Greenhouse Gas Emissions in Republic of Bulgaria 1988, 1990-2004. National Inventory Report 2004

Submission 2006

Hr. Vassilev, Ch. Christov, V. Hristova, B. Neshev

National Inventory Report prepared for submission in accordance with the UN Framework Convention on Climate Change (UNFCCC) [including electronic Excel spreadsheet files containing Common Reporting Format (CRF) data for 1988, 1990-2004]

This study has been performed by order and for the account of the Bulgaria Ministry of Environment and Water within the framework of Energy Institute contract No. 543/31.01.2006, project title "GHG Inventory of Bulgaria for 2004 under UNFCCC with National Report".

The Report and the CRF tables have been received approval of the Expert Environmental Council of the Executive Environmental Agency to the Ministry of Environment and Water.

ABBREVIATION'S LIST

CH_4	Methane
CO	Carbon oxide
CO_2	Carbon dioxide
CO_2-eq.	Carbon dioxide-equivalent
CORINAIR	The Atmospheric Emission Inventory for Europe
CRF	Common Reporting Format
DOC	Degradable Organic Content
EEA	Executive Environmental Agency
EI	Energy Institute
EUROSTAT	European Statistical Organisation
FAO	Food and Agriculture Organisation
GHG	Greenhouse Gas
GWP	Global Warming Potential
HFCs	Hydrofluorocarbons
IEA	International Energy Agency
IPCC	Intergovernmental Panel of Climate Change
KP	Kyoto Protocol
LPG	Liquid Petroleum Gas
LULUCF	Land Use and Land Use Change and Forestry
MAF	Ministry of Agriculture and Forestry
MEE	Ministry of Economy and Energy
MIA	Ministry of Internal Affairs
MoEW	Ministry of Environment and Water
MOI	Ministry of Interior
MSW	Municipal Solid Waste
N_2O	Nitrous oxide
NC	National Communications
NFPS	National Forest policy and strategy
NIR	National Inventory Report
NMVOCs	Non-Methane Volatile Organic Compounds
NOx	Nitrogen oxide
NAP	Nuclear Power Plant
NSI	National Statistical Institute
OECD	Organization for Economic Cooperation and Development
PFC	Perfluorocarbons
QA/QC	Systems for Quality Assessment and Quality Control
QMS	Quality Management System
RA	Reference Approach
RCD	Road Control Department
SA	Sectoral Approach
SBSTA	Subsidiary Body for Scientific and Technological Advice
SEEC	Superior Expert Ecological Council at MoEW
SF_6	Sulphur hexafluoride
SOx	Sulphur oxide
SWDS	Solid Waste Disposal Site
TPP	Thermo Power Plant
UNFCCC	UN Framework Convention on Climate Change

EXECUTIVE SUMMARY

ES.1. Background Information on the GHG Inventories and Climate Change

This report represents the annual GHG Inventory in Bulgaria for 2004.

This Inventory is prepared according to the UNFCCC Guideline approved by the Subsidiary Body for Scientific and Technological Appliance on The 21st session on 06-14.12.2004 in Buenos Aires. The rules and the structure of the National GHG Inventory Report are formed by this Guideline. The report is elaborated in compliance with the Revised IPCC Guidelines, 1996 and Good Practice, 2000.

According to the UNFCCC Guidance, the Inventory should be prepared in a way that ensures Transparency, Consistency, Comparativeness, Completeness and Accuracy.

These qualities of the Inventory are elements of the "Good Practices" were pointed out in the IPCC Good Practice Guidance, 2000.

That is the reason why the current report also presents:

- GHG emissions trends for the period 1988-2004;
- Methods and data for assessment of the uncertainty of the annual GHG emissions and trends;
- Key sources of the GHG emissions according to the methods from type Tier 1 and Tier 2 described in the Good Practice Guidance;
- Assessment of the system of Appliance and Control of the Quality.

Tables with data and GHG emissions are applied in the report and there formatted according to the Common Reporting Format for reporting the annual inventory. These tables are completed for the base year of Bulgaria – 1988 as well as for each year from the period of 1990-2004. In this inventory are included and additional CRF tables only for sector Land use change and Forestry, which are prepared in accordance with Good Practice Guidance only for this sector.

The full set of CRF tables and the text of the National Report as PDF-file are in the Internet page of MoEW (www.moew.government.bg) and on the Internet page of the Energy Institute (www.eninbg.com).

UNFCCC and Protocol from Kyoto

The Parliament of Bulgaria ratified the UN Framework Convention on Climate Change in March 1995. The Convention sets up its prerogatives for achieving the target for stabilization of greenhouse gas concentration in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.

The Convention separates the countries in two main groups: the first one is the group of countries listed in the Annex 1 (so-called Annex I Countries) and the second one is of these countries outside of this Annex 1. Countries of Annex I are the industrial countries which are members of the Organization for Economic Cooperation and Development (OECD) and countries with economy in transition (Russia, Baltic countries, Ukraine and Central and East Europe Countries). Bulgaria is a part of the group of countries with economy in transition.

The Kyoto Protocol (KP) was approved on the Third session of the Conference of the Parties in December 1997 in Kyoto, Japan. Until August 2004, KP was ratified by 159 countries, including Bulgaria, which ratified it on August 15th, 2002. After its ratification by the Russian Federation in November 2004, the Kyoto Protocol entered into force on February 16th 2005.

With Kyoto Protocol, the Parties to the Convention assumed the obligation not only to stabilize the GHG emissions, but also to reduce them with a certain rate regarding the base year for each country. In this case, Bulgaria's commitment for reducing the GHG emissions form the base year is 8% for the First Commitment Period under the Kyoto Protocol (2008-2012).

Report Requirements: UNFCCC and IPCC

Annex 1 Countries to the Convention must report annual GHG Inventory, which includes data for the GHG emissions for the base year and at least 1 year before the current Inventory.

The UNFCCC Guidance describes the GHG emission sources, methodologies for their calculation and the content of the reported materials on the Inventory. For this purpose, the Revised IPCC Guidance, 1996 and the Good Practice Guidance, 2000 for formatting and reporting the results from the GHG emission calculation are used.

Generally as a rule more exact methodologies for determination the GHG emissions in IPCC Guidance are recommended. This fact always leads to engagement more resources (human, technical). For that reason, it is necessary a reasonable and balanced combination between the accuracy of the method and the available resources.

Key Sources

In defining the key sources of GHG emissions, the IPCC/OECD methodology, proposed in the Good Practice Guidance for GHG Inventories, 2000 is used.

Two new key sources are added: Fugitive CH_4 emissions from the system for oil and gas and Indirect N_2O emissions from agricultural soils. The source N_2O emissions from stationary combustion are dropped out from the register.

The determination of the key sources according to the method type Tier 1 treats the national total annual emissions as well as the total trend for annual emissions.

The results from applying Tier 1 method in its two varieties (quantitative assessment of the participation in the total emissions and assessment of the trend of each source toward the total emission trend) are presented in details in Annex 1 of this report. From the total 41 emission sources, the key emission sources are 20 based on the quantitative assessment and 19 sources according to the trend assessment and the two types of assessment they give 95% of the total quantity of the GHG emissions expressed in CO_2-eq.

According to the method of type Tier 2, the assessment of the key sources is made by accounting the uncertainty of each source. The uncertainty is regarded as the combined uncertainty of the data (fuels, products, etc.) and the emission factors.

As a result of the applying of the two approaches for assessment of the key sources a list of total 25 sources, which are subject of the following assessments and analysis, is created. Only 11 of them are defined as key sources and they participate in all the applied methods and types of assessment (in quantity and trend).

Description of the Institutional Arrangement for Inventory Preparation

The activities for the preparation of the GHG Inventory in Bulgaria is coordinated and managed at a state level by the Ministry of Environment and Waters.

Executive Environmental Agency (EEA) is a subsidiary body of the MoEW. It coordinates all the activities connected with the collection of the data for fuels and other sources of GHG emissions. EEA is the main body responsible for the Inventory data collection, which is aggregated at a national level, by the following state bodies:

- National Statistical Institute (NSI);

- Department for road control in the Ministry of Internal Affairs;
- Department "Statistics" within the Ministry of Agriculture and Forests;
- Ministry of Economy and Energy;
- National Forest's Management within MAF;
- Executive Agency for soil resources within MAF;
- National Bureau on vegetable protection;
- Energy Efficiency Agency.

In the GHG Inventory are used data received directly from the large emitters from the energy and industry. These data are generalized by Executive Environmental Agency and by the organization, which prepares the Inventory – Energy Institute.

The Energy Institute Joint Stock Company is an executer of the current Inventory.

It completes all the activities on the contracting basis according to the Law of Public Orders.

The EI is a scientific and consultant organization with significant experience in researching and resolving the problems of climate change. All the GHG Inventory according to the IPCC methodology from 1988 till now is elaborated by the team from EI.

Organization of the National Inventory Report

In the organization of the Inventory Report of Bulgaria for the year 2004 and in the National Report the following improvements are made in comparison with the previous National Report from 2003:

- The base year 1988 is recalculated;
- CRF tables are prepared for all years in which the GHG Inventory is elaborated in the period of 1990–2004;
- Omissions and mistakes in selecting and applying of emission factors for assessment of the GHG emissions from large combustion plants are eliminated.

National Inventory Report starts with *Chapter 1* – Introduction, it includes general information for the process of elaboration of the GHG Inventory in Bulgaria, description of the key sources of GHG emissions, assessment of the methods, sources and emission factors as well as the uncertainty in their determination. In *Chapter 2* the GHG trends by type of sources and gases are analyzed. *Chapters 3 – 9* provide information in detail of the GHG emissions from the different sectors of the economy and services. The final *Chapter 10* presents information and results from GHG emissions recalculations done for the period 1988-2003 as well as comments on the executed improvements in relation with fulfilled checks-up and inspections by UNFCCC Secretariat's teams. There are seven appendixes in the report, which give detailed assessment of the used data, and the received results Part of the tables from the Common Reporting Format – CRF are applied.

ES.2. Summary of National Emission and Removal Related Trends

The GHG Inventory for the year 2004 revealed that the overall GHG emissions expressed in CO_2-eq. are 67 510.9 Gg not taking into account the sequestration in sector Land use Change and Forestry. The net emissions (including the sequestration from LUCF) are 59 291.5 Gg.

Table ES.1 represents the emission trends of the basic GHG, the overall emissions (not taking into account the LUCF) and the relative share of the overall emissions to the emissions from the base year 1988 referred to as 100%.

The analysis of the **Table ES.1** reveals that in 2004 the CO_2 emissions form the largest share of 78.6% from the overall GHG emissions expressed in CO_2-eq.; the CH_4 emissions are second with 14.5% and the N_2O emissions with a 6.5% share stand in the third place.

There can be seen that in the year 2004 the overall GHG emissions expressed in CO_2-eq. registered a light drop. The emissions for the year 2004 are 51% in comparison to the base year 1988 and they registered a decrease with 0.32% in comparison to the previous year 2003.

Summary of emission trend per gas, CO_2-eq., Gg

Table ES.1

Source category	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
CO_2 with LUCF	93 169	79 126	60 308	53 689	56 139	53 963	57 219	56 931	54 794	47 559	43 537	41 200	42 383	40 765	46 739	45 130
CO_2 excluding LUCF	98 302	85 283	67 944	61 101	63 615	61 265	64 744	63 449	61 665	54 419	50 736	50 176	51 851	49 083	53 795	53 096
CH_4	21 864	18 703	16 417	15 185	13 602	12 598	12 390	11 502	9 945	9 268	8 901	9 035	8 317	8 480	9 358	9 766
N_2O	12 061	10 450	7 793	6 377	5 671	5 805	5 838	5 757	5 404	4 400	4 473	4 911	4 568	4 443	4 434	4 395
HFCs	0	0	0	0	0	0	2.95	109.30	188.15	576.65	102.80	96.02	97.50	89.59	121	217
PFCs	75.55	47.31	21.32	27.92	19.03	45.83	46.94	45.88	37.26	69.44	43.55	33.14	16.29	21.42	21	33
SF_6	0	0	0	0	0	0	1.26	1.31	1.75	1.83	1.88	2.23	2.29	2.51	3	4
Total	**132 303**	**114 483**	**92 175**	**82 690**	**82 907**	**79 714**	**83 022**	**80 864**	**77 241**	**68 736**	**64 259**	**64 254**	**64 852**	**62 119**	**67 731**	**67 511**
Index (1988 = 100)																
Index CO_2 excluding LUCF	100	86.8	69.1	62.2	64.7	62.3	65.9	64.5	62.7	55.4	51.6	51.0	52.7	49.9	54.7	54.0
Index CH_4	100	85.5	75.1	69.5	62.2	57.6	56.7	52.6	45.5	42.4	40.7	41.3	38.0	38.8	42.8	44.7
Index N_2O	100	86.6	64.6	52.9	47.0	48.1	48.4	47.7	44.8	36.5	37.1	40.7	37.9	36.8	36.8	36.4
Index [group of six]	**100**	**86.5**	**69.7**	**62.5**	**62.7**	**60.3**	**62.8**	**61.1**	**58.4**	**52.0**	**48.6**	**48.6**	**49.0**	**47.0**	**51.2**	**51.0**
Index (1995 = 100)																
Index HFCs	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	0
Index PFCs	160.9	100.8	45.4	59.5	40.5	97.6	100.0	97.7	79.4	147.9	92.8	70.6	34.7	45.6	44.1	70.7
Index SF_6	0.0	0.0	0.0	0.0	0.0	0.0	100.0	103.7	138.9	145.1	148.8	176.9	181.7	198.7	199.4	291.5
Index [group of new gases]	147.7	92.5	41.7	54.6	37.2	89.6	100.0	92.3	76.3	139.3	88.8	69.1	36.3	46.8	45.4	45.4

In **Table ES.2** are presented shares of the overall GHG emissions by sectors for the period 1988-2004. The percentage was calculated out of the overall emissions without taking into account the CO_2 sequestration.

Sector contribution in aggregated emissions, %

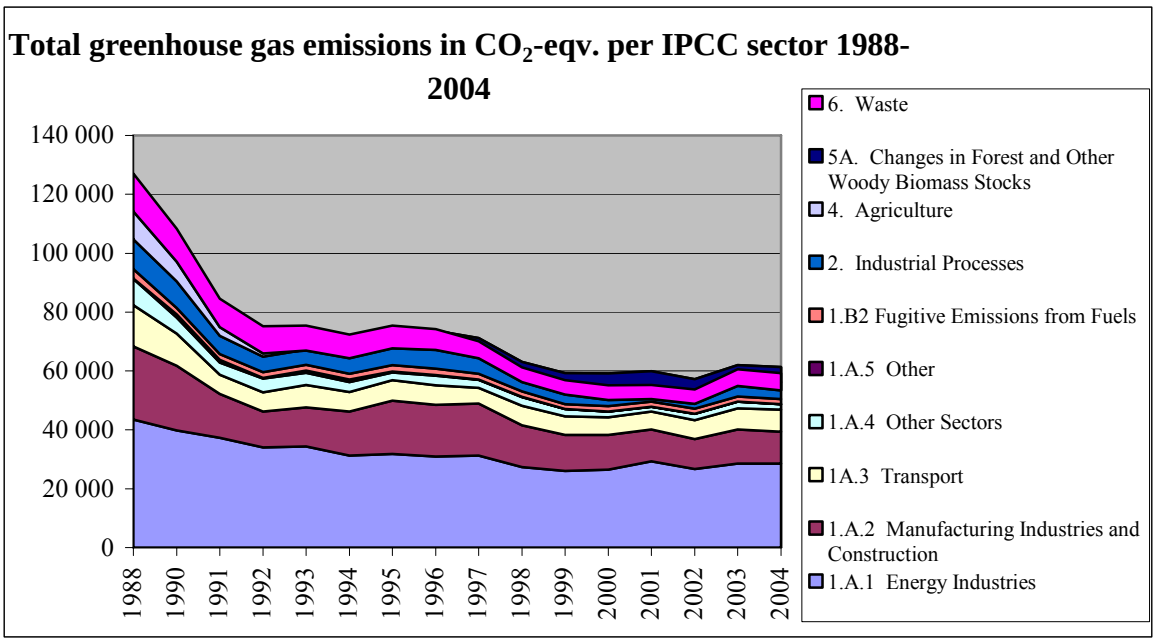
Table ES.2

Sector/ year	1988	1990	1991	1992	1993	1994	1995	1996
Energy	71.51	71.12	71.31	72.12	74.94	74.08	74.59	75.10
Industrial processes	7.68	7.84	6.81	6.41	6.20	7.60	8.93	9.18
Agriculture	11.00	11.31	11.42	10.31	8.62	8.27	7.15	7.04
Forestry	-3.88	-5.38	-8.28	-8.96	-9.02	-9.16	-9.06	-8.06
Waste	9.81	9.72	10.45	11.17	10.24	10.05	9.33	8.68
Sector/ year	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Energy	76.37	77.25	75.88	74.78	76.55	75.95	75.71	74.80
Industrial processes	8.90	7.69	7.67	9.08	9.00	8.49	8.86	8.86
Agriculture	7.24	7.72	8.82	8.39	7.00	7.82	7.15	7.56
Forestry	-8.90	-9.98	-11.20	-13.97	-14.60	-13.39	-10.44	-11.80
Waste	7.49	7.33	7.64	7.74	7.45	7.74	8.28	8.78

The analyses of the **Table ES.2** show that the Energy sector forms the largest share of the overall emissions in 2004 – 75%. Second in share for the year 2003 is sector Industrial Process – 9%, and in the third place stands the sector Waste in practice with the same share.

In **Figure ES.1** are presented the aggregated emissions by sectors in compliance with the IPCC classification.

Figure ES.1



The uncertainty of the aggregated GHG emissions according to the method from type Tier 1 is about 3.2%. The uncertainty of the level f the overall emissions are considerably larger and it is about 12.4%. This fact shows that the emission's accounting in the base year 1988 leads to a reduction of the uncertainty indexes only in comparison to the emission's accounting of the current year.

ES.3 Overview of Sources and Sink Category Emission Estimates and Trends

In **Table ES.3** are presented the CO_2 emission trends from IPCC sectors for the period 1988- 2004.

Energy Sector

The Bulgarian Energy sector has key position in the national economy. It is the source of over 74% of the aggregated GHG emissions for the last inventory 2004.

In the year 2004 the decrease in general CO_2 emissions compared with the basis year 1988 is 46%.

This decrease is conditioned in the great value from the decrease in Industry – 56%, in Transport – 46% and especially in residential sector – 80%. Least decrease is in Energy – 37%, which is due to the structure of electric power units in production and significant electricity production from nuclear energy.

In comparison with the preceding 2003, in the present year is shown a little drop in CO_2 emissions, but as a whole the level from 2003 kept position. That note, that the tendency of liveliness in economy and increase of the energy efficiency are supporting for the second year in a row.

The analyses of **Figure ES.3** show that the Energy industries have the largest share. Only the Energy industry registered an increase in the relative share regarding the base year 1988 – from 46% to 57% in 2004. For other sub-sectors this share has decreased: in the Processing Industry – from 27.8% to 22.4% and mostly in the Public and Residential sector – from 9.8 to 3.6%.

The trend of Transport sector shows not large fluctuations, i.e. in 2004 the emissions increased by 4.3% compare to 2003 and they form 15.3% of the overall emissions of CO_2 in the sector. The fluctuations are in relation in bigger degree with the change in liquid fuel price as well as the process of restructure and renovation of the car park.

In sub-sector Other sectors (Services, Residential, Agriculture and Forestry) the general tendency varies as well.

The CO_2 emissions from non-energy use of fuels are accustomed to be reported in this sector and not in sector Industrial Processes.

Fugitive emissions of methane from mining and systems for extraction and distribution of oil and natural gas are part of the Energy sector as well.

The Coal Mining in Bulgaria is concentrated mainly in mines Maritsa East basin where lignite coals are extracted in surface mines. Around 40% of the country's electricity is produced by lignite coals. Relatively small quantities of brown and black coals are extracted in underground mines.

Petroleum and natural gas extraction is in a small scale – less than 1% from the total consumption in the country. Due to its geographical position, Bulgaria is natural energy centre in the region and because of that reason; the transit flows of the natural gas are significant. They are three times higher than the country's overall consumption, which accordingly lead to an increase of fugitive emissions of methane.

Industrial Processes

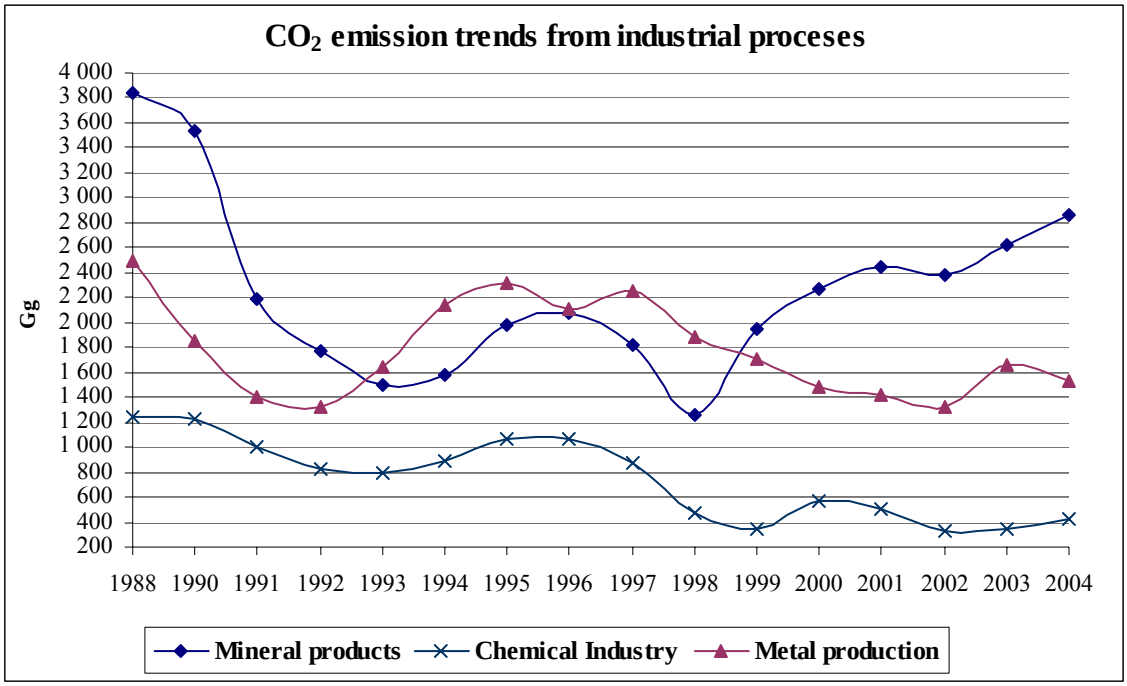
The emissions from Industrial processes comprise of all the main GHGs and GHG-precursors. A special attention is paid to the emissions of F-gases. The emissions of halocarbons and sulphur hexafluoride - SF_6 are classified in two separate sub-categories due to their great variety.

For all the category sources in this sector, there is a stable trend for emission's reduction from 1988 till present. N_2O have the largest reduction – 64.5% followed by CH_4 with 41.5% reduction and CO_2 - 36.4%. Taking into account the potential HFCs emissions it leads to an increase towards the 1995 base year with 124%.

In the current year, there was registered and decrease of the emissions (2%) for all gases in the sector compared to the year 2003. This decrease is conditioned by the drop of N_2O emissions with 26%, following by the decrease in CH_4 emissions – 18.6%. Increase in CO_2 emissions and F-gases lead to keep in practice the level in emissions from this sector for 2003. Detailed analyze of GHG emissions should be implement in Chapter 4.

In **Figure ES.2** are presented the emission trends for CO_2 for the main sub-sectors.

Figure ES.2



The analyses of the **Figure ES.2** show that the emission fluctuations follow the economical changes in the country. During the period under review, the following factors had the greatest influence on the macroeconomic level:

- Changes on the International market;
- Privatization of the state property;
- Collapse in some economical branches due to transition to market economy;
- Others.

Solvent Use

The GHG and precursors emissions in sector Solvent Use are released as a result of the production and use of paints and glues, solvent use in industry and households, dry cleaning, vegetable oil production and pharmaceuticals. Mainly NMVOCs and N_2O are emitted in this sector.

The IPCC Guidelines do not provide methodology for estimating emissions of NMVOCs, which are the main GHG-precursor emissions source in this sector. Therefore, for the purpose of GHG inventories in Bulgaria a simplified method for estimating the emissions of NMVOCs is used. It includes data from the GHG estimation after the CORINAIR methodology.

The N_2O emissions are not estimated in the Inventories of Bulgaria due to the lack of data for the use substances for anaesthesia, production of medicines, aerosol packages, etc.

Agriculture

The general reduction of GHG emissions from Agriculture for the period from the year 1988 is 65%. All emission categories of the sector decreased on the average with the same percents, as the biggest reduction is shown in agricultural soils – 66%.

In the present year, a growth of sector emissions is observed toward the year 2003 with 5.6%. This growth is stable after 2001. The biggest growth is in emissions of N_2O from agricultural soils. Analyze in details of GHG emissions in sector is implemented in Chapter 6.

In **Figure ES.3** the methane emission trends are presented and they form 46% of the overall sectors emission expressed in CO_2-eq.

There is a stable trend in emission's increase from 2001 up to now. Nevertheless, the drop related to the base year 1988 stands a very large one – above 65%.

The N_2O emissions from the sector are also large in volume. The most significant portion is released from agricultural soils. For the year 2004 it constituted around 86%, and for the entire period (1988, 1990-2004) this share remains in the range of 83 – 88%. The N_2O emissions from manure management and field burning of agricultural residues are one magnitude lower and they both total up to 13 – 14% of the overall N_2O emissions from this sector.

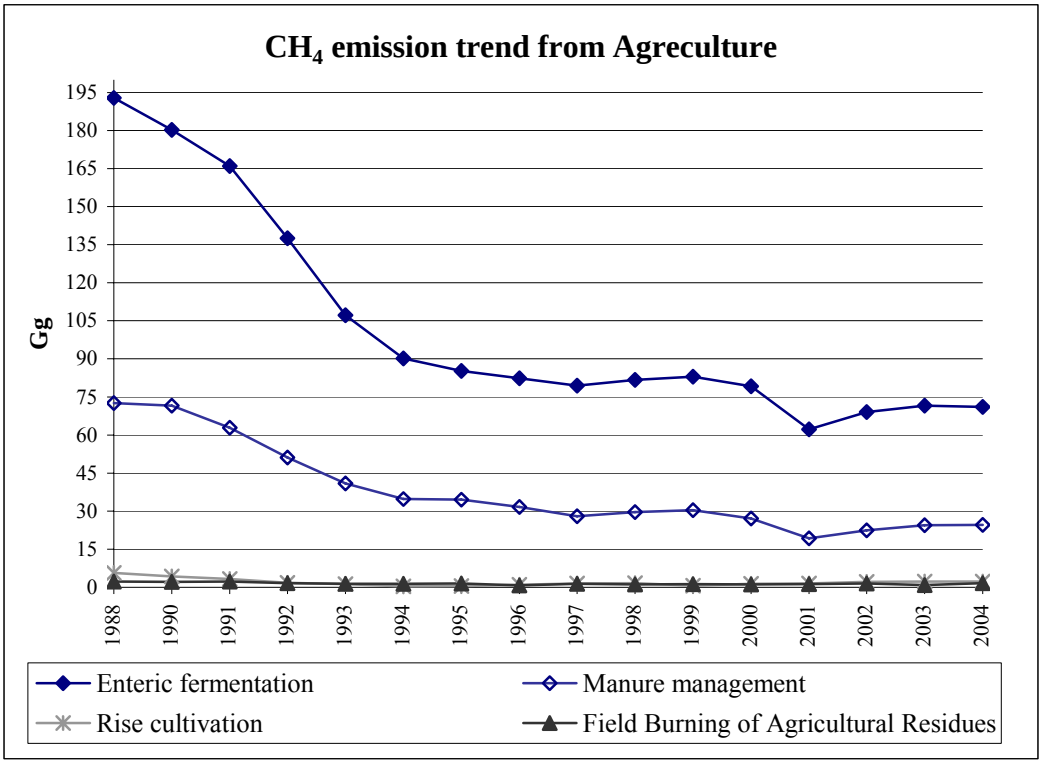
As a general, the N_2O emissions in 2004 (expressed in CO_2-eq.) are about 44% higher than the CH_4 emissions (expressed in CO_2-eq.).

Land Use Change and Forestry

Due to the great diversity and complicity of CO_2 sequestration and emitting in the Revised IPCC Guidelines are defined several categories:

- Changes in Forest and Other Woody Biomass Stocks;
- Forest and Grassland Conversion;
- Abandonment of Managed Lands;
- CO_2 Emissions and Removals from Soil;
- Other.

Figure ES.3



In the GHG Inventory for the year 2004, as well as for the previous years is estimated the net CO_2 removal from category Land Use Change and Forestry. CO_2 emissions or removal of CO_2 from rest of the above categories were not determined due to data lack or because some of the activities do not take place in Bulgaria.

The forests in Bulgaria are from the temperate zone. They are mainly two types of forests – broad-leaved and coniferous. The area of the forests in Bulgaria is around 30% from the total territory of the country. The varied relief suggests the existence of huge forest areas at the mountain and hilly regions of Central and South Bulgaria. There are still places where people have not penetrated yet.

The woody reserves of the Bulgarian forests is more than 530 millions m^3 with average annual growth of around 12-15 millions m^3. For the year 2004 the cut is in the range of 6.83 millions m^3.

Waste

The GHG emissions from the Waste sector result from the process of accumulation, disposal and management of solid wastes from the households and industry and industrial wastewater handling.

In 2004 the emissions from solid waste disposal head the first place of methane sources in Bulgaria and the fifth place from all GHG emission sources in the country.

The trend analysis for the CH_4 emissions from solid waste disposal decreased from 300 to 200 Gg annually during the period 1997-1999 and remained relatively stable during the last five years. The CH_4 emissions from wastewater and sludge are significantly smaller and have a trend, which does not vary to such a degree as it is for the solid waste trend.

The Wastewater handling is the second large CH_4 source in this sector. This source is on third place among all the methane sources in the Inventory of Bulgaria.

Others (CRF sector 7)

According to the IPCC classification this sector is assigned to represent all the GHG emission sources, which for some reason can not be included in the sectors mentioned above.

There are no such specified sources in Bulgaria, which can be reported in this sector.

There are sources of GHG emissions that are not put in the Inventory and it is advisable for the future some researches to be held for the assessment of their real volume as well as their influence on the overall GHG emissions in the country. Such kinds of sources are:

- Forestry fires;
- Candle use for different purposes;
- Clarification of the drinking water;
- Emissions from gases from food stores.

International Bunkers

GHG emissions from fuel combustion for international transportation are determined following the methodology proposed in IPCC Guidelines – Section Mobile Combustion of the Energy sector. During the preparation of the Bulgaria Inventory, the emissions from International bunkers are separated in two categories:

- GHG emissions from international marine;
- GHG emissions from international aviation.

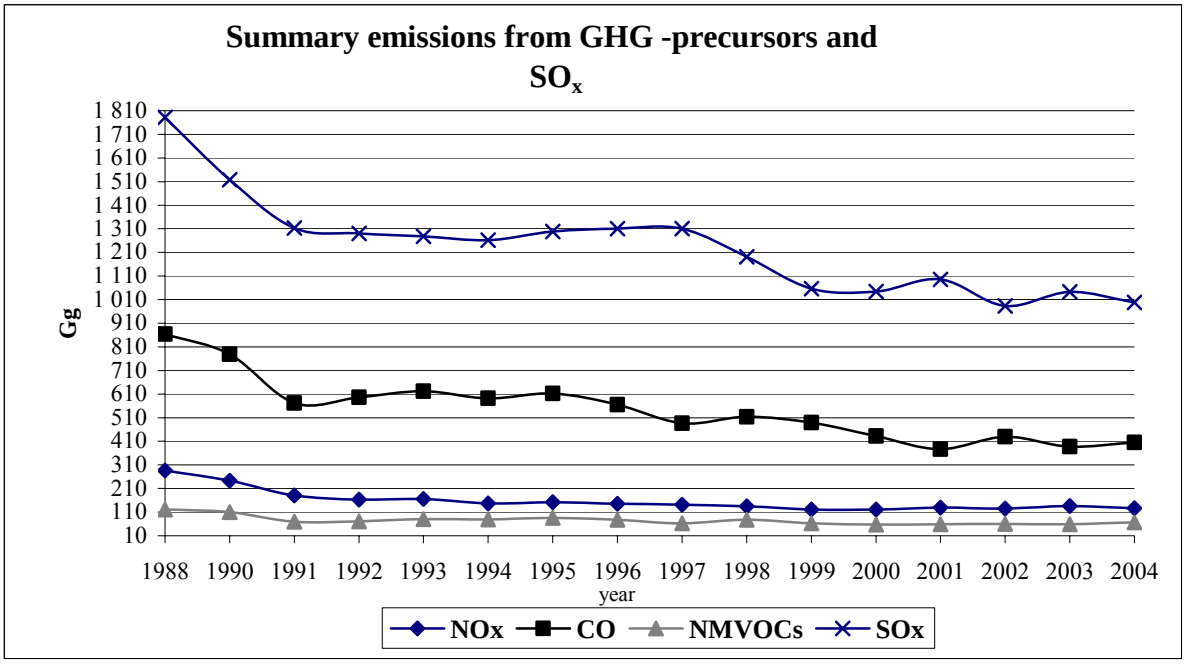
The GHG emissions from international marine in the year 2004 are decreased with 62% compared to the year 1988 whereas the emissions from international aviation are relatively smaller, i.e. - with 46%. The main reason for this difference is the liquidation of the navy for ocean fishing after the year 1999.

Trends of the GHG - Precursors and SOx

In the **Figure ES.4** are shown the variations of the trends of the emissions of GHG – precursors.

The emissions of GHG-precursors and SOx are reported only for Energy and Industrial Processes sectors in the Bulgarian inventories. In Solvent Use are released only emissions of NMVOCs. In the Field Burning of Agricultural Residues category of the Agricultural sector are emitted NOx and CO, which are also accounted.

Figure ES.4



The analyses of the **Figure ES.4** reveal slight variations within some years of the period when a certain increase compared to the previous was registered. Such a growth was registered in the year 2001 for the NOx and SOx emissions. In 2002 an increase of the CO and reduction of the SOx emissions was observed.

Summary of emission trend per source category and gas, Gg CO_2-eq.

Table ES.3

Source category	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
1. All energy (combustion and fugitive)	**94 616**	**81 425**	**65 731**	**59 634**	**62 127**	**59 050**	**61 928**	**60 727**	**58 990**	**53 101**	**48 757**	**48 050**	**49 645**	**47 178**	**51 313**	**50 497**
1A. Energy: fuel combustion	91 345	79 216	63 784	57 626	60 113	57 081	59 822	58 652	57 133	51 235	47 137	46 256	47 886	45 452	49 625	48 705
CO_2: 1. Energy industries	43 217	39 601	37 106	33 862	34 092	30 945	31 572	30 652	30 936	27 078	25 760	26 216	29 036	26 466	28 330	28 298
CO_2: 2. Industry	24 755	21 821	14 758	12 093	13 296	15 032	18 023	17 499	17 691	14 221	12 283	11 868	10 788	10 198	11 562	10 818
CO_2: 3. Transport	13 814	10 864	6 525	6 435	7 444	6 547	6 845	6 565	5 285	6 475	6 212	5 881	6 014	6 317	7 098	7 403
CO_2: 4. Other sectors	8 940	5 381	4 086	4 610	4 117	3 325	2 621	3 238	2 678	2 989	2 491	1 896	1 638	2 074	2 206	1 758
CO_2: 5. Other	0	1 006	882	196	733	810	315	261	112	49	0	0	0	0	0	0
CH_4	111	105	68	69	72	71	76	68	59	62	63	60	55	59	59	59
N_2O	508	438	360	359	360	352	371	370	372	361	328	335	356	339	371	370
B. Fugitive fuel emissions	**3 271**	**2 209**	**1 947**	**2 007**	**2 013**	**1 970**	**2 106**	**2 074**	**1 857**	**1 866**	**1 620**	**1 794**	**1 759**	**1 725**	**1 716**	**1 792**
CH_4	3 271	2 209	1 947	2 007	2 013	1 970	2 106	2 074	1 857	1 866	1 620	1 794	1 759	1 725	1 716	1 792
N_2O	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2. Industrial Processes (ISIC)	**10 155**	**8 976**	**6 281**	**5 299**	**5 136**	**6 058**	**7 476**	**7 423**	**6 870**	**5 286**	**4 929**	**5 835**	**5 837**	**5 277**	**5 990**	**5 979**
CO_2	7 576	6 610	4 588	3 903	3 933	4 606	5 368	5 235	4 963	3 606	3 990	4 315	4 375	4 028	4 628	4 819
CH_4	82	63	46	44	51	68	74	69	74	63	58	74	51	46	59	48
N_2O	2 422	2 255	1 626	1 324	1 133	1 338	1 921	1 962	1 614	968	732	1 314	1 295	1 089	1 159	858
HFCs	0	0	0	0	0	0	65	110	180	577	103	96	98	90	121	217
PFCs	76	47	21	28	19	46	47	46	37	69	44	33	16	21	21	33
SF_6	0	0	0	0	0	0	1	1	2	2	2	2	2	3	3	4
3. Solvent and Other Product Use	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
4. Agriculture	**14 559**	**12 953**	**10 529**	**8 525**	**7 150**	**6 591**	**5 935**	**5 696**	**5 591**	**5 309**	**5 666**	**5 394**	**4 541**	**4 859**	**4 833**	**5 106**
CH_4 Enteric fermentation	4 049	3 784	3 486	2 887	2 251	1 893	1 791	1 730	1 669	1 717	1 742	1 665	1 306	1 448	1 502	1 491
CH_4 Manure management	1 524	1 501	1 319	1 073	859	729	725	664	587	623	636	569	405	471	512	516
CH_4 Rice cultivation	119	90	69	38	26	7	12	22	32	34	12	30	33	44	48	48
CH_4 Field Burning of Agricultural Residues	46	46	49	34	28	29	31	17	28	25	27	24	27	32	19	34
N_2O Manure Management	1 056	1 030	921	760	606	510	496	461	422	452	467	429	321	368	395	396
N_2O Agricultural soils	7 750	6 488	4 668	3 722	3 372	3 415	2 872	2 797	2 845	2 452	2 773	2 671	2 442	2 488	2 352	2 612
N_2O Field Burning of Agricultural Residues	15	14	16	11	8	8	9	6	8	7	8	6	6	8	6	10

Source category	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
5. Land-Use Change and Forestry	**-5 133**	**-6 157**	**-7 636**	**-7 412**	**-7 476**	**-7 302**	**-7 524**	**-6 517**	**-6 872**	**-6 860**	**-7 200**	**-8 976**	**-9 467**	**-8 318**	**-7 056**	**-7 965**
CO_2	-5 133	-6 157	-7 636	-7 412	-7 476	-7 302	-7 524	-6 517	-6 872	-6 860	-7 200	-8 976	-9 467	-8 318	-7 056	-7 965
6. Waste	**12 973**	**11 129**	**9 634**	**9 233**	**8 493**	**8 014**	**7 746**	**7 019**	**5 783**	**5 038**	**4 906**	**4 975**	**4 829**	**4 805**	**5 596**	**5 928**
CO_2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
CH_4	12 663	10 905	9 432	9 032	8 301	7 832	7 577	6 858	5 640	4 879	4 742	4 820	4 681	4 655	5 445	5 778
N_2O	310	224	202	201	192	183	169	161	143	160	164	156	148	151	151	150
7. Other (please specify)																
NATIONAL TOTAL EMISSIONS	**132 303**	**114 483**	**92 175**	**82 690**	**82 907**	**79 714**	**83 085**	**80 865**	**77 233**	**68 736**	**64 259**	**64 254**	**64 852**	**62 119**	**67 731**	**67 511**
Memo item, not included in national total																
International bunker	**1 727**	**1 774**	**1 206**	**1 446**	**1 590**	**1 490**	**1 439**	**1 210**	**1 529**	**1 521**	**345**	**477**	**702**	**739**	**925**	**775**

ES.4. Other Information

Differences with the National Inventory

In general the results in line with the IPCC Methodology differ from the results of the National Inventory made according to the CORINAIR Methodology of the European Union. This mainly concerns the GHG emission- Precursors.

The reasons for the differences laid have methodological and structural character. There are certain differences in the size of the input data that are used for the calculation of the emission from combustion and technological processes. In contrast to the CORINAIR methodology, the IPCC Methodology does not account CO_2 emissions from the biomass combustion due to the fact that the net emissions from biomass are zero.

Uncertainty Assessment

The uncertainty assessment of the GHG Inventory is made following the methodology from the Good Practice Guidance.

The overall uncertainty of the GHG Inventory is becoming by combining the emission sources uncertainty and the emission factors uncertainty.

The overall uncertainty assessments for the 2003 Inventory, as well as the trend uncertainty in relation to the base year 1988 were made after the Tier 1 method.

The following data for determine the uncertainties are used:

- Available normative statistical difference in the overall energy balance of the country;
- Examples of the assessments proposed by the Good Practice Guidance;
- Expert assessment of Bulgarian and Foreign specialists for the activities in Agriculture Sector, Waste Management, etc;
- Analysis of the sensibility of some uncertainties, carried out at the Energy Institute;
- Literature data and information on the Inventory Revisions of The Netherlands, Slovakia, Canada, Austria and other countries.

In **Table ES.4** are presented in percentages the calculated uncertainties of the overall national GHG emissions for the year 2004 and the overall emission trend uncertainty to the base year till the year 2004.

Uncertainty in total GHG emissions, %

Table ES.4

Uncertainty	Uncertainty NIR 2005	Uncertainty NIR 2006
Uncertainty in total GHG emissions	13.00	12.46
Overall uncertainty into the trend in total GHG emissions	3.381	3.208

The contribution of each emission source to the overall **level** uncertainty of the total emissions for the year 2004 provides a possibility for the sources to be set in order. In this manner the emissions with the largest contribution can be defined. In **Table ES.5** are presented the first ten sources with the largest contribution.

Key sources with the maximum contribution to uncertainty of summary GHG emissions in 2004

Table ES.5

IPCC	IPCC sources	GHG	Uncertainty (% of national summary GHG emissions in 2004)
6A	CH_4 Emissions from Solid Waste Disposal Sites	CH_4	0.17
4D	Indirect N_2O Emissions from Agriculture Soils	N_2O	0.17
4D	Direct N_2O Emissions from Agriculture Soils	N_2O	0.11
1B	Fugitive Emissions from Coal Mining and Handling	CH_4	0.09
1A	CO_2 Emissions from Stationary Combustion- Energy Industries, Coal	CO_2	0.08
2B	N_2O Emissions from Nitric Acid Production	N_2O	0.06
2B	N_2O Emissions from Animal Production	N_2O	0.05
4B	N_2O Emissions from Manure Management	N_2O	0.04
4B	Emissions from Wastewater Handling	CH_4	0.04
6B	C_{H4} Emissions from Enteric Fermentation in Domestic Livestock	CH_4	0.03
	TOTAL		**0.84**

In **Table ES.6** are presented the first ten sources with the largest contribution to the trend assessment uncertainty of the overall GHG emissions for the period 1988-2004.

Key sources with the maximum contribution to uncertainty of GHG emissions summary trend in 1988-2004

Table ES.6

IPCC	IPCC sources	GHG	Uncertainty (% of the trend of total emissions for 1988-2004)
4D	Indirect N_2O Emissions from Agriculture Soils	N_2O	0.24
4D	Direct N_2O Emissions from Agriculture Soils	N_2O	0.12
6A	CH_4 Emissions from Solid Waste Disposal Sites	CH_4	0.09
1A	CO_2 Emissions from Stationary Combustion- Energy Industries, Coal	CO_2	0.07
4D	N_2O Emissions from Animal Production	N_2O	0.07
2B	N_2O Emissions from Nitric Acid Production	N_2O	0.07
	F- gases	PFC, HFC, SF_6	0.07
1B	Fugitive Emissions from Coal Mining and Handling	CH_4	0.04
4B	N_2O Emissions from Manure Management	N_2O	0.04
1A	CO_2 Emissions from Stationary Combustion – Oil	CO_2	0.04
	TOTAL		**0.84**

Completeness

In the GHG Inventory for the year 2004 are included all the sectors given in Revised IPCC Guidance, 1996 with the exception of:

- Emissions from the categories 5B-5E from Land Use Change and Forestry sector;
- CO_2 emissions from Solid Waste combustion;
- F-gases emissions from aerosol preparation use, fire-extinguishers, etc.;
- N_2O emissions from Solvent Use.

The emissions mentioned above exist, but there are no elaborated methodologies for their determination and for the quality collection of the input data.

Recalculations and Improvements

The GHG Inventory recalculation for the period 1988-2003 was carried out by assumptions and preconditions for each sector and source category and GHG sinks in compliance with the structure of Revised IPCC Guidelines, 1996. The changes can be generalized in the following groups:

A. Changes in the methodology of modelling the processes, activities and emission factors;
B. Changes in the structure of the fuel's data and GHG emitters activities;
C. Changes related to the errors of data transferring and the use of inconvenient parameters and emission factors.

The following changes in groups A and B were made in the **Energy sector**:

- Stationary processes of fuel combustion in Energy, Industry, Public sector, Household, Agriculture and Forestry;
- Transport – 1996.

In the sector **Industrial Processes** a revision of the data for the volumes and types of production was carried out using the structures and classifications according to the official statistical reports of National Statistical Institute for the period of 1990-2003.

- Main GHG emissions and their precursors from technical processes in Industry;
- Emissions of F- gases – PFC, HFC and SF_6.

The revision of the data for emission sources and emission factors in sector **Agriculture** is made by keeping with the main principle – i.e. for the period before the year 2000 data form the Ministry of Agriculture and Forestry and its relative agencies and organizations to be used in all cases when it is possible.

In the Inventory recalculations for this sector, the following statements are reported:

- GHG emissions from agricultural soils.

In the sector **Waste** are re evaluated solid waste disposal for period 1988, 1990-2004.

- Solid Waste collection and management.

In **Table ES.7** are presented the differences between the Inventories on the basis of recalculations in the National Inventory Report 2003 (Submission 2005) and the current report (Submission 2006).

Differences between NIR 2005 and NIR 2006 for 1988-2003 due to recalculation, %

Table ES.7

Gas/Sector	Source	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Energy	*% NIR-2006 versus NIR- 2005*															
CO_2		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.45	-0.05	0.00	0.00	0.00	0.00	0.00	0.27
CH_4		0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.04	-0.01	-0.19	-0.28	-0.28	-0.29	-0.29	-0.50
N_2O		-87.83	-88.00	-88.61	-88.15	-88.02	-87.92	-87.76	-87.56	-87.71	-86.46	-86.70	-86.09	-86.57	-85.85	-85.97
Industrial Processes																
CO_2		-3.44	-3.72	-0.25	-0.12	-0.06	-0.29	0.24	0.64	2.48	3.35	5.46	6.77	9.46	8.77	7.98
CH_4		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	0.00
N_2O		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	0.00
Solvent and Other Product Use																
NMVOCs		783.75	798.10	530.13	528.35	582.45	588.24	591.34	549.95	433.55	261.62	476.40	433.38	245.89	254.57	301.45
Agriculture																
CH_4		0.08	0.09	0.10	0.09	0.09	0.11	0.12	0.07	0.12	0.10	0.11	0.11	0.15	0.16	0.07
N_2O		11.68	10.62	8.02	8.46	9.46	9.83	8.14	10.58	8.95	8.14	8.80	9.41	9.16	8.15	10.11
Land-Use Change and Forestry																
CO_2 sink		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	0.00
Waste																
CH_4		-19.49	-19.81	-20.05	-20.14	-20.29	-20.32	-19.65	-19.53	-19.44	-19.45	0.00	0.00	0.00	0.00	0.00
N_2O		0.00	0.00	0.00	0.00	0.00	0.00	-4.48	-3.60	-1.33	-2.56	-2.66	-1.66	1.39	7.70	0.60
TOTAL without LUCF																
CO_2-eq.-without F-gases		-4.39	-4.54	-4.91	-5.27	-5.05	-5.02	-4.87	-4.35	-4.53	-4.42	-2.55	-2.35	-2.53	-2.38	-2.25
CO_2-eq.- total		-4.39	-4.53	-4.90	-5.27	-5.05	-5.02	-4.87	-4.22	-4.30	-3.61	-2.39	-2.20	-2.39	-2.23	-2.08
CO_2		-0.27	-0.30	-0.02	-0.01	0.00	-0.02	0.02	0.46	0.15	0.22	0.41	0.55	0.73	0.67	0.89
CH_4		-12.28	-12.57	-12.57	-13.03	-13.43	-13.67	-12.99	-12.64	-12.02	-11.29	-0.02	-0.03	-0.03	-0.02	-0.08
N_2O		-18.53	-19.26	-23.41	-26.69	-28.84	-27.53	-29.22	-28.54	-30.62	-32.19	-29.58	-26.94	-31.06	-29.19	-31.32

Recalculation of the Base Year 1988

As a result from the recalculation of the GHG emissions for the year 1988, the assessments showed some differences in comparison with the reported in the 2003 Inventory (Submission 2005) levels of all main GHG emissions and GHG emission – precursors.

The aggregated emissions of Bulgaria for the year 1988 are 132 303.16 Gg CO_2-eq. (not taking into account the CO_2 sequestration in forests). The difference between the preliminary assessment is with 4.4% less.

The share of CO_2 is 74.3%, the share of CH_4 is 16.5% and the N_2O – 9.1% all expressed in CO_2–eq. from the overall emissions.

The allocation of the aggregated emissions through sectors (without LUCF) is as follows:

- Energy industries – 32.9%;
- Industry – combustible processes - 18.7%;
- Transport – 10.6%;
- Households and services – 6.8%;
- Industrial processes – 7.7%;
- Agriculture – 11%;
- Waste – 9.8%.

The largest ***CO_2 emission*** source is Energy sector - 90 726 Gg or 68.6% of the overall GHG emissions in Bulgaria (not taking into account the sink from forests).

In sector Industrial Processes ***CO_2 emissions*** are decreased with 3.4% because of revalue GHG emissions from cement output.

The overall ***CH_4 emissions*** are 1 041 Gg, which indicates a decrease with 12.3%, compared to the previous inventory. This decrease is mainly on the account of the emissions from sector Waste.

The overall ***N_2O emissions*** are 38.9 Gg. This quantity has decreased compared to the previous inventory. Especially large is decrease in sector Energy because of changed emission factors. Sector Agriculture marked some increase with 11%, which can not compensate the decrease. Whereas sector Energy diminish the emissions with 87.7%, sector Agriculture increase them with 11.7% or total decrease is 18.5% compared to the preceding inventory.

Recalculation of the GHG Inventories for the Period of 1990 -2003

The analyses of **Table ES.7** presents that the change of the GHG emissions due to the recalculation is different in certain years. The shift of the main GHG emissions is in the following range:

- CO_2- from 3.7 till 9.5%;
- CH_4- from -20 till +0.1%;
- N_2O- from -88 till + 11.7%.

As a whole the recalculation of the GHG emissions should lead to an improvement of the total trend. The changes in the overall trend for the years 1988-2003 between the two following submissions of the inventories are presented in **Table ES.8**.

Difference between NIR 2005 and NIR 2006 for emission trends 1988-2003 (1995 for F- gases)

Table ES.8

Gas, Gg CO_2-eq.	Trend (absolute)			Trend (percentage)		
	NIR 2005	NIR 2006	Difference	NIR 2005	NIR 2006	Difference
CO_2	-45 250	-44 507	743	-46	-45	0.63
CH_4	-15 559	-12 506	3 053	-62	-57	5.23
N_2O	-8 349	-7 627	721	-56	-63	-6.85
HFCS	0	121	121			
PFCs	-55	-55	0	-73	-73	0
SF_6	3	3	0			
Total	**-69 210**	**-64 572**	**4 638**	-50.0	-48.8	**1.21**

The trends in absolute values are determined as differences between the sum GHG emissions for the years 2003 and 1988. If we assume that as the absolute value of the trend is lower so as the trend is better and consequently the recalculation leads to a positive result.

The trends in percentage are determined as the absolute trends are related to the emissions from the base year. Despite of the change in the emissions for the base year, in this case there is percentage reduction of the trends, which demonstrates again positive results from the recalculation.

Results form Revisions of GHG Inventories

The GHG Inventories in Bulgaria are object of check-ups and revisions by local and international teams.

In admitting and confirming the annual inventories, MoEW of Bulgaria applies two-grade system in which the works are examined by specialized scientific and expert councils as follows:

- Scientific and technical council in the Energy;
- Superior expert ecological council (SEEC) within MoEW.

A necessary condition for calling SEEC is the availability of works' reviews by independent experts and positions of relevant departments within the MoEW and within the Executive Environmental Agency.

Up to now the GHG Inventories of Bulgaria were object of the following international check-ups and revisions:

- Revision in country from international team of UNFCCC Secretariat – September 2003;
- Part for Bulgaria in the Synthetic Assessment Report of UNFCCC for the 1999-2001 Inventory 1999-2001;
- Desk Review for the 2002 Inventory, November 2004;
- Second Centralized review of Inventories for the year 2003 in Bonn, Germany, October 2005.

The results of these examinations indicated same omissions in inventories, which were removed or are in the process of investigation and removal. Some of them are as follows:

- Including the additional information in National Inventory Report;
- Comparison between the inventory data and the relevant data from international organizations.

In this report the recommendations and notes are commented in details from the last inventory revision 2003.

a. Concerning with more description in details of the fuels quantities and processes – sources of GHG emissions in the base year 1988;

b. Concerning recommendations for applying of method Tier 2 for assessment of fugitive emissions from coal mining; for emission assessment of pig iron and steel production and for assessment of emissions from waste management in depots;
c. Concerning defining of more reliable assessments for uncertainty at working with data and emission factors for each source and process from the inventory.

Planned Improvements

The general element of the planned improvements in the GHG inventories for Bulgaria is the National System for Assessment of Anthropogenic GHG Emissions. The development of this system started in 2005 with a project for preliminary investigation of the main principles, structures and rules for its setting-up.

The essential element is and the system for monitoring of the emissions of air pollutants. In the latest years this system works properly by coordination and management at a national level by Executive Environmental Agency. In this moment it is preparing a study for building of National system for assessment of GHG, like a part (module) from the existing system for monitoring of the emissions of air pollutants.

During the current year several projects for investigation and determination of the parameters and data necessary for the GHG emission inventory in sector Land Use Change and Forestry will start. The quality of the data in these sectors is estimated as unsatisfactory and for some categories they are missing at all. For that reason deep investigations must be done for defining the state of the available data, the possibility for their use and creating the methods for calculation of GHG emissions.

CHAPTER 1. INTRODUCTION

The Republic of Bulgaria joined the UN Framework Convention on Climate Change (UNFCCC), which took part in Rio de Janeiro in 1992. The Parliament ratified the UNFCCC in March 1995.

As an Annex I Party to the Convention, Bulgaria is committed to conduct annual inventories on greenhouse gas (GHG) emissions by sources and removals by sinks, using the GHG inventory methodology, approved by the UNFCCC.

The inventories issuance started with the country base year – 1988. The first inventories covered the period 1988-1994 as a part of the project "Country Study to Address Climate Change".

1.1. Background Information on GHG Inventories and Climate Change

This Report documents the annual GHG inventory in Bulgaria for 2004.

This inventory has been prepared in conformity with UNFCCC Guidelines, adopted at the 21^{-st} session of the Subsidiary Body for Scientific and Technological Advice (SBSTA), on 06-14.12 2004 in Buenos Aires. The Guidelines set up the rules and the structure of National GHG Inventory Report, prepared in compliance with the Revised 1996 IPCC Guidelines, and the IPCC Good Practice Guidance for National GHG Inventories, 2000.

According to the UNFCCC Guidelines, the inventory should be made in a way providing:

- Transparency;
- Consistency;
- Comparability;
- Completeness;
- Accuracy.

The above inventory's features are also elements of the "good practice", specified in the IPCC Good Practice Guidance, 2000.

In view of that this Report presented also the GHG emission trends for the period 1988-2003. The following was described as well:

1. Methods and data for uncertainty assessment of the annual GHG emissions and trends;
2. Key GHG emission sources according to methods of the type Tier 1 and Tier 2, specified in the Good Practice Guidance;
3. Assessment of the quality assurance and control system.

Tables with GHG data and emissions, drawn up after the Common Reporting Format (CRF) for reporting the annual inventories, are attached to the Report. These tables were completed for the base year for Bulgaria, 1988, and for each year of the period 1990-2004.

The full set of CRF Tables and the text of the National report as a PDF – file, have been uploaded on the web page of MoEW (www.moew.government.bg) and the Energy Institute (www.eninbg.com).

1.1.1. Greenhouse Gases and Climate Change: Global Warming Potential (GWP).

The main greenhouse gases to be reported pursuant to UNFCCC are as follows:

- Carbon dioxide - CO_2;
- Methane - CH_4;
- Nitrous oxide - N_2O;
- Hydrofluorocarbons – HFCs;

- Perfluorocarbons – PFCs;
- Sulphur hexafluoride - SF_6.

Each of these gases has a warming effect, which can be distinguished by its amount. As an example, the gases HFCs, PFCs and SF_6 (so called F-gases) have much greater warming effect compared to methane, nitrous oxide and carbon dioxide.

Because of that a common assessment criterion for the effect of each GHG on the atmosphere warming should be introduced. This criterion will allow totalling the effect of all GHGs, adjusted to a common base. This base is the so called Global Warming Potential (GWP), representing GHG emissions as CO_2-eq. emissions.

For defining of GWP, the Parties to the Convention and Kyoto Protocol accept values, over a time horizon of 100 years, as mentioned in the IPCC Second Assessment Report of 1999.
Further to the above mentioned main (direct) GHGs, there are also other gases that have warming effect to the atmosphere. Some of them, as CFCs and HCFCs, are subject of reduction in compliance with other international conventions as Montreal Protocol.

Other gases have indirect warming effect to the atmosphere (as NOx, CO and NMVOCs), or cooling effect as SOx. These gases are precursors of the greenhouse gas – troposphere ozone, and are subject of regional control protocols. That is why in the National Inventory Report only the total GHGs emissions – precursors, as well as the total SOx emissions were reported.

1.1.2. UNFCCC and the Kyoto Protocol

The UN Framework Convention on Climate Change was proposed for signing by the world commonwealth at the World Summit in 1992 in Rio de Janeiro. Bulgaria participated in that international forum and joined the Convention.

The Parliament ratified the UNFCCC in March 1995.

The Convention set as an ultimate objective the stabilization of the atmospheric GHGs concentration at levels, not allowing dangerous anthropogenic effects on the climate system. These levels must be achieved for a period, allowing the ecosystems to adapt in a natural way to the climate change.

The Convention divided the Parties into two main groups: those, listed in Annex 1 (known as Annex I Parties), and those, not listed in this Annex I. The Annex I Parties amount to 41. These are the industrial countries of the world, members of the Organization for Economic Cooperation and Development (OECD), and the countries with economy in transition (Russia, Baltic countries, Ukraine and the Central and East European countries). Bulgaria is a part of the group of the East European countries with economy in transition.

The Kyoto Protocol (KP) was adopted at the III^{-rd} Session of the Conference of the Parties to the Convention in December 1997, in Kyoto, Japan. KP was ratified by Bulgaria on 15.08.2002. After Russia ratified the KP in November 2004, it entered into force on 16 February 2005.

With the KP the Parties to the Convention took the commitment not only to stabilize the GHGs emissions, but also to reduce them by percentage, defined with respect to the base year of each Party. Bulgaria took the commitment to reduce the GHGs emissions from its base year, 1988, by 8% for the first commitment period pursuant to the Protocol (2008-2012).

There are possibilities, stipulated in the KP, for implementation of the undertaken commitments on GHGs emission reduction by applying the so called Kyoto mechanisms. These mechanisms are emissions trading, joint implementation projects and clean development mechanisms.

Another very significant issue of the KP is the requirement for introducing a National GHG Inventory System. This system has to integrate and bind as a whole all aspects of the GHG assessment and inventory (institutional, technological, methodological and monitoring-estimative).

1.1.3. Requirements to the Reports: UNFCCC and IPCC

Annex I Parties to the Convention should report the annual GHG inventory, where should be included data for the GHG emissions of the base year and at least one year, preceding the current inventory. The inventory for 2004 should be submitted to Secretariat to the UNFCCC on 15.04.2006, at the latest.

Since 2000, the annual inventories were subject of technical checks. Further to the above mentioned, the Annex I Parties should submit also National Communications on Climate Change, where measures and policies regarding reduction of GHG emissions for a certain prognosticated period should be indicated. Bulgaria submitted its III^{-rd} National communication on Climate Change in March 2002 and it will submit its IV^{-th} National communication this year.

UNFCCC

The UNFCCC Guidelines describes the GHG emission sources, the methods of their calculation and the content of the inventory reports. For obtaining the results from GHGs emissions' calculations, the Revised 1996 IPCC Guidelines, the 2000 IPCC Good Practice Guidance and Good Practice Guidance for LULUCF, should be used in general.

The tables of the Common Reporting Format (CRF) and the National inventory report are the two main documents, which report the annual consecutive inventories to Secretariat to the Convention. The Parties are obliged to publish the inventories on a paper carrier or in e-format on an Internet web-page.

IPCC

The IPCC methodology uses the concept of methods with a different complexity, describing the processes for estimating the input data, emission factors and GHG emissions. The complexity level of the method is indicated by Tier X, as the higher "X" is, the more complex the method is. For example:

- Tier 1 is the simplest method, requiring minimum data and no-complex processes models;
- Tier 2 is more complex and requires more input data and more complex models;
- Tier 3 is the most accurate method.

Generally, more accurate methods for determining GHG emissions are recommended. It always requires more resources of every kind (human, technical, etc.). Because of that it is necessary to have a reasonable and balanced combination of the method accuracy with the type and accuracy of the results obtained, as well as with the capabilities of the Party to provide the relevant information data and resources. The regulation of this balance is covered by the Good Practice Guidance, which gives the ways for optimal combining of results' accuracy and the capabilities of those, who prepare the inventory. The leading concept of this combination is the rule for using more accurate methods for the key sources of GHG emissions, on a first place.

1.1.4. Differences with the National Inventory

UNFCCC uses certain definitions regarding the structure of the emissions, which have to be included in the total emissions of the country.

As a whole, the results obtained by the IPCC methods differ from the results of the National inventory, which was carried out in compliance with the method CORINAIR of EU. It concerns mostly the GHG emissions – precursors.

The reasons for that difference have both methodical, calculation and structural origin. There are also certain differences in the quantity of the input data, used for calculating the emissions of combustible and technological processes. Unlike the CORINAIR methodology, IPCC methodology does not take into account the CO_2 emissions from biomass combustion, due to the fact that the net biomass emissions are zero.

1.1.5. Organization of the National Inventory Report

The organization of the inventory report for Bulgaria, 2004, and the corresponding National report have been improved compared to the preceding National report, 2003, as follows:

- Additional CRF Tables for 1988 and for the period 1990-2004 have been prepared for LULUCF sector;
- There are included new GHG emissions sources and are corrected models for calculations of emissions of F- gases, cement producing and solid waste disposal.

1.2. A description of the Institutional Arrangement for Inventory Preparation

All activities on preparation of GHG inventories in Bulgaria are coordinated and managed on a state level by the Ministry of Environment and Water.

1.2.1. Data Sources for GHG Inventory

The Executive Environment Agency (EEA) is a subsidiary authority to the Ministry of Environment and Water. It coordinates all activities, related to collecting data on fuels and other sources of GHG emissions. EEA is the core body for collecting inventory data, aggregated on a national level by the following state authorities:

- National Statistical Institute (NSI);
- Road Control Department (RCD) within the Ministry of Internal Affairs;
- Statistics Department within Ministry of Agriculture and Forestry (MAF);
- Ministry of Economy and Energy;
- Forestry Department within MAF;
- Soil Resource Executive Agency within MAF;
- National Service for Plant Protection, Quarantine and Agro chemistry;
- Energy Efficiency Agency.

The NSI plays a special role in data collection system for the inventory. Data for energy and material balances of the country, as well as major part of the calculations on the national inventory under the CORINAIR methodology are prepared in NSI. All data, related to solid waste and waste water, is also collected there.

NSI uses up-to-date statistical methods and procedures for data summarizing and structuring, harmonized with the provisions and methods of EUROSTAT.

The GHG inventory used data, received directly from large GHG emissions sources in the energy sector and the industry. This data was summarized by EEA and the organization, preparing the inventory - Energy Institute (EI).

1.2.2. National Inventory Report and CRF Tables

MoEW is responsible to the Secretariat to the UNFCCC for the annual GHG inventory report. The Ministry, together with EEA, organizes preparation of the inventory. All activities, related to the calculations of GHG emissions, drawing up and structuring of the results and analyses in the National Inventory Report and the CRF-Tables are assigned to an independent organization. The last one prepares the necessary materials, submits them for review by independent experts and reports to the High Expert Council of MoEW.

The present inventory was implemented by the Energy Institute (EI) – a private joint-stock company. All the work was carried out on a contract base, in compliance with Law on Public Procurement Orders.

EI is a scientific and consulting organization with large experience in climate change research. Since 1988 to the present, all GHG inventories made under the IPCC methods have been prepared by the EI team. The three National communications on climate change have been prepared by the same team. Now it works on the Fourth NC report. Significant part of EI activities are related to GHG emissions analyses and forecast models and methods development, formation of policies and measures on reduction of GHG emissions, as well as a scientific R & D, relevant to Kyoto mechanisms - projects for joint implementation and international emissions trading.

1.3. Brief Description of the Inventory Preparation Process

The GHG inventory represents a process, covering the following main activities:

- Collecting, processing and assessment of input data on used fuels, materials and other GHG emission sources;
- Selection and application of emission factors for estimating the emissions;
- Determination of the basic (key) GHG emission sources and assessment of the results uncertainty.

As a whole, the inventory is an open system, which can be expanded, improved and modified in regard to the country specific circumstances such as the fuel mix, technology level, national statistic practices, etc.

Each year during inventory, some changes occur that affect directly the activities above enlisted. Important inventory stage is the process of data transformation into a form, suitable for CRF Tables format. During this process, aggregation of the fuels by type is made (solid, liquid and gaseous), and further data is added, regarding parameters and indices, specifying the systems for transportation and distribution of oil and natural gas, milk production, protein consumption by the humans, the systems for fertilizer processing, etc. These activities are just a part of additional data, filled in the CRF Tables.

The organization and management of the inventory process in Bulgaria should be boosted and significantly improved after introducing the National assessment system of the GHG anthropogenic emissions. This system will start up to middle of 2006.

1.4. Brief General Description of Methodologies and Data Sources Used

The GHG inventory for the year 2004 was carried out in compliance with the 1996 Revised IPCC Guidelines. This approach is a combination of methods and means for GHG emission inventory, which stick to those, recommended in the Guidelines, but taking into, account the country specific circumstances during the relevant year.

An essential feature of the current inventory was the closer abidance to the Good Practice Guidance recommendations, where particular parameters of the GHG-emitting processes and activities were expanded and corrected.

The basic source for emission factors for current inventory was again the local practice, IPCC Revised Guidelines and the Good Practice Guidelines. Some data from the CORINAIR methodology was also used.

The specific Bulgarian circumstances for many activities were recognized, applying relevant parameters and emission factors. It concerned mostly the emission factors in the sectors Energy, Agriculture, some industrial processes and particularly the road transport. The transport data was obtained on the basis of scientific and practical research, considering the specifics of the motor fleet in the country. Due to the significant changes of the motor fleet during the past 6-7 years, and as a result of the renovation trend, all emission factors have to be revised in the near future, in accordance with the adopted motor vehicles categories (cars, buses, trucks).

Table 1.1 shows the methods and the emission factors applied, according to the adopted designations in the IPCC methodology, as follows:

Methods applied

D – IPCC standard method;

T 1, 2, 3 – methods of the type Tier 1, 2, 3;

NO – such method/emission factor not available;

RA – reference method;

NE – no estimation available.

Emission factors applied

D – standard IPCC emission factor;

C – by CORINAIR;

CS – specific for the country.

CRF Summary table 3 with methods and emission factors applied

Table 1.1

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2		CH_4		N_2O	
	Method applied	**Emission factor**	**Method applied**	**Emission factor**	**Method applied**	**Emission factor**
1. Energy						
A. Fuel Combustion	RA	CS, D				
1. Energy Industries	T2	CS, D	T2	CS, D	T2	CS, D
2. Manufacturing Industries and Construction	T2	CS, D	T2	CS, D	T2	CS, D
3. Transport	T2	C, CS, D	T2	C, CS, D	T2	C, CS, D
4. Other Sectors	T2	CS, D	T2	CS, D	T2	CS, D
5. Other	NO	NO	T2	CS, D	NO	NO
B. Fugitive Emissions from Fuels						
1. Solid Fuels	NE	NE	T1	D	NE	NE
2. Oil and Natural Gas	NE	NE	T1	D	NE	NE
2. Industrial Processes						
A. Mineral Products	T2, D	D	NO	NO	NO	NO
B. Chemical Industry	T1b	D	D	D	D	D
C. Metal Production	D	C, D	D	CS, D	NO	NO
D. Other Production	D	D				
E. Production of Halocarbons and SF_6						
F. Consumption of Halocarbons and SF_6						
G. Other						
3. Solvent and Other Product Use	**NO**	**NO**			**NO**	**NO**
4. Agriculture						
A. Enteric Fermentation			T1	D		
B. Manure Management			T1, T2	D, CS	D	D
C. Rice Cultivation			D	D		
D. Agricultural Soils	NO	NO	NO	NO	D	D
E. Prescribed Burning of Savannas			NO	NO	NO	NO
F. Field Burning of Agricultural Residues			D	D, CS	D	D, CS
G. Other						
5. Land-Use Change and Forestry						
A. Changes in Forest and Other Woody Biomass Stocks	CS	CS				
B. Forest and Grassland Conversion	NO	NO	NO	NO	NO	NO
C. Abandonment of Managed Lands	NE	NE				
D. CO_2 Emissions and Removals from Soil	NE	NE				
E. Other						
6. Waste						
A. Solid Waste Disposal on Land	NA	NA	D	D, CS		
B. Wastewater Handling			D	D, CS	D	D
C. Waste Incineration	NO	NO	NO	NO	NO	NO
D. Other						
7. Other *(please specify)*						
	HFCs		**PFCs**		**SF_6**	
	Method applied	**Emission factor**	**Method applied**	**Emission factor**	**Method applied**	**Emission factor**
2. Industrial Processes						
A. Mineral Products						
B. Chemical Industry	NO	NO	NO	NO	NO	NO
C. Metal Production			D	D	NO	NO
D. Other Production						
E. Production of Halocarbons and SF_6	NO	NO	NO	NO	NO	NO
F. Consumption of Halocarbons and SF_6	T1a	D	D	D	D	D
G. Other						

Carbon Dioxide Emissions

The CO_2 emissions are derived by combustion of fuels in the energy sector, transport and households. Data from the energy balance of the country is used for their calculation, as the balance summarizes the data from the combustion facilities, submitted to the NSI.

Parameters, specified in the Revised IPCC Guidelines, are used for estimation of the carbon stocks in the products, which is not CO_2 emission source. The reason for that is the lack of concrete measured values of the non-oxidized carbon portion in the petrol products and in the natural gas, utilized in Bulgaria.

Because of the fact that the combustion of solid waste is not spread in the country (for power production or for the purpose of liquidation), the corresponding CO_2 emissions are not reported.

Carbon Dioxide Sequestration

For the time being, Bulgaria reports on CO_2 sequestration from forestry only (category 5.A from sector Land-Use Change and Forestry). Data for C sequestration from forestry is on the basis of:

- Area of forestry used;
- Average annual forest growth by species (in m^3/ha/year);
- Annual felling (in m^3/year).

Estimation of the average annual forest biomass growth is made on the basis of data from forestry inventory, which is made each five years according to a methodology, approved by the forestry authorities. For estimation of the biomass dry content, a common conversion factor of 0.6 for both forestry types, coniferous and deciduous, is used.

There is an absorbing of CO_2 in the areas of agricultural crops, meadows and all roadside and village plantations. In the present inventory the amassed quantities of carbon in these areas are reported in the new LULUCF common table format that is prepared for the first time in this inventory.

Methane

CH_4 emissions from fuel combustions are estimated by data from the energy balance and the emission factors, determined by methods of the type Tier 2.

CH_4 emissions from road transport are estimated with emission factors, specific for the country, specified for the various motor vehicle categories. The main restrictions in this case are the quantities of used fuels, indicated in the general energy balance of the country.

Fugitive CH_4 emissions from coal mining and the systems for extraction and distribution of oil and natural gas are estimated, as a rule, by standard emission factors, specified in IPCC Guidance. Complete revision of the emission factors was carried out with the present inventory, especially for the systems for distribution of oil and natural gas. The emission factors were replaced by data, indicated in Good Practice Guidance.

Methane emissions from agriculture are estimated by method of the type Tier 1, excluding the manure handling emissions of cattle's and swine, where method of the type Tier 2 is used.

Methane emissions from solid waste disposal sites are estimated by the standard method, specified in IPCC Guidance. Using of methods with higher accuracy is not possible due to the lack of historically long time series for disposed household solid waste.

In the last revision of the 2003 inventory it is recommended that a method of the type Tier 2 be used as if any data is lacking, data from neighbouring countries should be used. Such a recommendation is aimless and meaningless because the practice and organization of gathering waste in the neighbouring countries is very different from the Bulgarian one despite the geographical proximity.

Nitrous Oxide

N_2O emissions from fuel combustions are estimated by data from the general energy balance of the country and emission factors, specific for the country. The emissions from road transport are estimated on the basis of the fuels used from the various motor vehicle categories, and specific emission factors, defined for each category. Those emission factors have been defined by experimental-analytic method for the period until 1995, and have not been changed since then.

N_2O emissions from chemicals output include the nitric acid production only. For the time being there is no data available on emissions from utilization of solvents and for anaesthesia.

N_2O emissions from agriculture soils are estimated in full accordance with the IPCC methodology. These emissions include all sources, provided for in the methodology as synthetic and natural fertilizers, crop residues, animal waste from pastures and indirect emissions from release of ammonia and NOx in the atmosphere, as well as due to drainage (leaching) of underground water.

Consumed proteins are calculated on the basis of the statistical data for the foodstuffs, consumed by humans. N_2O emissions are estimated on the proteins from the human waste, structured in sector Waste.

F- gases

There is no production of F- gases from the HFC and SF_6 groups in Bulgaria. However, in the aluminium production gases from the PFC group are emitted, subject of the inventory. Data on F-gases consumption is limited and allows just general assessments of the potential emissions of HFC and SF_6.

During the last years, large-scale inquiries were initiated for data collection regarding the available SF_6 quantities in the electrical equipment of the electric power system of the country. It resulted in reliable data for the fugitive SF_6 emissions during equipment operation for the period 1995 -2004.

Original Data Sources for the Inventory

The original data sources on GHG are as follows:

- data on used fuels: general energy balance of Bulgaria, prepared by NSI;
- data on consumed households biomass: MAF statistics and NSI energy balance;
- vehicles number, types and models – MIA – Department of the road control;
- industrial output – companies' reports, summarized in the material balances of NSI;
- SF_6 fugitive emissions: reports from the units of the Ministry of Economy and Energy (MEE);
- number of farming animals and plant crops: "Agro statistics" Department within MAF;
- quantity of used synthetic fertilizers: National Service for Plant Protection, Quarantine and Agro chemistry within MAF;
- land-use change and forestry: National Forestry Administration within MAF;
- disposal of solid waste and quantity of waste water: "Ecology" Department of NSI and "Waste" Department within MoEW.

Certain portion of the above mentioned data is available on the web-pages of NSI, MEE and MAF.

1.5. Brief Description of Key Categories

Determination of the basic (key) GHG emission sources was made on the IPCC/OECD methodology, included in Good Practice Guidance in the national GHG inventories, 2000.

The key source list was revised compared to the NIR 2005. Two new key sources were added: fugitive emissions from oil and gas systems and indirect N_2O emissions from agricultural soils. The source N_2O emissions from stationary combustion has dropped out the list.

Determination of the key emission sources according to the IPCC method of the type Tier 1 refers to the national annual overall emissions and to the annual overall emission trend as well.

Results of applying the method Tier 1 in its two varieties (quantitative assessment of the share in the overall emissions, and trend assessment for each source compared to the overall emission trend) are given on ***Annex 1*** of this report. There are 20 key sources by quantitative assessment and 19 key sources by trend assessment, of total 40 emissions sources, as for the two types of assessments they amount to 95% of the total quantity of GHG emissions, expressed in CO_2-eq.

According to method of the type Tier 2, assessment of the key sources is made by identifying the uncertainty of each source. In this case “uncertainty" means the combined uncertainty of the data (fuels, products, etc.) and of the emission factors.

Key sources assessment results, made by methods of the type Tier 1 and Tier 2 are presented in **Table 1.2.**

List of key source identified by IPCC Tier 1 and 2 level and trend assessments

Table 1.2

IPCC	*B*	*A*	*Key(L, T)*	*Tier 1*	*Tier 2*
	Gas	*Key source category*			
ENERGY SECTOR					
1A1	CO_2	CO_2 Emissions from Stationary Combustion- Energy Industries, Coal	Key(L, T)	L, T	L, T
1A3	CO_2	Mobile Combustion- road transportation	Key(L, T)	L, T	L, T
1A2	CO_2	CO_2 Emissions from Stationary Combustion- Manufacturing Industries, Coal	Key(L, T)	L, T	L, T
1A2	CO_2	CO_2 Emissions from Stationary Combustion – Gas	Key(L, T)	L, T	L, T
1A2	CO_2	CO_2 Emissions from Stationary Combustion – Oil	Key(L, T)	L, T	L, T
1A2	N_2O	N_2O Emissions from Stationary Combustion	Key(L)	-	L
1A2	CO_2	CO_2 Emissions from Stationary Combustion- Other Sectors, Coal	Key(L, T)	L, T	-
1B2	CH_4	Fugitive Emissions from Coal Mining and Handling	Key(L, T)	L, T	T
1A3	CO_2	Mobile Combustion-other transportation	Key(L, T)	L, T	-
1A2	CO_2	Non-energy fuel use- gas	Key(L)	L	-
		Total others	Key(L, T)	L	-
INDUSTRIAL PROCESSES					
2A	CO_2	CO_2 Emissions from Cement Production	Key(L)	L, T	L
2A	CO_2	CO_2 from Lime Production	Key(L, T)	L, T	-
2C	CO_2	CO_2 Emissions from Steel Production	Key(L, T)	L, T	-
2B	N_2O	N_2O Emissions from Nitric Acid Production	Key(L, T)	L	L, T
2B	CO_2	CO_2 Emissions from Ammonia Production	Key(T)	-	T
AGRICULTURAL SECTOR					
4A	CH_4	CH_4 Emissions from Enteric Fermentation in Domestic Livestock	Key(L, T)	L, T	L, T
4B	CH_4	CH_4 Emissions from Manure Management	Key(T)	T	T
4D	N_2O	Direct N_2O Emissions from Agriculture Soils	Key(L, T)	L, T	L, T
4D	N_2O	N_2O Emissions from Animal Production	Key(L, T)	L, T	L, T
4D	N_2O	Indirect N_2O Emissions from Agriculture Soils	Key(L, T)	L, T	L, T
4B	N_2O	N_2O Emissions from Manure Management	Key(L, T)	-	L, T
WASTE SECTOR					
6A	CH_4	CH_4 Emissions from Solid Waste Disposal Sites	Key(L, T)	L, T	L, T
6B	CH_4	Emissions from Wastewater Handling	Key(L, T)	L, T	L, T
6B	N_2O	Emissions from Wastewater Handling	Key(L, T)	T	L, T

As it can be seen, the method of the type Tier 2 gives preponderance to sources with higher degree of uncertainty. This results to a certain alteration of the results, as far as the proper classification of large GHG emitters is concerned, which have relatively low degree of uncertainty in their determination. (see ***Annex 1***).

As a result of applying the two approaches for assessment of key sources, a list of total 25 sources is formed, which take part in the key source assessment. Only 11 of all these are registered as key sources, included in all methods and kinds of assessment (by quantity and trend).

1.6. Information on the QA/QC Plan Including Verification and Treatment of Confidentiality Issues

Drawing up the GHG inventory is an aggregate of activities, subject of quality assessment and quality control.

The systems for quality assessment and quality control (QA/QC) are part of working procedures in the Bulgarian companies and organizations, and are subject of international quality control certification.

Issues on quality management of the following two stages of preparing the inventory will be discussed herein: preparation of initial data and calculation of the GHG emissions; and compiling of original CRF Tables and the National Inventory Report.

Quality Management of the Sources of Initial Data

Each organization – data source, solves the quality management issues in accordance with its internal rules and provisions. With some of the sources as NSI, MOI, etc., those rules follow strictly the international practices. For example, quality assessment/quality control procedures with NSI have been harmonized with the relevant instructions and provisions of EUROSTAT. Strict rules on data processing and storage, harmonized with international organizations such as Interpol, the US and European intelligent services, have been introduced within MOI.

Some of the large enterprises – GHG emission sources, have well arranged and effective quality management systems. Most of them have introduced quality management systems on the basis of ISO 9001:2000 standard.

Quality Management of the National Inventory Report and the CRF Tables

The main point of the inventory process is focused on the final results to be reported in the National Inventory Report and the CRF Tables. The Quality Management System (QMS) is responsible for obtaining the final results. Such a system, certified on ISO 9001:2000 standard, has been introduced in the Energy Institute.

The QMS contains all rules and procedures for management and control of the entire inventory process. Furthermore, specific checks are to be made at different inventory stages, thus additionally verifying the data, received by the original sources.

Together with development of National monitoring system for air pollutants including GHG emissions would be assessed the anthropogenic GHG emissions (requirement of Art. 5 of the Kyoto Protocol). The development of the system will started in 2006.

1.7. General Uncertainty Evaluation

As a whole, the uncertainty assessment of the GHG inventories follows the methodology of Good Practice Guidance.

It is known that the overall uncertainty is closely related to the GHG emission sources data uncertainty (fuels, activities, processes, etc.) and to the emission factor uncertainty.

The uncertainty of the GHG emission sources can be defined during data collection and processing, and it is a part of procedures, applied by the statistical agencies and organizations. Different criteria for uncertainty assessment are used, such as statistical subtraction, differences between the production, import, export and consumption of fuels, expert assessments, etc.

The uncertainty of the emission factors depends on the origin of the factors applied. In case the emission factors result from direct periodical measurements, the uncertainty is determined by the relevant methodology, related to the measuring methods and apparatuses.

The overall uncertainty of the GHG inventory is determined by combining the emission sources uncertainty and the emission factors uncertainty.

Two rules are applied in this process:

- Rule A – combination of the uncertainties by summing;

- Rule B – combination of the uncertainties by multiplying.

Since the GHG inventories are sums of products of emission sources, multiplied by emission factors, the two rules above can be used for determining the overall uncertainty of the inventory.

Rules A and B represent the foundation of the Tier 1 method, recommended in the Good Practice Guidance.

The overall uncertainty assessments for the 2004 GHG inventory, as well as the trend uncertainty compared to the base year (1988), were made by the Tier 1 method.

The necessary uncertainties for all the emission sources (key and non-key) and emission factors are presented in **Table 1.3**.

Following data has been used for assessment of uncertainties:

- the standard statistical subtraction, which is bound to the general energy balance of the country;
- exemplary assessments, proposed by the Good Practice Guidance;
- expert assessments of local and foreign experts on agriculture activities, waste management, etc.;
- sensibility analysis of some uncertainties, carried out by the Energy Institute;
- reference data and information for inventories in the Netherlands, Slovakia, Canada, Austria, etc.

Calculations on the uncertainty of each emission source (key or non-key), are given in **Table 1.4.**

Uncertainty Calculation and Reporting (level assessment), %

Table 1.3

ID	IPCC source category	Gas	Uncertainty 2004	
			Activity data uncertainty	Emission factor uncertainty
1	CO_2 Emissions from Stationary Combustion- Energy Industries, Coal	CO_2	5	7
2	Mobile Combustion- road transportation	CO_2	3	5
3	CO_2 Emissions from Stationary Combustion- Manufacturing Industries, Coal	CO_2	5	7
4	CO_2 Emissions from Stationary Combustion – Gas	CO_2	5	5
5	CH_4 Emissions from Solid Waste Disposal Sites	CH_4	20	100
6	CO_2 Emissions from Stationary Combustion – Oil	CO_2	5	5
7	CO_2 Emissions from Steel Production	CO_2	3	10
8	CH_4 Emissions from Enteric Fermentation in Domestic Livestock	CH_4	2	50
9	CO_2 Emissions from Cement Production	CO_2	3	30
10	CO_2 Emissions from Stationary Combustion- Other Sectors, Coal	CO_2	5	7
11	Emissions from Wastewater Handling	CH_4	30	80
12	Fugitive Emissions from Coal Mining and Handling	CH_4	10	200
13	Direct N_2O Emissions from Agriculture Soils	N_2O	3	250
14	CO_2 from Lime Production	CO_2	5	15
15	Indirect N_2O Emissions from Agriculture Soils	N_2O	3	500
16	N_2O Emissions from Nitric Acid Production	N_2O	10	200
17	Mobile Combustion-other transportation	CO_2	5	5
18	Non-energy fuel use- gas	CO_2	5	5
19	Fugitive Emissions from Oil and Gas Operations	CH_4	5	50
20	N_2O Emissions from Animal Production	N_2O	3	250
21	CH_4 Emissions from Manure Management	CH_4	2	50
22	CO_2 from Ammonia Production	CO_2	5	20
23	N_2O Emissions from Manure Management	N_2O	2	300
24	N_2O Emissions from Stationary Combustion	N_2O	5	200
25	Emissions from Wastewater Handling	N_2O	30	100
26	CO_2 from Soda Ash Production	CO_2	5	20
27	CO_2 Emissions from Industrial Processes - others	CO_2	5	20
28	Mobile Combustion-Railways	CO_2	3	5
29	Non - energy fuel use- liquid	CO_2	5	5
30	Non-CO_2 emissions from biomass combustion for energy use	CH_4, N_2O	5	20
31	Non-energy fuel use- solid	CO_2	5	20
32	CH_4 Emissions from Rice Production	CH_4	25	80
33	CH_4 Emissions from Industrial Processes - metal production	CH_4	5	20
34	Mobile Combustion-road transportation	N_2O	3	40
35	New gases	PFC, HFC	10	50
36	CH_4 Emissions from Stationary Combustion	CH_4	5	50
37	CH_4 Emissions from Agricultural Residue Burning	CH_4	25	50
38	Mobile Combustion-road transportation	CH_4	3	40
39	N_2O Emissions from Agricultural Residue Burning	N_2O	25	200
40	CO_2 Emissions from limestone and dolomite use	CO_2	5	15
41	Total others		5	20

Tier 1 Uncertainty Calculation and Reporting (level assessment), Gg CO_2-eq.

Table 1.4

IPCC source category	Gas	1988	2004	Comb. uncertainty	Combined uncertainty as% of total nat. emissions in 2004	Uncertainty into the trend in total nat. emissions,%
		Gg CO_2-eq.	Gg CO_2-eq.	%		
CO_2 Emissions from Stationary Combustion- Energy Industries, Coal	CO_2	31 318	25 083	8.6	3.2	1.4
Mobile Combustion- road transportation	CO_2	7 747	6 550	5.8	0.6	0.2
CO_2 Emissions from Stationary Combustion- Manufacturing Industries, Coal	CO_2	9 272	4 852	8.6	0.6	0.3
CO_2 Emissions from Stationary Combustion – Gas	CO_2	10 259	4 643	7.1	0.5	0.3
CH_4 Emissions from Solid Waste Disposal Sites	CH_4	10 818	4 545	102.0	6.9	1.2
CO_2 Emissions from Stationary Combustion – Oil	CO_2	19 685	4 211	7.1	0.4	0.3
CO_2 Emissions from Steel Production	CO_2	2 360	1 505	10.4	0.2	0.1
CH_4 Emissions from Enteric Fermentation in Domestic Livestock	CH_4	4 049	1 491	50.0	1.1	0.2
CO_2 Emissions from Cement Production	CO_2	2 006	1 376	30.1	0.6	0.1
CO_2 Emissions from Stationary Combustion- Other Sectors, Coal	CO_2	4 953	1 301	8.6	0.2	0.1
Emissions from Wastewater Handling	CH_4	1 845	1 233	85.4	1.6	0.4
Fugitive Emissions from Coal Mining and Handling	CH_4	1 992	1 233	200.2	3.7	0.4
Direct N_2O Emissions from Agriculture Soils	N_2O	3 273	1 159	250.0	4.3	1.0
CO_2 from Lime Production	CO_2	1 118	956	15.8	0.2	0.1
Indirect N_2O Emissions from Agriculture Soils	N_2O	2 825	915	500.0	6.8	2.0
N_2O Emissions from Nitric Acid Production	N_2O	2 422	858	200.2	2.5	0.6
Mobile Combustion-other transportation	CO_2	3 998	659	7.1	0.1	0.1
Non-energy fuel use- gas	CO_2	990	656	7.1	0.1	0.0
Fugitive Emissions from Oil and Gas Operations	CH_4	1 279	559	50.2	0.4	0.0
N_2O Emissions from Animal Production	N_2O	1 652	537	250.0	2.0	0.6
CH_4 Emissions from Manure Management	CH_4	1 524	516	50.2	0.4	0.1
CO_2 from Ammonia Production	CO_2	1 157	408	20.6	0.1	0.0
N_2O Emissions from Manure Management	N_2O	1 056	396	300.0	1.8	0.3
N_2O Emissions from Stationary Combustion	N_2O	396	317	200.1	0.9	0.2
CO_2 from Limestone and Dolomite use	CO_2	461	314	15.8	0.07	0.02
New gases	PFC, HFC, SF_6	1 845	254	104.4	0.4	0.5
Emissions from Wastewater Handling	CH_4	310	150	20.6	0.0	0.0
CO_2 from Soda Ash Production	CO_2	233	139	20.6	0.0	0.0
CO_2 Emissions from Industrial Processes - others	CO_2	39	97	5.8	0.0	0.0
Mobile Combustion-Railways	CO_2	368	89	7.1	0.0	0.0
Non-energy fuel use- liquid	CO_2	354	74	20.6	0.0	0.0
Non-CO_2 emissions from biomass combustion for energy use	CH_4, N_2O	34	69	20.6	0.0	0.0
Non-energy fuel use- solid	CO_2	80	53	83.8	0.1	0.0
CH_4 Emissions from Rice Production	CH_4	119	48	20.6	0.0	0.0

IPCC source category	Gas	1988	2004	Comb. uncertainty	Combined uncertainty as% of total nat. emissions in 2004	Uncertainty into the trend in total nat. emissions,%
		Gg CO_2-eq.	Gg CO_2-eq.	%		
CH_4 Emissions from Industrial Processes - metal production	CH_4	73	45	100.0	0.1	0.0
Mobile Combustion-road transportation	N_2O	48	38	51.0	0.0	0.0
CH_4 Emissions from Stationary Combustion	CH_4	49	35	50.2	0.0	0.0
CH_4 Emissions from Agricultural Residue Burning	CH_4	46	34	55.9	0.0	0.0
Mobile Combustion-road transportation	CH_4	54	21	40.1	0.0	0.0
N_2O Emissions from Agricultural Residue Burning	N_2O	15	10	201.6	0.0	0.0
Total others		179	81	20.6	0.0	0.0
Overall uncertainty in the year					**12.462**	**3.208**

The calculated uncertainties, in %, of the overall national GHG emissions for the year 2004, and the overall emission trend related to the base inventory year until 2004, are given in **Table 1.5**.

Uncertainty in total GHG emissions, %

Table 1.5

Uncertainty	Uncertainty NIR 2003	Uncertainty NIR 2004
Uncertainty in total GHG emissions	13.00	12.46
Overall uncertainty into the trend in total GHG emissions	3.381	3.208

In case uncertainty of 3.5% for all emission sources is assumed (this is the maximum statistical subtraction in the energy balance of the country), and engineering uncertainty of 5% for all emission factors is assumed, 2.51% uncertainty of the overall emissions, and 1.14% uncertainty of 2004 inventory trend will be obtained.

The contribution of each source to the general uncertainty of summary GHG emissions' **level** for 2004, allows to arrange the sources and to identify the highest contribution sources. This was made within the frames of Tier 2 from ***Annex 1***. The first ten sources with highest contribution are shown in **Table 1.6**.

Key sources with the maximum contribution to uncertainty of summary GHG emissions in 2004

Table 1.6

IPCC	IPCC sources	GHG	Uncertainty (% of national summary GHG emissions in 2004)
6A	CH_4 Emissions from Solid Waste Disposal Sites	CH_4	0.17
4D	Indirect N_2O Emissions from Agriculture Soils	N_2O	0.17
4D	Direct N_2O Emissions from Agriculture Soils	N_2O	0.11
1B	Fugitive Emissions from Coal Mining and Handling	CH_4	0.09
1A	CO_2 Emissions from Stationary Combustion- Energy Industries, Coal	CO_2	0.08
2B	N_2O Emissions from Nitric Acid Production	N_2O	0.06
2B	N_2O Emissions from Animal Production	N_2O	0.05
4B	N_2O Emissions from Manure Management	N_2O	0.04
4B	Emissions from Wastewater Handling	CH_4	0.04
6B	CH_4 Emissions from Enteric Fermentation in Domestic Livestock	CH_4	0.03
	TOTAL		**0.84**

The first ten sources with highest contribution to the uncertainty of GHG summary trend emissions for the period 1988-2004, are shown in **Table 1.7**.

Key sources with the maximum contribution to uncertainty of GHG emissions summary trend in 1988-2004

Table 1.7

IPCC	IPCC sources	GHG	Uncertainty (% of the trend of total emissions for 1988-2004)
4D	Indirect N_2O Emissions from Agriculture Soils	N_2O	0.24
4D	Direct N_2O Emissions from Agriculture Soils	N_2O	0.12
6A	CH_4 Emissions from Solid Waste Disposal Sites	CH_4	0.09
1A	CO_2 Emissions from Stationary Combustion- Energy Industries, Coal	CO_2	0.07
4D	N_2O Emissions from Animal Production	N_2O	0.07
2B	N_2O Emissions from Nitric Acid Production	N_2O	0.07
	F- gases	PFC, HFC, SF_6	0.07
1B	Fugitive Emissions from Coal Mining and Handling	CH_4	0.04
4B	N_2O Emissions from Manure Management	N_2O	0.04
1A	CO_2 Emissions from Stationary Combustion – Oil	CO_2	0.04
	TOTAL		**0.84**

Analysis of the above two tables showed that the highest contribution to the uncertainty of GHG summary emissions belongs to the sectors agriculture, waste and stationary combustion processes.

1.8. General Assessment of Inventory Completeness

GHG inventory for 2004 covered all sectors, included in IPCC Good Practice Guidance, 1996, excluding:

- emissions in categories 5B-5E of sector Land-use Change and Forestry;
- F-gases emissions from utilization of aerosols, fire-extinguishers, etc.;
- N_2O emissions from utilization of solvents.

The above mentioned emissions exist, however there is no methodology for their determination and efficient input data collection developed.

Now, we run a study for preparing of methodology for calculation of GHG emissions for category 5B-5E in LULUCF sector.

Additional information about the inventory completeness is given in ***Annex 5.***

CHAPTER 2. OVERALL GHG EMISSION TRENDS

2.1. Aggregated GHG Emission Trends

GHG emission inventory for 2004 showed that the overall GHG emissions in CO_2–eq. amounted to 67 510.9 Gg, without reporting of sequestration from sector Land-Use Change and Forestry (LUCF). The net emissions (without reporting of sequestration from LUCF) were 59 291.5 Gg.

In **Table 2.1** are given emission trends of the main GHG, the summary emissions (without reporting of LUCF) and the overall emissions share of the emissions from the base year 1988, assumed as 100%.

Analysis of **Table 2.1** shows, that in 2004, CO_2 emissions headed the list with the biggest share – 78.6% of the overall GHG emissions, expressed in CO_2-eq., CH_4 emissions ranked the second place with 14.45%, and N_2O emissions ranked the third place with 6.5%. This distribution has undergone some changes compared to the base 1988, as it is shown in **Figure 2.1**.

Summary of emission trends per gas, Gg

Table 2.1

Source category	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
CO_2 with LUCF	93 169	79 126	60 308	53 689	56 139	53 963	57 219	56 931	54 794	47 559	43 537	41 200	42 383	40 765	46 739	45 130
CO_2 excluding LUCF	98 302	85 283	67 944	61 101	63 615	61 265	64 744	63 449	61 665	54 419	50 736	50 176	51 851	49 083	53 795	53 096
CH_4	21 864	18 703	16 417	15 185	13 602	12 598	12 390	11 502	9 945	9 268	8 901	9 035	8 317	8 480	9 358	9 766
N_2O	12 061	10 450	7 793	6 377	5 671	5 805	5 838	5 757	5 404	4 400	4 473	4 911	4 568	4 443	4 434	4 395
HFCs	0	0	0	0	0	0	2.95	109.30	188.15	576.65	102.80	96.02	97.50	89.59	120.60	217.30
PFCs	75.55	47.31	21.32	27.92	19.03	45.83	46.94	45.88	37.26	69.44	43.55	33.14	16.29	21.42	20.69	33.18
SF_6	0	0	0	0	0	0	1.26	1.31	1.75	1.83	1.88	2.23	2.29	2.51	2.52	3.68
Total	**132 303**	**114 483**	**92 175**	**82 690**	**82 907**	**79 714**	**83 022**	**80 864**	**77 241**	**68 736**	**64 259**	**64 254**	**64 852**	**62 119**	**67 731**	**67 511**
Index (1988 = 100)																
Index CO_2 excluding LUCF	100	86.8	69.1	62.2	64.7	62.3	65.9	64.5	62.7	55.4	51.6	51.0	52.7	49.9	54.7	54.0
Index CH_4	100	85.5	75.1	69.5	62.2	57.6	56.7	52.6	45.5	42.4	40.7	41.3	38.0	38.8	42.8	44.7
Index N_2O	100	86.6	64.6	52.9	47.0	48.1	48.4	47.7	44.8	36.5	37.1	40.7	37.9	36.8	36.8	36.4
Index [group of six]	**100**	**86.5**	**69.7**	**62.5**	**62.7**	**60.3**	**62.8**	**61.1**	**58.4**	**52.0**	**48.6**	**48.6**	**49.0**	**47.0**	**51.2**	**51.0**
Index (1995 = 100)																
Index HFCs	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	0
Index PFCs	160.9	100.8	45.4	59.5	40.5	97.6	100.0	97.7	79.4	147.9	92.8	70.6	34.7	45.6	44.1	70.7
Index SF_6	0.0	0.0	0.0	0.0	0.0	0.0	100.0	103.7	138.9	145.1	148.8	176.9	181.7	198.7	199.4	291.5
Index [group of new gases]	147.7	92.5	41.7	54.6	37.2	89.6	100.0	92.3	76.3	139.3	88.8	69.1	36.3	46.8	45.4	45.4

Figure 2.1

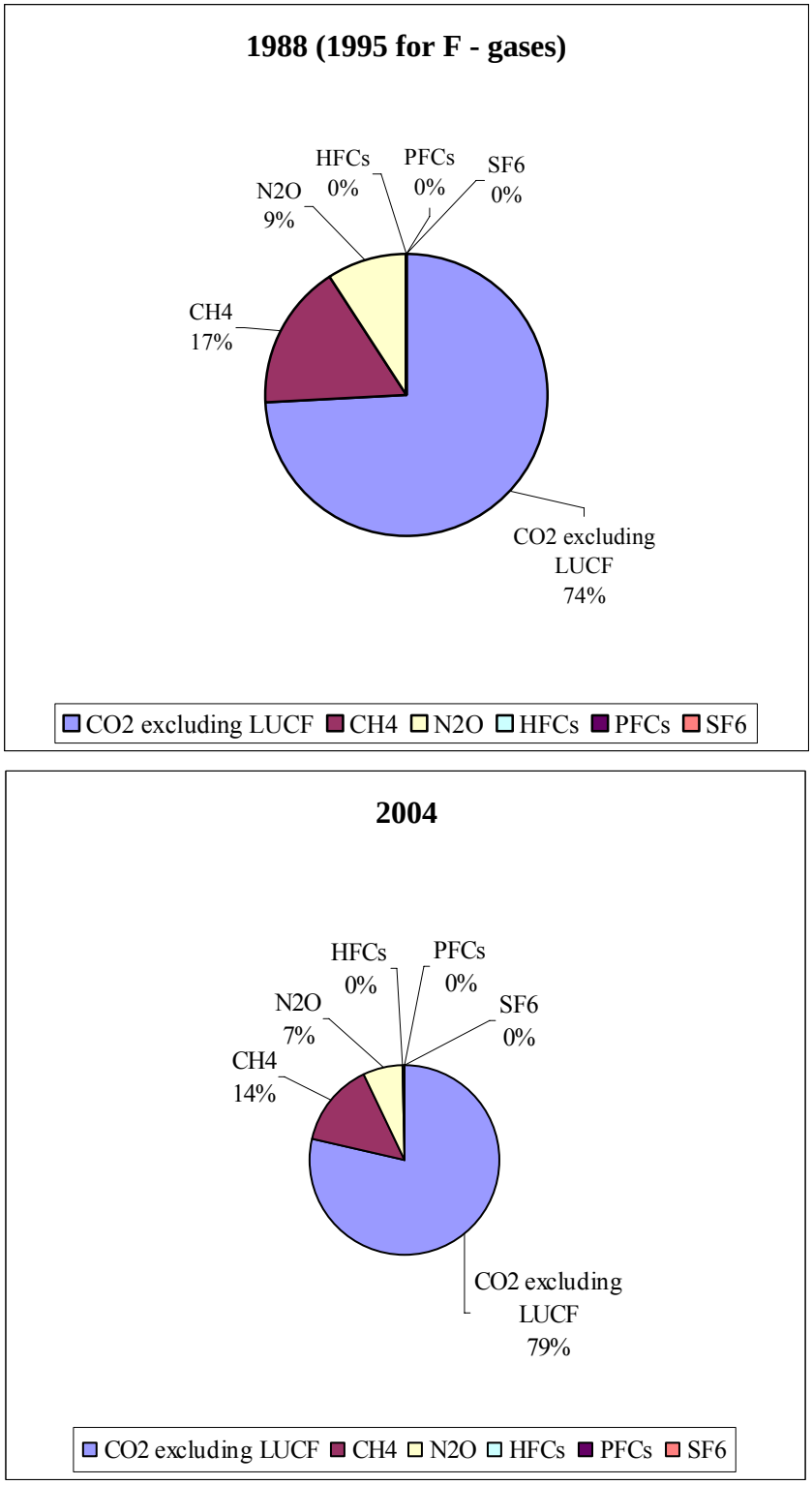
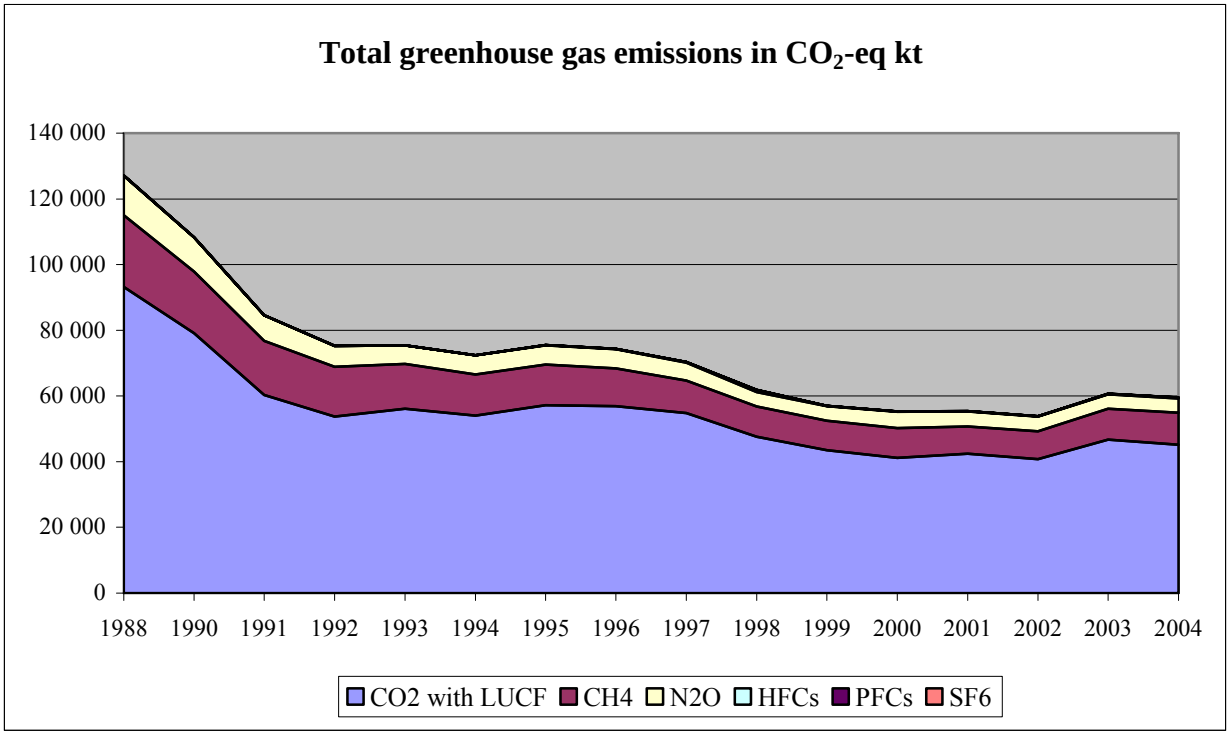


Figure 2.2 shows the change in the overall emissions for the period 1988-2004.

Figure 2.2



It can be seen that in 2004, the total GHG emissions in CO_2-eq., indicated a little decrease. 2004 emissions were 51% from the emissions in the base year, 1988, and decreased compared to the preceding 2003 by 0.32%. Detailed GHG emission trends by types of gases and source categories are given in ***Annex 7***.

Table 2.2 shows the overall emissions by sectors for the period 1988-2004, in CO_2-eq. The quantities of CO_2, sequestrated by forestry, is also included.

Aggregated GHG emissions by sector, Gg, CO_2-eq.

Table 2.2

Sector/ year	**1988**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**
Energy	94 616	81 425	65 731	59 634	62 127	59 050	61 928	60 727
Industrial processes	10 155	8 976	6 281	5 299	5 136	6 058	7 414	7 422
Agriculture	14 559	12 953	10 529	8 525	7 150	6 591	5 935	5 696
Forestry	-5 133	-6 157	-7 636	-7 412	-7 476	-7 302	-7 524	-6 517
Waste	12 973	11 129	9 634	9 233	8 493	8 014	7 746	7 019
Total (without LUCF)	**132 303**	**114 483**	**92 175**	**82 690**	**82 907**	**79 714**	**83 022**	**80 864**
Sector/ year	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Energy	58 990	53 101	48 757	48 050	49 645	47 178	51 181	50 497
Industrial processes	6 878	5 286	4 929	5 835	5 837	5 277	5 990	5 979
Agriculture	5 591	5 309	5 666	5 394	4 541	4 859	4 833	5 106
Forestry	-6 872	-6 860	-7 200	-8 976	-9 467	-8 318	-7 056	-7 965
Waste	5 783	5 038	4 906	4 975	4 829	4 805	5 596	5 928
Total (without LUCF)	**77 241**	**68 736**	**64 259**	**64 254**	**64 852**	**62 119**	**67 599**	**67 511**

Table 2.3 shows the shares in percentage of the overall GHG emissions by sectors for the period 1988-2004. This percent was calculated on the overall emissions, excluding CO_2 sequestration by forestry.

Sector contribution in aggregated emissions, %

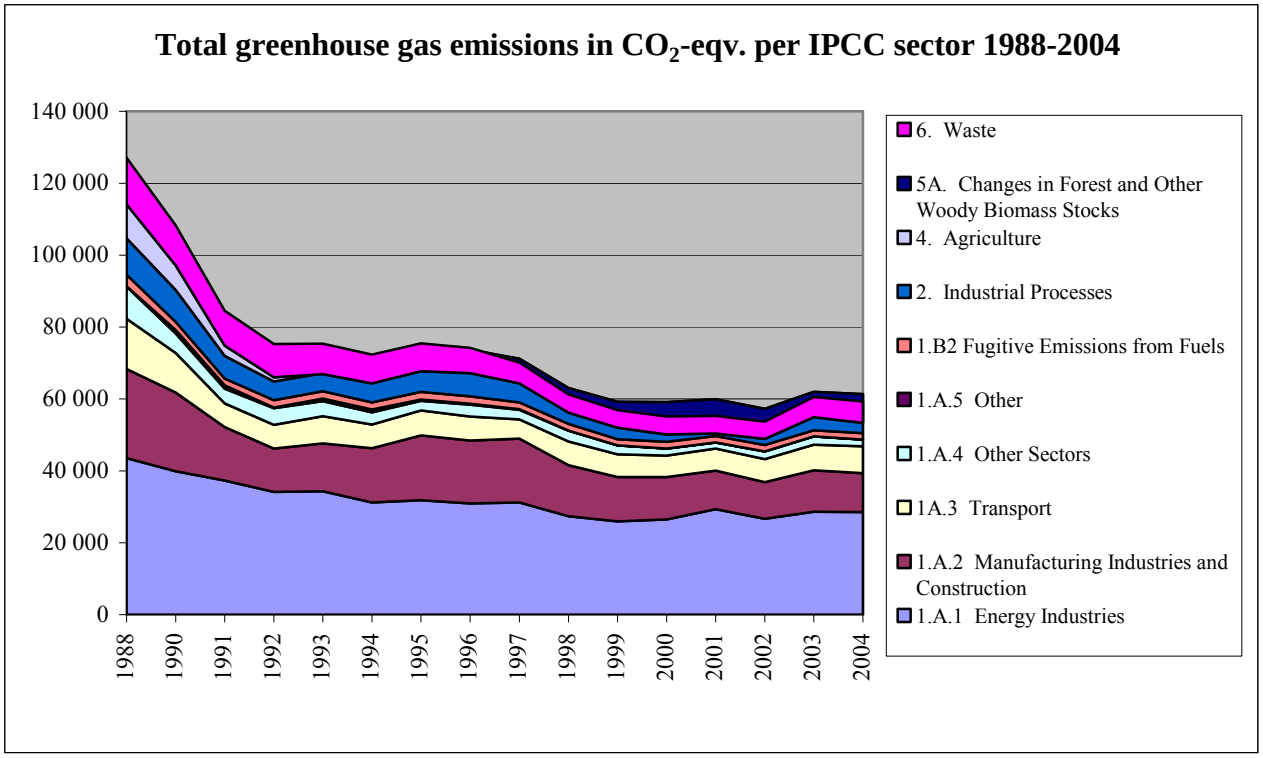
Table 2.3

Sector/ year	1988	1990	1991	1992	1993	1994	1995	1996
Energy	71.51	71.12	71.31	72.12	74.94	74.08	74.59	75.10
Industrial processes	7.68	7.84	6.81	6.41	6.20	7.60	8.93	9.18
Agriculture	11.00	11.31	11.42	10.31	8.62	8.27	7.15	7.04
Forestry	-3.88	-5.38	-8.28	-8.96	-9.02	-9.16	-9.06	-8.06
Waste	9.81	9.72	10.45	11.17	10.24	10.05	9.33	8.68
Sector/ year	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Energy	76.37	77.25	75.88	74.78	76.55	75.95	75.71	74.80
Industrial processes	8.90	7.69	7.67	9.08	9.00	8.49	8.86	8.86
Agriculture	7.24	7.72	8.82	8.39	7.00	7.82	7.15	7.56
Forestry	-8.90	-9.98	-11.20	-13.97	-14.60	-13.39	-10.44	-11.80
Waste	7.49	7.33	7.64	7.74	7.45	7.74	8.28	8.78

Analysis of **Table 2.3** shows that sector Energy, where GHG emissions come from fuel combustion, headed the list in 2004 with the biggest share – 75%. Sector Industrial processes ranked the second place with 9% and sector Waste ranked the third place with the same share.

Figure 2.3 shows the aggregated GHG emissions by sectors according to the IPCC classification.

Figure 2.3



The aggregated GHG emission trend's uncertainty, according to the method Tier 1, was 3.2%. The level (quantity) uncertainty of the overall emissions was much larger and achieved about 12.4%. The last thing indicates that reporting the emissions in the base 1988 leads to lowering the uncertainty parameters compared to the reporting of emissions of the current year.

2.2. GHG Emission Trends by Gas

Table 2.4 shows the CO_2 emission trends by IPCC sectors.

Reduction of the CO_2 overall emissions in 2004 compared to the base 1988 was 46%. That reduction was conditioned mostly by the reduction in industry – 56%, in transport - 46%, and especially in households - 80%. The lowest reduction was in the Energy sector - 37%, due to the structure of the electrical production facilities, including the significant output of electrical power, produced in the Nuclear Power Plant.

Compare to previous 2003 year, CO_2 emissions in current year have a little drop but as whole the 2003 level is kept. That means, the liveliness trend in economy and energy efficiency are observed for a second year in a row.

Table 2.5 shows the CH_4 emission trends by IPCC sectors.

Reduction of the CH_4 overall emissions in 2004 compared to the base 1988 was 55%. That reduction was conditioned mostly by the reduction in agriculture – 64%, in fugitive emissions from coal mining and gas and oil systems - 45%, and particularly in the solid waste - 58%. The lowest reduction was in the waste water treatment - 33%. The indicated reductions describe best the land reversion, changes of property and the large-scale agricultural restructuring.

Compared to the preceding 2003, a growth of CH_4 emissions can be seen in 2004, as follows: overall growth of 4.2%, 0.4% growth in agriculture, 18% drop in technological industrial processes, 7.8% growth in solid waste and 0.3% in waste water treatment. The last figure points to the preservation of the almost double rise in 2003 due to the specific decision of MoEW for a single time emission from some tailings ponds, where waste water was collected for a long period of time, which are let out under a specific regime also in 2004.

CO_2 emissions and sinks per IPCC sector 1988- 2004, Gg

Table 2.4

IPCC Sector	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
TOTAL NET NAT. EMISSIONS Incl. LUCF	**93 169**	**79 126**	**60 308**	**53 689**	**56 139**	**53 963**	**57 219**	**56 931**	**54 794**	**47 559**	**43 537**	**41 200**	**42 383**	**40 765**	**46 739**	**45 130**
TOTAL NET NAT. EMISSIONS Excl. LUCF	**98 302**	**85 283**	**67 944**	**61 101**	**63 615**	**61 265**	**64 744**	**63 449**	**61 665**	**54 419**	**50 736**	**50 176**	**51 851**	**49 083**	**53 795**	**53 096**
1. All energy (combustion and fugitive)	**90 726**	**78 673**	**63 357**	**57 197**	**59 682**	**56 658**	**59 376**	**58 214**	**56 703**	**50 813**	**46 746**	**45 861**	**47 475**	**45 054**	**49 167**	**48 276**
A. Fuel combustion total	90 726	78 673	63 357	57 197	59 682	56 658	59 376	58 214	56 703	50 813	46 746	45 861	47 475	45 054	49 825	48 276
1a Electricity and heat production	43 217	37 939	35 823	32 882	32 969	29 830	30 350	29 470	29 929	26 458	24 499	24 881	27 805	25 201	27 264	27 043
1bc Other transformation	0	1 306	921	922	1 063	1 067	1 171	1 131	957	621	1 120	1 286	1 179	1 217	1 024	1 202
2. Manufacturing Industries and Construction	24 755	21 821	14 758	12 093	13 296	15 032	18 023	17 499	17 691	14 221	12 283	11 868	10 788	10 198	11 533	10 818
3. Transport	13 814	10 864	6 525	6 435	7 444	6 547	6 845	6 565	5 285	6 475	6 212	5 881	6 014	6 317	7 098	7 403
4a Commercial/Institutional	1 068	172	124	107	114	96	64	114	46	288	503	330	574	388	287	200
4b Residential	6 654	4 787	3 633	4 354	3 890	2 962	2 456	3 095	2 632	2 544	1 795	1 362	884	1 511	1 741	1 354
4c Agriculture/Forestry/Fishing	1 219	422	330	149	114	267	102	28	0	157	194	204	180	174	178	204
5. Other	0	1 006	882	196	733	810	315	261	112	49	0	0	0	0	0	0
B. Fugitive fuel emissions	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1. Solid fuels																
2. Crude oil and natural gas																
2. Industrial Processes (ISIC)	**7 576**	**6 610**	**4 588**	**3 903**	**3 933**	**4 606**	**5 368**	**5 235**	**4 963**	**3 606**	**3 990**	**4 315**	**4 375**	**4 028**	**4 628**	**4 819**
3. Solvent and Other Product Use																
5. Land-Use Change and Forestry	**-5 133**	**-6 157**	**-7 636**	**-7 412**	**-7 476**	**-7 302**	**-7 524**	**-6 517**	**-6 872**	**-6 860**	**-7 200**	**-8 976**	**-9 467**	**-8 318**	**-7 056**	**-7 965**
6. Waste	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
7. Other (please specify)																
International bunker	**1 718**	**1 766**	**1 198**	**1 438**	**1 583**	**1 483**	**1 432**	**1 204**	**1 520**	**1 512**	**345**	**475**	**699**	**735**	**921**	**772**
CO_2 Marine	969	874	878	873	844	850	882	732	1 092	1 022	26	205	306	336	436	366
CO_2 Aviation	749	892	320	565	739	632	549	472	428	490	319	270	393	399	485	405

CH_4 emissions per IPCC sector 1988- 2004, Gg

Table 2.5

IPCC Sector	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
TOTAL NET NATIONAL EMISSIONS	**1 041**	**891**	**782**	**723**	**648**	**600**	**590**	**548**	**474**	**441**	**424**	**430**	**396**	**404**	**446**	**465**
1. All energy (combustion and fugitive)	**161.0**	**110.2**	**96.0**	**98.9**	**99.3**	**97.2**	**103.9**	**102.0**	**91.2**	**91.8**	**80.1**	**88.3**	**86.4**	**84.9**	**84.5**	**88.1**
A. Fuel combustion total	5.3	5.0	3.3	3.3	3.4	3.4	3.6	3.3	2.8	2.9	3.0	2.8	2.6	2.8	2.8	2.8
1. Energy	0.8	0.9	0.7	0.7	0.6	0.5	0.6	0.5	0.5	0.4	0.4	0.4	0.5	0.4	0.5	0.4
2. Industry	0.6	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2
3. Transport	3.0	2.9	1.4	1.7	1.9	1.9	2.0	1.7	1.3	1.4	1.5	1.3	1.1	1.2	1.2	1.1
4. Other sectors	0.3	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.3	0.3	0.4	0.3	0.4	0.4	0.4
4a Commercial/Institutional	0.01	0.00	0.00	0.00	0.01	0.00	0.02	0.03	0.01	0.01	0.01	0.02	0.01	0.6	0.4	0.6
4b Residential	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.3	0.3	0.4	0.4	0.4
4c Agriculture/Forestry/Fishing	0.048	0.040	0.026	0.026	0.005	0.017	0.005	0.000	0.000	0.006	0.038	0.048	0.007	0.010	0.013	0.014
5. Other	0.6	0.6	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.5	0.5	0.5	0.5	0.6	0.4	0.6
B. Fugitive fuel emissions	155.7	105.2	92.7	95.6	95.9	93.8	100.3	98.8	88.4	88.9	77.1	85.4	83.7	82.2	81.7	85.3
1. Solid fuels	94.8	75.8	65.1	71.5	71.4	66.7	69.2	67.3	60.7	63.7	56.0	57.1	57.7	58.5	57.5	58.7
2. Crude oil and natural gas	60.9	29.4	27.6	24.1	24.5	27.1	31.1	31.4	27.7	25.1	21.1	28.3	26.0	23.7	24.2	26.6
2. Industrial Processes (ISIC)	**3.9**	**3.0**	**2.2**	**2.1**	**2.4**	**3.2**	**3.5**	**3.3**	**3.5**	**3.0**	**2.8**	**3.5**	**2.4**	**2.2**	**2.8**	**2.3**
3. Solvent and Other Product Use																
4. Agriculture	**273.2**	**258.1**	**234.4**	**192.0**	**150.7**	**126.6**	**121.8**	**115.8**	**110.3**	**114.2**	**115.1**	**108.9**	**84.4**	**95.0**	**99.1**	**99.5**
A. Enteric Fermentation	192.8	180.2	166.0	137.5	107.2	90.1	85.3	82.4	79.5	81.8	83.0	79.3	62.2	69.0	71.5	71.0
B. Manure Management	72.6	71.5	62.8	51.1	40.9	34.7	34.5	31.6	27.9	29.6	30.3	27.1	19.3	22.4	24.4	24.6
C. Rice Cultivation	5.7	4.3	3.3	1.8	1.3	0.3	0.6	1.0	1.5	1.6	0.6	1.4	1.6	2.1	2.3	2.3
D. Agricultural Soils																
F. Field Burning of Agricultural Residues	2.2	2.2	2.3	1.6	1.3	1.4	1.5	0.8	1.3	1.2	1.3	1.1	1.3	1.5	0.9	1.6
G. Other																
5. Land-Use Change and Forestry	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
6. Waste	**603.0**	**519.3**	**449.1**	**430.1**	**395.3**	**372.9**	**360.8**	**326.6**	**268.6**	**232.3**	**225.8**	**229.5**	**222.9**	**221.7**	**259.3**	**275.2**
A. Solid Waste Disposal on Land	515.1	452.8	397.5	382.8	355.2	335.7	311.4	279.7	228.8	198.0	195.7	201.3	200.0	199.9	200.8	216.4
B. Wastewater Handling	87.9	66.5	51.7	47.3	40.1	37.3	49.3	46.9	39.8	34.3	30.1	28.3	22.9	21.8	58.5	58.7
C. Waste Incineration																
D. Other																
7. Other (please specify)																

Table 2.6 shows the N_2O emission trends by IPCC sectors.

The overall N_2O emission reduction in 2004, compared to the base 1988, was 63%. That reduction was conditioned mostly by the reduction in the industrial processes - 64%, and particularly in the agriculture - 66%. The indicated reductions describe best the processes of fertilizers and manure handling, and the reduction of plant crops.

Compared to the preceding 2003, a reduction of N_2O emissions can be seen in 2004, as follows: overall reduction of 0.7%, same level in energy sector, 24.3% reduction in technological industrial processes, and growth by 9% in agriculture. The last appeared to be a direct result from the rich grain crop in 2004.

N_2O emissions per IPCC sector 1988- 2004, Gg

Table 2.6

IPCC Sector	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
TOTAL NET NATIONAL EMISSIONS	**38.9**	**33.7**	**25.1**	**20.6**	**18.3**	**18.7**	**18.8**	**18.6**	**17.4**	**14.2**	**14.4**	**15.8**	**14.7**	**14.3**	**14.3**	**14.2**
1. All energy (combustion and fugitive)	**1.6**	**1.4**	**1.2**	**1.2**	**1.2**	**1.1**	**1.2**	**1.2**	**1.2**	**1.2**	**1.1**	**1.1**	**1.1**	**1.1**	**1.2**	**1.2**
A. Fuel combustion total	1.6	1.4	1.2	1.2	1.2	1.1	1.2	1.2	1.2	1.1	1.0	1.1	1.1	1.1	1.2	1.2
1a Electricity and heat production	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.8	0.8	0.7	0.8	0.8
1bc Other transformation	0.000	0.004	0.004	0.004	0.004	0.004	0.004	0.005	0.004	0.003	0.004	0.004	0.004	0.003	0.08	0.003
2. Industry	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
3. Transport	0.3	0.3	0.2	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
4. Other Sectors	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
5. Other	0.0	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B. Fugitive fuel emissions	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1. Solid fuels																
2. Crude oil and natural gas																
2. Industrial Processes (ISIC)	**7.8**	**7.3**	**5.2**	**4.3**	**3.7**	**4.3**	**6.2**	**6.3**	**5.2**	**3.1**	**2.4**	**4.2**	**4.2**	**3.5**	**3.7**	**2.8**
3. Solvent and Other Product Use																
4. Agriculture	**28.5**	**24.3**	**18.1**	**14.5**	**12.9**	**12.7**	**10.9**	**10.5**	**10.6**	**9.4**	**10.5**	**10.0**	**8.9**	**9.2**	**8.9**	**9.7**
A. Enteric Fermentation																
B. Manure Management	3.4	3.3	3.0	2.5	2.0	1.6	1.6	1.5	1.4	1.5	1.5	1.4	1.0	1.2	1.3	1.3
C. Rice Cultivation																
D. Agricultural Soils	25.0	20.9	15.1	12.0	10.9	11.0	9.3	9.0	9.2	7.9	8.9	8.6	7.9	8.0	7.6	8.4
E. Prescribed Burning of Savannas																
F. Field Burning of Agricultural Residues	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
G. Other																
5. Land-Use Change and Forestry	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
6. Waste	**1.0**	**0.7**	**0.7**	**0.6**	**0.6**	**0.6**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**
7. Other																

Table 2.7 shows the actual emissions of F-gases.

The 2004 reduction of the overall F-gases emissions, compared to the base 1995, was 52.3%. This reduction described best the aluminium output reduction, which led to reduction of PFC's emissions by 72.6%. However, the actual SF_6 emissions increased by 192% because of the large-scale investigation of the power equipment, using SF_6.

Compared to the preceding 2003, a slight increase of the overall emissions by 5% can be seen. This was due to the increased use of SF_6 in the electrical equipments.

Actual emissions of HFCs, PFCs, SF_6- Gg CO_2-eq.

Table 2.7

New gases, Gg	1988	1990	1991	1992	1993	1994	1995	1996
HFCs- total							2.95	
PFCs-total	75.55	47.31	21.32	27.92	19.03	45.83	46.94	45.88
SF_6-use							1.26	1.31
Total HFCs/PFCs/SF_6	75.55	47.31	21.32	27.92	19.03	45.83	51.16	47.19
HFCs- potential							62.16	109.30
PFCs-potential								
SF_6-potential								
New gases, Gg	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
HFCs- total								
PFCs-total	37.26	69.44	43.55	33.14	16.29	21.42	20.69	20.69
SF_6-use	1.75	1.83	1.88	2.23	2.29	2.51	2.52	3.68
Total HFCs/PFCs/SF_6	39.01	71.27	45.43	35.37	18.58	23.93	23.21	24.37
HFCs- potential	188.15	576.65	102.80	96.02	97.50	89.59	120.60	217.30
PFCs-potential								
SF_6-potential				29.40	2.39	2.39	6.36	

In accordance to the recommendation of the experts from the Second Centralized Review of Inventories of Bulgaria held in October 2005 in Bon, Germany, the potential emissions of HFCs are added to the overall emissions of F-gases. In this way the recommendations from the Guidance of Good Practice are kept. And the total emissions of GHG are increased.

2.3. GHG Emission Trends by Source Categories

Table 2.8 shows the GHG aggregated emission trends by IPCC sectors. Obviously, sector Energy had the biggest contribution to the overall emissions, expressed in CO_2-eq. It was followed by sector Industrial processes (especially after 2000) and sectors Waste and Agriculture.

Energy

A steady trend towards emission reduction in this sector has been observed since 1988. The highest reduction was in the public sector (including households) - 80%, industry - 56%, and transport - 46%, and the lowest in the power engineering - 34.5%.

Compared to the preceding 2003, a reduction of emissions of all categories in the energy sector can be seen in 2004, except for transport and fugitive emissions from coal production, petrol and gas. Chapter 3 of this Report contains more detailed analysis of GHG emissions in the sector.

Industrial Processes

A steady trend towards emission reduction in this sector has been observed since 1988. The highest reduction was with F-gases – 64.6%, and with N_2O - 41%, whilst with CO_2 it was 36.4%.

Compared to the preceding 2003, a slow reduction of emissions of all categories in the sector can be seen in 2004. This is due to the reduction of emissions of N_2O - 26%, followed by the reduction of emissions of CH_4 - 18.6%. The increase of CO_2 emissions and F-gases leads to the preservation of the level of emissions from this sector in 2003. Chapter 4 of this Report contains more detailed analysis of GHG emissions in the sector.

Agriculture

The overall emission reduction in the sector has amounted to 65% since 1988. Emissions of all categories in this sector reduced at the rate of the same percent, as the highest was the reduction with the agricultural soils – 66%.

Compared to the preceding 2003, a growth of emissions in the sector can be seen in 2004 by 5.6%. This growth has been stable after 2001. The biggest is the growth of N_2O from agricultural soil. Chapter 6 of this Report contains more detailed analysis of GHG emissions in the sector.

Land-Use Change and Forestry

In this sector for the first time Bulgaria reports not only emissions of biomass change. Emissions of carbon absorbing from the agricultural soil, pastures and meadows and the forest soil are reported.

The annual CO_2 sequestration was about 7 - 9 million tones for the period after 1988. It was about 11% of the overall GHG emissions for 2004. Chapter 7 of this Report contains more detailed analysis of GHG emissions in the sector.

Waste

The total sector emission reduction from the base year until now was 54.3%. This reduction described best the emission reduction from solid waste, which was about 58%.

During the current year there is practically no increase of the waste water emissions and their high level from the previous year is kept. There is an overall growth of emissions in this sector compared to 2003 by 5.9% due to the higher level of CH_4 emissions and disposal of solid waste- growth by 7.8%.

Chapter 8 of this Report contains more detailed analysis of GHG emissions in the sector.

International Bunkering

International bunkering emissions of marine and air transport were reported separately from the overall emissions of the country. Compared to the base year, their reduction was by 55%. This reduction was considerably lower that the average reduction for the period 1999-2002, which reflected the low activity of the international transport.

2.4. Emissions Trends of GHG-Precursors and SOx

Table 2.9 shows the GHG-precursors aggregated emission trends. As a whole, the emissions from all gases decreased in the period after the base 1988. This decrease was due to different reasons, as far as the emission sources were concerned.

Summary of emission trend per source category and gas, Gg CO_2-eq.

Table 2.8

Source category	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
1. All energy (combustion and fugitive)	**94 616**	**81 425**	**65 731**	**59 634**	**62 127**	**59 050**	**61 928**	**60 727**	**58 990**	**53 101**	**48 757**	**48 050**	**49 645**	**47 178**	**51 313**	**50 497**
1A. Energy: fuel combustion	91 345	79 216	63 784	57 626	60 113	57 081	59 822	58 652	57 133	51 235	47 137	46 256	47 886	45 452	49 625	48 705
CO_2: 1. Energy industries	43 217	39 601	37 106	33 862	34 092	30 945	31 572	30 652	30 936	27 078	25 760	26 216	29 036	26 466	28 330	28 298
CO_2: 2. Industry	24 755	21 821	14 758	12 093	13 296	15 032	18 023	17 499	17 691	14 221	12 283	11 868	10 788	10 198	11 562	10 818
CO_2: 3. Transport	13 814	10 864	6 525	6 435	7 444	6 547	6 845	6 565	5 285	6 475	6 212	5 881	6 014	6 317	7 098	7 403
CO_2: 4. Other sectors	8 940	5 381	4 086	4 610	4 117	3 325	2 621	3 238	2 678	2 989	2 491	1 896	1 638	2 074	2 206	1 758
CO_2: 5. Other	0	1 006	882	196	733	810	315	261	112	49	0	0	0	0	0	0
CH_4	111	105	68	69	72	71	76	68	59	62	63	60	55	59	59	59
N_2O	508	438	360	359	360	352	371	370	372	361	328	335	356	339	371	370
B. Fugitive fuel emissions	**3 271**	**2 209**	**1 947**	**2 007**	**2 013**	**1 970**	**2 106**	**2 074**	**1 857**	**1 866**	**1 620**	**1 794**	**1 759**	**1 725**	**1 716**	**1 792**
CH_4	3 271	2 209	1 947	2 007	2 013	1 970	2 106	2 074	1 857	1 866	1 620	1 794	1 759	1 725	1 716	1 792
N_2O	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2. Industrial Processes (ISIC)	**10 155**	**8 976**	**6 281**	**5 299**	**5 136**	**6 058**	**7 476**	**7 423**	**6 870**	**5 286**	**4 929**	**5 835**	**5 837**	**5 277**	**5 990**	**5 979**
CO_2	7 576	6 610	4 588	3 903	3 933	4 606	5 368	5 235	4 963	3 606	3 990	4 315	4 375	4 028	4 628	4 819
CH_4	82	63	46	44	51	68	74	69	74	63	58	74	51	46	59	48
N_2O	2 422	2 255	1 626	1 324	1 133	1 338	1 921	1 962	1 614	968	732	1 314	1 295	1 089	1 159	858
HFCs	0	0	0	0	0	0	65	110	180	577	103	96	98	90	121	217
PFCs	76	47	21	28	19	46	47	46	37	69	44	33	16	21	21	33
SF_6	0	0	0	0	0	0	1	1	2	2	2	2	2	3	3	4
3. Solvent and Other Product Use	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
4. Agriculture	**14 559**	**12 953**	**10 529**	**8 525**	**7 150**	**6 591**	**5 935**	**5 696**	**5 591**	**5 309**	**5 666**	**5 394**	**4 541**	**4 859**	**4 833**	**5 106**
CH_4 Enteric fermentation	4 049	3 784	3 486	2 887	2 251	1 893	1 791	1 730	1 669	1 717	1 742	1 665	1 306	1 448	1 502	1 491
CH_4 Manure management	1 524	1 501	1 319	1 073	859	729	725	664	587	623	636	569	405	471	512	516
CH_4 Rice cultivation	119	90	69	38	26	7	12	22	32	34	12	30	33	44	48	48
CH_4 Field Burning of Agricultural Residues	46	46	49	34	28	29	31	17	28	25	27	24	27	32	19	34
N_2O Manure Management	1 056	1 030	921	760	606	510	496	461	422	452	467	429	321	368	395	396
N_2O Agricultural soils	7 750	6 488	4 668	3 722	3 372	3 415	2 872	2 797	2 845	2 452	2 773	2 671	2 442	2 488	2 352	2 612
N_2O Field Burning of Agricultural Residues	15	14	16	11	8	8	9	6	8	7	8	6	6	8	6	10

Source category	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
5. Land-Use Change and Forestry	**-5 133**	**-6 157**	**-7 636**	**-7 412**	**-7 476**	**-7 302**	**-7 524**	**-6 517**	**-6 872**	**-6 860**	**-7 200**	**-8 976**	**-9 467**	**-8 318**	**-7 056**	**-7 965**
CO_2	-5 133	-6 157	-7 636	-7 412	-7 476	-7 302	-7 524	-6 517	-6 872	-6 860	-7 200	-8 976	-9 467	-8 318	-7 056	-7 965
6. Waste	**12 973**	**11 129**	**9 634**	**9 233**	**8 493**	**8 014**	**7 746**	**7 019**	**5 783**	**5 038**	**4 906**	**4 975**	**4 829**	**4 805**	**5 596**	**5 928**
CO_2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
CH_4	12 663	10 905	9 432	9 032	8 301	7 832	7 577	6 858	5 640	4 879	4 742	4 820	4 681	4 655	5 445	5 778
N_2O	310	224	202	201	192	183	169	161	143	160	164	156	148	151	151	150
7. Other (please specify)																
NATIONAL TOTAL EMISSIONS	**132 303**	**114 483**	**92 175**	**82 690**	**82 907**	**79 714**	**83 085**	**80 865**	**77 233**	**68 736**	**64 259**	**64 254**	**64 852**	**62 119**	**67 731**	**67 511**
Memo item, not included in national total																
International bunker	**1 727**	**1 774**	**1 206**	**1 446**	**1 590**	**1 490**	**1 439**	**1 210**	**1 529**	**1 521**	**345**	**477**	**702**	**739**	**925**	**775**

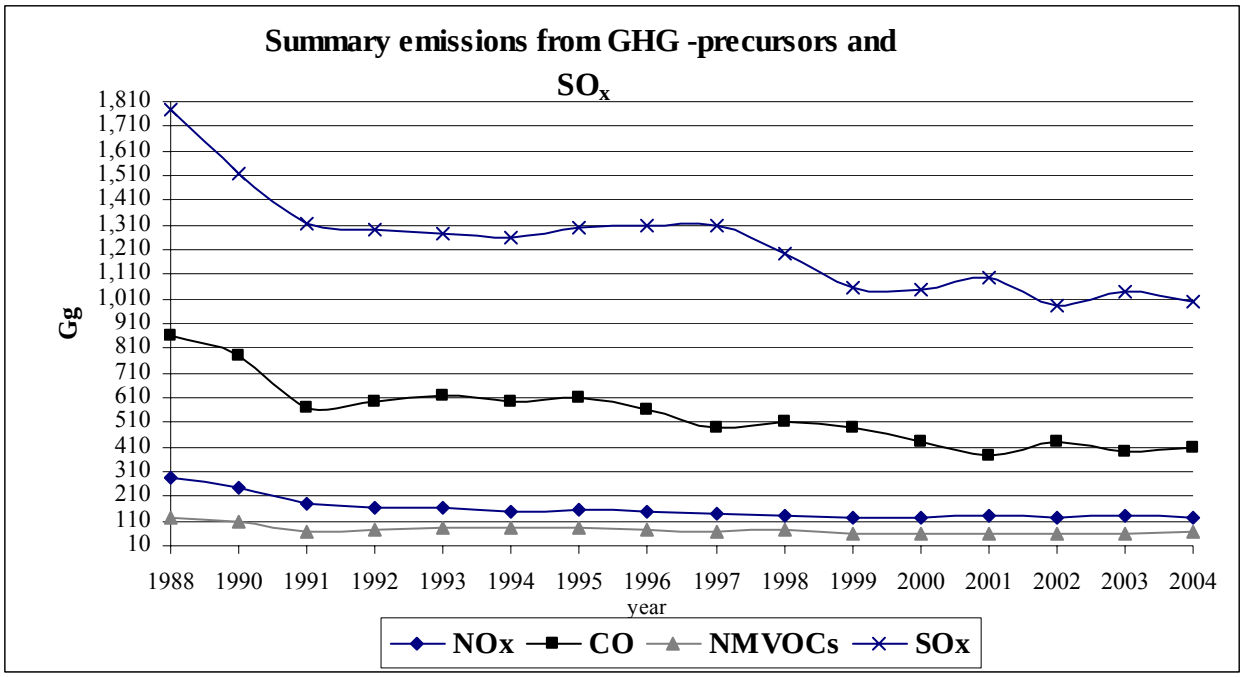
Trend in emissions of ozone and aerosol precursors, 1988-2004, Gg

Table 2.9

Compound	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Emissions in Gg																
Total NOx	286	243	180	163	166	147	152	146	141	134	121	121	129	125	135.35	126
Total CO	864	779	571	597	621	592	613	565	487	514	490	432	376	430	387	406
Total NMVOC	120	110	70	71	80	79	86	78	63	78	62	57	59	61	58	67
Total SO_2	1 781	1 517	1 313	1 290	1 278	1 261	1 299	1 311	1 310	1 192	1 056	1 045	1 096	983	1 043	998
Index (1988 = 100)																
Index total NOx	100	85	63	57	58	51	53	51	49	47	42	42	45	44	47	44
Index total CO	100	90	66	69	72	69	71	65	56	59	57	50	44	50	45	47
Index total NMVOC	100	91	58	59	66	66	72	65	52	65	52	47	49	50	49	56
Index total SO_2	100	85	74	72	72	71	73	74	74	67	59	59	62	55	59	56

Figure 2.4 shows changes of GHG-precursors emission trends.

Figure 2.4



Analysis of **Figure 2.4** shows a trend towards slight fluctuations in the period after 1999. The level is considerably stable.

NOx Emissions

Overall NOx emissions for the country in 2004 were 126 Gg. Compared to 2003, a decrease by 6.9% can be seen.

Sector Energy was a main source of NOx emissions in Bulgaria. It emitted 93% of the overall NOx emissions in 2004. The main part of emissions in this sector came from sub-sector Energy industries – 49% of the emissions in the sector. The observed increase of source emissions in 2004, compared to 2003, only by 0.2% reflects the stable work of the power system.

The second largest NOx emission source was transport. It marked a drop of 10.5% in 2004, compared to the preceding year due to the decrease consumption of diesel fuel in the group *Tracks.*

CO Emissions

Overall CO emissions for the country in 2004 were 405.63 Gg. Compared to 2003, increase by 4.8% can be seen.

Sector Energy was a main source of CO emissions in Bulgaria, and it emitted 90% of the overall emissions in the country. Increase by 0.9% is observed compared to the previous year.

The main part of emissions in this sector came from sub-sector Transport – 169.2 Gg in 2004. The observed reduction of emission source, compared to 2003, was as low as 7.2% and was due to the reduced gasoline consumption, despite slow increased diesel consumption in group *Cars*.

The second largest CO emission source was sub-sector Other – 143.44 Gg in 2004, or 39% of the overall emissions in the sector. Emissions from biomass combustion for the purpose of central heating were estimated. The emissions' increase, compared to 2003, was by 19.5%.

Sector Agriculture covers 8.3% from the total CO emissions in Bulgaria. Here is the highest growth compare to 2003 - 77.8%. This is due to a rich crop in 2004. As a result the volume of crop residue burned on field and for energy needs go up.

NMVOCs Emissions

The NMVOC emitters for Bulgaria were sectors: Energy, Industrial processes and Solvent use.

Overall emissions for the country in 2004 were 67.2 Gg. The emissions' increase, compared to 2003, was 15%.

Sector Energy was a main source of NMVOC emissions in Bulgaria, and it emitted 29.6 Gg or 44% of the overall NMVOC emissions in the country.

The main part of emissions in this sector came from sub-sector Transport – almost 43.4% of the overall emissions in the country in 2004.

Sector Solvent use was the second largest NMVOC emission source in Bulgaria, with 35% of the overall emissions in the country.

SO_x Emissions

The SO_x emitters for Bulgaria were sectors: Energy and Industrial processes.

Overall emissions in 2004 were 997.5 Gg. The emissions' drop, compared to 2003, was 4.4%.

Sector Energy was a main source of SO_x emissions in Bulgaria. It emitted over 84.6% of the overall SO_x emissions in 2004. The main part of emissions in this sector came from sub-sector Energy industries – 844 Gg in 2004.

The second largest SO_x emission source was sub-sector Manufacturing industries and construction, with 8.1%, and on third place – sector Other sectors, with 4.5%.

Sector Industrial Processes has emitted in 2004 only 2% from the sulphur oxide emissions in Bulgaria.

CHAPTER 3. ENERGY

3.1. General Description

In accordance to the IPCC classification, the Energy sector comprises of emissions resulting from end-use fuel combustion. Fugitive emissions from extraction, transmission and distribution of solid, liquid and gaseous fuels are also included in this sector.

Combustion processes' emissions were divided to the following sub-sectors according to the IPCC structure:

- Energy industries;
- Manufacturing industries and construction;
- Transport;
- Other sectors (Services, Households, Agriculture and Forestry);
- Other.

The *fugitive* emissions are:

- coal mining;
- extraction, transportation and distribution of petrol products and natural gas.

The Energy sector in Bulgaria holds a key position in the national economy. It was the source of over 74% of the aggregated GHG emissions for the last inventory 2004.

Table 3.1 shows CO_2 emission trends of the above sub-sectors for the period 1988, 1990-2004.

The analysis of **Table 3.1** shows that the Energy industries kept the largest share - over 45% of the overall emissions in this sector. It was the only sector, where an increase of the relative share compared to the base 1988, can be observed – from 46% up to 56% in 2004. For all other sectors this share decreased: manufacturing industries from 26 down to 21% transport from 14.6 up to 14.7%, and especially in the public sector and households – from 9.4 down to 3.5%. The last figure can be assumed as a positive result from the reduced direct fuel combustion in the households, which led to an overall GHG emission and air pollutants' reduction.

The emissions growth in the energy industries, compared to the preceding year, can be observed only in transport and for fugitive emissions of coal mining and petrol and gas systems.

The trend of Transport sector shows slight fluctuations, as in 2004 the emissions increased and were 4.3% of the overall CO_2 emissions in the sector. Despite the fluctuations resulted from variations of liquid fuel prices, and from restructuring and renovation of the vehicles as well, there is a stable tendency for slow growth of emissions.

The overall trend in sub-sector Other sectors (Services, Households, Agriculture and Forestry) displayed fluctuations as well.

All emissions described above, resulted from fossil fuels combustion. CO_2 emissions from biomass combustion were not taken into account because these were not included in the net GHG overall emissions.

Emissions from Sector Energy were assessed by data from the National energy balance of the country. This balance summarized all balances of companies and other large GHG sources at national level. The methodology of GHG emission calculation is presented in ***Annex 2*** to this Report.

CO_2 emissions from non-energy use of fuels were reported in this sector and not in sector Industrial Process due to the fact that they belong exactly to this sector.

The fugitive emissions from coal mining, from extraction, transmission and distribution of petrol products and natural gas are also part of this sector.

The coal mining in Bulgaria is concentrated mainly in Maritza Iztok Mines, where lignite is mined in surface mines. About 40% of the electrical power in the country is produced by these mines. Brown and black coal mining has significantly less share.

Extraction of petrol products and natural gas in the country reported for less that 1% of the overall consumption. Due to its geographic location Bulgaria turned out to be a natural energy centre in the region and because of this the natural gas transits were significant. They were about 3 times larger than the overall consumption of the country and lead to the corresponding increase of methane fugitive emissions, reported in 2004 inventory.

Trends in greenhouse gas emissions from Energy sector, Gg CO_2-eq.

Table 3.1

Source category	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
1. All energy (combustion and fugitive)	**94 616**	**81 425**	**65 731**	**59 634**	**62 127**	**59 050**	**61 928**	**60 727**	**58 990**	**53 101**	**48 757**	**48 050**	**49 645**	**47 178**	**51 341**	**50 497**
1A. Energy: fuel combustion	91 345	79 216	63 784	57 626	60 113	57 081	59 822	58 652	57 133	51 235	47 137	46 256	47 886	45 452	49 625	48 705
CO_2: 1. Energy industries	43 217	39 601	37 106	33 862	34 092	30 945	31 572	30 652	30 936	27 078	25 760	26 216	29 036	26 466	28 330	28 298
CO_2: 2. Industry	24 755	21 821	14 758	12 093	13 296	15 032	18 023	17 499	17 691	14 221	12 283	11 868	10 788	10 198	11 562	10 818
CO_2: 3. Transport	13 814	10 864	6 525	6 435	7 444	6 547	6 845	6 565	5 285	6 475	6 212	5 881	6 014	6 317	7 098	7 403
CO_2: 4. Other sectors	8 940	5 381	4 086	4 610	4 117	3 325	2 621	3 238	2 678	2 989	2 491	1 896	1 638	2 074	2 206	1 758
CO_2: 5. Other	0	1 006	882	196	733	810	315	261	112	49	0	0	0	0	0	0
CH_4	111	105	68	69	72	71	76	68	59	62	63	60	55	59	59	59
N_2O	508	438	360	359	360	352	371	370	372	361	328	335	356	339	371	370
1B2. Fugitive fuel emissions	**3 271**	**2 209**	**1 947**	**2 007**	**2 013**	**1 970**	**2 106**	**2 074**	**1 857**	**1 866**	**1 620**	**1 794**	**1 759**	**1 725**	**1 716**	**1 792**
CH_4	3 271	2 209	1 947	2 007	2 013	1 970	2 106	2 074	1 857	1 866	1 620	1 794	1 759	1 725	1 716	1 792
N_2O	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Key Sources

Table 3.2 shows the basic (key) and non-key GHG sources in sector Energy. CO_2 was the main source of all key sources. From all the rest, just the N_2O emissions from the stationary combustion and the fugitive methane emissions from the coal mining, were key sources.

Key sources in Energy sector (Methods Tier 1 and Tier 2)

Table 3.2

IN	IPCC source category	Key sources
1	CO_2 Emissions from Stationary Combustion- Energy Industries, Coal	Yes
2	CO_2 Emissions from Stationary Combustion- Manufacturing Industries, Coal	Yes
3	CO_2 Emissions from Stationary Combustion – Gas	Yes
4	CO_2 Emissions from Stationary Combustion – Oil	Yes
5	N_2O Emissions from Stationary Combustion	Yes
6	CO_2 Emissions from Stationary Combustion- Other Sectors, Coal	Yes
7	CH_4 Emissions from Stationary Combustion	No
8	CO_2 Emissions from Non-energy fuel use- gas	Yes
9	CO_2 Emissions from Non-energy fuel use- oil	No
10	CO_2 Emissions from Non-energy fuel use- oil	No
11	CO_2 Emissions from Mobile Combustion- road transportation	Yes
12	CO_2 Emissions from Mobile Combustion-other transportation	Yes
13	CH_4 Emissions from Mobile Combustion- road transportation	No
14	CO_2 Emissions from Mobile Combustion- Railways	No
15	N_2O Emissions from Mobile Combustion- road transportation	No
16	Fugitive Emissions from Coal Mining and Handling	Yes
17	Fugitive Emissions from Oil and Gas Operations	Yes

CO_2 Emissions from Biomass

The biomass fuels in Bulgaria have been used mainly in the public sector, households and the agriculture, for the purposes of heat production, hot water and cooking. Biomass means firewood, wood processing waste, and waste biomass from forestry. Production of bio fuels has started recently, however it is an initial stage and not covered by the inventory yet.

Table 3.3 shows CO_2 emissions at biomass combustion in the different sector categories.

Analysis of **Table 3.3** displayed a steady trend of biomass consumption growth since 1988 to the present. CO_2 emissions increased by 151% in 2004, compared to 1988. This growth was realized mainly in households, which held the largest share, namely 71% from the overall CO_2 emissions from biomass in 2004. The household emissions share is doubled compare to 1988.

3.2. Fuel Combustion

CO_2 emissions are calculated following the two methods, given below:

- "Top - down" (Reference approach) which deals with the apparent fuel consumption, taking into account the carbon flows into and of the country and stock changes;
- "Bottom - up" (Sectoral approach) which deals with the fuel consumption by sectors, sources and technology types that emit GHG.

Fuel combustion emissions are given in **Table 3.4.** The reduction trend of main GHG emissions was kept until 2000. Then emission fluctuations can be seen, with trend towards growth. CO_2 emissions in 2004 were reduced by 46.8%, compared to 1988. The corresponding reduction of CH_4 emissions was 45%, and of N_2O emissions by 27.4%.

The uncertainty assessment of GHG emissions from fuel combustion was on the basis of the uncertainties of fuel quantities and the emission factors for stationary and mobile combustion processes. These uncertainties were estimated at about 6-9% for CO_2 emissions, 50-100% for CH_4 emissions and 100-200% for N_2O emissions.

Electrical power and heat production had the biggest share of CO_2 emissions from fuel combustion - 56%. *Manufacturing industries* ranked the second place by 22.4%, followed by transport – 15.3%. CH_4 and N_2O emissions were considerably lower than CO_2 emissions, as their overall share in the total emissions (in CO_2-eq.) from fuel combustion was less than 9%.

The general data source for fuel quantities used in the energy sector was the Energy balance of the country. It contained all primary and secondary fuels, used for energy needs and for non-energy consumption.

Fuel conversion from natural units into energy units was made by the help of conversion factors, specific for the country. Data base for the annual GHG inventory included both natural and energy units, by means of which the current conversion factors were determined. These factors are elements of the input data control system. The GHG emissions were calculated by the following base equation according to sectoral approach:

$$Emissions = \sum(EF_{abc} * Source_{abc}),$$

where:
EF – emission factor [kg/TJ]
Source = Energy flow [TJ]
a – fuel type
b – sector type (sub-sector or group)
c – technology type

For the 2004 inventory preparation, as well as for the preceding inventories, aggregated emission factors were used.

Organic CO_2 emissions (Gg) reported as "CO_2 from biomass" (from CRF 1A combustion)

Table 3.3

	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
A. Fuel Combustion	**1 469**	**1 312**	**1 307**	**1 288**	**1 168**	**1 288**	**1 560**	**1 610**	**1 681**	**2 402**	**2 413**	**2 955**	**2 876**	**3 390**	**3 411**	**3 694**
1.A.1 Energy Industries	0.0	2.2	4.6	1.9	1.6	1.7	98.0	44.4	92.6	0.0	0.0	0.0	0.0	0.0	0.1	0.1
1.A.2 Manufacturing Industries and Construction	54.7	56.0	36.6	42.9	21.6	25.5	26.6	22.9	17.3	95.0	100.5	118.4	177.3	191.7	241.6	259.6
1A.3 Transport	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.A.4 Other Sectors	628	453	355	448	396	464	609	733	751	1 583	1 582	2 176	2 054	2 461	2 575	2 670
a Commercial/Institutional	*75.1*	*18.7*	*14.8*	*16.5*	*11.6*	*12.7*	*12.5*	*6.2*	*8.6*	*103.3*	*56.4*	*40.1*	*36.3*	*33.0*	*53.5*	*37.0*
b Residential	*513.1*	*400.6*	*318.3*	*403.5*	*380.2*	*435.8*	*593.1*	*726.3*	*742.3*	*1 475.6*	*1 478.9*	*2 075.6*	*2 010.9*	*2 417.9*	*2 508.9*	*2619.0*
c Agriculture/Forestry/Fishing	*39.5*	*33.7*	*21.9*	*28.5*	*3.9*	*15.2*	*3.7*	*0.0*	*0.0*	*4.1*	*46.6*	*60.3*	*6.4*	*10.0*	*13.0*	*14.0*
1.A.5 Other	786.1	800.6	910.8	795.2	749.3	796.8	826.2	809.6	820.1	724.1	730.5	660.7	645.2	737.1	593.4	763.9

Emissions and sinks for Energy sector 1988-2004, Gg

Table 3.4

IPCC Sector	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
1. All energy (combustion and fugitive)	**90 726**	**78 673**	**63 357**	**57 197**	**59 682**	**56 658**	**59 376**	**58 214**	**56 703**	**50 813**	**46 746**	**45 861**	**47 475**	**45 054**	**49 167**	**48 276**
A. Fuel combustion total	90 726	78 317	62 995	57 139	59 623	56 610	59 325	58 163	56 652	50 813	46 605	45 813	47 424	45 006	49 125	48 224
1a Electricity and heat production	43 217	37 939	35 823	32 882	32 969	29 830	30 350	29 470	29 929	26 458	24 499	24 881	27 805	25 201	27 264	27 043
1bc Other transformation	0	1 306	921	922	1 063	1 067	1 171	1 131	957	621	1 120	1 286	1 179	1 217	1 024	1 202
2. Industry	24 755	21 821	14 758	12 093	13 296	15 032	18 023	17 499	17 691	14 221	12 283	11 868	10 788	10 198	11 533	10 818
3. Transport	13 814	10 864	6 525	6 435	7 444	6 547	6 845	6 565	5 285	6 475	6 212	5 881	6 014	6 317	7 098	7 403
4a Commercial/Institutional	1 068	172	124	107	114	96	64	114	46	288	503	330	574	388	287	200
4b Residential	6 654	4 787	3 633	4 354	3 890	2 962	2 456	3 095	2 632	2 544	1 795	1 362	884	1 511	1 741	1 354
4c Agriculture/Forestry/Fishing	1 219	422	330	149	114	267	102	28	0	157	194	204	180	174	178	204
5. Other	0	1 006	882	196	733	810	315	261	112	49	0	0	0	0	0	0

IPCC Sector	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
CH_4																
1. All energy (combustion and fugitive)	**161.4**	**110.4**	**96.1**	**99.0**	**99.4**	**97.3**	**104.0**	**102.2**	**91.3**	**92.1**	**80.4**	**88.6**	**86.7**	**85.3**	**84.9**	**88.6**
A. Fuel combustion total	5.6	5.2	3.4	3.4	3.5	3.5	3.7	3.4	2.9	3.2	3.3	3.2	3.0	3.2	3.2	3.2
1. Energy	0.8	0.9	0.7	0.7	0.6	0.5	0.6	0.5	0.5	0.4	0.4	0.4	0.5	0.4	0.5	0.4
2. Industry	0.6	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2
3. Transport	3.0	2.9	1.4	1.7	1.9	1.9	2.0	1.7	1.3	1.4	1.5	1.3	1.1	1.2	1.2	1.1
4. Other sectors	0.32	0.21	0.11	0.11	0.07	0.09	0.10	0.12	0.12	0.25	0.29	0.38	0.33	0.39	0.41	0.43
4a Commercial/Institutional	0.05	0.01	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.02	0.03	0.01	0.01	0.01	0.02	0.01
4b Residential	0.22	0.16	0.08	0.08	0.06	0.07	0.09	0.11	0.12	0.23	0.23	0.32	0.31	0.37	0.38	0.40
4c Agriculture/Forestry/Fishing	0.05	0.04	0.03	0.03	0.01	0.02	0.01	0.00	0.00	0.01	0.04	0.05	0.01	0.01	0.01	0.01
5. Other	0.6	0.6	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.5	0.5	0.5	0.5	0.6	0.4	0.6
B. Fugitive fuel emissions	155.7	105.2	92.7	95.6	95.9	93.8	100.3	98.8	88.4	88.9	77.1	85.4	83.7	82.2	81.7	85.3
1. Solid fuels	94.8	75.8	65.1	71.5	71.4	66.7	69.2	67.3	60.7	63.7	56.0	57.1	57.7	58.5	57.5	58.7
2. Crude oil and natural gas	60.9	29.4	27.6	24.1	24.5	27.1	31.1	31.4	27.7	25.1	21.1	28.3	26.0	23.7	24.2	26.6
N_2O																
1. All energy (combustion and fugitive)	**1.64**	**1.41**	**1.16**	**1.16**	**1.16**	**1.13**	**1.20**	**1.19**	**1.20**	**1.16**	**1.06**	**1.08**	**1.15**	**1.09**	**1.20**	**1.19**
A. Fuel combustion total	1.64	1.41	1.16	1.16	1.16	1.13	1.20	1.19	1.20	1.16	1.06	1.08	1.15	1.09	1.20	1.19
1a Electricity and heat production	0.97	0.80	0.79	0.81	0.80	0.79	0.83	0.82	0.85	0.80	0.72	0.75	0.83	0.74	0.82	0.81
1bc Other transformation	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	0.00	0.00
2. Industry	0.14	0.21	0.09	0.08	0.08	0.10	0.11	0.11	0.13	0.09	0.07	0.07	0.07	0.07	0.08	0.07
3. Transport	0.33	0.25	0.15	0.14	0.17	0.14	0.14	0.14	0.12	0.13	0.12	0.11	0.11	0.11	0.13	0.14
4. Other Sectors	0.16	0.10	0.07	0.08	0.07	0.06	0.06	0.08	0.07	0.11	0.10	0.12	0.11	0.13	0.14	0.14
5. Other	0.03	0.04	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.03
B. Fugitive fuel emissions	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	0.00	0.00

3.2.1. Energy Industries

Description of Source Categories

Sub-sector Energy industries included the groups:

- Public Electricity and Heat Production;
- Petroleum Refining;
- Solid fuels Production and Other Energy Industries.

The aggregation level for sub-sector Energy industries was the fuel type and the power plant type – only for electricity production, co-generation and for heat production. On the basis of data, specific for the country, as well as data from IPCC Guidance, summary emission factors were determined for the main GHG - CO_2, CH_4 and N_2O, for the GHG-precursors - CO, NO_x and NMVOC, and for the SOx. At the end of 2002, desulphurization facilities in TPP Maritza Iztok 2 started to operate, thus reducing the SOx emissions. **Table 3.5** shows the GHG emissions from sub-sector Energy industries.

The stationary combustion processes in the Energy industries (power engineering, petroleum refineries, solid fuels production and other energy industries) with **coal** were the largest GHG emission source in Bulgaria. This source emitted 25 083 Gg of CO_2 in 2004, which represented 37% of the total GHG emissions, expressed in CO_2-eq.

Methodology

This emission source included the main power facilities in Bulgaria, combusting domestic low-caloric lignite, with high sulphur and ash content. CO_2 emissions were estimated by a method of the type Tier 2, using the data from the energy balance of the country, prepared by NSI. National emission factors were used for the main GHGs, obtained by measurement and analytical calculations for power plants in the complex Maritza Iztok, where domestic lignite are combusted. These emission factors were aggregated to fuel type and power plant type – electricity power plants, co-generation plants, auto- generator plants and heat plants. Using a method of the type Tier 2 meets the requirements of Good Practice Guidance due to the fact that this source is included in the key source list – see **Table 3.2**.

The CO_2 emissions in 2004 are the same as in 2003. It was due to a stable structure of the power units after stopping of the two units in NPP Kozloduy, increased energy efficiency in industry and household and due to energy market conditions in the region. Indicator for that was the fact that the gross electricity consumption in the country decreased by 3.6%, and the export went up by 7.1% - **Table 3.6.**

GHG emissions from the energy industries (1A1), Gg

Table 3.5

Gas/subsourse	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
CO_2																
a Public Electricity and Heat Production	43 217	37 939	35 823	32 882	32 969	29 830	30 350	29 470	29 929	26 458	24 499	24 881	27 805	25 201	27 264	27 043
b. Petroleum Refining	0	356	362	58	59	48	51	51	51	0	142	48	52	48	42	53
c. Manufacture of Solid Fuels and Other Energy Industries	0	1 306	921	922	1 063	1 067	1 171	1 131	957	621	1 120	1 286	1 179	1 217	1 024	1 202
CH_4																
a Public Electricity and Heat Production	0.84	0.87	0.71	0.63	0.56	0.50	0.53	0.49	0.49	0.42	0.39	0.39	0.43	0.39	0.42	0.41
b. Petroleum Refining	0.00	0.01	0.01	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
c. Manufacture of Solid Fuels and Other Energy Industries	0.00	0.04	0.03	0.03	0.03	0.03	0.03	0.04	0.03	0.02	0.03	0.04	0.03	0.03	0.03	0.03
N_2O																
a Public Electricity and Heat Production	0.97	0.80	0.79	0.81	0.80	0.79	0.83	0.82	0.85	0.80	0.72	0.75	0.83	0.74	0.82	0.81
b. Petroleum Refining	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	0.00	0.00
c. Manufacture of Solid Fuels and Other Energy Industries	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	0.00	0.00

Gross production, import, export and gross consumption of electricity, millions kWh

Table 3.6

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Gross Production	**45 021**	**44 328**	**42 121**	**38 834**	**35 546**	**37 901**	**38 318**	**42 001**	**42 801**	**42 828**	**41 711**	**38 265**	**40 927**	**43 968**	**42 732**	**42 546**	**41 620**
Fossil fuel, non CHP	19 973	20 700	19 899	17 898	17 271	17 303	16 762	17 675	17 060	17 457	16 964	15 115	15 781	18 468	15 960	17 624	15 517
Nuclear	16 030	14 565	14 665	13 184	11 552	13 896	15 334	17 261	18 082	17 751	16 899	15 814	18 178	19 553	20 222	17 278	16 815
CHP and other	6 422	6 371	5 705	5 311	4 660	4 760	4 713	4 558	4 676	4 692	4 533	4 357	4 010	3 781	3 810	4 350	5 925
Hydro	2 596	2 691	1 852	2 441	2 063	1 941	1 509	2 506	2 984	2 928	3 315	2 979	2 958	2 166	2 741	3 294	3 363
Import	4 450	4 937	5 387	3 083	3 289	1 634	1 173	1 961	1 803	785	564	1 670	964	1 092	2 040	1 283	742
Export	304	548	1 597	959	584	1 518	1 245	2 121	2 252	4 335	4 211	3 627	5 584	8 017	8 335	6 772	6 620
Gross domestic use	***49 167***	***48 716***	***45 911***	***40 958***	***38 252***	***38 017***	***38 246***	***41 841***	***42 352***	***39 278***	***38 064***	***36 309***	***36 307***	***37 043***	***36 437***	***37 057***	***35 742***

Uncertainty and Consistency of Time Series

The uncertainty of this source category was 9%.

The analysis of time series indicated a permanent reduction trend until 1998. In the next period emission increase started, mainly due to the increased export and stopping of the two 440 MW units in NPP Kozloduy. Export increase revealed a great dynamics. In 1997 it doubled, compared to the preceding years. In 2001 export doubled again, thus reaching in natural units up to 8 335 GWh in 2002.

The fuels used by this emission source, were determined in the energy balance and were aggregated by type – solid, liquid and gaseous, for the purposes of the CRF Tables. Besides, the secondary gases, coke-oven gas and blast furnace gas, were added to the solid fuels, and dry gas from oil refining and petroleum coke were added to the liquid fuels.

3.2.2. Manufacturing Industries and Construction

Description of Source Categories

Sub-sector Manufacturing Industries and Construction included the groups:

- Ferrous metallurgy;
- Non-ferrous metallurgy;
- Chemical industry;
- Pulp and Paper production and printing industry;
- Food industry;
- Other.

The group Other included machinery construction, electrical engineering, light industry and auto-generating plants for combined production of electrical and thermal energy.

The aggregation level of sub-sector Manufacturing industries and construction was mainly the fuel type, as in some cases the type of combustion technology was reported as well. **Table 3.7** shows basic GHG emissions in the sub-sector categories.

Emissions from Manufacturing Industries and Construction (1A1), Gg

Table 3.7

Gas/sub-source	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
CO_2																
a. Iron and Steel	5 171	3 448	3 080	2 757	3 163	4 318	5 198	4 675	5 079	3 449	2 420	3 332	3 057	2 843	3 486	3 028
b. Non-Ferrous Metals	637	366	275	243	324	336	366	388	344	420	447	399	362	293	277	332
c. Chemicals	4 049	3 487	2 844	2 115	2 125	2 337	3 237	3 210	2 741	2 079	1 781	3 129	2 748	2 145	1 980	2 369
d. Pulp, Paper	196	61	121	72	24	29	33	30	8	274	201	191	138	362	280	221
e. Food Processing, Beverages and Tobacco	613	228	154	219	131	87	88	53	69	676	674	642	548	526	485	474
f. Other	14 089	14 231	8 284	6 688	7 528	7 926	9 102	9 143	9 450	7 323	6 760	4 175	3 935	4 029	5 025	4 393
CH_4																
a. Iron and Steel	0.05	0.04	0.03	0.02	0.02	0.03	0.03	0.03	0.03	0.04	0.03	0.03	0.03	0.03	0.03	0.03
b. Non-Ferrous Metals	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00
c. Chemicals	0.07	0.05	0.03	0.02	0.03	0.03	0.04	0.04	0.03	0.02	0.02	0.05	0.06	0.05	0.06	0.07
d. Pulp, Paper	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.01	0.01	0.01
e. Food Processing, Beverages and Tobacco	0.02	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.03	0.03	0.03	0.02	0.02	0.02	0.02
f. Other	0.41	0.25	0.23	0.19	0.21	0.21	0.25	0.25	0.23	0.19	0.19	0.11	0.10	0.09	0.11	0.11
N_2O																
a. Iron and Steel	0.04	0.02	0.02	0.02	0.02	0.03	0.04	0.04	0.04	0.02	0.01	0.01	0.01	0.01	0.02	0.02
b. Non-Ferrous Metals	0.01	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	0.003	0.004
c. Chemicals	0.01	0.01	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.02
d. Pulp, Paper	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	0.00	0.00
e. Food Processing, Beverages and Tobacco	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00
f. Other	0.08	0.17	0.06	0.05	0.05	0.06	0.06	0.06	0.08	0.06	0.04	0.03	0.03	0.03	0.04	0.03

CO_2 emissions from **coal** combustion in this sub-sector were a key source, ranked at **third place** in key source list, and was responsible for 7% of the total GHG emissions of Bulgaria in 2004. The biggest share in these emissions had the other industries (machinery construction, electrical engineering, factory plants, etc.), ferrous metallurgy and the chemistry. These industry branches topped 90% of the emissions in the sub-sector – see **Table 3.8.**

CO_2 emissions of non-energy fuel use were added to this sub-sector as well. Key sources were the emissions from non-energy use of natural gas.

The key source list included also two sources - CO_2 emissions from stationary combustion of liquid and gaseous fuels. In these key sources were included mainly the categories of this sub-sector and sub-sector Public Electricity and Heat Production, in a ratio of 52 to 48% for the gaseous fuels, and 81 to 19% for the liquid fuels.

Methodology

This emission source included the main power facilities in Bulgaria industry, combusting all basic types of fuels. CO_2 emissions were estimated by a method of the type Tier 2, using the data from the energy balance of the country, prepared by NSI. National emission factors were mainly used for the basic GHGs, as well as standard IPCC factors. Method of the type Tier 1 was applied for emissions from non-energy use of fuels. This method corresponds to the good practice only for non-energy emissions of solid and liquid fuels, which were not key sources – see **Table 3.2**.

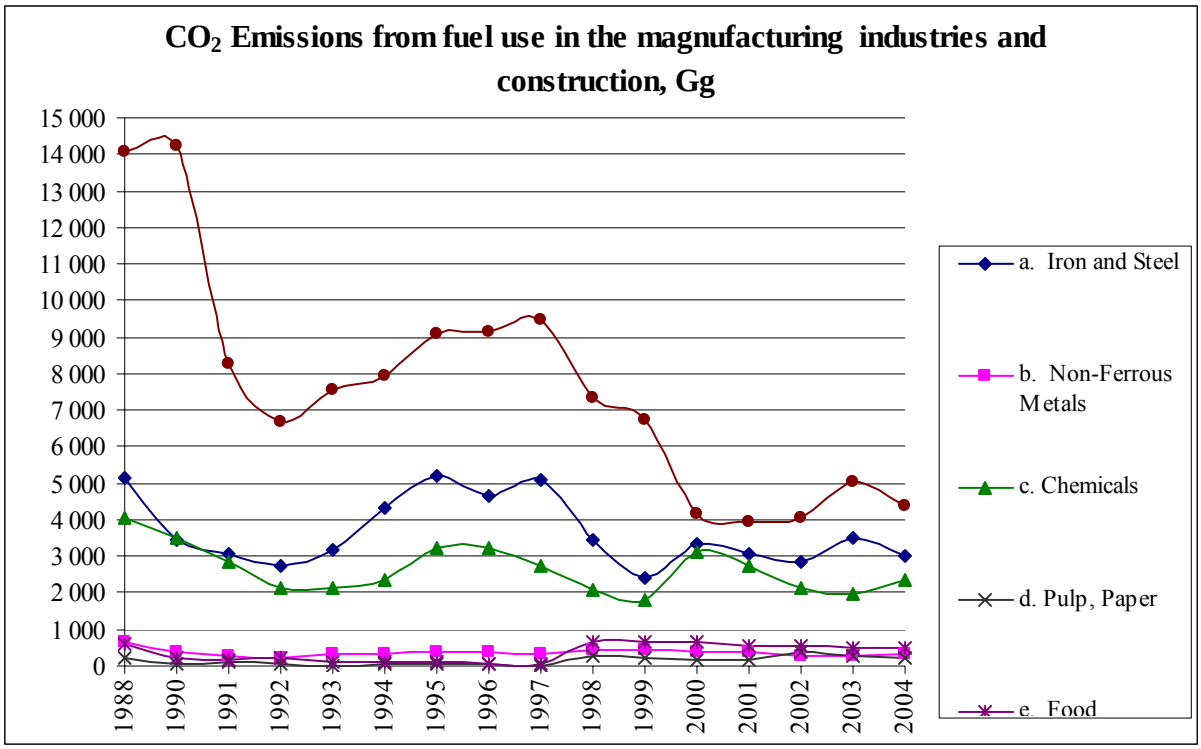
Using a method of the type Tier 2/3 met the requirements of Good Practice Guidance due to the fact that this source was included in the key source list.

Uncertainty and Consistency of Time Series

The uncertainty of this source category was 7 - 9%.

The CO_2 emissions trends are shown on **Figure 3.1.**

Figure 3.1



The analysis of time series indicated a permanent reduction trend, with two minimums – in 1992 and in 2000. These two minimums reflected the economy crisis, related to the transition to market mechanisms of functioning and management, closing down a number of undertakings, and the change of the international markets of the country. Significant contribution to the emission reduction had the programs and measures for energy efficiency, as well as the technological renovation of branches such as food industry, machinery and electricity engineering, construction and others. There was a growth in the last four years, biggest in 2003, as it reflected surmounting of the crisis.

Table 3.9 shows the CO_2 emissions by basic types of fuels in the sub-sector.

CO_2 emissions from fuel use in the Manufacturing Industries and Construction, Gg

Table 3.8.

Gas/subsourse	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
a. Iron and Steel	5 171	3 448	3 080	2 757	3 163	4 318	5 198	4 675	5 079	3 449	2 420	3 332	3 057	2 843	3 486	3 028
feedstock	80	72	37	48	64	74	78	74	82	47	54	71	52	45	53	51
b. Non-Ferrous Metals	637	366	275	243	324	336	366	388	344	420	447	399	362	293	277	332
c. Chemicals	4 049	3 487	2 844	2 115	2 125	2 337	3 237	3 210	2 741	2 079	1 781	3 129	2 748	2 145	1 980	2 369
fuel combustion (Tier 1)	2 704	2 262	1 498	979	1 099	1 354	1 938	1 774	1 482	1 109	882	1 849	1 765	1 453	1 249	1 517
feedstock	1 344	1 225	1 346	1 135	1 027	983	1 299	1 436	1 259	969	899	1 280	984	692	730	852
d. Pulp, Paper	196	61	121	72	24	29	33	30	8	274	201	191	138	362	280	221
e. Food Processing, Beverages and Tobacco	613	228	154	219	131	87	88	53	69	676	674	642	548	526	485	474
f. Other	14 089	14 231	8 284	6 688	7 528	7 926	9 102	9 143	9 450	7 323	6 760	4 175	3 935	4 029	5 025	4 393
Total	**24 755**	**21 821**	**14 758**	**12 093**	**13 296**	**15 032**	**18 023**	**17 499**	**17 691**	**14 221**	**12 283**	**11 868**	**10 788**	**10 198**	**11 533**	**10 818**

CO_2 emissions by main fuels type in the Manufacturing Industries and Construction, Gg

Table 3.9

Gas/sub - source	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Totals	**24 809**	**21 877**	**14 794**	**12 136**	**13 318**	**15 058**	**18 050**	**17 522**	**17 709**	**14 316**	**12 383**	**11 987**	**10 965**	**10 390**	**11 775**	**11 077**
Liquid Fuels	7 740	2 075	3 596	2 577	2 280	2 350	3 326	3 015	3 424	4 540	4 107	3 415	3 008	3 240	3 495	3 219
Solid Fuels	9 353	14 277	6 087	5 066	6 083	7 542	8 627	8 469	9 832	5 723	5 242	5 033	4 863	4 504	5 398	4 905
Gaseous Fuels	7 661	5 469	5 074	4 451	4 933	5 139	6 070	6 015	4 435	3 959	2 934	3 420	2 917	2 455	2 641	2 693
Biomass	55	56	37	43	22	25	27	23	17	95	100	118	177	192	242	260
Other Fuels																

The analysis of the table above indicated that solid fuels had the majority in the base year, and this has been kept during the whole inventory period. Reduction of overall emission level in 2004 was more than two times, compared to the base year. There is not fuels with no clear origin, indicated in the category Other fuels. Thus, in Bulgarian inventory, unlike some developed EU countries, the problem of identification of the so called unspecified fuels does not exist.

Table 3.10 shows CO_2 emissions of non-energy use of fuels. These emissions were reported by applying the Reference Approach, as well as for the Sectoral approach (start from NSI 2005).

Trends in CO_2 emissions by feedstock use of energy carriers according to the IPCC Reference Approach, Gg

Table 3.10

Gas/sub-source	1988	1990	1991	1992	1993	1994	1995	1996
Totals	**1 424**	**1 298**	**1 383**	**1 183**	**1 091**	**1 056**	**1 377**	**1 511**
Liquid Fuels	354	206	105	102	123	100	454	452
Solid Fuels	80	72	37	48	64	74	78	74
Gaseous Fuels	990	1 019	1 241	1 033	904	883	845	985
Gas/sub-source	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Totals	**1 341**	**1 017**	**953**	**1 351**	**1 036**	**737**	**783**	**903**
Liquid Fuels	415	438	330	336	50	60	74	76
Solid Fuels	82	47	54	71	52	45	53	51
Gaseous Fuels	844	532	569	944	933	632	656	776

Emission trend from **non-energy** use of fuels indicated significant reduction, till 2003. As in 2004 there is an increase again at the cost of the non-energy use of the natural gas. The cause is the observed stir in the production of nitrous fertilizers. The structure of these fuels was also changed, as the share of gaseous fuels increased from 69% in 1988 up to 86% in 2004, and the share of liquid fuel emissions decreased from 25% to 8.4% accordingly. The share of emissions of solid materials remains practically the same- 5 - 6% during the whole period from 1988 till now.

3.2.3. Transport

Description of Source Categories

Sub-sector Transport included the groups air, sea, road, inland waterway transport and other kinds of transport. The group Other transport included emission sources form agriculture and construction, such as agriculture machinery for land cultivation, wood processing machinery, construction machinery, etc. The last are so-called off-road machines. This type of machines are basically users of diesel fuel. Only a small part of them (tree cutters, mowers and others) uses avio gasoline or motor gasoline.

The aggregation level was by fuel type, vehicle type and dimensions (the engine volume for cars and the loading capacity for trucks). In this case the emission factors are expressed in natural units, i.e. g/kg of fuel. It did not concern LPG, for which the emission factor is expressed in energy units GJ.

Table 3.11 shows the GHG emission trends from mobile sources for the period 1988-2004.

Trends of greenhouse gas emissions from Transport sub sector, Gg

Table 3.11

Gas/sub-source	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
CO_2	**13 814**	**10 864**	**6 525**	**6 435**	**7 444**	**6 547**	**6 845**	**6 565**	**5 285**	**6 475**	**6 212**	**5 881**	**6 014**	**6 317**	**7 098**	**7 403**
a Civil aviation	612	317	270	315	315	317	276	214	183	120	35	32	46	48	56	104
b. Road transport	7 747	7 586	4 418	4 646	5 751	4 976	5 390	5 306	4 016	5 151	5 324	5 008	5 187	5 484	6 267	6 550
c. Railways	368	334	223	175	178	132	114	121	1	131	120	122	106	97	89	89
d. Navigation	1 088	58.2	3.6	6.6	9.2	12.3	12.5	36.8	5.2	9.6	8.2	0.0	0.0	0.0	0.0	0.0
e. Other transport	3 998	2 569	1 610	1 293	1 192	1 109	1 053	888	1 079	1 064	724	720	675	688	685	659
CH_4	**2.98**	**2.91**	**1.41**	**1.70**	**1.93**	**1.88**	**2.02**	**1.70**	**1.26**	**1.40**	**1.46**	**1.30**	**1.12**	**1.21**	**1.24**	**1.11**
a Civil aviation	0.06	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01
b. Road transport	2.55	2.59	1.21	1.54	1.78	1.73	1.89	1.59	1.13	1.26	1.35	1.19	1.02	1.11	1.14	1.01
c. Railways	0.03	0.03	0.02	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01
d. Navigation	0.08	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	0.00
e. Other transport	0.26	0.28	0.18	0.14	0.13	0.13	0.12	0.10	0.12	0.12	0.10	0.10	0.09	0.09	0.09	0.09
N_2O	**0.33**	**0.25**	**0.15**	**0.14**	**0.17**	**0.14**	**0.14**	**0.14**	**0.12**	**0.13**	**0.12**	**0.11**	**0.11**	**0.11**	**0.13**	**0.14**
a Civil aviation	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	0.00	0.00
b. Road transport	0.16	0.15	0.09	0.09	0.12	0.10	0.10	0.11	0.08	0.10	0.10	0.09	0.09	0.09	0.11	0.12
c. Railways	0.01	0.01	0.01	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
d. Navigation	0.03	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	0.00
e. Other transport	0.13	0.09	0.06	0.05	0.04	0.04	0.04	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02

CO_2 emissions from **road transport** were key source of GHG emissions. This source ranked second place in key source list (estimated by method Tier 1 – with emission level assessment). These emissions were 10% of the overall country emissions in 2004. Another key source were the CO_2 emissions from **other transport**, with 1% share in the overall emissions. These were: CO_2 emissions from railway transport, N_2O and CH_4 emissions from the road transport.

The *road transport* was the largest emission source of main GHG in sub-sector Transport - 89% of the CO_2 emissions, 91% of methane emissions, and 86% of N_2O emissions.

CO_2 emissions from the other kinds of transport were significantly less (about two times), compared to the road transport. Off-road emissions were about one time less than the road transport.

The *avian transport* emissions were spitted between domestic and international transport on the basis of expert assessment. The overall quantities of the used kerosene used were indicated in the energy balance of the country. It was assumed that 80% of kerosene was used for international transport and the relevant emissions were reported in international bunkering.

After 2000, there was no navigation on the Danube and the Black sea for the purposes of domestic passenger transport and because of that no fuels were reported. Only fuels for international transport were indicated.

Table 3.12 shows GHG-precursors emissions with the highest values in this sub-sector – for CO and NMVOC from the corresponding overall emissions of the country, and on second place for NOx, following the Energy sector.

The main GHG emissions from the source increased by approx. 4.3% in 2004, compared to the preceding year. This was due to increased diesel fuel consumption in the road transport.

Table 3.13 shows the trend of fuel quantities, used by the road transport. It shows a stable growth after 1997.

GHG-precursors emissions from Mobile sources, Gg

Table 3.12

year	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
NOx	115.6	97.8	57.6	51.7	56.0	48.9	49.4	45.4	41.8	46.5	42.6	41.0	39.7	41.8	45.4	40.6
CO	454.3	434.8	216.0	260.4	304.0	296.9	327.6	267.5	189.9	233.9	229.3	198.4	171.8	185.0	182.5	169.2
NMVOCs	67.1	66.3	34.2	39.1	45.9	44.0	48.2	40.6	29.9	37.8	36.5	31.5	28.1	30.0	30.1	29.2
SO_2	57.8	18.0	10.5	9.6	11.0	9.1	8.8	9.4	7.8	8.3	8.0	7.1	7.3	7.5	8.8	9.5

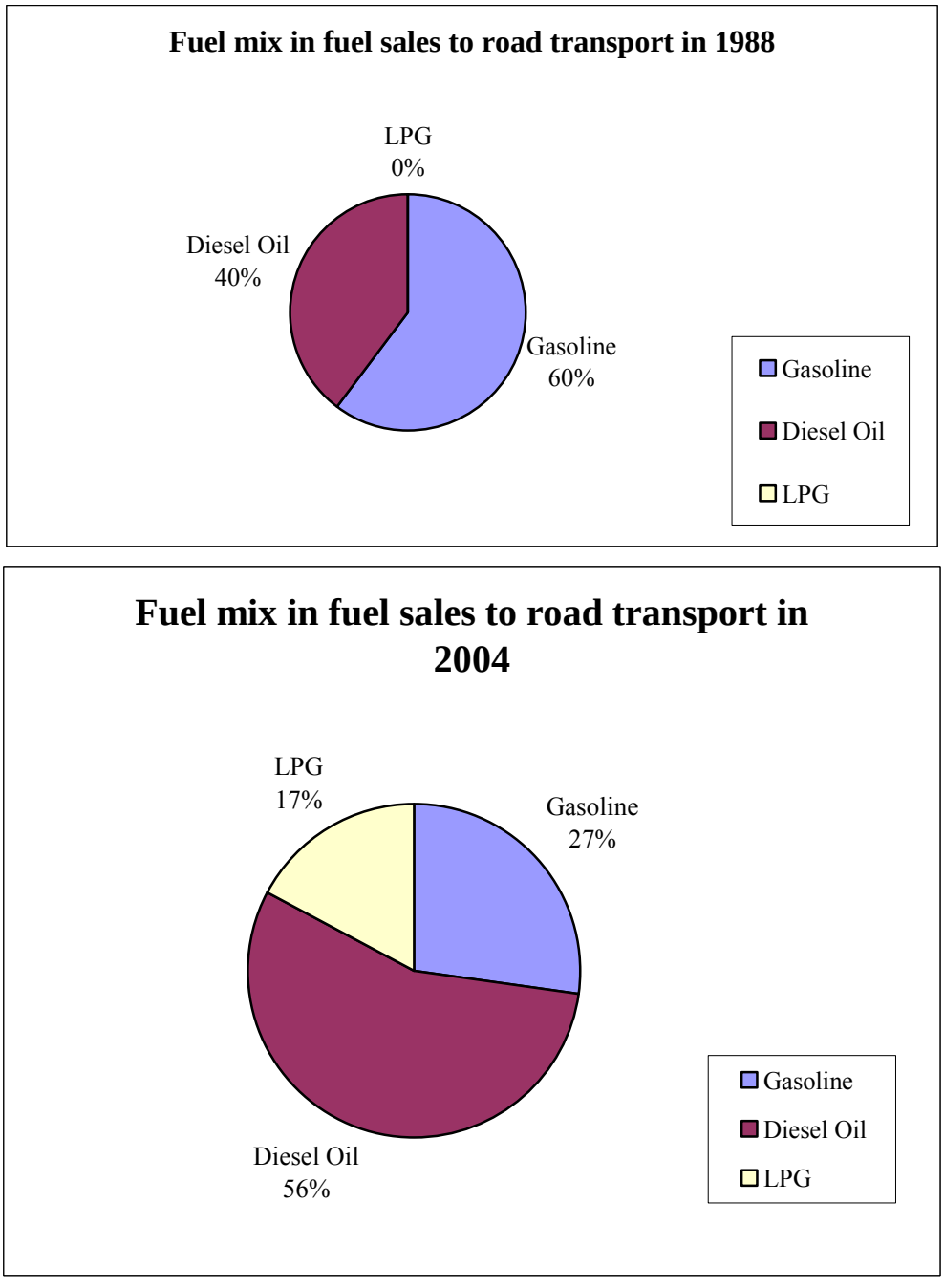
Fuels for Road Transportation, TJ

Table 3.13

	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Gasoline	63 235	61 643	28 955	36 908	43 176	43 572	48 050	40 431	26 780	35 168	34 564	29 019	24 928	26 795	25 762	24 554
Diesel Oil	41 817	42 455	30 959	27 490	35 914	26 138	26 839	33 191	27 337	31 821	33 761	30 204	33 794	34 296	44 112	50 006
LPG	11.54	0.90	1.20	0.14	1.70	5.60	4.40	15.00	27.60	3 057	4 156	9 842	13 061	15 046	16 825	15 558
Total	**105 063**	**104 098**	**59 915**	**64 399**	**79 092**	**69 716**	**74 893**	**73 637**	**54 145**	**70 046**	**72 481**	**69 065**	**71 783**	**76 137**	**86 699**	**90 117**

Figure 3.2 shows the change in the fuel sales in 2004, compared to the base 1988. A clear trend towards increase of fuel sales can be seen, concerning the fuels that emit less air pollutants, including GHG. Obviously the LPG consumption trend is remarkable. The volume of consumed LPG in road transportation is over the 17% from total fuel road consumption in 2004. The last observations shows that there is saturation and the increase of LPG consumptions is smaller than in the last 2-3 years.

Figure 3.2



The fuel sales, shown on **Figure 3.2** and **Table 3.13 and GHG emissions in Table 3.11** should be estimated on the basis of more than a double increase of number of automobiles (cars, trucks, buses) in 2004, compared to the base year.

Methodology

The CO_2 emissions were calculated according to the reported fuel consumption in the Energy Balance. The consumed fuels were apportioned for different vehicle types - cars, buses and trucks. A methodology is applied which helps to distribute; considering the number of vehicles, engine volume, loading capacity and the mileage. Data for the number of vehicles was provided by the Road Control Department within the Ministry of Interior (MOI).

The emissions were estimated after a method of the type Tier 2, with emission factors depending on the engine volume, loading capacity and the fuel type. The emission factors were based on measurements and studies of the motor fleet in the country. The characteristic features of these fleet vehicles have not changed significantly since the last GHG inventory, 2003. The indices retained nearly the same: high average age of the cars, (40% from the cars are over 20 years old and only 10% below 10 years), big share of old cars (Lada, Moskvich, Trabant, etc.), significant number of the imported second-hand cars (over 150 000 ones in the current year), relatively not a big share of the imported new cars. Nevertheless, a trend towards increase of the quantity of new cars was outlined which is deepening in the current year. In 2004 more new cars are imported which means a rise of nearly 40% compared to 2003. There was also a growth of second-hand car sales.

Uncertainty and Consistency of Time Series

The uncertainty of this source category was 6-7% for CO_2 emissions and 100% for methane and N_2O emissions.

The CO_2 emission trends in transport formed uniform time series because for the whole period after the base 1988, there have been no changes in the methodology of calculation and collection of data for types of vehicles.

3.2.4. Other Sectors

Description of Source Categories

Sub-sector Other sectors included the groups:

- Commercial/institutional and services;
- Households;
- Agriculture and forestry.

In the sub-sector Other sectors were included only stationary sources, as the aggregation level was the type of the fuel and the combustion technology in the corresponding group (services, households, agriculture). The emission factors applied were combination of those standard values, recommended by the IPCC Guidance, and results from measurements and analytical studies, factors specific for the country.

Table 3.14 shows the main GHG emissions in the sub-sector.

The analysis of **Table 3.14** showed that the category **households** had a predominating role. More than 77% of CO_2 emissions, 95% of methane emissions and 94% of N_2O emissions were emitted from this category.

The CO_2 emissions from stationary combustion processes – **other sectors, coal,** were key GHG emission source. This source ranked tenth place in key source list (estimated by method Tier 1 – with emission level assessment) and produced 2% of the overall emissions of the country in 2004.

The consumption of fuels in the sector Households was purposed on heat and hot water production, and cooking. These activities allow using of broad range of energy carriers and technologies, and due to that they have a great potential for reduction of GHG emissions.

Bulgarian practices was a good example for that, showing a significant consumption of wood and wood waste in the households.

The CO_2 emissions form wood and wood waste combustion in 2004 were 2 619 Gg, shows yearly increase by 4% in the last two years of inventory.

Methodology

The GHG emissions were calculated according to the reported fuel consumption in the Energy Balance. A method of the type Tier 2 was applied, with emission factors, estimated after IPCC and local measurements and analytical calculations as well.

Uncertainty and Consistency of Time Series

The uncertainty of this source category was 9% for CO_2 emissions and 50% for methane and N_2O emissions.

The CO_2 emission trends in the sector formed uniform time series because for the whole period after the base 1988, there have been no changes in the methodology of calculation and collection of data. It should be noticed that the impact of the seasonal temperature changes was not reported evidently. It did not affect significantly the emitted gases, because the heating standards have not been observed always, especially in some public buildings (schools, social facilities), and in the households as well. One of the main reasons is the high fuels and centralized district heating prices. Utilization of natural gas for heating is still in initial stage.

The uncertainty assessment for each category of the sub-sector should be different and considerably higher that the above mentioned, as a rule. This conclusion comes form the international practices and will be investigated in future inventories for the conditions in Bulgaria.

3.2.5. Other

The GHG emissions from the use of biomass for obtaining power were estimated in this category. However, the quantities of wood and wood waste, given in the Energy Balance, were not reported here (see p. 3.2.4 above).

The following was considered as a power source in this category:

- dry twigs and brushwood and other kinds of woody biomass;
- vegetal residues from grain, vineyards, etc.;
- used charcoal;
- sludge combustion.

CO_2 emissions from this source in 2004 were 763.9 Gg.

3.2.6. Comparison of the Sectoral Approach with the Reference Approach

The Reference approach (RA) is a method for estimating CO_2 combustion emissions by the help of limited input data. For this purpose the apparent consumption of fuels and the CO_2 emission factors of fuel combustion were needed. By the Reference approach were verified the results for CO_2

emissions, obtained with the Sectoral approach (SA). A detailed description of this method is given in ***Annex 4***.

Table 3.15 presents the CO_2 emissions, calculated by the Reference approach, and the emissions from fuel combustion, calculated by the Sectoral approach.

Comparison of the two approaches indicated difference 0.52% for 2004.

Emission trend as per the two approaches for the period 1988-2004 is practically the same – reduction by -46.8%. CO_2 emission reduction was biggest with the liquid fuels – 66.7%, followed by gaseous, 52% and solid fuels, 30%.

Trends of greenhouse gas emissions form Other sectors, Gg

Table 3.14

IPCC Sector	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
CO_2																
4a Commercial/Institutional	1 068	172	124	107	114	96	64	114	46	288	503	330	574	388	287	200
4b Residential	6 654	4 787	3 633	4 354	3 890	2 962	2 456	3 095	2 632	2 544	1 795	1 362	884	1 511	1 741	1 354
4c Agriculture/Forestry/Fishing	1 219	422	330	149	114	267	102	28.24	0.00	157	194	204	180	174	178	204
CH_4																
4a Commercial/Institutional	0.05	0.01	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.02	0.03	0.01	0.01	0.01	0.02	0.01
4b Residential	0.22	0.16	0.08	0.08	0.06	0.07	0.09	0.11	0.12	0.23	0.23	0.32	0.31	0.37	0.38	0.40
4c Agriculture/Forestry/Fishing	0.05	0.04	0.03	0.03	0.01	0.02	0.01	0.00	0.00	0.01	0.04	0.05	0.01	0.01	0.01	0.01
N_2O																
4a Commercial/Institutional	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00
4b Residential	0.13	0.09	0.07	0.08	0.07	0.06	0.06	0.07	0.07	0.10	0.09	0.11	0.10	0.13	0.13	0.13
4c Agriculture/Forestry/Fishing	0.01	0.01	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

Comparison of CO_2 emissions: Reference Approach (RA) versus National Approach (NA), Gg

Table 3.15

IPCC Sector	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Reference Approach																
Liquid Fuels	34 832	28 320	19 254	15 300	18 317	16 873	16 634	14 575	12 068	11 412	11 742	10 879	10 683	11 923	12 198	11 631
Solid Fuels	44 926	40 554	34 727	32 758	34 722	31 760	32 835	33 418	34 897	32 541	28 693	28 900	31 564	28 649	32 151	31 451
Gaseous Fuels	11 401	12 085	10 158	8 978	8 435	8 493	10 293	10 440	8 225	7 436	5 978	6 358	5 905	5 271	5 475	5 444
Total RA	**91 159**	**80 960**	**64 139**	**57 036**	**61 474**	**57 126**	**59 763**	**58 432**	**55 190**	**51 389**	**46 413**	**46 136**	**48 152**	**45 843**	**49 825**	**48 526**
National approach	90 726	78 673	63 357	57 197	59 682	56 658	59 376	58 214	56 703	50 813	46 746	45 861	47 475	45 054	49 167	48 276
Difference	***0.48***	***2.91***	***1.23***	***-0.28***	***3.00***	***0.83***	***0.65***	***0.37***	***-2.67***	***1.13***	***-0.71***	***0.60***	***1.42***	***1.75***	***1.34***	***0.52***

3.2.7. Non-energy Use of Fuels

Description of Source Categories

CO_2 emissions from non-energy use of fuels were structured in sub-sector Manufacturing industries and construction of Energy sector. The fuels were used as raw materials mainly in Ferrous metallurgy and Chemistry. The overall share of these emission sources from the summary emissions of the country in 2004 was as low as 1.33%, as this share was retained for the whole inventory period after the base year, 1988. Only the emissions from non-energy use of natural gas were key source, ranked at the eighteenth place in key source list.

The portion of carbon, which is stocked in products like asphalt, plastic, fertilizers, etc., was estimated by ratios, proposed by IPCC Guidance. There are no measurements in Bulgaria for estimation of ratios, specific for the country.

Methodology

CO_2 emissions from non-energy use of fuels were estimated by the emission factors applied in the Reference approach. In Bulgarian inventory a certain part of the fuel parameters (low calorific value and emission factors) was specific for the country and served for estimation of these emissions as well. As a whole, the emission calculation method was of type Tier 1.

Uncertainty and consistency of time series

The uncertainty of this source category was estimated by scientific information, on the basis of assessments of international experts, and it amounted to 6-7%.

The emission trends are shown in **Table 3.16** for the main types of fuels – liquid, solid and gaseous.

The overall emissions of Bulgaria from non-energy use of fuels in 2004 dropped down by 36.6%, compared to the base year 1988.

3.2.8. International Bunkers

Description of source categories

The International Bunkers includes international air and sea transport.

The international transport of passengers and cargo uses fuel combustion, as GHG and pollutants in the atmosphere are emitted. These GHG emissions were also a subject of the inventory.

The GHG emissions from fuel combustion in international transport were estimated in compliance with the methods, proposed by IPCC Guidance, in the sector Mobile sources of Energy sector. The obtained GHG emission quantities were not included in the summary emissions of the country, but reported separately in the relevant CRF tables.

In Bulgarian GHG inventories, international transport emissions were divided into two categories:

- GHG emissions from sea international transport;
- GHG emissions from air international transport.

Table 3.17 shows the fuels (in TJ) and CO_2 emissions for the period 1988-2004.

CO_2 emissions from non-energy use of fuels

Table 3.16

Fuels	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Liquid Fuels	354	206	105	102	123	100	454	452	415	438	330	336	50	60	74	76
Solid Fuels	80	72	37	48	64	74	78	74	82	47	54	71	52	45	53	51
Gaseous Fuels	990	1 019	1 241	1 033	904	883	845	985	844	532	569	944	933	632	656	776
Total	**1 424**	**1 298**	**1 383**	**1 183**	**1 091**	**1 056**	**1 377**	**1 511**	**1 341**	**1 017**	**953**	**1 351**	**1 036**	**737**	**783**	**903**

International bunkers: energy consumption (TJ) and related CO_2 emissions (Gg) 1988-2004

Table 3.17

Source	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Energy consumption																
Marine Bunkers	**12 439**	**11 295**	**11 430**	**11 049**	**10 589**	**10 664**	**10 684**	**9 240**	**12 524**	**12 812**	**333**	**2 696**	**4 017**	**4 416**	**5 723**	**4 813**
Gasoline	0.00	1.00	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	0.00
Gas/Diesel Oil	7 659	2 777	2 664	2 725	2 336	2 240	2 240	2 240	2 240	2 703	294	2 696	3 975	4 416	5 723	4 813
Residual Fuel Oil	4 780	8 517	8 766	8 324	8 253	8 424	8 444	7 000	10 284	10 109	39.00	0.00	42.00	0.00	0.00	0.00
Aviation Bunkers	**10 602**	**12 638**	**4 536**	**8 004**	**10 464**	**8 958**	**7 782**	**6 686**	**6 056**	**6 938**	**4 522**	**3 822**	**5 571**	**5 654**	**6 870**	**5 741**
Jet Kerosene	10 602	12 377	4 446	7 967	10 427	8 892	7 731	6 668	6 031	6 896	4 522	3 822	5 571	5 654	6 870	5 741
Gasoline	0.00	260.20	89.60	36.56	36.43	66.00	51.17	17.60	24.59	41.85	0.00	0.00	0.00	0.00	0.00	0.00
Total	***23 041***	***23 933***	***15 966***	***19 053***	***21 053***	***19 622***	***18 466***	***15 926***	***18 580***	***19 750***	***4 855***	***6 518***	***9 588***	***10 070***	***12 594***	***10 554***
CO_2 Emissions																
Marine Bunkers	**969**	**874**	**878**	**873**	**844**	**850**	**882**	**732**	**1 092**	**1 022**	**26**	**205**	**306**	**336**	**436**	**366**
Gasoline	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gas/Diesel Oil	583	208	200	204	178	171	201	174	262	206	22	205	302	336	436	366
Residual Fuel Oil	386	665	678	669	666	680	681	558	830	816	3	0	3	0	0	0
Aviation Bunkers	**749**	**892**	**320**	**565**	**739**	**632**	**549**	**472**	**428**	**490**	**319**	**270**	**393**	**399**	**485**	**405**
Jet Kerosene	749	874	314	562	736	628	546	471	426	487	319	270	393	399	485	405
Gasoline	0.0	18.4	6.3	2.6	2.6	4.7	3.6	1.2	1.7	3.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	***1 718***	***1 766***	***1 198***	***1 438***	***1 583***	***1 483***	***1 432***	***1 204***	***1 520***	***1 512***	***345***	***475***	***699***	***735***	***921***	***772***

The international marine bunkering emissions in 2004 dropped by 62% compared to 1988, while the air bunkering emissions dropped less, i.e. by 46%. The main reason for that was the liquidation of the deep-sea fishery fleet after 1999.

Methodology

The GHG emissions were estimated, using the data from the Energy Balance of the country. The fuel quantities for sea and air transport were specified in the balance. Certain complications resulted from the fuel data for air transport, since the last was separated by domestic and international transport. That is why the fuels for international transport were determined by expertise.

During the international transport, the main GHG are emitted - CO_2, CH_4 and N_2O, GHG-precursors NO, CO, NMVOCs, as well as SOx. The GHG emissions were estimated by Tier 1 method with the emission factors determined on the basis of the experimental and analytical studies, taking into account the country specific conditions (type and size of ships and airplanes, value of cargo, destinations and etc.).

Table 3.18 shows the trends of main GHG and GHG precursors emissions.

Trend in greenhouse gas emissions from International Bunkers 1988-2004, Gg

Table 3.18

Source	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
CH_4																
Marine Bunkers	*0.04*	*0.02*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.02*	*0.01*	*0.00*	*0.01*	*0.02*	*0.02*	*0.03*	*0.03*
Gasoline	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	0.00	0.00
Gas/Diesel Oil	0.04	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.00	0.01	0.02	0.02	0.03	0.03
Residual Fuel Oil	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	0.00	0.00
Aviation Bunkers	*0.02*	*0.04*	*0.01*	*0.02*	*0.02*	*0.02*	*0.02*	*0.01*	*0.01*	*0.02*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*
Jet Kerosene	0.02	0.02	0.01	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Gasoline	0.00	0.02	0.01	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
Total	**0.06**	**0.06**	**0.03**	**0.03**	**0.04**	**0.03**	**0.03**	**0.03**	**0.03**	**0.03**	**0.01**	**0.02**	**0.03**	**0.04**	**0.05**	**0.04**
N_2O																
Marine Bunkers	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.03*	*0.03*	*0.00*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*
Gasoline	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	0.00	0.00
Gas/Diesel Oil	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.00	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01
Residual Fuel Oil	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00
Aviation Bunkers	*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*	*0.00*	*0.00*
Jet Kerosene	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	0.00	0.00
Gasoline	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	0.00	0.00
Total	**0.02**	**0.02**	**0.02**	**0.02**	**0.02**	**0.02**	**0.02**	**0.02**	**0.03**	**0.03**	**0.00**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**
NOx																
Marine Bunkers	*22.80*	*22.44*	*22.60*	*22.44*	*21.81*	*22.03*	*22.71*	*18.79*	*28.03*	*26.46*	*0.56*	*4.35*	*6.50*	*7.12*	*9.23*	*7.76*
Gasoline	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	0.00	0.00
Gas/Diesel Oil	12.35	4.41	4.23	4.33	3.77	3.61	4.25	3.68	5.55	4.37	0.47	4.35	6.40	7.12	9.23	7.76
Residual Fuel Oil	10.45	18.03	18.37	18.11	18.04	18.42	18.46	15.11	22.48	22.10	0.09	0.00	0.09	0.00	0.00	0.00
Aviation Bunkers	*2.99*	*3.50*	*1.26*	*2.25*	*2.95*	*2.52*	*2.19*	*1.89*	*1.71*	*1.94*	*1.28*	*1.08*	*1.58*	*1.60*	*1.94*	*1.62*
Jet Kerosene	2.99	3.50	1.26	2.25	2.95	2.52	2.19	1.89	1.71	1.94	1.28	1.08	1.58	1.60	1.94	1.62
Gasoline	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	0.00	0.00
Total	**25.783**	**25.94**	**23.86**	**24.69**	**24.76**	**24.54**	**24.90**	**20.68**	**29.73**	**28.41**	**1.84**	**5.43**	**8.07**	**8.72**	**11.17**	**9.38**

Source	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
CO																
Marine Bunkers	*4.12*	*1.81*	*1.74*	*1.76*	*1.58*	*1.54*	*1.75*	*1.49*	*2.24*	*1.86*	*0.15*	*1.37*	*2.02*	*2.25*	*2.91*	*2.45*
Gasoline	0.00	0.02	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
Gas/Diesel Oil	3.90	1.39	1.34	1.37	1.19	1.14	1.34	1.16	1.75	1.38	0.15	1.37	2.02	2.25	2.91	2.45
Residual Fuel Oil	0.23	0.39	0.40	0.40	0.39	0.40	0.40	0.33	0.49	0.48	0.00	0.00	0.00	0.00	0.00	0.00
Aviation Bunkers	*1.24*	*7.45*	*2.59*	*1.77*	*2.06*	*2.56*	*2.08*	*1.18*	*1.27*	*1.77*	*0.53*	*0.45*	*0.65*	*0.66*	*0.80*	*0.67*
Jet Kerosene	1.24	1.44	0.52	0.93	1.22	1.04	0.90	0.78	0.70	0.80	0.53	0.45	0.65	0.66	0.80	0.67
Gasoline	0.00	6.01	2.07	0.84	0.84	1.52	1.18	0.41	0.57	0.97	0.00	0.00	0.00	0.00	0.00	0.00
Total	**5.36**	**9.26**	**4.32**	**3.53**	**3.64**	**4.10**	**3.83**	**2.67**	**3.51**	**3.63**	**0.68**	**1.82**	**2.67**	**2.91**	**3.71**	**3.12**

In 2004 were emitted main GHG at the amount of 775.4 Gg CO_2-eq. The sea transport emitted 48%, and the air transport - 52%. After the big drop in 1999, all GHG emissions increased more than twice in 2004.

Uncertainty and consistency of time series

The uncertainty of this emission source category has never been estimated in Bulgarian inventory. As per scientific information, it was estimated to approx. 2%, which was too optimistic estimation. Considering the uncertainty of the emission factors in the transport an estimation of 7 - 9% is more realistic.

In 1999 a big drop of the data for sea bunkering fuels use was observed. This drop was due to the change of the statistical accounting in NSI and its harmonization in compliance with EUROSTAT.

3.3. Fugitive Methane Emissions from Coal Mining and Systems for Gas and Oil Extraction and Distribution

3.3.1. Description of Sources

The fugitive methane emissions from coal mining are one of the largest methane emission sources in Bulgaria. They are ranked 12-th place in key source list, with share more than 2% of overall emissions for the country in 2004. The fugitive emissions from systems for gas and oil extraction and distribution are also key source (19 places) and had a share of approx. 1% of overall GHG emissions.

Coal mining

The fugitive CH_4 emissions from coal mining were included in this category.

The coal in Bulgaria is mined in surface and underground mines. The main domestic resource – lignite, is mined in surface mines. in the complex Maritza Iztok. The yearly production is closely connected with the plans of electro energy production and amounts to 25-30 million tones. The local lignite have low caloricity – up to 1500 calories in kg., a high content of humidity and sulphur. The last provoked the necessity of building installation for desulphurization (the first started working at the end of 2002). As a result from the desulphurization, emissions of CO_2 are gained which are taken into account in the inventory.

Brown, black and anthracite coal is mined in underground mines. The basic yearly quantity amounts to 3 million tones for the last few years. In the base year over 5 million tones of the same type of coal have been mined.

In Bulgaria considerable quantity of imported energy and coking coal are being used - over 4.5 million tones in the current year. At their transportation and processing no accidental methane emissions are observed.

Table 3.19 shows the fugitive methane emission trends in coal mining.

CH_4 fugitive emissions from coal mining and handling 1988-2004

Table 3.19

Coal Mining and Handling, kt	**1988**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Underground Mines	**5 180**	**3 848**	**3 220**	**3 600**	**3 682**	**3 328**	**3 381**	**3 198**	**2 779**	**2 993**	**2 712**	**2 719**	**2 756**	**2 860**	**2 695**	**2 844**
brown	4 984	3 705	3 092	3 352	3 419	3 155	3 187	3 060	2 677	2 902	2 590	2 602	2 646	2 766	2 644	2 811
black	131	100	86	203	222	144	170	119	88	78	122	118	98	83	43	33
anthracite	65	43	42	45	41	29	24	19	14	13	0	0	12	11	8	1
Surface Mines	**29 191**	**27 827**	**25 231**	**26 736**	**25 351**	**25 429**	**27 449**	**28 104**	**26 929**	**27 117**	**22 586**	**23 712**	**23 856**	**23 158**	**24 604**	**23 642**
lignite	29 191	27 827	25 231	26 736	25 351	25 429	27 449	28 104	26 929	27 117	22 586	23 712	23 856	23 158	24 604	23 642
CH_4 Emissions, Gg																
Underground Mines	69.4	51.6	43.1	48.2	49.3	44.6	45.3	42.9	37.2	40.1	36.3	36.4	36.9	38.3	36.1	38.1
Surface Mines	25.4	24.2	22.0	23.3	22.1	22.1	23.9	24.5	23.5	23.6	19.7	20.7	20.8	20.2	21.4	20.6
Total	**94.8**	**75.8**	**65.1**	**71.5**	**71.4**	**66.7**	**69.2**	**67.3**	**60.7**	**63.7**	**56.0**	**57.1**	**57.7**	**58.5**	**57.5**	**58.7**

The fugitive methane emissions in 2004 were 1 232.7 Gg CO_2-eq. They marked a rise by 2% compared to the preceding year, due to the increased mining of brown coal.

The fugitive methane emissions from the underground mining were about 65% of the emissions of this source, although the coal quantities from underground mining was less than 10.7% of the overall coal mining in the country, expressed in natural (mass) units - tone.

Extraction, refining, transportation and distribution of oil and natural gas

This source included the CH_4 fugitive emissions from:

- Extraction of oil and natural gas;
- Supplies, transportation and refining of oil;
- Transport and distribution of natural gas in the country;
- Transit of natural gas for neighbouring countries;
- LPG supplies at the special gas stations.

Table 3.20 shows the trends of methane fugitive emissions from oil and gas systems.

Activity data and CH_4 fugitive emissions from oil and gas

Table 3.20

PJ	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Oil																
Production	3.29	2.54	2.45	2.24	1.81	1.54	1.82	1.38	1.18	1.36	1.83	1.9240	1.44	1.59	1.294	1.280
Transport	545.830	353.23	194.8	103.09	242.3	296.1	340	295.8	253.7	236.3	237.5	223.7	219.4	221.8	214.8	225.0
Refining / Storage	547.528	353.5	195.9	102.55	242.3	296.1	340	295.8	253.7	236.3	240.5	226.06	219.8	222.1	214.28	224.75
LPG- consumed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.1	4.2	9.8	13.1	15.0	16.8	17.3
Natural Gas																
Production	0.3	0.5	0.3	1.3	2.3	1.9	1.7	1.4	1.2	1.0	0.9	0.5	0.8	0.7	0.5	11.2
Transmission	247	337	331	321	328	329	381	384	385	390	465	521	540	553	558	552
Distribution	208	226	193	170	159	160	192	196	155	137	116	122	114	100	104	100
Venting /Flaring																
Oil	551	356	198	105	244	298	342	297	255	238	242	228	221	224	216	226
Gas	0.7	0.9	0.7	2.5	4.6	3.8	3.3	2.8	2.4	1.9	1.8	1.0	1.5	1.4	1.1	22.3
Emissions CH_4, Gg	**1988**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Oil	**0.82**	**0.53**	**0.30**	**0.16**	**0.37**	**0.45**	**0.51**	**0.45**	**0.38**	**0.47**	**0.52**	**0.72**	**0.83**	**0.91**	**0.97**	**1.00**
Production	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
Transport	0.41	0.26	0.15	0.08	0.18	0.22	0.25	0.22	0.19	0.18	0.18	0.17	0.16	0.17	0.16	0.17
Refining / Storage	0.41	0.26	0.15	0.08	0.18	0.22	0.25	0.22	0.19	0.18	0.18	0.17	0.16	0.17	0.16	0.17
LPG consumed	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.16	0.38	0.50	0.58	0.64	0.66
Natural Gas	**60.06**	**28.85**	**27.27**	**23.88**	**24.04**	**26.57**	**30.50**	**30.97**	**27.31**	**24.82**	**20.81**	**27.85**	**25.44**	**22.98**	**23.62**	**25.43**
Production / Processing	0.03	0.04	0.03	0.11	0.19	0.16	0.14	0.12	0.10	0.08	0.08	0.04	0.06	0.06	0.04	0.93
Transmission	3.09	3.67	4.05	4.11	4.42	4.80	5.11	5.51	5.93	6.20	6.58	6.86	6.60	6.86	7.04	6.61
Distribution	0.00	0.00	0.00	0.03	0.03	0.03	0.03	0.03	0.04	0.06	0.12	0.19	0.31	0.43	0.51	0.63
Other Leakage	56.95	25.14	23.20	19.63	19.40	21.58	25.22	25.31	21.25	18.48	14.04	20.76	18.46	15.62	16.04	17.25
Venting /Flaring	**0.02**	**0.02**	**0.01**	**0.03**	**0.05**	**0.04**	**0.04**	**0.03**	**0.03**	**0.02**	**0.02**	**0.02**	**0.02**	**0.02**	**0.01**	**0.21**
Oil	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.01	0.00	0.01	0.00	0.00
Gas	0.01	0.01	0.01	0.02	0.04	0.03	0.03	0.03	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.20
Total	**60.903**	**29.40**	**27.58**	**24.07**	**24.46**	**27.06**	**31.05**	**31.45**	**27.72**	**25.32**	**21.35**	**28.58**	**26.29**	**23.91**	**24.60**	**26.64**

The CH_4 fugitive emissions, expressed in CO_2-eq. in 2004 were 559.4 Gg, or less than 1% of the summary GHG emissions. The emission growth in 2004 was 10%, compared to 2003, and it was mainly due to the new pipelines for distribution of natural gas in the country.

The extracted quantities of oil and gas in Bulgaria are very low and represent less than 1% from the consumption of these fuels in the country.

The quantities of natural gas, imported and transited by the national gas system to neighbouring countries, were far more bigger that domestic consumption – about 3 times in 2004.

The methane fugitive emissions from the distribution gas networks in the industry and households were estimated by the quantities of natural gas in section Final energy consumption of the general energy balance of the country.

3.3.2. Methodology

The methane fugitive emissions from coal mining were estimated by method of the type Tier 1, as emission factors, given in IPCC Guidance, were used.

From the emission factors, given in IPCC Guidance, were chosen relevant values, considering that the underground mines have average depth not more than 400 m, and the surface mines for lignite have depth more than 25 m. The emission factors of the underground mining are 10 times bigger than those of the surface mining, expressed in m^3 CH_4/t mined coal. According to the Good Practice Guidance, provided this is a key source, more precise method should be used. What is ahead is working out a methodology for more exact calculation of the underground mines emissions that will reach the level of Tier 2.

Applying of more precise methods is not possible at the present due to the limited data.

Calculation of CH_4 fugitive emissions from gas and oil systems was estimated by method of the type Tier 1.

Emission factors, given in Good Practice Guidance, were used for the 2004 inventory. These parameters were estimated, as a rule, on a unit length of the pipelines, and they differed significantly from the standard parameters, specified in the Revised IPCC Guidance for the different regions of the world.

Table 3.21 shows the lengths of the natural gas distribution pipeline networks and their development since 1988.

Development of the natural gas distribution pipeline network, km

Table 3.21

Length of network	**1988**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**
Natural Gas - transit	265	300	350	375	400	450	475	605
Natural Gas - domestic transmission	969	1 169	1 269	1 269	1 369	1 469	1 569	1 600
Natural Gas - domestic distribution	0	0	0	50	50	50	50	50
Total	**1 234**	**1 469**	**1 619**	**1 694**	**1 819**	**1 969**	**2 094**	**2 255**
Length of network	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Natural Gas - transit	670	710	840	945	840	945	945	945
Natural Gas - domestic transmission	1 700	1 769	1 790	1 800	1 800	1 800	1 869	1 700
Natural Gas - domestic distribution	60	100	200	300	500	700	816	1 016
Total	**2 430**	**2 579**	**2 830**	**3 045**	**3 140**	**3 445**	**3 630**	**3 661**

The data on crude oil and natural gas quantities was taken from the Energy balance of the country, where it was aggregated on a national level.

As it can be seen on **Table 3.20**, the broad use of LPG as a fuel for cars started in 1998, reaching almost 10% from the overall fuel consumption in the country in 2004.

Besides the fugitive methane emissions, significant NMVOCs emissions from gasoline refuelling at gasoline stations, and from its delivery from refineries, as well as NOx, CO and NMVOCs emissions from burning the refinery flame torch, can bee seen. These emissions were structured and calculated in sector Industrial processes.

3.3.3. Uncertainty and Consistency of Time Series

The uncertainty of this emission source category was estimated as follows:

- 200% for coal mining;
- 50% for oil and natural gas systems.

The changes of the refined oil trends showed a reduction by 46% in 1996, compared to 1988. In the next period the oil consumption was relatively steady, at levels about 220 PJ per annum, or approx. 5.4 million tones.

The natural gas consumption was double reduced in 2004, compared to 1988. It was due to curtail industrial production from the fertilizers factories and it could not be compensated by the speed up gas consumption of households in the last years.

The quantities of transited natural gas had a steady growing trend. They increased about 10 times for the period 1988-2004.

CHAPTER 4. INDUSTRIAL PROCESSES

4.1. General Sector Description

GHG emissions from the Industrial Processes sector are obtained as a result of the industrial technological processes and/or material products consumption. With this type of emissions no combustion processes are involved.

The industrial process emissions encompass emissions from all main GHGs and GHG-precursors. Special attention is paid to industrial emissions and emissions from F-gases usage.

GHG emissions are grouped in the following sub sectors according to industries:

- Mineral products;
- Chemical industry;
- Metal production;
- Other production;
- Production of Halocarbons (HFC's, PFC's) and SF_6;
- Consumption of Halocarbons and SF_6;
- Others.

In the Other production sub sector, emissions from the Food industry and Pulp and paper production are included.

In the Other sub sector, emissions from gasoline transportation, refuelling of vehicles with gasoline at petrol stations, and plastic and adhesive production have been included.

Halocarbons and sulphur hexafluoride - SF_6 emissions are differentiated in two separate sub sectors, due to their big variety as types of gases and very high global warming potential.

During the preparation of the national GHG inventory report for the year 2004 as well as for the preceding years, certain difficulties were encountered due to data confidentiality of some production processes and technologies. Therefore, the inventory report for 2004 overcomes those difficulties using NSI identified emission data according to the CORINAIR methodology.

GHG emissions trends are given in **Table 4.1**.

Trend in greenhouse gas emissions from Industrial Processes (category 2), Gg

Table 4.1

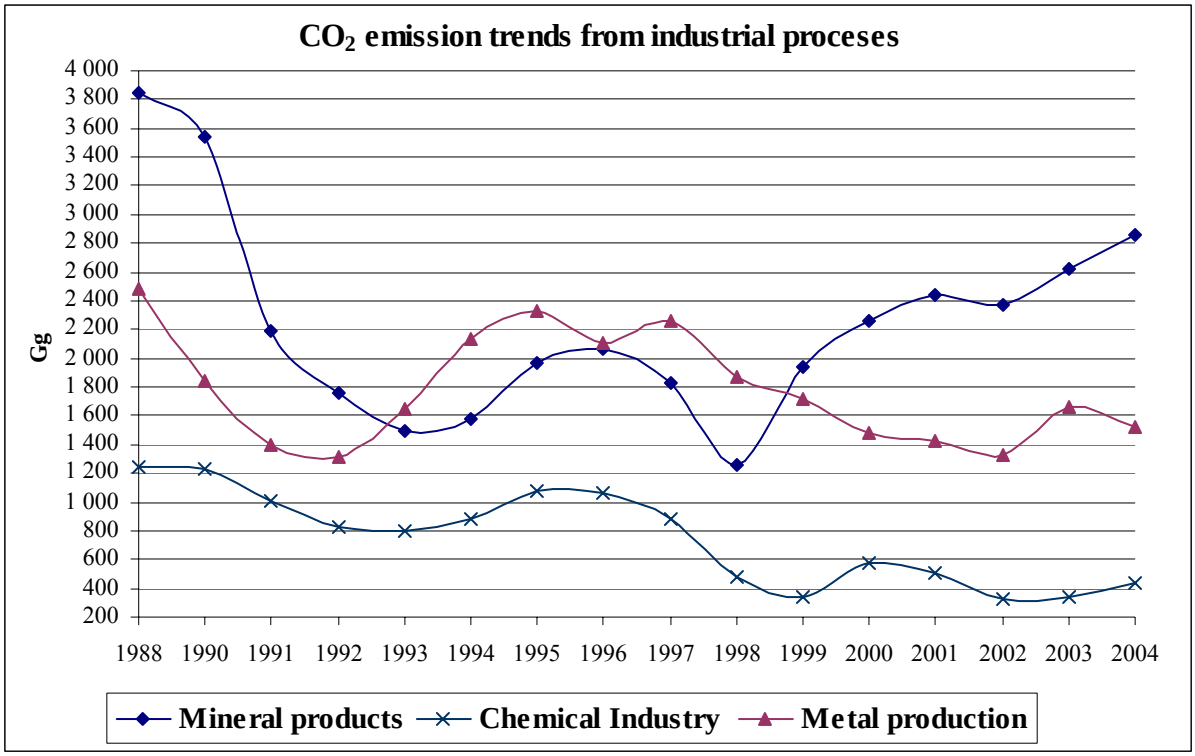
Gas/Subcategory	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
CO_2																
2A. Mineral Products	3 845	3 542	2 187	1 764	1 498	1 584	1 973	2 071	1 825	1 255	1 941	2 262	2 447	2 377	2 621	2 860
2B. Chemical Industry	1 246	1 225	1 004	823	793	888	1 072	1 063	878	474	338	570	507	325	345	432
2C. Metal Production	2 485	1 844	1 397	1 316	1 642	2 134	2 323	2 101	2 260	1 877	1 711	1 483	1 422	1 326	1 662	1 527
2D. Other Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2G. Other (please specify)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CH_4																
2A. Mineral Products	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	0.00	0.00
2B. Chemical Industry	0.04	0.02	0.01	0.01	0.03	0.03	0.04	0.02	0.02	0.21	0.46	0.15	0.14	0.13	0.27	0.14
2C. Metal Production	3.49	2.76	2.05	1.94	2.25	3.00	3.29	3.04	3.29	2.62	2.23	3.37	2.28	2.06	2.51	2.13
2D. Other Production	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	0.00	0.00
2G. Other (please specify)	0.36	0.25	0.14	0.14	0.17	0.18	0.20	0.20	0.20	0.18	0.07	0.00	0.00	0.00	0.00	0.00
N_2O																
2B. Chemical Industry	7.81	7.28	5.25	4.27	3.65	4.32	6.20	6.33	5.21	3.12	2.36	4.24	4.18	3.51	3.74	2.77
B2. Nitric Acid Production	7.81	7.28	5.25	4.27	3.65	4.32	6.20	6.33	5.21	3.12	2.36	4.24	4.18	3.51	3.74	2.77
F-gases																
CF_4-Mg	10.18	6.38	2.87	3.76	2.56	6.18	6.33	6.18	5.02	9.36	5.87	4.47	2.20	2.89	2.79	4.47
C_2F_6-Mg	1.02	0.64	0.29	0.38	0.26	0.62	0.63	0.62	0.50	0.94	0.59	0.45	0.22	0.29	0.28	0.45
SF_6-Gg CO_2-eq.							1.26	1.31	1.75	1.83	1.88	2.23	2.29	2.51	2.52	3.68

The main data source for the quantities of produced prime and raw materials and manufactured goods is the NSI.

The biggest share of the aggregated GHG emissions from sector Industrial Processes for 2004 has CO_2 – 84%, followed by N_2O with 15% and CH_4 with 0.8% in CO_2–eq.

CO_2 emission trends for the main categories are given in **Figure 4.1**.

Figure 4.1



The analysis of **Figure 4.1** reveals that the emission fluctuations follow the changes of economic activity. Key factors on macroeconomic level were:

- Changes in international markets;
- Privatization of state property;
- Others.

It can be noted that during the period after the year 2000, certain stabilization of CO_2 emissions has been observed, and after 2002 - there is a tendency of an increase.

The following key sources are in the sector:

- CO_2 from steel production (ranked 7 with more than 2% share);
- CO_2 from cement production (ranked 9 with 2% share);
- N_2O from quicklime production (ranked 14 with 1% share);
- N_2O from nitric acid production (ranked 16 with 1% share).

The ranking above is from the list of main emission sources, prepared according to the Tier 1 method, with an estimation of the emission level. Non-key sources from this list are:

- CO_2 from ammonia production;
- CO_2 from soda ash production;
- CO_2 from the production of other products;
- CH_4 from metal production;

- CO_2 emissions from the use of limestone and dolomite;
- F- gases emissions.

GHG emissions are calculated following the default method according to the equation:

*Emissions = Production * Emission factor*,

where the *production* is in physical units (m^3, kg, m^2 etc.), the *emission factors* are in kg emissions per unit production.

The emissions factors, as a rule, are selected from the IPCC Guidelines but part of them are taken from the adapted in Bulgaria CORINAIR methodology (for the production of steel, ammonia, sinter and other).

4.2. Mineral Products

4.2.1. Source Description

Two key GHG sources contribute to the emissions in this sub sector, which are traditional in the economy of the country. These are the production of cement and lime.

CO_2 emissions from ***cement*** production are 1 376 Gg in the year 2004, which is 2% of the aggregated GHG emissions. During the last five years, there has been a stabilization of the production with a tendency for slight increase. The increase of GHG emissions in 2004 is 13.6%, compared to 2003.

CO_2 emissions from ***quick lime*** production are 955.6 Gg in the year 2004, which is a slightly more than 1% of the aggregated GHG emissions. The increase of the CO_2 emissions in 2004 compared to 2003 is 3.7%.

The emissions of CO_2 from the ***use of limestone and dolomite*** in the ferrous metallurgy are for the first time included in the present inventory after organizational and technical activities have been carried out for the quantity of used materials to be determined. Data was provided for the whole period 1988-2004 which secured the consistency of the time order.

CO_2 emissions from ***soda ash production*** are 110.8 Gg in 2004. In 2004 data was received over the use of soda ash, which is also a source of CO_2 emissions. By the help of extrapolation of the data for the period 2000-2002. the full temporary session of data for the inventories has been prepared in Bulgaria. In 2004 the CO_2 emissions from the use of soda ash are about 20% from the emissions at the production of this product.

The CO_2 emissions from glass production are included in the Other emission source of the sector.

4.2.2. Methodology

The Tier 2 method from the Good Practice Guidance is used when determining the emissions from ***cement*** production. As the CO_2 emissions are correlated with data from the produced clinker – emission factors and quantities, their specification is made on the basis of the produced clinker. The emission factor is determined according to the formulas given in the Good Practice Guidance.

The quantities of ***quick lime*** are given by the NSI and the emission factors are adopted by the IPCC Guidelines.

The CO_2 emission factors at use of limestone and dolomite are accepted according to the data from the Revised Guidelines of IPCC, 1996.

Data for the quantities of produced and used ***soda ash*** is confidential. Therefore, the determination of emissions follows a special methodology, coordinated with NSI.

4.2.3. Uncertainty and Consistency of Time Series

The uncertainty from emissions from the sub sector is within the 16-30% range and the higher percentage relates for the cement production. For the non-key sources, the uncertainty is 20%.

The CO_2 emission trends for Mineral products production is given in **Table 4.2.**

CO_2 emissions from Mineral products 1988-2004, Gg

Table 4.2

Years/Sources	1988	1990	1991	1992	1993	1994	1995	1996
2A1. Cement Production	2 006	1 707	860	773	727	692	750	780
2A2. Lime Production	1 118	1 222	812	572	417	522	747	778
2A3. Limestone and Dolomite Use	461	366	302	277	262	239	286	310
2A4. Soda Ash	233	222	199	131	79	114	170	181
Soda Ash Production	107	101	87	50	25	44	77	84
Soda Ash Use	126	121	112	81	54	71	93	97
2A7. Other (please specify)	27	24	14	11	13	17	19	22
Glass Production	27	24	14	11	13	17	19	22
Desulphurized Emissions	0	0	0	0	0	0	0	0
Total	3 845	3 542	2 187	1 764	1 498	1 584	1 973	2 071
Years/Sources	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
2A1. Cement Production	652	788	1 051	1 124	1 166	1 157	1 211	1 376
2A2. Lime Production	692	48	561	798	918	855	921	956
2A3. Limestone and Dolomite Use	286	248	219	215	224	206	298	314
2A4. Soda Ash	178	157	102	117	130	119	129	139
Soda Ash Production	84	79	67	90	109	100	106	111
Soda Ash Use	93	78	35	27	21	19	23	28
2A7. Other (please specify)	18	14	8	8	9	40	62	75
Glass Production	18	14	8	8	9	15	8	13
Desulphurized Emissions	0	0	0	0	0	24	54	61
Total	1 825	1 255	1 941	2 262	2 447	2 377	2 621	2 860

The analysis of **Table 4.2** shows a stable trend of the GHG emissions from the two main sources – cement and lime production. Some 81% of the emissions in 2004 originate from them. This share is kept during the years, as in 1988 it amounts to 81%, with the emissions from the cement production forming the bigger share, namely – 52%.

4.3. Chemical Industry

4.3.1. Source Description

N_2O emissions from ***nitric acid*** production, expressed in CO_2-eq. were 868 Gg for the year 2004. The emission decrease in 2004 is some 24% compared to 2003 as the current level remains higher than the level in 1999.

CO_2 emissions from ***ammonia*** production were 407.6 Gg for the year 2004. The increase of emissions in 2004 is some 21% compared to 2003 and the big fall after 1998 has been overcome. During the current year there is a stir in the production of nitric fertilizers.

Non energy emissions from the use of fuel in this sub sector are calculated and classified in the sub sector Chemistry of the Energy sector.

4.3.2. Methodology

Data for ***nitric acid*** production is confidential, due to which N_2O emissions are defined on the basis of a special methodology. The emission factors for the calculation of N_2O emission are from the IPCC Guidelines, taking into consideration the technologies, used in Bulgaria.

The quantity of produced ***ammonia*** is provided by NSI and the emission factor is determined with the adapted CORINAIR methodology, approved for use in Bulgaria. Therefore, the emission factor in use is quite different from the standard value in the IPCC Guidelines.

4.3.3. Uncertainty and Consistency of Time Series

The uncertainty of N_2O emissions from nitric acid production is estimated at 200%. The uncertainty of CO_2 emissions from the production of ammonia is 21%.

The trends of GHG emissions in this sub sector are given in **Table 4.3.**

The analysis of **Table 4.3** shows a trend of significant reduction of GHG emissions in the year 2004 compared to 1988 – about three times for the ammonia and nitric acid production.

4.4. Metal Production

4.4.1. Source Description

CO_2 process emissions from the ***steel*** production are a key source contributing 2% of the total GHG emissions in the year 2003 - 1 505 Gg. This is the biggest source of GHG emissions in the Industrial Processes sector.

CH_4 emissions from the production of metals and PFC emissions of aluminium are non-key GHG emission sources.

CH_4 emissions from sub sector Metal production comprise of emissions from the production of pig iron, sinter and coke.

Non energy emissions from fuel use in this sub sector are calculated and classified in the Iron and Steel production category of the Energy sector.

4.4.2. Methodology

The production quantities for the purposes of the inventory have been provided by the statistics of NSI and the emission factors are determined by taking into account the steel production technologies (basic oxygen furnace and electric arc furnace). For the purpose we use a method which using the analytical way calculates the emission factor using data from the adapted CORINAIR methodology, used in NSI. Therefore, this factor differs significantly from the recommended in the IPCC Guidelines aggregated emission factor for pig iron and steel production.

As a rule, data for the produces quantities of coke and pig iron is confidential. Therefore, the GHG emissions are calculated following a special methodology, coordinated with NSI.

4.4.3. Uncertainty and Consistency of Time Series

The uncertainty of CO_2 emissions from steel production is estimated at 10% and those of CH_4 emissions – at 20%. Total uncertainty of F-gases is estimated at 51%.

The trends of GHG emissions in this sub sector are given in **Table 4.4**

The analysis of **Table 4.4** reveals significant decrease of GHG emissions in the year 2004 compared to 1988 – 36% for steel production, 42% for coke and 21.7% for pig iron.

The 2004 inventory report presents also potential HFC emissions, which are determined on the basis of import substances, containing greenhouse gases - HFC-23, HFC-32, HFC-125, HFC-134a, HFC–152a, HFC-143a and HFC-227ea. The potential GHG emissions are accounted when forming the summary of GHG emissions due to the fact that the actual emissions are not valuated. By this the Good Practice Guidance of requirements are regarded.

4.5. Halocarbon and SF_6 Production

F-gases are not produced in Bulgaria.

4.6. Halocarbon and SF_6 Consumption

4.6.1. Source Description

This emission source includes actual emissions of PFCs F-gases during aluminium production and fugitive emissions of SF_6 from high voltage equipment where this gas is used as an insulator. The total emission of this source in the year 2004 is 36.86 Gg CO_2-eq. The emission level in the year 2004 is higher than the previous year by 58.8%. This is due mainly to the increased production of aluminium.

4.6.2. Methodology

To determine the fugitive emissions of SF_6 from electrical equipment, the proposal for emission factor from the Good Practice Guidance is applied.

NSI has no data on the actual consumption of HFCs according to the classification in the IPCC Guidelines, namely gases used for the production of refrigeration and air conditioning equipment, foam blowing, fire extinguishers, aerosols, solvents and other applications (tobacco processing, production of adhesive/glue, ink, paint, etc.).

PFCs emissions from aluminium production are determined by the emission factors, proposed in the IPCC Guidelines.

GHG emissions from Chemical industry processes, Gg

Table 4.3

Source	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
CO_2																
Ammonia Production	1 157	1 128	942	780	763	858	1 037	1 030	847	454	326	558	500	318	337	408
Calcium Carbide	89.3	96.5	61.8	43.2	30.3	30.6	34.6	33.4	31.4	20.2	12.3	11.9	6.8	7.6	8.3	24.4
N_2O																
Nitric Acid Production	7.8	7.3	5.2	4.3	3.7	4.3	6.2	6.3	5.2	3.1	2.4	4.2	4.2	3.5	3.7	2.8

GHG emissions from Metal industry processes, Gg

Table 4.4

Sources	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
CO_2																
Steel	2 360	1 793	1 326	1 273	1 594	2 045	2 236	2 017	2 158	1 837	1 668	1 458	1 391	1 305	1 640	1 505
Ferroalloys Production	113	43.2	67.2	38.4	45.6	81.6	79.2	76.8	96.0	28.8	35.7	20.3	28.0	18.4	18.2	17.4
Aluminium Production	12.0	7.5	3.4	4.4	3.0	7.3	7.5	7.3	5.9	11.0	6.9	5.3	2.6	3.4	3.3	5.3
CH_4																
Pig Iron	1.29	1.03	0.85	0.75	0.90	1.30	1.42	1.33	1.45	1.25	1.04	1.99	1.01	0.97	1.21	1.01
Sinter	1.46	1.04	0.84	0.77	0.90	1.15	1.25	1.13	1.22	0.97	0.93	0.90	0.88	0.71	0.88	0.71
Coke	0.73	0.69	0.37	0.42	0.46	0.56	0.62	0.58	0.62	0.40	0.27	0.47	0.40	0.38	0.42	0.42
F-gases																
HFCs- potential							62.2	109.3	188.2	576.7	102.8	96.0	97.5	89.6	120.6	217.3
PFCs-potential																
SF6-potential												29.40	2.39	2.39	6.36	0.00

4.6.3. Recalculation of Sources

For the purpose of the GHG inventory report, additional data was collected from all enterprises in the country, using electrical commutation devices with SF_6. Thus, the existing information was updated, and fugitive SF_6 emissions from the operation of this kind of devices were recalculated.

4.7. Other industrial Processes

4.7.1. Source Description

This source includes CO_2 emissions from, glass, ferroalloys and aluminium production and also from desulphurization. The emissions for the year 2004 are 97.5 Gg. They increase 16.3% compared to 2003 due to the increased emissions from the desulphurization process in the Maritza Iztok power stations. These latest emissions account for more than 63% of the source emissions.

CO_2 emissions from the production of ferroalloys and aluminium in 2004 are considerably higher than the preceding year because of the rise of aluminium with more than 60%. Emissions of glass also increase with 68.4%% due to of the start of new producers in this field. The considerably big fluctuations of the emissions of this source reflect the big investments made in this field aiming at modernization and increase of capacity.

4.7.2. Methodology

Data for the produced quantities from this source is given by NSI and the emission factors are adopted according to the IPCC Guidelines.

Data for calcium carbide is confidential. Therefore, GHG emissions are calculated following special methodology.

4.7.3. Uncertainty and Consistency of Time Series

The uncertainty of CO_2 emissions from this source is estimated at 21%.

CHAPTER 5. SOLVENT USE

5.1. General Description

GHG emissions in the Solvent use sector are result from the processes in the production and use of paint and adhesives, use of solvents in industry and households, dry cleaning, vegetable oil production, production of pharmaceuticals and anaesthesia. The emissions from this sector are mainly of NMVOCs and N_2O.

GHG inventories in Bulgaria use a simplified method for the calculation of NMVOC emissions, which includes use of data from the GHG calculation following the CORINAIR methodology.

N_2O emissions have not been assessed during the inventory in Bulgaria due to lack of data for the substances used in anaesthesia, production of pharmaceuticals, sprays, etc.

5.2. NMVOCs Emissions from Solvent Use

5.2.1. Source Description

NMVOCs emissions are described for the following activities;

- Use of paints (including water based paints);
- Paint and lacquer production;
- Use of chemicals for dry cleaning;
- Vegetable oil production;
- Use of adhesives;
- Use of solvents in industry and households;
- Production of pharmaceuticals.

There are no key GHG emissions in this sector.

NMVOCs emissions amount to 23.65 Gg, which is almost 35% of the emissions of this gas in Bulgaria. The emission growth in the year 2004 is 62.6% compared to 2003 mainly due to increased production of paints and the wider use of solvents in the industry and household.

5.2.2. Methodology

NMVOCs emissions are calculated with emission factors, given in the approved in Bulgaria methodology for GHG emission calculation with balancing methods. This methodology is prepared on the basis of the CORINAIR methodology, taking into consideration the specifics of some metallurgy and chemical technologies of the country.

Due lack of data about the emissions from dry cleaning and use of paint and solvents there is a difference in the levels of the yearly aggregated emission trends before and after 1997. While the aggregated NMVOCs emissions are almost constant at levels 11 Gg to 13 Gg for the period 1988-1997, after 1997 there is tendency for a constant rise in the emissions from this sector. Indicator for this is the rise of 114% in the period 1997-2004.

5.2.3. Uncertainty and Consistency of Time Series

Due to the fact that NMVOCs emissions are GHG-precursors, there is no data in the bibliography on their uncertainty.

The trends in NMVOCs emissions are given in **Table 5.1**.

Trends in NMVOCs emissions from solvent and other product use, Gg

Table 5.1

Gas/sub-source	1988	1990	1991	1992	1993	1994	1995	1996
A. Paint Application	0.14	0.126	0.06	0.079	0.117	0.163	0.18	0.212
B. Degreasing and Dry Cleaning	0	0	0	0	0	0	0	0
C. Chemical Products, Manufacturing and Processing	1.251	0.826	0.347	0.351	0.271	0.28	0.377	0.447
D. Other (please specify)								
Vegetable oil production	3.115	2.512	1.917	2.323	2.721	2.543	3.428	2.878
Use of lacquers and solvents	8.987	8.669	8.596	8.485	8.46	8.427	8.385	8.341
Pharmacy	0.126	0.121	0.12	0.119	0.118	0.118	0.117	0.117
Total	13.62	12.25	11.04	11.36	11.69	11.53	12.49	11.99
Gas/sub-source	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
A. Paint Application	0.168	0.858	2.428	0.52	0.686	0.59	0.898	1.166
B. Degreasing and Dry Cleaning	0	0	0.336	0.035	0.286	0.014	0.011	0.005
C. Chemical Products, Manufacturing and Processing	0.453	10.39	4.117	0.699	11.98	11.96	10.7	18.6
D. Other (please specify)								
Vegetable oil production	2.798	1.876	1.83	1.845	1.607	1.222	1.393	1.236
Use of lacquers and solvents	8.283	8.23	2	7.48	2.435	3.239	1.434	2.537
Pharmacy	0.116	0.115	0.115	0.114	0.111	0.11	0.109	0.109
Total	11.82	21.47	10.83	10.69	17.1	17.13	14.54	23.65

The analysis of **Table 5.1** shows violation of the consistency of time series in 1998. This is due to the inclusion of a new emissions source - bitumen production used for covering the roads with asphalt.

CHAPTER 6. AGRICULTURE

6.1. General Description

GHG emissions from sector Agriculture result from the activities during the production and processing of agricultural products, soil fertilization and animal manure processing and preservation.

All emissions from combustion processes for energy production are reported in the Agricultural and Forestry sub sector of the Energy sector while the emissions from agricultural machines are reported in the category Other Transportation of the Transport sub sector of the Energy sector.

GHG process emissions in sector Agriculture are grouped in the following sub sectors:

- Enteric fermentation from domestic livestock;
- Manure management;
- Rice cultivation;
- Agricultural soils;
- Field burning of agricultural residues.

The processes and activities, from the sub sectors given above, emit mostly the gases CH_4 and N_2O in Bulgaria.

During the process of field burning of agricultural residues, certain quantities of GHG precursors are emitted. Although the burning of stubble-fields is banned in Bulgaria the practice shows that not only stubble-fields are burnt but also areas with crops with no economical value for their owners. Due to this fact in the inventories valuations of this source of emissions are made.

GHG emissions trends from the sector are given in **Table 6.1**.

The biggest CH_4 emission source in the sector is the sub-sector Enteric Fermentation from domestic livestock.

The biggest N_2O emission source is the Agricultural Soils sub sector.

The following GHG emission sources emerge as key sources for the year 2004:

- CH_4 from Enteric fermentation (ranked 8 with more than 2% share);
- Direct N_2O emissions from agricultural soils (ranked 13 with 1% share);
- Indirect emissions of N_2O from the agricultural soil (ranked 15 shares 1%);
- N_2O emissions from grazing animals (ranked 20 with 1% share).

The ranking above comes from the list of key sources, drafted according to the Tier 1 method with an estimation of emissions level. Non key sources from this list are:

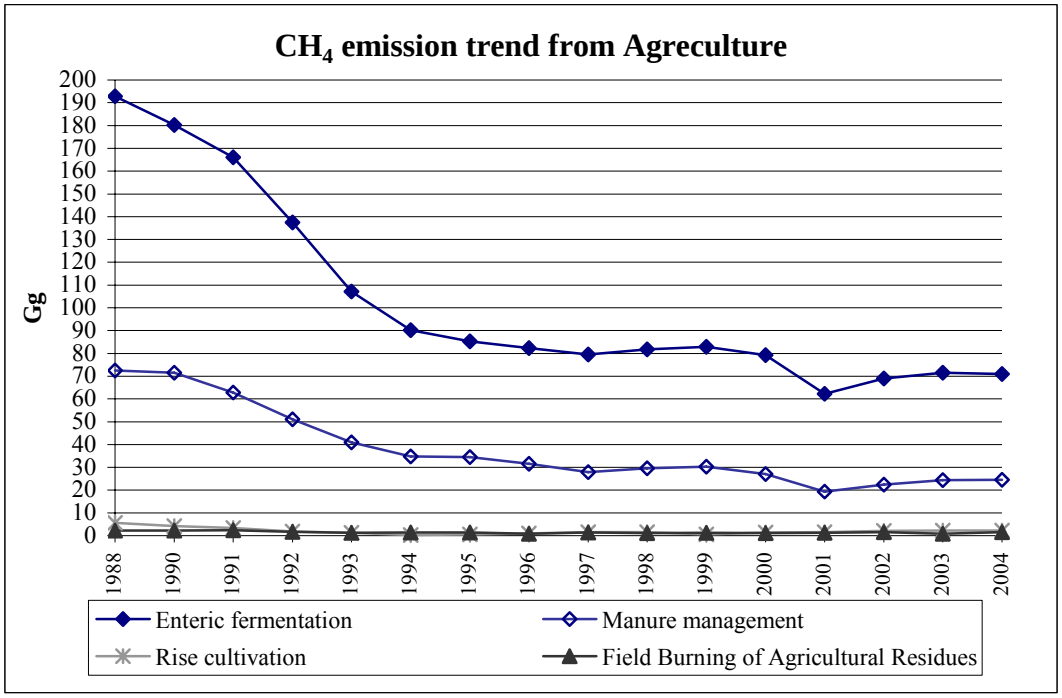
- Methane emissions from manure treatment;
- N_2O emissions from manure treatment;
- CH_4 emissions from rice cultivation;
- CH_4 emissions from field burning of agricultural residues;
- N_2O emissions from field burning of agricultural residues.

Trend in greenhouse gas emissions from Agriculture, Gg

Table 6.1

	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
CH_4																
4A. Enteric Fermentation	192.79	180.17	165.99	137.48	107.19	90.13	85.27	82.38	79.48	81.77	82.95	79.28	62.20	68.97	71.52	71.02
4B. Manure Management	72.55	71.49	62.81	51.10	40.90	34.72	34.52	31.60	27.93	29.64	30.30	27.08	19.30	22.42	24.38	24.55
4C. Rice Cultivation	5.68	4.26	3.30	1.82	1.26	0.33	0.56	1.05	1.53	1.61	0.57	1.44	1.57	2.11	2.27	2.30
4F. Field Burning of Agricultural Residues	2.21	2.20	2.32	1.62	1.33	1.40	1.46	0.81	1.34	1.19	1.30	1.15	1.30	1.50	0.91	1.61
N_2O																
4B. Manure Management	3.41	3.32	2.97	2.45	1.96	1.64	1.60	1.49	1.36	1.46	1.51	1.38	1.03	1.19	1.27	1.28
4D. Agricultural Soils	25.00	20.93	15.06	12.01	10.88	11.02	9.27	9.02	9.18	7.91	8.95	8.61	7.88	8.03	7.59	8.42
4D1 Direct Soil Emissions	10.56	8.43	5.26	4.02	3.97	4.37	3.38	3.17	3.45	2.66	3.34	3.25	3.48	3.49	3.10	3.74
a. Synthetic Fertilizers	7.65	5.60	2.62	1.97	2.34	2.87	1.83	2.01	2.16	1.38	1.98	2.05	2.38	2.20	1.99	2.33
b. Animal Wastes Applied to Soils	1.92	1.86	1.62	1.32	1.05	0.88	0.88	0.80	0.70	0.76	0.79	0.72	0.56	0.66	0.72	0.73
c. N-fixing Crops	0.06	0.05	0.06	0.05	0.03	0.03	0.05	0.03	0.03	0.03	0.02	0.01	0.01	0.01	0.01	0.01
d. Crop Residue	0.92	0.92	0.97	0.68	0.55	0.58	0.61	0.34	0.56	0.49	0.54	0.47	0.53	0.62	0.38	0.66
e. Cultivation of Histosols	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
4D2 Animal Production	5.33	4.96	4.62	3.83	3.08	2.76	2.71	2.65	2.56	2.55	2.50	2.34	1.61	1.74	1.75	1.73
4D3 Indirect Emissions	9.12	7.53	5.18	4.15	3.82	3.89	3.18	3.20	3.17	2.70	3.11	3.02	2.78	2.80	2.73	2.95
Atmospheric Deposition	2.00	1.71	1.27	1.03	0.91	0.88	0.76	0.75	0.74	0.66	0.73	0.70	0.61	0.63	0.62	0.66
Nitrogen Leaching and Run-off	7.12	5.82	3.91	3.12	2.92	3.01	2.41	2.44	2.44	2.04	2.38	2.32	2.17	2.17	2.11	2.29
4F. Field Burning of Agricultural Residues	0.05	0.05	0.05	0.04	0.02	0.03	0.03	0.02	0.03	0.02	0.03	0.02	0.02	0.03	0.02	0.03

Figure 6.1



Methane emission trends are given in **Figure 6.1**. They form 46% of the total emissions in the sector in CO_2-eq. A steady trend of emissions increase is observed since 2001. Despite that, the drop compared to the base 1988 year remain rather big – more than 63%.

N_2O emissions from the sector are also significant. The biggest share belongs to the agricultural soils emissions. It is about 87% in the year 2004 and for the entire period 1988-2003, the share is in the range of 83-88%. N_2O emissions from manure management and field burning of agricultural residues are of an order of magnitude smaller and in total are about 13-15% from the aggregated N_2O emissions of the sector.

In total, the N_2O emissions, expressed in CO_2-eq. for 2004, are 44% bigger than the CH_4 emissions in CO_2-eq.

6.2. Enteric Fermentation

6.2.1. Source Description

The emissions from this key source result from the fermentation in the digestive system of ruminant animals. In Bulgaria are bred all domestic animals indicated in IPCC except for llamas and camels.

CH_4 emissions in CO_2-eq. were 1 491.5 Gg in the year 2004 – some 2% from the total GHG emissions. The slight decrease in the year 2004 was 0.7% compared to 2003 and is due to which is due to the weak distribution of the basic type of animals. While there is an increase in breed of dairy- cattle and swine by 1.6% the sheep has decreased by 1% and non-dairy cattle by 7%.

6.2.2. Methodology

CH_4 emissions are determined using standard emission factors from the IPCC Guidelines in the framework of the Tier 1 method. These factors are summarized for different animal types, and only cattle is classified according to geographical regions principle. The inventory adopts cattle emission factor (including dairy cows) for the Eastern European region.

6.2.3. Uncertainty and Consistency of Time Series

The uncertainty from methane emissions from this source is 50%.

The methane emissions from the enteric fermentation of domestic livestock are given in **Table 6.2**.

The analysis of **Table 6.2** shows a steady trend of the emission growth after 2001. It is evident that the drop of 63% compared to 1988 can't be easily overcome in the next 10 years at such temps of raising.

The average number of animals per year is given in **Table 6.3**.

The time series for the different types of domestic animals has been consistent despite the change of the survey methodology in the year 2000.

6.3. Manure Management

6.3.1. Source Description

Despite the fact that this emission source does not belong to the group of key sources, it remains one of the biggest CH_4 emitters out of all sectors, ranked 5-6 for the entire 1988-2004 period.

CH_4 emissions expressed in CO_2-eq. were 515.6 Gg for the year 2004. Their increase compared to the year 2003 is 0.7%, which is due to the slight general increase of the average annual number of livestock.

Manure management leads to N_2O emissions, which expressed in CO_2-eq. amount to 395.9 Gg during the year 2004. The emissions increase is even lower - 0.3% compared to 2003.

N_2O emissions from this sub sector do not include animal waste from pastures.

6.3.2. Methodology

CH_4 emissions are determined according to the Tier 1 method using standard values from the IPCC Guidelines. Only for cattle (dairy and non-dairy) and swine, emission factors are calculated according to the Tier 2 method. Specific parameters for the systems for management and storage of manure have been given for this method in Bulgaria.

CH_4 emissions due to enteric fermentation, 1988-2004, Gg

Table 6.2

Animal type	1988(a)	1990(a)	19991(a)	1992(a)	1993(a)	1994(a)	1995(a)	1996(a)	1997(a)	1998(a)	1999(a)	2000(a)	2001(a)	2002(a)	2003(a)	2004(a)
Cattle	107.05	99.93	92.12	77.22	59.60	48.48	44.55	43.07	42.72	46.03	48.54	47.59	40.70	46.19	48.75	48.33
Dairy Cattle	50.93	48.70	47.41	42.96	36.68	31.11	29.12	29.42	30.12	32.74	34.52	34.31	27.57	29.38	29.16	29.59
Non-Dairy Cattle	56.12	51.23	44.71	34.26	22.92	17.37	15.43	13.65	12.60	13.29	14.02	13.28	13.13	16.81	19.59	18.74
Buffalo	1.31	1.33	1.39	1.30	1.08	0.85	0.75	0.69	0.60	0.58	0.54	0.47	0.37	0.39	0.42	0.44
Sheep	69.98	64.27	58.57	46.07	34.31	28.64	27.12	25.61	23.47	22.48	21.29	19.34	12.10	13.20	13.31	13.16
Goats	2.16	2.33	2.63	2.91	3.22	3.68	4.07	4.21	4.54	5.03	5.23	5.04	3.14	3.57	3.70	3.61
Camels and Llamas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Horses	2.20	2.11	2.07	2.05	2.04	2.22	2.55	2.89	2.87	2.54	2.47	2.53	2.62	2.38	2.16	2.29
Mules and Asses	3.55	3.49	3.48	3.36	3.22	3.06	2.95	3.01	2.89	2.55	2.30	2.16	2.03	1.72	1.46	1.44
Swine	6.11	6.39	5.50	4.37	3.56	3.04	3.09	2.73	2.24	2.40	2.43	1.99	1.08	1.34	1.52	1.55
Poultry	0.42	0.32	0.25	0.21	0.16	0.16	0.19	0.17	0.15	0.15	0.15	0.15	0.16	0.18	0.20	0.21
Total	**192.79**	**180.17**	**165.99**	**137.48**	**107.19**	**90.13**	**85.27**	**82.38**	**79.48**	**81.77**	**82.95**	**79.28**	**62.20**	**68.97**	**71.52**	**71.02**

Number of animals 1988-2004 (1 000 head)

Table 6.3

Animal type	1988(a)	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Cattle	1 631	1 516	1 384	1 142	862	694	635	607	597	642	677	661	575	663	710	700
Dairy Cattle	629	601	585	530	453	384	360	363	372	404	426	424	340	363	360	365
Non-Dairy Cattle	1 002	915	798	612	409	310	275	244	225	237	250	237	234	300	350	335
Buffalo	24	24	25	24	20	15	14	13	11	10	10	9	7	7	8	8
Sheep	8 747	8 034	7 321	5 759	4 289	3 580	3 390	3 201	2 934	2 811	2 661	2 418	1 512	1 650	1 663	1 646
Goats	432	465	525	582	644	736	814	841	907	1 007	1 047	1 008	629	715	740	722
Horses	122	117	115	114	113	123	142	160	159	141	137	141	146	132	120	127
Mules and Asses	355	349	348	336	322	306	295	301	289	255	230	216	203	172	146	144
Swine	4 076	4 259	3 664	2 911	2 376	2 029	2 063	1 820	1 490	1 601	1 617	1 328	718	893	1 014	1 032
Poultry	41 614	32 168	24 853	20 790	16 185	15 812	18 868	17 418	15 497	15 226	15 324	14 977	16 498	18 072	20 036	20 723

(a) average

6.3.3. Uncertainty and Consistency of Time Series

The uncertainty of methane emissions from this source is 50% and of N_2O emissions - 300%.

The methane and N_2O emissions from manure management are given in **Table 6.4**.

The analysis of **Table 6.4** shows a small increase of methane and N_2O emission for the present inventory, compared to the emissions from the preceding year and maintaining the low level compared to the base 1988 year – i.e. 66% reduction.

6.4. Rice Cultivation

Rice cultivation is a traditional Bulgarian agricultural activity. During the structural reforms, rice crop areas decreased from 14 100 ha in 1988 to 1 420 ha in 1999. There has been a restoration of rice crop areas after 1999, reaching 5 644 ha in 2005.

48.2 Gg CH_4 CO_2-eq. have been emitted in 2004. The emission increase of 1% compared to the year 2003 is due to the slightly increased areas of rice crops.

CH_4 emission calculation is carried out according to the default method from the IPCC Guidelines. The value adopted as an emission factor is based on expert assessment taking into consideration the water regime for the rice crops in Bulgaria.

6.5. N_2O Emissions from Agricultural Soils

6.5.1. Source Description

The emissions from this sub sector include the following main categories N_2O emissions;

- Direct emissions;
- Emissions from pasture animals;
- Indirect emissions.

Only the first two categories out of the three listed above are key sources in the year 2003.

Direct emissions are a result of:

- Soil fertilization with synthetic nitrogenous fertilizers;
- Nitrogen input from manure applied to soils (excluding manure from pasture animals);
- Decomposition of waste from N-fixing crops;
- Decomposition of vegetable waste from other cultures;
- Cultivation of histosols.

The emissions of ***pasture animals*** include emissions from the excretion on pasture range and paddock.

Trend in GHG emissions from Manure management 1988-2004, Gg

Table 6.4

Livestock	1988(a)	1990(a)	19991(a)	1992(a)	1993(a)	1994(a)	1995(a)	1996(a)	1997(a)	1998(a)	1999(a)	2000(a)	2001(a)	2002(a)	2003(a)	2004(a)
CH_4																
Cattle	23.74	22.17	20.46	17.17	13.28	10.82	9.94	9.62	9.55	10.29	10.86	10.65	9.09	10.30	10.86	10.77
Dairy Cattle	11.51	11.00	10.71	9.71	8.29	7.03	6.58	6.65	6.80	7.40	7.80	7.75	6.23	6.64	6.59	6.68
Non-Dairy Cattle	12.23	11.17	9.75	7.47	5.00	3.79	3.36	2.97	2.75	2.90	3.06	2.89	2.86	3.66	4.27	4.09
Buffalo	0.22	0.22	0.23	0.21	0.18	0.14	0.12	0.11	0.10	0.09	0.09	0.08	0.06	0.06	0.07	0.07
Sheep	2.45	2.25	2.05	1.61	1.20	1.00	0.95	0.90	0.82	0.79	0.75	0.68	0.42	0.46	0.47	0.46
Goats	0.08	0.08	0.09	0.10	0.12	0.13	0.15	0.15	0.16	0.18	0.19	0.18	0.11	0.13	0.13	0.13
Horses	0.25	0.24	0.24	0.24	0.24	0.26	0.29	0.33	0.33	0.29	0.29	0.29	0.30	0.28	0.25	0.26
Mules and Asses	0.41	0.40	0.40	0.38	0.37	0.35	0.34	0.34	0.33	0.29	0.26	0.25	0.23	0.20	0.17	0.16
Swine	40.54	42.36	36.44	28.95	23.63	20.18	20.52	18.10	14.82	15.92	16.08	13.21	7.14	8.88	10.09	10.27
Poultry	4.87	3.76	2.91	2.43	1.89	1.85	2.21	2.04	1.81	1.78	1.79	1.75	1.93	2.11	2.34	2.42
Total	**72.55**	**71.49**	**62.81**	**51.10**	**40.90**	**34.72**	**34.52**	**31.60**	**27.93**	**29.64**	**30.30**	**27.08**	**19.30**	**22.42**	**24.38**	**24.55**
N_2O																
Total	**3.41**	**3.32**	**2.97**	**2.45**	**1.96**	**1.64**	**1.60**	**1.49**	**1.36**	**1.46**	**1.51**	**1.38**	**1.03**	**1.19**	**1.27**	**1.28**

Additional information on nitrogen flows related to direct soil emissions, t N/yr

Table 6.5

Nitrogen flows (t N/yr)	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Direct soil emissions																
Use of synthetic fertilizers	487 027	356 347	166 572	125 526	148 840	182 842	116 591	127 800	137 217	87 747	126 242	130 435	151 166	139 870	126 837	148 462
Nitrogen input from manure applied to soils	122 020	118 355	102 807	84 025	66 711	55 994	55 828	50 753	44 837	48 462	50 429	45 764	35 697	41 733	45 899	46 383
N-fixing Crops	39.62	34.41	35.85	31.04	19.19	20.22	31.90	17.73	17.90	16.83	15.15	6.95	7.34	7.45	7.75	7.35
Crop Residue	587	584	617	433	350	370	390	215	354	314	344	300	339	393	239	422
N excretion on pasture range and paddock	169 589	157 939	146 932	121 979	98 061	87 708	86 345	84 345	81 363	81 038	79 420	74 473	51 326	55 333	55 818	55 164
% of nitrogen input to soils from total manure	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
Indirect soil emissions																
Indirect deposition	308 147	256 929	180 394	144 844	132 000	132 799	109 950	110 149	108 839	93 999	107 005	103 597	93 900	95 156	93 138	100 261

Indirect emissions include:

- ammonia and nitrous oxides release in the ambient air after nitrogen fertilization;
- emissions from drawing of water.

Activities described above are differentiated according to the IPCC classification. One has to take into consideration that the existing emissions of methane from soil are considered natural (non-anthropogenic) and are not subject of the inventory.

Direct N_2O emissions were 1 159 Gg CO_2-eq. in 2004, which is more than 1% of the aggregated GHG emissions during the year. The emission increase in 2004 compared to 2003 is about 20% due to the bigger quantities of synthetic nitrogenous fertilizers and manure deposited in soils. The latter is connected with the more favourable climate conditions for the agricultural activities in the current year – see **Table 6.5**.

N_2O emissions from Agricultural soils, Gg

Table 6.6

Nitrogen flows (t N/yr)	**1988**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**
Direct soil emissions								
Use of synthetic fertilizers	7.65	5.60	2.62	1.97	2.34	2.87	1.83	2.01
Nitrogen input from manure applied to soils	1.92	1.86	1.62	1.32	1.05	0.88	0.88	0.80
N-fixing Crops	0.06	0.05	0.06	0.05	0.03	0.03	0.05	0.03
Crop Residue	0.92	0.92	0.97	0.68	0.55	0.58	0.61	0.34
Cultivation of histosols	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N excretion on pasture range and paddock	5.33	4.96	4.62	3.83	3.08	2.76	2.71	2.65
Indirect soil emissions	9.11	7.53	5.18	4.15	3.82	3.89	3.18	3.20
Total	25.00	20.93	15.06	12.01	10.88	11.02	9.27	9.02
Nitrogen flows (t N/yr)	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Direct soil emissions								
Use of synthetic fertilizers	2.16	1.38	1.98	2.05	2.38	2.20	1.99	2.33
Nitrogen input from manure applied to soils	0.70	0.76	0.79	0.72	0.56	0.66	0.72	0.73
N-fixing Crops	0.03	0.03	0.02	0.01	0.01	0.01	0.01	0.01
Crop Residue	0.56	0.49	0.54	0.47	0.53	0.62	0.38	0.66
Cultivation of histosols	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N excretion on pasture range and paddock	2.56	2.55	2.50	2.34	1.61	1.74	1.75	1.73
Indirect soil emissions	3.17	2.70	3.11	3.02	2.78	2.80	2.73	2.95
Total	9.18	7.91	8.95	8.61	7.88	8.03	7.59	8.42

Indirect N_2O emissions were 915 Gg CO_2-eq. in 2004. These category emissions also increases with a little more than 8% compared to 2003.

Only the emissions from pasture animals decrease slightly by 1.1%.

6.5.2. Methodology

The emissions from this source are determined after a selection of parameters, indicators and emission factors, given as prototypes in the IPCC Guidelines. So far, there are no assessments of these parameters and emission factors, which result from the measurements in the country.

The manure quantity is calculated using the prototype parameters for different types of animals in the Eastern Europe region, given in the IPCC Guidelines. The synthetic fertilizers quantities are provided by the National Service for Plant Protection at the Ministry of Agriculture and Forestry.

6.5.3. Uncertainty and Consistency of Time Series

The uncertainty from the direct N_2O emissions from this source is 250% and from the indirect emissions - 500%.

N_2O emissions from this source for all categories n the sub sector are given in **Table 6.6**.

The consistency of time series for the source categories given in **Table 6.6** is provided due to lack of changes in the methodology, used for calculations, and the source of data.

6.6. Field Burning of Agricultural Residues

CH_4 emissions from this source result from field burning. Despite the fact that field burning is prohibited, this tradition continues and is emission source not only of main GHGs but also of GHGs-precursors.

33.8 Gg CH_4 in CO_2-eq. have been emitted in 2004. The increase is 78%, compared to the year 2003, on the assumption that 10% of the vegetal residues, left on the fields after yielding crop, are burned. N_2O, NOx and CO emissions are reduced by 27%, 27% and 40% respectively. This increase is due to the better harvesting in the current year. Respectively the emissions of GHG-precursors are also increased.

The crop residues quantities are calculated under the methodology of IPCC on the basis of data from MAF for the quantities of vegetable crop yields.

The content of C and N in the vegetable residues is determined by the ratios given in the Good Practice Guidance.

CHAPTER 7. LAND-USE CHANGE AND FORESTRY

7.1. General Description

The Land-Use Change and Forestry sector covers the processes of CO_2 exchange between the biomass sources (forests, grass and other plants, soils, etc.) and the atmosphere. The CO_2 flow exchange from and to the atmosphere is a set of processes, which result from anthropogenic activity. For example, CO_2 sequestration by forests is related to forest management and use of woodlands aimed at industrial timbering. The reforestation of uncultivated lands, aimed at erosion control, also results in CO_2 accumulation in biomass.

CO_2 emissions in the atmosphere are related to thinning and burning of forests to convert them in agricultural lands, and also because of changes in the organic compounds of the soils due to erosion or chemical treatment.

Due to the significant complexity and heterogeneity of the CO_2 removal and emission processes, the revised IPCC Guidelines define several sub sectors, which encompass the following categories:

A. Changes in Forest and other woody biomass stocks.

This category includes the processes of woody biomass growing, felling and timbering. As a rule, the net carbon balance in Bulgaria is in the direction of CO_2 removal from the atmosphere.

B. Forest and Grassland conversion.

These activities aim at the conversion of land for agricultural use for the production of crops and animal breeding.

C. Abandonment of managed lands.

These are agricultural lands (fields, pastures, plantations, etc.) which resume their initial vegetation cover (woody or grassy).

D. CO_2 Emissions and removals from soil.

This category includes processes and activities that change the organic composition of the soils. Such is the introduction of minerals during soil treatment, erosion process, etc.

E. Other.

This category includes activities, which also result in changes of CO_2 flows from and to the atmosphere. Such are soil drainage, shifting the cultivation periods of crop farming (mostly in the tropical regions), succession of longer and shorter cultivation periods, flooding due to the construction of hydro technical installations, changes of underground waters due to human interference, etc.

By introduction of Good Practice Guidance 2000, especially for this sector the scientific level of inventory has been greatly increased and conditions appeared for better covering of the emission sources. For the purpose CRF tables of new types have been invented which are united in a new general format for accounts.

In the 2004 GHG inventory, and also for the preceding years, the net CO_2 removal from category A – Changes in Forest and other woody biomass stocks has been determined. CO_2 emissions or removals from the categories B to E mentioned above have not been determined due to the lack of data or lack of the corresponding activities in Bulgaria.

At the moment a new scientific research is being worked on which is to give answers to all questions connected to the GHG emissions from the rest categories B-E.

As a temporary solution preliminary data are used about the categories: vegetation areas, grasslands and pasture-grounds, wetlands, which fill the new CRF tables.

7.2. CO_2 Sinks from Forestry

7.2.1. Source Description

Bulgarian forests belong to the temperate climate zone. For the most part they are two types – deciduous and coniferous.

The forests in Bulgaria cover about 30% of the territory of the country. The terrain varies and presumes the presence of big woodlands in the mountain and semi mountain areas of Central and Southern Bulgaria. There are places where no man's foot has ever been set.

In 2004 the total forests area in Bulgaria (deciduous and coniferous) was 4064 thousand ha. More than 79% of the forests are state property, 8% are municipal and 10% are private property. The forest areas for timbering and site formation are 65.9%, the protective and recreational forests – 26.6% and protected forest and territories – 7.5%.

The wood stock of the Bulgarian forests is more than 591 millions m^3 with an average annual growth of about 15 millions m^3. The volume of cut wood was 76.18 millions m^3 in 2004.

7.2.2. Methodology

During the GHG inventory, data for stocked carbon and changes in forests was based on the following elements;

- forest area, in ha;
- average annual growth in m^3/ha/year;
- cut biomass in m^3/year.

The control on the management and use of ***forest areas*** is carried out by the Forest Law. It sets common rules to which are subject all forests (according to ownership, type of forest, purpose and other characteristics).

The average annual growth of the forests is determined following a special methodology of the forestry authorities once in each five years within the framework of the successive forest inventory. For the period between two inventories, the growth is assumed to be constant, which leads to some uncertainty in the determination of the annual net carbon sequestration by forests. This uncertainty is being removed by the successive forest inventory, when a reassessment of the condition and volume of the forest biomass is made. **Table 7.1** gives the calculated carbon uptake factor in the two main types Bulgarian forests.

Implied carbon uptake factors (in t C/ha) in changes in forest and other woody biomass stocks (IPCC category 5A2)

Table 7.1

Implied uptake factor	1988	1990	1991	1992	1993	1994	1995	1996
Evergreen	0.847	0.919	0.952	0.988	1.027	1.036	1.057	1.065
Deciduous	0.847	0.874	0.901	0.929	0.955	0.965	0.971	0.968
Implied uptake factor	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Evergreen	1.078	0.972	1.095	1.202	1.194	1.219	1.192	1.180
Deciduous	0.963	0.808	0.948	1.031	1.004	0.984	0.971	0.933

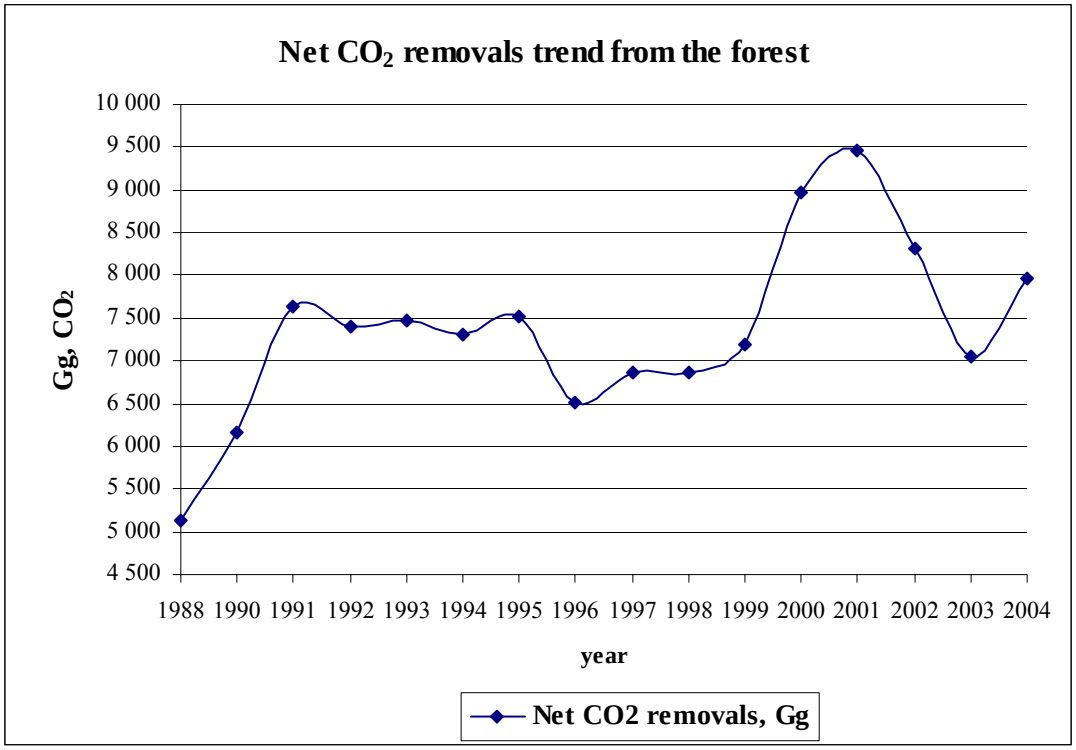
The volume of the ***cut wood*** is determined annually on the basis of preliminary plans for felling and as a result of real organized felling.

7.2.3. Uncertainty and Consistency of Time Series

CO_2 removal is formed by the net balance of the atmosphere absorbed C and the volume of cut biomass (wood) used for heating, pulp production and other biomass consuming activities.

The trend of the removed CO_2 is showed in **Figure 7.1** on the basis of the prerequisite of having a constant annual forest growth for the periods 1990-1994, 1995-1999 and 2000-2003 and the carbon sink was determinate by the volume of realized cuts.

Figure 7.1



The analysis of the CO_2 removals trend from the forest shows a significant change for the period 1988-1991 in the range of 5 100 - 7 700 Gg, a relative stabilization during the period 1992-1995 at a level of about 7 500 Gg, a drop in the year 1996 to 6 500 Gg and a following steady tendency of increase until 2001. After this period of steady increase follows a drop due to increased felling.

The quantities of CO_2 removals from forests are given in **Table 7.2** for the entire GHGs inventory period.

CO_2 emission/removals from changes in forest and other woody biomass stocks, Gg

Table 7.2

CO_2, Gg	**1988**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**
Carbon uptake increment	2 761	2 962	3 062	3 163	3 263	3 321	3 362	3 362
Carbon release	-1 361	-1 283	-980	-1 141	-1 224	-1 330	-1 309	-1 584
Carbon net uptake	1 400	1 679	2 082	2 021	2 039	1 991	2 052	1 777
Net CO_2 removals	**5 133**	**6 157**	**7 636**	**7 412**	**7 476**	**7 302**	**7 524**	**6 517**
CO_2, Gg	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Carbon uptake increment	3 362	3 362	3 362	3 698	3 698	3 698	3 698	4 110
Carbon release	-1 487	-1 490	-1 398	-1 250	-1 116	-1 429	-1 773	-1 938
Carbon net uptake	1 874	1 871	1 964	2 448	2 582	2 269	1 924	2 172
Net CO_2 removals	**6 872**	**6 860**	**7 200**	**8 976**	**9 467**	**8 318**	**7 056**	**7 965**

The quantity of CO_2 removals was 7 965 Gg in 2004. The growth of the removals in 2004 was about 12.9% compared to 2003. It is due to the decreased wood cut in the current year.

7.2.4. Planned Improvements

A number of discussions with experts on forests, experts on forestry management and GHG inventory experts have been carried out in 2005.

As a result, a procedure started for assigning a research project that ended by assigning a research development to the team from MAF, the Institute of Forests and Energy Institute, which will asses the possibilities for including sub sectors 5C and 5D in the GHG inventories.

The inclusion of sector 5B is not a question of present interest due to the fact that after the restitution of the agricultural lands to their owners, there is no need of additional areas of arable land. On the contrary – some portion of the arable land is still not used on purpose and is deserted. We expect this condition to be changed dramatically after the accession of Bulgaria to the EU in 2007.

CHAPTER 8. WASTE

8.1. General Description

GHG emissions in the Waste sector result from the processes of collection, storage and management of solid waste from household and the public sector and waste water treatment from household and industry.

According to the IPCC nomenclature, the following categories in this sector are considered:

- Solid waste disposal;
- Wastewater handling;
- Waste incineration;
- Other.

Only the first two categories from those mentioned above are included in inventory for Bulgaria.

The methane and N_2O emission trends in this sector are given in **Table 8.1**.

Trend in GHG emissions from Waste handling, Gg

Table 8.1

Gases	1988	1990	1991	1992	1993	1994	1995	1996
CH_4								
6A Solid waste disposal	515.1	452.8	397.5	382.8	355.2	335.7	311.4	279.7
6B Waste water handling	87.85	66.52	51.67	47.25	40.12	37.28	49.34	46.86
6C Waste incineration	NO	NO	NO	NO	NO	NO	NO	NO
6D Other								
N_2O								
6B Waste water handling	1.00	0.72	0.65	0.65	0.62	0.59	0.54	0.52
Gases	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
CH_4								
6A Solid waste disposal	228.8	198	195.7	201.3	200	199.9	200.8	216.4
6B Waste water handling	39.79	34.33	30.11	28.27	22.93	21.79	58.48	58.72
6C Waste incineration	NO	NO	NO	NO	NO	NO	NO	NO
6D Other								
N_2O								
6B Waste water handling	0.46	0.52	0.53	0.50	0.48	0.49	0.49	0.48

Two key GHG emission sources are given in **Table 8.1**:

- Methane emissions from solid waste disposal (ranked 5 with more than 7% share);
- Methane emissions from waste water handling (ranked 11 with more than 2% share).

N_2O emissions from waste water handling are a non-key source. In fact, there are reported nitric oxides emissions from the consumption of proteins by the population.

8.2. Solid Waste Disposal

8.2.1. Source Description

Solid waste can be managed by disposal in landfills, recycling, and incineration for elimination or energy production. GHG emissions in this sector are accounted for only for the disposed solid waste.

As mentioned above, the emissions from this source are key sources both for the level estimation and also for the trend estimation in the total GHG emissions (see ***Annex 1***).

The emissions from this source are ranked first amongst the methane emissions in Bulgaria in 2004, and ranked fifth amongst all sources of GHG emissions in the country.

In accordance to certain criteria like:

- the presence of mechanical cover materials;
- levelling of waste.

and others Bulgarian depots are classified up to 2004 as controlled and un-controlled. After the Change of the Bulgarian Waste Law the concept un-controlled depots dropped out.

The criteria analysis given in the Revised IPCC Guidelines gives us grounds to classify all controlled depots to the "managed SWD" category.

8.2.2. Methodology

Solid wastes disposal emit CH_4 as a result of the processes of anaerobic and aerobic decomposition of their organic content. The inventory in 2004 as in the previous inventories assumes that the emitted methane is 50% of the total emitted biogas from the landfills.

The proposed standard methodology in the IPCC Guidelines is used for the determination of the quantities emitted methane. This methodology uses indices and parameters accounting for:

- the landfill category and the waste composition;
- the content of the degradable organic matter;
- the fraction of organic compound, converted to methane;
- the quantity of methane used for energy production;
- the quantity of oxidized methane in the upper layers of the landfill.

The parameters used in Bulgaria are given in **Table 8.2**.

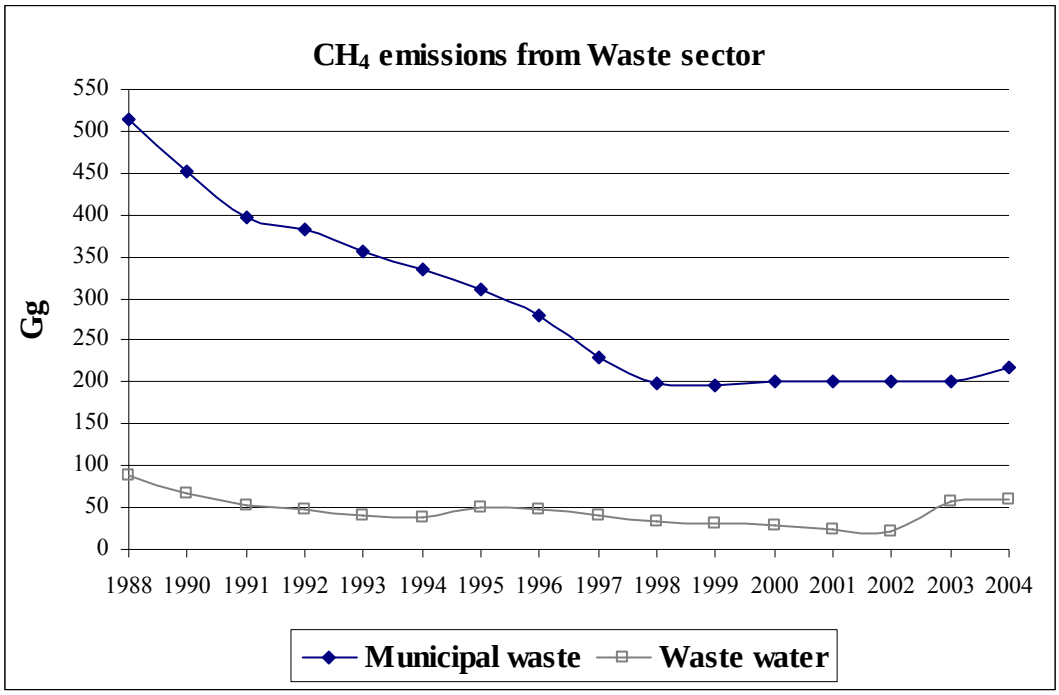
As this is a key source, using the Tier 1 method does not correspond to the good practice requirements. This means that a higher order method should be applied. So far, this is not possible for Bulgaria, due to the fact that there are no sufficient historical time series to make an estimation of the collected waste. Discussions were held on this issue by the revising team from the Second Centralized Review of Inventories of GHG (October 2005, Bon, Germany). The recommendations that were made by the team for the determining of the missing data under the method of extrapolation with data from other countries have proved invalid. The only true way for solving this problem is a scientific research for creating a methodology to be carried out, which should generate the missing data based on solid scientific grounds. Regretfully the financing of the inventing of such a methodology is beyond Bulgaria's financial strength at the moment but it should be decided in the framework of the National Inventory evaluation system.

8.2.3. Uncertainty and Consistency of Time Series

The uncertainty of the emissions from this source is estimated at 101%.

The change of the emission trend for the period 1988, 1990-2004 is given in **Figure 8.1**.

Figure 8.1



The trend analysis shows that CH_4 emissions from solid waste disposal decrease from 515 to 196 Gg for the period 1988-1999 and keep a relatively steady level for the last five years.

8.3. Wastewater Handling

8.3.1. Source Description

The second biggest CH_4 source in this sector is wastewater handling. This source is ranked third amongst all methane sources in the Bulgarian inventory.

N_2O emissions from wastewater handling are not a key source.

Treatment of industrial wastewater handling and domestic wastewater handling is considered in separate groups.

Wastewater handling is a CH_4 source of emissions in anaerobic conditions. The conditions for anaerobic and aerobic processing are usually combined, which is reflected by the introduction of a correction factor.

Wastewater sludge treatment also belongs to this CH_4 source. As the volume of sludge has not been accounted for in the statistics for the last four years, it is assumed that 5% from the total volume of wastewaters is allocated to sludge.

8.3.2. Methodology

The determination of CH_4 emissions follows the standard methodology given in the IPCC Guidelines. It comprises of the following steps:

1. Determination of the total amount of organic matter in wastewater and sludge in respect to the systems for their handling;
2. Estimation of the emission factors for each wastewater handling system;
3. Calculation of CH_4 emissions via multiplication of the total organic amount by the emission factors for each wastewater handling system.

Input data of different aggregation and accuracy level is used for the cases of handling industrial wastewater and sludge, and domestic wastewater and sludge.

Household data has higher uncertainty level as some average parameters per capita of the population has been used.

There is statistics for the industrial wastewaters according to types of industry, which allows accounting the diverse degradable organic matter in the related industry. This leads to higher precision for methane emission estimation.

Using Tier 1 methods for this type of key source does not correspond to the good practice requirements. This means that a higher order method should be applied, which is not possible for Bulgaria at present. The reasons for that is the absence of enough reliable data on the required parameters and methodology for their definition and use.

8.3.3. Uncertainty and Consistency of Time Series

The uncertainty of the emissions estimation from this source is given at 85%.

The quantities of wastewater and the share of treated wastewater for the years of the inventories in Bulgaria are given in **Table 8.3**.

CH_4 emissions from wastewater handling, expressed in CO_2-eq., amount to 1 233 Gg in 2004, which is 2% of the total GHG emissions. CH_4 emissions from industrial wastewater are the dominant here, forming 85% of the total CH_4 emissions from wastewater.

The trend analysis of the industrial wastewater shows a steady tendency for a decrease, reaching its minimum in 2002. However, there is a rapid rise in 2003 compared to the preceding year. The reason for this is the decision of the Ministry of Environment and Water for the discharge of several big tailing ponds in the country. This high level of the emissions of wastewater is kept in 2004 due to the same reason.

Wastewater with nitrogen content, which is released as N_2O in the atmosphere, results from food consumption by the population. N_2O emissions expressed in CO_2-eq. amount to 150 Gg in 2004. Their decrease of 0.6% is minimal compared to 2003. It reflects the decrease of population, which is of the same degree - 0.51%. It could be said that practically the consumption of proteins by the population in the last two years is not considerably changed and not increased.

8.4. Waste Incineration

Bulgaria has no solid waste incineration for energy production.

There are only sporadic examples of hazardous and dangerous waste incineration, which do not emit GHG emissions.

Parameters used in the IPCC Tier 1 method for Solid Waste handling

Table 8.2

Description	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Total population (1000s)	8 987	8 669	8 596	8 485	8 460	8 427	8 385	8 341	8 283	8 230	8 191	8 149	7 929	7 845	7 801	7 761
Waste generation rate (kg/capita/day)	2.36	2.44	2.59	2.59	2.37	1.92	1.47	1.32	1.20	1.06	1.07	1.12	1.11	1.12	1.13	1.09
Fraction of MSW disposed to SWDS	0.95	0.95	0.95	0.95	0.95	0.95	0.99	0.99	0.97	0.99	0.99	0.99	1.00	1.00	1.00	1.00
Fraction of DOC in MSW	0.175	0.175	0.175	0.175	0.175	0.175	0.175	0.175	0.175	0.175	0.175	0.175	0.175	0.175	0.175	0.175
Fraction of wastes incinerated	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Fraction of wastes recycled	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00	0.01	0.01
CH_4 oxidation factor	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	0.00	0.00
CH_4 fraction in landfill gas	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Number of SWDS recovering CH_4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Composition of land filled waste (%)																
Paper and paperboard	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	9.0	10.0	11.1	10.3	10.1
Food and garden waste	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	40.0	39.0	39.5	39.6	37.8
Plastics	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	9.0	9.0	11.1	11.7	13.6
Glass	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	5.0	5.0	5.3	5.0	5.6
Textiles	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	3.0	4.0	3.8	4.1	4.4
Other (specify)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	34.0	33.0	29.2	29.3	26.1

Wastewater handling

Table 8.3

Wastewater handling	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Total wastewater (th. m^3)																
domestic	347 697	334 340	277 235	271 250	264 392	248 206	240 255	235 209	241 912	271 766	254 509	264 648	245 692	229 870	241 331	236 564
industrial	1 297 706	958 103	771 609	793 598	622 774	530 675	585 636	550 233	485 169	415 492	438 693	328 497	274 475	225 023	666 142	657 812
Treated wastewater (%)																
domestic	50	51	53	53	53	56	60	63	68	68	68	69	72	73	73	73
industrial	60	60	57	49	50	56	61	60	62	60	62	48	44	60	84	84

CHAPTER 9. OTHER (SECTOR 7 FROM CRF)

This sector from the IPCC classification is designated to submit all GHGs emission sources, which for one or another reason have not been categorized at one of the 6 preceding sectors.

The Bulgaria inventory has no such specific sources to be reported in this sector.

Even so, the Other category can be commented here, because it is used in various places in the inventory.

The Other category appears in each sector, described in the preceding Chapters 2-8. It includes emission sources that belong to the sector but can not be related to, and included in any of the categories of the sector.

The Other category appears as one of the emission sources in the list of key and non-key sources, drafted according to the good practice requirements. The emissions of this source are 80.78 Gg for the inventory in 2004. It incorporates GHG emissions from all small sources that can not be regarded as part of the remaining 40 entries in this list. The size of this source for the inventory of the base year is bigger and amounts to 179.38 Gg.

Bulgaria has GHG emissions, which are not included in the inventory, so in future, research on their actual volume, and influence on the total GHG emissions in the country should be conducted. Such sources are:

- forest fires;
- use of candles for various purposes;
- drinking water purification;
- gas emissions from food stores.

CHAPTER 10. RECALCULATION OF GHG EMISSIONS AND IMPROVEMENTS

10.1. Prerequisites and Assumptions During the Recalculations

The GHG emission recalculation for the inventories, carried out during the period 1988-2004, was made using assumptions and prerequisites for each sector and source category, and GHG removals in accordance with the Revised IPCC Guidelines, 1996 as follows:

- **Energy**
  - Stationary combustion processes in Energy and Industry; household, agriculture and forestry;
  - Transport 1996.
- **Industrial Processes**
  - Main GHG emissions and their precursors from industrial technological processes;
  - F-gases emissions – PFC, HFC and SF_6.
- **Agriculture**
  - GHG emissions from agricultural lands.
- **Waste**
  - Solid waste collection and treatment.

For each of the above mentioned categories some changes are made and they can be classified in the following groups:

A. Changes in the methodology of process modelling, activities and emission factors;
B. Changes in the data structuring for fuels and activities, emitting GHG;
C. Changes concerning errors during data transfer and calculation of emissions.

Energy sector

Group A changes were made in the Energy sector.

- A change of the emission factors for emissions of N_2O from all kinds of fuels in the stationary burning processes.

It its previous inventories the emissions of N_2O were determined by emission factors which in their most part were accepted on the base of local research and calculations valid for 15-20 years. In all revisions of the Bulgarian inventories from 2000 till now, the high levels of these emission factors have been commented on. These levels considerably exceeded the standard amounts in the IPCC Guidelines. In order for eventual discrepancies to be avoided due to a lack of new data about calculations in the country, we accepted to work with the standard emission factors with which all the emissions from 1988, 1990 till 2003 have been recalculated.

- Corrections in the data about emissions of GHG in sub sector Transport for 1996 – group B.

The correction fill the lack of the part of data about used fuels in 1996 and eliminates the wrong sum of biomass emissions for the entire transport, due to error in the formula employed. This correction is reflected visibly only for the years 1990-1999 and approves the consistency of the time order.

Industrial Processes sector

A great revision of data for the volume and type of production of minerals has been carried out, using data from the enterprises.

Available data was changed in the following directions:

- Evaluation of the emissions of cement production completely on the base of the clinker produced data– group A.

For the purpose the quantities of clinker produced in the country have been revised and the respective bulks of import and export have been reported.

- Introducing a new CO_2- emission source – emissions from the use of limestone and dolomite- group A and B.

Up to the present there were not any data about the used quantities of limestone and dolomite in the country. After exploring and isolating the data the respective quantities of limestone and dolomite used for production of pig iron and steel, have been determined. With them, the whole time series from 1988, 1990 to 2004 was full filed.

- Data for soda ash consumption has been added– group B.

Data for soda ash were lacking for the period 2000-2002 and this broke the stability of the time series. The problem has been resolved by extrapolation of the data about the above-mentioned years on the base of the quantities of used chemicals before and after this period.

Sector Agriculture

Revision of data on emission sources and emission factors in sector Agriculture is made in terms of parameters, which are used to determine emissions at the burning of stubble-fields and N_2O emissions from agricultural soil. The inventory recalculation for this sector takes into account:

- The amount of the parameter FracR has been changed – group A.

The parameter FracR is used as the standard value from the IPCC Guidelines has been assigned to it- 0.45. This amount is bigger than the one used so far- 0.1 and leads to the increase of emissions of GHG.

- Rise of the in-direct N_2O emissions- group B.

Data for the nitrogenous fertilizers quantities applied to soil has been taken from the National Service for Plant Protection at the Ministry of Agriculture and Forestry. In the rare cases of lack of data, following consultations with experts from the National Service, data on the basis of the official statistics from NSI have been agreed upon.

Waste sector

Solid Waste Disposed (SWD) quantities have been recalculated for the period 1988, 1990-2004.

- Recalculation of SWD - group A.

This recalculation was imposed because of the Waste Law, which concerns the classification of depots. After this change the concept un-controlled depots drops out. Taking this into account, all depots in the country are controlled, which corresponds to the category managed depots in the IPCC Guidelines. In accordance to this the parameter 'Share of the degradable organic content' of the waste sizing 0.6 for the period before 1999, has been accepted.

- Recalculation of N_2O emissions from the population – group B.

The food consumption containing protein by the population leads to emissions of N_2O. The data about the yearly consumption of proteins by the population after 1995 have been revised, which

affected the emissions, too. They were recalculated in accordance with the new levels of consumption.

10.2. Introducing Improvements for GHG Emissions Levels

The differences between inventories due to the recalculations in the National GHG Inventory Report 2003 (Submission 2005) and the present report (Submission 2006) are given in **Table 10.1.**

10.2.1. Recalculation of the Base Year - 1988

In the previous NIR 2005 the main allowances and requirements were described in detail at the preparation of the inventory for the base 1988.

The inventory of the base 1988 year was prepared on the base of the material balances of NSI for 1988. For this year there was no energy balance to be used. The first energy balance for Bulgaria is for 1990. There are several differences between material and energy balance, which render the task of preparation of energy balance on the base of the material one, very difficult and connected with expert evaluations, allowances and conventions. Due to this reason there is not a unified algorithm and proceeding for preparation of energy balance. The pointed difficulties have been overcome by the help of the methods of analogy and extrapolation.

At the present inventory the base 1988 has been recalculated only on the base of the changes shown in p. 10.1 The following results turned out.

Total GHG emissions

Total aggregated emissions in Bulgaria are 132 303.16 Gg CO_2-eq. (without accounting CO_2 sequestration by the forests) for 1988. The difference with the preceding estimation is 4.4% lower.

Out of the total emissions, the share of CO_2 is 74.3%, of CH_4 16.5% and of N_2O 9.1% expressed in CO_2–eq.

The distribution of the aggregated emissions in sectors (without forests) is as follows:

- Energy – 32.9%;
- Industrial processes – 7.7%;
- Industry- burning processes- 18.7%;
- Transport 10.6%;
- Household and services- 6.8%;
- Agriculture – 11%;
- Waste – 9.8%.

CO_2 emissions

The biggest CO_2 emitter is the Energy sector - 90 726 Gg or 68.6% from the total GHG emissions in Bulgaria (without accounting sequestration by forests).

In total, CO_2 emissions from sector Energy stay unchanged in comparison to the previous year.

In sector Industrial processes CO_2 emissions have been reduced by 3.4% because of the re-evaluated emissions from the cement production.

CH_4 emissions

The total CH_4 emissions are 1 041 Gg, which displays a decrease, compared to the preceding inventory by about 12.3%. This decrease is mainly on behalf of the emissions in sector Waste.

Differences between NIR 2004 and NIR 2005 for 1988-2003 due to recalculation, %

Table 10.1

Gas/Sector	Source	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Energy	*% NIR-2006 versus NIR- 2005*															
CO_2		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.45	-0.05	0.00	0.00	0.00	0.00	0.00	0.27
CH_4		0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.04	-0.01	-0.19	-0.28	-0.28	-0.29	-0.29	-0.50
N_2O		-87.83	-88.00	-88.61	-88.15	-88.02	-87.92	-87.76	-87.56	-87.71	-86.46	-86.70	-86.09	-86.57	-85.85	-85.97
Industrial Processes																
CO_2		-3.44	-3.72	-0.25	-0.12	-0.06	-0.29	0.24	0.64	2.48	3.35	5.46	6.77	9.46	8.77	7.98
CH_4		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	0.00
N_2O		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	0.00
Solvent and Other Product Use																
NMVOCs		783.75	798.10	530.13	528.35	582.45	588.24	591.34	549.95	433.55	261.62	476.40	433.38	245.89	254.57	301.45
Agriculture																
CH_4		0.08	0.09	0.10	0.09	0.09	0.11	0.12	0.07	0.12	0.10	0.11	0.11	0.15	0.16	0.07
N_2O		11.68	10.62	8.02	8.46	9.46	9.83	8.14	10.58	8.95	8.14	8.80	9.41	9.16	8.15	10.11
Land-Use Change and Forestry																
CO_2 sink		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	0.00
Waste																
CH_4		-19.49	-19.81	-20.05	-20.14	-20.29	-20.32	-19.65	-19.53	-19.44	-19.45	0.00	0.00	0.00	0.00	0.00
N_2O		0.00	0.00	0.00	0.00	0.00	0.00	-4.48	-3.60	-1.33	-2.56	-2.66	-1.66	1.39	7.70	0.60
TOTAL without LUCF																
CO_2-eq.-without F-gases		-4.39	-4.54	-4.91	-5.27	-5.05	-5.02	-4.87	-4.35	-4.53	-4.42	-2.55	-2.35	-2.53	-2.38	-2.25
CO_2-eq.- total		-4.39	-4.53	-4.90	-5.27	-5.05	-5.02	-4.87	-4.22	-4.30	-3.61	-2.39	-2.20	-2.39	-2.23	-2.08
CO_2		-0.27	-0.30	-0.02	-0.01	0.00	-0.02	0.02	0.46	0.15	0.22	0.41	0.55	0.73	0.67	0.89
CH_4		-12.28	-12.57	-12.57	-13.03	-13.43	-13.67	-12.99	-12.64	-12.02	-11.29	-0.02	-0.03	-0.03	-0.02	-0.08
N_2O		-18.53	-19.26	-23.41	-26.69	-28.84	-27.53	-29.22	-28.54	-30.62	-32.19	-29.58	-26.94	-31.06	-29.19	-31.32

N_2O emissions

The total emissions of N_2O are 38.9 Gg. This quantity has decreased compared to the preceding inventory. The biggest reduction are observed in sectors Energy due to the changed emission factors. In sector Agriculture there is some increase by 11%. While the sector Energy decreases its emissions by 87.7% sector Agriculture increases them by 11.7% or the sum of the decrease in the frame of the inventory is 18.5% compared to the preceding inventory.

10.2.2. Recalculation of GHG Inventories for 1990-2003

The analysis of **Table 10.1** shows that the change in GHG emissions, as a result of recalculation, is different in different years. The emission change of the main GHGs varies in the following ranges:

- CO_2- from 3.7 to 9.5%;
- CH_4- from -20 to +0.1%;
- N_2O- from -88 to + 11.7%.

Obviously the variations of change for methane and N_2O are too big while for CO_2 they are small.

10.3. Introduction of Improvements in the GHG Emissions Trends

In total, the recalculation of GHG emissions should lead to improvement of the common trend, which is expressed in its reduction of absolute value compared to the previous year.

The changes of the common trend 1988-2003 between two consecutive inventory submissions are given in **Table 10.2.**

Difference between NIR 2005 and NIR 2006 for emission trends 1988-2003 (1995 for F- gases)

Table 10.2

Gas, Gg CO_2-eq.	Trend (absolute)			Trend (percentage)		
	NIR 2005	NIR 2006	Difference	NIR 2005	NIR 2006	Difference
CO_2	-45 250	-44 507	743	-46	-45	0.63
CH_4	-15 559	-12 506	3 053	-62	-57	5.23
N_2O	-8 349	-7 627	721	-56	-63	-6.85
HFCS	0	121	121			
PFCs	-55	-55	0	-73	-73	0
SF_6	3	3	0			
Total	**-69 210**	**-64 572**	**4 638**	-50.0	-48.8	**1.21**

The trends in absolute values are defined as differences between the aggregated GHG emissions in 2003 and 1988. If one assumes that the lower the absolute trend value is, the better it is, undoubtedly the recalculation gives a positive result.

The trends in percentages are defined as absolute trends in relation to base year emissions. Despite the emissions change in the base year, for this case, a percentage decline in the trend is observed, which demonstrates once again a positive result from the recalculation.

10.4. Recalculation, Inventory Revisions and Planned Improvements.

10.4.1. Restructuring of Sources

The changes in the inventory recalculations were shown in detail in item 10.1. Some of these changes concern the structuring of emission sources.

For example, the potential emissions of HFC were included in the total emissions of GHG.

In general, the structure of the inventory in Bulgaria follows exactly the structure of IPCC, therefore there were no problems during the preparation and inserting data in the CRF tables.

10.4.2. Source Complexity

GHGs inventories include all sectors and categories from the Revised IPCC Guidelines, 1996 with the exception of the following:

- N_2O emissions during fire extinguishers use, aerosol packing and for anaesthesia;
- Fugitive CO_2 emissions from coal mining;
- Actual emissions from use of HFC gases.

As a whole the complexity of sources has been greatly increased because new sources has been introduced – emissions from the use of limestone and dolomite, emissions from the use of soda ash as well as a improvement of methodology for the evaluation of the emissions in the cement production.

10.4.3. Changes in CRF Tables Compared to Previous Submissions

The tables included in ***Annex 7*** are part of all CRF tables, included in the GHGs inventory report for 2004. These are:

- Aggregated CRF tables for the base year and for the last 4 years - 2000-2004 (Tables 7A);
- Tables with recalculation for some years of the inventories (Tables 8a 8b);
- CRF tables 10 for the trends of main GHGs;
- CRF trend tables for precursors and SOx;
- CRF tables for sector Change in the use of lands and forests.

Table 9 for the completeness of the inventory is given in ***Annex 5.***

In the present inventory for the first time there is an attempt at preparation of account tables and drawings with the help of the CRF- reporter. This is a new program, which comes to replace the Excel files used so far with the purpose of improving the accounting at the preparation of the yearly inventories of GHG.

10.4.4. Completeness of CRF Fails

As shown above, CRF tables include all background tables. In the tables, fuels are aggregated, the secondary gases – coke gas and blast furnace gas are related to solid fuels, while the dry gas from petroleum refining – to liquid fuels. Petrol coke is also related to liquid fuels.

Liquid Petroleum Gas (LPG) emissions are related to liquid fuels with the exception of the transport sub sector, where they belong to a separate category Other.

Lack of specific numbers for some data has been substituted by notation keys, which describe the status of certain data cell. For example, NE denotes "has not been estimated but exists", NO – "does not exist", C – "confidential", etc.

10.4.5. Results from Revisions of GHG Inventories.

GHG inventories in Bulgaria are being inspected and revised by local and international teams.

During the adoption and approval of the annual inventories at the Bulgarian Ministry of Environment and Water (MoEW), a two tier system is being used, where the Submissions are reviewed by expert scientific councils:

- Scientific and technical council at the Energy Institute;
- Superior expert ecological council (SEEC) within MoEW).

The necessary condition for SEEC assembly is the presence of reviews of the Submission by independent experts and assessment by the relevant departments from the Ministry and the National Environmental Executive Agency.

So far the GHG inventories in Bulgaria have been subject of the following international verifications and revisions:

- Revision in the country by international team of the UNFCCC Secretariat, September 2003;
- The section for Bulgaria in the Synthetic and Assessment Report of UNFCCC for inventories 1999-2001, 2003;
- Desk review of the 2002 inventory, November 2004;
- Second Centralized Review of Inventories for 2003 in Bon, Germany, October 2005.

The results from those revisions showed some omissions in the inventories, which have been removed or are being investigated and will be removed. Some of them are:

- *Comparison of the inventory data with the corresponding data of international organizations.*

The analysis of the data used Bulgaria inventory sometimes shows some differences with the respective data from international organizations such as IEA, FAO and others. This is due to several reasons, which are in the Bulgarian information sources, as well as in the international sources. In this connection, the respective Bulgarian organizations are familiar with these differences and they work to lessen them to their minimum.

- *Including additional information in the National Inventory Report.*

As a rule for all inventories, not only the Bulgarian one, references are made for including data and materials for increasing the popularity and consistency of the inventory. This requirement should be performed on the principle of wise combination of the bulk and importance of the additional information.

In this report we will make sure to comment in detail on the references and notes from the last revision of inventory 2003.

1. *About the more detailed description of the quantities of fuel and processes- sources of emissions of GHG for the base 1988.*

The main difficulty in the inventory of GHG for 1988 was to determine the quantity of fuel, designated for transformation, the fuels for final consumption and the bulks in the processes of transformation of fuels and energy. For a basic point the existing in NSI material balances were used. A methodology was created for the formation of the basic categories necessary for building of the energy balance. In this process different proportions and correlations took part that have been

created for the existing energy balance for 1990. The widest use was for the comparative technique and the method of interpolation and extrapolation.

The data outside the energy balance was taken from the respective NSI reports. Here the main difficulty was the different forms of classification, which had nothing to do with the present Eurostat classifications. Again under the method of analogy the quantities of products and the types of activities sources of GHG emissions have been correctly evaluated.

2. About the reference for the application of methods of the type Tier 2 for the evaluation of the fugitive emissions from coal production; for the evaluation of the emissions from the production of pig iron and steel and for emissions evaluation of the solid waste disposal.

The three sources of GHG emissions described above are part of the key emissions for Bulgaria and in accordance with the Good Practice Guidance the more exact methods should be used. We agree with this but we face problems that on this stage turn out to be insoluble, namely:

- lack of methodology for creating data needed by methods from higher level of assessment;
- lack of resources for financing of the researches for adaptation and creation of methods accounting country specific conditions.

3. About the determining of more reliable evaluations for the inaccuracy at the work with data and emission factors for every source and process of the inventory.

The occasion for this reference is our observation that we work principally with literature data when the inaccuracy is measured. The experienced calculation and determining of the inaccuracy for various sources of GHG is possible and necessary, however it is too expensive and labour-consuming. That is why the reference of the inspecting team for inaccuracies to be determined for each particular year sounds to us, at this stage, as a task completely unattainable. Even in terms of methodology up to this moment the Good Practice Guidance does not offer a methodology for evaluation of the overall inaccuracy of the trend in which different inaccuracies for the current and base year to be used.

10.4.6. Planned Improvements

The basic element for the planned improvements of the inventories of GHG in Bulgaria is the National System for evaluation of anthropogenesis emissions of GHG.

The preparation of this system starts in 2005 with a project for preliminary research of basic principals, structures and rules for its preparation. It will be developed as element of the monitoring emissions system for air pollution. This system works successfully in the last years under coordination and guidance on the national level by the Executive Environment Agency.

In the current year a project starts for investigation and determination of parameters and data necessary for the inventory of emissions of GHG in the sector Land Use Change and Forests. It is known that the quantities of the data in this sector has been evaluated as unsatisfactory and for some categories there is no data at all. That is why detailed investigations lays ahead for the determining of the condition of the present data, the possibility of their use in the inventories and the creation of a methodology for calculation of the emissions of GHG.

Implementation of the European emission trading scheme also will bring improvement of the quality and availability of information for activity data and emission factors.

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ANNEX 1: KEY SOURCES OF GHG EMISSIONS

1.1 Introduction

According to the definition of Good Practice Guidance, key sources of GHG emissions are these sources, which are responsible for 95% of the sum of aggregated GHG emission expressed in CO_2-eq. in the country.

The key sources are defined according to the IPCC classification. It is advisably the key sources that in superior degree are correspondent to the structure of the fuels and the activities in the country. This is the reason for the appliance of the methods for determination of the list of the key sources for Bulgaria in line with the practice in the country.

By method **type Tier 1** are defined key sources accounting two rules:

- Rule A – Level assessment of the GHG emissions in absolute value expressed in Gg;
- Rule B – Trend assessment of the emissions from the base year till the current year of the inventory.

By applying ***rule A*** is used information for the volume of the source emissions only for the current year of the inventory. In this sense it gives the most complete assessment of the key sources for the current year.

The application of ***rule B*** requires information for the GHG emissions for the base year in the country. That means that the trend assessment includes additional information and gives the possibility for thorough analysis of the key sources.

The application of method from **type Tier 2** requires the introduction of uncertainty assessments for each source of GHG emissions. After this an arrangement of these sources is done in accordance with the above mentioned rules A and B. As expected, this method increases the weight of such sources of emissions, which are more incorrect. In this sense a contradiction can occur as for example – more insignificant source (with lower level of GHG emissions) to stand at fore-place in the list of key sources due to its higher inaccuracy.

The comparison with the list of key sources (method Tier 1, Rule A) given in the previous 2005 Submission presents the following:

- N_2O emissions from stationary combustible processes is dropped out in the new list;
- The source Fugitive emissions from the oil and gas systems and Indirect N_2O emissions from agricultural soils are included in the new list.

1.2 Tier 1 method for Assessment of Key Sources.

In **Table A1.1** and **Table A1.2** are presented lists with the key sources determined in accordance with the rules A and B.

Source ranking using IPCC Tier 1 level assessment 2004, Gg CO_2-eq.

Table A1.1

ID	IPCC source category	Gas	Emissions (Gg, CO_2-eq.) 2004	Assessment Level	Cumulative
1	CO_2 Emissions from Stationary Combustion- Energy Industries, Coal	CO_2	25 082.65	0.37	0.372
2	Mobile Combustion- road transportation	CO_2	6 549.98	0.10	0.469
3	CO_2 Emissions from Stationary Combustion- Manufacturing Industries, Coal	CO_2	4 852.45	0.07	0.540
4	CO_2 Emissions from Stationary Combustion – Gas	CO_2	4 643.30	0.07	0.609
5	CH_4 Emissions from Solid Waste Disposal Sites	CH_4	4 545.24	0.07	0.677
6	CO_2 Emissions from Stationary Combustion – Oil	CO_2	4 210.91	0.06	0.739
7	CO_2 Emissions from Steel Production	CO_2	1 504.73	0.02	0.761
8	CH_4 Emissions from Enteric Fermentation in Domestic Livestock	CH_4	1 491.48	0.02	0.783
9	CO_2 Emissions from Cement Production	CO_2	1 376.28	0.02	0.804
10	CO_2 Emissions from Stationary Combustion- Other Sectors, Coal	CO_2	1 300.81	0.02	0.823
11	Emissions from Wastewater Handling	CH_4	1 233.07	0.02	0.841
12	Fugitive Emissions from Coal Mining and Handling	CH_4	1 232.71	0.02	0.859
13	Direct N_2O Emissions from Agriculture Soils	N_2O	1 158.86	0.02	0.877
14	CO_2 from Lime Production	CO_2	955.60	0.01	0.891
15	Indirect N_2O Emissions from Agriculture Soils	N_2O	914.99	0.01	0.904
16	N_2O Emissions from Nitric Acid Production	N_2O	858.11	0.01	0.917
17	Mobile Combustion-other transportation	CO_2	659.44	0.01	0.927
18	Non-energy fuel use- gas	CO_2	656.40	0.01	0.937
19	Fugitive Emissions from Oil and Gas Operations	CH_4	559.28	0.01	0.945
20	N_2O Emissions from Animal Production	N_2O	537.46	0.01	0.953
21	CH_4 Emissions from Manure Management	CH_4	515.60	0.01	0.960
22	CO_2 from Ammonia Production	CO_2	407.65	0.01	0.966
23	N_2O Emissions from Manure Management	N_2O	395.85	0.01	0.972
24	N_2O Emissions from Stationary Combustion	N_2O	316.52	0.00	0.977
25	CO_2 from Limestone and Dolomite use	CO_2	314.27	0.00	0.982
26	New gases	PFC, HFC, SF6	254.16	0.00	0.985
27	Emissions from Wastewater Handling	N_2O	149.94	0.00	0.988
28	CO_2 from Soda Ash Production	CO_2	138.92	0.00	0.990
29	CO_2 Emissions from Industrial Processes - others	CO_2	97.47	0.00	0.991
30	Mobile Combustion-Railways	CO_2	89.39	0.00	0.992
31	Non-energy fuel use- liquid	CO_2	74.07	0.00	0.994
32	Non- CO_2 emissions from biomass combustion for energy use	CH_4, N_2O	69.07	0.00	0.995
33	Non-energy fuel use- solid	CO_2	52.86	0.00	0.995
34	CH_4 Emissions from Rice Production	CH_4	48.20	0.00	0.996
35	CH_4 Emissions from Industrial Processes - metal production	CH_4	44.82	0.00	0.997
36	Mobile Combustion-road transportation	N_2O	37.79	0.00	0.997
37	CH_4 Emissions from Stationary Combustion	CH_4	35.18	0.00	0.998
38	CH_4 Emissions from Agricultural Residue Burning	CH_4	33.80	0.00	0.998
39	Mobile Combustion-road transportation	CH_4	21.28	0.00	0.999
40	N_2O Emissions from Agricultural Residue Burning	N_2O	9.55	0.00	0.999
41	Total others		80.78	0.00	
	Totals		**67 510.92**		

The analysis of the **Table A1.1** shows that sum number of the key sources is 20 from total 41 sources. They are ordered in places by their growth in the first row of the table. This row is called ***primary*** with its symbol **T1 – l.**

A big difference is observed between the first and the following key sources in the primary row. Whereas the first source renders 37% of the total emissions in the country, the second one gives 10% and the third one – 7%. Frequently, for the purposes of different analyses of the GHG emissions are searched these key sources, which give over 55% of the total emissions. For the Bulgarian inventory these sources turned out to be the first five ones.

The order of the key sources accounting the emission trend is presented in **Table A1.2**. The table's analysis and its comparison with the upper table show the following changes:

- The total number of key sources has increased compare to previous submission and is 19 numbers;
- 3 sources have dropped out from the list with key sources and 2 more are included;
- There is a re-arrangement of the key sources – some of them are in upper place (from 6^{th} and 17^{th} relatively to a 2^{nd} and 4^{rd}), others are in lower places (from 2^{nd} and 4^{rd} to a 3^{th} and 8^{th} place).

In the last column of **Table A1.2** is given the order of the sources in line with the Rule B (with a designation **T1-t**) and in the first column are the numbers of the sources from the primary row.

A considerable step upper have such sources as New gases – from 26^{th} place to a 7^{th} place and CO_2 from combustion in transport - other type of transport – 17^{th} place to a 4^{th} place, etc.

The determination of the key sources according to this rule leads to an accounting of the rate of emissions change of each source for the past period expressed in its trend towards the base year. This brings the opportunity for additional assessments of performances of the key sources. For example, the key sources, which render over 55% of the assessment of the sum trend, are only the first three sources.

Source ranking using IPCC Tier 1 trend assessment 2004, Gg CO_2-eq.

Table A1.2

IN	IPCC Source Categories	Gas	CO_2-eq. 1988	CO_2-eq. 2004	Trend assessment	% Contribution to Trend	Cumulative total of Trend	T1- trend
1	CO_2 Emissions from Stationary Combustion-Energy Industries, Coal	CO_2	31 317.79	25 082.65	0.26	0.327	0.327	1
6	CO_2 Emissions from Stationary Combustion – Oil	CO_2	19 684.73	4 210.91	0.17	0.210	0.537	2
2	Mobile Combustion- road transportation	CO_2	7 747.49	6 549.98	0.08	0.093	0.630	3
17	Mobile Combustion-other transportation	CO_2	3 998.39	659.44	0.04	0.050	0.680	4
10	CO_2 Emissions from Stationary Combustion-Other Sectors, Coal	CO_2	4 953.42	1 300.81	0.04	0.044	0.724	5
5	CH_4 Emissions from Solid Waste Disposal Sites	CH_4	10 817.92	4 545.24	0.03	0.035	0.759	6
26	New gases	PFC, HFC, SF_6	1 844.93	254.16	0.02	0.025	0.783	7
4	CO_2 Emissions from Stationary Combustion – Gas	CO_2	10 258.84	4 643.30	0.02	0.021	0.805	8
8	CH_4 Emissions from Enteric Fermentation in Domestic Livestock	CH_4	4 048.54	1 491.48	0.02	0.021	0.825	9
15	Indirect N_2O Emissions from Agriculture Soils	N_2O	2 824.66	914.99	0.02	0.019	0.844	10
13	Direct N_2O Emissions from Agriculture Soils	N_2O	3 273.15	1 158.86	0.01	0.018	0.863	11
14	CO_2 from Lime Production	CO_2	1 117.84	955.60	0.01	0.014	0.876	12
16	N_2O Emissions from Nitric Acid Production	N_2O	2 421.72	858.11	0.01	0.014	0.890	13
9	CO_2 Emissions from Cement Production	CO_2	2 006.25	1 376.28	0.01	0.013	0.903	14
20	N_2O Emissions from Animal Production	N_2O	1 652.29	537.46	0.01	0.011	0.914	15
7	CO_2 Emissions from Steel Production	CO_2	2 360.38	1 504.73	0.01	0.011	0.924	16
11	Emissions from Wastewater Handling	CH_4	1 844.93	1 233.07	0.01	0.010	0.935	17
21	CH_4 Emissions from Manure Management	CH_4	1 523.61	515.60	0.01	0.009	0.944	18
12	Fugitive Emissions from Coal Mining and Handling	CH_4	1 991.58	1 232.71	0.01	0.008	0.952	19
22	CO_2 from Ammonia Production	CO_2	1 157.13	407.65	0.01	0.007	0.959	20
18	Non-energy fuel use- gas	CO_2	990.06	656.40	0.00	0.005	0.964	21
23	N_2O Emissions from Manure Management	N_2O	1 056.05	395.85	0.00	0.005	0.969	22
3	CO_2 Emissions from Stationary Combustion-Manufacturing Industries, Coal	CO_2	9 272.44	4 852.45	0.00	0.004	0.974	23
24	N_2O Emissions from Stationary Combustion	N_2O	396.43	316.52	0.00	0.004	0.978	24
31	Non- energy fuel use- liquid	CO_2	354.00	74.07	0.00	0.004	0.982	25
30	Mobile Combustion-Railways	CO_2	368.04	89.39	0.00	0.004	0.985	26

IN	IPCC Source Categories	Gas	CO_2-eq. 1988	CO_2-eq. 2004	Trend assessment	% Contribution to Trend	Cumulative total of Trend	T1- trend
19	Fugitive Emissions from Oil and Gas Operations	CH_4	1 278.86	559.28	0.00	0.003	0.988	27
25	CO_2 from Limestone and Dolomite use	CO_2	460.83	314.27	0.00	0.003	0.991	28
29	CO_2 Emissions from Industrial Processes - others	CO_2	38.61	97.47	0.00	0.003	0.994	29
32	Non-CO_2 emissions from biomass combustion for energy use	CH_4, N_2O	34.39	69.07	0.00	0.002	0.996	30
28	CO_2 from Soda Ash Production	CO_2	233.19	138.92	0.00	0.001	0.997	31
36	Mobile Combustion-road transportation	N_2O	48.27	37.79	0.00	0.000	0.997	32
34	CH_4 Emissions from Rice Production	CH_4	119.25	48.20	0.00	0.000	0.998	33
33	Non-energy fuel use- solid	CO_2	80.42	52.86	0.00	0.000	0.998	34
41	Total others		179.38	80.78	0.00	0.000	0.998	35
37	CH_4 Emissions from Stationary Combustion	CH_4	48.73	35.18	0.00	0.000	0.999	36
38	CH_4 Emissions from Agricultural Residue Burning	CH_4	46.35	33.80	0.00	0.000	0.999	37
27	Emissions from Wastewater Handling	N_2O	310.49	149.94	0.00	0.000	0.999	38
35	CH_4 Emissions from Industrial Processes - metal production	CH_4	73.20	44.82	0.00	0.000	1.000	39
39	Mobile Combustion-road transportation	CH_4	53.52	21.28	0.00	0.000	1.000	40
40	N_2O Emissions from Agricultural Residue Burning	N_2O	15.10	9.55	0.00	0.000	1.000	41
	Totals		**132 303.16**	**67 510.92**	**0.81**			

1.3 Method Tier 2 for Assessment of the Key Sources

With the use of the uncertainty assessments for each key source as a weight factor/coefficient is done a new order of the key sources. This is the core of the method from type Tier 2 described in the Good Practice Guidance.

In **Table A1.3** is presented the list of key sources after the application of Rule A. In the last column are given the serial numbers from the list with designation **T2-l**.

In the order of the key sources in the upper table are present the following changes in comparison with the primary row:

- the total number of key sources is decreased on 18 numbers compare to previous submission;
- 5 sources are out the list of the key sources and three others are included;
- there is a re-order of the key sources – some are at upper place (from 20, 15, 12 relatively to a 7, 2, 4) and others are come down (from 1, 2 and 3 to a 5, 14 and 12 place).

It is evident that the use of the uncertainties as weight coefficients gives more priority to the incorrect emission sources as are the emissions from nitric oxides from soils, emissions from the nitric acid production and other similar.

In the **Table A1.4** is presented the list of key sources received of the application of Rule B. In the last are given the serial numbers of the list with designation **T2-t.**

In the order of the key sources according to this approach in the upper table are shown the biggest changes compared to the primary row:

- the total number of key sources is decreased on 17 numbers compare to previous submission;
- 7 sources were come out of the list with the key sources and 4 more are included;
- there is a significant re-order of the sources related to the solid wastes and agricultural soils – from 15, 13 and 5 place, they moved to the first three places;
- significant sources of GHG emissions are come down notably – from 2, 3, and 4 places relatively to a 14, 28, and 21nd place.

Obviously, the use of the uncertainties as weight coefficients in combination with the emission trend toward the base year shows a completely different picture of the key sources compared to the assessments by the method type Tier 1 in which only the emission absolute level is accounted.

The overall conclusion from the analysis of the key sources by the two methods is that it is possible to cover wilder range of characteristics/peculiarities of this index category the GHG inventory.

Sorted Tier 2 level assessment Key sources

Table A1.3

IN	IPCC source category	Gas	CO_2-eq. 2004	Share	Comb. Unc. %	T2 Level ass., %	% of Level ass.	Cumul. share	T2-level
5	CH_4 Emissions from Solid Waste Disposal Sites	CH_4	4 545.24	0.067	102.0	6.87	0.172	0.172	1
15	Indirect N_2O Emissions from Agriculture Soils	N_2O	914.99	0.014	500.0	6.78	0.169	0.341	2
13	Direct N_2O Emissions from Agriculture Soils	N_2O	1 158.86	0.017	250.0	4.29	0.107	0.448	3
12	Fugitive Emissions from Coal Mining and Handling	CH_4	1 232.71	0.018	200.2	3.66	0.091	0.540	4
1	CO_2 Emissions from Stationary Combustion- Energy Industries, Coal	CO_2	25 082.65	0.372	8.6	3.20	0.080	0.620	5
16	N_2O Emissions from Nitric Acid Production	N_2O	858.11	0.013	200.2	2.55	0.064	0.683	6
20	N_2O Emissions from Animal Production	N_2O	537.46	0.008	250.0	1.99	0.050	0.733	7
23	N_2O Emissions from Manure Management	N_2O	395.85	0.006	300.0	1.76	0.044	0.777	8
11	Emissions from Wastewater Handling	CH_4	1 233.07	0.018	85.4	1.56	0.039	0.816	9
8	CH_4 Emissions from Enteric Fermentation in Domestic Livestock	CH_4	1 491.48	0.022	50.0	1.11	0.028	0.844	10
24	N_2O Emissions from Stationary Combustion	N_2O	316.52	0.005	200.1	0.94	0.023	0.867	11
3	CO_2 Emissions from Stationary Combustion- Manufacturing Industries, Coal	CO_2	4 852.45	0.072	8.6	0.62	0.015	0.882	12
9	CO_2 Emissions from Cement Production	CO_2	1 376.28	0.020	30.1	0.61	0.015	0.898	13
2	Mobile Combustion- road transportation	CO_2	6 549.98	0.097	5.8	0.57	0.014	0.912	14
4	CO_2 Emissions from Stationary Combustion – Gas	CO_2	4 643.30	0.069	7.1	0.49	0.012	0.924	15
6	CO_2 Emissions from Stationary Combustion – Oil	CO_2	4 210.91	0.062	7.1	0.44	0.011	0.935	16
19	Fugitive Emissions from Oil and Gas Operations	CH_4	559.28	0.008	50.2	0.42	0.010	0.946	17
26	New gases	PFC, HFC, SF6	254.16	0.004	104.4	0.39	0.010	0.955	18
21	CH_4 Emissions from Manure Management	CH_4	515.60	0.008	50.2	0.38	0.010	0.965	19
7	CO_2 Emissions from Steel Production	CO_2	1 504.73	0.022	10.4	0.23	0.006	0.971	20
14	CO_2 from Lime Production	CO_2	955.60	0.014	15.8	0.22	0.006	0.976	21
10	CO_2 Emissions from Stationary Combustion- Other Sectors, Coal	CO_2	1 300.81	0.019	8.6	0.17	0.004	0.980	22
22	CO_2 from Ammonia Production	CO_2	407.65	0.006	20.6	0.12	0.003	0.984	23
25	CO_2 from Limestone and Dolomite use	CO_2	314.27	0.005	15.8	0.07	0.002	0.985	24
17	Mobile Combustion-other transportation	CO_2	659.44	0.010	7.1	0.07	0.002	0.987	25
18	Non-energy fuel use- gas	CO_2	656.40	0.010	7.1	0.07	0.002	0.989	26
35	CH_4 Emissions from Industrial Processes - metal production	CH_4	44.82	0.001	100.0	0.07	0.002	0.991	27
33	Non-energy fuel use- solid	CO_2	52.86	0.001	83.8	0.07	0.002	0.992	28
27	Emissions from Wastewater Handling	N_2O	149.94	0.002	20.6	0.05	0.001	0.993	29
28	CO_2 from Soda Ash Production	CO_2	138.92	0.002	20.6	0.04	0.001	0.994	30

IN	IPCC source category	Gas	CO_2-eq. 2004	Share	Comb. Uncle. %	T2 Level ass., %	% of Level ass.	Cumul. share	T2-level
36	Mobile Combustion-road transportation	N_2O	37.79	0.001	51.0	0.03	0.001	0.995	31
40	N_2O Emissions from Agricultural Residue Burning	N_2O	9.54	0.000	201.6	0.03	0.001	0.996	32
38	CH_4 Emissions from Agricultural Residue Burning	CH_4	33.80	0.001	55.9	0.03	0.001	0.997	33
37	CH_4 Emissions from Stationary Combustion	CH_4	35.18	0.001	50.2	0.03	0.001	0.997	34
41	Total others		80.78	0.00	20.62	0.02	0.00	0.998	35
31	Non- energy fuel use- liquid	CO_2	74.07	0.001	20.6	0.02	0.001	0.998	36
32	Non- CO_2 emissions from biomass combustion for energy use	CH_4, N_2O	69.07	0.001	20.6	0.02	0.001	0.999	37
34	CH_4 Emissions from Rice Production	CH_4	48.20	0.001	20.6	0.01	0.000	0.999	38
39	Mobile Combustion-road transportation	CH_4	21.28	0.000	40.1	0.01	0.000	1.000	39
30	Mobile Combustion-Railways	CO_2	89.39	0.001	7.1	0.01	0.000	1.000	40
29	CO_2 Emissions from Industrial Processes - others	CO_2	97.47	0.001	5.8	0.01	0.000	1.000	41
	TOTALS		**67 510.92**			**40.01**			

Sorted Tier 2 trend assessment Key sources

Table A1.4

IN	IPCC Source Categories	Gas	CO_2-eq. 1988	CO_2-eq. 2004	Trend ass.	Comb. Uncle. %	T2 Trend ass. %	% of Trend ass.	Cumul. of Trend	T2-trend
15	Indirect N_2O Emissions from Agriculture Soils	N_2O	2 824.66	914.99	0.015	500	7.64	0.241	0.241	1
13	Direct N_2O Emissions from Agriculture Soils	N_2O	3 273.15	1 158.86	0.015	250	3.71	0.117	0.359	2
5	CH_4 Emissions from Solid Waste Disposal Sites	CH_4	10 817.92	4 545.24	0.028	102	2.89	0.091	0.450	3
1	CO_2 Emissions from Stationary Combustion- Energy Industries, Coal	CO_2	31 317.79	25 082.65	0.264	9	2.27	0.072	0.521	4
20	N_2O Emissions from Animal Production	N_2O	1 652.29	537.46	0.009	250	2.22	0.070	0.592	5
16	N_2O Emissions from Nitric Acid Production	N_2O	2 421.72	858.11	0.011	200	2.20	0.069	0.661	6
26	New gases	PFC, HFC, SF6	1 844.93	254.16	0.020	104	2.08	0.066	0.727	7
12	Fugitive Emissions from Coal Mining and Handling	CH_4	1 991.58	1 232.71	0.006	200	1.26	0.040	0.766	8
23	N_2O Emissions from Manure Management	N_2O	1 056.05	395.85	0.004	300	1.25	0.039	0.806	9
6	CO_2 Emissions from Stationary Combustion – Oil	CO_2	19 684.73	4 210.91	0.169	7	1.20	0.038	0.844	10
8	CH_4 Emissions from Enteric Fermentation in Domestic Livestock	CH_4	4 048.54	1 491.48	0.017	50	0.83	0.026	0.870	11
11	Emissions from Wastewater Handling	CH_4	1 844.93	1 233.07	0.008	85	0.72	0.023	0.893	12
24	N_2O Emissions from Stationary Combustion	N_2O	396.43	316.52	0.003	200	0.66	0.021	0.914	13
2	Mobile Combustion- road transportation	CO_2	7 747.49	6 549.98	0.075	6	0.44	0.014	0.928	14
21	CH_4 Emissions from Manure Management	CH_4	1 523.61	515.60	0.008	50	0.38	0.012	0.940	15
9	CO_2 Emissions from Cement Production	CO_2	2 006.25	1 376.28	0.010	30	0.31	0.010	0.949	16
10	CO_2 Emissions from Stationary Combustion- Other Sectors, Coal	CO_2	4 953.42	1 300.81	0.036	9	0.31	0.010	0.959	17
17	Mobile Combustion-other transportation	CO_2	3 998.39	659.44	0.040	7	0.28	0.009	0.968	18
14	CO_2 from Lime Production	CO_2	1 117.84	955.60	0.011	16	0.18	0.006	0.974	19
19	Fugitive Emissions from Oil and Gas Operations	CH_4	1 278.86	559.28	0.003	50	0.14	0.004	0.978	20
4	CO_2 Emissions from Stationary Combustion – Gas	CO_2	10 258.84	4 643.30	0.017	7	0.12	0.004	0.982	21
22	CO_2 from Ammonia Production	CO_2	1 157.13	407.65	0.005	21	0.11	0.003	0.985	22
7	CO_2 Emissions from Steel Production	CO_2	2 360.38	1 504.73	0.009	10	0.09	0.003	0.988	23
31	Non-energy fuel use- liquid	CO_2	354.00	74.07	0.003	21	0.06	0.002	0.990	24
25	CO_2 from Limestone and Dolomite use	CO_2	460.83	314.27	0.002	16	0.04	0.001	0.991	25

IN	IPCC Source Categories	Gas	CO_2-eq. 1988	CO_2-eq. 2004	Trend ass.	Comb. Uncle. %	T2 Trend ass. %	% of Trend ass.	Cumul. of Trend	T2-trend
18	Non-energy fuel use- gas	CO_2	990.06	656.40	0.004	7	0.03	0.001	0.992	26
32	Non- CO_2 emissions from biomass combustion for energy use	CH_4, N_2O	34.39	69.07	0.001	21	0.03	0.001	0.993	27
3	CO_2 Emissions from Stationary Combustion- Manufacturing Industries, Coal	CO_2	9 272.44	4 852.45	0.004	9	0.03	0.001	0.994	28
33	Non-energy fuel use- solid	CO_2	80.42	52.86	0.000	84	0.03	0.001	0.995	29
35	CH_4 Emissions from Industrial Processes - metal production	CH_4	73.20	44.82	0.000	100	0.02	0.001	0.996	30
30	Mobile Combustion-Railways	CO_2	368.04	89.39	0.003	7	0.02	0.001	0.996	31
36	Mobile Combustion-road transportation	N_2O	48.27	37.79	0.000	51	0.02	0.001	0.997	32
38	CH_4 Emissions from Agricultural Residue Burning	CH_4	46.35	33.80	0.000	56	0.02	0.001	0.998	33
37	CH_4 Emissions from Stationary Combustion	CH_4	48.73	35.18	0.000	50	0.02	0.000	0.998	34
29	CO_2 Emissions from Industrial Processes - others	CO_2	38.61	97.47	0.002	6	0.01	0.000	0.998	35
28	CO_2 from Soda Ash Production	CO_2	233.19	138.92	0.001	21	0.01	0.000	0.999	36
40	N_2O Emissions from Agricultural Residue Burning	N_2O	15.10	9.55	0.000	201.6	0.0	0.000	0.999	37
34	CH_4 Emissions from Rice Production	CH_4	119.25	48.20	0.000	21	0.01	0.000	0.999	38
39	Mobile Combustion-road transportation	CH_4	53.52	21.28	0.000	40	0.01	0.000	1.000	39
41	Total others		179.38	80.78	0.00	20.62	0.01	0.00	1.000	40
27	Emissions from Wastewater Handling	N_2O	310.49	149.94	0.000	21	0.01	0.000	1.000	41
	Totals		**132 303.16**	**67 510.92**			**32**	**1.00**		

ANNEX 2: METHODOLOGY AND DATA FOR ASSESSMENT OF CO_2 EMISSIONS FROM FUEL COMBUSTION

CO_2 emissions from fuel combustion are calculated on the basis of statistics for combustible fuels, carbon content of the fuels and the degree of oxidation. A difference between the following main categories is made:

- Stationary combustion of fossil fuels;
- Mobile combustion of fossil fuels;
- Non-energy use of the fuels;
- Waste and biomass combustion.

Stationary Combustion

CO_2 emissions from fuels in electric plants, refineries, large industrial consumers and other sources are determined on the basis of fuel quantities given in the overall energy balance of the country and emissions factors presented in **Table A2.1**. These factors are aggregated at a level type of fuel. As it is seen from the table, they account also the type of the combustion technology depending on the source. More detailed separation of the emission factors in industrial sectors and types of electric power plants is presented in the National Inventory Report for the year 2002.

In the present inventory the change is made of emission factors for N_2O emissions at fuel combustion in the above sources. Used up to now emission factors were defined on the basis of local trials and were considerable bigger from the standard IPCC factors.

In the result of implemented our study was determined that the big part by the initial information for defining of these factors was not sufficiently fully, authenticable and valid. Because of that we decided to work with standard factors till new measuring and analytic calculation of factors be implemented.

In our general assessment, the level of N_2O emissions from stationary processes in condition of Bulgaria is not appreciated. In **Table A2.2** are given for comparison values of emission factors for implemented fuels in electric power plants from the types: condensing, co-generation in district heating systems and auto generation.

Default CO_2 emission factors used for Sectoral Approach

Table A2.1

Fuels	Carbon content	LCV	EF	EF
	%	GJ/t	kg/t	kg/GJ
Hard coal				
Residential	79	24.0	2 431	101.3
Metal industry	68.5	21.0	2 127	101.3
Public Power Plant	66.6	23.1	2 342	101.4
CHP	65.9	26.0	2 938	113.0
Coke	84	30.0	3 180	106.0
Petroleum Coke	99	31.0	3 193	103.0
Brown Coal				
Public Power Plant	55	12.0	1 141	95.1
CHP	47	9.0	810	90.0
Metal industry	58	18.0	1 721	95.6
Residential	55	18.0	1 721	95.6
Lignite				
Public Power Plant	18	6.5	728	112.0
CHP	25	7.6	760	100.0
Residential	30	10.4	1 147	110.3
Wood, sp. m^3	45	3.8	375	98.7
BKB	62	18.2	1 820	100.0
Gasoline	87	44.0	3 172	72.1
Diesel Oil	87	41.9	3 189	76.1
LPG	82	52.0	3 245	62.4
Gas Oil	87	41.5	3 042	73.3
Residual Fuel Oil	86	39.8	3 049	76.6
Natural Gas, th. nm^3	58	33.5	1 870	55.8
Dry gas		45.0	2 970	66.0
Coke oven gas, th. m^3		17.6	827	47.0
Blast furnace gas, th. m^3		3.7	877	237.0

Table A2.2

Only Electricity Public Generation	EF, g/GJ	
	N_2O	N_2O
	new	old
Natural Gas	0.1	3.0
LPG	0.6	0
Gas Oil	0.4	1.84
Residual Fuel Oil	0.3	18.20
Anthracite	1.60	18.20
Black Coal	1.60	18.20
Brown Coal	1.60	22
Lignite	2.3	40.3
Coke	1.60	0
Diesel Oil	0.4	1.84
BKB	2.0	40.3

Combined Heat & Electricity Public Generation	EF, g/GJ	
	N_2O new	N_2O old
Coke Gas	0.1	0.00
Blast Gas	0.1	0.00
Natural Gas	0.1	3.0
LPG	0.6	0
Gas Oil	0.4	1.84
Residual Fuel Oil	0.3	18.20
Anthracite	1.60	18.20
Black Coal	1.60	18.20
Brown Coal	1.60	22
Lignite	2.3	40.3
Dry gas	0.1	0
Diesel Oil	0.4	1.84
BKB	2.0	40.3
Combined Heat & Electricity Auto-generation	**EF, g/GJ**	
	N_2O new	N_2O old
Natural Gas 1000 m^3	0.1	3.0
LPG	0.1	0
Gas Oil	0.4	0
Res. Fuel Oil + Gudron	0.3	18.22
Anthracite	1.60	18.20
Black Coal	1.60	18.20
Brown Coal	1.60	22
Lignite	2.3	40.3
Coke/Tar	1.60	18.20
Dry gas	0.1	18.20
BKB/ Waste industrial	2.0	40.3
Coke Gas	0.1	0.00
Blast Gas	0.1	0.00
Heat Plants	**EF, g/GJ**	
	N_2O new	N_2O old
Natural Gas	0.1	3.0
LPG	0.1	0
Gas Oil	0.4	0
Residual Fuel Oil	0.3	18.20
Anthracite	1.60	18.10
Black Coal	1.60	18.10
Brown Coal	1.60	22
Lignite	2.0	40.3
Coke	1.60	0
Wood	1.60	0
BKB	2.0	40.3

Mobile Combustion

The mobile sources of CO_2 emissions include all types of transport as well as the internal-combustion engines used in the agriculture and forestry and construction sector (so-called "off-road" motor vehicles).

The methodology of GHG emission calculation, including the carbon dioxide is based on the method from type Tier 2 which uses the following main data sources:

- Quantities of consumed fuels by types;
- Number, type and size of the motor vehicles;
- Average size of the road distance and the delivered cargoes;
- Differentiated emission factors by kind, type and size of the motor vehicles.

In defining the CO_2 emissions, the emission factors do not depend significantly on the type and the technology of the combustion and in this sense the differentiation of the factors is only by type of fuel. However, regarding the other GHGs, the type of the motor vehicle play a main role. The classification of emission factors by types of motor vehicles is given in annex to the previous National Inventory Report for the year 2004.

CO_2 emissions from international marine and air transport combustion are calculated with the same data and emission factors as for the domestic transport, but they are related to the international bunkers and are not included in the overall national GHG emissions. They are reported at separate positions in the CRF tables.

Non-energy use of fuels

The application of the Reference Approach for calculation of the national CO_2 emissions includes also a determination of the stored carbon in the products. In this manner is accounted the non-energy use of the fuels as well as their usage as row materials for the production of chemicals.

The share of the carbon stored in products is presented in **Table A2.3**.

The values indicated in the table are standard and are taken from the Revised IPCC Guidance. It is evident from the data in the table that one part of the carbon is emitted in the atmosphere as CO_2 emissions. Till now these emissions were accounted only at the Reference Approach. Starting from the preceding inventory 2003, they are accounted at the Sectoral Approach already as well. Respectively, it is done for all the past inventories in the framework of the done recalculations.

CO_2 emissions from non-energy use of fuels are structured in category Manufacturing Industry and Construction at sector Energy.

Carbon storage fractions for energy carriers used as feedstock

Table A2.3

FUEL TYPE	Fraction of carbon stored 2003
Naphtha	0.75
Lubricants	0.50
Bitumen	1.00
Coal Oils and Tars (from Coking Coal)	0.75
Natural Gas	0.33
Gas/Diesel Oil	0.50
LPG	0.80
Gudron	0.85
Other (please specify)	
Petroleum Coke	0.85
Residual Oil	0.75
Kerosene	0.8
Distillate	1
Turpentine and Solvent gasoline	0.85
Low octane gasoline, refinery gasoline	0.8

Waste and biomass combustion

A practice of waste combustion for energy production is not yet introduced in Bulgaria. At a moment investigations are carried out within this direction. The wastes are combusted only for the purpose of their liquidation as emission pollutants and they are not calculated by the IPCC methodology. It regards some dangerous wastes and wastes from medical service of the population and etc.

Biomass combustion (mainly wood and wooden wastes form felling) for energy production, food preparation and other purposes is a common practice in Bulgaria. The CO_2 emissions from these activities are net emissions and they do not participate in the GHG Inventory. The same is applied to the plant combustible wastes, which are picked up by the people.

Other GHG emissions and GHG precursors are calculating and are including in GHG inventory.

In the last two-three years, an expressed tendency is observed of increasing wood consumption for household heating. The cause of that is increased prize of liquid fuels, coals and briquettes and slowly speeds of entering of nature gas in the households.

ANNEX 3: METHODOLOGY FOR CALCULATION OF GHG EMISSIONS FOR SOME SOURCES AND SINKS

3.1 Methodology for Calculation of GHG Emissions from Sources in Bulgaria

The GHG emissions from fuel combustion and technological processes are calculated on the basis of combination of specific for the country methodologies and emission factors and such as those given in the IPCC Guidance as standards.

Emissions of carbon dioxide from sources other than fuels

The sources of CO_2 emissions in Bulgaria regardless of fuels are:

- Steel production;
- Cement production; Lime production;
- Lime production;
- Ammonia production;
- Production and consumption of soda ash;
- Carbide production;
- Consumption of limestone and dolomite;
- Glass production;
- Desulphurization of output gases in thermo-electric power plants;
- Steel, aluminium and Ferro-alloys production.

The determination of the emissions from the upper sources is done by the methods of types Tier 1 and Tier 2 (only for cement) according the Good Practice Guidance. The first sulphur purification installation works from the end of the year 2002 at the energy complex Maritza East. The calculation of the emitted CO_2 in the atmosphere is based on the quantities of used for this purpose lime.

Emissions of methane

Methane emissions from *fuel combustion* represent considerable smaller part from the other emission sources from these type GHG emissions. They stay at the end of the list of non-emission key sources of GHG emissions.

The fugitive emissions of methane from the coal extraction and systems of extraction and transmission/distribution of gas comprise over 3% of the overall emissions in the country. From them, the fugitive emissions from coal extraction are key source. The emission factors for their determination are given in the previous 2004 National Inventory Report.

One of the most considerable sources of methane is the *Agriculture*. The emissions from enteric fermentation and from manure management take up bigger part of these emissions. They are determined by method from type Tier 1 and only for the emissions of cattle and swine manure is applied method from type Tier 2. Most part of the emission factors are taken from the Good Practice Guidance and from the Revised IPCC Guidelines.

Methane emissions from the deposing of *solid waste* are the biggest GHG source in Bulgaria. They comprise 7% of the overall emissions in the country for the year 2004. Despite of this the used method for their determination is from type Tier 1. This does not meet the requirement of the good practices but for now that is the situation in Bulgaria because the time series for the quantities of the collected wastes is not sufficiently large. In the framework of a National system for assessment of anthropogenic GHG emissions must be implement a general research for creating of such time series, in which the problem with the lack of data would be central. The present accountancy in Bulgaria not support for solving the problem too. Using of imitation models, which works with data

extrapolation including data from neighbourly countries should be investigate and ground in such one study.

Emissions of nitrogen oxide

N_2O emissions from *fuel combustion* represent small part of the overall emissions from this type GHGs for the year 2004 – around 8%. The energy sub-sectors – electricity and heat production emit the major part of them.

Certain quantities of N_2O – 19.5% are emitted from the *technological processes* and moreover in production of nitric acid. At a present there are no data for the emissions of this GHG within the category sources from sector Solvent Use.

One of the most significant sources of N_2O is the *Agriculture*. The emissions of this sector are 68% from the overall emissions from this type GHG for the year 2004.

The biggest source of N_2O emissions within the sector is the agricultural soils. The parameters and the emission factors that are used for calculation are taken from the Revised IPCC Guidance. They had undergone a certain correction after the held revision of the 2003 Inventory by the international team from the UNFCCC Secretariat in Bonn, Germany, 2005. In **Table A3.1** are presented the parameters and the emission factors used in the 2004 Inventory.

Emissions of HFCs, PFCs and SF_6

There is no production of F-gases in Bulgaria.

There is an import of substances and products that contain halocarbons. In this way only potential emissions of HFCs are determined.

Actual emissions of PFCs are only from aluminium production. Their determination is according to method from type Tier 1 given in the IPCC Guidelines.

Actual emissions of SF_6 are defined only on the basis of the fugitive emissions from the fulfilled with this gas electric commutation apparatuses. For this purpose the standard method from the Good Practice Guidance is applied.

Parameters and Emission factors for Agriculture

Table A3.1

Enteric Fermentation	CH_4 EF (kg/head/yr)
1. Cattle	
Dairy Cattle	81.00
Non-Dairy Cattle	56.00
2. Buffalo	55.00
3. Sheep	8.00
4. Goats	5.00
5. Camels and Llamas	0.00
6. Horses	18.00
7. Mules and Asses	10.00
8. Swine	1.50
9. Poultry	0.01

Manure Management	**CH_4** **EF** (kg/head/yr)
1. Cattle	16.00
Dairy Cattle	18.30
Non-Dairy Cattle	12.21
2. Buffalo	9.00
3. Sheep	0.28
4. Goats	0.18
5. Camels and Llamas	NO
6. Horses	2.08
7. Mules and Asses	1.14
8. Swine	9.95
9. Poultry	0.12
Manure Management	**N** kg/head/yr
Non-Dairy Cattle	50.0
Dairy Cattle	70.0
Sheep	16.0
Swine	20.0
Poultry	0.6
Other (please specify)	25.0
Animal Waste Management System	**N_2O** **EF3**, kg N_2O - N/kg N excreted
Anaerobic lagoon	0.001
Liquid system	0.001
Solid storage and dry lot	0.020
Other	0.005

Agriculture soils- Direct N_2O Emissions		
EF1	kg N_2O – N/ kg N	0.01
EF2	kg N_2O – N/ ha/yr	8.00
$Frac_{BURN}$	kg N/ kg crop-N	0.1
$Frac_R$	kg N/ kg crop-N	0.45
$Frac_{FUEL}$	kg N/ kg N excreted	0.0
$Frac_{GASF}$	kg NH_3 – N+NOx-N/ kg of synthetic fertilizer N applied	0.1
$Frac_{GASM}$	kg NH_3 – N+NOx-N/ kg of N excreted by livestock	0.2
$Frac_{GRAZ}$	Range 45-50%	43.5% for 2004
$Frac_{NCRBF}$	kg N/ kg of dry biomass	0.030
$Frac_{NCR0}$	kg N/ kg of dry biomass	0.015
EF3	kg N_2O – N/ kg N excreted	
Animal Waste Management System	*Daily spread*	0.00
	Pasture range and paddock(grazing)	0.02

Agriculture soil - Indirect N_2O Emissions		
$EF4_{(N\ deposition)}$	kg N_2O – N/ kg NH_3 – N and NOx – N emitted	0.01
$EF5_{(leaching/runoff)}$	kg N_2O – N/ kg N leaching/runoff	0.025
$Frac_{LEACH}$	kg N/ kg of fertilizer or manure N	0.10
$EF6_{(sewage)}$	kg N_2O – N/ kg N sewage-N produced	0.01
$Frac_{NPR}$	kg N/ kg of protein	0.16

Rice Cultivation	**With fertilizing**	**Without fertilizing**
	kg/ha/yr	
EF - CH_4	403	162

Agriculture Residue		
	C fraction % dm	N-C ratio
1. Cereals		
Wheat	0.4853	0.0058
Barley	0.4567	0.0094
Maize - corn	0.4709	0.0200
Oats	0.4567	0.0154
Rye	0.4567	0.0102
Rice	0.4144	0.0162
Other (please specify)		
Maize – for fodder	0.4709	0.0200
2. Pulse (1)		
Dry bean	0.45	0.0444
Peas	0.45	0.0316
Soybeans	0.45	0.0511
Other (please specify)		
Lentils	0.45	0.0511
Chick-Peas	0.45	0.0511
3 Tuber and Root		
Potatoes	0.4226	0.0260
Other (please specify)		
4 Sugar Beet	0.4072	0.0246
5 Other (please specify)		
Cotton	0.450	0.018
Sunflower	0.471	0.02
Tobacco	0.471	0.02
Feed beet	0.407	0.0560
Peanut	0.450	0.0236

3.2 Additional Data for the Forest in Bulgaria

Background

The area of the territories and forests from the forestry fund of Bulgaria (forestry fund) in 2004 is 4 063 555 ha which is 36% of the country's territory. The area covered with forests is 3 648 005 ha which defines 32.1% wooded territories of the country. Compared with the year 2002, the area of the forestry fund has increased with 48 319 ha due to the management of the non-arranged forests till now.

The total wooded surface (including pine-scrub) has increased with 100 549 ha as a result of newly arranged forests and the completed forestations. The un-afforested area prepared for forestation as well the forestry pastures have decreased respectively with 9 100 ha and 12 132 ha.

The area of the forests by type of property is distributed according to **Table A3.2** as follows, where data are for 2003:

Forest Area by type of ownership 2003

Table A3.2

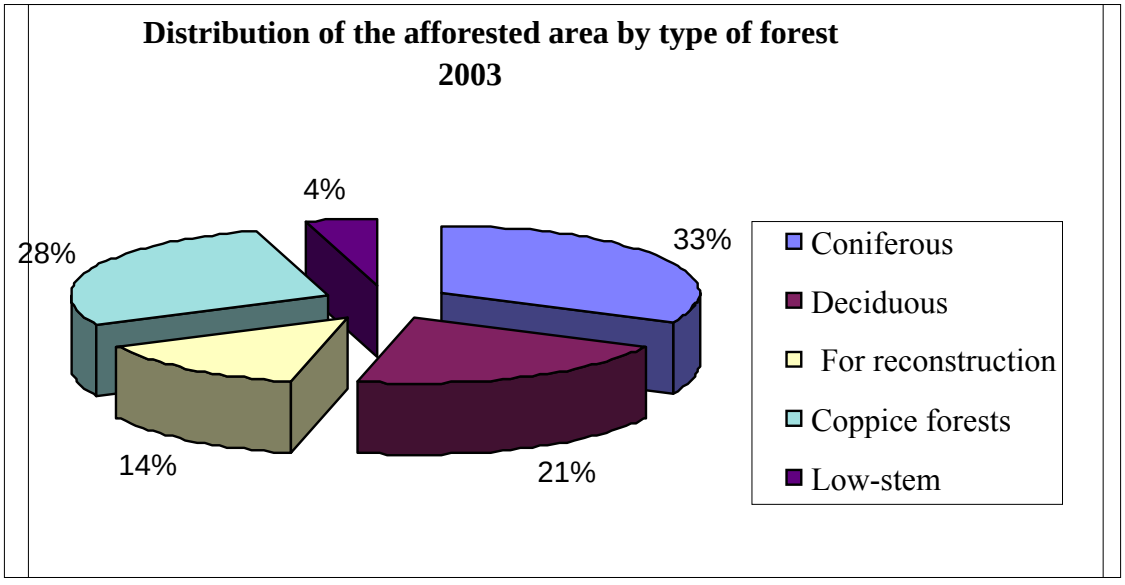
Type	Area – ha		%	
	total	afforested	From total	from afforested
State	3 195 314	2 797 529	79.6	78.9
Municipal	339 273	304 857	8.4	8.6
Private subjects	376 919	351 381	9.4	9.9
Private law subjects	7 604	6 861	0.2	0.2
Religious organizations	33 666	27 393	0.8	0.8
Others	62 460	59 416	1.6	1.6
Total	**4 015 236**	**3 547 456**	**100**	**100**

The changes in type of property are expressed in decrease the forests that are state property on the account of the increase in the forests that are municipality's property. These changes are due to the undertaken processes of reinstatement of the forests to the former owners.

The wooden reserve exceeds 591 millions m^3 within average annaul increase in around 15.223 millions m^3 and usage of the wood – 6 569 918 m^3. The planned usage for the year 2004 according to forestry management projects is 8 017 269 m^3, about 89.6% are realized from them.

The distribution of the afforested forestry area by type of woods is presented in **Figure A3.1** in percents.

Figure A3.1



The review of the dynamic in the structure of the forestry fund for the period of 2002-2004 demonstrates increase in the afforested area with coniferous forests, deciduous high-stem, offshoot and low-stem forests and decrease in the forests for reconstruction.

The area of forests that are mainly kept for timbering and site formation are 65.9%. The forests for recreation and protection occupy 26.6% and the forests and lands at the protective territories – 7.5% from the country's forestry fund.

In the year 2003 in total 9 000 ha new forests have been planted and other 2 652.3 ha are fulfilled for recuperation from the losses of forest crops. 67.7% from them are afforested with deciduous types. The afforested are mainly orientated towards an increase in the afforested area in the country,

recuperation of the forests, destroyed by fires, droughts and natural disasters. With the aim of creating stable forestry plantations, the priority in planting is given to the local tree species.

A state of health of forests

The international cooperative programme for collaboration "FORESTS" – IKE is carried out in compliance with the approved international methodology for "Assessment and monitoring of the of the impact of the polluted air on the forest's ecosystems" from European economic commission and the Regulation of the European commission.

In the year 2003, 144 experimental areas are studied and in 40 of them the studies are complex. The total number of the researched trees is 5 115, 2 959 of them are coniferous and 2 156 are deciduous. The ten regions with conventional borders approved in 1993 are preserved.

Compared to the results from 2002 in all the studied types the relative share of the bad to hard damaged and perished trees (classes of defoliation 1-4) has increased with 4.8%, and the share of the damaged (classes of defoliation 2-4) has slowly decreased – with 3.4%.

In total, 13% of all the studied coniferous trees and 27.9% of the deciduous are not damaged. The share the little damaged has significantly increased in the coniferous trees as well as the deciduous (respectively with 9.3% and 6.7%) whereas the share of the healthy ones has decreased. Among the coniferous trees in the two age groups, the common spruce (*Picea abies*) is in relatively the best condition, and among the deciduous is the common beech (*Fagus sylvatica*).

The condition of all tree types is formed as a result of complex influence of different natural and anthropogenic factors. The attacks from *Cecidomyia fagi, Rhynchaenus fagi, Dryomia circinuans, Gnomonia quercina, Microsphaera alphitoides, Neuroteurus numismalis, Nectria sp, Lophodermium sp., Cenangium sp., Heterobasidion annosum* and *Aphididae* are registered.

The management and the keeping of the trees are based on the policy and the regulative order to management of the forestry fund for a long term. For the forests with special and managerial purpose in the Republic of Bulgaria mainly a high-stem form of management is carried out. The type, methods and the ways of the felling, their intensity and repetition are in conformity with the age and the biological requirements of the tree's spices as well as the natural, economic and social conditions and are according to their function.

Activities related to the restructure of the Forest sector.

With a decision of Council of Ministers № 651 from 15.09.2003 a National Forest policy and strategy (NFPS) has been adopted based on the process of large participation of stakeholders, inter sectoral approach, integration with the National plan for economic development, co-ordination with the national legislation and the international obligations, as well as initiatives and conventions, partnership in appliance and public awareness. The main objectives of the NFPS are: sustainable development of economically vital forest sector in the conditions of market economy by multifunctional management of the forests; executing the objects and the means of the sustainable development of the forest sector in conformity with the international criteria and the responsibilities taken in this respect, setting-up conditions for providing national and international financial resources and support the sector's development.

The preparation for the project "Bulgaria – development of the forest sector" has successfully finished. It was supported by the World Bank. The aims of the project are: increasing the contribution of forests to the national economy and improvement of the living conditions of people in the rural regions by sustainable management of the state, private and municipal forests; improvement of the forest ecosystems' preserving through integrity of activities connected with the biodiversity preserving in forests and through better preservation of the threatened (crucial) ecosystems.

ANNEX 4: CO_2 REFERENCE APPROACH AND COMPARISON WITH SECTORAL APPROACH

There is a possibility for comparison and verification of the results with the sectoral approach when it is applied the reference approach for determination of CO_2 emissions from fuel combustion.

First step in the Reference Approach is calculating the gross consumption using the following formula:

Gross consumption = Production + Import – Export – International Bunkers – Provision Change

In the above equation the fuels are presented in natural fuel units (tons, m^3, etc.) from the Energy Balance. The conversion to energy units – TJ is done using conversion factors provided in the IPCC Guidelines. Local conversion factors are applied only for the local coal.

In the second step the determination of CO_2 emissions is applied. In general, the emission factors provided in the Revised IPCC Guidelines are applied.

For the latest few year research was carried out on the influence of some country specific emission factors. The comparative estimations of CO_2 emissions showed variation within 3%.

Third step in this approach is correction of overall CO_2 emissions by excluding emissions from fuels used as feedstock and for non-energy use.

In **Table A4.1** are presented the CO_2 emissions from the Energy Sector estimated both by the Reference and the Sectoral Approach.

The comparison between the overall emissions in these two approaches varies within 0.5 – 1.7% for the last five years under GHG inventory.

The differences between the emissions from the two approaches related to the main type of fuels are a result of the differences in the Fuel Balance. For example, the differences between the liquid fuels vary within 2 – 10% for the latest years and they are bigger for the Reference Approach. The differences are considerably smaller – under 2% for the solid fuels. There are also differences between the gas fuels and vary within 3 – 4%.

Main causes for the difference between Reference and Sectoral Approaches

Differences among the two approaches are mainly due to:

- Differences in the methodological approach;
- Different quantities of consumed fuels, including not taking into account the losses during fuel transformation in the sectoral approach;
- Different conversion factors for fuel conversion from natural units to energy units;
- Different emission factors for different combustion technologies used in the sectoral approach;
- Sensibility of the CO_2 emissions to the distribution of the petrol products produced in the refinery and to the carbon content of the crude petrol.

As a rule, energy values of fuels are used in Sector approach, which are defined on the basis of accounts. That means each fuel is calculated in accordance with accepted levels of aggregation of NSI, like in each year has not large differences. That is a potential source of differences in a case that for the Reference approach is used standard converter factors from IPCC Guidelines.

Influence upon differences between the two approaches has also the different emission factors. Since in the case raised the question for CO_2 emissions, these differences are not large. Cause for that is the relative independence of this GHG from the technology of fuel combustion.

Recalculations and corrections of mistakes

As a result of the recalculations there is a possibility for correction of mistakes and quality improvement of the calculated GHG emissions. In **Table A4.2** are presented the comparative CO_2 emission assessments from fuel combustion for the last five National Inventory Reports for the years 1999-2004.

The analyses of **Table A4.2** give opportunity for overall assessment of the result of the presented in Chapter 10 preconditions for carrying out the recalculations. In quantity expression it showed that CO_2 emissions are not changed after that last recalculation in present report (Presentation 2006).

Differences in emissions with 5 – 7% are observed among Presentation 2005 and Presentation 2004. For only the base year the difference is negative with 4%.

Comparison of CO_2 emissions: Reference Approach (RA) versus Sectoral Approach (SA) - NIR 2006, Gg

Table A4.1

Method/ Year	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Reference Approach																
Liquid	34 832	28 320	19 254	15 300	18 317	16 873	16 634	14 575	12 068	11 412	11 742	10 879	10 683	11 923	12 198	11 631
Solid	44 926	40 554	34 727	32 758	34 722	31 760	32 835	33 418	34 897	32 541	28 693	28 900	31 564	28 649	32 151	31 451
Gaseous	11 401	12 085	10 158	8 978	8 435	8 493	10 293	10 440	8 225	7 436	5 978	6 358	5 905	5 271	5 475	5 444
Others																
TOTAL - RA	**91 159**	**80 960**	**64 139**	**57 036**	**61 474**	**57 126**	**59 763**	**58 432**	**55 190**	**51 389**	**46 413**	**46 136**	**48 152**	**45 843**	**49 825**	**48 526**
Sectoral Approach																
Liquid	33 795	26 753	18 376	14 699	15 614	14 457	14 645	13 464	11 576	12 261	11 906	10 525	10 473	10 853	11 734	11 688
Solid	45 682	39 903	34 925	33 640	35 847	34 052	34 709	34 907	36 958	31 661	28 943	29 055	31 315	29 103	32 138	31 289
Gaseous	11 249	12 016	10 055	8 858	8 221	8 149	10 022	9 843	8 168	6 891	5 898	6 281	5 687	5 098	5 295	5 300
Others																
TOTAL - SA	**90 726**	**78 673**	**63 357**	**57 197**	**59 682**	**56 658**	**59 376**	**58 214**	**56 703**	**50 813**	**46 746**	**45 861**	**47 475**	**45 054**	**49 167**	**48 276**
Difference,%																
Liquid	3.1	5.9	4.8	4.1	17.3	16.7	13.6	8.2	4.3	-6.9	-1.4	3.4	2.0	9.9	4.0	-0.5
Solid	-1.7	1.6	-0.6	-2.6	-3.1	-6.7	-5.4	-4.3	-5.6	2.8	-0.9	-0.5	0.8	-1.6	0.0	0.5
Gaseous	1.4	0.6	1.0	1.3	2.6	4.2	2.7	6.1	0.7	7.9	1.4	1.2	3.8	3.4	3.4	2.7
Others																
TOTAL	**0.48**	**2.91**	**1.23**	**-0.28**	**3.00**	**0.83**	**0.65**	**0.37**	**-2.67**	**1.13**	**-0.71**	**0.60**	**1.42**	**1.75**	**1.34**	**0.52**

Differences of CO_2 emissions from fuel combustion in the Sectoral Approach due to recalculation, Gg, %

Table A4.2

Gas/Sector	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
NIR 2006	90 726	78 673	63 357	57 197	59 682	56 658	59 376	58 214	56 703	50 813	46 746	45 861	47 475	45 054	49 035	48 276
Difference 2006/2005	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
NIR 2005	90 726	78 673	63 357	57 197	59 682	56 658	59 376	57 955	56 733	50 813	46 746	45 861	47 475	45 054	49 035	
Difference 2005/2004	-4.2	3.6	4.4	4.3	4.4	5.6	6.1	6.3	6.9	5.6	6.0	7.5	5.7	4.7		
NIR 2004	94 673	75 942	60 674	54 839	57 173	53 659	55 986	54 541	53 067	48 113	44 104	42 649	44 917	43 052		
Difference 2004/2003	0	0	0	0	0	0	0	0	0	0	0	0	0			
NIR 2003	94 673	75 942	60 674	54 839	57 173	53 659	55 986	54 541	53 067	48 113	44 104	42 649	44 917			
Difference 2003/2001	-0.9	-1.1	-0.8	-0.4	-0.9	-1.1	-1.1	-10.9	-0.9	-0.8	-0.9					
NIR 2001	95 495	76 804	61 170	55 064	57 678	54 239	56 609	61 215	53 560	48 515	44 513					

Reference Approach and comparison with the Sectoral Approach

In **Table A4.3** are presented the reported emission differences in the Reference Approach and Sectoral Approach for the last five National Inventory Reports.

The analysis of the Table shows overall improvement of the quality assessment of total CO_2 emissions. It is expressed in reduction of the differences between the two approaches like the last seven years; the differences are lower from 1.5% with exception for the year 2002 with 1.7%.

Effect of recalculations on the comparison of CO_2 emissions in the RA versus NA (NIR's 2001-2006), Gg

Table A4.3

Gas/Sector	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
NIR 2006																
Reference Approach	91 159	80 960	64 139	57 036	61 474	57 126	59 763	58 432	55 190	51 389	46 413	46 136	48 152	45 843	49 825	48 526
National Approach	90 726	78 673	63 357	57 197	59 682	56 658	59 376	58 214	56 703	50 813	46 746	45 861	47 475	45 054	49 167	48 276
Difference	***0.5***	***2.9***	***1.2***	***-0.3***	***3.0***	***0.8***	***0.7***	***0.4***	***-2.7***	***1.1***	***-0.7***	***0.6***	***1.4***	***1.7***	***1.3***	***0.5***
NIR 2005																
Reference Approach	91 159	80 960	64 139	57 036	61 474	57 126	59 763	58 432	55 190	51 389	46 413	46 136	48 152	45 843	49 825	
National Approach	90 726	78 673	63 357	57 197	59 682	56 658	59 376	57 955	56 733	50 813	46 746	45 861	47 475	45 054	49 035	
Difference	***0.5***	***2.9***	***1.2***	***-0.3***	***3.0***	***0.8***	***0.7***	***0.8***	***-2.7***	***1.1***	***-0.7***	***0.6***	***1.4***	***1.7***	***1.6***	
NIR 2004																
Reference Approach	91 688	72 784	60 451	56 589	61 159	56 697	58 565	56 859	55 262	51 344	45 144	44 764	47 268	45 012		
National Approach	94 673	75 942	60 674	54 839	57 173	53 659	55 986	54 541	53 067	48 113	44 104	42 649	44 917	43 052		
Difference	***-3.2***	***-4.2***	***-0.4***	***3.2***	***7.0***	***5.7***	***4.6***	***4.2***	***4.1***	***6.7***	***2.4***	***5.0***	***5.2***	***4.6***		
NIR 2003																
Reference Approach	90 790	71 760	59 204	55 551	60 251	55 810	57 716	55 870	54 414	50 810	44 573	43 816	46 331			
National Approach	94 673	75 942	60 674	54 839	57 173	53 659	55 986	54 541	53 067	48 113	44 104	42 649	44 917			
Difference	***-4.1***	***-5.5***	***-2.4***	***1.3***	***5.4***	***4.0***	***3.1***	***2.4***	***2.5***	***5.6***	***1.1***	***2.7***	***3.1***			
NIR 2001																
Reference Approach	90 790	71 760	59 204	55 551	60 251	55 810	57 716	55 870	54 414	50 810	44 573					
National Approach	95 495	76 804	61 170	55 064	57 678	54 239	56 609	54 442	53 560	48 515	44 513					
Difference	***-4.9***	***-6.6***	***-3.2***	***0.9***	***4.5***	***2.9***	***2.0***	***2.6***	***1.6***	***4.7***	***0.1***					

ANNEX 5: ASSESSMENT OF COMPLETENESS OF INVENTORIES

In the 2004 GHG Inventory are included all the sectors mentioned in the Revised IPCC Guidelines, 1996 with the exception of:

- Actual F – gases emissions from use of aerosol preparations, fire-extinguishers, etc;
- N_2O emissions from solvent use.

The emissions mentioned above exist but there are no methodologies elaborated yet for quality collection of the input data.

As a result of the recommendations from the held revisions, there is an improvement in symbol use for designation of the type data. All the data have been revised which are lower than 1 and can come in the cell approved number format from CRF files.

In **Table A5.1** are presented explanations for the used symbols for designation of the type data in the inventory (Table 9 from CRF files).

INFORMATION ON NOTATION KEYS

Table A5.1

Sources and sinks not reported (NE)			
GHG	**Sector[(2)]**	**Source/sink category [(2)]**	**Explanation**
CO_2			
	1. Energy	B.1. a. Coal Mining	No emission factors available
	1. Energy	B.2. Oil and Natural Gas	No emission factors available
	1. Energy	B.1. b. Solid Fuel Transformation	No activity data and emission factors available
	2. Industrial Processes	A. Mineral Products	No data for Limestone and Dolomite Use, and Asphalt Roofing
	3. Solvent and Other Product Use	A. Paint Application	No emission factors available
	3. Solvent and Other Product Use	B. Degreasing and Dry Cleaning	No emission factors available
	3. Solvent and Other Product Use	D. Other - Use of N_2O for Anaesthesia	No activity data and emission factors available
	5. Land-Use Change and Forestry	B. Forest and Grassland Conversion	No country specific data
	5. Land-Use Change and Forestry	C. Abandonment of Managed Lands	No country specific data
	5. Land-Use Change and Forestry	D. CO_2 Emissions and Removals from Soil	No country specific data
	6. Waste	A. Solid Waste Disposal on Land	No emission factors available
CH_4			
	1. Energy	B.1. b. Solid Fuel Transformation	No activity data and emission factors available
	5. Land-Use Change and Forestry	B. Forest and Grassland Conversion	No country specific data

Sources and sinks not reported (NE))			
GHG	**Sector(2)**	**Source/sink category (2)**	**Explanation**
N_2O			
	1. Energy	B.2 Oil and Natural gas	No data available
	3. Solvent and Other Product Use	D. Other - Use of N_2O for Anaesthesia	No activity data and emission factors available
	5. Land-Use Change and Forestry	B. Forest and Grassland Conversion	No country specific data
	6. Waste	B.1. Wastewater Handling - Industrial Wastewater	No emission factors available
HFC-			
HFC-134	2. Industrial Processes	F(p). Total Potential Emissions of Halocarbons (by chemical) and SF_6 - Import	No data available
HFC-143	2. Industrial Processes	F(p). Total Potential Emissions of Halocarbons (by chemical) and SF_6- Import	No data available
HFC-236fa	2. Industrial Processes	F(p). Total Potential Emissions of Halocarbons (by chemical) and SF_6- Import	No data available
HFC-254ca	2. Industrial Processes	F(p). Total Potential Emissions of Halocarbons (by chemical) and SF_6- Import	No data available
HFC-41	2. Industrial Processes	F(p). Total Potential Emissions of Halocarbons (by chemical) and SF_6- Import	No data available
HFC-43-10mee	2. Industrial Processes	F(p). Total Potential Emissions of Halocarbons (by chemical) and SF_6- Import	No data available
HFCs	2. Industrial Processes	F(a). Consumption of Halocarbons and SF_6 (actual emissions - Tier 2)	No data available

Sources and sinks not reported (NE))			
GHG	**Sector(2)**	**Source/sink category (2)**	**Explanation**
PFCs			
C3F8	2. Industrial Processes	C. Metal Production Total Actual Emissions	No data available
C4F10	2. Industrial Processes	C. Metal Production Total Actual Emissions	No data available
C5F12	2. Industrial Processes	C. Metal Production Total Actual Emissions	No data available
C6F14	2. Industrial Processes	C. Metal Production Total Actual Emissions	No data available
c-C4F8	2. Industrial Processes	C. Metal Production Total Actual Emissions	No data available
PFCs	2. Industrial Processes	F(p). Total Potential Emissions of Halocarbons (by chemical) and SF_6	No data available
PFCs	2. Industrial Processes	F(a). Consumption of Halocarbons and SF_6 (actual emissions - Tier 2)	No data available
SF_6			
	2. Industrial Processes	F(p). Total Potential Emissions of Halocarbons (by chemical) and SF_6 Import: In products	No data available

Sources and sinks reported elsewhere (IE)(3)				
GHG	**Source/sink category**	**Allocation as per IPCC Guidelines**	**Allocation used by the Party**	**Explanation**
CO_2				
CH_4				
N_2O				
	4. Agriculture	B.10-13- N_2O Emissions from Manure Management- Other-Buffalo	B.10-13- N_2O Emissions from Manure Management- Non-Dairy Cattle	Nitrogen excretion for Buffalo is the same as for Non-Dairy Cattle

ANNEX 6: ADDITIONAL INFORMATION TO BE CONSIDERED AS PART OF NIR SUBMISSION.

Additional information regarding GHG Inventories in Bulgaria can be found in the following publications and works:

1. Third National Communication on Climate Change under UNFCCC, 2002.
2. Guidelines for balance method estimation of the pollutants emissions released in atmosphere, Sofia, 2000.
3. GHG Inventory recalculation for the year 1988 and for the period 1990-2001 applying Best Practices of IPCC/OECD, Energy Institute Archive, 2004.
4. Second National Action Plan on Climate Change of Bulgaria under UNFCCC, Sofia, 2004.
5. Feasibility study for National system for anthropogenic GHG estimation assessment, Register of Energy Institute, Sofia, 2005.

ANNEX 7: SOME CRF TABLES

In this Annex 7 were done some common tables from CRF. They show a complex characteristic of GHG inventory for 2004 as well as for a part of the previous years.

Annex 7.1 – Overall CRF Tables 7 for base 1988 year, 1990, 1995 and for period 2000-2004.

Annex 7.2 – CRF Tables for recalculation of 1988 and for period 1990-2003 (CRF tables 8a and 8b).

Annex 7.3 – CRF Trend tables 10 for CO_2, CH_4, N_2O and F-gases well as for all gases and sources in CO_2-eq.

Annex 7.4 – Trend tables for GHG-precursors and SOx.

Annex 7.5 – Trend tables for GHG for sector LULUCF.

7.1 IPCC Table 7A for the base 1988 year, 1990, 1995 and for the period 2000-2004

Table A7.1 GHG emissions in Bulgaria; IPCC Table 7A: 1988

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	CH_4	N_2O	HFCs[1]		PFCs[1]		SF_6		NO_x	CO	NMVOC	SO_2
					P	A	P	A	P	A				
	(Gg)				CO_2 equivalent (Gg)						(Gg)			
Total National Emissions and Removals	**98 302,01**	**-5 132,63**	**1 041,15**	**38,91**	**0,00**	**0,00**	**0,00**	**75,55**	**0,00**	**0,00**	**284,39**	**841,12**	**120,35**	**1 781,41**
1. Energy	**90 725,67**		**161,04**	**1,64**							**262,10**	**798,05**	**68,17**	**1 756,52**
A. Fuel Combustion — Reference Approach [2]	91 159,45													
Sectoral Approach [2]	90 725,67		5,30	1,64							262,10	798,05	68,17	1 756,52
1. Energy Industries	43 216,90		0,84	0,97							96,25	10,03	0,77	1 285,57
2. Manufacturing Industries and Construction	24 754,56		0,57	0,14							34,94	11,23	0,28	200,73
3. Transport	13 813,97		2,98	0,33							115,55	454,34	67,08	57,85
4. Other Sectors	8 940,25		0,32	0,16							13,76	174,83	0,04	212,37
5. Other	0,00		0,59	0,03							1,59	147,61	0,00	0,00
B. Fugitive Emissions from Fuels	0,00		155,74	0,00							0,00	0,00	0,00	0,00
1. Solid Fuels	0,00		94,84	0,00							0,00	0,00	0,00	0,00
2. Oil and Natural Gas	0,00		60,90	0,00							0,00	0,00	0,00	0,00
2. Industrial Processes	**7 576,34**		**3,89**	**7,81**	**0,00**	**0,00**	**0,00**	**75,55**	**0,00**	**0,00**	**21,69**	**19,40**	**38,57**	**24,89**
A. Mineral Products	3 844,72		0,00	0,00							0,00	0,00	2,92	1,22
B. Chemical Industry	1 246,45		0,04	7,81	0,00	0,00	0,00	0,00	0,00	0,00	20,23	10,76	6,33	15,79
C. Metal Production	2 485,18		3,49	0,00				75,55		0,00	0,13	3,68	0,23	1,67
D. Other Production [3]	NO										1,33	4,97	22,77	6,21
E. Production of Halocarbons and SF_6						0,00		0,00		0,00				
F. Consumption of Halocarbons and SF_6					0,00	0,00	0,00	0,00	0,00	0,00				
G. Other	0,00		0,36	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	6,31	0,00

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	CH_4	N_2O	HFCs [1]		PFCs[1]		SF_6		NO_x	CO	NMVOC
					P	A	P	A	P	A			
	(Gg)				CO_2 equivalent (Gg)				(Gg)				
3. Solvent and Other Product Use	**0,00**			**0,00**							**NO**	**NO**	**13,62**
4. Agriculture	**0,00**	**0,00**	**273,23**	**28,46**							0,60	23,67	0,00
A. Enteric Fermentation			192,79										
B. Manure Management			72,55	3,41									0,00
C. Rice Cultivation			5,68										0,00
D. Agricultural Soils	[4] NO	[4] NO	0,00	25,00									0,00
E. Prescribed Burning of Savannas			0,00	0,00							NO	NO	NO
F. Field Burning of Agricultural Residues			2,21	0,05							0,60	23,67	0,00
G. Other			0,00	0,00							0,00	0,00	0,00
5. Land-Use Change and Forestry	[5] **0,00**	[5] **-5 132,63**	**0,00**	**0,00**							**0,00**	**0,00**	**0,00**
A. Changes in Forest and Other Woody Biomass Stocks	[5] 0,00	[5] -5 132,63											
B. Forest and Grassland Conversion	0,00		0,00	0,00							0,00	0,00	NO
C. Abandonment of Managed Lands	[5] 0,00	[5] 0,00											
D. CO_2 Emissions and Removals from Soil	[5] 0,00	[5] 0,00											
E. Other	[5] 0,00	[5] 0,00	0,00	0,00							0,00	0,00	NO
6. Waste	**0,00**		**602,99**	**1,00**							**0,00**	**0,00**	**0,00**
A. Solid Waste Disposal on Land	[6] 0,00		515,14									0,00	0,00
B. Wastewater Handling			87,85	1,00							0,00	0,00	0,00
C. Waste Incineration	[6] 0,00		0,00	0,00							NO	NO	NO
D. Other	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**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	CH_4	N_2O	HFCs		PFCs		SF_6		NO_x	CO	NMVOC	SO_2
					P	A	P	A	P	A				
	(Gg)				CO_2 equivalent (Gg)				(Gg)					
Memo Items: [7]														
International Bunkers	**1 718,36**		**0,06**	**0,02**							**25,78**	**5,36**	**1,08**	**8,53**
Aviation	749,41		0,02	0,00							2,99	1,24	0,19	0,24
Marine	968,95		0,04	0,02							22,80	4,12	0,90	8,29
Multilateral Operations	**NO**		**NO**	**NO**							**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass	**1 468,56**													

Table A7.2 GHG emissions in Bulgaria; IPCC Table 7A: 1990

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	CH_4	N_2O	HFCs[1]		PFCs[1]		SF_6		NO_x	CO	NMVOC	SO_2
					P	A	P	A	P	A				
	(Gg)				CO_2 equivalent (Gg)						(Gg)			
Total National Emissions and Removals	**85 282,83**	**-6 156,99**	**890,63**	**33,71**	**0,00**	**0,00**	**0,00**	**47,31**	**0,00**	**0,00**	**242,98**	**778,73**	**110,06**	**1 517,12**
1. Energy	**78 672,85**		**110,19**	**1,41**							**221,69**	**716,00**	**67,34**	**1 500,61**
A. Fuel Combustion — Reference Approach [2]	80 959,88													
Sectoral Approach [2]	78 672,85		4,99	1,41							221,69	716,00	67,34	1 500,61
1. Energy Industries	39 601,23		0,91	0,80							61,81	10,03	0,84	1 114,64
2. Manufacturing Industries and Construction	21 821,39		0,35	0,21							49,83	8,73	0,19	220,08
3. Transport	10 863,71		2,91	0,25							97,80	434,83	66,25	17,99
4. Other Sectors	5 380,59		0,21	0,10							8,36	121,05	0,00	139,68
5. Other	1 005,93		0,60	0,04							3,89	141,36	0,05	8,22
B. Fugitive Emissions from Fuels	0,00		105,20	0,00							0,00	0,00	0,00	0,00
1. Solid Fuels	0,00		75,80	0,00							0,00	0,00	0,00	0,00
2. Oil and Natural Gas	0,00		29,40	0,00							0,00	0,00	0,00	0,00
2. Industrial Processes	**6 609,97**		**3,02**	**7,28**	**0,00**	**0,00**	**0,00**	**47,31**	**0,00**	**0,00**	**19,65**	**16,48**	**30,47**	**16,51**
A. Mineral Products	3 541,68		0,00	0,00							0,00	0,00	2,65	1,04
B. Chemical Industry	1 224,51		0,02	7,28	0,00	0,00	0,00	0,00	0,00	0,00	18,64	10,44	6,16	9,88
C. Metal Production	1 843,78		2,76	0,00				47,31		0,00	0,10	2,61	0,18	1,30
D. Other Production [3]	NO										0,92	3,43	16,10	4,29
E. Production of Halocarbons and SF_6						0,00		0,00		0,00				
F. Consumption of Halocarbons and SF_6					0,00	0,00	0,00	0,00	0,00	0,00				
G. Other	0,00		0,25	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	5,38	0,00

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	CH_4	N_2O	HFCs [1]		PFCs[1]		SF_6		NO_x	CO	NMVOC
					P	A	P	A	P	A			
	(Gg)				CO_2 equivalent (Gg)				(Gg)				
3. Solvent and Other Product Use	**0,00**			**0,00**							**NO**	**NO**	**12,25**
4. Agriculture	**0,00**	**0,00**	**258,13**	**24,30**							1,63	46,25	0,00
A. Enteric Fermentation			180,17										
B. Manure Management			71,49	3,32									0,00
C. Rice Cultivation			4,26										0,00
D. Agricultural Soils	[4] NO	[4] NO	0,00	20,93									0,00
E. Prescribed Burning of Savannas			0,00	0,00							NO	NO	NO
F. Field Burning of Agricultural Residues			2,20	0,05							1,63	46,25	0,00
G. Other			0,00	0,00							0,00	0,00	0,00
5. Land-Use Change and Forestry	[5] **0,00**	[5] **-6 156,99**	**0,00**	**0,00**							**0,00**	**0,00**	**0,00**
A. Changes in Forest and Other Woody Biomass Stocks	[5] 0,00	[5] -6 156,99											
B. Forest and Grassland Conversion	0,00		0,00	0,00							0,00	0,00	NO
C. Abandonment of Managed Lands	[5] 0,00	[5] 0,00											
D. CO_2 Emissions and Removals from Soil	[5] 0,00	[5] 0,00											
E. Other	[5] 0,00	[5] 0,00	0,00	0,00							0,00	0,00	NO
6. Waste	**0,00**		**519,30**	**0,72**							**0,00**	**0,00**	**0,00**
A. Solid Waste Disposal on Land	[6] 0,00		452,78									0,00	0,00
B. Wastewater Handling			66,52	0,72							0,00	0,00	0,00
C. Waste Incineration	[6] 0,00		0,00	0,00							NO	NO	NO
D. Other	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**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	CH_4	N_2O	HFCs		PFCs		SF_6		NO_x	CO	NMVOC	SO_2
					P	A	P	A	P	A				
	(Gg)				CO_2 equivalent (Gg)				(Gg)					
Memo Items: [7]														
International Bunkers	**1 766,14**		**0,06**	**0,02**							**25,94**	**9,26**	**0,68**	**13,55**
Aviation	892,2687		0,0401	0,0002							3,50	7,45	0,36	0,30
Marine	873,8762		0,0151	0,0218							22,44	1,81	0,32	13,25
Multilateral Operations	**NO**		**NO**	**NO**							**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass	**1 311,71**													

Table A7.3 GHG emissions in Bulgaria; IPCC Table 7A: 1995

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	CH_4	N_2O	HFCs[1]		PFCs[1]		SF_6		NO_x	CO	NMVOC	SO_2
					P	A	P	A	P	A				
	(Gg)				CO_2 equivalent (Gg)						(Gg)			
Total National Emissions and Removals	**64 743,62**	**-7 524,48**	**589,99**	**18,83**	**62,16**	**2,95**	**0,00**	**46,94**	**0,00**	**1,26**	**152,06**	**612,55**	**86,33**	**1 298,94**
1. Energy	**59 375,81**		**103,87**	**1,20**							**134,27**	**566,62**	**49,12**	**1 285,05**
A. Fuel Combustion — Reference Approach [2]	59 762,71													
Sectoral Approach [2]	59 375,81		3,60	1,20							134,27	566,62	49,12	1 285,05
1. Energy Industries	31 571,95		0,56	0,84							56,13	8,98	0,69	1 055,67
2. Manufacturing Industries and Construction	18 023,19		0,34	0,11							21,36	4,30	0,18	127,15
3. Transport	6 844,63		2,02	0,14							49,38	327,57	48,22	8,82
4. Other Sectors	2 621,01		0,10	0,06							4,96	88,45	0,00	90,96
5. Other	315,02		0,57	0,0391							2,45	137,32	0,04	2,45
B. Fugitive Emissions from Fuels	0,00		100,27	0,00							0,00	0,00	0,00	0,00
1. Solid Fuels	0,00		69,21	0,00							0,00	0,00	0,00	0,00
2. Oil and Natural Gas	0,00		31,0522	0,00							0,00	0,00	0,00	0,00
2. Industrial Processes	**5 367,81**		**3,52**	**6,20**	**62,16**	**2,95**	**0,00**	**46,94**	**0,00**	**1,26**	**16,70**	**15,25**	**24,71**	**13,90**
A. Mineral Products	1 973,17		0,00	0,00							0,00	0,00	2,13	0,46
B. Chemical Industry	1 071,58		0,04	6,20	0,00	0,00	0,00	0,00	0,00	0,00	15,92	9,60	5,67	8,62
C. Metal Production	2 323,06		3,29	0,00				46,94		0,00	0,12	3,20	0,24	1,77
D. Other Production [3]	NO										0,65	2,44	12,30	3,06
E. Production of Halocarbons and SF_6						0,00		0,00		0,00				
F. Consumption of Halocarbons and SF_6					62,16	2,95	0,00	0,00	0,00	1,26				
G. Other	0,00		0,20	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	4,37	0,00

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	CH_4	N_2O	HFCs [1]		PFCs[1]		SF_6		NO_x	CO	NMVOC
					P	A	P	A	P	A			
	(Gg)				CO_2 equivalent (Gg)						(Gg)		
3. Solvent and Other Product Use	**0,00**			**0,00**							**NO**	**NO**	**12,49**
4. Agriculture	**0,00**	**0,00**	**121,81**	**10,89**							1,09	30,69	0,00
A. Enteric Fermentation			85,27										
B. Manure Management			34,52	1,60									0,00
C. Rice Cultivation			0,56										0,00
D. Agricultural Soils	[4] NO	[4] NO	0,00	9,27									0,00
E. Prescribed Burning of Savannas			0,00	0,00							NO	NO	NO
F. Field Burning of Agricultural Residues			1,46	0,03							1,09	30,69	0,00
G. Other			0,00	0,00							0,00	0,00	0,00
5. Land-Use Change and Forestry	[5] **0,00**	[5] **-7 524,48**	**0,00**	**0,00**							**0,00**	**0,00**	**0,00**
A. Changes in Forest and Other Woody Biomass Stocks	[5] 0,00	[5] -7 524,48											
B. Forest and Grassland Conversion	0,00		0,00	0,00							0,00	0,00	NO
C. Abandonment of Managed Lands	[5] 0,00	[5] 0,00											
D. CO_2 Emissions and Removals from Soil	[5] 0,00	[5] 0,00											
E. Other	[5] 0,00	[5] 0,00	0,00	0,00							0,00	0,00	NO
6. Waste	**0,00**		**360,79**	**0,54**							**0,00**	**0,00**	**0,00**
A. Solid Waste Disposal on Land	[6] 0,00		311,45									0,00	0,00
B. Wastewater Handling			49,34	0,54							0,00	0,00	0,00
C. Waste Incineration	[6] 0,00		0,00	0,00							NO	NO	NO
D. Other	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**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	CH_4	N_2O	HFCs		PFCs		SF_6		NO_x	CO	NMVOC	SO_2
					P	A	P	A	P	A				
	(Gg)				CO_2 equivalent (Gg)				(Gg)					
Memo Items: [7]														
International Bunkers	**1 431,78**		**0,03**	**0,02**							**24,90**	**3,83**	**0,47**	**13,24**
Aviation	549,40		0,02	0,00							2,19	2,08	0,16	0,18
Marine	882,37		0,01	0,02							22,71	1,75	0,31	13,06
Multilateral Operations	**NO**		**NO**	**NO**							**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass	**1 560,14**													

Table A7.4 GHG emissions in Bulgaria; IPCC Table 7A: 2000

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	CH_4	N_2O	HFCs[1]		PFCs[1]		SF_6		NO_x	CO	NMVOC	SO_2
					P	A	P	A	P	A				
	(Gg)				CO_2 equivalent (Gg)						(Gg)			
Total National Emissions and Removals	**50 176,47**	**-8 976,23**	**430,25**	**15,84**	**96,02**	**0,00**	**0,00**	**33,14**	**29,40**	**2,23**	**121,26**	**431,83**	**57,04**	**1 044,65**
1. Energy	**45 861,46**		**88,26**	**1,08**							**109,44**	**398,33**	**31,95**	**1 029,34**
A. Fuel Combustion — Reference Approach [2]	46 136,32													
Sectoral Approach [2]	45 861,46		2,83	1,08							109,44	398,33	31,95	1 029,34
1. Energy Industries	26 215,75		0,43	0,76							49,07	5,89	0,40	885,80
2. Manufacturing Industries and Construction	11 868,18		0,23	0,07							14,06	4,36	0,04	79,97
3. Transport	5 881,45		1,30	0,11							40,98	198,36	31,51	7,09
4. Other Sectors	1 896,08		0,38	0,12							4,00	65,66	0,00	56,48
5. Other	0,00		0,50	0,0288							1,34	124,07	0,00	0,00
B. Fugitive Emissions from Fuels	0,00		85,43	0,00							0,00	0,00	0,00	0,00
1. Solid Fuels	0,00		57,09	0,00							0,00	0,00	0,00	0,00
2. Oil and Natural Gas	0,00		28,33	0,00							0,00	0,00	0,00	0,00
2. Industrial Processes	**4 315,01**		**3,51**	**4,24**	**96,02**	**0,00**	**0,00**	**33,14**	**29,40**	**2,23**	**11,09**	**9,36**	**14,39**	**15,31**
A. Mineral Products	2 261,77		0,00	0,00							0,00	0,00	0,93	0,71
B. Chemical Industry	569,90		0,15	4,24	0,00	0,00	0,00	0,00	0,00	0,00	10,89	5,18	4,77	11,66
C. Metal Production	1 483,34		3,37	0,00				33,14		0,00	0,08	3,71	0,27	2,34
D. Other Production [3]	NO										0,13	0,47	6,21	0,59
E. Production of Halocarbons and SF_6						0,00		0,00		0,00				
F. Consumption of Halocarbons and SF_6					96,02	0,00	0,00	0,00	29,40	2,23				
G. Other	0,00		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	2,22	0,00

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	CH_4	N_2O	HFCs [1]		PFCs[1]		SF_6		NO_x	CO	NMVOC
					P	A	P	A	P	A			
	(Gg)				CO_2 equivalent (Gg)				(Gg)				
3. Solvent and Other Product Use	**0,00**			**0,00**							**NO**	**NO**	**10,69**
4. Agriculture	**0,00**	**0,00**	**108,95**	**10,02**							**0,73**	**24,15**	**0,00**
A. Enteric Fermentation			79,28										
B. Manure Management			27,08	1,38									0,00
C. Rice Cultivation			1,44										0,00
D. Agricultural Soils	[4] NO	[4] NO	0,00	8,61									0,00
E. Prescribed Burning of Savannas			0,00	0,00							NO	NO	NO
F. Field Burning of Agricultural Residues			1,15	0,02							0,73	24,15	0,00
G. Other			0,00	0,00							0,00	0,00	0,00
5. Land-Use Change and Forestry	[5] **0,00**	[5] **-8 976,23**	**0,00**	**0,00**							**0,00**	**0,00**	**0,00**
A. Changes in Forest and Other Woody Biomass Stocks	[5] 0,00	[5] -8 976,23											
B. Forest and Grassland Conversion	0,00		0,00	0,00							0,00	0,00	NO
C. Abandonment of Managed Lands	[5] 0,00	[5] 0,00											
D. CO_2 Emissions and Removals from Soil	[5] 0,00	[5] 0,00											
E. Other	[5] 0,00	[5] 0,00	0,00	0,00							0,00	0,00	NO
6. Waste	**0,00**		**229,52**	**0,50**							**0,00**	**0,00**	**0,00**
A. Solid Waste Disposal on Land	[6] 0,00		201,25									0,00	0,00
B. Wastewater Handling			28,27	0,50							0,00	0,00	0,00
C. Waste Incineration	[6] 0,00		0,00	0,00							NO	NO	NO
D. Other	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**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	CH_4	N_2O	HFCs		PFCs		SF_6		NO_x	CO	NMVOC	SO_2
					P	A	P	A	P	A				
	(Gg)				CO_2 equivalent (Gg)				(Gg)					
Memo Items: [7]														
International Bunkers	**475,16**		**0,02**	**0,01**							**5,43**	**1,82**	**0,38**	**0,47**
Aviation	269,84		0,01	0,00							1,08	0,45	0,07	0,09
Marine	205,31		0,01	0,01							4,35	1,37	0,32	0,38
Multilateral Operations	**NO**		**NO**	**NO**							**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass	**2 955,11**													

Table A7.5 GHG emissions in Bulgaria; IPCC Table 7A: 2001

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	CH_4	N_2O	HFCs[1]		PFCs[1]		SF_6		NO_x	CO	NMVOC	SO_2
					P	A	P	A	P	A				
	(Gg)				CO_2 equivalent (Gg)				(Gg)					
Total National Emissions and Removals	**51 850,52**	**-9 467,15**	**396,06**	**14,74**	**97,50**	**0,00**	**0,00**	**16,29**	**2,39000**	**2,29362**	**129,04**	**376,10**	**57,52**	**1 084,97**
1. Energy	**47 475,34**		**86,36**	**1,15**							**117,37**	**341,76**	**28,59**	**1 081,91**
A. Fuel Combustion — Reference Approach [2]	48 151,65													
Sectoral Approach [2]	47 475,34		2,62	1,15							117,37	341,76	28,59	1 081,91
1. Energy Industries	29 035,91		0,47	0,83							59,84	6,34	0,43	956,90
2. Manufacturing Industries and Construction	10 788,11		0,22	0,07							13,43	5,24	0,03	79,20
3. Transport	6 013,52		1,12	0,11							39,69	171,78	28,12	7,30
4. Other Sectors	1 637,81		0,33	0,11							3,10	37,25	0,00	38,51
5. Other	0,00		0,48	0,03							1,31	121,15	0,00	0,00
B. Fugitive Emissions from Fuels	0,00		83,74	0,00							0,00	0,00	0,00	0,00
1. Solid Fuels	0,00		57,70	0,00							0,00	0,00	0,00	0,00
2. Oil and Natural Gas	0,00		26,04	0,00							0,00	0,00	0,00	0,00
2. Industrial Processes	**4 375,18**		**2,42**	**4,18**	**97,50**	**0,00**	**0,00**	**16,29**	**2,39**	**2,29**	**10,93**	**7,03**	**11,83**	**3,05**
A. Mineral Products	2 446,50		0,00	0,00							0,00	0,00	1,17	0,77
B. Chemical Industry	506,70		0,14	4,18	0,00	0,00	0,00	0,00	0,00	0,00	10,72	4,64	2,73	0,42
C. Metal Production	1 421,97		2,28	0,00				16,29		0,00	0,07	1,87	0,16	1,22
D. Other Production [3]	NO										0,14	0,51	5,77	0,64
E. Production of Halocarbons and SF_6						0,00		0,00		0,00				
F. Consumption of Halocarbons and SF_6					97,50	0,00	0,00	0,00	2,39000	2,29362				
G. Other	0,00		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	1,99	0,00

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	CH_4	N_2O	HFCs [1]		PFCs[1]		SF_6		NO_x	CO	NMVOC	SO_2
					P	A	P	A	P	A				
	(Gg)				CO_2 equivalent (Gg)						(Gg)			
3. Solvent and Other Product Use	**0,00**			**0,00**							**NO**	**NO**	**17,10**	**NO**
4. Agriculture	**0,00**	**0,00**	**84,37**	**8,93**							**0,74**	**27,32**	**0,00**	**0,00**
A. Enteric Fermentation			62,20											
B. Manure Management			19,30	1,03									0,00	
C. Rice Cultivation			1,57										0,00	
D. Agricultural Soils	[4] NO	[4] NO	0,00	7,88									0,00	
E. Prescribed Burning of Savannas			0,00	0,00							NO	NO	NO	
F. Field Burning of Agricultural Residues			1,30	0,02							0,74	27,32	0,00	
G. Other			0,00	0,00							0,00	0,00	0,00	NO
5. Land-Use Change and Forestry	[5] **0,00**	[5] **-9 467,15**	**0,00**	**0,00**							**0,00**	**0,00**	**0,00**	**0,00**
A. Changes in Forest and Other Woody Biomass Stocks	[5] 0,00	[5] -9 467,15												
B. Forest and Grassland Conversion	0,00		0,00	0,00							0,00	0,00	NO	
C. Abandonment of Managed Lands	[5] 0,00	[5] 0,00												
D. CO_2 Emissions and Removals from Soil	[5] 0,00	[5] 0,00												
E. Other	[5] 0,00	[5] 0,00	0,00	0,00							0,00	0,00	NO	NO
6. Waste	**0,00**		**222,91**	**0,48**							**0,00**	**0,00**	**0,00**	**0,00**
A. Solid Waste Disposal on Land	[6] 0,00		199,98									0,00	0,00	
B. Wastewater Handling			22,93	0,48							0,00	0,00	0,00	
C. Waste Incineration	[6] 0,00		0,00	0,00							NO	NO	NO	NO
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**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	CH_4	N_2O	HFCs		PFCs		SF_6		NO_x	CO	NMVOC	SO_2
					P	A	P	A	P	A				
	(Gg)				CO_2 equivalent (Gg)				(Gg)					
Memo Items: [7]														
International Bunkers	**699,16**		**0,03**	**0,01**							**8,07**	**2,67**	**0,56**	**0,75**
Aviation	393,30		0,01	0,00							1,58	0,65	0,10	0,13
Marine	305,85		0,02	0,01							6,50	2,02	0,46	0,62
Multilateral Operations	**NO**		**NO**	**NO**							**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass	**2 876,11**													

Table A7.6 GHG emissions in Bulgaria; IPCC Table 7A: 2002

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	CH_4	N_2O	HFCs[1]		PFCs[1]		SF_6		NO_x	CO	NMVOC	SO_2
					P	A	P	A	P	A				
	(Gg)				CO_2 equivalent (Gg)						(Gg)			
Total National Emissions and Removals	**49 082,81**	**-8 318,06**	**403,80**	**14,33**	**89,59**	**0,00**	**0,00**	**21,42**	**2,39**	**2,51**	**124,50**	**429,58**	**60,73**	**982,94**
1. Energy	**45 054,34**		**84,95**	**1,09**							**114,29**	**392,66**	**30,41**	**966,87**
A. Fuel Combustion — Reference Approach [2]	45 842,68													
Sectoral Approach [2]	45 054,34		2,80	1,09							114,29	392,66	30,41	966,87
1. Energy Industries	26 465,57		0,43	0,75							53,99	5,98	0,40	821,53
2. Manufacturing Industries and Construction	10 198,06		0,21	0,07							12,73	5,23	0,03	78,61
3. Transport	6 316,61		1,21	0,11							41,83	184,98	29,98	7,47
4. Other Sectors	2 074,11		0,39	0,13							4,25	58,05	0,00	59,27
5. Other	0,00		0,55	0,03							1,49	138,41	0,00	0,00
B. Fugitive Emissions from Fuels	0,00		82,15	0,00							0,00	0,00	0,00	0,00
1. Solid Fuels	0,00		58,50	0,00							0,00	0,00	0,00	0,00
2. Oil and Natural Gas	0,00		23,655	0,00							0,00	0,00	0,00	0,00
2. Industrial Processes	**4 028,47**		**2,19**	**3,51**	**89,59**	**0,00**	**0,00**	**21,42**	**2,39**	**2,51**	**9,26**	**5,37**	**13,19**	**16,06**
A. Mineral Products	2 376,60		0,00	0,00							0,00	0,00	1,89	0,73
B. Chemical Industry	325,40		0,13	3,51	0,00	0,00	0,00	0,00	0,00	0,00	9,06	2,98	3,36	13,56
C. Metal Production	1 326,47		2,0601	0,00				21,42		0,00	0,07	1,92	0,15	1,17
D. Other Production [3]	NO										0,13	0,48	5,71	0,60
E. Production of Halocarbons and SF_6						0,00		0,00		0,00				
F. Consumption of Halocarbons and SF_6					89,59	0,00	0,00	0,00	2,39	2,51				
G. Other	0,00		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	2,07	0,00

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	CH_4	N_2O	HFCs [1]		PFCs[1]		SF_6		NO_x	CO	NMVOC
					P	A	P	A	P	A			
	(Gg)				CO_2 equivalent (Gg)				(Gg)				
3. Solvent and Other Product Use	**0,00**			**0,00**							**NO**	**NO**	**17,13**
4. Agriculture	**0,00**	**0,00**	**95,00**	**9,24**							**0,95**	**31,55**	**0,00**
A. Enteric Fermentation			68,97										
B. Manure Management			22,42	1,19									0,00
C. Rice Cultivation			2,11										0,00
D. Agricultural Soils	[4] NO	[4] NO	0,00	8,03									0,00
E. Prescribed Burning of Savannas			0,00	0,00							NO	NO	NO
F. Field Burning of Agricultural Residues			1,50	0,0263							0,95	31,55	0,00
G. Other			0,00	0,00							0,00	0,00	0,00
5. Land-Use Change and Forestry	[5] **0,00**	[5] **-8 318,06**	**0,00**	**0,00**							**0,00**	**0,00**	**0,00**
A. Changes in Forest and Other Woody Biomass Stocks	[5] 0,00	[5] -8 318,06											
B. Forest and Grassland Conversion	0,00		0,00	0,00							0,00	0,00	NO
C. Abandonment of Managed Lands	[5] 0,00	[5] 0,00											
D. CO_2 Emissions and Removals from Soil	[5] 0,00	[5] 0,00											
E. Other	[5] 0,00	[5] 0,00	0,00	0,00							0,00	0,00	NO
6. Waste	**0,00**		**221,65**	**0,49**							**0,00**	**0,00**	**0,00**
A. Solid Waste Disposal on Land	[6] 0,00		199,86									0,00	0,00
B. Wastewater Handling			21,79	0,49							0,00	0,00	0,00
C. Waste Incineration	[6] 0,00		0,00	0,00							NO	NO	NO
D. Other	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**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	CH_4	N_2O	HFCs		PFCs		SF_6		NO_x	CO	NMVOC	SO_2
					P	A	P	A	P	A				
	(Gg)				CO_2 equivalent (Gg)				(Gg)					
Memo Items: [7]														
International Bunkers	**735,38**		**0,04**	**0,01**							**8,72**	**2,91**	**0,62**	**0,75**
Aviation	399,14		0,01	0,00							1,60	0,66	0,10	0,13
Marine	336,24		0,02	0,01							7,12	2,25	0,52	0,62
Multilateral Operations	**NO**		**NO**	**NO**							**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass	**3 389,72**													

Table A7.7 GHG emissions in Bulgaria; IPCC Table 7A: 2003

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	CH_4	N_2O	HFCs[1]		PFCs[1]		SF_6		NO_x	CO	NMVOC	SO_2
					P	A	P	A	P	A				
	(Gg)				CO_2 equivalent (Gg)						(Gg)			
Total National Emissions and Removals	**53 794,91**	**-7 055,98**	**445,64**	**14,30**	**120,60**	**0,00**	**0,00**	**20,69**	**6,36**	**2,52**	**135,35**	**387,18**	**58,38**	**1 043,21**
1. Energy	**49 166,77**		**84,51**	**1,20**							**124,77**	**362,05**	**30,61**	**1 025,56**
A. Fuel Combustion — Reference Approach [2]	49 824,54													
Sectoral Approach [2]	49 166,77		2,79	1,198							124,77	362,05	30,61	1 025,56
1. Energy Industries	28 329,87		0,45	0,82							57,73	6,04	0,42	866,04
2. Manufacturing Industries and Construction	11 533,47		0,24	0,08							15,85	6,34	0,05	90,39
3. Transport	7 097,83		1,24	0,13							45,41	182,50	30,15	8,78
4. Other Sectors	2 205,59		0,41	0,14							4,58	55,74	0,00	60,36
5. Other	0,00		0,44	0,03							1,20	111,43	0,00	0,00
B. Fugitive Emissions from Fuels	0,00		81,72	0,00							0,00	0,00	0,00	0,00
1. Solid Fuels	0,00		57,54	0,00							0,00	0,00	0,00	0,00
2. Oil and Natural Gas	0,00		24,18	0,00							0,00	0,00	0,00	0,00
2. Industrial Processes	**4 628,14**		**2,79**	**3,74**	**120,60**	**0,00**	**0,00**	**20,69**	**6,36**	**2,52**	**9,89**	**6,12**	**13,23**	**17,65**
A. Mineral Products	2 621,30		0,00	0,00							0,00	0,00	1,02	0,78
B. Chemical Industry	345,10		0,27	3,74	0,00	0,00	0,00	0,00	0,00	0,00	9,62	3,15	4,13	14,53
C. Metal Production	1 661,74		2,51	0,00				20,69		0,00	0,08	2,27	0,19	1,47
D. Other Production [3]	NO										0,19	0,70	5,90	0,88
E. Production of Halocarbons and SF_6						0,00		0,00		0,00				
F. Consumption of Halocarbons and SF_6					120,60	0,00	0,00	0,00	6,36	2,52				
G. Other	0,00		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	1,99	0,00

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	CH_4	N_2O	HFCs [1]		PFCs[1]		SF_6		NO_x	CO	NMVOC	SO_2
					P	A	P	A	P	A				
	(Gg)				CO_2 equivalent (Gg)						(Gg)			
3. Solvent and Other Product Use	**0,00**			**0,00**							**NO**	**NO**	**14,54**	**NO**
4. Agriculture	**0,00**	**0,00**	**99,07**	**8,88**							0,69	19,01	0,00	0,00
A. Enteric Fermentation			71,52											
B. Manure Management			24,38	1,27									0,00	
C. Rice Cultivation			2,27										0,00	
D. Agricultural Soils	[4] NO	[4] NO	0,00	7,59									0,00	
E. Prescribed Burning of Savannas			0,00	0,00							NO	NO	NO	
F. Field Burning of Agricultural Residues			0,91	0,02							0,69	19,01	0,00	
G. Other			0,00	0,00							0,00	0,00	0,00	NO
5. Land-Use Change and Forestry	[5] **0,00**	[5] **-7 055,98**	**0,00**	**0,00**							**0,00**	**0,00**	**0,00**	**0,00**
A. Changes in Forest and Other Woody Biomass Stocks	[5] 0,00	[5] -7 055,98												
B. Forest and Grassland Conversion	0,00		0,00	0,00							0,00	0,00	NO	
C. Abandonment of Managed Lands	[5] 0,00	[5] 0,00												
D. CO_2 Emissions and Removals from Soil	[5] 0,00	[5] 0,00												
E. Other	[5] 0,00	[5] 0,00	0,00	0,00							0,00	0,00	NO	NO
6. Waste	**0,00**		**259,27**	**0,49**							**0,00**	**0,00**	**0,00**	**0,00**
A. Solid Waste Disposal on Land	[6] 0,00		200,79									0,00	0,00	
B. Wastewater Handling			58,48	0,49							0,00	0,00	0,00	
C. Waste Incineration	[6] 0,00		0,00	0,00							NO	NO	NO	NO
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**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	CH_4	N_2O	HFCs		PFCs		SF_6		NO_x	CO	NMVOC	SO_2
					P	A	P	A	P	A				
	(Gg)				CO_2 equivalent (Gg)				(Gg)					
Memo Items: [7]														
International Bunkers	**920,82**		**0,05**	**0,01**							**11,17**	**3,71**	**0,79**	**0,96**
Aviation	485,03		0,01	0,00							1,94	0,80	0,12	0,16
Marine	435,78		0,03	0,01							9,23	2,91	0,67	0,80
Multilateral Operations	**NO**		**NO**	**NO**							**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass	**3 410,54**													

Table A7.8 GHG emissions in Bulgaria; IPCC Table 7A: 2004

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	CH_4	N_2O	HFCs[1]		PFCs[1]		SF_6		NO_x	CO	NMVOC	SO_2
					P	A	P	A	P	A				
	(Gg)				CO_2 equivalent (Gg)						(Gg)			
Total National Emissions and Removals	**53 095,60**	**-7 965,21**	**465,03**	**14,18**	**217,30**	**0,00**	**0,00**	**33,18**	**0,00**	**3,68**	**126,48**	**405,63**	**67,20**	**997,55**
1. Energy	**48 276,24**		**88,13**	**1,20**							**117,98**	**365,38**	**29,65**	**977,37**
A. Fuel Combustion — Reference Approach [2]	48 526,29													
Sectoral Approach [2]	48 276,24		2,79	1,20							117,98	365,38	29,65	977,37
1. Energy Industries	28 297,62		0,45	0,81							57,87	6,09	0,41	844,40
2. Manufacturing Industries and Construction	10 817,76		0,23	0,07							14,11	6,67	0,04	79,65
3. Transport	7 402,79		1,11	0,14							40,62	169,22	29,20	9,52
4. Other Sectors	1 758,07		0,43	0,14							3,84	39,96	0,00	43,81
5. Other	0,00		0,57	0,03							1,55	143,44	0,00	0,00
B. Fugitive Emissions from Fuels	0,00		85,34	0,00							0,00	0,00	0,00	0,00
1. Solid Fuels	0,00		58,70	0,00							0,00	0,00	0,00	0,00
2. Oil and Natural Gas	0,00		26,64	0,00							0,00	0,00	0,00	0,00
2. Industrial Processes	**4 819,35**		**2,27**	**2,77**	**217,30**	**0,00**	**0,00**	**33,18**	**0,00**	**3,68**	**7,39**	**6,44**	**13,89**	**20,17**
A. Mineral Products	2 859,84		0,00	0,00							0,00	0,00	1,75	0,91
B. Chemical Industry	432,09		0,14	2,77	0,00	0,00	0,00	0,00	0,00	0,00	7,21	3,80	3,87	17,53
C. Metal Production	1 527,43		2,13	0,00				33,18		0,00	0,08	2,26	0,17	1,25
D. Other Production [3]	NO										0,10	0,39	6,06	0,48
E. Production of Halocarbons and SF_6						0,00		0,00		0,00				
F. Consumption of Halocarbons and SF_6					217,30	0,00	0,00	0,00	0,00	3,68				
G. Other	0,00		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	2,04	0,00

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	CH_4	N_2O	HFCs [1]		PFCs[1]		SF_6		NO_x	CO	NMVOC	SO_2
					P	A	P	A	P	A				
	(Gg)				CO_2 equivalent (Gg)						(Gg)			
3. Solvent and Other Product Use	**0,00**			**0,00**							**NO**	**NO**	**23,65**	**NO**
4. Agriculture	**0,00**	**0,00**	**99,48**	**9,73**							**1,11**	**33,80**	**0,00**	**0,00**
A. Enteric Fermentation			71,02											
B. Manure Management			24,55	1,28									0,00	
C. Rice Cultivation			2,30										0,00	
D. Agricultural Soils	[4] NO	[4] NO	0,00	8,42									0,00	
E. Prescribed Burning of Savannas			0,00	0,00							NO	NO	NO	
F. Field Burning of Agricultural Residues			1,61	0,0308							1,11	33,80	0,00	
G. Other			0,00	0,00							0,00	0,00	0,00	NO
5. Land-Use Change and Forestry	[5] **0,00**	[5] **-7 965,21**	**0,00**	**0,00**							**0,00**	**0,00**	**0,00**	**0,00**
A. Changes in Forest and Other Woody Biomass Stocks	[5] 0,00	[5] -7 965,21												
B. Forest and Grassland Conversion	0,00		0,00	0,00							0,00	0,00	NO	
C. Abandonment of Managed Lands	[5] 0,00	[5] 0,00												
D. CO_2 Emissions and Removals from Soil	[5] 0,00	[5] 0,00												
E. Other	[5] 0,00	[5] 0,00	0,00	0,00							0,00	0,00	NO	NO
6. Waste	**0,00**		**275,16**	**0,48**							**0,00**	**0,00**	**0,00**	**0,00**
A. Solid Waste Disposal on Land	[6] 0,00		216,44									0,00	0,00	
B. Wastewater Handling			58,72	0,48							0,00	0,00	0,00	
C. Waste Incineration	[6] 0,00		0,00	0,00							NO	NO	NO	NO
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**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	CH_4	N_2O	HFCs		PFCs		SF_6		NO_x	CO	NMVOC	SO_2
					P	A	P	A	P	A				
	(Gg)				CO_2 equivalent (Gg)				(Gg)					
Memo Items: [7]														
International Bunkers	**771,79**		**0,04**	**0,01**							**9,38**	**3,12**	**0,66**	**0,81**
Aviation	405,35		0,01	0,00							1,62	0,67	0,10	0,13
Marine	366,45		0,03	0,01							7,76	2,45	0,56	0,67
Multilateral Operations	**NO**		**NO**	**NO**							**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass	**3 693,66**													

7.2 IPCC tables 8A and 8B for the base 1988 year and for the period 1990-2003

Table A 7.9 CRF recalculation tables, Tables 8a and 8b for 1988

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		CO_2			CH_4			N_2O		
		Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]
		CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)
Total National Emissions and Removals		**93 438.98**	**93 169.38**	**-0.29**	**24 924.58**	**21 864.16**	**-12.28**	**14 805.01**	**12 061.43**	**-18.53**
1. Energy		**90 725.67**	**90 725.67**	**0.00**	**3 381.88**	**3 381.88**	**0.00**	**4 173.95**	**507.98**	**-87.83**
1.A.	Fuel Combustion Activities	90 725.67	90 725.67	0.00	111.33	111.33	0.00	4 173.95	507.98	-87.83
1.A.1.	Energy Industries	43 216.90	43 216.90	0.00	17.73	17.73	0.00	3 534.47	302.11	-91.45
1.A.2.	Manufacturing Industries and Construction	24 754.56	24 754.56	0.00	11.91	11.91	0.00	286.49	44.90	-84.33
1.A.3.	Transport	13 813.97	13 813.97	0.00	62.60	62.60	0.00	100.94	100.94	0.00
1.A.4.	Other Sectors	8 940.25	8 940.25	0.00	6.71	6.71	0.00	252.05	49.41	-80.40
1.A.5.	Other	NO	NO		12.38	12.38	0.00	NE	10.62	100.00
1.B.	Fugitive Emissions from Fuels	NE	NE		3 270.55	3 270.55	0.00	NE	NE	
1.B.1.	Solid fuel	NE	NE		1 991.58	1 991.58	0.00	NE	NE	
1.B.2.	Oil and Natural Gas	NE	NE		1 278.97	1 278.97	0.00	NE	NE	
2. Industrial Processes		**7 845.94**	**7 576.34**	**-3.44**	**81.66**	**81.66**	**0.00**	**2 421.72**	**2 421.72**	**0.00**
2.A.	Mineral Products	4 114.32	3 844.72	-6.55	NA	NA		NA	NA	
2.B.	Chemical Industry	1 246.45	1 246.45	0.00	0.84	0.84	0.00	2 421.72	2 421.72	0.00
2.C.	Metal Production	2 485.18	2 485.18	0.00	73.20	73.20	0.00	NA	NA	
2.D.	Other Production	NO	NO							
2.G.	Other	NO	NO		7.62	7.62	0.00	NO	NO	
3. Solvent and Other Product Use				**0.00**						**0.00**
4. Agriculture		**0.00**	**0.00**	**0.00**	**5 733.12**	**5 737.78**	**0.08**	**7 898.85**	**8 821.24**	**11.68**
4.A.	Enteric Fermentation				4 048.54	4 048.54	0.00			
4.B.	Manure Management				1 523.61	1 523.64	0.00	1 056.05	1 056.05	0.00
4.C.	Rice Cultivation				119.25	119.25	0.00			
4.D.	Agricultural Soils [2]	NA	NA		NE	NE		6 829.22	7 750.09	13.48
4.E.	Prescribed Burning of Savannas						0.00			0.00
4.F.	Field Burning of Agricultural Residues				41.71	46.35	11.11	13.59	15.10	11.11
4.G.	Other				NO	NO		NO	NO	
5. Land-Use Change and Forestry (net) [3]		**-5 132.63**	**-5 132.63**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
5.A.	Changes in Forest and Other Woody Biomass Stocks	-5 132.63	-5 132.63	0.00						
5.B.	Forest and Grassland Conversion	NE	NE		NE	NE		NE	NE	
5.C.	Abandonment of Managed Lands	NE	NE							
5.D.	CO_2 Emissions and Removals from Soil	NE	NE							
5.E.	Other	NO	NO		NO	NO		NO	NO	

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		CO_2			CH_4			N_2O		
		Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]
		CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)
6. Waste		**0.00**	**0.00**	**0.00**	**15 727.92**	**12 662.84**	**-19.49**	**310.49**	**310.49**	**0.00**
6.A.	Solid Waste Disposal on Land	NE	NE		13 882.99	10 817.92	-22.08			
6.B.	Wastewater Handling				1 844.93	1 844.93	0.00	310.49	310.49	0.00
6.C.	Waste Incineration	NO	NO		NO	NO		NO	NO	
6.D.	Other			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
Memo Items:										
International Bunkers		**1 718.36**	**1 718.36**	**0.00**	**1.32**	**1.32**	**0.00**	**7.52**	**7.52**	**0.00**
Multilateral Operations		NO	NO		NO	NO		NO	NO	
CO_2 Emissions from Biomass		**1 468.56**	**1 468.56**	**0.00**						

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		HFCs			PFCs			SF_6		
		Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]
		CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)
Total Actual Emissions		**0.00**	**0.00**	**0.00**	**75.55**	**75.55**	**0.00**	**0.00**	**0.00**	**0.00**
2.C.3.	Aluminium Production				75.55	75.55	0.00	NA	NA	
2.E.	Production of Halocarbons and SF_6	NO	NO		NO	NO		NO	NO	
2.F.	Consumption of Halocarbons and SF_6	NE	NE		NE	NE		NE	NE	
	Other			0.00			0.00			0.00
Potential Emissions from Consumption of HFCs/PFCs and SF_6		**NE**	**NE**		**NE**	**NE**		**NE**	**NE**	

	Previous submission	Latest submission	Difference[1]
	CO_2 equivalent (Gg)		(%)
Total CO_2 Equivalent Emissions with Land-Use Change and Forestry [3]	133 244.13	127 170.53	-4.56
Total CO_2 Equivalent Emissions without Land-Use Change and Forestry [3]	138 376.76	132 303.16	-4.39

Table A 7.10 CRF recalculation tables, Tables 8a and 8b for 1990

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		CO_2			CH_4			N_2O		
		Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]
		CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)
Total National Emissions and Removals		**79 381.53**	**79 125.84**	**-0.32**	**21 392.68**	**18 703.29**	**-12.57**	**12 942.96**	**10 450.02**	**-19.26**
1. Energy		**78 672.85**	**78 672.85**	**0.00**	**2 313.90**	**2 313.90**	**0.00**	**3 654.59**	**438.37**	**-88.00**
1.A.	Fuel Combustion Activities	78 672.85	78 672.85	0.00	104.70	104.70	0.00	3 654.59	438.37	-88.00
1.A.1.	Energy Industries	39 601.23	39 601.23	0.00	19.17	19.17	0.00	2 964.22	248.73	-91.61
1.A.2.	Manufacturing Industries and Construction	21 821.39	21 821.39	0.00	7.45	7.45	0.00	523.52	65.53	-87.48
1.A.3.	Transport	10 863.71	10 863.71	0.00	61.02	61.02	0.00	78.75	78.75	0.00
1.A.4.	Other Sectors	5 380.59	5 380.59	0.00	4.39	4.39	0.00	68.66	31.95	-53.47
1.A.5.	Other	1 005.93	1 005.93	0.00	12.67	12.67	0.00	19.44	13.41	-31.00
1.B.	Fugitive Emissions from Fuels	0.00	0.00	0.00	2 209.20	2 209.20	0.00	0.00	0.00	0.00
1.B.1.	Solid fuel	NE	NE		1 591.81	1 591.81	0.00	NE	NE	
1.B.2.	Oil and Natural Gas	NE	NE		617.39	617.39	0.00	NE	NE	
2. Industrial Processes		**6 865.67**	**6 609.97**	**-3.72**	**63.46**	**63.46**	**0.00**	**2 255.50**	**2 255.50**	**0.00**
2.A.	Mineral Products	3 797.38	3 541.68	-6.73	NA	NA		NA	NA	
2.B.	Chemical Industry	1 224.51	1 224.51	0.00	0.38	0.38	0.00	2 255.50	2 255.50	0.00
2.C.	Metal Production	1 843.78	1 843.78	0.00	57.87	57.87	0.00	NA	NA	
2.D.	Other Production	NO	NO							
2.G.	Other	NO	NO		5.21	5.21	0.00	NO	NO	
3. Solvent and Other Product Use				**0.00**						**0.00**
4. Agriculture		**0.00**	**0.00**	**0.00**	**5 416.07**	**5 420.73**	**0.09**	**6 809.22**	**7 532.50**	**10.62**
4.A.	Enteric Fermentation				3 783.64	3 783.64	0.00			
4.B.	Manure Management				1 501.24	1 501.28	0.00	1 030.42	1 030.42	0.00
4.C.	Rice Cultivation				89.56	89.56	0.00			
4.D.	Agricultural Soils [2]	NA	NA		NE	NE		5 766.21	6 488.10	12.52
4.E.	Prescribed Burning of Savannas						0.00			0.00
4.F.	Field Burning of Agricultural Residues				41.63	46.25	11.11	12.58	13.98	11.11
4.G.	Other				NO	NO		NO	NO	
5. Land-Use Change and Forestry (net) [3]		**-6 156.99**	**-6 156.99**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
5.A.	Changes in Forest and Other Woody Biomass Stocks	-6 156.99	-6 156.99	0.00						
5.B.	Forest and Grassland Conversion	NE	NE		NE	NE		NE	NE	
5.C.	Abandonment of Managed Lands	NE	NE							
5.D.	CO_2 Emissions and Removals from Soil	NE	NE							
5.E.	Other	NO	NO		NO	NO		NO	NO	

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		CO_2			CH_4			N_2O		
		Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]
		CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)
6. Waste		**0.00**	**0.00**	**0.00**	**13 599.24**	**10 905.20**	**-19.81**	**223.66**	**223.66**	**0.00**
6.A.	Solid Waste Disposal on Land	NE	NE		12 202.42	9 508.38	-22.08			
6.B.	Wastewater Handling				1 396.82	1 396.82	0.00	223.66	223.66	0.00
6.C.	Waste Incineration	NO	NO		NO	NO		NO	NO	
6.D.	Other			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
Memo Items:										
International Bunkers		**1 766.14**	**1 766.14**	**0.00**	**1.16**	**1.16**	**0.00**	6.83	6.83	**0.00**
Multilateral Operations		NO	NO		NO	NO		NO	NO	
CO_2 Emissions from Biomass		**1 311.71**	**1 311.71**	**0.00**						

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		HFCs			PFCs			SF_6		
		Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]
		CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)
Total Actual Emissions		**0.00**	**0.00**	**0.00**	**47.31**	**47.31**	**0.00**	**0.00**	**0.00**	**0.00**
2.C.3.	Aluminium Production				47.31	47.31	0.00	NA	NA	
2.E.	Production of Halocarbons and SF_6	NO	NO		NO	NO		NO	NO	
2.F.	Consumption of Halocarbons and SF_6	NE	NE		NE	NE		NE	NE	
	Other			0.00			0.00			0.00
Potential Emissions from Consumption of HFCs/PFCs and SF_6		**NE**	**NE**		**NE**	**NE**		**NE**	**NE**	

	Previous submission	Latest submission	Difference[1]
	CO_2 equivalent (Gg)		(%)
Total CO_2 Equivalent Emissions with Land-Use Change and Forestry [3]	113 764.48	108 326.46	-4.78
Total CO_2 Equivalent Emissions without Land-Use Change and Forestry [3]	119 921.47	114 483.45	-4.53

Table A 7.11 CRF recalculation tables, Tables 8a and 8b for 1995

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		CO_2			CH_4			N_2O		
		Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]
		CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)
Total National Emissions and Removals		**57 206.11**	**57 219.15**	**0.02**	**14 239.87**	**12 389.84**	**-12.99**	**8 247.63**	**5 837.85**	**-29.22**
1. Energy		**59 375.81**	**59 375.81**	**0.00**	**2 181.26**	**2 181.26**	**0.00**	**3 026.56**	**370.56**	**-87.76**
1.A.	Fuel Combustion Activities	59 375.81	59 375.81	0.00	75.68	75.68	0.00	3 026.56	370.56	-87.76
1.A.1.	Energy Industries	31 571.95	31 571.95	0.00	11.86	11.86	0.00	2 652.74	259.53	-90.22
1.A.2.	Manufacturing Industries and Construction	18 023.19	18 023.19	0.00	7.09	7.09	0.00	285.09	35.40	-87.58
1.A.3.	Transport	6 844.63	6 844.63	0.00	42.50	42.50	0.00	44.18	44.18	0.00
1.A.4.	Other Sectors	2 621.01	2 621.01	0.00	2.17	2.17	0.00	28.93	19.32	-33.24
1.A.5.	Other	315.02	315.02	0.00	12.06	12.06	0.00	15.61	12.12	-22.34
1.B.	Fugitive Emissions from Fuels	0.00	0.00	0.00	2 105.58	2 105.58	0.00	0.00	0.00	0.00
1.B.1.	Solid fuel	NE	NE		1 453.48	1 453.48	0.00	NE	NE	
1.B.2.	Oil and Natural Gas	NE	NE		652.10	652.10	0.00	NE	NE	
2. Industrial Processes		**5 354.78**	**5 367.81**	**0.24**	**73.92**	**73.92**	**0.00**	**1 921.08**	**1 921.08**	**0.00**
2.A.	Mineral Products	1 960.14	1 973.17	0.66	NA	NA		NA	NA	
2.B.	Chemical Industry	1 071.58	1 071.58	0.00	0.74	0.74	0.00	1 921.08	1 921.08	0.00
2.C.	Metal Production	2 323.06	2 323.06	0.00	69.06	69.06	0.00	NA	NA	
2.D.	Other Production	NO	NO							
2.G.	Other	NO	NO		4.12	4.12	0.00	NO	NO	
3. Solvent and Other Product Use				**0.00**						**0.00**
4. Agriculture		**0.00**	**0.00**	**0.00**	**2 554.91**	**2 558.00**	**0.12**	**3 123.18**	**3 377.33**	**8.14**
4.A.	Enteric Fermentation				1 790.77	1 790.77	0.00			
4.B.	Manure Management				724.85	724.87	0.00	495.73	495.73	0.00
4.C.	Rice Cultivation				11.67	11.67	0.00			
4.D.	Agricultural Soils [2]	NA	NA		NE	NE		2 619.07	2 872.29	9.67
4.E.	Prescribed Burning of Savannas						0.00			0.00
4.F.	Field Burning of Agricultural Residues				27.62	30.69	11.11	8.38	9.31	11.11
4.G.	Other				NO	NO		NO	NO	
5. Land-Use Change and Forestry (net) [3]		**-7 524.48**	**-7 524.48**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
5.A.	Changes in Forest and Other Woody Biomass Stocks	-7 524.48	-7 524.48	0.00						
5.B.	Forest and Grassland Conversion	NE	NE		NE	NE		NE	NE	
5.C.	Abandonment of Managed Lands	NE	NE							
5.D.	CO_2 Emissions and Removals from Soil	NE	NE							
5.E.	Other	NO	NO		NO	NO		NO	NO	

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		CO_2			CH_4			N_2O		
		Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]
		CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)
6. Waste		**0.00**	**0.00**	**0.00**	**9 429.78**	**7 576.66**	**-19.65**	**176.80**	**168.88**	**-4.48**
6.A.	Solid Waste Disposal on Land	NE	NE		8 393.54	6 540.42	-22.08			
6.B.	Wastewater Handling				1 036.24	1 036.24	0.00	176.80	168.88	-4.48
6.C.	Waste Incineration	NO	NO		NO	NO		NO	NO	
6.D.	Other			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
Memo Items:										
International Bunkers		**1 431.78**	**1 431.78**	**0.00**	**0.69**	**0.69**	**0.00**	6.84	6.84	**0.00**
Multilateral Operations		NO	NO		NO	NO		NO	NO	
CO_2 Emissions from Biomass		**1 560.14**	**1 560.14**	**0.00**						

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		HFCs			PFCs			SF_6		
		Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]
		CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)
Total Actual Emissions		**2.95**	**2.95**	**0.00**	**46.94**	**46.94**	**0.00**	**1.26**	**1.26**	**0.00**
2.C.3.	Aluminium Production				46.94	46.94	0.00	NA	NA	
2.E.	Production of Halocarbons and SF_6	NO	NO		NO	NO		NO	NO	
2.F.	Consumption of Halocarbons and SF_6	2.95	2.95	0.00	NE	NE		1.26	1.26	0.00
	Other			0.00			0.00			0.00
Potential Emissions from Consumption of HFCs/PFCs and SF_6		**62.16**	**62.16**	0.00	**NE**	**NE**		**NE**	**NE**	

	Previous submission	Latest submission	Difference[1]
	CO_2 equivalent (Gg)		(%)
Total CO_2 Equivalent Emissions with Land-Use Change and Forestry [3]	79 744.76	75 498.00	-5.33
Total CO_2 Equivalent Emissions without Land-Use Change and Forestry [3]	87 269.24	83 022.47	-4.87

Table A 7.12 CRF recalculation tables, Tables 8a and 8b for 2000

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		CO_2			CH_4			N_2O		
		Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]
		CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)
Total National Emissions and Removals		**40 926.56**	**41 200.25**	**0.67**	**9 037.99**	**9 035.16**	**-0.03**	**6 722.67**	**4 911.45**	**-26.94**
1. Energy		**45 861.46**	**45 861.46**	**0.00**	**1 858.74**	**1 853.49**	**-0.28**	**2 410.97**	**335.34**	**-86.09**
1.A.	Fuel Combustion Activities	45 861.46	45 861.46	0.00	59.52	59.52	0.00	2 410.97	335.34	-86.09
1.A.1.	Energy Industries	26 215.75	26 215.75	0.00	8.96	8.96	0.00	2 248.33	234.81	-89.56
1.A.2.	Manufacturing Industries and Construction	11 868.18	11 868.18	0.00	4.90	4.90	0.00	62.37	20.15	-67.69
1.A.3.	Transport	5 881.45	5 881.45	0.00	27.32	27.32	0.00	34.48	34.48	0.00
1.A.4.	Other Sectors	1 896.08	1 896.08	0.00	7.93	7.93	0.00	65.79	36.97	-43.80
1.A.5.	Other	NO	NO		10.40	10.40	0.00	NE	8.92	100.00
1.B.	Fugitive Emissions from Fuels	0.00	0.00	0.00	1 799.22	1 793.97	-0.29	0.00	0.00	0.00
1.B.1.	Solid fuel	NE	NE		1 198.98	1 198.98	0.00	NE	NE	
1.B.2.	Oil and Natural Gas	NE	NE		600.24	594.99	-0.87	NE	NE	
2. Industrial Processes		**4 041.33**	**4 315.01**	**6.77**	**73.81**	**73.81**	**0.00**	**1 314.42**	**1 314.42**	**0.00**
2.A.	Mineral Products	1 988.09	2 261.77	13.77	NA	NA		NA	NA	
2.B.	Chemical Industry	569.90	569.90	0.00	3.10	3.10	0.00	1 314.42	1 314.42	0.00
2.C.	Metal Production	1 483.34	1 483.34	0.00	70.70	70.70	0.00	NA	NA	
2.D.	Other Production	NO	NO							
2.G.	Other	NO	NO		NO	NO		NO	NO	
3. Solvent and Other Product Use				**0.00**						**0.00**
4. Agriculture		**0.00**	**0.00**	**0.00**	**2 285.52**	**2 287.95**	**0.11**	**2 839.09**	**3 106.12**	**9.41**
4.A.	Enteric Fermentation				1 664.90	1 664.90	0.00			
4.B.	Manure Management				568.69	568.71	0.00	429.29	429.29	0.00
4.C.	Rice Cultivation				30.20	30.20	0.00			
4.D.	Agricultural Soils [2]	NA	NA		NE	NE		2 404.16	2 670.57	11.08
4.E.	Prescribed Burning of Savannas						0.00			0.00
4.F.	Field Burning of Agricultural Residues				21.73	24.15	11.11	5.63	6.26	11.11
4.G.	Other				NO	NO		NO	NO	
5. Land-Use Change and Forestry (net) [3]		**-8 976.23**	**-8 976.23**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
5.A.	Changes in Forest and Other Woody Biomass Stocks	-8 976.23	-8 976.23	0.00						
5.B.	Forest and Grassland Conversion	NE	NE		NE	NE		NE	NE	
5.C.	Abandonment of Managed Lands	NE	NE							
5.D.	CO_2 Emissions and Removals from Soil	NE	NE							
5.E.	Other	NO	NO		NO	NO		NO	NO	

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		CO_2			CH_4			N_2O		
		Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]
		CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)
6. Waste		**0.00**	**0.00**	**0.00**	**4 819.91**	**4 819.91**	**0.00**	**158.20**	**155.57**	**-1.66**
6.A.	Solid Waste Disposal on Land	NE	NE		4 226.25	4 226.25	0.00			
6.B.	Wastewater Handling				593.66	593.66	0.00	158.20	155.57	-1.66
6.C.	Waste Incineration	NO	NO		NO	NO		NO	NO	
6.D.	Other			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
Memo Items:										
International Bunkers		**475.16**	**475.16**	**0.00**	**0.47**	**0.47**	**0.00**	**1.60**	**1.60**	**0.00**
Multilateral Operations		NO	NO		NO	NO		NO	NO	
CO_2 Emissions from Biomass		**2 955.11**	**2 955.11**	**0.00**						

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		HFCs			PFCs			SF_6		
		Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]
		CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)
Total Actual Emissions		**0.00**	**0.00**	**0.00**	**33.14**	**33.14**	**0.00**	**2.23**	**2.23**	**0.00**
2.C.3.	Aluminium Production				33.14	33.14	0.00	NA	NA	
2.E.	Production of Halocarbons and SF_6	NO	NO		NO	NO		NO	NO	
2.F.	Consumption of Halocarbons and SF_6	NE	NE		NE	NE		2.23	2.23	0.00
	Other			0.00			0.00			0.00
Potential Emissions from Consumption of HFCs/PFCs and SF_6		**96.02**	**96.02**	0.00	**NE**	**NE**		**29.40**	**29.40**	0.00

	Previous submission	Latest submission	Difference[1]
	CO_2 equivalent (Gg)		(%)
Total CO_2 Equivalent Emissions with Land-Use Change and Forestry [3]	56 722.59	55 182.23	-2.72
Total CO_2 Equivalent Emissions without Land-Use Change and Forestry [3]	65 698.82	64 158.46	-2.34

Table A 7.13 CRF recalculation tables, Tables 8a and 8b for 2001

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		CO_2			CH_4			N_2O		
		Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]
		CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)
Total National Emissions and Removals		**42 005.17**	**42 383.37**	**0.90**	**8 319.86**	**8 317.34**	**-0.03**	**6 626.36**	**4 568.13**	**-31.06**
1. Energy		**47 475.34**	**47 475.34**	**0.00**	**1 818.87**	**1 813.62**	**-0.29**	**2 648.44**	**355.75**	**-86.57**
1.A.	Fuel Combustion Activities	47 475.34	47 475.34	0.00	55.07	55.07	0.00	2 648.44	355.75	-86.57
1.A.1.	Energy Industries	29 035.91	29 035.91	0.00	9.77	9.77	0.00	2 480.17	257.93	-89.60
1.A.2.	Manufacturing Industries and Construction	10 788.11	10 788.11	0.00	4.69	4.69	0.00	56.70	20.73	-63.44
1.A.3.	Transport	6 013.52	6 013.52	0.00	23.56	23.56	0.00	34.46	34.46	0.00
1.A.4.	Other Sectors	1 637.81	1 637.81	0.00	6.89	6.89	0.00	77.12	33.92	-56.01
1.A.5.	Other	NO	NO		10.16	10.16	0.00	NE	8.71	100.00
1.B.	Fugitive Emissions from Fuels	0.00	0.00	0.00	1 763.80	1 758.55	-0.30	0.00	0.00	0.00
1.B.1.	Solid fuel	NE	NE		1 211.79	1 211.79	0.00	NE	NE	
1.B.2.	Oil and Natural Gas	NE	NE		552.00	546.75	-0.95	NE	NE	
2. Industrial Processes		**3 996.97**	**4 375.18**	**9.46**	**50.90**	**50.90**	**0.00**	**1 295.16**	**1 295.16**	**0.00**
2.A.	Mineral Products	2 068.30	2 446.50	18.29	NA	NA		NA	NA	
2.B.	Chemical Industry	506.70	506.70	0.00	2.97	2.97	0.00	1 295.16	1 295.16	0.00
2.C.	Metal Production	1 421.97	1 421.97	0.00	47.93	47.93	0.00	NA	NA	
2.D.	Other Production	NO	NO							
2.G.	Other	NO	NO		NO	NO		NO	NO	
3. Solvent and Other Product Use				**0.00**						**0.00**
4. Agriculture		**0.00**	**0.00**	**0.00**	**1 769.00**	**1 771.73**	**0.15**	**2 536.50**	**2 768.93**	**9.16**
4.A.	Enteric Fermentation				1 306.25	1 306.25	0.00			
4.B.	Manure Management				405.21	405.21	0.00	320.64	320.64	0.00
4.C.	Rice Cultivation				32.96	32.96	0.00			
4.D.	Agricultural Soils [2]	NA	NA		NE	NE		2 210.17	2 441.96	10.49
4.E.	Prescribed Burning of Savannas						0.00			0.00
4.F.	Field Burning of Agricultural Residues				24.58	27.32	11.11	5.70	6.33	11.11
4.G.	Other				NO	NO		NO	NO	
5. Land-Use Change and Forestry (net) [3]		**-9 467.15**	**-9 467.15**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
5.A.	Changes in Forest and Other Woody Biomass Stocks	-9 467.15	-9 467.15	0.00						
5.B.	Forest and Grassland Conversion	NE	NE		NE	NE		NE	NE	
5.C.	Abandonment of Managed Lands	NE	NE							
5.D.	CO_2 Emissions and Removals from Soil	NE	NE							
5.E.	Other	NO	NO		NO	NO		NO	NO	

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		CO_2			CH_4			N_2O		
		Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]
		CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)
6. Waste		**0.00**	**0.00**	**0.00**	**4 681.08**	**4 681.08**	**0.00**	**146.25**	**148.29**	**1.39**
6.A.	Solid Waste Disposal on Land	NE	NE		4 199.50	4 199.50	0.00			
6.B.	Wastewater Handling				481.59	481.59	0.00	146.25	148.29	1.39
6.C.	Waste Incineration	NO	NO		NO	NO		NO	NO	
6.D.	Other			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
Memo Items:										
International Bunkers		**699.16**	**699.16**	**0.00**	**0.69**	**0.69**	**0.00**	**2.38**	**2.38**	**0.00**
Multilateral Operations		NO	NO		NO	NO		NO	NO	
CO_2 Emissions from Biomass		**2 876.11**	**2 876.11**	**0.00**						

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		HFCs			PFCs			SF_6		
		Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]
		CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)
Total Actual Emissions		**0.00**	**0.00**	**0.00**	**16.29**	**16.29**	**0.00**	**2.29**	**2.29**	**0.00**
2.C.3.	Aluminium Production				16.29	16.29	0.00	NA	NA	
2.E.	Production of Halocarbons and SF_6	NO	NO		NO	NO		NO	NO	
2.F.	Consumption of Halocarbons and SF_6	NE	NE		NE	NE		2.29	2.29	0.00
	Other			0.00			0.00			0.00
Potential Emissions from Consumption of HFCs/PFCs and SF_6		**97.50**	**97.50**	0.00	**NE**	**NE**		**2.39**	**2.39**	0.00

	Previous submission	Latest submission	Difference[1]
	CO_2 equivalent (Gg)		(%)
Total CO_2 Equivalent Emissions with Land-Use Change and Forestry [3]	56 969.97	55 287.42	-2.95
Total CO_2 Equivalent Emissions without Land-Use Change and Forestry [3]	66 437.12	64 754.57	-2.53

Table A 7.14 CRF recalculation tables, Tables 8a and 8b for 2002

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		CO_2			CH_4			N_2O		
		Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]
		CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)
Total National Emissions and Removals		**40 439.99**	**40 764.75**	**0.80**	**8 481.79**	**8 479.70**	**-0.02**	**6 274.80**	**4 442.98**	**-29.19**
1. Energy		**45 054.34**	**45 054.34**	**0.00**	**1 789.14**	**1 783.89**	**-0.29**	**2 397.83**	**339.33**	**-85.85**
1.A.	Fuel Combustion Activities	45 054.34	45 054.34	0.00	58.70	58.70	0.00	2 397.83	339.33	-85.85
1.A.1.	Energy Industries	26 465.57	26 465.57	0.00	8.97	8.97	0.00	2 228.10	231.12	-89.63
1.A.2.	Manufacturing Industries and Construction	10 198.06	10 198.06	0.00	4.40	4.40	0.00	65.22	21.08	-67.67
1.A.3.	Transport	6 316.61	6 316.61	0.00	25.51	25.51	0.00	35.55	35.55	0.00
1.A.4.	Other Sectors	2 074.11	2 074.11	0.00	8.22	8.22	0.00	68.97	41.63	-39.64
1.A.5.	Other	NO	NO		11.61	11.61	0.00	NE	9.96	100.00
1.B.	Fugitive Emissions from Fuels	0.00	0.00	0.00	1 730.44	1 725.19	-0.30	0.00	0.00	0.00
1.B.1.	Solid fuel	NE	NE		1 228.43	1 228.43	0.00	NE	NE	
1.B.2.	Oil and Natural Gas	NE	NE		502.01	496.76	-1.05	NE	NE	
2. Industrial Processes		**3 703.71**	**4 028.47**	**8.77**	**46.08**	**46.08**	**0.00**	**1 088.82**	**1 088.82**	**0.00**
2.A.	Mineral Products	2 051.84	2 376.60	15.83	NA	NA		NA	NA	
2.B.	Chemical Industry	325.40	325.40	0.00	2.82	2.82	0.00	1 088.82	1 088.82	0.00
2.C.	Metal Production	1 326.47	1 326.47	0.00	43.26	43.26	0.00	NA	NA	
2.D.	Other Production	NO	NO							
2.G.	Other	NO	NO		NO	NO		NO	NO	
3. Solvent and Other Product Use				**0.00**						**0.00**
4. Agriculture		**0.00**	**0.00**	**0.00**	**1 991.90**	**1 995.05**	**0.16**	**2 648.36**	**2 864.27**	**8.15**
4.A.	Enteric Fermentation				1 448.46	1 448.46	0.00			
4.B.	Manure Management				470.79	470.79	0.00	368.31	368.31	0.00
4.C.	Rice Cultivation				44.25	44.25	0.00			
4.D.	Agricultural Soils [2]	NA	NA		NE	NE		2 272.71	2 487.81	9.46
4.E.	Prescribed Burning of Savannas						0.00			0.00
4.F.	Field Burning of Agricultural Residues				28.40	31.55	11.11	7.34	8.16	11.11
4.G.	Other				NO	NO		NO	NO	
5. Land-Use Change and Forestry (net) [3]		**-8 318.06**	**-8 318.06**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
5.A.	Changes in Forest and Other Woody Biomass Stocks	-8 318.06	-8 318.06	0.00						
5.B.	Forest and Grassland Conversion	NE	NE		NE	NE		NE	NE	
5.C.	Abandonment of Managed Lands	NE	NE							
5.D.	CO_2 Emissions and Removals from Soil	NE	NE							
5.E.	Other	NO	NO		NO	NO		NO	NO	

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		CO_2			CH_4			N_2O		
		Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]
		CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)
6. Waste		**0.00**	**0.00**	**0.00**	**4 654.67**	**4 654.67**	**0.00**	**139.78**	**150.55**	**7.70**
6.A.	Solid Waste Disposal on Land	NE	NE		4 197.14	4 197.14	0.00			
6.B.	Wastewater Handling				457.53	457.53	0.00	139.78	150.55	7.70
6.C.	Waste Incineration	NO	NO		NO	NO		NO	NO	
6.D.	Other			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
Memo Items:										
International Bunkers		**735.38**	**735.38**	**0.00**	**0.75**	**0.75**	**0.00**	**2.62**	**2.62**	**0.00**
Multilateral Operations		NO	NO		NO	NO		NO	NO	
CO_2 Emissions from Biomass		**3 389.72**	**3 389.72**	**0.00**						

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		HFCs			PFCs			SF_6		
		Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]
		CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)
Total Actual Emissions		**0.00**	**0.00**	**0.00**	**21.42**	**21.42**	**0.00**	**2.51**	**2.51**	**0.00**
2.C.3.	Aluminium Production				21.42	21.42	0.00	NA	NA	
2.E.	Production of Halocarbons and SF_6	NO	NO		NO	NO		NO	NO	
2.F.	Consumption of Halocarbons and SF_6	NE	NE		NE	NE		2.51	2.51	0.00
	Other			0.00			0.00			0.00
Potential Emissions from Consumption of HFCs/PFCs and SF_6		**89.59**	**89.59**	0.00	**NE**	**NE**		**2.39**	**2.39**	0.00

	Previous submission	Latest submission	Difference[1]
	CO_2 equivalent (Gg)		(%)
Total CO_2 Equivalent Emissions with Land-Use Change and Forestry [3]	55 220.51	53 711.35	-2.73
Total CO_2 Equivalent Emissions without Land-Use Change and Forestry [3]	63 538.57	62 029.42	-2.38

Table A 7.15 CRF recalculation tables, Tables 8a and 8b for 2003

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		CO_2			CH_4			N_2O		
		Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]
		CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)
Total National Emissions and Removals		**46 265.40**	**46 738.93**	**1.02**	**9 365.83**	**9 358.42**	**-0.08**	**6 456.39**	**4 434.11**	**-31.32**
1. Energy		**49 035.44**	**49 166.77**	**0.27**	**1 783.56**	**1 774.68**	**-0.50**	**2 647.32**	**371.43**	**-85.97**
1.A.	Fuel Combustion Activities	49 035.44	49 166.77	0.27	58.53	58.53	0.00	2 647.32	371.43	-85.97
1.A.1.	Energy Industries	28 329.87	28 329.87	0.00	9.45	9.45	0.00	2 439.59	254.33	-89.57
1.A.2.	Manufacturing Industries and Construction	11 402.14	11 533.47	1.15	5.02	5.02	0.00	102.51	23.94	-76.64
1.A.3.	Transport	7 097.83	7 097.83	0.00	26.07	26.07	0.00	41.16	41.16	0.00
1.A.4.	Other Sectors	2 205.59	2 205.59	0.00	8.64	8.64	0.00	64.06	43.99	-31.33
1.A.5.	Other	NO	NO		9.34	9.34	0.00	NE	8.01	100.00
1.B.	Fugitive Emissions from Fuels	0.00	0.00	0.00	1 725.03	1 716.15	-0.51	0.00	0.00	0.00
1.B.1.	Solid fuel	NE	NE		1 208.32	1 208.32	0.00	NE	NE	
1.B.2.	Oil and Natural Gas	NE	NE		516.70	507.83	-1.72	NE	NE	
2. Industrial Processes		**4 285.94**	**4 628.14**	**7.98**	**58.54**	**58.54**	**0.00**	**1 159.38**	**1 159.38**	**0.00**
2.A.	Mineral Products	2 279.10	2 621.30	15.01	NA	NA		NA	NA	
2.B.	Chemical Industry	345.10	345.10	0.00	5.73	5.73	0.00	1 159.38	1 159.38	0.00
2.C.	Metal Production	1 661.74	1 661.74	0.00	52.81	52.81	0.00	NA	NA	
2.D.	Other Production	NO	NO							
2.G.	Other	NO	NO		NO	NO		NO	NO	
3. Solvent and Other Product Use				**0.00**						**0.00**
4. Agriculture		**0.00**	**0.00**	**0.00**	**2 079.11**	**2 080.57**	**0.07**	**2 499.45**	**2 752.15**	**10.11**
4.A.	Enteric Fermentation				1 502.33	1 501.94	-0.03			
4.B.	Manure Management				511.93	511.89	-0.01	394.56	394.56	0.00
4.C.	Rice Cultivation				47.73	47.73	0.00			
4.D.	Agricultural Soils [2]	NA	NA		NE	NE		2 099.54	2 351.66	12.01
4.E.	Prescribed Burning of Savannas						0.00			0.00
4.F.	Field Burning of Agricultural Residues				17.11	19.01	11.11	5.35	5.94	11.11
4.G.	Other				NO	NO		NO	NO	
5. Land-Use Change and Forestry (net) [3]		**-7 055.98**	**-7 055.98**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
5.A.	Changes in Forest and Other Woody Biomass Stocks	-7 055.98	-7 055.98	0.00						
5.B.	Forest and Grassland Conversion	NE	NE		NE	NE		NE	NE	
5.C.	Abandonment of Managed Lands	NE	NE							
5.D.	CO_2 Emissions and Removals from Soil	NE	NE							
5.E.	Other	NO	NO		NO	NO		NO	NO	

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		CO_2			CH_4			N_2O		
		Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]
		CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)
6. Waste		**0.00**	**0.00**	**0.00**	**5 444.63**	**5 444.63**	**0.00**	**150.24**	**151.14**	**0.60**
6.A.	Solid Waste Disposal on Land	NE	NE		4 216.55	4 216.55	0.00			
6.B.	Wastewater Handling				1 228.08	1 228.08		150.24	151.14	0.60
6.C.	Waste Incineration	NO	NO		NO	NO		NO	NO	
6.D.	Other			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
Memo Items:										
International Bunkers		**920.82**	**920.82**	**0.00**	**0.05**	**0.05**	**0.00**	**0.01**	**0.01**	**0.00**
Multilateral Operations		NO	NO		NO	NO		NO	NO	
CO_2 Emissions from Biomass		**3 410.54**	**3 410.54**	**0.00**						

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		HFCs			PFCs			SF_6		
		Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]
		CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)
Total Actual Emissions		**0.00**	**0.00**	**0.00**	**20.69**	**20.69**	**0.00**	**2.52**	**2.52**	**0.00**
2.C.3.	Aluminium Production				20.69	20.69	0.00	NA	NA	
2.E.	Production of Halocarbons and SF_6	NO	NO		NO	NO		NO	NO	
2.F.	Consumption of Halocarbons and SF_6	NE	NE		NE	NE		2.52	2.52	0.00
	Other			0.00			0.00			0.00
Potential Emissions from Consumption of HFCs/PFCs and SF_6		**120.60**	**120.60**	0.00	**NE**	**NE**		**NE**	**NE**	

	Previous submission	Latest submission	Difference[1]
	CO_2 equivalent (Gg)		(%)
Total CO_2 Equivalent Emissions with Land-Use Change and Forestry [3]	62 110.83	60 554.67	-2.51
Total CO_2 Equivalent Emissions without Land-Use Change and Forestry [3]	69 166.81	67 610.65	-2.25

7.3 CRF Trend tables 10 for main GHG

Table A 7.16 CRF Trend Tables 10: CO_2

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	(Gg)															
1. Energy	**90 725.67**	**78 672.85**	**63 356.62**	**57 197.49**	**59 681.67**	**56 658.23**	**59 375.81**	**58 214.04**	**56 702.54**	**50 812.88**	**46 746.32**	**45 861.46**	**47 475.34**	**45 054.34**	**49 166.77**	**48 276.24**
A. Fuel Combustion (Sectoral Approach)	90 725.67	78 672.85	63 356.62	57 197.49	59 681.67	56 658.23	59 375.81	58 214.04	56 702.54	50 812.88	46 746.32	45 861.46	47 475.34	45 054.34	49 166.77	48 276.24
1. Energy Industries	43216.90	39601.23	37106.22	33862.39	34091.59	30944.73	31571.95	30651.62	30936.08	27078.25	25760.34	26215.75	29035.91	26465.57	28329.87	28297.62
2. Manufacturing Industries and Construction	24754.56	21821.39	14757.67	12093.40	13296.03	15032.19	18023.19	17498.72	17691.26	14221.44	12283.00	11868.18	10788.11	10198.06	11533.47	10817.76
3. Transport	13813.97	10863.71	6524.57	6435.38	7443.93	6546.95	6844.63	6564.88	5284.73	6475.23	6211.56	5881.45	6013.52	6316.61	7097.83	7402.79
4. Other Sectors	8940.25	5380.59	4086.25	4610.45	4117.02	3324.75	2621.01	3237.68	2678.29	2988.84	2491.43	1896.08	1637.81	2074.11	2205.59	1758.07
5. Other	NE	1005.93	881.89	195.86	733.11	809.61	315.02	261.14	112.18	49.12	NO	NO	NO	NO	NO	NO
B. Fugitive Emissions from Fuels	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	0.00	0.00
1. Solid Fuels	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2. Oil and Natural Gas	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2. Industrial Processes	**7 576.34**	**6 609.97**	**4 587.58**	**3 903.19**	**3 933.38**	**4 606.42**	**5 367.81**	**5 234.90**	**4 962.60**	**3 606.50**	**3 990.18**	**4 315.01**	**4 375.18**	**4 028.47**	**4 628.14**	**4 819.35**
A. Mineral Products	3 844.72	3 541.68	2 187.28	1 763.86	1 498.20	1 584.06	1 973.17	2 070.69	1 824.82	1 255.03	1 941.00	2 261.77	2 446.50	2 376.60	2 621.30	2 859.84
B. Chemical Industry	1 246.45	1 224.51	1 003.80	823.12	793.00	888.36	1 071.58	1 062.93	878.27	474.39	338.39	569.90	506.70	325.40	345.10	432.09
C. Metal Production	2 485.18	1 843.78	1 396.50	1 316.21	1 642.18	2 133.99	2 323.06	2 101.29	2 259.51	1 877.08	1 710.79	1 483.34	1 421.97	1 326.47	1 661.74	1 527.43
D. Other Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
E. Production of Halocarbons and SF_6																
F. Consumption of Halocarbons and SF_6																
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
4. Agriculture	**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**	**0.00**	**0.00**
A. Enteric Fermentation	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
B. Manure Management	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C. Rice Cultivation	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
D. Agricultural Soils [2]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
E. Prescribed Burning of Savannas	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
F. Field Burning of Agricultural Residues	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Land-Use Change and Forestry [3]	**-5 132.63**	**-6 156.99**	**-7 635.70**	**-7 412.03**	**-7 475.77**	**-7 301.67**	**-7 524.48**	**-6 517.45**	**-6 871.54**	**-6 860.50**	**-7 199.77**	**-8 976.23**	**-9 467.15**	**-8 318.06**	**-7 055.98**	**-7 965.21**
A. Changes in Forest and Other Woody Biomass Stocks	-5 132.63	-6 156.99	-7 635.70	-7 412.03	-7 475.77	-7 301.67	-7 524.48	-6 517.45	-6 871.54	-6 860.50	-7 199.77	-8 976.23	-9 467.15	-8 318.06	-7 055.98	-7 965.21
B. Forest and Grassland Conversion	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
C. Abandonment of Managed Lands	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
D. CO_2 Emissions and Removals from Soil	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
E. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
6. Waste	**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**	**0.00**	**0.00**
A. Solid Waste Disposal on Land	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
B. Waste-water Handling	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C. Waste Incineration	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
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**	**0.00**	**0.00**
	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total Emissions/Removals with LUCF [4]	**93 169.38**	**79 125.84**	**60 308.49**	**53 688.65**	**56 139.29**	**53 962.98**	**57 219.15**	**56 931.48**	**54 793.60**	**47 558.88**	**43 536.73**	**41 200.25**	**42 383.37**	**40 764.75**	**46 738.93**	**45 130.38**
Total Emissions without LUCF[4]	**98 302.01**	**85 282.83**	**67 944.19**	**61 100.68**	**63 615.06**	**61 264.65**	**64 743.62**	**63 448.94**	**61 665.14**	**54 419.38**	**50 736.50**	**50 176.47**	**51 850.52**	**49 082.81**	**53 794.91**	**53 095.60**
Memo Items:																
International Bunkers	**1 718.36**	**1 766.14**	**1 198.34**	**1 438.15**	**1 582.72**	**1 482.87**	**1 431.78**	**1 203.60**	**1 519.50**	**1 512.41**	**344.76**	**475.16**	**699.16**	**735.38**	**920.82**	**771.79**
Aviation	749.41	892.27	320.22	565.07	738.75	632.43	549.40	472.02	427.55	490.42	319.22	269.84	393.30	399.14	485.03	405.35
Marine	968.95	873.88	878.12	873.09	843.97	850.44	882.37	731.58	1 091.95	1 021.99	25.53	205.31	305.85	336.24	435.78	366.45
Multilateral Operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass	**1 468.56**	**1 311.71**	**1 306.93**	**1 288.44**	**1 168.19**	**1 287.58**	**1 560.14**	**1 609.51**	**1 680.95**	**2 402.19**	**2 412.84**	**2 955.11**	**2 876.11**	**3 389.72**	**3 410.54**	**3 693.66**

Table A 7. 17 CRF Trend tables 10: CH_4

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
								(Gg)								
Total Emissions	**1 041.15**	**890.63**	**781.74**	**723.09**	**647.71**	**599.91**	**589.99**	**547.70**	**473.55**	**441.35**	**423.85**	**430.25**	**396.06**	**403.80**	**445.64**	**465.03**
1. Energy	**161.04**	**110.19**	**95.96**	**98.89**	**99.30**	**97.17**	**103.87**	**102.03**	**91.22**	**91.81**	**80.14**	**88.26**	**86.36**	**84.95**	**84.51**	**88.13**
A. Fuel Combustion (Sectoral Approach)	5.30	4.99	3.25	3.30	3.42	3.37	3.60	3.25	2.81	2.93	3.00	2.83	2.62	2.80	2.79	2.79
1. Energy Industries	0.84	0.91	0.74	0.66	0.59	0.53	0.56	0.52	0.52	0.44	0.43	0.43	0.47	0.43	0.45	0.45
2. Manufacturing Industries and Construction	0.57	0.35	0.31	0.25	0.27	0.28	0.34	0.32	0.30	0.30	0.28	0.23	0.22	0.21	0.24	0.23
3. Transport	2.98	2.91	1.41	1.70	1.93	1.88	2.02	1.70	1.26	1.40	1.46	1.30	1.12	1.21	1.24	1.113
4. Other Sectors	0.32	0.21	0.11	0.11	0.07	0.09	0.10	0.12	0.12	0.25	0.29	0.38	0.33	0.39	0.41	0.43
5. Other	0.59	0.60	0.67	0.57	0.56	0.59	0.57	0.58	0.61	0.54	0.55	0.50	0.48	0.55	0.44	0.57
B. Fugitive Emissions from Fuels	155.74	105.20	92.71	95.59	95.88	93.80	100.27	98.78	88.41	88.87	77.14	85.43	83.74	82.15	81.72	85.34
1. Solid Fuels	94.84	75.80	65.12	71.53	71.42	66.74	69.21	67.33	60.69	63.73	56.01	57.09	57.70	58.50	57.54	58.70
2. Oil and Natural Gas	60.90	29.40	27.58	24.07	24.46	27.06	31.05	31.45	27.72	25.14	21.13	28.33	26.04	23.66	24.18	26.64
2. Industrial Processes	**3.89**	**3.02**	**2.21**	**2.09**	**2.45**	**3.21**	**3.52**	**3.27**	**3.51**	**3.01**	**2.77**	**3.51**	**2.42**	**2.19**	**2.79**	**2.27**
A. Mineral Products	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Chemical Industry	0.04	0.02	0.01	0.01	0.03	0.03	0.04	0.02	0.02	0.21	0.46	0.15	0.14	0.13	0.27	0.14
C. Metal Production	3.49	2.76	2.05	1.94	2.25	3.00	3.29	3.04	3.29	2.62	2.23	3.37	2.28	2.06	2.51	2.13
D. Other Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
E. Production of Halocarbons and SF_6																
F. Consumption of Halocarbons and SF_6																
G. Other	0.36	0.25	0.14	0.14	0.17	0.18	0.20	0.20	0.20	0.18	0.07	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
4. Agriculture	**273.23**	**258.13**	**234.43**	**192.02**	**150.67**	**126.58**	**121.81**	**115.83**	**110.27**	**114.21**	**115.13**	**108.95**	**84.37**	**95.00**	**99.07**	**99.48**
A. Enteric Fermentation	192.79	180.17	165.99	137.48	107.19	90.13	85.27	82.38	79.48	81.77	82.95	79.28	62.20	68.97	71.52	71.02
B. Manure Management	72.55	71.49	62.81	51.10	40.90	34.72	34.52	31.60	27.93	29.64	30.30	27.08	19.30	22.42	24.38	24.55
C. Rice Cultivation	5.68	4.26	3.30	1.82	1.26	0.33	0.56	1.05	1.53	1.61	0.57	1.44	1.57	2.11	2.27	2.30
D. Agricultural Soils	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agricultural Residues	2.21	2.20	2.32	1.62	1.33	1.40	1.46	0.81	1.34	1.19	1.30	1.15	1.30	1.50	0.91	1.61
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Land-Use Change and Forestry	**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**	**0.00**	**0.00**
A. Changes in Forest and Other Woody Biomass Stocks	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
B. Forest and Grassland Conversion	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
C. Abandonment of Managed Lands	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
D. CO_2 Emissions and Removals from Soil	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
E. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
6. Waste	**602.99**	**519.30**	**449.14**	**430.08**	**395.29**	**372.94**	**360.79**	**326.57**	**268.55**	**232.32**	**225.81**	**229.52**	**222.91**	**221.65**	**259.27**	**275.16**
A. Solid Waste Disposal on Land	515.14	452.78	397.47	382.83	355.17	335.65	311.45	279.72	228.76	197.99	195.71	201.25	199.98	199.86	200.79	216.44
B. Waste-water Handling	87.85	66.52	51.67	47.25	40.12	37.28	49.34	46.86	39.79	34.33	30.11	28.27	22.93	21.79	58.48	58.72
C. Waste Incineration	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
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**	**0.00**	**0.00**
	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Memo Items:																
International Bunkers	**0.06**	**0.06**	**0.03**	**0.03**	**0.04**	**0.03**	**0.03**	**0.03**	**0.03**	**0.03**	**0.01**	**0.02**	**0.03**	**0.04**	**0.05**	**0.04**
Aviation	0.02	0.04	0.01	0.02	0.02	0.02	0.02	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01
Marine	0.04	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.00	0.01	0.02	0.02	0.03	0.03
Multilateral Operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass																

Table A7.18 CRF Trend tables 10: N_20

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	(Gg)															
Total Emissions	**38.91**	**33.71**	**25.14**	**20.57**	**18.29**	**18.73**	**18.83**	**18.57**	**17.43**	**14.19**	**14.43**	**15.84**	**14.74**	**14.33**	**14.30**	**14.18**
1. Energy	**1.64**	**1.41**	**1.16**	**1.16**	**1.16**	**1.13**	**1.20**	**1.19**	**1.20**	**1.16**	**1.06**	**1.08**	**1.15**	**1.09**	**1.20**	**1.20**
A. Fuel Combustion (Sectoral Approach)	1.64	1.41	1.16	1.16	1.16	1.13	1.20	1.19	1.20	1.16	1.06	1.08	1.15	1.09	1.20	1.20
1. Energy Industries	0.97	0.80	0.79	0.82	0.80	0.79	0.84	0.83	0.85	0.80	0.73	0.76	0.83	0.75	0.82	0.81
2. Manufacturing Industries and Construction	0.14	0.21	0.09	0.08	0.08	0.10	0.11	0.11	0.13	0.09	0.07	0.07	0.07	0.07	0.08	0.07
3. Transport	0.33	0.25	0.15	0.14	0.17	0.14	0.14	0.14	0.12	0.13	0.12	0.11	0.11	0.11	0.13	0.14
4. Other Sectors	0.16	0.10	0.07	0.08	0.07	0.06	0.06	0.08	0.07	0.11	0.10	0.12	0.11	0.13	0.14	0.14
5. Other	0.03	0.04	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.03
B. Fugitive Emissions from Fuels	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	0.00	0.00
1. Solid Fuels	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2. Oil and Natural Gas	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2. Industrial Processes	**7.81**	**7.28**	**5.25**	**4.27**	**3.65**	**4.32**	**6.20**	**6.33**	**5.21**	**3.12**	**2.36**	**4.24**	**4.18**	**3.51**	**3.74**	**2.77**
A. Mineral Products	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Chemical Industry	7.81	7.28	5.25	4.27	3.65	4.32	6.20	6.33	5.21	3.12	2.36	4.24	4.18	3.51	3.74	2.77
C. Metal Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
D. Other Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
E. Production of Halocarbons and SF_6																
F. Consumption of Halocarbons and SF_6																
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
4. Agriculture	**28.46**	**24.30**	**18.08**	**14.49**	**12.86**	**12.69**	**10.89**	**10.53**	**10.56**	**9.39**	**10.48**	**10.02**	**8.93**	**9.24**	**8.88**	**9.73**
A. Enteric Fermentation	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
B. Manure Management	3.41	3.32	2.97	2.45	1.96	1.64	1.60	1.49	1.36	1.46	1.51	1.38	1.03	1.19	1.27	1.28
C. Rice Cultivation	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
D. Agricultural Soils	25.00	20.93	15.06	12.01	10.88	11.02	9.27	9.02	9.18	7.91	8.95	8.61	7.88	8.03	7.59	8.42
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agricultural Residues	0.05	0.05	0.05	0.04	0.02	0.03	0.03	0.02	0.03	0.02	0.03	0.02	0.02	0.03	0.02	0.03
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Land-Use Change and Forestry	**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**	**0.00**	**0.00**
A. Changes in Forest and Other Woody Biomass Stocks	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
B. Forest and Grassland Conversion	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
C. Abandonment of Managed Lands	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
D. CO_2 Emissions and Removals from Soil	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
E. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
6. Waste	**1.00**	**0.72**	**0.65**	**0.65**	**0.62**	**0.59**	**0.54**	**0.52**	**0.46**	**0.52**	**0.53**	**0.50**	**0.48**	**0.49**	**0.49**	**0.48**
A. Solid Waste Disposal on Land	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
B. Waste-water Handling	1.00	0.72	0.65	0.65	0.62	0.59	0.54	0.52	0.46	0.52	0.53	0.50	0.48	0.49	0.49	0.48
C. Waste Incineration	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
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**	**0.00**	**0.00**
	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Memo Items:																
International Bunkers	**0.02**	**0.02**	**0.02**	**0.02**	**0.02**	**0.02**	**0.02**	**0.02**	**0.03**	**0.03**	**0.00**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**
Aviation	NE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	NO	NO	NO	NO	NO	NO
Marine	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.00	0.01	0.01	0.01	0.01	0.01
Multilateral Operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass																

Table A7.19 CRF Trend tables 10: F-gases

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	(Gg)															
Emissions of HFCs[5] - CO_2 equivalent (Gg)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**2.95**	**109.30**	**188.15**	**576.66**	**102.80**	**96.02**	**97.50**	**89.59**	**120.60**	**217.30**
HFC-23	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
HFC-32	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
HFC-41	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
HFC-43-10mee	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
HFC-125	NE	NE	NE	NE	NE	NE	0.00	NE	NE	NE	NE	NE	NE	NE	NE	NE
HFC-134	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
HFC-134a	NE	NE	NE	NE	NE	NE	2.95	109.30	188.15	576.66	102.80	96.02	97.50	89.59	120.60	217.30
HFC-152a	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
HFC-143	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
HFC-143a	NE	NE	NE	NE	NE	NE	0.0	NE	NE	NE	NE	NE	NE	NE	NE	NE
HFC-227ea	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
HFC-236fa	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
HFC-245ca	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Emissions of PFCs[5] - CO_2 equivalent (Gg)	**75.55**	**47.31**	**21.32**	**27.92**	**19.03**	**45.83**	**46.94**	**45.88**	**37.26**	**69.44**	**43.55**	**33.14**	**16.29**	**21.42**	**20.69**	**33.18**
CF_4	0.01	0.01	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00
C_2F_6	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	0.00	0.00
C_3F_8	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C_4F_{10}	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
c-C_4F_8	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C_5F_{12}	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C_6F_{14}	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Emissions of SF_6[5] - CO_2 equivalent (Gg)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.26**	**1.31**	**1.75**	**1.83**	**1.88**	**2.23**	**2.29**	**2.51**	**2.52**	**3.68**
SF_6							0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table A7.20 CRF Trend tables 10: Total trend

GREENHOUSE GAS EMISSIONS	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	CO_2 equivalent (Gg)															
Net CO_2 emissions/removals	93 169,38	79 125,84	60 308,49	53 688,65	56 139,29	53 962,98	57 219,15	56 931,48	54 793,60	47 558,88	43 536,73	41 200,25	42 383,37	40 764,75	46 738,93	45 130,38
CO_2 emissions (without LUCF) [6]	98 302,01	85 282,83	67 944,19	61 100,68	63 615,06	61 264,65	64 743,62	63 448,94	61 665,14	54 419,38	50 736,50	50 176,47	51 850,52	49 082,81	53 794,91	53 095,60
CH_4	21 864,16	18 703,29	16 416,64	15 184,89	13 601,96	12 598,11	12 389,84	11 501,77	9 944,56	9 268,35	8 900,86	9 035,16	8 317,34	8 479,70	9 358,42	9 765,73
N_2O	12 061,43	10 450,02	7 793,15	6 376,52	5 670,61	5 805,07	5 837,85	5 756,75	5 404,30	4 399,86	4 473,17	4 911,45	4 568,13	4 442,98	4 434,11	4 395,44
HFCs	0,00	0,00	0,00	0,00	0,00	0,00	2,95	109,30	188,15	576,66	102,80	96,02	97,50	89,59	120,60	217,30
PFCs	75,55	47,31	21,32	27,92	19,03	45,83	46,94	45,88	37,26	69,44	43,55	33,14	16,29	21,42	20,69	33,18
SF_6	0,00	0,00	0,00	0,00	0,00	0,00	1,26	1,31	1,75	1,83	1,88	2,23	2,29	2,51	2,52	3,68
Total (with net CO_2 emissions/removals)	**127 170,53**	**108 326,46**	**84 539,60**	**75 277,97**	**75 430,89**	**72 411,99**	**75 497,99**	**74 346,50**	**70 369,63**	**61 875,03**	**57 058,98**	**55 278,25**	**55 384,92**	**53 800,94**	**60 675,27**	**59 545,71**
Total (without CO_2 from LUCF) [6] [8]	**132 303,16**	**114 483,45**	**92 175,30**	**82 690,00**	**82 906,66**	**79 713,66**	**83 022,47**	**80 863,95**	**77 241,17**	**68 735,53**	**64 258,75**	**64 254,48**	**64 852,07**	**62 119,00**	**67 731,25**	**67 510,92**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	CO_2 equivalent (Gg)															
1. Energy	94 615,53	81 425,13	65 731,36	59 633,51	62 126,65	59 050,42	61 927,63	60 726,70	58 989,69	53 101,46	48 757,14	48 050,29	49 644,72	47 177,56	51 312,89	50 497,37
2. Industrial Processes	10 155,28	8 976,24	6 281,40	5 298,74	5 136,45	6 057,74	7 413,97	7 422,30	6 877,91	5 286,23	4 929,04	5 834,64	5 837,32	5 276,89	5 989,869	5 979,297
3. Solvent and Other Product Use	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	0,00	0,00
4. Agriculture	14 559,02	12 953,23	10 528,85	8 524,76	7 150,11	6 591,20	5 935,33	5 696,14	5 590,83	5 309,36	5 666,09	5 394,07	4 540,66	4 859,32	4 832,727	5 105,998
5. Land-Use Change and Forestry [7]	-5 132,63	-6 156,99	-7 635,70	-7 412,03	-7 475,77	-7 301,67	-7 524,48	-6 517,45	-6 871,54	-6 860,50	-7 199,77	-8 976,23	-9 467,15	-8 318,06	-7 055,98	-7 965,21
6. Waste	12 973,33	11 128,86	9 633,69	9 233,00	8 493,45	8 014,30	7 745,54	7 018,82	5 782,74	5 038,47	4 906,48	4 975,48	4 829,38	4 805,23	5 595,77	5 928,25
7. 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	0,00	0,00	0,00

7.4 Trend tables for GHG-precursors and SOx.

Table A7.21 Emissions of GHG-precursors: NOx

		1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Total National Emissions and Removals		**285,55**	**242,98**	**180,23**	**162,65**	**166,00**	**146,81**	**152,06**	**145,59**	**141,23**	**133,94**	**120,90**	**121,26**	**129,04**	**124,50**	**135,35**	**126,48**
1. Energy		**262,10**	**221,69**	**164,32**	**150,04**	**155,10**	**134,08**	**134,27**	**128,04**	**126,29**	**124,50**	**113,32**	**109,44**	**117,37**	**114,29**	**124,77**	**117,98**
A. Fuel Combustion	Reference Approach [2]																
	Sectoral Approach [2]	262,10	221,69	164,32	150,04	155,10	134,08	134,27	128,04	126,29	124,50	113,32	109,44	117,37	114,29	124,77	117,98
1. Energy Industries		96,25	61,81	75,96	71,89	71,00	57,27	56,13	52,88	54,16	51,18	46,85	49,07	59,84	53,99	57,73	57,87
2. Manufacturing Industries and Construc		34,94	49,83	20,00	15,88	17,00	18,44	21,36	21,14	23,30	19,31	17,47	14,06	13,43	12,73	15,85	14,11
3. Transport		115,55	97,80	57,59	51,75	56,03	48,86	49,38	45,42	41,75	46,48	42,56	40,98	39,69	41,83	45,41	40,62
4. Other Sectors		13,76	8,36	7,11	8,44	7,72	6,22	4,96	6,20	5,07	5,88	4,96	4,00	3,10	4,25	4,58	3,84
5. Other		1,59	3,89	3,66	2,09	3,35	3,30	2,45	2,41	2,02	1,66	1,48	1,34	1,31	1,49	1,20	1,55
B. Fugitive Emissions from Fuels		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	0,00	0,00
1. Solid Fuels																	
2. Oil and Natural Gas																	
2. Industrial Processes		**21,689**	**19,65**	**13,99**	**11,33**	**10,01**	**11,80**	**16,70**	**16,90**	**14,00**	**8,61**	**6,61**	**11,09**	**10,93**	**9,26**	**9,895**	**7,389**
A. Mineral Products		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	0,00	0,00
B. Chemical Industry		20,23	18,64	13,36	10,80	9,44	11,17	15,92	16,20	13,34	8,11	6,21	10,89	10,72	9,06	9,62	7,21
C. Metal Production		0,13	0,10	0,07	0,07	0,08	0,11	0,12	0,11	0,11	0,10	0,09	0,08	0,07	0,07	0,08	0,08
D. Other Production [3]		1,33	0,92	0,55	0,46	0,49	0,52	0,65	0,59	0,55	0,40	0,31	0,13	0,14	0,13	0,19	0,10
E. Production of Halocarbons and SF_6																	
F. Consumption of Halocarbons and SF_6																	
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	0,00	0,00	0,00
3. Solvent and Other Product Use																	
4. Agriculture		**1,76**	**1,63**	**1,92**	**1,28**	**0,89**	**0,93**	**1,09**	**0,64**	**0,93**	**0,82**	**0,98**	**0,73**	**0,74**	**0,95**	**0,69**	**1,11**
A. Enteric Fermentation																	
B. Manure Management																	
C. Rice Cultivation																	
D. Agricultural Soils																	
E. Prescribed Burning of Savannas																	
F. Field Burning of Agricultural Residues		1,76	1,63	1,922	1,281	0,89	0,93	1,09	0,64	0,93	0,82	0,98	0,73	0,74	0,95	0,69	1,11
G. Other																	
5. Land-Use Change and Forestry		**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**	**0,00**	**0,00**
A. Changes in Forest and Other Woody Biomass																	
B. Forest and Grassland Conversion																	
C. Abandonment of Managed Lands																	
D. CO_2 Emissions and Removals from Soil																	
E. Other																	
6. Waste		**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**	**0,00**	**0,00**
A. Solid Waste Disposal on Land																	
B. Wastewater Handling																	
C. Waste Incineration																	
D. Other																	
7. Other *(please specify)*																	
Biomass																	
International bunker		**25,78**	**25,94**	**23,86**	**24,69**	**24,76**	**24,54**	**24,90**	**20,68**	**29,73**	**28,41**	**1,84**	**5,43**	**8,07**	**8,72**	**11,17**	**9,38**

Table A7.22 Emission of GHG-precursors: CO

	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Total National Emissions and Removals	**863,80**	**778,73**	**571,27**	**596,62**	**621,48**	**592,03**	**612,55**	**565,41**	**486,72**	**513,56**	**489,52**	**431,83**	**376,10**	**429,58**	**387,18**	**405,63**
1. Energy	**798,05**	**716,00**	**510,00**	**551,91**	**582,98**	**549,71**	**566,62**	**533,70**	**445,68**	**479,46**	**455,42**	**398,33**	**341,76**	**392,66**	**362,05**	**365,38**
A. Fuel Combustion Reference Approach (2)																
Sectoral Approach (2)	798,05	716,00	510,00	551,91	582,98	549,71	566,62	533,70	445,68	479,46	455,42	398,33	341,76	392,66	362,05	365,38
1. Energy Industries	10,03	10,03	10,85	8,01	8,12	6,88	8,98	7,35	8,23	5,67	5,79	5,89	6,34	5,98	6,04	6,09
2. Manufacturing Industries and Construct	11,23	8,73	4,30	4,03	3,54	3,73	4,30	4,02	3,61	4,48	4,38	4,36	5,24	5,23	6,34	6,67
3. Transport	454,34	434,83	215,97	260,37	303,97	296,85	327,57	267,55	189,90	233,92	229,33	198,36	171,78	184,98	182,50	169,22
4. Other Sectors	174,83	121,05	119,91	141,56	136,54	103,56	88,45	113,85	93,04	99,35	78,76	65,66	37,25	58,05	55,74	39,96
5. Other	147,61	141,36	158,98	137,94	130,81	138,69	137,32	140,94	150,90	136,05	137,17	124,07	121,15	138,41	111,43	143,44
B. Fugitive Emissions from Fuels	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	0,00	0,00
1. Solid Fuels																
2. Oil and Natural Gas																
2. Industrial Processes	**19,40**	**16,48**	**12,53**	**10,66**	**10,66**	**12,89**	**15,25**	**14,78**	**12,92**	**9,141**	**6,73**	**9,36**	**7,03**	**5,37**	**6,12**	**6,44**
A. Mineral Products	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	0,00	0,00
B. Chemical Industry	10,76	10,44	8,69	7,18	7,06	7,94	9,60	9,52	7,83	4,23	3,06	5,18	4,64	2,98	3,15	3,80
C. Metal Production	3,68	2,61	1,77	1,76	1,78	2,99	3,20	3,05	3,04	3,43	2,53	3,71	1,87	1,92	2,27	2,26
D. Other Production (3)	4,97	3,43	2,07	1,72	1,83	1,95	2,44	2,21	2,05	1,48	1,14	0,47	0,51	0,48	0,70	0,39
E. Production of Halocarbons and SF_6																
F. Consumption of Halocarbons and SF_6																
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	0,00	0,00	0,00
3. Solvent and Other Product Use																
4. Agriculture	**46,35**	**46,25**	**48,74**	**34,06**	**27,84**	**29,43**	**30,69**	**16,93**	**28,12**	**24,96**	**27,36**	**24,15**	**27,32**	**31,55**	**19,01**	**33,80**
A. Enteric Fermentation																
B. Manure Management																
C. Rice Cultivation																
D. Agricultural Soils																
E. Prescribed Burning of Savannas																
F. Field Burning of Agricultural Residues	46,350	46,252	48,736	34,061	27,840	29,428	30,685	16,927	28,122	24,961	27,361	24,145	27,315	31,552	19,014	33,804
G. Other																
5. Land-Use Change and Forestry	**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**	**0,00**	**0,00**
A. Changes in Forest and Other Woody Biomass																
B. Forest and Grassland Conversion																
C. Abandonment of Managed Lands																
D. CO_2 Emissions and Removals from Soil																
E. Other																
6. Waste	**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**	**0,00**	**0,00**
A. Solid Waste Disposal on Land																
B. Wastewater Handling																
C. Waste Incineration																
D. Other																
7. Other *(please specify)*																
Biomass																
International bunker	**5,36**	**9,26**	**4,32**	**3,53**	**3,64**	**4,10**	**3,83**	**2,67**	**3,51**	**3,63**	**0,68**	**1,82**	**2,67**	**2,91**	**3,71**	**3,12**

Table A 7. 23 Emission of GHG-precursors: NMVOCs

	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Total National Emissions and Removals	**120,36**	**110,06**	**69,56**	**71,36**	**79,76**	**79,37**	**86,33**	**77,96**	**63,06**	**77,66**	**62,40**	**57,04**	**59,16**	**60,74**	**58,38**	**67,20**
1. Energy	**68,17**	**67,34**	**35,32**	**39,99**	**46,65**	**44,66**	**49,12**	**41,25**	**30,52**	**38,31**	**36,97**	**31,95**	**28,59**	**30,41**	**30,61**	**29,65**
A. Fuel Combustion Reference Approach (2)																
Sectoral Approach (2)	68,17	67,34	35,32	39,99	46,65	44,66	49,12	41,25	30,52	38,31	36,97	31,95	28,59	30,41	30,61	29,65
1. Energy Industries	0,77	0,84	0,88	0,70	0,57	0,50	0,69	0,46	0,46	0,42	0,40	0,40	0,43	0,40	0,42	0,41
2. Manufacturing Industries and Construct	0,28	0,19	0,17	0,15	0,15	0,14	0,18	0,18	0,15	0,10	0,10	0,04	0,03	0,03	0,05	0,04
3. Transport	67,08	66,25	34,24	39,11	45,88	44,00	48,22	40,57	29,89	37,78	36,48	31,51	28,12	29,98	30,15	29,20
4. Other Sectors	0,047	0,00	0,00	0,01	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
5. Other	0,00	0,05	0,04	0,02	0,05	0,02	0,04	0,04	0,02	0,01	0,00	0,00	0,00	0,00	0,00	0,00
B. Fugitive Emissions from Fuels	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	0,00	0,00
1. Solid Fuels																
2. Oil and Natural Gas																
2. Industrial Processes	**38,57**	**30,47**	**23,20**	**20,01**	**21,42**	**23,17**	**24,71**	**24,71**	**20,72**	**17,874**	**14,60**	**14,39**	**13,47**	**13,19**	**13,226**	**13,892**
A. Mineral Products	2,92	2,65	1,57	1,20	1,41	1,84	2,13	2,37	1,97	1,57	0,86	0,93	1,17	1,89	1,02	1,75
B. Chemical Industry	6,33	6,16	5,14	4,26	4,17	4,69	5,67	5,62	4,63	4,64	4,19	4,77	4,37	3,37	4,13	3,87
C. Metal Production	0,23	0,18	0,14	0,13	0,16	0,22	0,24	0,22	0,24	0,21	0,18	0,27	0,16	0,15	0,19	0,17
D. Other Production (3)	22,77	16,10	13,71	11,32	11,93	12,47	12,30	12,57	10,94	8,11	6,48	6,21	5,77	5,71	5,90	6,06
E. Production of Halocarbons and SF_6																
F. Consumption of Halocarbons and SF_6																
G. Other	6,31	5,38	2,64	3,10	3,76	3,95	4,37	3,92	2,94	3,35	2,90	2,22	1,99	2,07	1,99	2,04
3. Solvent and Other Product Use	**13,62**	**12,25**	**11,04**	**11,36**	**11,69**	**11,53**	**12,49**	**11,99**	**11,82**	**21,47**	**10,83**	**10,69**	**17,10**	**17,13**	**14,542**	**23,655**
4. Agriculture	**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**	**0,00**	**0,00**
A. Enteric Fermentation																
B. Manure Management																
C. Rice Cultivation																
D. Agricultural Soils																
E. Prescribed Burning of Savannas																
F. Field Burning of Agricultural Residues																
G. Other																
5. Land-Use Change and Forestry	**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**	**0,00**	**0,00**
A. Changes in Forest and Other Woody Biomass																
B. Forest and Grassland Conversion																
C. Abandonment of Managed Lands																
D. CO_2 Emissions and Removals from Soil																
E. Other																
6. Waste	**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**	**0,00**	**0,00**
A. Solid Waste Disposal on Land																
B. Wastewater Handling																
C. Waste Incineration																
D. Other																
7. Other *(please specify)*																
Biomass																
International bunker	**1,08**	**0,68**	**0,43**	**0,47**	**0,48**	**0,45**	**0,47**	**0,39**	**0,52**	**0,46**	**0,11**	**0,38**	**0,56**	**0,62**	**0,79**	**0,66**

Table A7.24 Emission of SOx

	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Total National Emissions and Removals	**1 781,41**	**1 517,12**	**1 313,22**	**1 290,34**	**1 278,44**	**1 261,43**	**1 298,94**	**1 310,50**	**1 310,44**	**1 191,88**	**1 056,41**	**1 044,65**	**1 095,82**	**982,94**	**1 043,21**	**997,55**
1. Energy	**1 756,52**	**1 500,61**	**1 302,41**	**1 279,46**	**1 266,96**	**1 248,88**	**1 285,05**	**1 295,83**	**1 295,46**	**1 178,77**	**1 047,27**	**1 029,34**	**1 081,91**	**966,87**	**1 025,56**	**977,37**
A. Fuel Combustion Reference Approach (2)																
Sectoral Approach (2)	1 756,52	1 500,61	1 302,41	1 279,46	1 266,96	1 248,88	1 285,05	1 295,83	1 295,46	1 178,77	1 047,27	1 029,34	1 081,91	966,87	1 025,56	977,37
1. Energy Industries	1 285,57	1 114,64	1 030,12	1 016,79	1 005,10	1 010,76	1 055,67	1 042,40	1 043,22	948,97	851,85	885,80	956,90	821,53	866,04	844,40
2. Manufacturing Industries and Construct	200,73	220,08	124,48	98,16	97,84	110,21	127,15	125,76	149,26	118,97	110,16	79,97	79,20	78,61	90,39	79,65
3. Transport	57,85	17,99	10,53	9,59	11,02	9,07	8,82	9,45	7,80	8,35	8,00	7,09	7,30	7,47	8,78	9,52
4. Other Sectors	212,37	139,68	129,59	152,66	145,46	110,99	90,96	116,03	94,31	102,46	77,26	56,48	38,51	59,27	60,36	43,81
5. Other	0,00	8,22	7,69	2,27	7,55	7,86	2,45	2,20	0,87	0,02	0,00	0,00	0,00	0,00	0,00	0,00
B. Fugitive Emissions from Fuels													0,00	0,00	0,00	0,00
1. Solid Fuels																
2. Oil and Natural Gas																
2. Industrial Processes	**24,89**	**16,51**	**10,81**	**10,88**	**11,48**	**12,55**	**13,90**	**14,67**	**14,98**	**13,104**	**9,13**	**15,31**	**13,91**	**16,06**	**17,65**	**20,17**
A. Mineral Products	1,22	1,04	0,52	0,47	0,44	0,42	0,46	0,47	0,40	0,48	0,66	0,71	0,77	0,73	0,78	0,91
B. Chemical Industry	15,79	9,88	6,66	7,32	7,64	8,08	8,62	9,78	10,24	9,19	5,75	11,66	11,28	13,56	14,53	17,53
C. Metal Production	1,67	1,30	1,05	0,95	1,11	1,62	1,77	1,66	1,78	1,59	1,30	2,34	1,22	1,17	1,47	1,25
D. Other Production (3)	6,21	4,29	2,59	2,14	2,28	2,43	3,06	2,77	2,56	1,85	1,43	0,59	0,64	0,60	0,88	0,48
E. Production of Halocarbons and SF_6																
F. Consumption of Halocarbons and SF_6																
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	0,00	0,00	0,00
3. Solvent and Other Product Use																
4. Agriculture	**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**	**0,00**	**0,00**
A. Enteric Fermentation																
B. Manure Management																
C. Rice Cultivation																
D. Agricultural Soils																
E. Prescribed Burning of Savannas																
F. Field Burning of Agricultural Residues																
G. Other																
5. Land-Use Change and Forestry	**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**	**0,00**	**0,00**
A. Changes in Forest and Other Woody Biomass																
B. Forest and Grassland Conversion																
C. Abandonment of Managed Lands																
D. CO_2 Emissions and Removals from Soil																
E. Other																
6. Waste	**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**	**0,00**	**0,00**
A. Solid Waste Disposal on Land																
B. Wastewater Handling																
C. Waste Incineration																
D. Other																
7. Other *(please specify)*																
Biomass																
International bunker	**8,53**	**13,55**	**13,72**	**13,14**	**13,03**	**13,24**	**13,24**	**11,04**	**15,98**	**15,80**	**0,20**	**0,47**	**0,75**	**0,75**	**0,96**	**0,81**

7.5 Trend tables for GHG for sector LULUCF

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Change from 1990[1] to latest reported year
	(Gg)																(%)
CO_2 [2]	-25 305.74	-26 086.79	-28 919.87	-22 006.91	-19 054.48	-19 533.90	-20 456.94	-13 417.64	-18 583.40	-17 214.56	-18 564.30	-18 807.54	-20 583.77	-21 495.22	-14 863.35	-22 108.10	-12.64
A. Forest Land	-5137.61	-6161.98	-7637.28	-7409.10	-7475.77	-7301.67	-7524.48	-6517.45	-6871.54	-6860.50	-7199.77	-8976.23	-9467.15	-8318.06	-7055.98	-7965.21	55.04
B. Cropland	-20588.10	-20444.79	-21774.29	-15129.85	-12140.49	-12804.73	-13487.95	-7466.12	-12272.74	-10916.37	-11918.54	-10399.19	-11705.79	-13763.02	-8390.43	-14721.11	-28.50
C. Grassland	-174.24	-82.74	-102.63	-70.68	-40.93	-30.21	-47.23	-36.78	-41.83	-40.41	-48.70	-34.84	-13.55	-16.85	-19.65	-24.48	-85.95
D. Wetlands	594.22	602.71	594.33	602.71	602.71	602.71	602.71	602.71	602.71	602.71	602.71	602.71	602.71	602.71	602.71	602.71	1.43
E. Settlements	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	
F. Other Land	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
CH_4	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		0.00	0.00
A. Forest Land	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	
B. Cropland	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	
C. Grassland	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	
D. Wetlands	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
E. Settlements	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	
F. Other Land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
N_2O	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		0.00	0.00
A. Forest Land	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	
B. Cropland	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	
C. Grassland	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	
D. Wetlands	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
E. Settlements	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	
F. Other Land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
Land Use, Land-Use Change and Forestry [2] (Gg CO_2 equivalent)	**-25 305.74**	**-26 086.79**	**-28 919.87**	**-22 006.91**	**-19 054.48**	**-19 533.90**	**-20 456.94**	**-13 417.64**	**-18 583.40**	**-17 214.56**	**-18 564.30**	**-18 807.54**	**-20 583.77**	**-21 495.22**	**-14 863.35**	**-22 108.10**	**-12.64**