1379		6.6	65.45	0.00	0.00	0.00	0.00	0.00	0.00	2.1	29.4	139.3	27.3
C. Metal Production		3132		0.8	0.03				297.88		0.03	2.0	168.7	2.1	7.7
D. Other Production		IE										0.0	0.0	82.6	0.0
E. Production of Halocarbons and SF6							14091.96		0.00		0.00				
F. Consumption of Halocarbons and SF6	c					5413.15	1998.32	650.00	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	0.0
3. Solvent and Other Product Use	d	**0**			**0.00**									**523.0**	
4. Agriculture		0		**1016.0**	**99.03**							0.0	0.0	0.0	
A. Enteric Fermentation				905.1	0.00									0.0	
B. Manure Management				110.9	4.22									0.0	
C. Rice Cultivation				0.0	0.00									0.0	
D. Agricultural Soils				0.0	94.16									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	g	**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	IE												
E. Other	hi	3766	-1100												
6. Waste		**554**		**907.3**	**3.62**							**3.2**	**2.7**	**9.1**	**1.6**
A. Solid Waste Disposal on Land		0		872.0	0.00							0.0	0.0	8.7	0.0
B. Wastewater Handling	j	0		35.3	3.51							0.0	0.0	0.0	0.0
C. Waste Incineration		554		0.0	0.12							3.2	2.7	0.4	1.6
D. Other		0		0.0	0.00							0.0	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**	**0.0**
Memo Items: (7)															
International Bunkers	k	**27450**		**4.2**	**1.08**							**232.0**	**94.7**	**52.3**	**104.0**
Aviation	k	20238		**3.5**	**0.62**							**100.5**	**77.6**	**47.4**	**5.1**
Marine	k	7213		**0.7**	**0.46**							**131.5**	**17.1**	**4.9**	**98.8**
Multilateral Operations		**NO**		**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 2002		
													1997		
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	**559049**	**-11557**	**2852.0**	**196**	**7272.00**	**18446.80**	**494.74**	**661.24**	**0.10**	**0.05**	**1849**	**5211**	**1920**	**1665**
1. Energy		**529925**		**979.3**	**23.46**							**1843.6**	**5003.8**	**1179.2**	**1610.2**
A. Fuel Combustion	Reference Approach	541036													
	Sectoral Approach	521207		95.4	23.25							1839.3	4961.4	713.4	1594.4
1. Energy Industries		183447		20.6	7.48							452.0	103.1	10.3	1165.5
2. Manufacturing Industries and Construction		93229		14.1	3.54							256.3	731.0	29.5	252.4
3. Transport		129624		21.1	10.55							961.1	3740.8	597.6	54.5
4. Other Sectors		117095		39.4	1.58							141.7	370.4	74.5	113.9
5. Other	b	3613		0.2	0.15							28.2	9.1	1.6	8.2
B. Fugitive Emissions from Fuels		8718		883.9	0.21							4.2	42.4	485.9	15.8
1. Solid Fuels		2406		445.6	0.00							0.2	21.7	0.2	8.6
2. Oil and Natural Gas		6312		438.3	0.21							4.0	20.7	465.6	7.3
2. Industrial Processes		**12505**		**6.7**	**67.02**	**7272.00**	**18446.80**	**494.74**	**661.24**	**0.10**	**0.05**	**4.3**	**205.1**	**210.0**	**54.5**
A. Mineral Products		9623		0.7	0.00							0.0	3.3	9.9	18.1
B. Chemical Industry		888		5.3	66.99	0.00	0.00	0.00	0.00	0.00	0.00	2.4	28.2	125.3	26.4
C. Metal Production		2073		0.7	0.03				236.95		0.03	2.0	173.6	2.1	10.0
D. Other Production		IE										0.0	0.0	81.5	0.0
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	0.03				
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	0.0
3. Solvent and Other Product Use	d	**0**			**0.00**									**513.3**	
4. Agriculture		0		**1003.7**	**101.99**							0.0	0.0	0.0	
A. Enteric Fermentation				893.0	0.00									0.0	
B. Manure Management				110.7	4.22									0.0	
C. Rice Cultivation				0.0	0.00									0.0	
D. Agricultural Soils				0.0	97.11									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	g	**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	IE												
E. Other	hi	3675	-1100												
6. Waste		**208**		**862.2**	**3.58**							**0.0**	**1.7**	**0.3**	**0.5**
A. Solid Waste Disposal on Land		0		826.0	0.00							0.0	0.0	8.3	0.0
B. Wastewater Handling	j	0		36.2	3.50							0.0	0.0	0.0	0.0
C. Waste Incineration		208		0.0	0.07							0.2	1.7	0.1	0.5
D. Other		0		0.0	0.00							0.0	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**	**0.0**
Memo Items: (7)															
International Bunkers	k	**29617**		**4.5**	**1.18**							**254.1**	**101.6**	**55.9**	**123.7**
Aviation	k	21552		**3.8**	**0.64**							**107.8**	**82.5**	**50.4**	**6.8**
Marine	k	8064		**0.7**	**0.52**							**147.1**	**19.1**	**5.5**	**116.9**
Multilateral Operations		**NO**		**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 2002			
												1998			
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	**561639**	**-11528**	**2723.6**	**187**	**8607.30**	**20182.62**	**500.64**	**651.74**	**0.08**	**0.06**	**1737**	**4943**	**1785**	**1589**
1. Energy		**532556**		**902.4**	**24.72**							**1732.2**	**4751.3**	**1069.1**	**1539.9**
A. Fuel Combustion	Reference Approach	548245													
	Sectoral Approach	524834		96.6	24.52							1728.1	4709.6	644.6	1524.4
1. Energy Industries		180067		22.7	7.92							452.9	106.9	8.3	1177.5
2. Manufacturing Industries and Construction		90434		13.7	3.24							245.6	703.1	29.1	202.3
3. Transport		122763		19.3	11.66							863.9	3528.7	529.4	47.2
4. Other Sectors		118779		40.7	1.57							144.0	362.8	76.2	91.4
5. Other	b	3181		0.2	0.13							21.7	8.1	1.3	6.0
B. Fugitive Emissions from Fuels		8332		805.9	0.20							4.1	41.7	424.5	15.5
1. Solid Fuels		2054		375.6	0.00							0.3	21.6	0.2	8.6
2. Oil and Natural Gas		6277		430.3	0.20							3.8	20.1	424.3	6.9
2. Industrial Processes		**12352**		**4.7**	**59.45**	**8607.30**	**20182.62**	**500.64**	**651.74**	**0.08**	**0.06**	**4.0**	**187.9**	**205.1**	**48.5**
A. Mineral Products		9681		0.7	0.00							0.0	3.3	9.0	13.1
B. Chemical Industry		1111		3.4	39.42	0.00	0.00	0.00	0.00	0.00	0.00	2.2	17.7	113.3	26.5
C. Metal Production		1610		0.6	0.03				223.41		0.03	1.8	166.9	2.0	8.9
D. Other Production		IE										0.0	0.0	80.0	0.0
E. Production of Halocarbons and SF6							16332.71		0.00		0.00				
F. Consumption of Halocarbons and SF6	c					8607.30	3849.91	500.64	428.33	0.08	0.04				
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	0.0
3. Solvent and Other Product Use	d	**0**			**0.00**									**503.2**	
4. Agriculture		0		**1005.2**	**99.17**							0.0	0.0	0.0	
A. Enteric Fermentation				893.7	0.00									0.0	
B. Manure Management				111.5	4.88									0.0	
C. Rice Cultivation				0.0	0.00									0.0	
D. Agricultural Soils				0.0	94.30									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	**10523**	**-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	12987	IE												
E. Other	hi	3537	-1100												
6. Waste		**208**		**811.2**	**3.65**							**1.0**	**3.3**	**7.9**	**0.7**
A. Solid Waste Disposal on Land		0		774.0	0.00							0.0	0.0	7.7	0.0
B. Wastewater Handling	j	0		37.2	3.50							0.0	0.0	0.0	0.0
C. Waste Incineration		209		0.1	0.16							1.0	3.3	0.2	0.7
D. Other		0		0.0	0.00							0.0	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**	**0.0**
Memo Items: (7)															
International Bunkers	k	**32910**		**4.8**	**1.30**							**280.4**	**110.9**	**60.9**	**124.5**
Aviation	k	24122		**4.0**	**0.74**							**120.2**	**90.1**	**55.0**	**7.7**
Marine	k	8788		**0.8**	**0.56**							**160.2**	**20.8**	**5.9**	**116.8**
Multilateral Operations		NO		NO	NO							NO	NO	NO	NO
CO2 Emissions from Biomass	kl	**5022**													

Table 10: SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7A) — Submission 2002 — 1999

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		**552057**	**-11539**	**2980.6**	**145**	**9653.09**	**8600.54**	**541.23**	**670.19**	**0.08**	**0.06**	**1609**	**4727**	**1601**	**1210**
1. Energy		**523125**		**829.2**	**25.63**							**1603.8**	**4524.6**	**962.8**	**1169.7**
A. Fuel Combustion	Reference Approach	541765													
	Sectoral Approach	514839		107.7	25.43							1600.0	4495.3	597.9	1157.6
1. Energy Industries		130848		32.9	7.94							422.3	94.7	10.4	878.2
2. Manufacturing Industries and Construction		89698		13.4	3.20							230.4	717.3	29.0	156.1
3. Transport		123488		17.8	12.72							706.8	3309.5	479.2	35.2
4. Other Sectors		117674		43.5	1.44							137.5	365.8	78.1	81.8
5. Other	b	3136		0.2	0.13							22.9	7.9	1.3	6.3
B. Fugitive Emissions from Fuels		8286		721.5	0.20							3.8	29.4	364.9	12.1
1. Solid Fuels		3396		310.9	0.00							0.2	15.4	0.2	7.4
2. Oil and Natural Gas		3891		410.7	0.20							3.6	14.0	364.7	4.7
2. Industrial Processes		**13157**		**4.0**	**10.16**	**9653.09**	**8600.54**	**541.23**	**670.19**	**0.08**	**0.06**	**4.3**	**190.5**	**160.8**	**39.7**
A. Mineral Products		9091		0.6	0.00							0.0	1.5	8.3	9.0
B. Chemical Industry		1113		2.7	18.13	0.00	0.00	0.00	0.00	0.00	0.00	2.4	9.7	78.4	23.1
C. Metal Production		2953		0.7	0.03				209.87		0.03	1.9	187.2	1.9	7.6
D. Other Production		IE										0.0	0.0	80.1	0.0
E. Production of Halocarbons and SF6							4321.50		0.00		0.00				
F. Consumption of Halocarbons and SF6	c					9653.09	4279.04	541.23	460.32	0.08	0.04				
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	0.0
3. Solvent and Other Product Use	d	**0**			**0.00**									**462.3**	
4. Agriculture		0		**1003.2**	**97.34**							0.0	0.0	0.0	
A. Enteric Fermentation				893.6	0.00									0.0	
B. Manure Management				109.7	4.94									0.0	
C. Rice Cultivation				0.0	0.00									0.0	
D. Agricultural Soils				0.0	92.40									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	**16367**	**-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	12759	IE												
E. Other	h	3608	-1100												
6. Waste		**208**		**752.1**	**3.62**							**1.1**	**3.7**	**7.3**	**0.8**
A. Solid Waste Disposal on Land		0		716.0	0.00							0.0	0.0	7.2	0.0
B. Wastewater Handling	i	0		36.0	3.45							0.0	0.0	0.0	0.0
C. Waste Incineration		208		0.1	0.17							1.1	3.7	0.2	0.8
D. Other		0		0.0	0.00							0.0	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**	**0.0**
Memo Items: (7)															
International Bunkers	k	**32781**		**4.9**	**1.22**							**247.9**	**111.9**	**63.2**	**88.9**
Aviation	k	26424		4.3	0.81							132.1	96.8	58.9	5.9
Marine	k	6357		0.6	0.41							115.9	15.0	4.3	83.1
Multilateral Operations		**NO**		**NO**	**NO**							**NO**	**NO**	**NO**	**NO**
CO2 Emissions from Biomass	kl	**6409**													

Table 11: SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7A)												Submission 2002			
												2000			
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	**557750**	**-11653**	**2426.7**	**142**	**10732.35**	**9316.30**	**534.78**	**668.23**	**0.08**	**0.06**	**1520**	**4170**	**1499**	**1166**
1. Energy		**529424**		**757.1**	**26.59**							**1514.4**	**3974.6**	**894.1**	**1130.0**
A. Fuel Combustion	Reference Approach	534084													
	Sectoral Approach	521612		98.3	26.44							1511.3	3946.0	522.1	1120.0
1. Energy Industries		190833		36.1	8.46							438.3	93.5	9.7	906.4
2. Manufacturing Industries and Construction		86510		12.7	2.93							216.3	607.0	28.6	117.2
3. Transport		123046		16.0	13.56							699.3	2901.9	413.3	25.8
4. Other Sectors		118322		33.3	1.32							135.4	336.3	69.2	64.6
5. Other	b	3900		0.2	0.13							22.0	7.3	1.3	6.1
B. Fugitive Emissions from Fuels		7812		658.7	0.15							3.1	28.5	362.0	10.0
1. Solid Fuels		2300		265.0	0.00							0.3	15.6	0.2	7.0
2. Oil and Natural Gas		5509		393.7	0.15							2.9	13.0	361.8	3.0
2. Industrial Processes		**13111**		**3.0**	**19.97**	**10732.35**	**9316.30**	**534.78**	**668.23**	**0.08**	**0.06**	**4.0**	**199.5**	**163.5**	**35.1**
A. Mineral Products		8534		0.6	0.00							0.0	2.7	9.6	10.6
B. Chemical Industry		1389		2.5	19.94	0.00	0.00	0.00	0.00	0.00	0.00	2.2	9.7	73.5	17.1
C. Metal Production		3187		0.7	0.03				203.10		0.03	1.8	187.0	1.8	7.4
D. Other Production		IE										0.0	0.0	78.7	0.0
E. Production of Halocarbons and SF6							4316.77		0.00		0.00				
F. Consumption of Halocarbons and SF6	c					10732.35	4999.53	534.78	465.13	0.08	0.04				
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	0.0
3. Solvent and Other Product Use	d	**0**			**0.00**									**444.5**	
4. Agriculture		**0**		**968.9**	**91.17**							0.0	0.0	0.0	
A. Enteric Fermentation				863.7	0.00									0.0	
B. Manure Management				105.2	4.63									0.0	
C. Rice Cultivation				0.0	0.00									0.0	
D. Agricultural Soils				0.0	86.55									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	g	**15007**	**-11653**												
A. Changes in Forest and Other Woody Biomass Stocks	f		-10553												
B. Forest and Grassland Conversion		0													
C. Abandonment of Managed Lands		0	0												
D. CO2 Emissions and Removals from Soil	g	11441	IE												
E. Other	hi	3566	-1100												
6. Waste		**208**		**697.0**	**3.81**							**1.1**	**3.7**	**6.0**	**0.0**
A. Solid Waste Disposal on Land		0		660.0	0.00							0.0	0.0	6.6	0.0
B. Wastewater Handling	j	0		36.9	3.64							0.0	0.0	0.0	0.0
C. Waste Incineration		208		0.1	0.17							1.1	3.7	0.2	0.8
D. Other		0		0.0	0.00							0.0	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**	**0.0**
Memo Items: (7)															
International Bunkers	k	**34137**		**5.0**	**1.24**							**244.8**	**116.7**	**66.7**	**75.9**
Aviation	k	28544		**4.5**	**0.88**							**142.9**	**103.4**	**62.9**	**6.5**
Marine	k	5594		**0.5**	**0.36**							**101.9**	**13.2**	**3.8**	**69.4**
Multilateral Operations		**NO**		**NO**	**NO**							**NO**	**NO**	**NO**	**NO**
CO2 Emissions from Biomass	kl	**6040**													

Footnotes for Tables 1 to 11

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 1505 Gg in 1990 and 1033 Gg in 2000
e Field burning ceased in 1994
f 5A Removals are sum of removals to forest biomass, forest litter and forest soil.
g 5D Emissions are sum of emissions from soils and removals to soils due to land use change (not forestry), Set Aside and liming of agricultural land.
h 5E Emissions are sum of 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
NE Not estimated
NO Not occurring
IE Included elsewhere

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 taken from the Digest of UK Energy Statistics (DTI, 2001) 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 6 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 2000 inventory giving an overall uncertainty for carbon dioxide emissions of ±2.2-2.7%. (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. Removals are reported with a negative sign. This differs from the format used in the Common Reporting Format where net emissions are reported (=emissions +removals). 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 1999 Inventory was published (Salway *et al*, 2001). Overall emissions have been revised upwards by 5057 Gg CO_2.[♦] Comparisons between the inventories refer to the year 1999 and the main changes are:

[*] Emissions from fuel combustion are defined as IPCC category 1A and refer to the combustion of fuels for energy production.

[♦] One Gg equals one thousand tonnes.

1) Fuel Combustion
   - There has been a significant increase in emissions of CO_2 (1419 Gg) from Public Electricity Production in 1999. This arises from revisions in the energy statistics mainly for coal but with a contribution from natural gas consumption.
   - There has been a small increase in emissions reported from petroleum refineries (344 Gg). This arises from minor revisions in the energy statistics for gas oil, LPG and natural gas.
   - Emissions reported for manufacturing industry have been revised upwards by 966 Gg CO_2. This arises from revisions in the energy statistics mainly for burning oil and natural gas.
   - There has been a large increase in emissions reported from transport (1878 Gg). This arises from revisions in the energy statistics for diesel oil and petrol.
   - Emissions from LPG fuelled road vehicles have been included. Emissions are estimated from 1996 to 2000. In 2000, LPG powered vehicle contributed 64 Gg CO_2 to the road transport emission.
   - There has been a small increase in emissions from 1A4a Commercial and Institutional of 571 Gg CO_2. This arises from revisions to the fuel consumption reported for the public sector and commercial sector. Emissions from municipal solid waste incinerators that produce heat are now included 1A4a Commercial and Institutional. This new source however only accounts for 39 Gg CO_2.
   - There has been a reduction of 308 Gg CO_2 in domestic emissions due to revisions downwards in coal and anthracite consumption.
2) Fugitive Emissions From Fuels
   - Emissions from solid smokeless fuel production have been revised upwards. The revision arises from the assumption that anthracite is used in the production process rather than coking coal. Anthracite has a higher carbon content than coking coal. The change is applied from 1996 onwards to reflect the change from the older coking processes to the modern briquetting processes. The increase in emissions is 144 Gg CO_2.
3) Industrial Processes
   - Emissions from cement production have fallen by 152 Gg CO_2 owing to a 2.5% reduction in the emission factor used. This new factor is based on a new estimate of the CaO content of UK cement clinker provided by the British Cement Association
   - Emissions from the production of Fletton bricks have been included in the inventory for the first time. The emission arises from the combustion of carbonaceous material which occurs naturally within Fletton clay. The emission is estimated as 93 Gg CO_2
   - The methodology used to calculate emissions from 3C1 Iron and Steel processes has been revised in line with Tier 1 of the IPCC Good Practice Guidance. Also there have been revisions to the coke consumption data used. This has resulted in a reduction in emissions of 283 Gg CO_2.
4) Industrial Processes
   - Emissions from clinical waste incinerators are now included in the inventory. This adds 208 Gg CO_2 to the total.
5) Land Use Change and Forestry
   - There have been only minor changes to emissions and removals. These are minor corrections to peat extraction and a revision to emissions from soils in 1999 due to land use change.

All changes to the methodologies have been applied to all years of the inventory (1990 to 2000) in order to maintain consistency of the time series.

3.3 DISCUSSION OF THE ESTIMATES

Figure 1 shows emissions of carbon dioxide for the years 1990-2000 broken down by major IPCC source category. Emissions have declined since 1990 and are currently lower by around 7.5% than 1990 levels. However, emissions increased slightly by 0.9% between 1999 and 2000.

Analysing emissions by source shows that emissions from energy industries contribute 34% of total CO_2 emissions. This sector has seen a decline in emissions of 16% between 1990 and 2000. The major components of this sector are electricity generation, refineries, offshore gas consumption and the 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 13% in the amount of electricity generated† but a large decrease in CO_2 emissions from power stations of around 22% due to:

(i) The greater efficiency of the CCGT stations compared with conventional stations - around 46% 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 24%.✦

Between 1999 and 2000, emissions from power stations increased by 8% as a result of a 13% increase in coal consumption. This increase in coal burn is contrary to the predominant trend when coal consumption fell by 52% between 1990 and 1999. The increase has been attributed to reductions in nuclear and gas-fired generation due to repairs and maintenance. This increase of 11.7 Tg CO_2 is around 2% of the UK total.

The contribution from the other components of energy industries is much smaller. Emissions from refineries fell by 11% between 1999 and 2000 and are similar to 1990 levels. Emissions from other energy industries are dominated by the offshore industry where gas consumption has increased over the period. Those from the solid fuel transformation industries are small in comparison and have declined.

Emissions from manufacturing industry have also decreased between 1990 and 2000 by around 8%. This compares with a 2% increase in energy consumption (excluding electricity and non-energy use of fuel) by industry suggesting an overall improvement in emission per unit energy consumption.

Emissions from transport have increased by 5.5% since 1990. Transport emissions are dominated by the contribution from road transport. This rose by 6% over the period. Petrol

† Electricity generated by Major Power Producers, DTI (2001)
✦ Electricity supplied (gross) by Major Power Producers, DTI (2001)

usage has declined by around 12% 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 8.6 % 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 1% but are subject to fluctuation from year to year. Again natural gas use has increased with coal and oil usage declining. Overall, emissions from this sector have increased by 5%.

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 2000 and are declining gradually. Since 1990 they have fallen by 22%. Land use change and forestry emissions fell by 8% or 1.36 Tg CO_2 between 1999 and 2000. This reduction is explained by the variation in the underlying activity data. Removals from land use change have decreased by 10% 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 between 1998 to 2000 due to reduced fuel oil consumption. It accounts for 16% of bunker emissions in 2000. The remainder is air traffic and this has risen by approximately 93% since 1990.

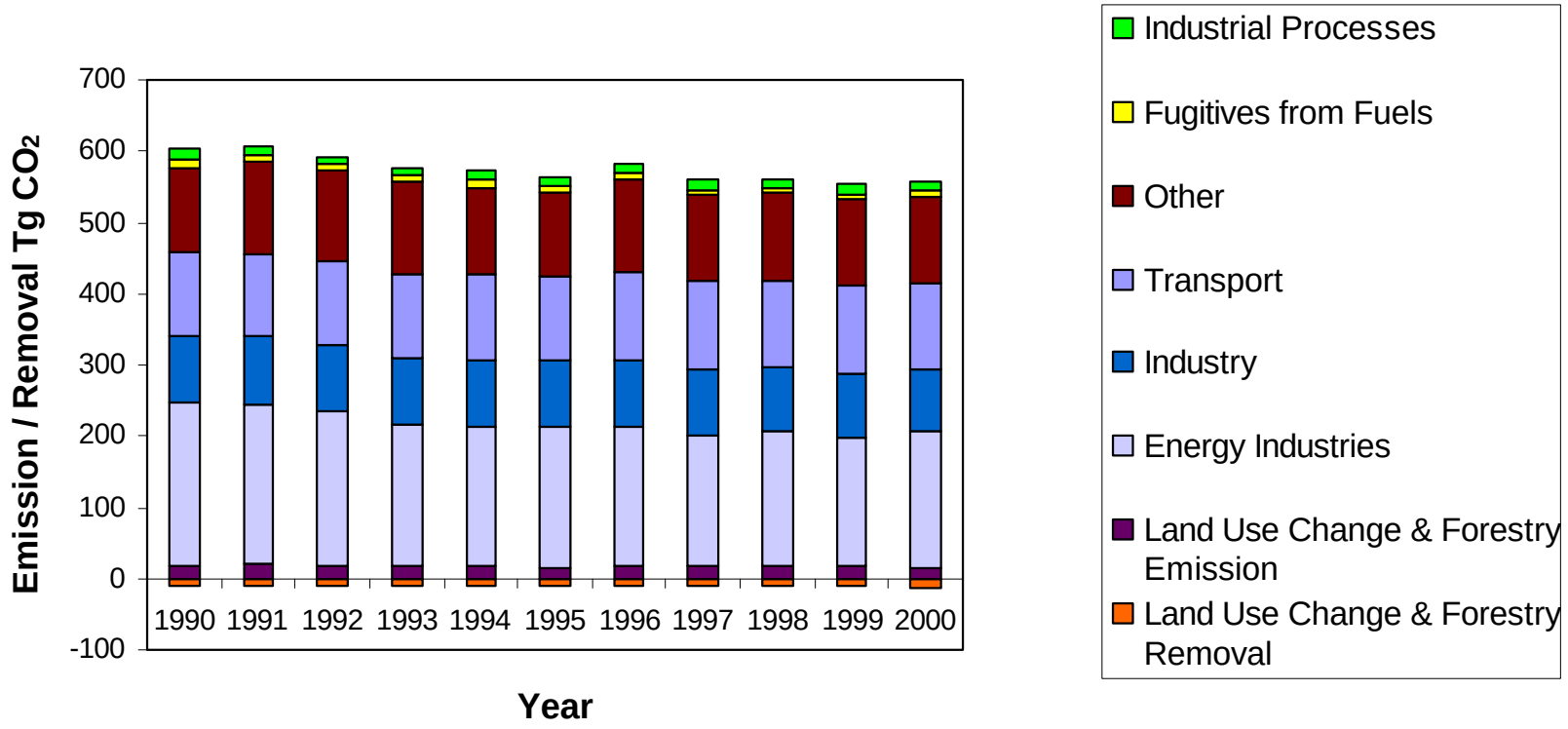
3.4 THE IPCC REFERENCE CARBON DIOXIDE INVENTORY

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 3.3% compared with 6.3 % 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 agriculture, waste disposal, leakage from the gas distribution system and coal mining. 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 21 %. 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 1999 Inventory (Salway *et al*, 2001). Overall emissions have been revised downwards by 43 Gg CH_4. Comparisons between the inventories refer to the year 1999 and the main changes are:

1) Fuel combustion
   - The emission factor used for sinter plant has been revised based on data supplied by Corus (2000). This has resulted in an increased emission of 1.5Gg in 1A2a Iron and Steel.
   - The changes in the inventory for CH_4 emissions from road transport are mainly due to the use of revised vehicle emission factors from COPERT III (European Environment Agency, 2000) providing more detail on the effects of speed or drive cycle on emissions of these pollutants. Functions relating emission factor to average speed were used for light duty vehicles and for heavy-duty vehicles, different factors were used for journeys on urban, rural and highway roads. Such detailed information on the effects of speed or road type on methane emission factors had not hitherto been available. COPERT III provides emission factors for vehicles only up to Euro I standards. For the more modern Euro II and Euro III vehicles now on the road, the CH_4 emission factors were reduced by the same ratio as the Euro I to Euro II and III reductions in the NMVOC emission factors. A small change in the inventory also arises from a minor change in the historic UK vehicle kilometre data, based on a more detailed analysis of traffic data available for Northern Ireland. Emissions from road transport have been reduced by 0.66 Gg
   - Emissions from the residential sector have reduced by 1.7 Gg methane as a result of a revision in the coal consumption statistics.
   - A new source, emissions from municipal solid waste incineration for heat production has been included in 1A4a Commercial and Institutional, however its contribution to emissions is negligible.
   - Overall emissions from fuel combustion (1A) have fallen by 0.925 Gg methane. This includes the changes listed above together with those arising from revisions to the energy statistics.
2) Fugitive emissions from fuels

- Emissions from gas leakage have been revised downwards by around 44 Gg methane in 1999. The new estimates are based on revised estimates of the methane content of natural gas. The estimates have been revised throughout the time series. The revised data are discussed in Appendix 3.

3) Industrial Processes
   - A number of new sources have been included for the first time. These include Fletton brick production (0.6 Gg), ethylene production (1 Gg), and methanol production (0.03 Gg). Emissions from other organic chemicals have been revised and a time series produced. As a result of these changes, emissions from industrial processes have increased by 1.5 Gg methane
4) Agriculture
   - There have been only small changes in methane emissions from agriculture resulting from changes in the livestock statistics and a revision in the classification of certain modes of animal waste disposal between solid storage & dry lot and land spreading. Emissions in 1999 have increased by 0.42 Gg methane of which dairy cattle were responsible for 0.28 Gg methane.
5) Waste
   - Emissions from clinical waste incinerators are now included in the inventory, however their contribution to methane emissions is negligible.

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 33% 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 6%. The decline reflects a reduction in dairy cattle numbers during this period. Agricultural emissions fell by 3% between 1999 and 2000 due to a decline in cattle and pig numbers.

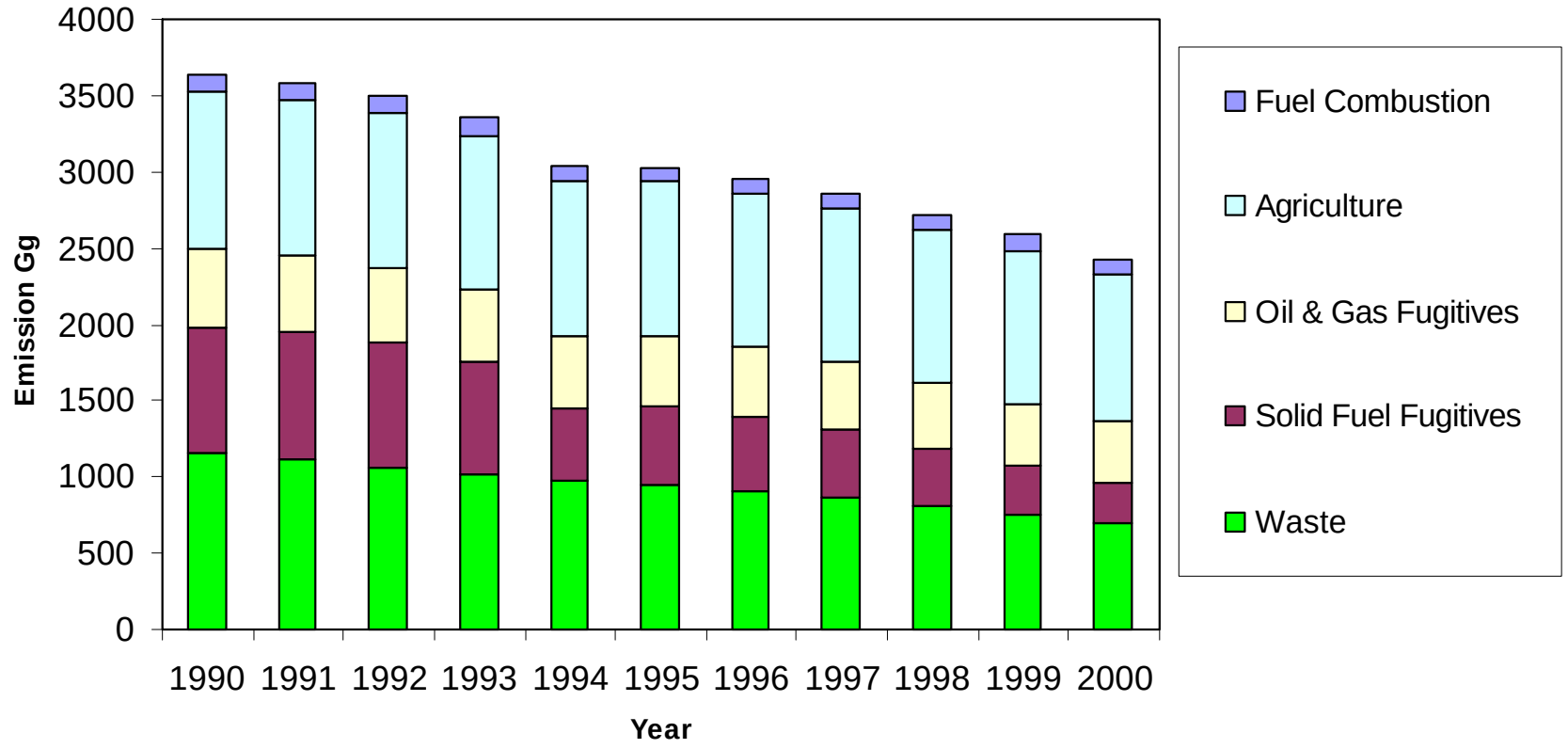
The second largest component of the total methane emission is waste. This comprises landfills, waste water treatment and waste incineration. Wastewater treatment emissions are small compared with landfill, and incineration is negligible. Wastewater emissions depend on the mode of disposal: sea dumping, land spreading or incineration. The sewage sludge disposed of in landfills is allocated to the landfill estimate. 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 41% 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 23% over the period 1990 to 2000. 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 from cold vents and other fugitives have declined though those from flaring show little overall change. Emissions are estimated on the basis of a survey of operators by SCOPEC (2001). 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 68% due to a general decline in coal production. The inventory currently reports emissions only from working mines because it was previously thought that those from closed mines were negligible. However, a recent review (Sage, 2001) reported estimates ranging from 20 to 300 Gg. DEFRA is planning further research to establish a more reliable estimate from this source.

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 1999 Inventory (Salway *et al*, 2001). Overall emissions have been revised upwards by 6 Gg N_2O. Comparisons between the inventories refer to the year 1999 and the main changes are:

1) Fuel Combustion
   - Emissions from the combustion of coke-oven gas are estimated in the new inventory, however the total only amounts to 0.1 Gg N_2O.
   - Emissions from road transport have been revised downwards by 2 Gg N_2O. This revision represents a change of around 14% in road transport emissions. The changes in the inventory are mainly due to the use of revised vehicle emission factors from COPERT III (European Environment Agency, 2000) providing more detail on the effects of speed or drive cycle on emissions of these pollutants. Different factors are now used for petrol cars and LGVs with three-way catalyst (meeting Euro I standards and on) on urban, rural and highway roads. Such detailed information on the effects of speed or road type on nitrous oxide emission factors had not hitherto been available. COPERT III provides emission factors for vehicles only up to Euro I standards. A small change in the inventory also arises from a minor change in the historic UK vehicle kilometre data, based on a more detailed analysis of traffic data available for Northern Ireland.
2) Agriculture
   - There have been changes in N_2O emissions from agriculture resulting from changes in the livestock statistics but mainly a revision in the classification of certain modes of animal waste disposal between solid storage & dry lot and land spreading. Emissions in 1999 have increased by 2 Gg N_2O. This is accounted for by an increase 2.2 Gg in agricultural soils but a decrease of 0.2 Gg in manure management. The agricultural soils increase arises from increased amount of animal nitrogen applied to land and the resultant increase in leaching and deposition emissions.
3) Industrial Processes
   - There has been a large revision in emissions from nitric acid production of 6.4 Gg. This revision is based on new measurements taken on a plant after it was retrofitted with an abatement system for NO_x. Whilst the system reduced NO_x, it resulted in an increase in N_2O emissions.
6) Waste
   - Emissions from clinical waste incinerators are now included in the inventory, however their contribution to methane emissions is negligible.

The methodology of the estimates is discussed in Appendices 1 to 7. Any methodological changes have been applied as necessary to all years from 1990 in order to maintain time series consistency.

5.3 DISCUSSION OF THE ESTIMATES

UK Emissions of nitrous oxide have declined by around 35% over the period 1990 to 2000. Emissions are very uncertain with an estimated mean emission of 141 Gg in 2000 within a range of 35 Gg to 515 Gg. (See Appendix 8). Emissions are dominated by agriculture, which accounted for 64% of the total in 2000. Agricultural emissions arise from a number of sources:

- Cultivation of legumes
- Synthetic fertilizer application
- Crop residues
- Histosols
- Improved grass
- Manures 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)

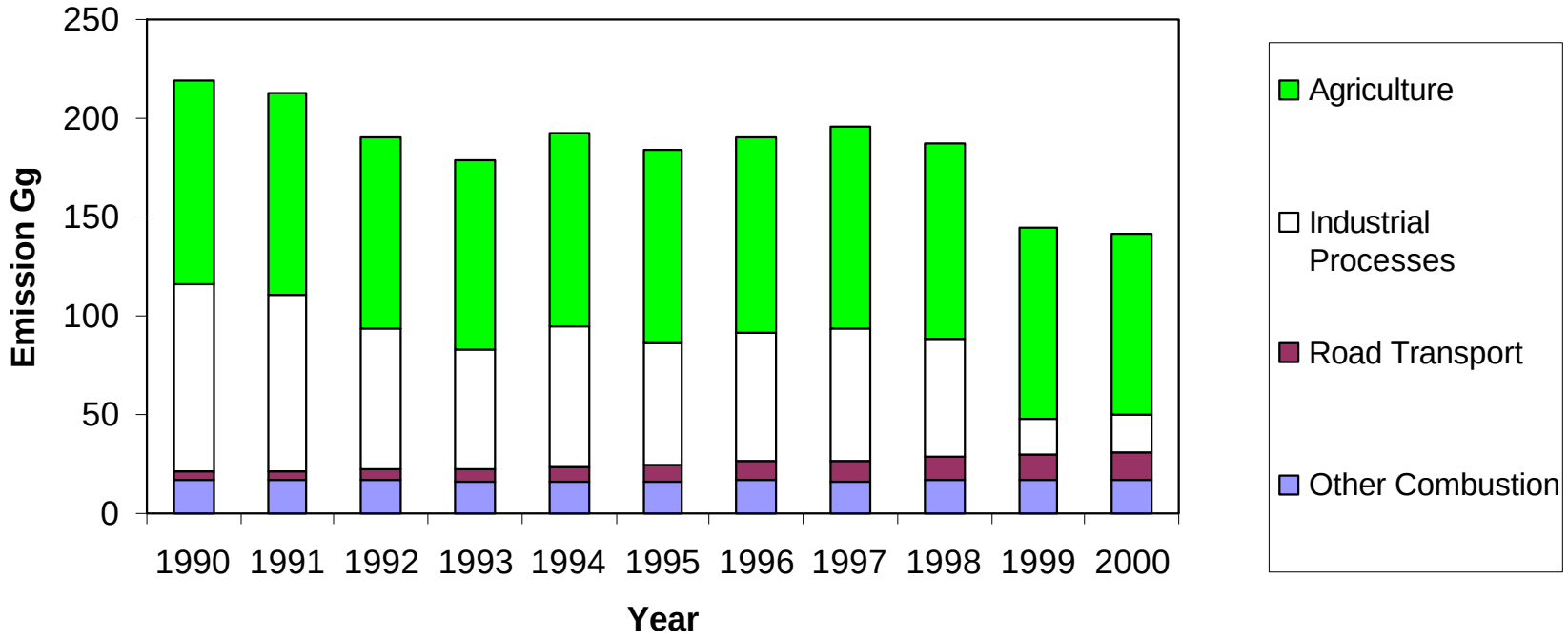
Emissions from agriculture have declined by 12% over the period 1990 to 2000 driven by a fall in synthetic fertilizer application and a decline in animal population over the period. Emissions fell by 6% between 1999 and 2000 with reductions in most of the component sources. The drivers for this fall appear to be animal numbers and synthetic fertiliser application. Agricultural stubble burning was banned in England and Wales in 1993 resulting in a slight decrease in the agricultural emission.

The next largest source is from fuel combustion (19%). These emissions arise mainly 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 5 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 2000 was 9%.

There has been a large decline in N_2O emissions from industrial sources. Emissions fell by 79% between the years 1990 and 2000. 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. However, emissions show an increase between 1998 and 1999, because of the installation of an abatement system for NO_x which had the effect of raising N_2O emissions. 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 2000 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 are very limited data on N_2O emissions from large gas turbines. Public power emissions are around 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. 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 43% of 1998 levels. Emissions have increased by 8% between 1999 and 2000, representing an overall decrease of 18% between 1990 and 2000. Halocarbon production is the largest source of HFCs. Emissions from the manufacture of halocarbons accounted for 46% of the total HFC emissions in 2000. Emissions in 2000 from this sector fell dramatically because of an HFC destruction system was fitted to the HCFC plant. Refrigeration and air conditioning is the next largest source of HFCs and contributes 26% of the total. Here emissions arise due to leakage from refrigeration and air conditioning equipment during its manufacture and lifetime. Aerosols contribute approximately 16% 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 0.4% of total emissions.

There has been a significant revision in by-product emissions from HCFC manufacture. The revision is based on new data on the effectiveness of the recently installed abatement systems. Emissions are around 2391 Gg CO_2 equivalent higher in 1999, than in the previous inventory.

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 2000.

PFCs also form as a by-product during aluminium smelting and this contributes around 30% of the UK GWP total of PFC emissions in 2000. 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 90% 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 6% 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 2.13 between 1990 and 2000. The largest source is from magnesium manufacture which accounted for 39% of the UK Total in 2000. It is not possible to recover the SF_6 so the total annual consumption is emitted to atmosphere. Another major source is electrical insulation accounting for 36 % of emissions in 2000. 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 (25%).

Emissions from magnesium production in 1998 and 1999 have been revised downwards to reflect lower levels of production. The reduction is around 120 kt CO_2 equivalent in 1999. Emissions from electrical insulation have been increased in 1998 and 1999 due to increased losses from equipment used by regional electricity distributors. The emissions have increased by 316 kt CO_2 equivalent in 1999.

Figure 4: UK Emissions of Hydrofluorocarbons

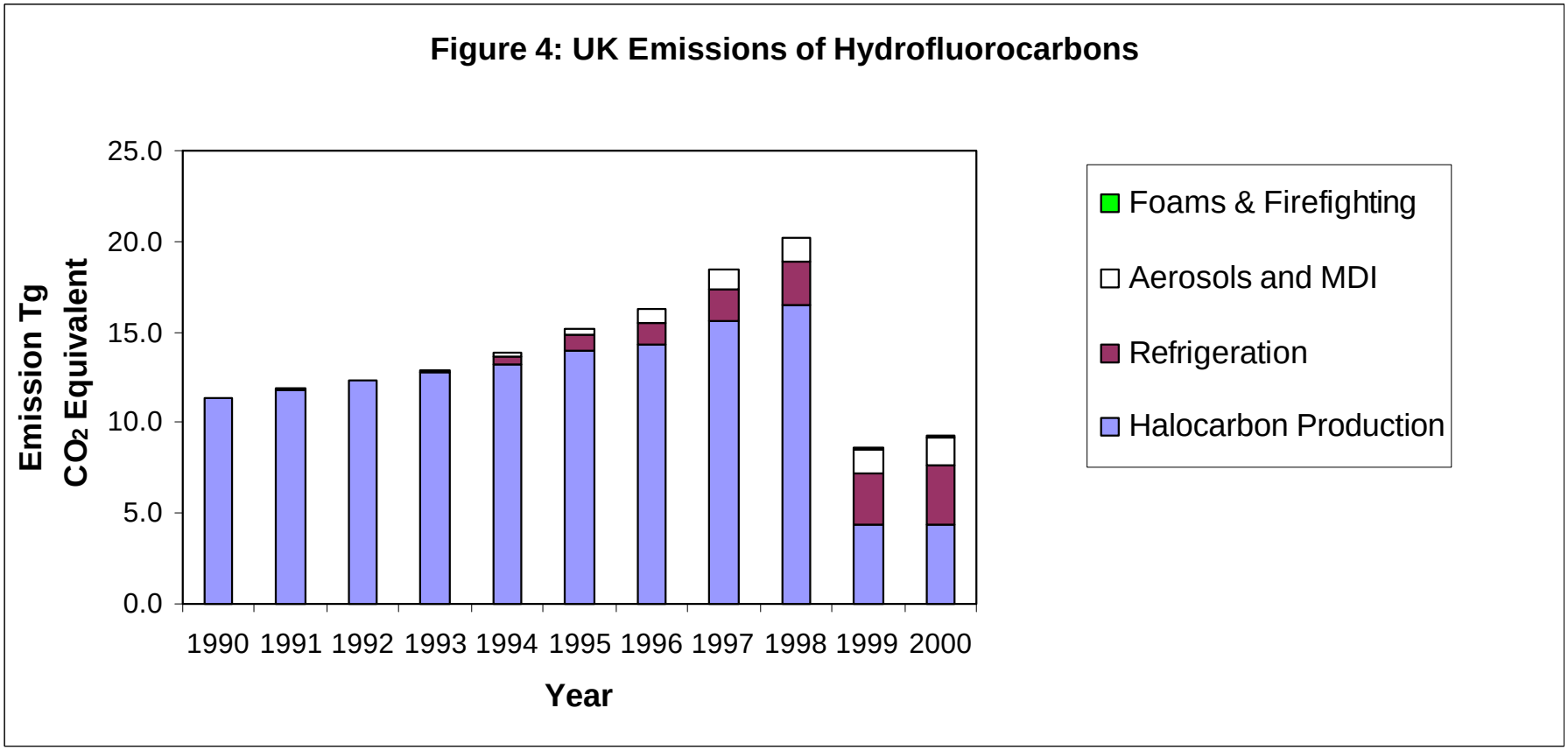


Figure 5: UK Emissions of Perfluorocarbons

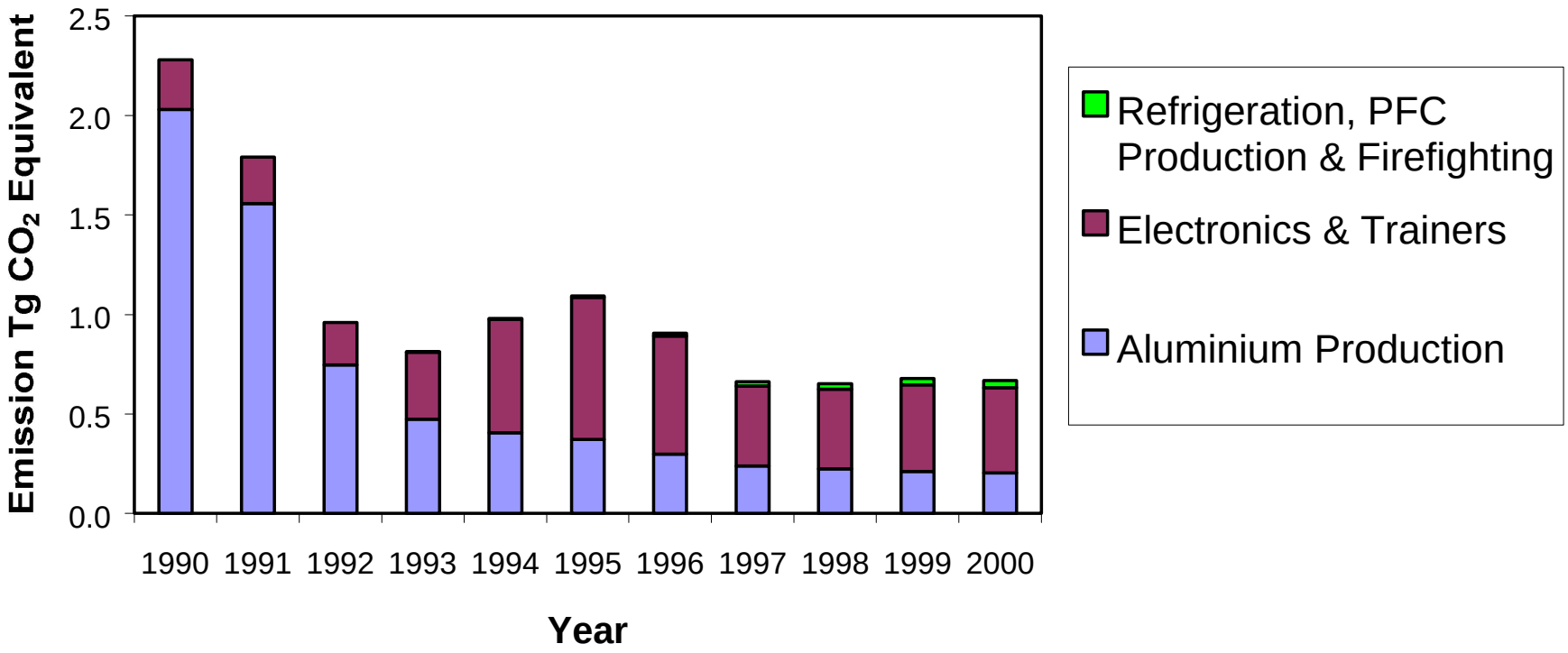
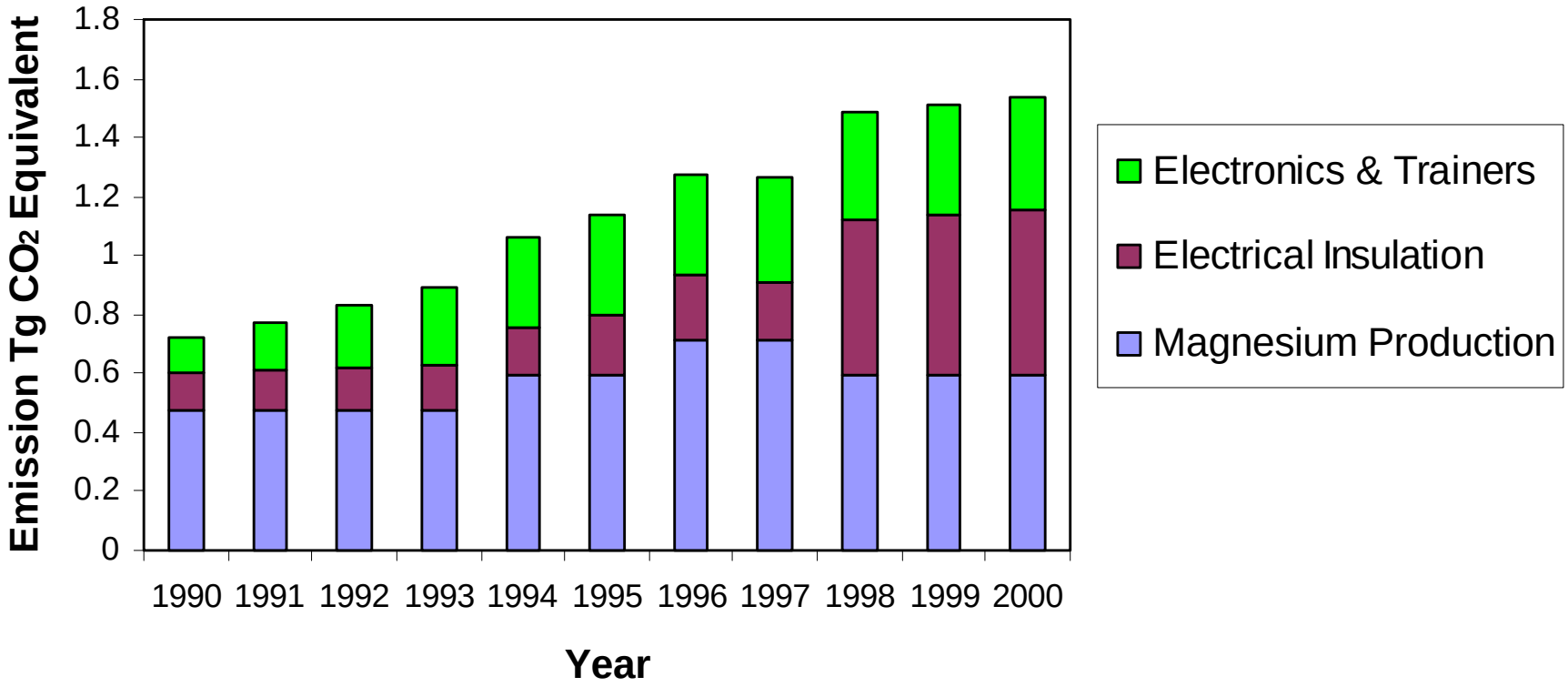


Figure 6: UK Emissions of Sulphur Hexafluoride



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 ±7%.

7.2 DEVELOPMENT OF THE METHODOLOGY

A number of changes to the methodology have been made since the 1999 Inventory (*Salway et al*, 2001). Overall emissions have been revised upwards by 8 Gg NO_x in 1999. Comparisons between the inventories refer to the year 1999 and the main changes are:

These are:

1) Fuel Combustion
   - Emissions from coke ovens have been revised based on a more detailed set of emissions data from Corus (2001). Most of the emissions arise from the combustion of coke-oven gas and these emissions have increased by 1.9 Gg.
   - Emissions from sinter plant have been revised based on a more detailed set of data from Corus (2001. Emissions have increased by 5.5 Gg.
   - Emissions due to road transport have increased by 1.9 Gg. This decrease can be attributed to revisions in vehicle kilometre data used in these estimates
   - The remaining changes are minor and are due to revisions in the fuel statistics. Overall, emissions from 1A Combustion have increased by 9.5 Gg NO_x
2) Industrial Processes
   - There have been extensive revisions of emissions from iron and steel processes based on more detailed data supplied by Corus (2001). In particular, emissions from blast furnaces, electric arc furnaces and basic oxygen furnaces. However, emissions from these processes are not particularly large and the changes amount to a decrease of around 1.8 Gg NO_x.

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 45% 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 7 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 52% since 1990. The total road vehicle kilometres in 2000 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 2000, emissions from 1A1 Energy Industries fell by approximately 50%. The main reason for this was a fall in emissions from power stations of around 54%. 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. However, between 1999 and 2000, emissions increased by 6% due to an increased consumption of coal in power stations. The increase has been attributed to reduced utilisation of nuclear and gas-fired generation plant due to repairs and maintenance.

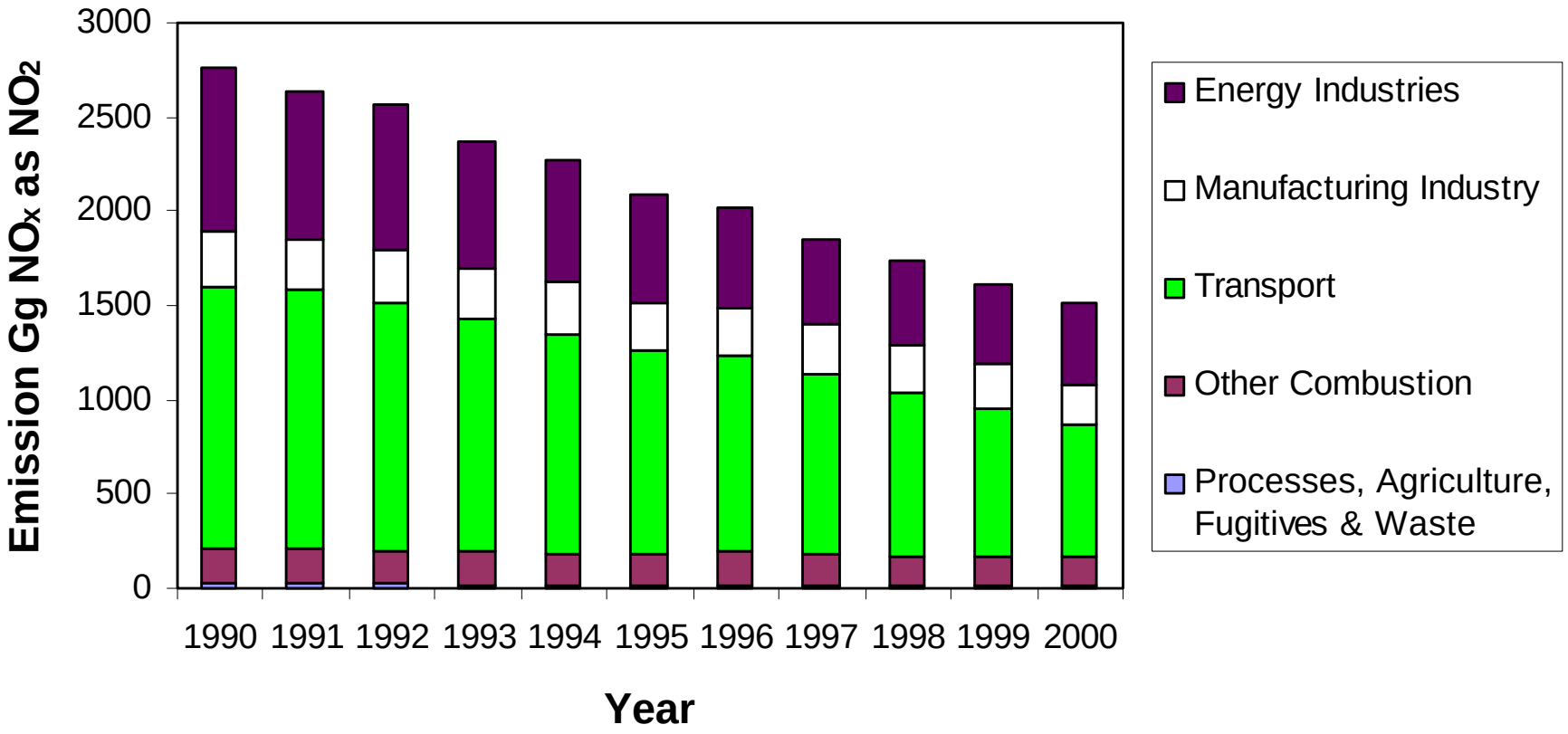
Combustion emissions from industry fell by 24 % from 1990 to 2000. This is a result of the switch from coal and oil to natural gas.

Fugitive emissions from 1B2 Oil and Natural Gas have fallen by 45% over the period 1990 to 2000. Most of this is flaring.

Emissions from Other Sectors combustion increased between 1990 and 1998 but declined in 1999 and 2000 to levels 3.5% below 1990 levels. There is probably little overall 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 16% of the National Total. Since 1999, aviation emissions became the major component of this sector and they accounted for 58.4 % of bunker emissions in 2000. Between 1990 and 2000, emissions of nitrogen oxides from air traffic rose by 96.3%. Emissions from marine bunkers increased between 1990 to 1998, but then fell in 1999 and 2000 to around 15% below 1990 levels. This was due to decreasing consumption of fuel oil.

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 2000, 66% 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 ±20%.

8.2 DEVELOPMENT OF THE METHODOLOGY

A number of changes have been made to the methodology since the 1999 Inventory (Salway, 2000). Overall emissions have been revised downwards by 30 Gg CO in 1999. Comparisons between the inventories refer to the year 1999 and the main changes are:

1) Fuel Combustion
   - Emissions from manufacturing industry have increased by 242 Gg CO. This is entirely due to a revision of sinter plant emissions. The new estimate is based on more detailed data supplied by Corus (2001). Previously emissions were only available on a site basis and not disaggregated by process. Hence a large proportion of the sinter plant emission was included with other iron and steel processes and reported under 3C1 Iron and Steel Processes. Now the contribution from sinter plant has been more reliably estimated and reported under fuel combustion.
   - The road transport emissions have decreased by 2.9 Gg due to revisions in the vehicle kilometre statistics used in the road transport model.
   - There has been a small increase in CO emissions (7.5 Gg) from the residential sector (1A4b). This is predominantly due to a revision in the energy statistics on domestic consumption of coal and anthracite.
2) Fugitive Emissions from Fuels
   - There has been a decrease of 12 Gg from coke production. The new estimate is based on data reported in the Pollution Inventory and detailed data supplied by Corus (2001). The methodology has been revised to avoid double counting the process emission and the fuel combustion emission associated with coke ovens.
3) Industrial Processes
   - There are a number of new sources which have been identified in the inventory for the first time. These are Fletton brick production (1.5 Gg), chemical industry reformer plant (2.1 Gg), carbon black production (0.9 Gg) and primary lead production (69 Gg). The estimates are based on data reported in the Pollution Inventory, which have been extensively reviewed to remove sources which are likely to be fuel combustion and consequently are included elsewhere in the inventory. Some of these sources had been included before but were aggregated into a general chemical industry category.
   - There have been large revisions to CO emissions reported under Iron and Steel Processes. The revisions are based on more detailed data on individual processes supplied by Corus (2001). The main change has been a transfer of around 252 Gg CO which had previously been attributed to basic oxygen furnaces, to sinter plant. Sinter plant emissions are reported under 1A2 Combustion in Manufacturing Industry.

- Overall the emissions reported under 2 Industrial Processes have reduced by 250 Gg

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 42%. The most important source is road transport where emissions have fallen by 45% 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. Industrial combustion contributes around 15% to the UK total. A major portion of this arises from sinter plant in the iron and steel industry.

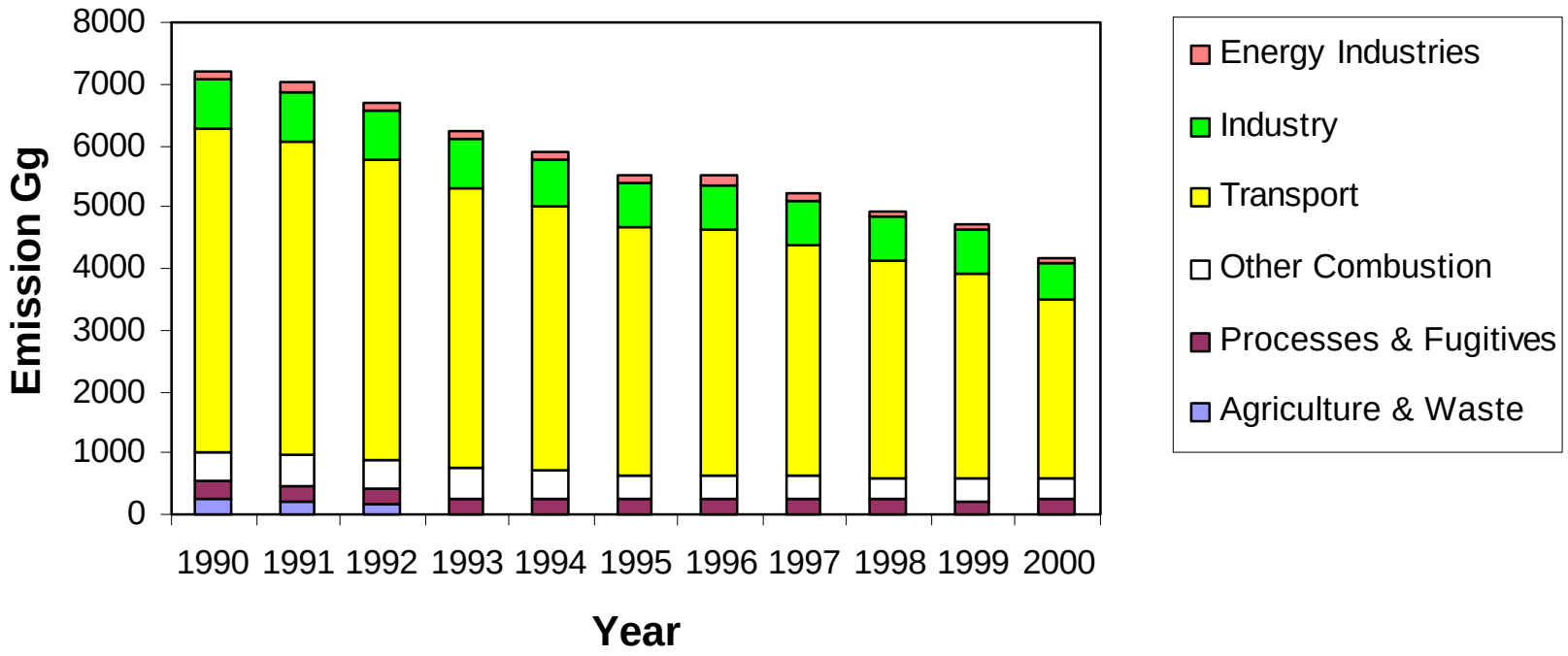
Emissions from Other Sectors have decreased by 29% since 1990 almost entirely as a result of decreased residential solid fuel combustion in favour of gas and electricity. This consumption has fluctuated considerably over the period but has fallen markedly since 1993. Emissions from the residential sector were 310 Gg in 2000 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. Emissions from these sources are now believed to contribute approximately 7% 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, 2001). These emissions arise from blast furnaces, electric arc furnaces, basic oxygen furnaces, non-ferrous metals and various processes in the organic chemical industry. Iron and Steel processes make the largest contribution particularly emissions arising from basic oxygen furnaces. The estimates have been improved based on more detailed data provided by Corus (2001). Sinter plant emissions are the major component of iron and steel emissions but these are reported in the combustion category, 1A2a. The remaining iron and steel emissions are classified as process emissions and are reported in category 2C1 and account for around 2% of the total in 2000. Total emissions from industrial processes are around 4.5% of the UK total

Other emission sources are small compared with transport, off-road sources and processes. Power station emissions have decreased since 2000 and are now 47% of 1990 levels. In 2000, this sector accounted for 1.4% 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 35% of the UK estimate of NMVOC emissions come from fuel 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 ±10%.

9.2 DEVELOPMENT OF THE METHODOLOGY

A number of changes have been made to the methodology since the 1999 Inventory (*Salway et al*, 2001). Overall emissions have been revised upwards by 36 Gg NMVOC in 1999. Comparisons between the inventories refer to the year 1999 and the main changes are:

1. Fuel Combustion
    - Road transport emissions have increased by 1.3 Gg due to revisions in the vehicle kilometre statistics used in the road transport model.
    - There has been a significant decrease in NMVOC emissions (1.2 Gg) from the residential sector (1A4b). This is due to a revision in the consumption of domestic coal and anthracite
2. Fugitive emissions from fuels

- There has been a large increase of 46 Gg in emissions from leakage from the natural gas transmission system. This is due to a revision of the NMVOC content of natural gas. The new estimates show a significantly higher NMVOC content. The revisions have been applied over the time series.

3. Industrial Processes
   - A number of new processes have been identified based on data reported in the Pollution Inventory. These are Fletton brick production (0.6 Gg); glass fibre and wool production (0.14 Gg); coal tar and bitumen processes (0.1 Gg); solvent and oil recovery, wood products production (0.2 Gg) and malting in the food industry (2 Gg).
4. Solvent and other product use
   - There has been a net decrease in emissions of 9 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 40% since 1990. The main source is transport which accounts for 28% of total emissions. Almost all these emissions are from road transport, and since 1990, they have fallen by around 57%. 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%, 24 % and 11% of emissions respectively.

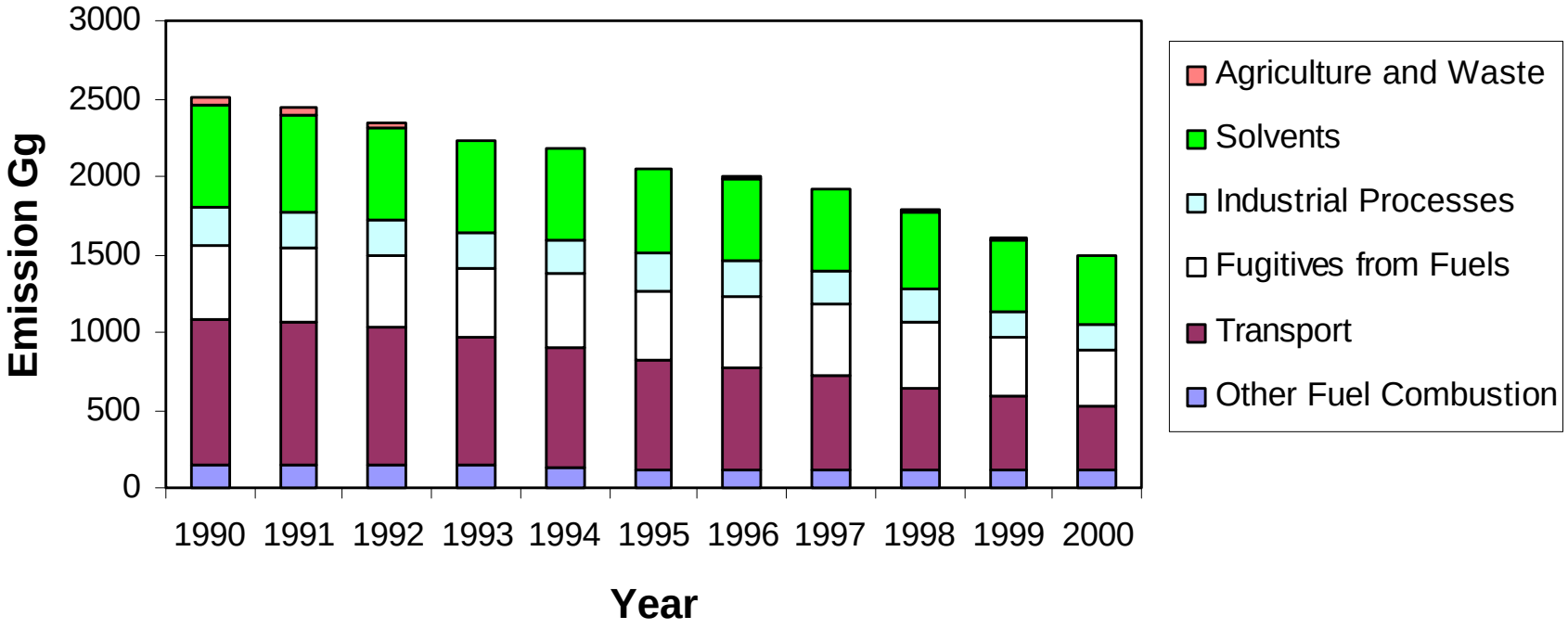
Emissions from 1B2 Oil and Natural Gas have decreased by 22% since 1990 and constitute 24 % of the UK Total. This includes emissions from gas leakage which comprise around 4% of the UK Total at present and are declining as a result of the gas main replacement programme underway since 1990. Emissions from petrol distribution are around 6% 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 34% 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 96% 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 ±3%.

10.1 DEVELOPMENT OF THE METHODOLOGY

A number of changes have been made to the methodology since the 1999 Inventory (Salway *et al*, 2001). Overall emissions have been revised upwards by 23 Gg SO_2 in 1999. Comparisons between the inventories refer to the year 1999 and the main changes are:

1. Fuel Combustion
   - There has been a significant reduction in SO_2 emissions from the combustion of coke oven gas. The reduction arises from the use of a lower emission factor for coke oven gas derived from a more detailed set of data on coke oven emissions supplied by Corus (2001). The reduction in emissions is around 13 Gg SO_2. These emissions occur in 1A1c Manufacture of solid fuels and 1A2 manufacturing Industry and Construction.
   - Emissions from sinter plant have increased by 2.2 Gg SO_2. The new estimate is based on a more detailed set of data which identify specific processes supplied by Corus (2001).
   - Emissions from road transportation have increased by 1.4 Gg SO_2. This revision is due to the provision of more precise data on the sulphur contents of road fuels, that is the data supplied have been quoted to more significant figures.
   - Emissions from the commercial and institutional sector have increased by 5Gg SO_2 as a result of revisions to the coal and fuel oil statistics.
   - Emissions from the domestic sector have reduced by 1.2 Gg SO_2 due to revisions to the domestic coal consumption statistics and a revision to the sulphur content of coal in 1999.
2. Fugitive Emissions from Fuels
   - There has been a significant revision in emissions from coke production. The increase of 6.5 Gg SO_2 is based on detailed data supplied by Corus (2001).
3. Industrial Processes
   - A new source, Fletton brick production is now included in the inventory. The emissions are based on data reported in the Pollution Inventory and are 9 Gg SO_2 in 1999.
   - A number of new sources have been identified in the chemical industry. These include carbon black production (6 Gg) and sulphuric acid use in the chemical industry (0.8 Gg). These estimates are based on data reported in the Pollution Inventory. Some of these emissions were included in previous inventories but aggregated together in a

general chemical industry category. Overall emissions from the chemical industry have increased by 8.7 Gg.

- Emissions from blast furnaces have revised upwards by 1.7 Gg SO_2, however emissions from electric arc furnaces have been reduced by 1.5 Gg SO_2 so total emissions from iron and steel processes have increased by 0.2 Gg SO_2. The new estimates are based on detailed data provided by Corus (2001).

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 69%.

The largest contribution to SO_2 emissions is from power stations which account for 71% of the total in 2000. Since 1990 these emissions have declined by 70% 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 0.217 Tg of SO_2 were removed in 2000 compared with a total emission from coal fired power stations of 0.793 Tg.

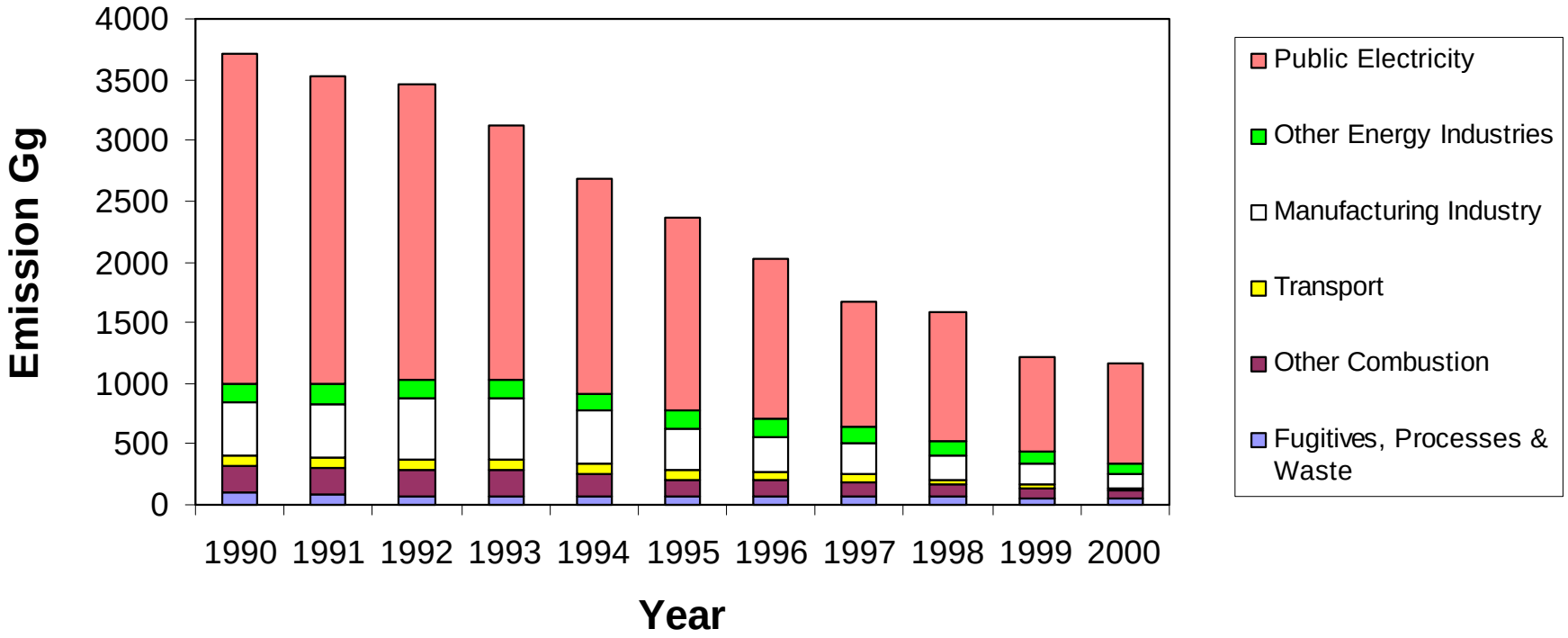
In 1998, there was a small increase in SO_2 emissions from power stations. This can be attributed to a small increase in coal consumption and a breakdown at the FGD plant at Drax. In 1999, emissions decreased again due to the FGD plant at Drax operating normally again and a decline in coal consumption (DTI, 2001). Between 1999 and 2000 there has been a 6% increase in emissions. This is due to a 13% increase in coal combustion in power stations. This increase in coal burn is contrary to the predominant trend over the period where coal consumption fell by 52% between 1990 and 1999. The increase has been attributed to reductions in nuclear and gas-fired generation due to repairs and maintenance.

Emissions of SO_2 from manufacturing industry accounted for around 10% of the total in 2000. Since 1994 emissions have fallen by 77% which compares with a 2% increase in fuel consumption (excluding electricity) by industry (DTI, 2001). 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, mainly refineries and coke production account for 7% 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 international aviation have increased steadily since 1990. However, emissions from international marine transport increased until 1998 but then fell and by 2000 were 25% below 1990 levels. This is due to a decrease in consumption of fuel oil. In 2000, international aviation only accounted for 6.5 Gg of emissions whilst international marine bunkers were responsible for 69 Gg SO_2. Emissions from international marine have fluctuated during 1990 to 2000 but from 1998 onwards, they have decreased sharply and in 2000 are 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 12 shows GWPs defined on a 100 year horizon, IPCC (1996).

Table 12: 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 13 and Figure 11.

Table 12 GWP Weighted Greenhouse Gas Emissions (Tg[1] CO_2 Equivalent)

	Base Year[2]	1990	1991	1992	1993	1994	1995
Carbon Dioxide (emissions)	603.1	603.1	606.8	592.1	576.6	572.6	563.6
Methane	76.5	76.5	75.4	73.6	70.4	63.9	63.6
Nitrous Oxide	67.9	67.9	66.0	59.1	55.4	59.8	57.1
HFCs	15.2	11.4	11.9	12.3	12.9	13.8	15.2
PFCs	1.1	2.3	1.8	1.0	0.8	1.0	1.1
SF_6	1.1	0.7	0.8	0.8	0.9	1.1	1.1
Total	764.9	761.8	762.6	738.9	717.1	712.2	701.7
Carbon Dioxide (removals)	-10.6	-10.6	-10.7	-10.8	-11.1	-11.3	-11.5
Carbon Dioxide (net emission)[1]	592.5	592.5	596.2	581.3	565.6	561.3	552.1
Total (net emissions)[1]	754.3	751.3	751.9	728.1	706.0	700.9	690.2

Table 12 (Continued)

	1996	1997	1998	1999	2000	% change 1990-00
Carbon Dioxide	583.5	559.0	561.6	552.9	557.7	-7.5
Methane	62.2	59.9	57.2	54.4	51.0	-33.4
Nitrous Oxide	59.1	60.8	58.0	44.9	43.8	-35.4
HFCs	16.3	18.4	20.2	8.6	9.3	-18.1
PFCs	0.9	0.7	0.7	0.7	0.7	-70.7
SF_6	1.3	1.3	1.5	1.5	1.5	113
Total	723.3	700.1	699.1	662.9	664.1	-12.8%
Carbon Dioxide (removals)	-11.6	-11.6	-11.5	-11.5	-11.7	-10.4%
Carbon Dioxide (net emission)[3]	571.9	547.5	550.1	541.3	546.1	-7.8%
Total (net emissions)[3]	711.7	688.5	687.6	651.3	652.4	-13.2%

1 One Tg is equal to 10^{12} g or one million tonnes.
2 The 1990 base year is the sum of 1990 totals for CO_2 ,CH_4 and N_2O and 1995 totals for HFC, PFC and SF_6
3 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 1.7% of the total. This is because their mass emissions are very small. Overall the total weighted emission has fallen by 13.8% since 1990 with all gases declining except SF_6.

Weighted greenhouse gas emissions broken down by sector are shown in Figure 13. The largest contributions are energy industries (29%), transport (19%) and industry (18%). Since 1990, most sectors have declined with the exception of transport and other. The most significant reductions are a 16% fall in energy industries (mainly power stations) and a 23% fall in industry (largely adipic acid production). Fugitive emissions (mainly coal mining) have fallen by 46% and waste by 38% (mainly landfill) however these sources together only account for 5%.

The uncertainty in the combined GWP weighted emission of all the greenhouse gases was estimated as 13.9% in 1990, and 15.1% in 2000. The approach used is discussed in Appendix 8.

Figure 11: UK Emissions of Greenhouse Gases Weighted by GWP

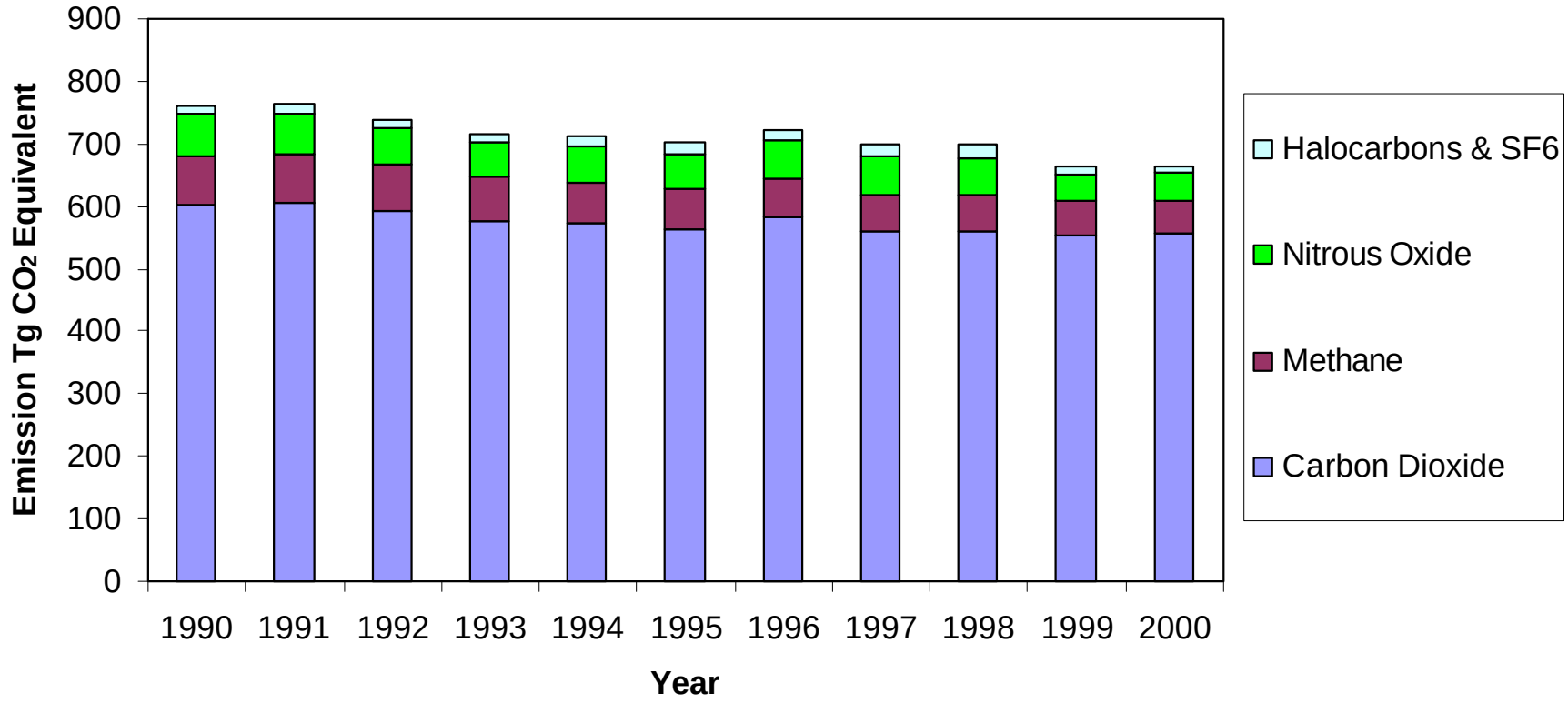
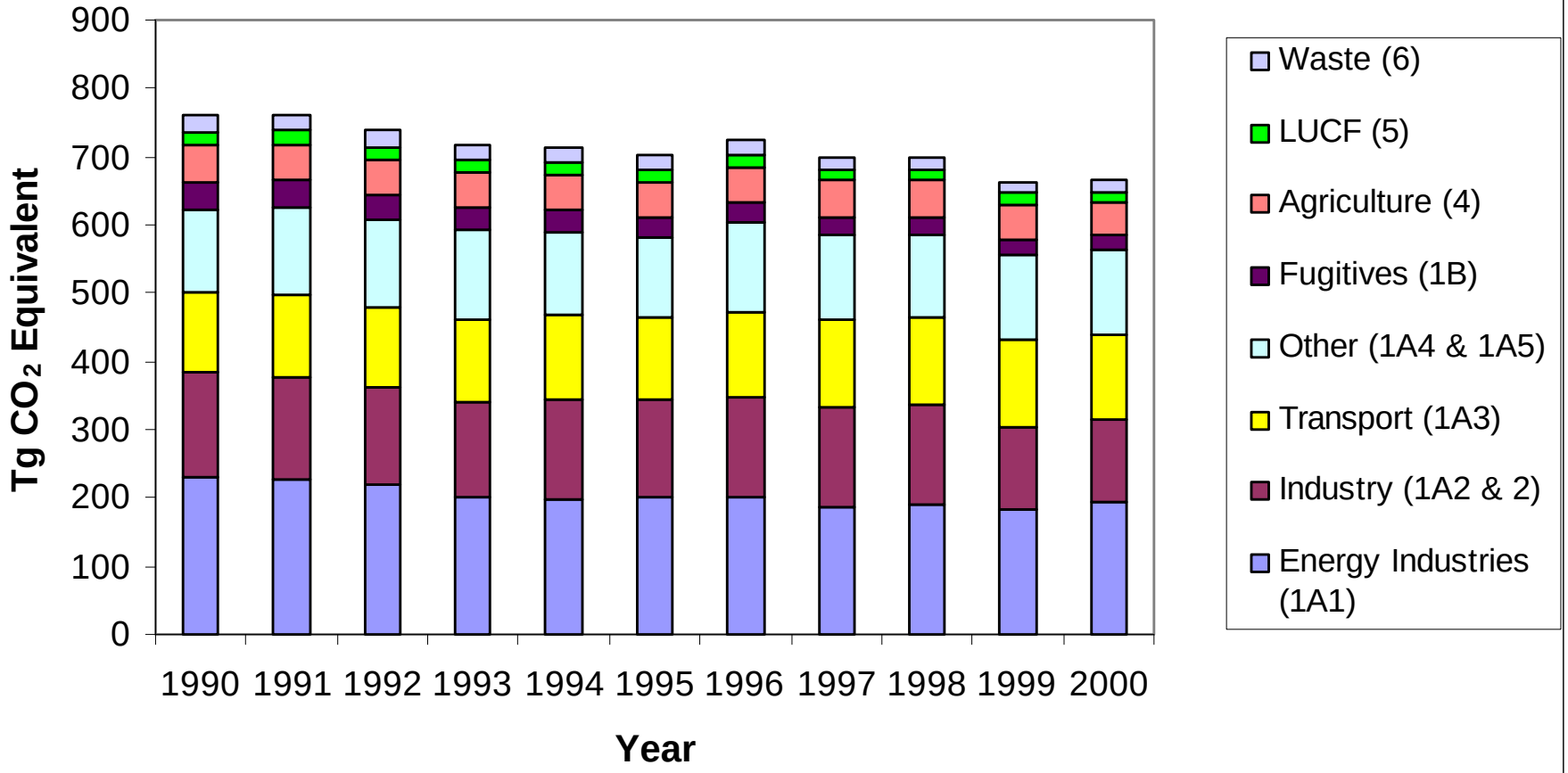


Figure 12: UK Greenhouse Gas Emissions by Source



12 Methodological Changes to the Inventory

This section describes the methodological changes made to the inventory since the last 1999 Inventory was released. 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 Appendices 1 to 7.

12.1 ENERGY (1A)

Petroleum Refining (1A1b)
The gross calorific value used for petroleum coke has been revised from 31 GJ/t to 37.5 GJ/t gross. For pollutants such as N_2O, CH_4 and NMVOC where energy based default emission factors are used, the emissions will have increased, but the change is negligible.

Manufacture of Solid Fuels (1A1ci)
The emission factors used for coke oven gas have been revised following a review of the point source data available for Iron and Steel Processes (Corus, 2001; Environment Agency, 2001). Emissions of NO_x, CO and SO_2 from coke oven furnaces have been revised. Only the reduction in NO_x and SO_2 emissions is significant. Emissions of N_2O from coke oven gas combustion are now included based on a CORINAIR default factor, but they are not significant.

Manufacturing Industry and Construction (1A2)
The emission factors for sinter plant have been completely revised based on a detailed set of emission factors supplied by Corus (2001), the main UK steel producer. The new data give a breakdown of the different iron and steel processes (e.g. sinter plant, coke ovens, blast furnaces etc). Sinter plants are considered as combustion sources, consequently there have been large increases in emissions reported in 1A2a. The result has been increases in emissions of methane, CO, NO_x and NMVOC but a reduction in SO_2.

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.

There has been a small revision upwards to the sulphur content of coal used in industry 1997 to 1999 arising from an improvement in the mass balance used to estimate average coal sulphur content.

A new source of CO, namely soda ash production has been included. As the emission arises from coke burnt in the lime kilns associated with the process, it has been included under industrial combustion.

Road Transport (1A3b)
There have been significant revisions to the methodology used to estimate emissions of methane and N_2O from road transport. They involve the use of vehicle emission factors from COPERT III (European Environment Agency, 2000) providing more detail on the effects of speed or drive cycle on emissions of these pollutants. These have resulted in a significant increase in N_2O emissions (2 Gg) and a decrease in methane emissions (0.7 Gg) in 1999.

Emissions of carbon dioxide arising from the consumption of liquefied petroleum gas (LPG) by road vehicles have been included in the inventory. Data are available from 1996 to 2000. Emissions are rather small and rise to 64 Gg CO_2 in 2000.

Other Sectors (1A4)
A new source has been added, namely the combustion of municipal solid waste for heat production. The source has been classified as 1A4A Commercial/Institutional. The estimated emissions are small.

There has been a small revision upwards in the sulphur content of coal used in the domestic and commercial sectors from 1997 to 1999 arising from an improvement in the mass balance used to estimate average coal sulphur contents. Sulphur dioxide emissions have risen as a result.

There have been minute revisions in the SO_2 emission arising from the combustion of domestic burning oil between 1996 and 1999 due to more precise S-content data supplied by UKPIA.

12.2 FUGITIVE EMISSIONS (1B)

Solid Fuel Fugitive Emissions (1B1b)
The previous inventory used USEPA (1997) emission factors for fugitive emissions arising from patent fuel production. These emissions factors have been revised on the USEPA web site, typically decreasing by a factor of two. The new factors are used for CO, NO_x, and SO_2. Emissions of CO_2 are estimated from a mass balance on the patent fuel produced and the fuels used in its production. In recent years the traditional coking processes have been replaced by processes which briquette powdered anthracite and petroleum coke. Hence, in the mass balance the carbon content appropriate to anthracite rather than coking coal is now used for 1996-2000.

Fugitive emissions from coke ovens have been revised based on data supplied by Corus (2001). Emissions of SO_2 and NMVOC have increased whilst those of CO have decreased. Only the changes in CO and SO_2 are significant.

Emissions of CO_2 are estimated from a mass balance on the coke and coke oven gas produced and the fuels used in its production. According to DTI (2001) a small proportion of the coke oven gas reported is synthetic coke oven gas made by mixing blast furnace gas and natural gas. A correction has been introduced to account for this gas in the mass balance. The correction is applied for 1996-2000 for which data are available. There seems to have been little use of synthetic coke oven gas prior to this date.

Refineries Storage (1B2aiv)
There has been a revision to the emissions of NMVOC from storage at refineries reported under 1B2a. Emissions have decreased slightly for all years 1990 to 1999.

Natural Gas Transmission/Distribution (1B2b)
Emissions from natural gas transmission have been revised downwards from 1990-99. The revision arises from a correction to the data used for the methane content of natural gas. Data that were previously understood to have been on a weight basis were found to have been on a molar basis. The revision has resulted in a reduction of 44 Gg methane. Accordingly, it has been necessary to revise the emissions of NMVOC upwards.

12.3 INDUSTRIAL PROCESSES (2)

Cement Production (2A1)
The carbon emission factor used for cement production has been revised downwards by 2.5%. This is due to the provision of data by the British Cement Association on the average calcium oxide content of UK cement clinker. The previous estimates used the IPCC default value.

Fletton Brick Production (2A7)
Emissions of CO_2 are produced by the combustion of carbonaceous material which occurs naturally in the Fletton clay used. The emission was around 93 Gg CO_2 in 1999 though the estimates are very uncertain. Emissions of methane, CO, SO_2 and NMVOC are also estimated based on data reported in the Pollution Inventory.

Glass Fibre and Wool (2A7)
Emissions of NMVOC from glass fibre and glass wool production are now reported. Estimates are derived from the Pollution Inventory and are extrapolated using production estimates.

Nitric Acid (2B2)
Emissions have been revised upwards in 1999 as a result of measurements made by a plant operator. The measurements were made after the installation of a NO_x abatement system to their plant in 1999. The modification has resulted in a significant increase in N_2O emissions.

Chemical Industry (2B5)
The methodology for estimating methane emissions from the chemical inventory has been improved. Emissions from ethylene and methanol production were estimated separately and a time series produced based on operator's data reported in the Pollution Inventory, (Environment Agency, 2001). Other sources in the chemical inventory are aggregated. This replaces the single figure estimate reported in the previous inventory.

Emissions of CO, NO_x, SO_2 and NMVOC from the chemical industry have been revised. Separate estimates have been provided for carbon black (CO), reforming (CO), coal tar and bitumen processes (NMVOC), solvent and oil recovery (NMVOC), nitric acid use (NO_x) and sulphuric acid use (SO_2). Other process emissions reported in the Pollution Inventory have been reviewed and allocated to 'other chemical industry'.

Iron and Steel Production (2C1)
The methodology for calculating CO_2 emissions from iron and steel processes has been revised in line with the IPCC Tier 2 methodology. The methodology now takes account of carbon sources and sinks in iron making, steel making and electric arc furnaces. Emissions have reduced as a result.

Emissions of other pollutants blast furnaces and basic oxygen furnaces have been revised based on detailed data supplied by Corus (2001). There have been significant reductions in SO_2 and CO emissions and a minor increase in NMVOC. To some extent the reduction in CO in iron and steel processes is offset by the CO increase in sinter plant emissions (1A2a).

Other Non-Ferrous Metals (2C5)
Emissions of carbon monoxide for a number of non-ferrous metal production are now reported. These are emissions reported in the Pollution Inventory (Environment Agency, 2001). They arise from primary lead/zinc, secondary copper, secondary lead and various other non-ferrous metal production processes.

Pulp and Paper (2D1)
A new source of NMVOC has been included under 2D1. These are emissions from wood products manufacture.

Emissions of Halocarbons and Sulphur Hexafluoride (2E)
The by-product emissions from HCFC 22 manufacture have been revised based on recent data on the performance of the plant abatement system in 1999 and 2000. Emissions of sulphur hexafluoride from electrical insulation have been increased for 1998 and 1999 based on revised emission data from the Electricity Association.

12.4 AGRICULTURE (4)

Manure Management (4B) and Agricultural Soils (4D)
Whilst there have been no changes in the methodology used for the agricultural emissions, there has been a significant change in the way some animal manures are classified in the estimation of animal waste management system (AWMS) emissions. In effect, a greater proportion of manure is classified as daily spread. This has increased emissions of N_2O from agricultural soils. There have also been minor revisions in cattle numbers in the years 1990-91, 1998 and 1999 resulting in small changes in methane emissions

12.5 LAND USE CHANGE AND FORESTRY (5)

CO_2 Emissions and Removals from Soils (5D)
There have been only been minor changes to the land use change and forestry estimates and these arise from corrections and revisions to the activity data used in 1998 and 1999. However, the format used for reporting emissions in the CRF has been revised, in that emissions from upland drainage and lowland drainage are now reported in 5D rather than 5E.

12.6 WASTE (6)

Waste Incineration (6C)
Emissions of carbon dioxide from the incineration of clinical waste are now reported.

13 References

Corus (2001). Corus Default Emission Factors, Personal Communication

DOE, (1994), Climate Change: The UK Programme; United Kingdom's First Report under the Framework Convention on Climate Change, HMSO, London.

DOE, (1997), Climate Change: The UK Programme; United Kingdom's Second Report under the Framework Convention on Climate Change, The Stationary Office, London.

DTI, (2001), Digest of United Kingdom Energy Statistics 2001, London, The Stationary Office

Eggleston, HS, Salway, AG, Charles, D, Jones, BMR, Milne, R, (1998), Treatment of Uncertainties for National Estimates of Greenhouse Gas Emissions, National Environmental Technology Centre, AEA Technology, Report AEAT - 2688.

Environment Agency, (2001), 2000 Pollution Inventory. Personal Communication

European Environment Agency (2000), COPERT III : Computer Programme to Calculate Emissions from Road Transport - Methodology and Emission Factors (Version 2.1), L. Ntziachristos and Z Samaras, European Topic Centre on Air Emissions, European Environment Agency, November 2000

IPCC, (1996), Climate Change 1995. The Science of Climate Change. Contribution of Working Group 1 to the Second Assessment Report of the Intergovernmental Panel on Climate Change. Ed. Houghton, JT, Cambridge University Press.

IPCC, (1997), IPCC Revised 1996 Guidelines for National Greenhouse Gas Inventories, IPCC WGI Technical Support Unit, Hadley Centre, Meteorological Office, Bracknell, UK.

IPCC, (2000), Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, ed. Penman, J, Kruger, D, Galbally, I, *et al*, IPCC National Greenhouse Gas Inventories Programme, Technical Support Programme Technical Support Unit, Institute for Global Environmental Strategies, Hayama, Kanagawa, Japan

MCG, (1999), UK Emissions of HFCs, PFCs and SF_6 Potential Emission Reduction Options. A study for the Department of the Environment carried out by March Consulting Group. Telegraphic House, Waterfront Quay, Salford Quays, Manchester

Sage, PW, (2001), Methane from Abandoned Coal Mines in the UK, AEA Technology, Report AEAT/ENV/R.0500, Harwell, UK

Salway, AG, (1995), UK Greenhouse Gas Emission Inventory, 1990 to 1993. Annual Report for submission under the Framework Convention on Climate Change. National Environmental Technology Centre, AEA Technology, AEA/16419178/R/001, ISBN 0-7058-1709-1.

Salway, AG, (1996), UK Greenhouse Gas Emission Inventory, 1990 to 1994. Annual Report for submission under the Framework Convention on Climate Change. National Environmental Technology Centre, AEA Technology, AEA/20092001/R/003, ISBN 0-7058-1728-8.

Salway, AG, (1997), UK Greenhouse Gas Emission Inventory, 1990 to 1995. Annual Report for submission under the Framework Convention on Climate Change. National Environmental Technology Centre, AEA Technology, AEAT-2121, ISBN 0-7058-1755-5.

Salway, AG, (1998), UK Greenhouse Gas Inventory, 1990 to 1996. Supplementary Report for submission under the Framework Convention on Climate Change. National Environmental Technology Centre, AEA Technology, AEAT - 3436, ISBN 0-7058-1766-1.

Salway, AG, (1998a), Comparison between the IPCC default and UK Detailed Inventories 1990-1996, National Environmental Technology Centre, AEA Technology, AEAT-4457

Salway, AG, (1999), UK Greenhouse Gas Inventory, 1990 to 1997. Annual Report for submission under the Framework Convention on Climate Change. National Environmental Technology Centre, AEA Technology, AEAT-5689, ISBN 0-7058-1786-5.

Salway, AG, (2000), UK Greenhouse Gas Inventory, 1990 to 1998. Annual Report for submission under the Framework Convention on Climate Change. National Environmental Technology Centre, AEA Technology, AEAT/R/ENV/0302, ISBN 0-7058-1796-2

Salway, AG, Murrells, TP, Milne, R, Ellis, S, (2001), UK Greenhouse Gas Inventory, 1990 to 1999. Annual Report for submission under the Framework Convention on Climate Change. National Environmental Technology Centre, AEA Technology, AEAT/R/ENV/0524, ISBN 0-7058-1797-0

SCOPEC (2001), Environmental Database for Emissions and Discharges from Offshore Installations, Atmospheric Emissions Inventory, 2001. Personal communication from UKOOA.

USEPA, (1997), United States Environmental Protection Agency, Compilation of Air Pollutant Emission Factors Vol. 1, 5th Edition, AP-42, North Carolina. USEPA website

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 2002

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO2	CH4	N2O	NOX	CO	NMVOC	SO2
	(Gg)						
Total Energy	**568,744.81**	**1,453.44**	**17.98**	**2,742.66**	**6,750.99**	**1,554.67**	**3,661.78**
A. Fuel Combustion Activities (Sectoral Approach)	**556,606.80**	**120.96**	**17.67**	**2,736.89**	**6,689.42**	**1,088.81**	**3,623.42**
1. Energy Industries	**228,089.43**	**7.65**	**7.32**	**880.80**	**142.97**	**10.95**	**2,884.09**
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	0.36	39.68	6.87	1.18	152.97
c. Manufacture of Solid Fuels and Other Energy Industries	11,981.52	1.41	0.77	60.39	22.35	2.41	8.07
2. Manufacturing Industries and Construction	**94,133.37**	**12.97**	**3.82**	**284.14**	**797.77**	**30.15**	**433.64**
a. Iron and Steel	22,829.68	8.66	0.45	27.98	390.07	1.50	54.05
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)	71,303.69	4.31	3.37	256.16	407.71	28.65	379.59
Other industry				256.16	407.71	28.65	379.59
3. Transport	**116,580.83**	**30.15**	**4.34**	**1,396.21**	**5,262.19**	**944.72**	**90.09**
a. Civil Aviation	2,158.43	0.12	0.07	6.93	7.77	1.38	0.41
b. Road Transportation	109,038.96	29.59	3.31	1,305.24	5,240.01	938.07	62.92
c. Railways	1,888.54	0.12	0.72	20.61	6.12	2.88	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 2002

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO2	CH4	N2O	NOX	CO	NMVOC	SO2
	(Gg)						
4. Other Sectors	**112,537.75**	**69.92**	**1.98**	**140.26**	**473.11**	**100.84**	**206.36**
a. Commercial/Institutional	30,270.09	3.12	0.34	36.66	8.64	1.65	87.42
b. Residential	79,077.51	65.75	0.89	64.42	439.32	92.78	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**	**1,332.49**	**0.31**	**5.77**	**61.58**	**465.87**	**38.35**
1. Solid Fuels	**3,000.36**	**819.20**	**0.01**	**0.50**	**27.07**	**0.30**	**22.11**
a. Coal Mining	0.00	818.46	NO	NO	NO	NO	
b. Solid Fuel Transformation	3,000.36	0.74	0.01	0.50	27.07	0.30	22.11
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**	**513.29**	**0.30**	**5.28**	**34.50**	**465.56**	**16.24**
a. Oil	1,567.13	93.43		1.38	7.08	391.71	15.90
b. Natural Gas	0.00	398.11				42.49	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)	**2,979.41**						

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

1990
Submission 2002

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	**14,148.40**	**8.61**	**94.46**	**41.77**	**11,373.84**	**250.18**	**2,281.00**	**0.11146**	**0.03**	**10.45**	**198.60**	**242.43**	**54.87**
A. Mineral Products	**9,628.70**	**1.12**	**0.00**							**0.00**	**5.25**	**13.01**	**14.14**
1. Cement Production	6,659.34												IE
2. Lime Production	1,191.52												
3. Limestone and Dolomite Use	1,369.47												
4. Soda Ash Production and Use	167.31												
5. Asphalt Roofing	NE										NE	NE	
6. Road Paving with Asphalt	NE									NE	NE	9.83	NE
7. Other (please specify)	241.07	1.12	0.00							0.00	5.25	3.18	14.14
Glass Production	IE	NO	NO							NO	NO	0.31	NO
Fletton Brick Production	IE	IE	IE							IE	5.25	2.87	14.14
B. Chemical Industry	**1,358.31**	**6.71**	**94.42**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**8.37**	**24.52**	**148.22**	**32.53**
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	6.71	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.27	24.52	148.22	32.53
Sulphuric Acid & Pigment Production										NO	NO	NO	32.53
Other Organic Chemicals										0.27	24.52	148.22	NO
C. Metal Production	**3,161.39**	**0.78**	**0.04**	**0.00**	**0.00**	**0.00**	**2,031.00**	**0.00**	**0.02**	**2.09**	**168.83**	**2.05**	**8.20**
1. Iron and Steel Production	2,711.07	0.78	0.04							1.75	103.27	2.05	2.15
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	43.59	0.00	1.76
Other Non-Ferrous Metals										NO	43.59	NE	1.76

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

1990
Submission 2002

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**	**79.14**	**0.00**
1. Pulp and Paper										NE	NE	5.69	NE
2. Food and Drink	IE											73.45	
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 2002

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO2 (d)	N2O	NMVOC
	(Gg)		
Total Solvent and Other Product Use	**0.00**	**0.00**	**665.65**
A. Paint Application	**NE**	**NA**	**208.81**
B. Degreasing and Dry Cleaning	**NE**	**NA**	**86.49**
C. Chemical Products, Manufacture and Processing			**47.64**
D. Other (please specify)	0.00	0.00	322.71
(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	63.55
(Agrochemicals Use)	NE	NA	5.30
(Industrial Adhesives)	NE	NA	57.15
(Non-aerosol consumer products)	NE	NA	63.25
(Paper coating)	NE	NA	12.46
(Printing)	NE	NA	47.22
(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 2002

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CH4	N2O	NOx	CO	NMVOC
	(Gg)				
Total Agriculture	**1,032.07**	**103.05**	**9.07**	**266.04**	**34.96**
A. Enteric Fermentation	**908.49**				
1. Cattle	687.31				
Dairy Cattle	295.89				
Non-Dairy Cattle	391.42				
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	**110.910**	**4.88**			**0.00**
1. Cattle	72.37				
Dairy Cattle	33.29				
Non-Dairy Cattle	39.08				
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 2002

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		0.19			NO
12. Solid Storage and Dry Lot		4.13			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**	**97.91**			**0.00**
1. Direct Soil Emissions	0.00	45.83			NO
2. Animal Production	0.00	16.85			NO
3. Indirect Emissions	0.00	34.69			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 2002

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	-7,883.33					
3. Boreal Forests	NO	NO					
4. Grasslands/Tundra	NO	NO					
5. Other (please specify)	0.00	0.00					
Harvested Wood	NO	-1,573.00					
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**	**IE**					
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 2002

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 (1)	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(Gg)						
Total Waste	**811.74**	**1,150.41**	**3.47**	**4.72**	**3.15**	**11.29**	**4.33**
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	**811.74**	**0.03**	**0.13**	**4.72**	**3.15**	**0.12**	**4.33**
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 2002

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)		**603,052.49**	**-10,556.33**	**3,644.54**	**218.94**	**41.77**	**11,373.84**	**250.18**	**2,281.00**	**0.11**	**0.03**	**2,766.90**	**7,218.78**	**2,509.00**	**3,720.59**
1. Energy		**568,744.01**		**1,453.44**	**17.90**							**2,742.66**	**6,750.99**	**1,554.67**	**3,661.78**
A. Fuel Combustion	Reference Approach	572,762.39													
	Sectoral Approach	556,606.80		120.96	17.67							2,736.89	6,689.42	1,088.81	3,623.42
1. Energy Industries		238,089.43		7.65	7.38							880.80	142.97	10.95	2,884.09
2. Manufacturing Industries and Construction		94,133.37		12.97	3.83							284.14	797.77	30.15	433.64
3. Transport		116,580.83		80.15	4.34							1,396.21	5,262.19	944.72	90.09
4. Other Sectors		112,593.75		69.92	1.98							140.26	473.11	100.84	206.36
5. Other (b)		5,265.43		0.26	0.21							35.48	13.37	2.15	9.24
B. Fugitive Emissions from Fuels		12,138.01		1,332.49	0.31							5.77	61.58	465.87	38.35
1. Solid Fuels		3,000.36		819.20	0.01							0.50	27.07	0.30	22.11
2. Oil and Natural Gas		9,137.65		513.29	0.30							5.28	34.50	465.56	16.24
2. Industrial Processes		**14,140.40**		**0.61**	**94.46**	**41.77**	**11,373.84**	**250.18**	**2,281.00**	**0.11**	**0.03**	**10.45**	**190.60**	**242.43**	**54.87**
A. Mineral Products		9,628.70		1.12	0.00							0.00	5.25	13.01	14.14
B. Chemical Industry		1,338.31		6.71	94.40	0.00	0.00	0.00	0.00	0.00	0.00	8.37	24.52	148.22	32.53
C. Metal Production		3,161.39		0.78	0.04				2,031.00		0.02	2.09	168.83	2.05	8.20
D. Other Production		0.00										0.00	0.00	79.14	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 2002

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**									**605.65**	
4. Agriculture	**0.00**	**0.00**	**1,032.870**	**103.05**							9.07	366.04	34.96	0.00
A. Enteric Fermentation			908.492											
B. Manure Management			110.91	4.88									0.00	
C. Rice Cultivation			0.00										0.00	
D. Agricultural Soils			0.00	97.91									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	366.04	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	-7,283.33												
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	-3,100.00	0.00	0.00							0.00	0.00		
6. Waste	**811.74**		**1,150.41**	**3.47**							**4.72**	**3.15**	**11.29**	**4.33**
A. Solid Waste Disposal on Land	0.00		1,117.00									0.00	11.17	
B. Wastewater Handling (i)	0.00		33.38	3.33							0.00	0.00	0.00	
C. Waste Incineration	811.74		0.03	0.13							4.72	3.15	0.12	4.33
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 2002

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)	**2,979.41**													

SECTORAL TABLES 2000

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

2000
Submission 2002

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO2	CH4	N2O	NOX	CO	NMVOC	SO2
	(Gg)						
Total Energy	**529,424.06**	**757.06**	**26.59**	**1,514.40**	**3,974.58**	**884.09**	**1,130.01**
A. Fuel Combustion Activities (Sectoral Approach)	**521,612.39**	**98.34**	**26.44**	**1,511.27**	**3,946.03**	**522.06**	**1,120.04**
1. Energy Industries	**190,833.08**	**36.14**	**8.46**	**438.33**	**93.51**	**9.70**	**906.38**
a. Public Electricity and Heat Production	154,134.09	28.24	6.73	357.89	60.28	7.53	825.90
b. Petroleum Refining	16,587.55	0.69	0.34	28.32	5.60	1.17	72.04
c. Manufacture of Solid Fuels and Other Energy Industries	20,111.44	7.20	1.39	52.12	27.63	1.01	8.44
2. Manufacturing Industries and Construction	**86,509.90**	**12.68**	**2.97**	**216.32**	**606.96**	**28.64**	**117.16**
a. Iron and Steel	21,258.03	7.93	0.35	27.36	244.64	1.43	23.44
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)	65,251.87	4.75	2.62	188.96	362.32	27.21	93.71
Other industry				188.96	362.32	27.21	93.71
3. Transport	**123,046.07**	**16.04**	**13.56**	**699.30**	**2,901.90**	**413.28**	**25.81**
a. Civil Aviation	3,329.71	0.15	0.11	10.88	11.08	1.86	0.76
b. Road Transportation	115,655.51	15.59	12.74	628.55	2,881.31	408.05	5.92
c. Railways	1,363.77	0.06	0.52	11.04	3.08	1.50	1.15
d. Navigation	2,647.88	0.24	0.17	48.05	6.24	1.78	17.95
e. Other Transportation (please specify)	49.19	0.00	0.02	0.78	0.19	0.09	0.04
Aircraft Support Vehicles				0.78	0.19	0.09	0.04

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

2000
Submission 2002

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO2	CH4	N2O	NOX	CO	NMVOC	SO2
	(Gg)						
4. Other Sectors	**118,321.51**	**33.33**	**1.32**	**135.35**	**336.33**	**69.20**	**64.59**
a. Commercial/Institutional	29,956.83	3.16	0.14	30.85	3.16	1.93	16.00
b. Residential	85,879.50	29.16	0.56	72.96	309.79	61.57	44.48
c. Agriculture/Forestry/Fisheries	2,485.18	1.01	0.63	31.54	23.38	5.70	4.10
5. Other (please specify)	**2,901.83**	**0.15**	**0.12**	**21.96**	**7.33**	**1.24**	**6.10**
a. Stationary	0.00	0.00	0.00	0.00	0.00	0.00	0.00
b. Mobile	0.00	0.00	0.00	21.96	7.33	1.24	6.10
Military Aircraft and Naval Vessels				21.96	7.33	1.24	6.10
B. Fugitive Emissions from Fuels	**7,811.67**	**658.72**	**0.15**	**3.13**	**28.54**	**362.03**	**9.98**
1. Solid Fuels	**2,302.57**	**264.99**	**0.00**	**0.25**	**15.59**	**0.18**	**7.01**
a. Coal Mining	0.00	264.45	NO	NO	NO	NO	
b. Solid Fuel Transformation	2,302.57	0.54	0.00	0.25	15.59	0.18	7.01
c. Other (please specify)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2. Oil and Natural Gas	**5,509.10**	**393.73**	**0.15**	**2.88**	**12.96**	**361.84**	**2.97**
a. Oil	709.61	12.37		0.66	0.70	273.66	1.07
b. Natural Gas	0.00	332.93				63.22	IE
c. Venting and Flaring	4,799.49	48.44	0.15	2.22	12.25	24.96	1.90
Venting	3.38	27.61				10.90	NO
Flaring	4,796.11	20.83	0.15	2.22	12.25	14.06	1.90
d. Other (please specify)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Exploration: Well testing			IE				
Memo Items:							
International Bunkers (k)	**34,137.35**	**5.05**	**1.24**	**244.77**	**116.68**	**66.69**	**75.91**
Aviation (k)	28,543.57	4.53	0.88	142.86	103.45	62.92	6.52
Marine (k)	5,593.79	0.51	0.36	101.90	13.23	3.78	69.39
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO
CO2 Emissions from Biomass (kl)	**6,839.94**						

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

2000
Submission 2002

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	**13,110.61**	**3.80**	**19.97**	**10,732.35**	**9,316.30**	**534.78**	**668.23**	**0.07864**	**0.06**	**4.02**	**199.50**	**163.52**	**35.15**
A. Mineral Products	**8,534.14**	**0.59**	**0.00**							**0.00**	**2.72**	**9.58**	**10.57**
1. Cement Production	5,779.93												IE
2. Lime Production	1,291.40												
3. Limestone and Dolomite Use	1,190.78												
4. Soda Ash Production and Use	143.07												
5. Asphalt Roofing	NE										NE	NE	
6. Road Paving with Asphalt	NE									NE	NE	7.80	NE
7. Other (please specify)	128.95	0.59	0.00							0.00	2.72	1.79	10.57
Glass Production	IE	NO	NO							NO	NO	0.16	NO
Fletton Brick Production	IE	IE	IE							IE	2.72	1.63	10.57
B. Chemical Industry	**1,389.30**	**2.54**	**19.94**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**2.20**	**9.74**	**73.51**	**17.13**
1. Ammonia Production	1,389.30	NE								IE	IE	IE	NO
2. Nitric Acid Production			14.65							2.04			
3. Adipic Acid Production			5.29							NE	NE	IE	
4. Carbide Production	0.00	0.00									NO	NO	NO
5. Other (please specify)	0.00	2.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16	9.74	73.51	17.13
Sulphuric Acid & Pigment Production										NO	NO	NO	17.13
Other Organic Chemicals										0.16	9.74	73.51	NO
C. Metal Production	**3,187.17**	**0.67**	**0.03**	**0.00**	**0.00**	**0.00**	**203.10**	**0.00**	**0.03**	**1.82**	**187.04**	**1.76**	**7.44**
1. Iron and Steel Production	2,717.31	0.67	0.03							1.44	85.29	1.76	1.88
2. Ferroalloys Production	IE	NE								NE	NE	NE	NE
3. Aluminium Production	469.85	NE					203.10			0.39	23.50	NE	4.51
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	78.25	0.00	1.05
Other Non-Ferrous Metals										NO	78.25	NE	1.05

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

2000
Submission 2002

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**	**78.66**	**0.00**
1. Pulp and Paper										NE	NE	0.23	NE
2. Food and Drink	IE											78.43	
E. Production of Halocarbons and SF6					**4,316.77**		**0.00**		**0.00**				
1. By-product Emissions					4,316.77		0.00		0.00				
Production of HCFC-22					IE								
Other (c)					4,316.77		IE		NO				
2. Fugitive Emissions					IE		IE		NO				
3. Other (please specify)					0.00		0.00		0.00				
F. Consumption of Halocarbons and SF6				**10,732.35**	**4,999.53**	**534.78**	**465.13**	**0.08**	**0.04**				
1. Refrigeration and Air Conditioning Equipment				8,832.93	3,354.32	60.94	33.08		NO				
2. Foam Blowing				175.50	119.45	0.00	0.00		NO				
3. Fire Extinguishers				211.06	16.82	46.18	4.39		NO				
4. Aerosols/ Metered Dose Inhalers				1,512.86	1,508.94	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	427.67	427.67	0.08	0.04				
Semiconductors, Electrical and production of trainers				NO	NO	427.67	427.67	0.08	0.04				
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) 2000

Submission 2002

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO2 (d)	N2O	NMVOC
	(Gg)		
Total Solvent and Other Product Use	**0.00**	**0.00**	**444.52**
A. Paint Application	**NE**	**NA**	**126.70**
B. Degreasing and Dry Cleaning	**NE**	**NA**	**46.65**
C. Chemical Products, Manufacture and Processing			**20.29**
D. Other (please specify)	0.00	0.00	250.88
(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	48.00
(Agrochemicals Use)	NE	NA	3.50
(Industrial Adhesives)	NE	NA	31.06
(Non-aerosol consumer products)	NE	NA	69.26
(Paper coating)	NE	NA	2.78
(Printing)	NE	NA	27.65
(Seed oil extraction)	NE	NA	2.34
(Wood preservation)	NE	NA	20.29
(Other Use of Solvent)	NE	NA	46.00

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

2000
Submission 2002

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CH4	N2O	NOx	CO	NMVOC
	(Gg)				
Total Agriculture	**968.85**	**91.17**	**0.00**	**0.00**	**0.00**
A. Enteric Fermentation	**863.69**				
1. Cattle	648.77				
Dairy Cattle	271.97				
Non-Dairy Cattle	376.80				
2. Buffalo	NO				
3. Sheep	199.24				
4. Goats	0.38				
5. Camels and Llamas	NO				
6. Horses	5.24				
7. Mules and Asses	NO				
8. Swine	9.72				
9. Poultry	0.00				
10. Other (please specify)	0.33				
Deer	0.33				
B. Manure Management	**105.163**	**4.63**			**0.00**
1. Cattle	67.68				
Dairy Cattle	30.60				
Non-Dairy Cattle	37.08				
2. Buffalo	NO				
3. Sheep	4.77				
4. Goats	0.01				
5. Camels and Llamas	NO				
6. Horses	0.41				
7. Mules and Asses	NO				
8. Swine	19.45				
9. Poultry	12.85				

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

2000

Submission 2002

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		0.17			NO
12. Solid Storage and Dry Lot		3.91			NO
13. Other (please specify)		0.54			0.00
Other		0.54			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**	**86.55**			**0.00**
1. Direct Soil Emissions	0.00	40.32			NO
2. Animal Production	0.00	16.31			NO
3. Indirect Emissions	0.00	29.40			NO
4. Other (please specify)	0.00	0.52			0.00
Improved Grass	0.00	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)

2000
Submission 2002

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)	**15,006.97**	**-11,652.67**	**(a)**	**0.00**	**0.00**	**0.00**	**0.00**
A. Changes in Forest and Other Woody Biomass Stocks	**0.00**	**-10,552.67**					
1. Tropical Forests	NO	NO					
2. Temperate Forests (f)	NO	-9,401.33					
3. Boreal Forests	NO	NO					
4. Grasslands/Tundra	NO	NO					
5. Other (please specify)	0.00	0.00					
Harvested Wood	NO	-1,151.33					
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)	**11,440.89**	**IE**					
E. Other (please specify) (h) (i)	**3,566.08**	**-1,100.00**		**0.00**	**0.00**	**0.00**	**0.00**

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

2000

Submission 2002

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 (1)	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(Gg)						
Total Waste	**208.16**	**696.97**	**3.81**	**1.10**	**3.67**	**6.78**	**0.78**
A. Solid Waste Disposal on Land	**0.00**	**660.00**		**0.00**	**0.00**	**6.60**	
1. Managed Waste Disposal on Land	NA	660.00		NA	NA	6.60	
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		**36.89**	**3.64**	**0.00**	**0.00**	**0.00**	
1. Industrial Wastewater		0.00	NE	NA	NA	NE	
2. Domestic and Commercial Wastewater (j)		36.89	3.64	NA	NA	NE	
3. Other *(please specify)*		0.00	0.00	0.00	0.00	0.00	
C. Waste Incineration	**208.16**	**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)

2000

Submission 2002

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)		**557,749.80**	**-11,652.67**	**2,426.68**	**141.54**	**10,732.35**	**9,316.30**	**534.78**	**668.23**	**0.08**	**0.06**	**1,519.53**	**4,177.75**	**1,498.91**	**1,165.94**
1. Energy		**529,424.06**		**757.06**	**26.59**							**1,514.40**	**3,974.58**	**884.09**	**1,130.01**
A. Fuel Combustion	Reference Approach	554,084.49													
	Sectoral Approach	521,612.39		98.34	26.44							1,511.27	3,946.03	522.06	1,120.04
1. Energy Industries		190,833.08		36.14	8.46							438.33	93.51	9.70	906.38
2. Manufacturing Industries and Construction		86,509.90		12.68	2.97							216.32	606.96	28.64	117.16
3. Transport		123,046.07		16.04	13.56							699.30	2,901.90	413.28	25.81
4. Other Sectors		118,321.51		33.33	1.32							132.35	336.33	69.20	64.59
5. Other (b)		2,901.83		0.15	0.12							21.96	7.33	1.24	6.10
B. Fugitive Emissions from Fuels		7,811.67		658.72	0.15							3.13	28.54	362.03	9.98
1. Solid Fuels		2,302.57		264.99	0.00							0.25	15.59	0.18	7.01
2. Oil and Natural Gas		5,509.10		393.73	0.15							2.88	12.96	361.84	2.97
2. Industrial Processes		**13,110.61**		**3.80**	**19.97**	**10,732.35**	**9,316.30**	**534.78**	**668.23**	**0.08**	**0.06**	**4.02**	**199.50**	**163.52**	**35.15**
A. Mineral Products		8,534.14		0.59	0.00							0.00	2.72	9.58	10.59
B. Chemical Industry		1,389.30		2.54	19.04	0.00	0.00	0.00	0.00	0.00	0.00	2.20	9.74	93.51	17.13
C. Metal Production		3,187.17		0.67	0.03				203.10		0.03	1.82	187.04	1.76	7.44
D. Other Production		0.00										0.00	0.00	58.66	0.00
E. Production of Halocarbons and SF6							4,316.77		0.00		0.00				
F. Consumption of Halocarbons and SF6						10,732.35	4,999.53	534.78	465.13	0.08	0.04				
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)

2000

Submission 2002

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**									**464.52**	
4. Agriculture	**0.00**	**0.00**	**968.053**	**91.17**							0.00	0.00	0.00	0.00
A. Enteric Fermentation			863.691											
B. Manure Management			105.16	4.63									0.00	
C. Rice Cultivation			0.00										0.00	
D. Agricultural Soils			0.00	86.55									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 (s)	**15,006.97**	**-11,652.67**	**0.00**	**0.00**							**0.00**	**0.00**	**0.00**	**0.00**
A. Changes in Forest and Other Woody Biomass Stocks (f)	0.00	-9,401.33												
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)	11,440.89	0.00												
E. Other (h)	3,566.08	-1,100.00	0.00	0.00							0.00	0.00		
6. Waste	**208.16**		**696.97**	**3.81**							**1.10**	**3.67**	**6.70**	**0.70**
A. Solid Waste Disposal on Land	0.00		660.00									0.00	6.60	
B. Wastewater Handling (j)	0.00		36.89	3.64							0.00	0.00	0.00	
C. Waste Incineration	208.16		0.08	0.17							1.10	3.67	0.10	0.70
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**

(Sheet 3 of 3)													2000	
													Submission 2002	
GREENHOUSE GAS SOURCE AND SINK	CO2	CO2	CH4	N2O	HFCs		PFCs		SF6		NOx	CO	NMVOC	SO2
CATEGORIES	emissions	removals			P	A	P	A	P	A				
	(Gg)				CO2 equivalent (Gg)						(Gg)			
Memo Items:														
International Bunkers (k)	**34,137.35**		**5.05**	**1.24**							**244.77**	**116.68**	**66.69**	**75.91**
Aviation (k)	28,543.57		4.53	0.88							142.86	103.45	62.92	6.52
Marine (k)	5,593.79		0.51	0.36							101.90	13.23	3.78	69.39
Multilateral Operations	**NO**		**NO**	**NO**							**NO**	**NO**	**NO**	**NO**
CO2 Emissions from Biomass (kl)	**6,839.94**													

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 1505 Gg in 1990 and 1033 Gg in 2000.
e Field burning ceased in 1994.
f 5A Removals are sum of removals to forest biomass, forest litter and forest soil.
g 5D Emissions are sum of emissions from soils and removals to soils due to land use change (not forestry), Set Aside and liming of agricultural land.
h 5E Emissions are sum of 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.
NE Not estimate
NO Not occurring
IE Included elsewhere