Greenhouse Gas Emissions in Republic of Bulgaria 1988, 1990-2003. National Inventory Report 2003

Submission 2005

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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, 1990-2003]

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.562/05.11.2004, project title "GHG Inventory of Bulgaria for 2003 under UNFCCC with National Report".

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

EXECUTIVE SUMMARY

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

This report represents the annual GHG Inventory in Bulgaria for 2003.

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 Guidance for National GHG Inventories, 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 the GHG emissions trends for the period 1988-2003. There are described as well:

- 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 1990-2003.

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. Annex 1 Countries are 41. These 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 from East Europe.

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. This means that the Inventory Report should be submitted until 15.04.2005 to the UNFCCC Secretariat.

Annex 1 Countries should present National Communications on Climate Change in which policies and measures for reduction of GHG emissions for certain prognostic period must be given. Bulgaria presented its III-rd National Communication on Climate Change in March 2002 and the Forth National Communication will be presented this year.

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.

The IPCC Methodology uses the conception for applying the methodologies with different rate of complexity which describe the processes of determination of the input data, emission factors and GHG emissions.

Generally as a rule more exact methodologies for determination the GHG emissions 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 accuracy of the received results and the possibilities of the country for appliance of the certain information area and 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.

The list of the key sources is changed compared with the NIR, 2004. There are added two new key sources: CO_2 emissions from non-energy usage of natural gas and CH_4 emission from waste water treatment. The source for fugitive CH_4 emissions from the systems for extraction and transportation of oil and gas is dropped out.

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 39 emission sources, the key emission sources are 19 based on the quantitative assessment and 18 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.

The method from type Tier 2 gain priority over sources with higher rate of uncertainty. This leads to a certain distortion of the results concerning the correct rating of the large emitters of GHG emissions which have relatively lower decree of uncertainty in their determination.

As a result of the applying of the two approaches for assessment of the key sources a list of total 24 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 Energy and Energy resources;
- Ministry of Economy;
- 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 which provides publicity and competitive character of the process of assigning the task.

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 2003 and in the National Report the following improvements are made in comparison with the previous National Report from 2002.

- The structure of the National Report is changing completely as well as the arrangement of some parts according to the requirements of the UNFCCC Guidance.
- The base year 1988 is recalculated using the complete national balance materials for the fuels;
- CRF tables are prepared for all years in which the GHG Inventory is elaborated in the period of 1990 – 2002.
- The CO_2 emissions from non-energy usage of the fuels is included;
- 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 complete picture 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 1988-2002 as well as comments on the executed improvements in

relation with fulfilled checks-up and inspections by UNFCCC Secretariat's teams. There are 7 appendixes in the report which give more complete and detailed assessment of the used data and the received results as well as part of the tables prepared for the Common Reporting Format – CRF.

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

The GHG Inventory for the year 2003 revealed that the overall GHG emissions expressed in CO_2–eq. are 69 167 Gg not taking into account the sequestration in sector Land use Change and Forestry. The net emissions (including the sequestration from LUCF) are 62 111 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 2003 the CO_2 emissions form the largest share of 75 % from the overall GHG emissions expressed in CO_2-eq.; the CH_4 emissions are second with 15 % and the N_2O emissions with a 10 % share stand in the third place.

There can be seen that in the year 2003 the overall of the GHG emissions expressed in CO_2-eq. registered an increase. The emissions for the year 2003 are 50 % in comparison to the base year 1988 and they registered an increase with 9.2 % in comparison to the previous year 2002.

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
CO_2 with LUCF	93 439	78 376	59 438	53 497	55 409	53 167	56 891	56 378	54 592	47 393	43 330	40 927	42 005	40 440	46 265
CO_2 excluding LUCF	98 572	84 533	67 074	60 910	62 884	60 469	64 416	62 895	61 463	54 253	50 530	49 903	51 472	48 758	53 321
CH_4	24 925	21 393	18 777	17 459	15 712	14 592	14 240	13 165	11 303	10 441	8 903	9 038	8 320	8 482	9 366
N_2O	14 805	12 943	10 176	8 698	7 968	8 010	8 248	8 056	7 789	6 489	6 352	6 723	6 626	6 275	6 456
HFCs	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
PFCs	76	47	21	28	19	46	47	46	37	69	44	33	16	21	21
SF_6	0	0	0	0	0	0	1	1	2	2	2	2	2	3	3
Total	**138 377**	**118 916**	**96 047**	**87 095**	**86 584**	**83 117**	**86 954**	**84 164**	**80 595**	**71 255**	**65 830**	**65 699**	**66 437**	**63 539**	**69 167**
Index (1988 = 100)															
Index CO_2 excluding LUCF	100	85,8	68,0	61,8	63,8	61,3	65,3	63,8	62,4	55,0	51,3	50,6	52,2	49,5	54,1
Index CH_4	100	85,8	75,3	70,0	63,0	58,5	57,1	52,8	45,3	41,9	35,7	36,3	33,4	34,0	37,6
Index N_2O	100	87,4	68,7	58,8	53,8	54,1	55,7	54,4	52,6	43,8	42,9	45,4	44,8	42,4	43,6
Index [group of six]	**100**	**85,9**	**69,4**	**62,9**	**62,6**	**60,1**	**62,8**	**60,8**	**58,2**	**51,5**	**47,6**	**47,5**	**48,0**	**45,9**	**50,0**
Index (1995 = 100)															
Index HFCs	0	0	0	0	0	0	100	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
Index SF_6	0,0	0,0	0,0	0,0	0,0	0,0	100,0	103,7	138,9	145,1	149,0	176,7	181,4	198,9	199,7
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

In **Table ES.2** are presented shares of the overall GHG emissions by sectors for the period 1988-2003. 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

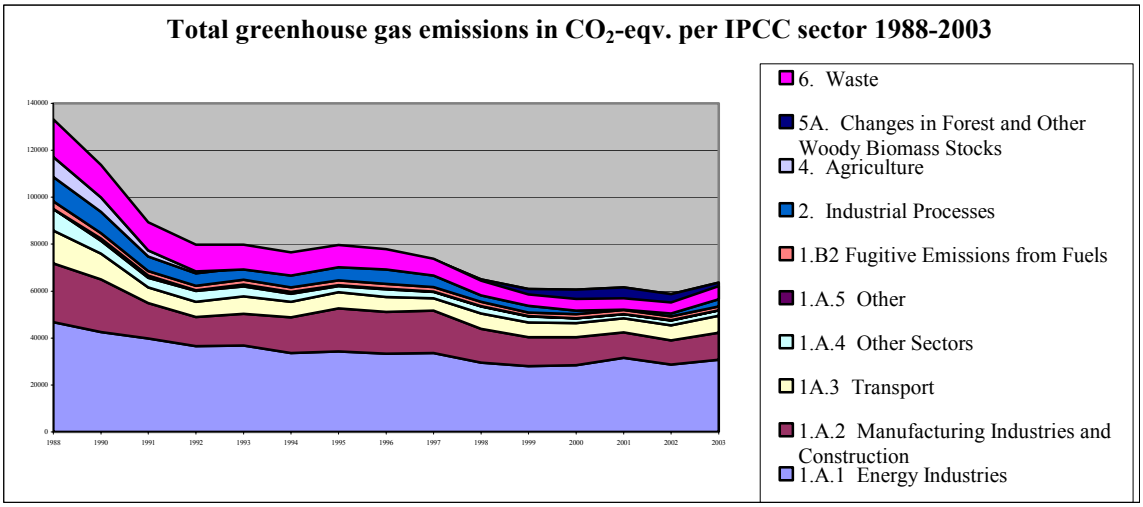
Sector/ year	1988	1990	1991	1992	1993	1994	1995
Energy	71,02	70,58	70,70	71,38	74,18	73,41	74,01
Industrial processes	7,53	7,70	6,49	6,08	5,89	7,23	8,48
Agriculture	9,85	10,19	10,43	9,36	7,79	7,43	6,51
Forestry	-3,71	-5,13	-7,88	-8,49	-8,56	-8,70	-8,62
Waste	11,59	11,53	12,38	13,19	12,15	11,93	11,01

Sector/ year	1996	1997	1998	1999	2000	2001	2002	2003
Energy	74,71	76,42	77,71	77,32	76,30	78,18	77,50	77,30
Industrial processes	8,62	8,14	6,44	7,02	8,32	8,07	7,65	7,99
Agriculture	6,37	6,59	7,13	8,20	7,80	6,48	7,30	6,62
Forestry	-7,72	-8,51	-9,62	-10,94	-13,66	-14,25	-13,09	-10,20
Waste	10,29	8,85	8,72	7,46	7,58	7,27	7,55	8,09

The analyses of the **Table ES.2** show that the Energy sector forms the largest share of the overall emissions in 2003 – 77 %. Second in share for the year 2003 is sector Waste, and in the third place stands the Industrial Process sector.

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 3.4 %. The uncertainty of the level f the overall emissions is considerably larger and it is about 13 %. 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- 2003.

Energy Sector

The Bulgarian Energy sector has key position in the national economy. It is the source of over 77 % of the aggregated GHG emissions for the last inventory 2003.

For all the Sources Category in this sector there is a sustainable trend for GHG emission reduction from 1988 till present. The largest reduction is in the Public sector (including the Communal sector) – 75.3 %, the Industry – 54 % and the Transport sector – 48.6 % and the least one is this in the Energy sector – 34.4 %.

There is registered an increase in the emissions in the Energy sector compared to the year 2002 in all categories. The largest increase is this in the Transportation sector – 12.4 % and also in the Industry – 11.8 % and it is lower in the Energy sector – 7 % and in the Public sector – 6.4 %.

The analyses of **Figure ES.3** show that the Energy industries have the largest share – over 45 % of the overall emissions in this sector. Only the Energy industry registered an increase in the relative share regarding the base year 1988 – from 44 % to 53 % in 2003. For all the other sub-sectors this share has decreased: in the Processing Industry – from 25 % to 21 %, at the transportation sector – from 14 % to a 13 % and mostly in the Public and Communal Sector – from 9 to 4 %. The last figure can be received as a good result from the decreased direct fuel combustion in the Residential sector which leads to the overall reduction of the GHG emissions and the air pollutants.

The emission's increase in the *Energy* sector compared to the previous year is due to the decommissioning of 1 and 2 units (880 MW) of NPP Kozloduy and the increased consumption in the country despite of the reduced electricity export.

The trend of *Transport* sector shows large fluctuations, i.e. in 2003 the emissions increased and they form 14 % of the overall emissions of CO_2 in the sector. The fluctuations are in relation with the change in liquid fuel price as well as the process of restructure and renovation of the car park.

The overall trend of sub-sector *"Other sectors"* (Services, Residential, Agriculture and Forestry) varies as well. The decrease from 1998 up to last two years was overcome and an emission's increase was registered.

The CO_2 emissions from non-energy usage of the fuels is 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 "Maritza 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 center 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 and 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 and very high Global Warming Potential (GWP).

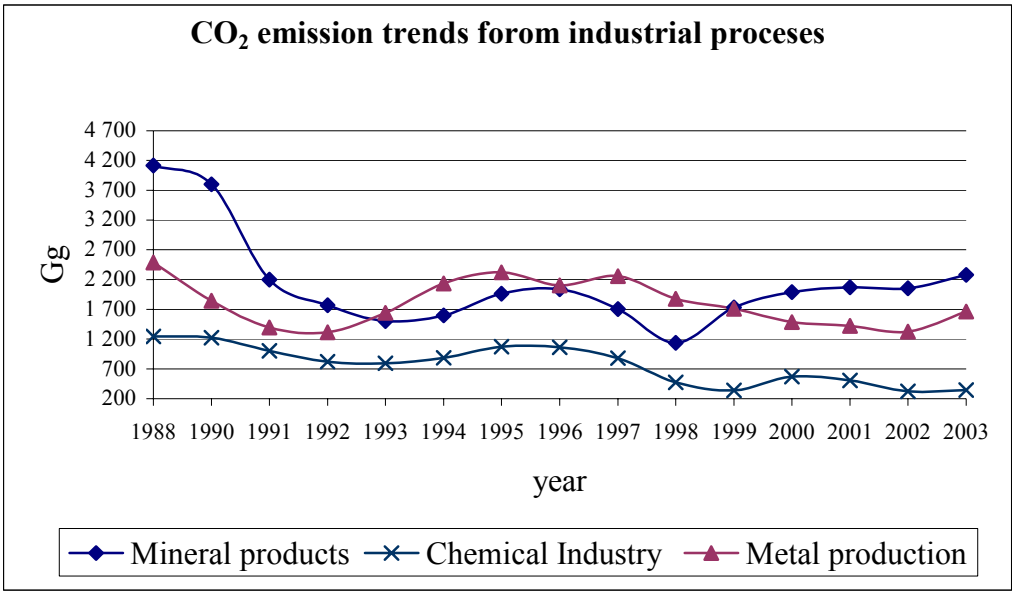
The largest share in the overall GHG emissions from the sector Industrial Processes for the year 2003 has CO_2 with 77 %, followed by N_2O with 21 % and CH_4 with 2 % expressed in CO_2–Eq.

For all the category sources in this sector there is a stable trend for emission's reduction from 1988 till present. The F-gases and N_2O have the largest reduction – 68 % and 62 % whereas the CO_2 reduction is 45 %.

In the current year there was registered an increase of the emissions for all gases in the sector compared to the year 2002. The largest growth is in CH_4- 28.3 % followed by CO_2 -15.7 % and N_2O by 6.4 %.

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 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 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 anesthesia, production of medicines, aerosol packages, etc.

Agriculture

The GHG emissions from Agriculture are released as a result of the activities for production and processing of agricultural goods, soil fertilization and manure management. All the emissions related to combustion of fuels for energy are reported in sub-sector Agriculture and Forestry in the

Energy sector, and the emissions from agricultures machines – in group Other Transportation, sub-sector Transport of the Energy sector.

The processes and activities in sector Agriculture are the main sources of CH_4 and N_2O.

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

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 63 %.

The N_2O emissions from the sector are also large in volume. The most significant portion is released from agricultural soils. For the year 2003 it constituted around 84 %, and for the entire period (1988 – the year 2003) 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 – 15 % of the overall N_2O emissions from this sector.

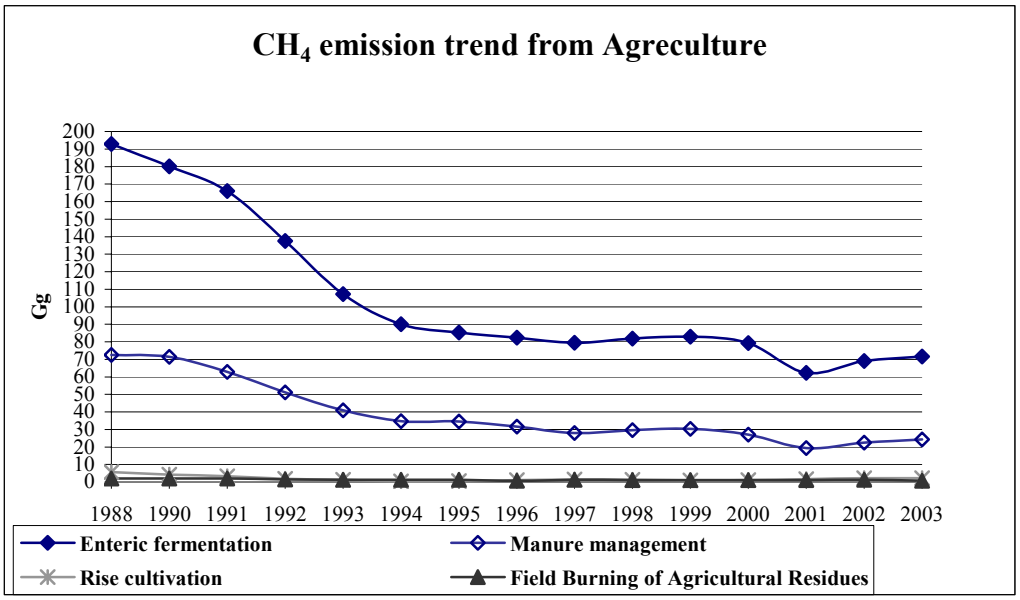
As a general the N_2O emissions in 2003 (expressed in CO_2 Eq.) are about 17 % higher than the CH_4 emissions (expressed in CO_2 Eq.).

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 2003, 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 forest 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 annual growth of around 12-13 millions m^3. For the year 2003 the cut is in the range of 6.57 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, as well as from domestic and industrial wastewater handling.

In 2003 the emissions from solid waste disposal head the first place of methane sources in Bulgaria and the sixth place from all GHG emission sources in the country. These amounts remain practically the same compared to the previous years in all Bulgaria Inventories till now.

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 three 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 kind 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 2003 are decreased with 55 % compared to the year 1988 whereas the emissions from international aviation are relatively smaller, i.e. - with 35 %. The main reason for this difference is the liquidation of the navy for ocean fishing after the year 1999.

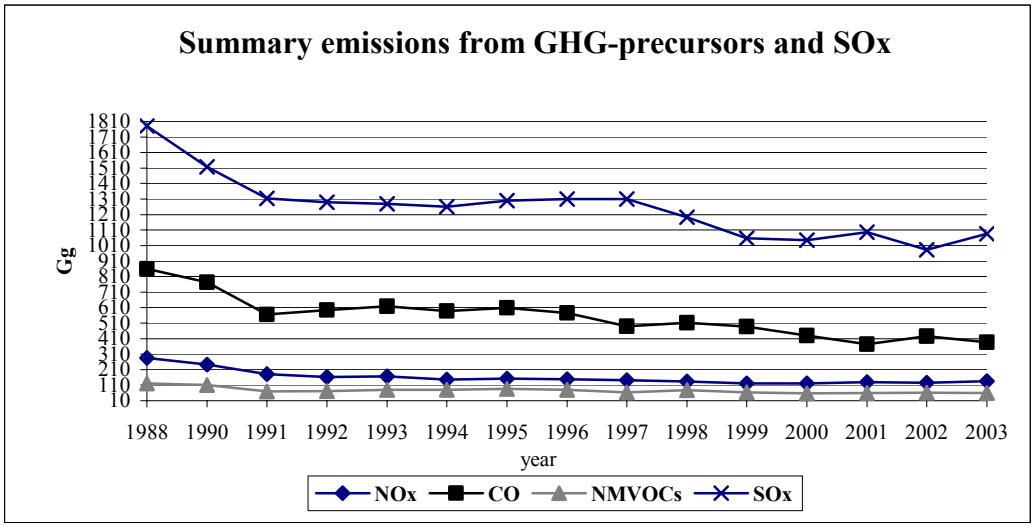
GHG Trends – Precursors and SOx

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** reveals 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
1. All energy (combustion and fugitive)	**98 282**	**84 641**	**68 530**	**62 305**	**64 769**	**61 608**	**64 584**	**63 074**	**61 673**	**55 409**	**50 899**	**50 131**	**51 943**	**49 241**	**53 466**
1A. Energy: fuel combustion	95 011	82 432	66 583	60 298	62 755	59 638	62 478	60 999	59 816	53 539	49 274	48 332	50 179	47 511	51 741
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
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	11 402
CO_2:3. Transport	13 814	10 864	6 525	6 435	7 444	6 547	6 845	6 306	5 315	6 475	6 212	5 881	6 014	6 317	7 098
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
CO_2:5. Other	0	1 006	882	196	733	810	315	261	112	49	0	0	0	0	0
CH_4	111	105	68	69	72	71	76	69	59	62	63	60	55	59	59
N_2O	4 174	3 655	3 158	3 031	3 002	2 909	3 027	2 975	3 024	2 664	2 465	2 411	2 648	2 398	2 647
B. Fugitive fuel emissions	**3 271**	**2 209**	**1 947**	**2 007**	**2 013**	**1 970**	**2 106**	**2 074**	**1 857**	**1 870**	**1 625**	**1 799**	**1 764**	**1 730**	**1 725**
CH_4	3 271	2 209	1 947	2 007	2 013	1 970	2 106	2 074	1 857	1 870	1 625	1 799	1 764	1 730	1 725
N_2O	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2. Industrial Processes (ISIC)	**10 425**	**9 232**	**6 293**	**5 303**	**5 139**	**6 071**	**7 401**	**7 280**	**6 570**	**4 593**	**4 620**	**5 465**	**5 362**	**4 863**	**5 527**
CO_2	7 846	6 866	4 599	3 908	3 936	4 620	5 355	5 202	4 843	3 490	3 784	4 041	3 997	3 704	4 286
CH_4	82	63	46	44	51	68	74	69	74	63	58	74	51	46	59
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
HFCs	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
PFCs	76	47	21	28	19	46	47	46	37	69	44	33	16	21	21
SF_6	0	0	0	0	0	0	1	1	2	2	2	2	2	3	3
3. Solvent and Other Product Use	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
4. Agriculture	**13 632**	**12 225**	**10 108**	**8 171**	**6 803**	**6 236**	**5 678**	**5 382**	**5 319**	**5 081**	**5 401**	**5 125**	**4 306**	**4 640**	**4 579**
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
CH_4 Manure management	1 524	1 501	1 319	1 073	859	729	725	664	586	622	636	569	405	471	512
CH_4 Rice cultivation	119	90	69	38	26	7	12	22	32	28	12	30	33	44	48
CH_4 Field Burning of Agricultural Residues	42	42	44	31	25	26	28	15	25	22	25	22	25	28	17
N_2O Manure Management	1 056	1 030	921	760	606	510	496	461	422	452	467	429	321	368	395
N_2O Agricultural soils	6 829	5 766	4 254	3 372	3 028	3 064	2 619	2 485	2 577	2 234	2 511	2 404	2 210	2 273	2 100
N_2O Field Burning of Agricultural Residues	14	13	15	10	7	7	8	5	7	6	8	6	6	7	5

Source category	**1988**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
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**
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
6. Waste	**16 038**	**13 823**	**11 999**	**11 511**	**10 607**	**10 011**	**9 607**	**8 689**	**7 146**	**6 221**	**4 911**	**4 978**	**4 827**	**4 794**	**5 595**
CO_2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CH_4	15 728	13 599	11 797	11 310	10 414	9 829	9 430	8 522	7 001	6 057	4 742	4 820	4 681	4 655	5 445
N_2O	310	224	202	201	192	183	177	167	145	164	169	158	146	140	150
7. Other (please specify)															
NATIONAL TOTAL EMISSIONS	**138 377**	**119 921**	**96 929**	**87 291**	**87 317**	**83 927**	**87 269**	**84 425**	**80 707**	**71 304**	**65 830**	**65 699**	**66 437**	**63 539**	**69 167**
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**

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 determined 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 2003 and the overall emission trend uncertainty to the base year till the year 2003.B

Uncertainty in total GHG emissions, %

Table ES.4

Uncertainty	Uncertainty NIR 2002	Uncertainty NIR 2003
Uncertainty in total GHG emissions	13.998	13.00
Overall uncertainty into the trend in total GHG emissions	2.263	3.381

The contribution of each emission source to the overall **level** uncertainty of the total emissions for the year 2003 provide 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 2003

Table ES.5

IPCC	IPCC sources	GHG	Uncertainty (% of national summary GHG emissions in 2003)
1A	N_2O Emissions from Stationary Combustion	N_2O	0,18
6A	CH_4 Emissions from Solid Waste Disposal Sites	CH_4	0,15
4D	Indirect N_2O Emissions from Agriculture Soils	N_2O	0,09
4D	Direct N_2O Emissions from Agriculture Soils	N_2O	0,09
1B	Fugitive Emissions from Coal Mining and Handling	CH_4	0,08
2B	N_2O Emissions from Nitric Acid Production	N_2O	0,08
1A	CO_2 Emissions from Stationary Combustion- Energy Industries, Coal	CO_2	0,07
4D	N_2O Emissions from Animal Production	N_2O	0,05
4B	N_2O Emissions from Manure Management	N_2O	0,04
6B	Emissions from Wastewater Handling	CH_4	0,04
	TOTAL		**0,86**

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 – 2003.

Key sources with the maximum contribution to uncertainty of GHG emissions summary trend in 1988-2003

Table ES.6

IPCC	IPCC sources	GHG	Uncertainty (% of the total emissions trend for 1988-2003)
6A	CH_4 Emissions from Solid Waste Disposal Sites	CH_4	0,23
4D	Direct N_2O Emissions from Agriculture Soils	N_2O	0,14
4D	Indirect N_2O Emissions from Agriculture Soils	N_2O	0,14
1A	N_2O Emissions from Stationary Combustion	N_2O	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	0,06
	Total others		0,04
1B	Fugitive Emissions from Coal Mining and Handling	CH_4	0,04
4B	N_2O Emissions from Manure Management	N_2O	0,03
1A	CO_2 Emissions from Stationary Combustion – Oil	CO_2	0,03
	TOTAL		**0,87**

Completeness

In the GHG Inventory for the year 2003 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 – 2002 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 classified in the following groups:

A. Changes in the methodology of modeling the processes, activities and emission factors.
Б. Changes in the structure of the fuel's data and GHG emitters activities;
B. 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:

- Accounting the CO_2 emissions from non-energy use of the fuels – group A.
- Correct structure of the quantities of solid fuels put into the conversion in energy-converted processes (coke and briquettes) – groups B and C.
- Corrections in the CH_4 and N_2O emissions from biomass from the category "Other Type of Transport" from the Transport sub-sector – group C.
- Corrections in the emission factors of the CO_2 emissions from the dry gas combustion in Petroleum Processing, of coke gas and blast gas – group A.
- Accounting of the fugitive emissions of methane from natural gas transit – group A.
- Use of the completely renovated emission factors for fugitive emissions of methane from the petroleum and gas systems – group A.
- Addition of fugitive emissions of methane in the petroleum and gas systems – group B.

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 – 2002.

- In the category "G. Other" according to CRF the overall quantities of produced plastics, synthetic rubber and glues are put in it- group A.
- Data for the food production are added which are missing for the period till the year 1997 – group B.
- Addition of the PFCs emissions in the aluminum production – group B.
- Addition of emissions from the Petroleum - group A.

Processing emissions are added as follows:

  - SOx, NOx, CO and NMVOCs emissions from flaring of waste gases;
  - NMVOCs emissions from expedition of oil produced in the refineries;
  - NMVOCs emissions from petrol refueling at the petrol stations.
- Complete revision of the fugitive emissions of SF_6 from use of the electricity appliance with high voltage – group B.

The changes in sector **Solvent Use** are addition of emissions from "Solvent Use by the population" and correction of the emission factors for NMVOCs emissions from paint production.

- Correction of the emission factor for GHG emissions from paint production – group A.
- Re-assessment of the emissions from household consumption of solvent for the period of 1988-1997 – group A;
- Addition of the emissions from production of bitumen and re-assessment of the emission factors for emissions from the production of ceiling materials soaked with asphalt – group B.

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. It is knowing that for this period the official data for the Agriculture were collected in the National Statistical Institute and not in the Statistic Department of the MAF.

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

- Data for the number of the domestic livestock for the period till the year 2000 are not recalculated in compliance with the new methodology for half-year accounting – group B.
- Recalculation of the quantities of synthetic nitrous fertilizers applied to soils – group B.
- Recalculation of the size of the agricultural land – group B.
- Additional data for the quantities of vegetable crops – group B.

In sector **Land Use Change and Forestry** were actualized only the data for the thinning after a discussion with experts from National Forest Management Department within the MAF. The data for the years 1994, 1996 and 1997 were corrected by eliminating mistakes with preliminary and incorrect assessment of the total quantity of thinned wood for these years – groups B and C.

In sector **Waste** are recalculated the quantities of the disposed solid waste for the period of 1990-1994 as well as the quantities of industrial wastewater for the same period.

- Recalculation of the Disposed Solid Waste – group A.
- Recalculation of CH_4 emissions from wastewaters – group B.
- Re-assessment of the quantities of consumed food by the population for the period 1995-2002 – group B.
- Revision of data for the quantities of wastewater for the years 1998 and 1999 – group B.

In **Table ES.7** are presented the differences between the Inventories on the basis of recalculations in the National Inventory Report 2002 (Submission 2004) and the current report (Submission 2005).

Differences between NIR 2004 and NIR 2005 for 1988-2002 due to recalculation, %

Table ES.7

Gas/Sector	Source	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Energy	*% NIR-2005 versus NIR-2004*														
CO_2		-4,17	3,60	4,42	4,30	4,39	5,59	6,05	6,26	6,91	5,61	5,99	7,53	5,69	4,65
CH_4		-30,34	-49,81	-49,12	-45,08	-43,18	-43,69	-46,72	-47,56	-43,99	-40,53	-39,10	-37,90	-36,61	-33,31
N_2O		-11,82	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-0,04	-0,04	0,00	0,00	0,00
Industrial Processes															
CO_2		0,00	0,00	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		88,61	8,95	7,02	7,20	7,24	6,05	5,91	6,66	6,04	6,39	2,67	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
Solvent and Other Product Use															
NMVOCs		-71,73	-65,05	-46,43	-46,07	-39,05	-40,16	-45,48	-50,69	-51,40	-26,08	46,08	0,00	197,80	186,10
Agriculture															
CH_4		0,04	0,04	0,04	0,05	0,05	0,07	0,09	0,07	0,07	0,33	-0,32	0,34	0,00	0,00
N_2O		5,73	-9,79	-18,16	-10,76	-2,08	8,07	-4,82	-3,95	1,61	-4,21	4,57	0,04	0,07	-0,01
Land-Use Change and Forestry															
CO_2 sink		10,21	6,16	-3,11	-2,93	6,46	4,68	0,07	-9,35	17,43	10,07	8,96	0,00	0,00	0,00
Waste															
CH_4		13,87	-12,27	-26,57	-28,31	-27,48	8,56	0,00	0,72	0,00	0,01	-2,06	0,00	0,00	0,00
N_2O		31,79	0,00	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 without LUCF															
CO_2-eq-without F-gases		-2,48	-1,80	-4,61	-4,70	-3,42	3,03	1,54	1,71	2,82	1,82	2,46	3,28	2,33	1,77
CO_2-eq- total		-2,43	-1,76	-4,58	-4,67	-3,40	3,08	1,54	1,71	2,82	1,83	2,47	3,28	2,33	1,78
CO_2		-3,85	3,30	4,11	4,02	4,11	5,15	5,53	5,71	6,33	5,23	5,52	6,88	5,23	4,28
CH_4		1,98	-16,38	-24,85	-26,10	-26,02	-5,21	-11,80	-12,48	-11,71	-11,10	-11,79	-11,09	-11,21	-9,53
N_2O		-0,38	-5,40	-10,16	-5,43	-0,96	3,46	-1,88	-1,49	0,61	-1,81	2,08	0,01	0,03	0,00

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 2002 Inventory (Submission 2004) levels of all main GHG emissions and GHG emission – precursors.

The aggregated emissions of Bulgaria for the year 1988 are 138 376.76 Gg CO_2-Eq. (not taking into account the CO_2 sequestration in forests). The difference between the preliminary assessment is with 2.4 % less.

The share of CO_2 is 71 %, the share of CH_4 is 18 % and the N_2O - 11 % all expressed in CO_2–Eq. from the overall emissions.

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

- Energy – 71.0 %;
- Industrial Processes – 7.5 %;
- Agriculture – 9.8 %;
- Waste – 11.6 %.

The largest ***CO_2 emission*** source is Energy sector - 90 726 Gg or 65.5 % of the overall GHG emissions in Bulgaria (not taking into account the sink from forests).

As a whole the CO_2 emissions from Energy sector are reduced with 4.2 % with significant re-allocation between certain sub-sectors.

There are no changes in the CO_2 emissions in the sector "Industrial Processing". But there is a significant increase in the quantities of CO_2 sequestrated from forests (with about 10.2 %) due to the recalculated volumes of thinned wood.

The overall ***CH_4 emissions*** are 1 187 Gg which indicates an increase with 2 % compared to the precious inventory. This increase is on the account of the emissions from sector Waste and sector Agriculture.

Sector Industrial Processes has the smallest absolute amount of emissions but it registers the largest increase – with 89 %. It is due to the increased emissions from the production of metals (accounting the agglomerate - a source missing till now).

The overall ***N_2O emissions*** are 47.8 Gg. This quantity has not changed compared to the previous inventory. Changes are observed only in sectors Energy and Agriculture which are in mutual compensation. Whereas sector Energy reduces its emissions with 11.8 %, the sector Agriculture increases them with 5.7 % compared with the previous inventory. Accounted in net values these changes in percentage are almost equal. The biggest increase in percentage is that in sector Waste – 32 %. But it does not influence by the overall increase because it has a very small absolute value.

Recalculation of the GHG Inventories for the Period of 1990 -2002

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 till 7 %;
- CH_4- from -5 till -25 %;
- N_2O- from -10 till + 3.5 %.

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 – 2002 between the two following submissions of the inventories are presented in **Table ES.8**.

Difference between NIR 2004 and NIR 2005 for emission trends 1988-2002 (1995 for F- gases)

Table ES.8

Gas, Gg CO_2-eq.	Trend (absolute)			Trend (percentage)		
	NIR 2004	NIR 2005	Difference	NIR 2004	NIR 2005	Difference
CO_2	-55 763	-49 814	5 949	-54	-51	3,9
CH_4	-15 066	-15 559	-493	-62	-62	-0,8
N_2O	-8 586	-8 530	56	-58	-58	0,2
HFCS	-3	-3	0	-100	-100	0,0
PFCs	-26	-26	-1	-54	-56	-1,6
SF_6	1	1	0		100	99,7
Total	**-79 442**	**-73 930**	**5 512**	**-56**	**-53**	**2,6**

The trends in absolute values are determined as differences between the sum GHG emissions for the years 2002 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:

- Country's revision by an international team from the Secretariat of UNFCCC, 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.

The results from these check-ups showed several omissions in the Inventories, which were eliminated or are in the process of investigation and elimination. Some of them are as follows:

- Non-uniformity of the time series;
- Lack of commentaries for zero designations for emissions and other parameters and indexes in the CRF tables;
- Comparison between the inventory data and the relevant data from international organizations;
- Non-complexity of the CRF tables for all years till 1998;
- Including of the additional information in the National Inventory Report;

As a rule in all the inventories (not only in Bulgaria) recommendations for additional including of data and material are made in order to improve the transparency and consistency of the inventories. This requirement must be fulfilled on the principle of reasonable combination of the volume and the (grade of) importance of the additional information. In this report we have tried to include several new materials compared to the previous report for 2004 presentation which can demonstrate more clearly the GHG emissions in Bulgaria.

Planned Improvements

The 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.

Key element from the improvements is 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.

During the current year several projects for investigation and determination of the parameters and data necessary for the GHG emission inventory in sectors Agriculture and 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 in the inventories and the necessity for collection of additional information.

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 2003.

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 – 2003.

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 totaling 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. It entered into force in March 1994.

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 Co-operation 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. Until August 2004, the KP was ratified by 159 countries, including Bulgaria which ratified it 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 GHGs emissions of the base year and at least one year, preceding the current inventory. It means that the inventory for 2003 should be submitted to Secretariat to the UNFCCC on 15.04.2005, 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, and the 2000 IPCC Good Practice Guidance, 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 calculating efforts;
- Tier 2 is more complex and requires more input data;
- 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.

To this effect, Bulgaria is trying to apply more accurate methods even in cases, where there are no specific methods and data for the country, following the recommendations in IPCC documents.

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 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, 2003, and the corresponding National report have been improved compared to the preceding National report, 2002, as follows:

- The structure of the National report has been entirely changed and the organization of its content has been made in accordance with the requirements of the UNFCCC Guidelines;
- The base year 1988 has been recalculated, using the complete national material balances of fuels;
- CRF Tables for all years have been prepared, together with a GHG inventory for the period 1990 - 2002 г.
- CO_2 emissions of non-energy use of fuels have been included;
- Omissions and mistakes on selection and application of emissions factors for GHG emissions assessment of large combusting facilities have been eliminated.

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 Energy and Energy Resources;
- Ministry of economy;
- Forestry Department within MAF;
- Soil Resource Executive Agency within MAF;
- National Service for Plant Protection, Quarantine and Agrochemistry;
- 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, which ensured publicity and competitiveness of the assigning task process.

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. Significant part of EI activities are related to GHG emissions analyses and trends, 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 will be boosted and significantly improved after introducing the National assessment system of the GHG anthropogenic emissions. This system is at preliminary study stage, which commenced in the beginning of 2005. The elaboration of the system is envisaged at the end of 2005.

1.4. Brief General Description of Methodologies and Data Sources Used

The GHG inventory for the year 2003 was carried out in compliance with the 1996 Revised IPCC Guidelines, without changing the methodology approach used in the previous inventories until 2002. 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 IPCC Revised 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 5-6 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;

T1,2,3 – 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	T3	CS, D	T3	CS, D	T3	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	NA	NA	D	D,CS		
A. Solid Waste Disposal on Land			D	D,CS	D	D
B. Wastewater Handling	NO	NO	NO	NO	NO	NO
C. Waste Incineration						
D. Other						
	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.

The present inventory reports for a first time on CO_2 emissions from the non-energy fuel utilization, taking into account the quantities of the carbon stored in the products.

Because of the fact that the combustion of solid household waste is not widely 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.

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.

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 anesthesia.

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 aluminum 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 -2003.

As a whole, the data on the current F-gases emissions is too limited and does not correspond to the actual consumption level at the moment.

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 Energy and Energy Resources (MEER);
- number of farming animals and plant crops: "Agrostatistics" Department within MAF;
- quantity of used synthetic fertilizers: National Service for Plant Protection, Quarantine and Agrochemistry 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, MEER 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 2004. Two new key sources were added: CO_2 emissions from non-energy use of natural gas and CH_4 emissions from waste water treatment. The source CH_4 fugitive emissions from extraction and distribution of oil and natural gas 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 19 key sources by quantitative assessment and 18 key sources by trend assessment, of total 39 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
1A	N_2O	N_2O Emissions from Stationary Combustion	Key(L,T)	L,T	L,T
1A2	CO_2	CO_2 Emissions from Stationary Combustion- Other Sectors, Coal	Key(L,T)	L,T	T
1B2	CH_4	Fugitive Emissions from Coal Mining and Handling	Key(L,T)	L	L,T
1A3	CO_2	Mobile Combustion-other transportation	Key(L,T)	L	T
1A2	CO_2	Non-energy fuel use- gas	Key(L)	L	-
		Others	Key(T)	T	T
INDUSTRIAL PROCESSES					
2A	CO_2	CO_2 Emissions from Cement Production	Key(L)	L	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 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)	T	L,T
4B	N_2O	N_2O from animal waste processing	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

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 24 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 9000:2000 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 9000:2000 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.

The introducing of the National System for estimation of anthropogenic emissions (requirement of Art. 5 of the Kyoto Protocol), which development started in 2005, will bring the existing QMSs of the particular inventory process' participants together into a common national system, which will lead to a significant improvement of inventories' quality.

1.7. General Uncertainty Evaluation

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

Part 6 of Guidance contains a detailed analysis of the conditions and preconditions to be taken into account when determining the overall GHG emission uncertainty during inventory preparation.

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 2003 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

IN	IPCC source category	Gas	Unc. 2003	
			AD	EF
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	CO_2 Emissions from Stationary Combustion – Oil	CO_2	5	5
6	CH_4 Emissions from Solid Waste Disposal Sites	CH_4	20	100
7	N_2O Emissions from Stationary Combustion	N_2O	5	200
8	CO_2 Emissions from Stationary Combustion- Other Sectors, Coal	CO_2	5	7
9	CO_2 Emissions from Steel Production	CO_2	3	10
10	CH_4 Emissions from Enteric Fermentation in Domestic Livestock	CH_4	2	50
11	Emissions from Wastewater Handling	CH_4	30	80
12	Fugitive Emissions from Coal Mining and Handling	CH_4	10	200
13	CO_2 Emissions from Cement Production	CO_2	3	30
14	N_2O Emissions from Nitric Acid Production	N_2O	10	200
15	Direct N_2O Emissions from Agriculture Soils	N_2O	3	250
16	CO_2 from Lime Production	CO_2	5	15
17	Mobile Combustion-other transportation	CO_2	5	5
18	Non-energy fuel use- gas	CO_2	5	5
19	N_2O Emissions from Animal Production	N_2O	3	250
20	Indirect N_2O Emissions from Agriculture Soils	N_2O	3	500
21	Fugitive Emissions from Oil and Gas Operations	CH_4	5	50
22	CH_4 Emissions from Manure Management	CH_4	2	50
23	N_2O Emissions from Manure Management	N_2O	2	300
24	CO_2 from Ammonia Production	CO_2	5	20
25	N_2O Emissions from Wastewater Handling	N_2O	30	100
26	CO_2 from Soda Ash Production	CO_2	5	20
27	Mobile Combustion-Railways	CO_2	3	5
28	CO_2 Emissions from Industrial Processes - others	CO_2	5	20
29	Non- energy fuel use - liquide	CO_2	5	5
30	Non-energy fuel use- solid	CO_2	5	7
31	CH_4 Emissions from Industrial Processes - metal production	CH_4	5	20
32	CH_4 Emissions from Rice Production	CH_4	25	80
33	Mobile Combustion-road transportation	N_2O	3	40
34	CH_4 Emissions from Stationary Combustion	CH_4	5	50
35	Mobile Combustion-road transportation	CH_4	3	100
36	New gases	PFC, HFC, SF_6	10	50
37	CH_4 Emissions from Agricultural Residue Burning	CH_4	25	50
38	N_2O Emissions from Agricultural Residue Burning	N_2O	25	200

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

Table 1.4

IPCC source category	Gas	1988 year	2003 year	Comb. uncertainty %	Combined uncertainty as % of total nat. emissions in 2003	Uncertainty into the trend in total nat. emissions, %
CO_2 Emissions from Stationary Combustion-Energy Industries, Coal	CO_2	31 318	25 051	8.6	3.1	1.4
Mobile Combustion- road transportation	CO_2	7 747	6 267	5.8	0.5	0.2
CO_2 Emissions from Stationary Combustion-Manufacturing Industries, Coal	CO_2	9 272	5 214	8.6	0.6	0.3
CO_2 Emissions from Stationary Combustion – Gas	CO_2	10 259	4 638	7.1	0.5	0.2
CO_2 Emissions from Stationary Combustion – Oil	CO_2	19 685	4 562	7.1	0.5	0.3
CH_4 Emissions from Solid Waste Disposal Sites	CH_4	13 883	4 217	102	6.2	2.2
N_2O Emissions from Stationary Combustion	N_2O	4 073	2 606	200	7.5	0.8
CO_2 Emissions from Stationary Combustion-Other Sectors, Coal	CO_2	4 953	1 690	8.6	0.2	0.1
CO_2 Emissions from Steel Production	CO_2	2 360	1 640	10	0.2	0.1
CH_4 Emissions from Enteric Fermentation in Domestic Livestock	CH_4	4 049	1 502	50	1.1	0.2
Emissions from Wastewater Handling	CH_4	1 845	1 228	85	1.5	0.4
Fugitive Emissions from Coal Mining and Handling	CH_4	1 992	1 208	200	3.5	0.3
CO_2 Emissions from Cement Production	CO_2	2 737	1 189	30	0.5	0.1
N_2O Emissions from Nitric Acid Production	N_2O	2 422	1 159	200	3.4	0.1
Direct N_2O Emissions from Agriculture Soils	N_2O	3 455	1 036	250	3.7	1.2
CO_2 from Lime Production	CO_2	1 118	921	16	0.2	0.1
Mobile Combustion-other transportation	CO_2	3 998	685	7.1	0.1	0.1
Non-energy fuel use- gas	CO_2	990	656	7.1	0.1	0.0
N_2O Emissions from Animal Production	N_2O	1 652	544	250	2.0	0.5
Indirect N_2O Emissions from Agriculture Soils	N_2O	1 722	519	500	3.8	1.2
Fugitive Emissions from Oil and Gas Operations	CH_4	1 362	517	50	0.4	0.1
CH_4 Emissions from Manure Management	CH_4	1 524	512	50	0.4	0.1
N_2O Emissions from Manure Management	N_2O	1 056	395	300	1.7	0.3
CO_2 from Ammonia Production	CO_2	1 157	337	21	0.1	0.0
N_2O Emissions from Wastewater Handling	N_2O	310	150	104	0.2	0.0
CO_2 from Soda Ash Production	CO_2	233	106	21	0.0	0.0
Mobile Combustion-Railways	CO_2	368	89	5.8	0.0	0.0
CO_2 Emissions from Industrial Processes - others	CO_2	39	84	21	0.0	0.0
Non- energy fuel use - liquide	CO_2	354	74	7.1	0.0	0.0
Non-energy fuel use - solid	CO_2	80	53	8.6	0.0	0.0
CH_4 Emissions from Industrial Processes - metal production	CH_4	73	53	21	0.0	0.0
CH_4 Emissions from Rice Production	CH_4	119	48	84	0.1	0.0
Mobile Combustion-road transportation	N_2O	48	35	40	0.0	0.0

IPCC source category	Gas	1988 year	2003 year	Comb. uncertainty %	Combined uncertainty as % of total nat. emissions in 2003	Uncertainty into the trend in total nat. emissions, %
CH_4 Emissions from Stationary Combustion	CH_4	49	32	50	0.0	0.0
Mobile Combustion-road transportation	CH_4	54	24	100	0.0	0.0
New gases	PFC, HFC, SF_6	76	23	51	0.0	0.0
CH_4 Emissions from Agricultural Residue Burning	CH_4	42	17	55.9	0.0	0.0
N_2O Emissions from Agricultural Residue Burning	N_2O	14	5	202	0.0	0.0
Total others		1 890	78	50	0.1	0.3
TOTALS		**138 377**	**69 167**			
Overall uncertainty in the year					13.0	3.4

The calculated uncertainties, in %, of the overall national GHG emissions for the year 2003, and the overall emission trend related to the base inventory year until 2003, are given in **Table 1.5**.

Uncertainty in total GHG emissions, %

Table 1.5

Uncertainty	Uncertainty NIR 2002	Uncertainty NIR 2003
Uncertainty in total GHG emissions	13.998	13.00
Overall uncertainty into the trend in total GHG emissions	2.263	3.381

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, 2.46 % uncertainty of the overall emissions, and 1.1 % uncertainty of 2002 inventory trend will be obtained.

The contribution of each source to the general uncertainty of summary GHG emissions' **level** for 2003, 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 2003

Table 1.6

IPCC	IPCC sources	GHG	Uncertainty (% of national summary GHG emissions in 2003)
1A	N_2O Emissions from Stationary Combustion	N_2O	0.18
6A	CH_4 Emissions from Solid Waste Disposal Sites	CH_4	0.15
4D	Indirect N_2O Emissions from Agriculture Soils	N_2O	0.09
4D	Direct N_2O Emissions from Agriculture Soils	N_2O	0.09
1B	Fugitive Emissions from Coal Mining and Handling	CH_4	0.08
2B	N_2O Emissions from Nitric Acid Production	N_2O	0.08
1A	CO_2 Emissions from Stationary Combustion- Energy Industries, Coal	CO_2	0.07
4D	N_2O Emissions from Animal Production	N_2O	0.05
4B	N_2O Emissions from Manure Management	N_2O	0.04
6B	Emissions from Wastewater Handling	CH_4	0.04
	TOTAL		**0.86**

The first ten sources with highest contribution to the uncertainty of GHG summary trend emissions for the period 1988-2003, are shown in **Table 1.7**.

Key sources with the maximum contribution to uncertainty of GHG emissions summary trend in 1988-2003

Table 1.7

IPCC	IPCC sources	GHG	Uncertainty (% of the total emissions trend for 1988-2003)
6A	CH_4 Emissions from Solid Waste Disposal Sites	CH_4	0.23
4D	Direct N_2O Emissions from Agriculture Soils	N_2O	0.14
4D	Indirect N_2O Emissions from Agriculture Soils	N_2O	0.14
1A	N_2O Emissions from Stationary Combustion	N_2O	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	0.06
	Total others		0.04
1B	Fugitive Emissions from Coal Mining and Handling	CH_4	0.04
4B	N_2O Emissions from Manure Management	N_2O	0.03
1A	CO_2 Emissions from Stationary Combustion – Oil	CO_2	0.03
	TOTAL		**0.87**

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 2003 covered all sectors, included in IPCC Good Practice Guidance, 1996, excluding:

- emissions in categories 5B-5E of sector Land-use Change and Forestry;
- CO_2 emissions from combustion of solid waste
- 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.

Developments have been initiated recently, in order to clarify the problems and assess the possibilities for solutions.

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 2003 showed that the overall GHG emissions in CO_2–eq. amounted to 69 167 Gg, without reporting of sequestration from sector Land-Use Change and Forestry (LUCF). The net emissions (without reporting of sequestration from LUCF) were 62 111 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 %.

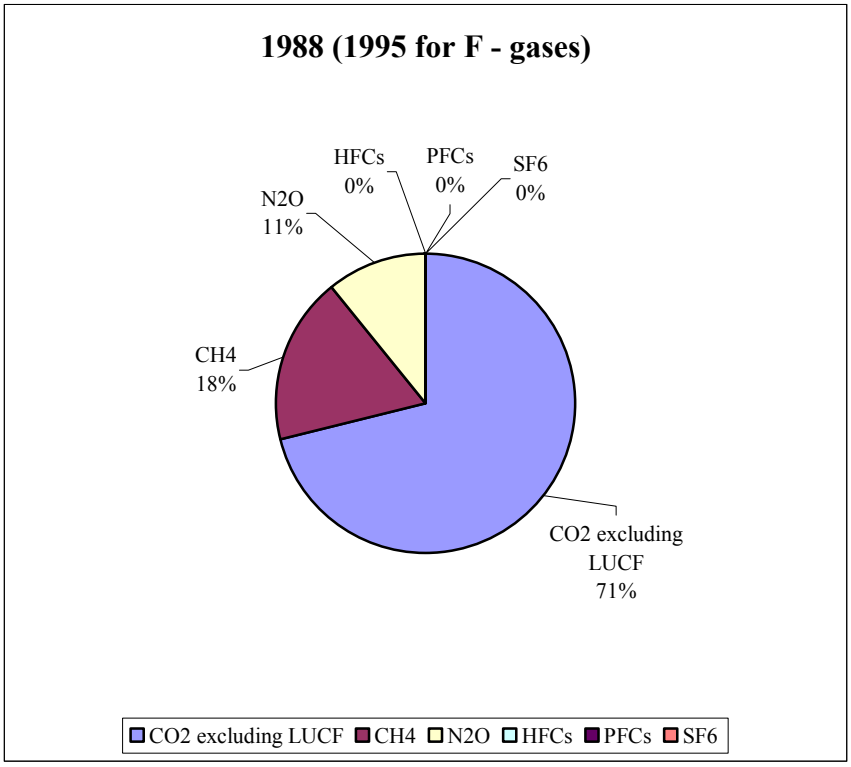
Analysis of **Table 2.1** shows, that in 2003, CO_2 emissions headed the list with the biggest share – 75 % of the overall GHG emissions, expressed in CO_2-eq., CH_4 emissions ranked the second place with 15 %, and N_2O emissions ranked the third place with 10 %. This distribution has undergone some 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
CO_2 with LUCF	93 439	78 376	59 438	53 497	55 409	53 167	56 891	56 378	54 592	47 393	43 330	40 927	42 005	40 440	46 265
CO_2 excluding LUCF	98 572	84 533	67 074	60 910	62 884	60 469	64 416	62 895	61 463	54 253	50 530	49 903	51 472	48 758	53 321
CH_4	24 925	21 393	18 777	17 459	15 712	14 592	14 240	13 165	11 303	10 441	8 903	9 038	8 320	8 482	9 366
N_2O	14 805	12 943	10 176	8 698	7 968	8 010	8 248	8 056	7 789	6 489	6 352	6 723	6 626	6 275	6 456
HFCs	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
PFCs	76	47	21	28	19	46	47	46	37	69	44	33	16	21	21
SF_6	0	0	0	0	0	0	1	1	2	2	2	2	2	3	3
Total	**138 377**	**118 916**	**96 047**	**87 095**	**86 584**	**83 117**	**86 954**	**84 164**	**80 595**	**71 255**	**65 830**	**65 699**	**66 437**	**63 539**	**69 167**
Index (1988 = 100)															
Index CO_2 excluding LUCF	100	85.8	68.0	61.8	63.8	61.3	65.3	63.8	62.4	55.0	51.3	50.6	52.2	49.5	54.1
Index CH_4	100	85.8	75.3	70.0	63.0	58.5	57.1	52.8	45.3	41.9	35.7	36.3	33.4	34.0	37.6
Index N_2O	100	87.4	68.7	58.8	53.8	54.1	55.7	54.4	52.6	43.8	42.9	45.4	44.8	42.4	43.6
Index [group of six]	**100**	**85.9**	**69.4**	**62.9**	**62.6**	**60.1**	**62.8**	**60.8**	**58.2**	**51.5**	**47.6**	**47.5**	**48.0**	**45.9**	**50.0**
Index (1995 = 100)															
Index HFCs	0	0	0	0	0	0	100	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
Index SF_6	0.0	0.0	0.0	0.0	0.0	0.0	100.0	103.7	138.9	145.1	149.0	176.7	181.4	198.9	199.7
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

Figure 2.1


1988 (1995 for F - gases)
HFCs 0%
PFCs 0%
SF6 0%
N2O 11%
CH4 18%
CO2 excluding LUCF 71%
CO2 excluding LUCF
CH4
N2O
HFCs
PFCs
SF6

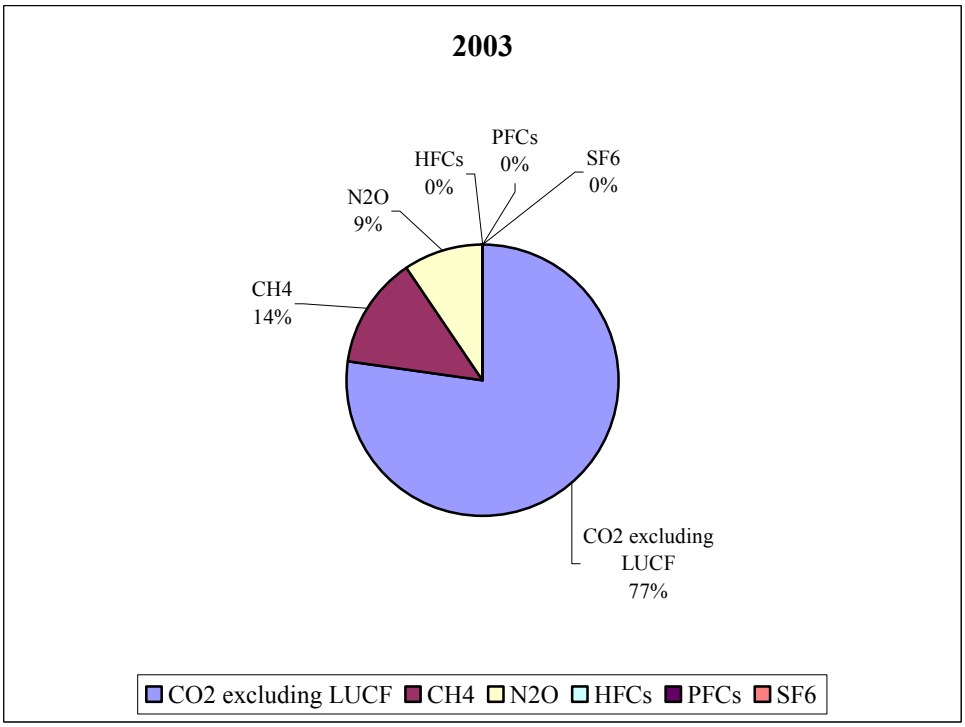
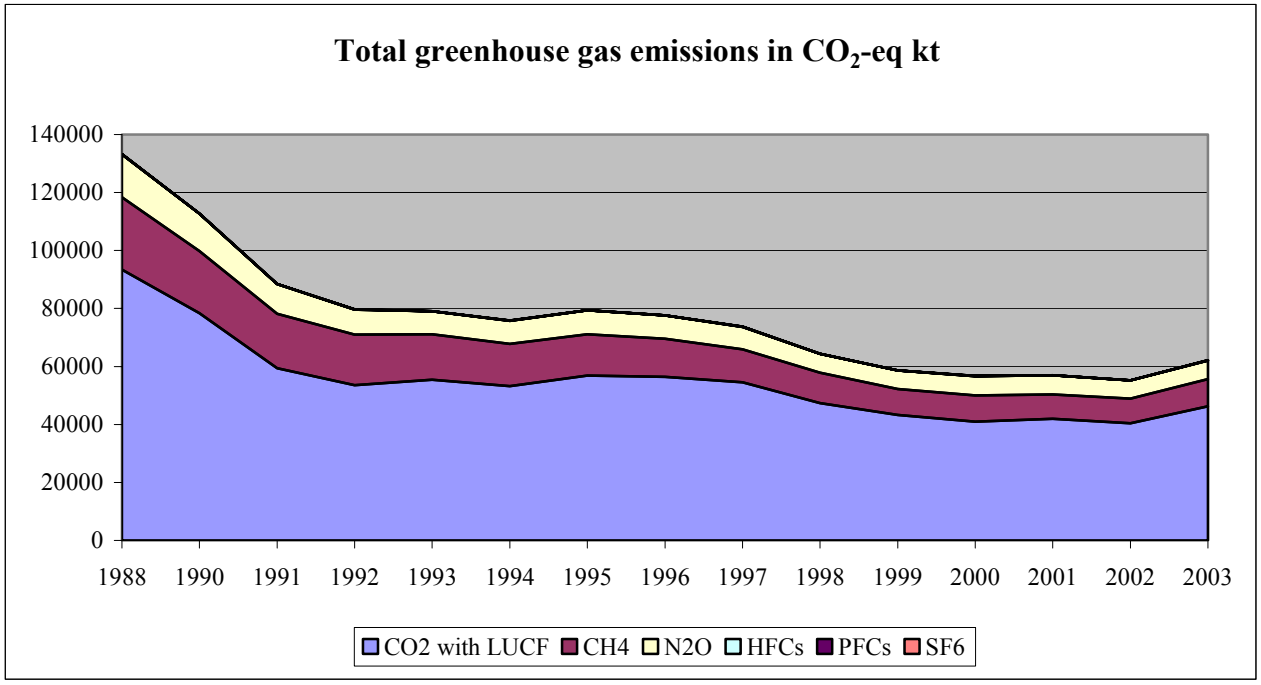

2003
PFCs 0%
HFCs 0%
SF6 0%
N2O 9%
CH4 14%
CO2 excluding LUCF 77%
CO2 excluding LUCF
CH4
N2O
HFCs
PFCs
SF6

Figure 2.2 shows the change in the overall emissions for the period 1988–2003 г.

Figure 2.2



It can be seen that in 2003, the total GHG emissions in CO_2-eq., indicated growth. 2003 emissions were 50 % from the emissions in the base year, 1988, and increased compared to the preceding 2002 by 9.2 %. 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 1988–2003, 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
Energy	98 282	84 641	68 530	62 305	64 769	61 608	64 584
Industrial processes	10 425	9 232	6 293	5 303	5 139	6 071	7 401
Agriculture	13 632	12 225	10 108	8 171	6 803	6 236	5 678
Forestry	-5 133	-6 157	-7 636	-7 412	-7 476	-7 302	-7 524
Waste	16 038	13 823	11 999	11 511	10 607	10 011	9 607
Total (without LUCF)	**138 377**	**119 921**	**96 929**	**87 291**	**87 317**	**83 927**	**87 269**

Sector/ year	1996	1997	1998	1999	2000	2001	2002	2003
Energy	63 074	61 673	55 409	50 899	50 131	51 943	49 241	53 466
Industrial processes	7 280	6 570	4 593	4 620	5 465	5 362	4 863	5 527
Agriculture	5 382	5 319	5 081	5 401	5 125	4 306	4 640	4 579
Forestry	-6 517	-6 872	-6 860	-7 200	-8 976	-9 467	-8 318	-7 056
Waste	8 689	7 146	6 221	4 911	4 978	4 827	4 794	5 595
Total (without LUCF)	**84 425**	**80 707**	**71 304**	**65 830**	**65 699**	**66 437**	**63 539**	**69 167**

Table 2.3 shows the shares in percentage of the overall GHG emissions by sectors for the period 1988–2003. This percent was calculated on the overall emissions, excluding CO_2 sequestration by forestry.

Sector contribution in aggregated emissions, %

Table 2.3

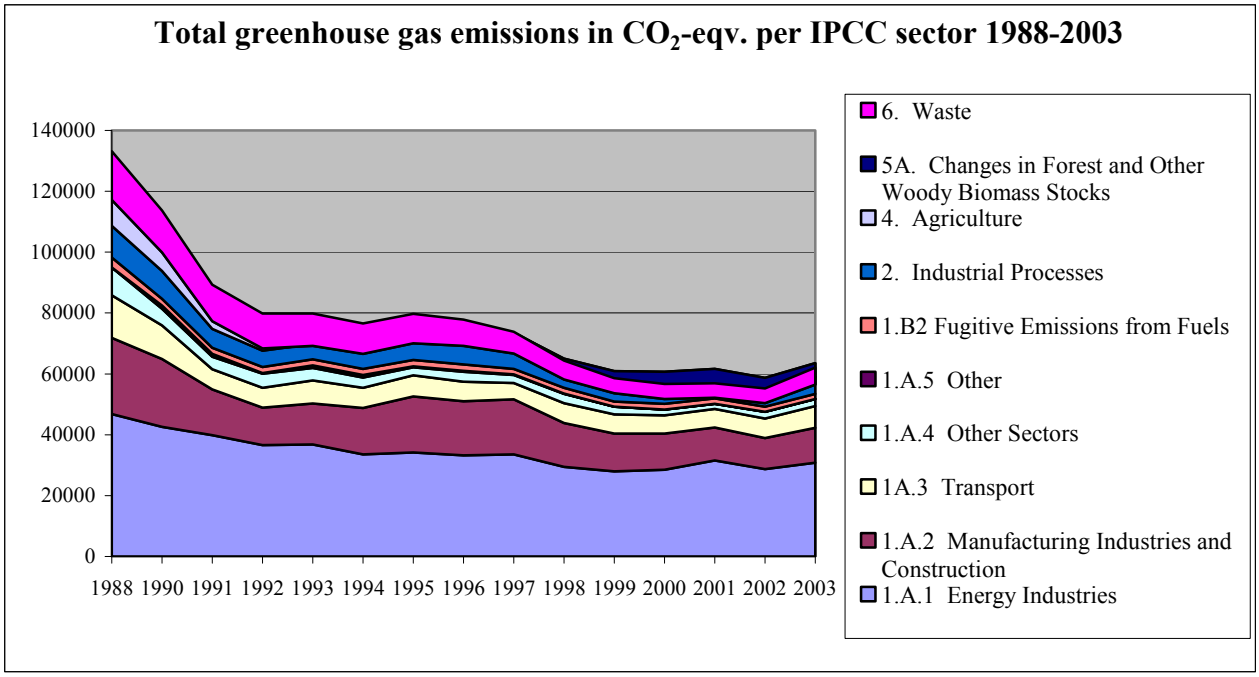
Sector/ year	1988	1990	1991	1992	1993	1994	1995
Energy	71.02	70.58	70.70	71.38	74.18	73.41	74.01
Industrial processes	7.53	7.70	6.49	6.08	5.89	7.23	8.48
Agriculture	9.85	10.19	10.43	9.36	7.79	7.43	6.51
Forestry	-3.71	-5.13	-7.88	-8.49	-8.56	-8.70	-8.62
Waste	11.59	11.53	12.38	13.19	12.15	11.93	11.01

Sector/ year	1996	1997	1998	1999	2000	2001	2002	2003
Energy	74.71	76.42	77.71	77.32	76.30	78.18	77.50	77.30
Industrial processes	8.62	8.14	6.44	7.02	8.32	8.07	7.65	7.99
Agriculture	6.37	6.59	7.13	8.20	7.80	6.48	7.30	6.62
Forestry	-7.72	-8.51	-9.62	-10.94	-13.66	-14.25	-13.09	-10.20
Waste	10.29	8.85	8.72	7.46	7.58	7.27	7.55	8.09

Analysis of **Table 2.3** shows that sector "Energy", where GHG emissions come from fuel combustion, headed the list in 2003 with the biggest share – 77 %. Sector "Waste" ranked the second place, and sector "Industrial processes" ranked the third place.

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 about 3.4 % at 1 % change. The level (quantity) uncertainty of the overall emissions was much larger and achieved about 13 %. 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 2003 compared to the base 1988, was 49.5 %. That reduction was conditioned mostly by the reduction in industry – 53 %, in transport - 41 %, and

particularly in households - 74 %. The lowest reduction was in the Energy sector - 37 %, due to the good structure of the electrical production facilities, including the significant output of electrical power, produced in the Nuclear Power Plant.

The relatively highest CO_2 emissions' growth for the whole period in question after 1988, was reported in 2003 compared to the preceding 2002. The total CO_2 emissions' growth was 8.8 %, formed by 8.2 % growth of the energy sector, 11.8 % of the industry, 12.4 % of the transport, 15.1 % of the households, and 15.5 % of the technological industrial processes. The relatively high growth of the households' emissions indicated for a better well-being, as well as a negative trend of utilization of fuels with high-emission factors – domestic coal, in general.

Table 2.5 shows the CH_4 emission trends by IPCC sectors.

Reduction of the CH_4 overall emissions in 2003 compared to the base 1988, was 62 %. That reduction was conditioned mostly by the reduction in agriculture – 63.7 %, in fugitive emissions from coal mining and gas and oil systems - 47 %, and particularly in the solid waste - 69.6 %. 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 2002, a growth of CH_4 emissions can be seen in 2003, as follows: overall growth of 10.4 %, 4.3 % growth in agriculture, 27.2 % in technological industrial processes, 0.4 % in solid waste and 168 % in waste water treatment. The last figure was extremely high 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. The above data indicated a revival trend in the agriculture and an overcome of the big fall in the period until 2001.

CO_2 emissions and sinks per IPCC sector 1988- 2003, Gg

Table 2.4

IPCC Sector	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
TOTAL NET NAT. EMISSIONS Incl. LUCF	**93 439**	**79 382**	**60 320**	**53 693**	**56 142**	**53 977**	**57 206**	**56 639**	**54 704**	**47 442**	**43 330**	**40 927**	**42 005**	**40 440**	**46 265**
TOTAL NET NAT. EMISSIONS Excl. LUCF	**98 572**	**85 539**	**67 956**	**61 105**	**63 618**	**61 278**	**64 731**	**63 156**	**61 576**	**54 303**	**50 530**	**49 903**	**51 472**	**48 758**	**53 321**
1. All energy (combustion and fugitive)	**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**
A. Fuel combustion total	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
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
1bc Other transformation	0	1 662	1 283	981	1 122	1 115	1 222	1 181	1 007	621	1 262	1 334	1 231	1 265	1 066
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	11 402
3. Transport	13 814	10 864	6 525	6 435	7 444	6 547	6 845	6 306	5 315	6 475	6 212	5 881	6 014	6 317	7 098
4a Commercial/Institutional	1 068	172	124	107	114	96	64	114	46	288	503	330	574	388	287
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
4c Agriculture/Forestry/Fishing	1 219	422	330	149	114	267	102	28	0	157	194	204	180	174	178
5. Other	0	1 006	882	196	733	810	315	261	112	49	0	0	0	0	0
B. Fugitive fuel emissions	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)	**7 846**	**6 866**	**4 599**	**3 908**	**3 936**	**4 620**	**5 355**	**5 202**	**4 843**	**3 490**	**3 784**	**4 041**	**3 997**	**3 704**	**4 286**
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**
6. Waste	**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**
CO_2 Marine	969	874	878	873	844	850	882	732	1 092	1 022	26	205	306	336	436
CO_2 Aviation	749	892	320	565	739	632	549	472	428	490	319	270	393	399	485

CH_4 emissions per IPCC sector 1988- 2003, Gg

Table 2.5

IPCC Sector	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
TOTAL NET NATIONAL EMISSIONS	**1 187**	**1 019**	**894**	**831**	**748**	**695**	**678**	**627**	**538**	**497**	**424**	**430**	**396**	**404**	**446**
1. All energy (combustion and fugitive)	**161.0**	**110.2**	**96.0**	**98.9**	**99.3**	**97.2**	**103.9**	**102.1**	**91.2**	**92.0**	**80.4**	**88.5**	**86.6**	**85.2**	**84.9**
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
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
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
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
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**
4a Commercial/Institutional	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
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
4c Agriculture/Forestry/Fishing	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
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
B. Fugitive fuel emissions	155.7	105.2	92.7	95.6	95.9	93.8	100.3	98.8	88.4	89.0	77.4	85.7	84.0	82.4	82.1
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
2. Crude oil and natural gas	60.9	29.4	27.6	24.1	24.5	27.1	31.1	31.4	27.7	25.3	21.4	28.6	26.3	23.9	24.6
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**
3. Solvent and Other Product Use															
4. Agriculture	**273.0**	**257.9**	**234.2**	**191.9**	**150.5**	**126.4**	**121.7**	**115.7**	**110.1**	**113.8**	**115.0**	**108.8**	**84.2**	**94.9**	**99.0**
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
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
C. Rice Cultivation	5.7	4.3	3.3	1.8	1.3	0.3	0.6	1.0	1.5	1.3	0.6	1.4	1.6	2.1	2.3
D. Agricultural Soils															
F. Field Burning of Agricultural Residues	2.0	2.0	2.1	1.5	1.2	1.3	1.3	0.7	1.2	1.1	1.2	1.0	1.2	1.4	0.8
G. Other															
5. Land-Use Change and Forestry	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
6. Waste	**748.9**	**647.6**	**561.8**	**538.6**	**495.9**	**468.0**	**449.0**	**405.8**	**333.4**	**288.4**	**225.8**	**229.5**	**222.9**	**221.7**	**259.3**
A. Solid Waste Disposal on Land	661.1	581.1	510.1	491.3	455.8	430.8	399.7	359.0	293.6	254.1	195.7	201.3	200.0	199.9	200.8
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
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 2003, compared to the base 1988, was 56.5 %. That reduction was conditioned mostly by the reduction in energy sector – 37 %, in industrial processes - 52 %, and particularly in the agriculture - 68.2 %. The indicated reductions describe best the processes of fertilizers and manure handling, and the reduction of plant crops.

Compared to the preceding 2002, a growth of N_2O emissions can be seen in 2003, as follows: overall growth of 3 %, 10.4 % growth in energy sector, 5.2 % in technological industrial processes, and reduction by 4.7 % in agriculture. The last appeared to be a direct result from the poor grain crop in 2003.

N_2O emissions per IPCC sector 1988- 2003, Gg

Table 2.6

IPCC Sector	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
TOTAL NET NATIONAL EMISSIONS	**47.8**	**41.8**	**32.8**	**28.1**	**25.7**	**25.8**	**26.6**	**26.0**	**25.1**	**20.9**	**20.5**	**21.7**	**21.4**	**20.2**	**20.8**
1. All energy (combustion and fugitive)	**13.5**	**11.8**	**10.2**	**9.8**	**9.7**	**9.4**	**9.8**	**9.6**	**9.8**	**8.6**	**8.0**	**7.8**	**8.5**	**7.7**	**8.5**
A. Fuel combustion total	13.5	11.8	10.2	9.8	9.7	9.4	9.8	9.6	9.8	8.6	8.0	7.8	8.5	7.7	8.5
1a Electricity and heat production	11.4	9.6	8.9	8.8	8.6	8.3	8.6	8.4	8.5	7.7	7.0	7.2	8.0	7.2	7.9
1bc Other transformation	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
2. Industry	0.9	1.7	0.9	0.7	0.7	0.7	0.9	0.9	1.1	0.6	0.6	0.2	0.2	0.2	0.3
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
4. Other Sectors	0.8	0.2	0.2	0.1	0.1	0.2	0.1	0.1	0.0	0.2	0.3	0.2	0.2	0.2	0.2
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
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
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**
3. Solvent and Other Product Use															
4. Agriculture	**25.5**	**22.0**	**16.7**	**13.4**	**11.7**	**11.6**	**10.1**	**9.5**	**9.7**	**8.7**	**9.6**	**9.2**	**8.2**	**8.5**	**8.1**
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
C. Rice Cultivation															
D. Agricultural Soils	22.0	18.6	13.7	10.9	9.8	9.9	8.4	8.0	8.3	7.2	8.1	7.8	7.1	7.3	6.8
E. Prescribed Burning of Savannas															
F. Field Burning of Agricultural Residues	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
G. Other															
5. Land-Use Change and Forestry	**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**	**0.6**	**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 2003 reduction of the overall F-gases emissions, compared to the base 1995, was 54.6 %. This reduction described best the aluminum output reduction, which led to reduction of PFCs emissions by 56 %. However, the actual SF_6 emissions increased by 99 % because of the large-scale investigation of the power equipment, using SF_6 as agent for electric arc extinguishing.

Compared to the preceding 2002, a slight reduction of the overall emissions by 3 % can be seen. This was due to fluctuations in aluminum output.

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

Table 2.7

New gases, Gg	1 988	1 990	1 991	1 992	1 993	1 994	1 995	1 996
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

New gases, Gg	1 997	1 998	1 999	2 000	2 001	2 002	2 003
HFCs- total							
PFCs-total	37.26	69.44	43.55	33.14	16.29	21.42	20.69
SF_6-use	1.75	1.83	1.88	2.23	2.29	2.51	2.52
Total HFCs/PFCs/SF_6	39.01	71.27	45.43	35.37	18.58	23.93	23.21

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 г.) and sectors Waste and Agriculture. Particularly for 2003, sector Waste ranked the second place.

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) - 75.3 %, industry - 54 %, and transport - 48.6 %, and the lowest in the power engineering - 34.4 %.

Compared to the preceding 2002, a growth of emissions of all categories in the energy sector can be seen in 2003. The highest growth was in transport -12.4 % and the industry -11.8 %, and lower – in the power engineering - 7 %, and the public sector - 6.4 %. 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 - 68 %, and with N_2O - 62 %, whilst with CO_2 it was 45 %.

Compared to the preceding 2002, a growth of emissions of all categories in the sector can be seen in 2003. The highest growth was with CH_4 - 28.3 %, followed by CO_2 – 15.7 %, and 6.4 % with N_2O. 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 66 % 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 – 70 %.

Compared to the preceding 2002, a growth of emissions in the sector can be seen in 2003. This growth has been stable after 2001. The highest growth was of CH_4 emissions of manure handling – 8.7 %. The N_2O emissions, however, reported reduction of about 7 %, due to the poor crop in 2003. Chapter 6 of this Report contains more detailed analysis of GHG emissions in the sector.

Land-Use Change and Forestry

In this sector Bulgaria reports only emissions of biomass change. The annual CO_2 sequestration was about 7 - 9 mln. tone for the period after 1988. It was about 11 % of the overall GHG emissions for 2003. 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 65 %. This reduction described best the emission reduction from solid waste, which was about 70 %.

Compared to the preceding 2002, a growth of 16.7 % of emissions in the sector can be seen in 2003. This growth is extremely high - 130 % with waste water emissions, due to a change of exploitation regime of several large tailings ponds. The CH_4 emission level from disposal of solid waste was almost steady during the last five years. 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 46 %. This reduction was considerably lower that the average reduction for the period 1999 - 2002 г., 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
1. All energy (combustion and fugitive)	**98 282**	**84 641**	**68 530**	**62 305**	**64 769**	**61 608**	**64 584**	**63 074**	**61 673**	**55 409**	**50 899**	**50 131**	**51 943**	**49 241**	**53 466**
1A. Energy: fuel combustion	95 011	82 432	66 583	60 298	62 755	59 638	62 478	60 999	59 816	53 539	49 274	48 332	50 179	47 511	51 741
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
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	11 402
CO_2:3. Transport	13 814	10 864	6 525	6 435	7 444	6 547	6 845	6 306	5 315	6 475	6 212	5 881	6 014	6 317	7 098
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
CO_2:5. Other	0	1 006	882	196	733	810	315	261	112	49	0	0	0	0	0
CH_4	111	105	68	69	72	71	76	69	59	62	63	60	55	59	59
N_2O	4 174	3 655	3 158	3 031	3 002	2 909	3 027	2 975	3 024	2 664	2 465	2 411	2 648	2 398	2 647
B. Fugitive fuel emissions	**3 271**	**2 209**	**1 947**	**2 007**	**2 013**	**1 970**	**2 106**	**2 074**	**1 857**	**1 870**	**1 625**	**1 799**	**1 764**	**1 730**	**1 725**
CH4	3 271	2 209	1 947	2 007	2 013	1 970	2 106	2 074	1 857	1 870	1 625	1 799	1 764	1 730	1 725
N2O	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2. Industrial Processes (ISIC)	**10 425**	**9 232**	**6 293**	**5 303**	**5 139**	**6 071**	**7 401**	**7 280**	**6 570**	**4 593**	**4 620**	**5 465**	**5 362**	**4 863**	**5 527**
CO_2	7 846	6 866	4 599	3 908	3 936	4 620	5 355	5 202	4 843	3 490	3 784	4 041	3 997	3 704	4 286
CH_4	82	63	46	44	51	68	74	69	74	63	58	74	51	46	59
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
HFCs	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
PFCs	76	47	21	28	19	46	47	46	37	69	44	33	16	21	21
SF_6	0	0	0	0	0	0	1	1	2	2	2	2	2	3	3
3. Solvent and Other Product Use	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
4. Agriculture	**13 632**	**12 225**	**10 108**	**8 171**	**6 803**	**6 236**	**5 678**	**5 382**	**5 319**	**5 081**	**5 401**	**5 125**	**4 306**	**4 640**	**4 579**
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
CH_4 Manure management	1 524	1 501	1 319	1 073	859	729	725	664	586	622	636	569	405	471	512
CH_4 Rice cultivation	119	90	69	38	26	7	12	22	32	28	12	30	33	44	48
CH_4 Field Burning of Agricultural Residues	42	42	44	31	25	26	28	15	25	22	25	22	25	28	17
N_2O Manure Management	1 056	1 030	921	760	606	510	496	461	422	452	467	429	321	368	395
N_2O Agricultural soils	6 829	5 766	4 254	3 372	3 028	3 064	2 619	2 485	2 577	2 234	2 511	2 404	2 210	2 273	2 100
N_2O Field Burning of Agricultural Residues	14	13	15	10	7	7	8	5	7	6	8	6	6	7	5

Source category	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
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**
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
6. Waste	**16 038**	**13 823**	**11 999**	**11 511**	**10 607**	**10 011**	**9 607**	**8 689**	**7 146**	**6 221**	**4 911**	**4 978**	**4 827**	**4 794**	**5 595**
CO_2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CH_4	15 728	13 599	11 797	11 310	10 414	9 829	9 430	8 522	7 001	6 057	4 742	4 820	4 681	4 655	5 445
N_2O	310	224	202	201	192	183	177	167	145	164	169	158	146	140	150
7. Other (please specify)															
NATIONAL TOTAL EMISSIONS	**138 377**	**119 921**	**96 929**	**87 291**	**87 317**	**83 927**	**87 269**	**84 425**	**80 707**	**71 304**	**65 830**	**65 699**	**66 437**	**63 539**	**69 167**
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**

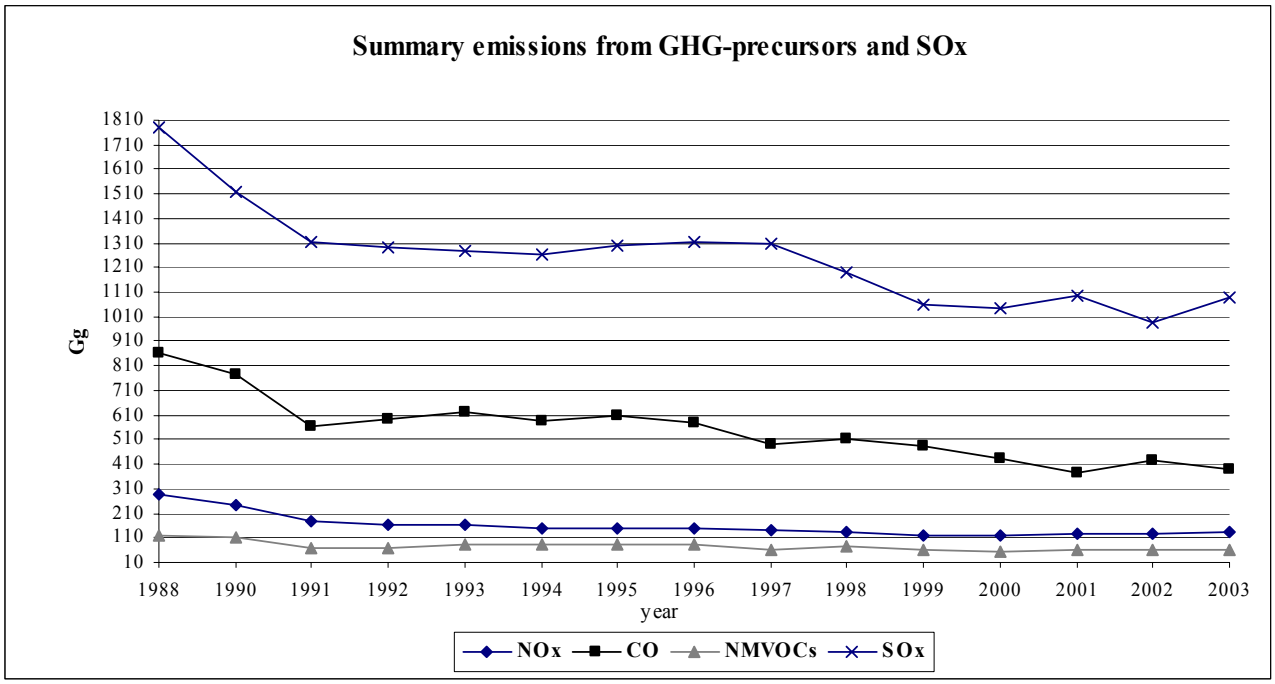
Trend in emissions of ozone and aerosol precursors, 1988-2003, Gg

Table 2.9

Compound	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Emissions in Gg															
Total NOx	285	243	180	163	166	147	152	147	141	134	121	121	129	124	135
Total CO	859	774	566	593	619	589	609	576	489	511	487	429	373	426	385
Total NMVOC	120	110	69.6	71.4	79.8	79.4	86.3	79.4	63.8	78.5	63.1	57.0	59.0	60.7	58.4
Total SO_2	1 782	1 517	1 313	1 291	1 279	1 262	1 299	1 311	1 311	1 192	1 056	1 045	1 096	983	1 043
Index (1988 = 100)															
Index total NOx	100	85.1	63.1	57.0	58.1	51.4	53.2	51.6	49.5	46.9	42.3	42.5	45.2	43.6	47.4
Index total CO	100	90.1	65.9	69.0	72.0	68.6	70.9	67.0	56.9	59.5	56.7	50.0	43.5	49.6	44.8
Index total NMVOC	100	91.4	57.8	59.3	66.3	65.9	71.7	65.9	53.0	65.2	52.4	47.4	49.1	50.5	48.5
Index total SO_2	100	85.2	73.7	72.4	71.8	70.8	72.9	73.6	73.5	66.9	59.3	58.6	61.5	55.2	58.5

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 some years of the period, where a certain increase, compared to the preceding year, can be seen. Such an increase can be seen for 2001 with NOx and SOx. In 2002, increase of CO emissions and decrease of SOx emissions can be observed.

In GHG inventories for Bulgaria, GHG-precursors emissions and SOx emissions were determined in sectors "Energy" and "Industrial Processes" only. In sector "Solvent use", only NMVOCs emissions can be seen. In category "Field Burning of Agricultural Residues", sector "Agriculture", also NOx and CO emissions were received, and those were assessed accordingly.

NOx Emissions

Overall NOx emissions for the country in 2003 were 135.29 Gg. Compared to 2002, an increase by 8.7 % can be seen.

Sector "Energy" was a main source of NOx emissions in Bulgaria. It emitted 92 % of the overall NOx emissions in 2003. The main part of emissions in this sector came from sub-sector "Energy industries" – 57.7 Gg in 2003, or 46 % of the emissions in the sector. The observed increase of source emissions in 2003, compared to 2002, was 6.9 %. The reason for this was decommissioning of reactors 1 and 2 of the Nuclear Power Plant Kozloduy at the end of 2002.

The second largest NOx emission source was transport. It marked a growth of 8.5 % in 2003, compared to the preceding year.

CO Emissions

Overall CO emissions for the country in 2003 were 385.28 Gg. Compared to 2002, reduction by 10 % can be seen.

Sector "Energy" was a main source of CO emissions in Bulgaria, and it emitted 94 % of the overall emissions in the country.

The main part of emissions in this sector came from sub-sector "Transport" - 182.5 Gg in 2003. The observed reduction of emission source, compared to 2002, was as low as 1.3 % and was due to the reduced gasoline consumption, despite the increased diesel consumption in Group "Road transport".

The second largest CO emission source was sub-sector "Other" – 111.41 Gg in 2003, or 31 % of the overall emissions in the sector. Emissions from biomass combustion for the purpose of central heating were estimated. The emissions' reduction, compared to 2002, was by 19.5 %.

NMVOCs Emissions

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

Overall emissions for the country in 2003 were 58.4 Gg. The emissions' reduction, compared to 2002, was 3.8 %.

Sector "Energy" was a main source of NMVOC emissions in Bulgaria, and it emitted 30.6 Gg or 52 % of the overall NMVOC emissions in the country.

The main part of emissions in this sector came from sub-sector "Transport" – almost 52 % of the overall emissions in the country in 2003.

Sector "Solvent use" was the second largest NMVOC emission source in the country, with 24 % 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 2003 were 1042.7 Gg. The emissions' growth, compared to 2002, was 6.1 %.

Sector "Energy" was a main source of SO_x emissions in Bulgaria. It emitted over 83 % of the overall SO_x emissions in 2003.

The main part of emissions in this sector came from sub-sector "Energy industries" – 866 Gg in 2003.

The second largest SO_x emission source was sub-sector "Manufacturing industries and construction", with 8.6 %, and on third place – sector "Other sectors", with 5.8 %.

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 77 % of the aggregated GHG emissions for the last inventory 2003.

Table 3.1 shows CO_2 emission trends of the above sub-sectors for the period 1988 - 2003.

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 44 % up to 53 % in 2003. For all other sectors this share decreased: manufacturing industries from 25 down to 21 %, transport from 14 down to 13 %, and especially in the public sector and households – from 9 down to 4 %. 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, was due to the decommissioning of units 1 and 2 (880 MW) in NPP Kozloduy, and the increased power consumption in the country, despite the decreased export of electrical power.

The trend of Transport sector shows slight fluctuations, as in 2003 the emissions increased and were 14 % of the overall CO_2 emissions in the sector. The fluctuations resulted from variations of liquid fuel prices, and from restructuring and renovation of the vehicles as well.

The overall trend in sub-sector "Other sectors" (Services, Households, Agriculture and Forestry) displayed fluctuations as well. The 1998 reduction was surmounted and emissions growth was observed in the last two years.

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 Process emissions 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 center 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 2003 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
1. All energy (combustion and fugitive)	**98 282**	**84 641**	**68 530**	**62 305**	**64 769**	**61 608**	**64 584**	**63 074**	**61 673**	**55 409**	**50 899**	**50 131**	**51 943**	**49 241**	**53 466**
1A. Energy: fuel combustion	95 011	82 432	66 583	60 298	62 755	59 638	62 478	60 999	59 816	53 539	49 274	48 332	50 179	47 511	51 741
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
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	11 402
CO_2:3. Transport	13 814	10 864	6 525	6 435	7 444	6 547	6 845	6 306	5 315	6 475	6 212	5 881	6 014	6 317	7 098
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
CO_2:5. Other	0	1 006	882	196	733	810	315	261	112	49	0	0	0	0	0
CH_4	111	105	68	69	72	71	76	69	59	62	63	60	55	59	59
N_2O	4 174	3 655	3 158	3 031	3 002	2 909	3 027	2 975	3 024	2 664	2 465	2 411	2 648	2 398	2 647
1B2. Fugitive fuel emissions	**3 271**	**2 209**	**1 947**	**2 007**	**2 013**	**1 970**	**2 106**	**2 074**	**1 857**	**1 870**	**1 625**	**1 799**	**1 764**	**1 730**	**1 725**
CH_4	3 271	2 209	1 947	2 007	2 013	1 970	2 106	2 074	1 857	1 870	1 625	1 799	1 764	1 730	1 725
N_2O	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	No

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 132 % in 2003, compared to 1988. This growth was realized mainly in households, which held the largest share, namely 73 % from the overall CO_2 emissions from biomass.

3.2. Source Category

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;

- "Bottom - up" (Sectoral approach) which deals with the fuel consumption by sectors, sources and technology types that emit GHGs.

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 2003 were reduced by 46 %, compared to 1988. The corresponding reduction of CH_4 emissions was 47 %, and of N_2O emissions by 37 %.

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 23 %, followed by transport - 14 %. 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:

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

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 2003 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

Source category	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
A. Fuel Combustion	1 469	1 310	1 302	1 287	1 167	1 286	1 462	1 565	1 588	2 402	2 413	2 955	2 876	3 390	3 410
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
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
1A.3 Transport	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
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
b Residential	513	401	318	404	380	436	593	726	742	1 476	1 479	2 076	2 011	2 418	2 509
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
1.A.5 Other	786	801	911	795	749	797	826	810	820	724	730	661	645	737	593

Emissions and sinks for Energy sector 1988-2003, Gg

Table 3.4

IPCC Sector	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
CO_2															
1. All energy (combustion and fugitive)	**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**
A. Fuel combustion total	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
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
1bc Other transformation	0	1 662	1 283	981	1 122	1 115	1 222	1 181	1 007	621	1 262	1 334	1 231	1 265	1 066
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	11 402
3. Transport	13 814	10 864	6 525	6 435	7 444	6 547	6 845	6 306	5 315	6 475	6 212	5 881	6 014	6 317	7 098
4a Commercial/Institutional	1 068	172	124	107	114	96	64	114	46	288	503	330	574	388	287
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
4c Agriculture/Forestry/Fishing	1 219	422	330	149	114	267	102	28	0	157	194	204	180	174	178
5. Other	0	1 006	882	196	733	810	315	261	112	49	0	0	0	0	0

IPCC Sector	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
CH_4															
1. All energy (combustion and fugitive)	**161.0**	**110.2**	**96.0**	**98.9**	**99.3**	**97.2**	**103.9**	**102.1**	**91.2**	**92.0**	**80.4**	**88.5**	**86.6**	**85.2**	**84.9**
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
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
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
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
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
4a Commercial/Institutional	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
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
4c Agriculture/Forestry/Fishing	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
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
B. Fugitive fuel emissions	155.7	105.2	92.7	95.6	95.9	93.8	100.3	98.8	88.4	89.0	77.4	85.7	84.0	82.4	82.1
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
2. Crude oil and natural gas	60.9	29.4	27.6	24.1	24.5	27.1	31.1	31.4	27.7	25.3	21.4	28.6	26.3	23.9	24.6
N_2O															
1. All energy (combustion and fugitive)	**13.46**	**11.79**	**10.19**	**9.78**	**9.68**	**9.38**	**9.76**	**9.60**	**9.75**	**8.59**	**7.95**	**7.78**	**8.54**	**7.73**	**8.54**
A. Fuel combustion total	13.46	11.79	10.19	9.78	9.68	9.38	9.76	9.60	9.75	8.59	7.95	7.78	8.54	7.73	8.54
1a Electricity and heat production	11.40	9.55	8.85	8.76	8.61	8.28	8.56	8.41	8.47	7.71	6.99	7.25	8.00	7.19	7.87
1bc Other transformation	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
2. Industry	0.92	1.69	0.92	0.70	0.72	0.74	0.92	0.93	1.11	0.58	0.58	0.20	0.18	0.21	0.33
3. Transport	0.33	0.25	0.15	0.14	0.17	0.14	0.14	0.13	0.12	0.13	0.12	0.11	0.11	0.11	0.13
4. Other Sectors	0.81	0.22	0.18	0.11	0.09	0.18	0.09	0.06	0.04	0.17	0.26	0.21	0.25	0.22	0.21
5. Other	0.00	0.06	0.08	0.06	0.09	0.03	0.05	0.05	0.02	0.00	0.00	0.00	0.00	0.00	0.00
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

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 25 051 Gg of CO_2 in 2003, which represented 36 % 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 3, 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 3 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 growth in 2003 by about 8 %, compared to 2002, was due to increased electrical power production from facilities, using lignite, because of the stopping of the two units in NPP Kozloduy. Indicator for that was the fact that the gross electricity consumption in the country increased by 1.8 %, and the export went down by 19 % - **Table 3.6.**

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

Table 3.5

Gas/sub-source	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
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
b. Petroleum Refining	0	356	362	58	59	48	51	51	51	0	142	48	52	48	42
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
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
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
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
N_2O															
a Public Electricity and Heat Production	11.40	9.55	8.85	8.76	8.61	8.28	8.56	8.41	8.47	7.71	6.99	7.25	8.00	7.19	7.87
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
c. Manufacture of Solid Fuels and Other Energy Industries	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00

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

Table 3.6

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
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**
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
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
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
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
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
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
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***

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 1999. 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 8000 GWh per annum.

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
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
b. Non-Ferrous Metals	637	366	275	243	324	336	366	388	344	420	447	399	362	293	146
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
d. Pulp, Paper	196	61	121	72	24	29	33	30	8	274	201	191	138	362	280
e. Food Processing, Beverages and Tobacco	613	228	154	219	131	87	88	53	69	676	674	642	548	526	485
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
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
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
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
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
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
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
N_2O															
a. Iron and Steel	0.00	0.00	0.00	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. Non-Ferrous Metals	0.00	0.00	0.00	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. Chemicals	0.00	0.00	0.00	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. 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
e. Food Processing, Beverages and Tobacco	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
f. Other	0.92	1.69	0.92	0.70	0.72	0.74	0.92	0.93	1.11	0.58	0.58	0.20	0.18	0.21	0.33

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 8 % of the total GHG emissions of Bulgaria in 2003. 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 Power plants, in a ratio of 50 to 50 % for the gaseous fuels, and 77 to 16 % 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 2/3, 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**.

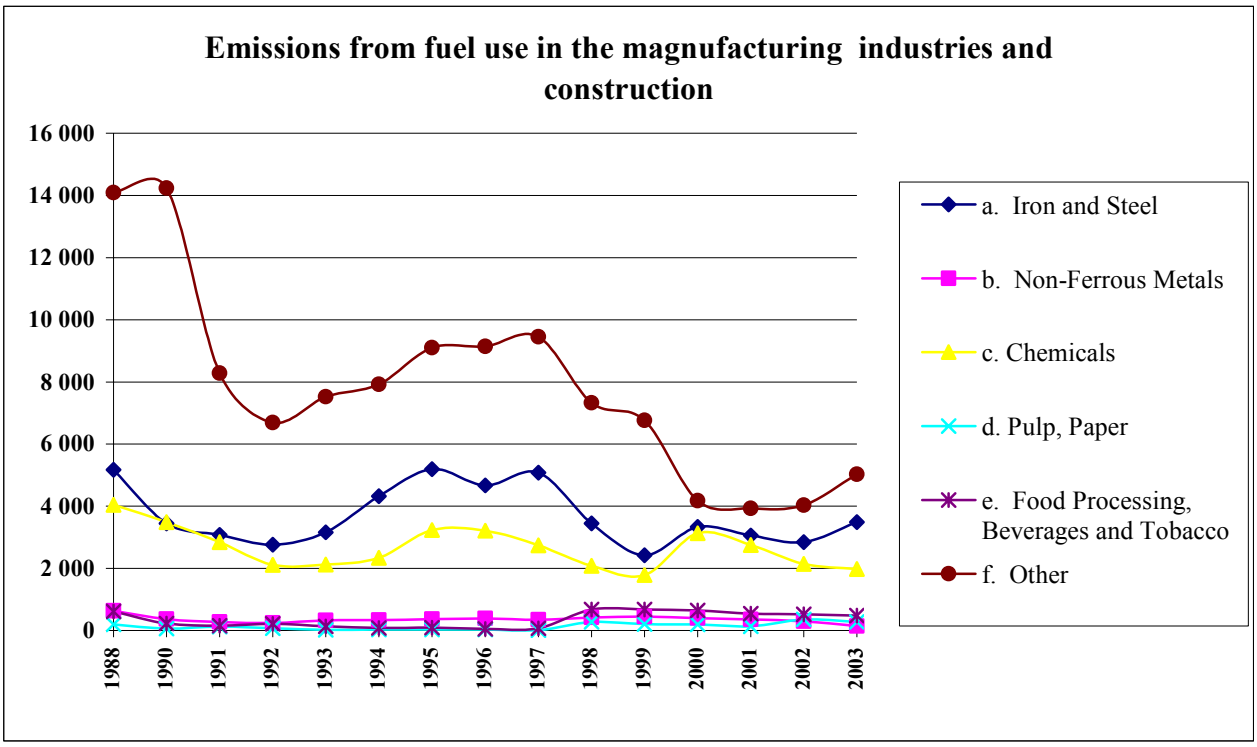
Using a method of the type Tier 2/3 met the requirements of Good Practice Guidance due to the fact that this source was included in the key source list.

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 1999 - 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 for 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, some chemistry and building materials industries. There was a growth in the last three 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/sub-source	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
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
feedstock	80	72	37	48	64	74	78	74	82	47	54	71	52	45	53
b. Non-Ferrous Metals	637	366	275	243	324	336	366	388	344	420	447	399	362	293	146
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
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
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
d. Pulp, Paper	196	61	121	72	24	29	33	30	8	274	201	191	138	362	280
e. Food Processing, Beverages and Tobacco	613	228	154	219	131	87	88	53	69	676	674	642	548	526	485
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
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**	**11 402**

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
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**	**11 644**
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
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	5 266
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
Biomass	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
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 2003 was almost two times, compared to the base year. Due to the methodology of fuel data collection and processing, used by NSI, there were no fuels with vague origin, indicated in the category "Other fuels". Thus, in Bulgarian inventory, unlike some developed EU countries, the problem of inventory 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, and for a first time in this inventory - by applying the Sectoral approach.

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	80.4	72.3	36.8	47.9	63.9	73.5	77.5	74.3
Gaseous Fuels	990	1 019	1 241	1 033	904	883	845	985

Gas/sub-source	1997	1998	1999	2000	2001	2002	2003
Totals	**1 341**	**1 017**	**953**	**1 351**	**1 036**	**737**	**783**
Liquid Fuels	415	438	330	336	50	60	74
Solid Fuels	82.3	47.3	54.1	70.8	52.5	44.7	52.9
Gaseous Fuels	844	532	569	944	933	632	656

Emission trend from **non-energy** use of fuels indicated significant reduction, by 45 % in 2003, compared to the base year. The structure of these fuels was also changed, as the share of gaseous fuels increased from 69.5 % in 1988 up to 84 % in 2003, and the share of liquid fuel emissions decreased from 25 % to 9.4 % accordingly. A slight increase by approx. 1 % was observed with solid fuel emissions.

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

Table 3.11 shows the GHG emission trends from mobile sources for the period 1988 - 2003.

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
CO_2	**13 814**	**10 864**	**6 525**	**6 435**	**7 444**	**6 547**	**6 845**	**6 306**	**5 315**	**6 475**	**6 212**	**5 881**	**6 014**	**6 317**	**7 098**
a Civil aviation	612	317	270	315	315	317	276	214	183	120	35.5	31.9	46.4	47.8	56.2
b. Road transport	7 747	7 586	4 418	4 646	5 751	4 976	5 390	4 881	4 046	5 151	5 324	5 008	5 187	5 484	6 267
c. Railways	368	334	223	175	178	132	114	113	1.4	131	120	122	106	97.4	89.1
d. Navigation	1 088	58.2	3.6	6.6	9.2	12.3	12.5	34.1	5.2	9.6	8.2	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	1 063	1 079	1 064	724	720	675	688	685
CH_4	**2.98**	**2.91**	**1.41**	**1.70**	**1.93**	**1.88**	**2.02**	**1.75**	**1.27**	**1.40**	**1.46**	**1.30**	**1.12**	**1.21**	**1.24**
a Civil aviation	0.06	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.004	0.001	0.002	0.003	0.004	0.003
b. Road transport	2.55	2.59	1.21	1.54	1.78	1.73	1.89	1.61	1.14	1.26	1.35	1.19	1.02	1.11	1.14
c. Railways	0.03	0.03	0.02	0.01	0.01	0.01	0.01	0.01	0.0001	0.01	0.01	0.01	0.01	0.01	0.01
d. Navigation	0.08	0.004	0.0003	0.0005	0.001	0.001	0.001	0.003	0.0004	0.001	0.001	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	0.12	0.12	0.12	0.10	0.10	0.09	0.09	0.09
N_2O	**0.33**	**0.25**	**0.15**	**0.14**	**0.17**	**0.14**	**0.14**	**0.13**	**0.12**	**0.13**	**0.12**	**0.11**	**0.11**	**0.11**	**0.13**
a Civil aviation	0.00070	0.00004	0.00003	0.00001	0.00001	0.00003	0.00002	0.00001	0.00001	0.00002	0.0000002	0.00002	0.00003	0.00004	0.00003
b. Road transport	0.16	0.15	0.09	0.09	0.12	0.10	0.10	0.10	0.08	0.10	0.10	0.09	0.09	0.09	0.11
c. Railways	0.01	0.01	0.01	0.004	0.004	0.003	0.003	0.003	0.000	0.003	0.003	0.003	0.003	0.002	0.002
d. Navigation	0.03	0.00	0.00	0.0002	0.0002	0.0003	0.0003	0.0009	0.0001	0.0002	0.0002	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

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 9 % of the overall country emissions in 2003. 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" - 88 % of the CO_2 emissions, 92 % of methane emissions, and 83 % 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 kerosene used were indicated in the energy balance of the country. It was assumed that 90 % of kerosene was used for international transport and the relevant emissions were reported in 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 and reported in bunkering.

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. SO_2 emissions had the lowest values among all source categories in the GHG inventory.

The main GHG emissions from the source increased by approx. 12,4 % in 2003, compared to the preceding year. This was due to increased fuel consumption in the road transport. **Table 3.13** shows the trend of fuel quantities, used by the road transport.

In 2003 the trend for increase of the fuels in road transport was retained. The largest increase was observed with diesel fuel – by 28.6 % compared to the preceding year. Gasoline was made an excluding with a decrease by 3.7 % compared to the preceding year.

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
NOx	115.6	97.8	57.6	51.7	56.0	48.9	49.4	47.2	42.0	46.5	42.6	41.0	39.7	41.8	45.8
CO	454.3	434.8	216.0	260.4	304.0	296.9	327.6	279.4	194.8	233.9	229.3	198.4	171.8	185.0	182.8
NMVOCs	67.1	66.3	34.2	39.1	45.9	44.0	48.2	42.0	30.6	37.8	36.5	31.5	28.1	30.0	30.3
SO_2	57.8	18.0	10.5	9.6	11.0	9.1	8.8	9.8	7.8	8.3	8.0	7.1	7.3	7.5	8.8

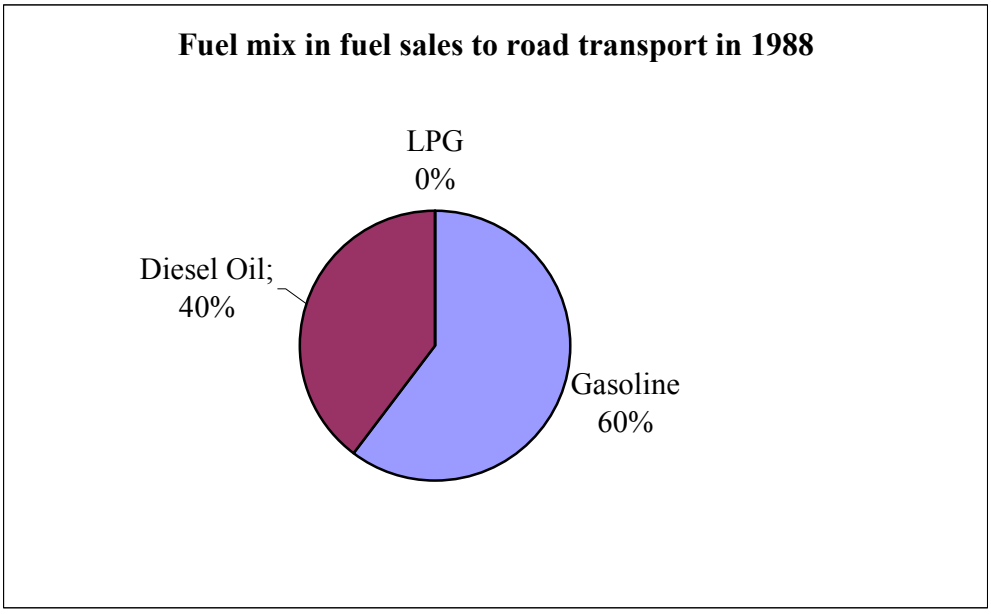
Fuels for Road Transportation, TJ

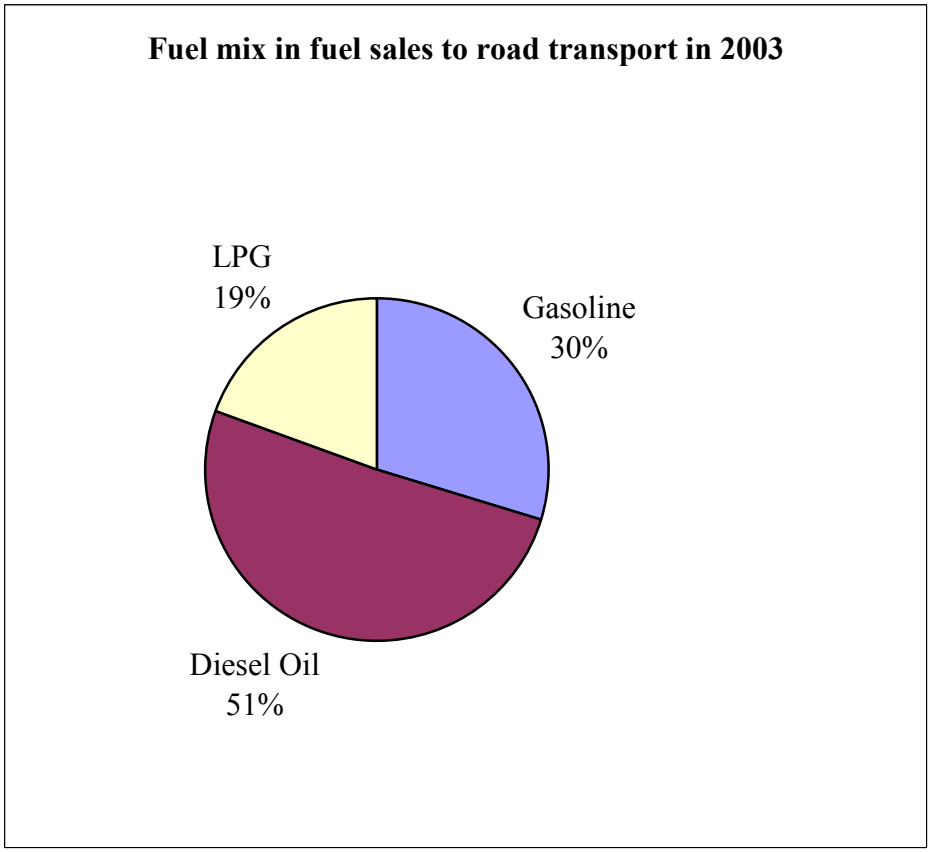
Table 3.13

	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Gasoline	63 235	61 643	28 955	36 908	43 176	43 572	48 050	41 664	26 780	35 168	34 564	29 019	24 928	26 795	25 762
Diesel Oil	41 817	42 455	30 959	27 490	35 914	26 138	26 839	30 981	26 846	31 821	33 761	30 204	33 794	34 296	44 112
Natural Gas															
Biomass															
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
Total	**105 063**	**104 098**	**59 915**	**64 399**	**79 092**	**69 716**	**74 893**	**72 660**	**53 654**	**70 046**	**72 481**	**69 065**	**71 783**	**76 137**	**86 699**

Figure 3.2 shows the change in the fuel sales in 2003, 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.

Figure 3.2





The fuel sales, shown on **Figure 3.2** and **Table 3.13,** should be estimated on the basis of the almost double increase of number of automobiles (cars, trucks, buses) in 2003, 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. The apportionment was made by 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, 2002. The indices retained nearly the same: high average age of the cars, high portion of old cars (Lada, Moskvich, Trabant, etc.) significant number of the imported second-hand cars, relatively small share of the imported new cars. Nevertheless, a trend towards increase of the quantity of new cars was outlined. There was 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 values, recommended by the IPCC Guidance, and results from measurements and analytical studies, 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 79 % of CO_2 emissions, 93 % of methane emissions and 55 % 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 eighth 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 2003. The “CO_2 emissions from stationary combustion processes – liquid” of this sub-sector had their share as well, similar to their share in the non-key source “Methane emissions from stationary combustion processes”.

The consumption of fuels in this sub-sector 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 biomass combustion in 2003 were 2575 Gg, or by 48 % more, compared to the household data in **Table 3.14**.

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 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, due to the high electricity and thermal power 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 firewood and wood waste, given in the Energy Balance, were not reported here.

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 2003 were 593.4 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 differences within the range of -2.7 % up to +3 %.

Emission trend as per the two approaches for the period 1988 – 2003 was -45.3 % for RA, and -46 % for SA. CO_2 emission reduction was biggest with the liquid fuels - 65 %, followed by gaseous, 52 % and solid fuels, 28.4 %.

The implemented comparison of the two approaches within the frame of 2003 inventory was far more precise than the preceding inventories due to the fact that in the Sectoral approach were reported the emissions from non-energy use of fuels, which was not made before. In this way the methodical discrepancy with RA was surmounted, since the emissions from non-energy use of fuels were always reported with RA.

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
CO_2															
4a Commercial/Institutional	1 068	172	124	107	114	96	64	114	46	288	503	330	574	388	287
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
4c Agriculture/Forestry/Fishing	1 219	422	330	149	114	267	102	28.24	0.00	157	194	204	180	174	178
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
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
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
N_2O															
4a Commercial/Institutional	0.28	0.04	0.04	0.03	0.03	0.02	0.01	0.02	0.01	0.06	0.13	0.06	0.11	0.08	0.05
4b Residential	0.02	0.02	0.01	0.02	0.02	0.02	0.03	0.03	0.03	0.06	0.06	0.09	0.09	0.11	0.11
4c Agriculture/Forestry/Fishing	0.51	0.16	0.13	0.05	0.05	0.14	0.06	0.01	0.00	0.04	0.07	0.06	0.05	0.04	0.04

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
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
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
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
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
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	*0.48*	*2.91*	*1.23*	*-0.28*	*3.00*	*0.83*	*0.65*	*0.82*	*-2.72*	*1.13*	*-0.71*	*0.60*	*1.42*	*1.75*	*1.61*

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 2003 was as low as 1.1 %, 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 next to last 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 2003 dropped down by 45 %, compared to the base year 1988. The highest reduction was with liquid fuels - 79 %, followed by solid and gaseous, by 34 % each.

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 GHGs 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 - 2003.

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
Liquid Fuels	354.0	205.9	104.9	102.2	123.1	100.0	453.7	451.6	414.9	437.7	330.1	336.0	50.4	59.6	74.1
Solid Fuels	80.4	72.3	36.8	47.9	63.9	73.5	77.5	74.3	82.3	47.3	54.1	70.8	52.5	44.7	52.9
Gaseous Fuels	990	1 019	1 241	1 033	904	883	845	985	844	532	569	944	933	632	656
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**

International bunkers: energy consumption (TJ) and related CO_2 emissions (Gg) 1988-2003

Table 3.17

Source	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
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**
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
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
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
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**
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
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
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***
CO_2 Emissions															
Marine Bunkers	**969**	**874**	**878**	**873**	**844**	**850**	**882**	**732**	**1 092**	**1 022**	**26**	**205**	**306**	**336**	**436**
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
Gas/Diesel Oil	583	208	200	204	178	171	201	174	262	206	22.4	205	302	336	436
Residual Fuel Oil	386	665	678	669	666	680	681	558	830	816	3.2	0.0	3.4	0.0	0.0
Aviation Bunkers	**749**	**892**	**320**	**565**	**739**	**632**	**549**	**472**	**428**	**490**	**319**	**270**	**393**	**399**	**485**
Jet Kerosene	749	874	314	562	736	628	546	471	426	487	319	270	393	399	485
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
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***

The international sea bunkering emissions in 2003 dropped by 55 % compared to 1988, while the air bunkering emissions dropped considerably less, i.e. by 35 %. 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 1988-2003, Gg

Table 3.18

Source	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
CO_2															
Marine Bunkers	*969*	*874*	*878*	*873*	*844*	*850*	*882*	*732*	*1 092*	*1 022*	*25.53*	*205*	*306*	*336*	*436*
Gasoline	0.00	0.07	0.00	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	583	208	200	204	178	171	201	174	262	206	22.37	205	302	336	436
Residual Fuel Oil	386	665	678	669	666	680	681	558	830	816	3.17	0.00	3.42	0.00	0.00
Aviation Bunkers	*749*	*892*	*320*	*565*	*739*	*632*	*549*	*472*	*428*	*490*	*319*	*270*	*393*	*399*	*485*
Jet Kerosene	749	874	314	562	736	628	546	471	426	487	319	270	393	399	485
Gasoline	0.00	18.42	6.34	2.59	2.58	4.67	3.62	1.25	1.74	2.96	0.00	0.00	0.00	0.00	0.00
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**
CH_4															
Marine Bunkers	*0.042*	*0.015*	*0.014*	*0.015*	*0.013*	*0.012*	*0.014*	*0.013*	*0.019*	*0.015*	*0.002*	*0.015*	*0.022*	*0.024*	*0.031*
Gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas/Diesel Oil	0.042	0.015	0.014	0.015	0.013	0.012	0.014	0.013	0.019	0.015	0.002	0.015	0.022	0.024	0.031
Residual Fuel Oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aviation Bunkers	*0.021*	*0.040*	*0.014*	*0.018*	*0.023*	*0.022*	*0.018*	*0.014*	*0.014*	*0.016*	*0.009*	*0.008*	*0.011*	*0.011*	*0.014*
Jet Kerosene	0.021	0.025	0.009	0.016	0.021	0.018	0.015	0.013	0.012	0.013	0.009	0.008	0.011	0.011	0.014
Gasoline	0.000	0.015	0.005	0.002	0.002	0.004	0.003	0.001	0.001	0.002	0.000	0.000	0.000	0.000	0.000
Total	**0.063**	**0.055**	**0.029**	**0.033**	**0.036**	**0.034**	**0.033**	**0.027**	**0.032**	**0.031**	**0.011**	**0.022**	**0.033**	**0.036**	**0.045**
N_2O															
Marine Bunkers	*0.024*	*0.022*	*0.022*	*0.022*	*0.021*	*0.021*	*0.022*	*0.018*	*0.027*	*0.025*	*0.001*	*0.005*	*0.008*	*0.008*	*0.011*
Gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas/Diesel Oil	0.015	0.005	0.005	0.005	0.004	0.004	0.005	0.004	0.007	0.005	0.001	0.005	0.008	0.008	0.011
Residual Fuel Oil	0.010	0.017	0.017	0.017	0.017	0.017	0.017	0.014	0.021	0.020	0.000	0.000	0.000	0.000	0.000
Aviation Bunkers	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*
Jet Kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total	**0.024**	**0.022**	**0.022**	**0.022**	**0.021**	**0.021**	**0.022**	**0.018**	**0.027**	**0.026**	**0.001**	**0.005**	**0.008**	**0.008**	**0.011**

Source	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
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*
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
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
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
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*
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
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
Total	**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**
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*
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
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
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
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*
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
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
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**

After CO_2 emissions, more significant were the NOx and CO emissions.

In 2003 were emitted main GHGs at the amount of 925.1 Gg CO_2-eq. The sea transport emitted 48 %, and the air transport - 52 %. After the big drop in 1999, all GHG emissions increased almost twice in 2003.

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 according to us. Considering the uncertainty of the emission factors in the transport as a whole, we think that an estimation of 7 - 9 % is more realistic.

In 1999 a drop of sea bunkering fuels use was observed, which decreased the consistency of the time series. Most probably, this drop was due to the change of the statistical accounting 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 2003. The fugitive emissions from systems for gas and oil extraction and distribution were not key source 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. Brown, black and anthracite coal is mined in underground mines.

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

CH_4 fugitive emissions from coal mining and handling 1988-2003

Table 3.19

Coal Mining and Handling, kt	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
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**
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
black	131	100	86	203	222	144	170	119	88	78	122	118	98	83	43
anthracite	65	43	42	45	41	29	24	19	14	13	0	0	12	11	8
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**
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
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
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
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**

The fugitive methane emissions in 2003 were 1207 Gg CO_2-eq. They marked a drop by 1.7 % compared to the preceding year, due to the reduced mining of brown coal.

The fugitive methane emissions from the underground mining were about 63 % of the emissions of this source, although the coal quantities from underground mining was less than 10 % of the overall coal mining in the country, expressed in natural (mass) units - tonne.

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 neighboring countries.

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
Oil															
Production	3.3	2.5	2.5	2.2	1.8	1.5	1.8	1.4	1.2	1.4	1.8	1.9	1.4	1.6	1.3
Transport	546	353	195	103	242	296	340	296	254	236	237	224	219	222	215
Refining / Storage	548	354	196	103	242	296	340	296	254	236	240	226	220	222	214
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
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
Transmission	247	337	331	321	328	329	381	384	385	390	465	521	540	553	558
Distribution	208	226	193	170	159	160	192	196	155	137	116	122	114	100	104
Venting /Flaring															
Oil	551	356	198	105	244	298	342	297	255	238	242	228	221	224	216
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
Emissions CH_4, Gg	**1988**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
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**
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
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
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
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
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**
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
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
Distribution	56.95	25.14	23.20	19.66	19.43	21.62	25.25	25.34	21.28	18.54	14.16	20.94	18.77	16.06	16.54
Venting /Flaring															
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
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

The CH_4 fugitive emissions, expressed in CO_2-eq. in 2003 were 516 Gg, or less than 1 % of the summary GHG emissions. The emission growth in 2003 was 3 %, compared to 2002, and it was mainly due to the new pipelines for transportation and 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 neighboring countries, were far more bigger that domestic consumption – about 4 times in 2003.

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. This will be one of the head directions for improvement of the next inventories. 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 IPCC Guidance, were used for the 2003 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. The change of the emission factors had an effect on all inventories since 1988 until present, so these were recalculated.

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**
Natural Gas - transit	670	710	840	945	840	945	945
Natural Gas - domestic transmission	1 700	1 769	1 790	1 800	1 800	1 800	1 869
Natural Gas - domestic distribution	60	100	200	300	500	700	816
Total	**2 430**	**2 579**	**2 830**	**3 045**	**3 140**	**3 445**	**3 630**

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.

Emissions from refueling of vehicles with LPG at the gas stations, were reported for a first time in this inventory. As it can be seen on **Table 3.20**, the broad use of this fuel started in 1998, reaching almost 8 % from the overall fuel consumption in the country in 2003.

Besides the fugitive methane emissions, significant NMVOCs emissions from gasoline refueling 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 mln. tone.

The natural gas consumption was double reduced in 2003, compared to 1988. It was due to curtail industrial production 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 - 2003.

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. This type of emissions are referred to as "non-combustion" because 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 (HFCs, PFCs) 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, refueling 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 2003 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 2003 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

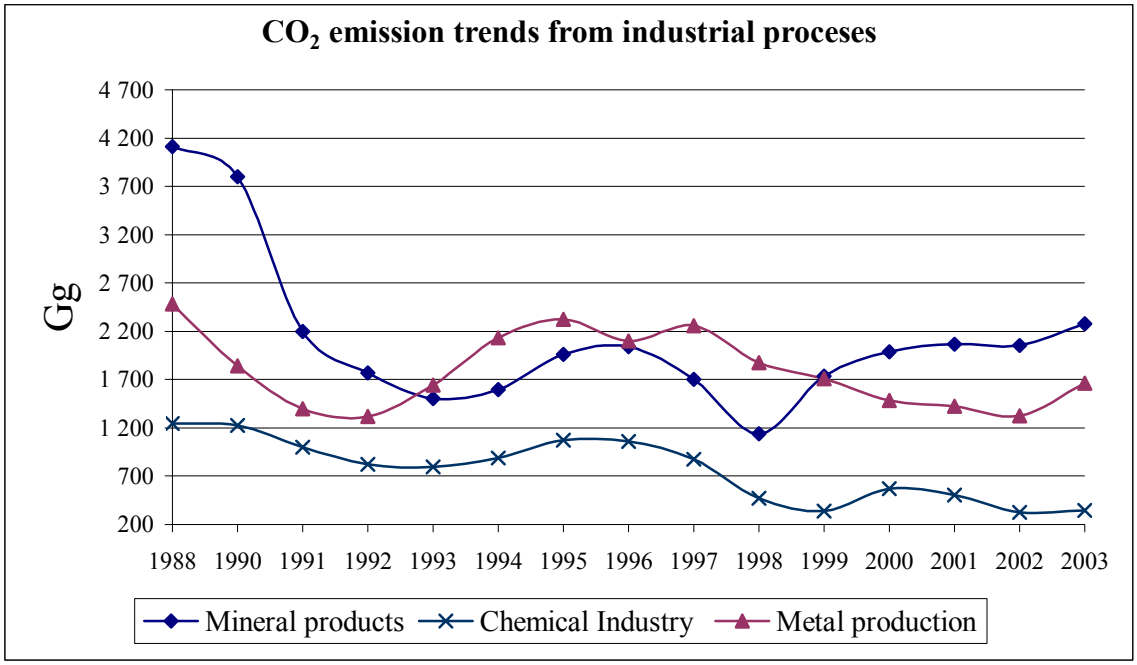
Table 4.1

Gas/Subcategory	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
CO_2															
2A. Mineral Products	4 114	3 797	2 199	1 769	1 501	1 598	1 960	2 037	1 705	1 138	1 734	1 988	2 068	2 052	2 279
2B. Chemical Industry	1 246	1 225	1 004	823	793	888	1 072	1 063	878	474	338	570	507	325	345
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
2D. Other Production	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
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
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
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
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
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
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
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
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
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
SF_6-Gg CO_2-eq.							1.26	1.31	1.75	1.83	1.88	2.23	2.29	2.51	2.52

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 2003 has CO_2 – 77 %, followed by N_2O with 21 % and CH_4 with 1 % 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. During the inspected period, key factors on macroeconomic level were:

- Changes in international markets;
- Privatization of state property;
- Collapse in some economic sectors due to transition from planned to market economy
- 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 9 with more than 2 % share);
- CO_2 from cement production (ranked 13 with 2 % share);
- N_2O from nitric acid production (ranked 14 with 2 % share);
- CO_2 from lime 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;
- 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 1 189 Gg in the year 2003, 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 2003 is 12.5 %, compared to 2002.

CO_2 emissions from ***quick lime*** production are 921 Gg in the year 2003, which is a slightly more than 1 % of the aggregated GHG emissions. The increase of the CO_2 emissions in 2003 compared to 2002 is 7.7 %.

During the production of some mineral products like glass and soda ash, GHG in smaller quantities are emitted (about 1 % of the aggregated GHG emissions) and are classified as non-key emission sources. CO_2 emissions from soda ash production are 106 Gg in 2003 and the 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. Data for the import and export of clinker is confidential and for this reason the quantities of clinker are determined on the basis of the produced quantities of cement. The emission factor is determined according to the formulas given in the Good Practice Guidance.

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

Data for the quantities of produced and used ***soda ash*** is confidential. Therefore, the determination of emission 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 - 2003, Gg

Table 4.2

Years/Sources	1988	1990	1991	1992	1993	1994	1995	1996
2A1. Cement Production	*2 737*	*2 329*	*1 174*	*1 054*	*992*	*944*	*1 023*	*1 057*
2A2. Lime Production	*1 118*	*1 222*	*812*	*572*	*417*	*522*	*747*	*778*
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	**4 114**	**3 797**	**2 199**	**1 769**	**1 501**	**1 598**	**1 960**	**2 037**

Years/Sources	1997	1998	1999	2000	2001	2002	2003
2A1. Cement Production	*818*	*861*	*1 018*	*1 092*	*1 032*	*1 057*	*1 189*
2A2. Lime Production	*692*	*48*	*561*	*798*	*918*	*855*	*921*
2A4. Soda Ash	*178*	*157*	*102*	*90*	*109*	*100*	*106*
Soda Ash Production	84	79	67	90	109	100	106
Soda Ash Use	93	78	35	0	0	0	0
2A7. Other (please specify)	*18*	*14*	*8*	*8*	*9*	*40*	*62*
Glass Production	18	14	8	8	9	15	8
Desulphurized Emissions	0	0	0	0	0	24	54
Total	**1 705**	**1 138**	**1 734**	**1 988**	**2 068**	**2 052**	**2 279**

The analysis of **Table 4.2** shows a stable trend of the GHG emissions from the two main sources – cement and lime production. Some 92 % of the emissions in this sub sector originate from them. This share is kept during the years, as in 1988 it amounts to 93 %, with the emissions from the cement production forming the bigger share, namely – 66 %.

4.3. Chemical Industry

4.3.1. Source Description

N_2O emissions from ***nitric acid*** production, expressed in CO_2-eq. were 1159 Gg for the year 2003. The emission increase in 2003 is some 6 % compared to 2002 overcoming the decrease as for the year 2001.

CO_2 emissions from ***ammonia*** production were 337 Gg for the year 2003. The increase of emissions in 2003 is some 6 % compared to 2002 and the big fall after 1997 has not been overcome – it is at level of about 60 %. The production of nitrate fertilizers is still very much limited.

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. This GHG emission source is a typical example of the dynamics of the term "confidentiality" for economies in

transition, as the Bulgarian. For example, the quantity of nitric acid produced in 2002 was confidential data, while not being such in 2001, becoming confidential once again in 2003.

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 2003 compared to 1988 – about three times for the ammonia production and twice for 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 – 1640 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 from the production of aluminum are non-key GHG emission sources. Their total volume for the year 2003 is less than 80 Gg CO_2-eq.

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). The emission factor is determined in analytical way using data from the adapted CORINAIR methodology, used in NSI. Therefore, it 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 2003 compared to 1988 – 30 % for steel production, 42 % for coke and 6 % for pig iron. GHG emission trends of steel production change more gradually from those of pig iron production where emission vary in large scales. This is due to the variations of world metal market.

The 2003 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 not accounted when forming the summary of GHG emissions in order to avoid double-counting.

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 aluminum 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 2003 is 23.2 Gg CO_2-eq. The emission level in the year 2003 is practically the same as in the preceding year.

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 aluminum 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
CO_2															
Ammonia Production	1 157	1 128	942	780	763	858	1 037	1 030	847	454	326	558	500	318	337
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
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

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
CO_2															
Steel Production	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
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
Aluminum 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
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
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
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
F-gases															
HFCs- potential							62.16	-	-	577	103	96.02	97.50	89.59	121
PFCs-potential															
SF_6-potential												29.40	2.39	2.39	6.36

4.6.3. Recalculation of Sources

For the purpose of the GHG inventory report in 2003, 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 calcium carbide, glass, ferroalloys and aluminum production and also from desulphurization. The emissions for the year 2003 are 83.8 Gg. They increase 37 % compared to 2002 due to the almost doubled emissions from the desulphurization process in the Maritza Iztok power stations. These latest emissions account for more than 73 % of the source emissions.

CO_2 emissions from the production of ferroalloys and aluminum in 2003 are in fact the same as during the preceding year. Emissions from the production of calcium carbide increase by 9 % and those of glass decrease by 42 % due to phasing out the production of plate glass in that year.

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 anesthesia. The emissions from this sector are mainly of NMVOCs and N_2O.

IPCC Guidelines do not provide methodology to determine NMVOC emissions, which is the main source of GHG emissions in this sector. Due to this reason, 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 anesthesia, 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 14.5 Gg, which is almost 25 % of the emissions of this gas in Bulgaria. The emission reduction in the year 2003 is 15 % compared to 2002 mainly due to the curtail production of paints and lacquers.

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 to the methodological differences in the calculation of NMVOCs emissions, there is a difference in the trend of the aggregated emission trends after 1998. While the aggregated NMVOCs emissions change from 48.1 Gg to 29 Gg for the period 1988-1998, there is a drop in 1999 and the emissions change within the range 6 - 10 Gg for the period 1999-2002.

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	0.13	0.06	0.08	0.12	0.16	0.18	0.21
B. Degreasing and Dry Cleaning	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. Chemical Products, Manufacturing and Processing	1.25	0.83	0.35	0.35	0.27	0.28	0.38	0.45
D. Other (please specify)								
Vegetable oil production	3.11	2.51	1.92	2.32	2.72	2.54	3.43	2.88
Use of lacquers and solvents	8.99	8.67	8.60	8.48	8.46	8.43	8.38	8.34
Pharmacy	0.13	0.12	0.12	0.12	0.12	0.12	0.12	0.12
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
A. Paint Application	0.17	0.86	2.43	0.52	0.69	0.59	0.90
B. Degreasing and Dry Cleaning	0.00	0.00	0.34	0.04	0.29	0.01	0.01
C. Chemical Products, Manufacturing and Processing	0.45	10.39	4.12	0.70	11.98	11.96	10.70
D. Other (please specify)							
Vegetable oil production	2.80	1.88	1.83	1.84	1.61	1.22	1.39
Use of lacquers and solvents	8.28	8.23	2.00	7.48	2.43	3.24	1.43
Pharmacy	0.12	0.12	0.11	0.11	0.11	0.11	0.11
Total	**11.82**	**21.47**	**10.83**	**10.69**	**17.10**	**17.13**	**14.54**

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 management.

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 CH_4 and N_2O.

During the process of field burning of agricultural residues, certain quantities of GHG precursors are emitted.

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

The biggest CH_4 emission source in the sector is the 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 2003:

- CH_4 from Enteric fermentation (ranked 10 with more than 2 % share);
- Direct N_2O emissions from agricultural soils (ranked 15 with 1 % share);
- N_2O emissions from grazing animals (ranked 19 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:

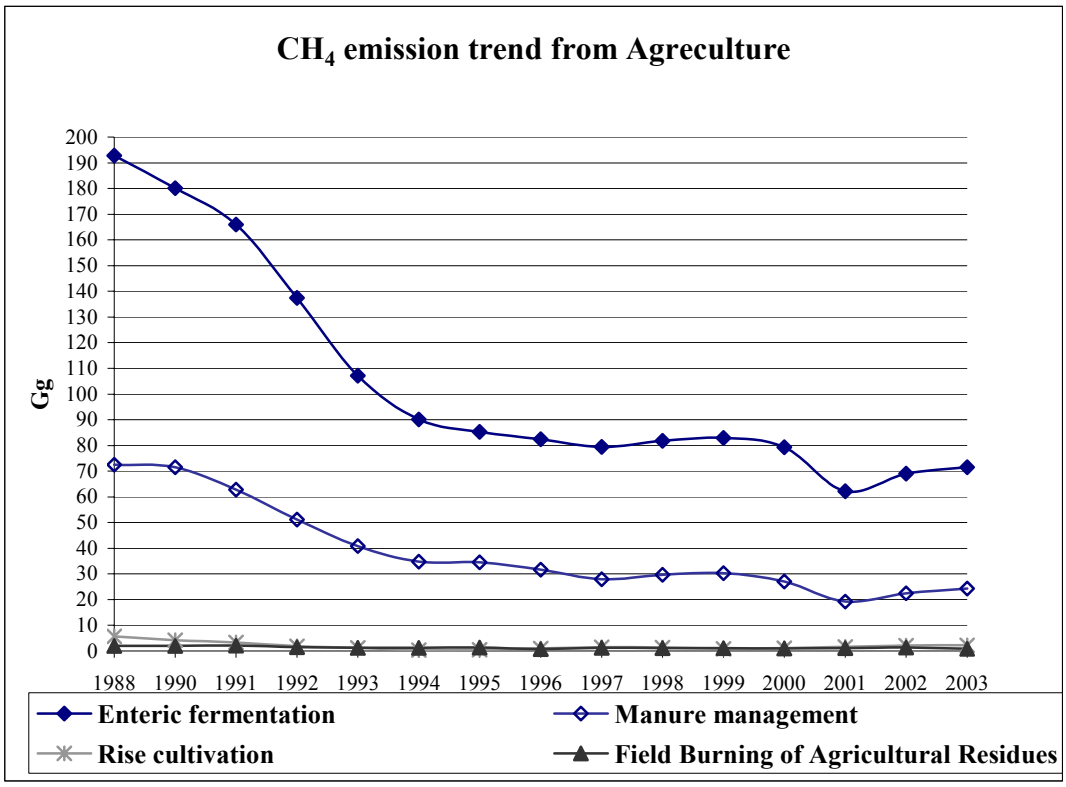
- Indirect N_2O emissions from agricultural soils;
- Methane emissions from manure treatment;
- N_2O emissions from manure treatment;
- CH_4 emissions from rice cultivation;
- CH_4 emissions from field burning of agricultural residues;
- N_2O emissions from field burning of agricultural residues.

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
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	71.54
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
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
4F. Field Burning of Agricultural Residues	1.99	1.98	2.09	1.46	1.19	1.26	1.32	0.73	1.21	1.07	1.17	1.03	1.17	1.35	0.81
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
4D. Agricultural Soils	22.03	18.60	13.72	10.88	9.77	9.88	8.45	8.02	8.31	7.21	8.10	7.76	7.13	7.33	6.77
4D1 Direct Soil Emissions	11.15	9.02	5.88	4.46	4.32	4.74	3.77	3.39	3.80	2.98	3.69	3.55	3.82	3.88	3.34
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
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
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
d. Crop Residue	1.51	1.50	1.59	1.11	0.90	0.95	1.00	0.55	0.91	0.81	0.88	0.77	0.87	1.01	0.61
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
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	1.76
4D3 Indirect Emissions	5.55	4.62	3.23	2.59	2.37	2.39	1.97	1.98	1.95	1.68	1.92	1.86	1.69	1.71	1.67
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
Nitrogen Leaching and Run-off	3.56	2.91	1.95	1.56	1.46	1.50	1.21	1.22	1.22	1.02	1.19	1.16	1.09	1.09	1.05
4F. Field Burning of Agricultural Residues	0.044	0.041	0.048	0.032	0.022	0.023	0.027	0.016	0.023	0.020	0.024	0.018	0.018	0.024	0.017

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 84 % in the year 2003 and for the entire period 1988-2003, the share is in the range 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 2003, are 17 % 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. There are no llamas and camels bred in Bulgaria as domestic animals.

CH_4 emissions in CO_2-eq. were 1 502 Gg in the year 2003 – some 2 % from the total GHG emissions. The increase in the year 2003 was 3.7 % compared to 2002 and is due to the larger number of the most popular livestock – cows, swine and poultry.

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. As the methane emissions are a key source, the application of the Tier 1 method does not correspond to the requirements of the good practices.

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, as in 2003 they amount to more than 15 % compared to 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 1988-2003 period.

CH_4 emissions expressed in CO_2-eq. were 512 Gg for the year 2003. Their increase compared to the year 2002 is 8.7 %, which is due to the 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 Gg during the year 2003. The emissions increase is 7 % compared to 2002.

N_2O emissions from this sub sector do not include animal waste from pastures as these wastes are not collected and treated in the systems, used for manure management.

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.

CH_4 emissions due to enteric fermentation, 1988-2003, 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)
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
- 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
- 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
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
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
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
Camels and Llamas	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	2.17
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	1.47
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
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
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**	**71.54**

Number of animals 1988 - 2003 (1000 head)

Table 6.3

Animal type	1988(a)	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Cattle	1 631	1 575	1 457	1 310	974	750	638	632	582	612	671	682	635	691	728
- Dairy Cattle(3)	629	606	597	574	487	419	349	370	357	387	421	431	367	358	362
- Non-Dairy Cattle	1 002	969	860	736	487	331	289	262	225	225	250	251	267	333	366
Buffalo	23.89	23.00	25.52	25.16	22.11	17.25	13.67	13.71	11.44	10.55	10.37	9.28	6.52	7.50	7.88
Sheep	8 747	8 130	7 938	6 703	4 814	3 763	3 398	3 383	3 020	2 848	2 774	2 549	1 571	1 728	1 599
Goats	432	433	498	553	611	676	795	833	849	966	1 048	1 046	675	755	725
Horses	122	119	115	114	114	113	133	151	170	148	133	141	151	114	128
Mules and Asses	355	350	348	347	324	320	291	298	304	273	237	223	197	148	145
Swine	4 076	4 332	4 187	3 141	2 680	2 071	1 986	2 140	1 500	1 480	1 721	1 512	789	997	1 032
Poultry	41 614	36 338	27 998	21 707	19 872	12 497	19 126	18 609	16 227	14 766	15 686	14 963	18 006	18 138	21 934

(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 1420 ha in 1999. There has been a restoration of rice crop areas after 1999, reaching 5644 ha in 2003.

CH_4 emissions from this source result from the processes of anaerobic decomposition of the organic material in the rice crops.

48 Gg CH_4 CO_2-eq. have been emitted in 2003. The emission increase of 8 % compared to the year 2002 is due to the 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 -2003, Gg

Table 6.4

Livestocks	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)
CH_4															
Cattle	23.74	22.17	20.46	17.17	13.28	10.82	9.94	9.62	9.55	10.30	10.86	10.65	9.09	10.30	10.86
- 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
- Non-Dairy Cattle	12.24	11.17	9.75	7.47	5.00	3.79	3.36	2.98	2.75	2.90	3.06	2.89	2.86	3.66	4.27
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
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
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
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
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
Swine	40.54	42.36	36.44	28.94	23.62	20.17	20.52	18.10	14.82	15.92	16.08	13.21	7.14	8.88	10.09
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
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**
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**

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
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
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
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
Crop Residue	961	955	1 010	708	573	606	639	352	579	514	562	492	555	644
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
% 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
Indirect soil emissions														
Indirect deposition	217 582	182 798	130 668	105 146	94 865	94 520	79 224	79 062	77 818	68 062	76 747	74 074	66 226	67 482

Indirect emissions include:

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

Emissions in this category are due to: release of ammonia and nitrous oxides as a result from synthetic and organic fertilization, during which interaction with soil and groundwater occurs, and also the deposition of nitrogen in rivers, lakes and underground water as a result from leaching and rinsing.

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 1 036 Gg CO_2-eq. in 2003, which is more than 1 % of the aggregated GHG emissions during the year. The emission reduction in 2003 compared to 2002 is about 8 % due to the smaller quantities synthetic nitrogenous fertilizers and manure deposited in soils – see **Table 6.5.**

N_2O emissions from Agricultural soils, Gg

Table 6.6

	1988	1990	1991	1992	1993	1994	1995	1996
Direct soil emissions	***11.15***	***9.02***	***5.88***	***4.46***	***4.32***	***4.74***	***3.77***	***3.39***
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	1.51	1.50	1.59	1.11	0.90	0.95	1.00	0.55
Cultivation of histosols	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
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	***5.55***	***4.62***	***3.23***	***2.59***	***2.37***	***2.39***	***1.97***	***1.98***
Total	**22.03**	**18.60**	**13.72**	**10.88**	**9.77**	**9.88**	**8.45**	**8.02**

	1997	1998	1999	2000	2001	2002	2003
Direct soil emissions	***3.80***	***2.98***	***3.69***	***3.55***	***3.82***	***3.88***	***3.34***
Use of synthetic fertilizers	2.16	1.38	1.98	2.05	2.38	2.20	1.99
Nitrogen input from manure applied to soils	0.70	0.76	0.79	0.72	0.56	0.66	0.72
N-fixing Crops	0.03	0.03	0.02	0.01	0.01	0.01	0.01
Crop Residue	0.91	0.81	0.88	0.77	0.87	1.01	0.61
Cultivation of histosols	0.003	0.003	0.003	0.003	0.003	0.003	0.003
N excretion on pasture range and paddock	***2.56***	***2.55***	***2.50***	***2.34***	***1.61***	***1.74***	***1.76***
Indirect soil emissions	***1.95***	***1.68***	***1.92***	***1.86***	***1.69***	***1.71***	***1.67***
Total	**8.31**	**7.21**	**8.10**	**7.76**	**7.13**	**7.33**	**6.77**

Indirect N_2O emissions were 519 Gg CO_2-eq. in 2003. This category emissions also decreases with a little more than 2 % compared to 2002.

Only the emissions from pasture animals increase slightly by 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.

The total N_2O emissions reduction in this sub sector, compared to 1988, is more than three times for each of the categories, described above.

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.

17.1 Gg CH_4 in CO_2-eq. have been emitted in 2003. The reduction is 40 %, compared to the year 2002, 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.

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

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

GHG emissions are calculated by application of emission ratios between C, H, N and O in relation to the molecule content of the respective GHG.

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 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.

In the 2003 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.

7.2 CO_2 Sequestration from Forest

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 2003 the total forests area in Bulgaria (deciduous and coniferous) was 3547 thousand ha. Compared to 2002, forests area was increased by 11 481 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 530 mil. m^3 with an annual growth of about 12-13 mil. m^3. The volume of cut wood was 6.57 mil. m^3 in 2003.

The review of the dynamics of the structure of the forest stock for the period 2002-2003 shows an increase of the afforested coniferous forests, deciduous high steam and coppice forests and diminishing of forests for reconstruction.

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	0.85	0.92	0.95	0.99	1.03	1.04	1.06	1.06
Deciduous	0.85	0.87	0.90	0.93	0.95	0.97	0.97	0.97

Implied uptake factor	1997	1998	1999	2000	2001	2002	2003
Evergreen	1.08	0.97	1.09	1.20	1.19	1.22	1.19
Deciduous	0.96	0.81	0.95	1.03	1.00	0.98	0.97

In general the calculation factor is bigger for evergreen forests, being relatively stable for the entire GHG inventory period for Bulgaria.

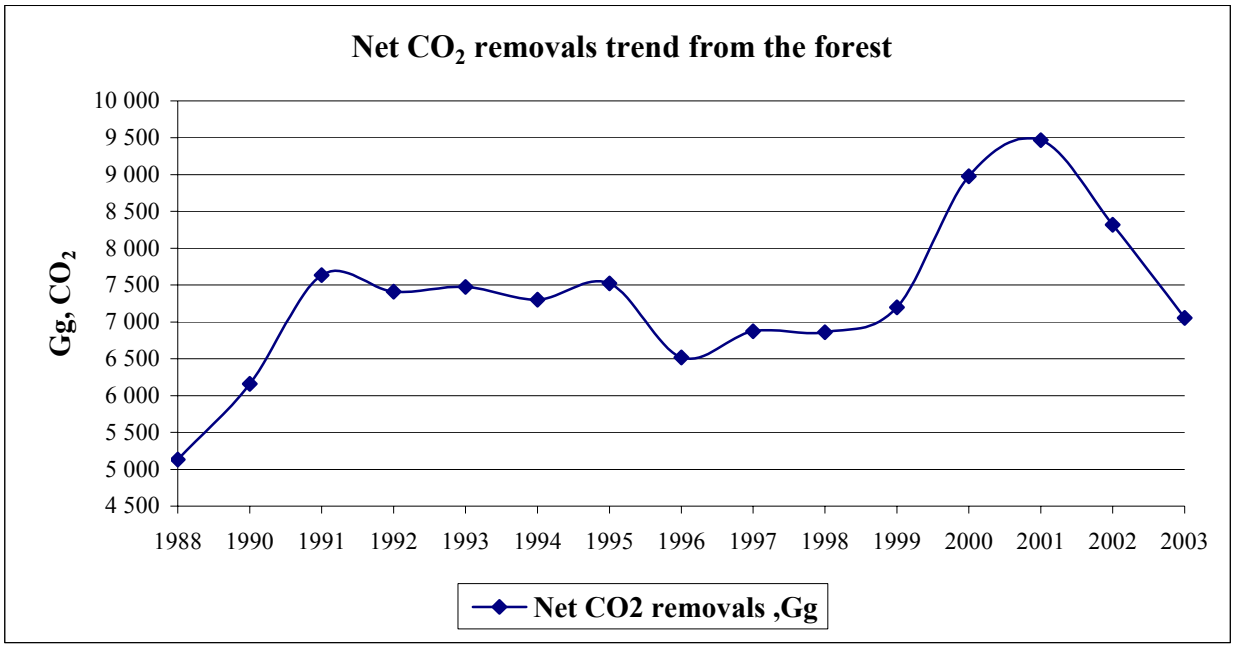
The volume of the ***cut wood*** is determined annually on the basis of preliminary plans for felling and as a result of real organized felling.

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.

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 5100 - 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 6500 Gg and a following steady tendency of increase until 2001. After this period of steady increase follows a drop until 2003 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	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
Net C removals	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	1997	1998	1999	2000	2001	2002	2003
Carbon uptake increment	3 362	3 362	3 362	3 698	3 698	3 698	3 698
Carbon release	-1 487	-1 490	-1 398	-1 250	-1 116	-1 429	-1 773
Net C removals	1 874	1 871	1 964	2 448	2 582	2 269	1 924
Net CO_2 removals	**6 872**	**6 860**	**7 200**	**8 976**	**9 467**	**8 318**	**7 056**

The quantity of CO_2 removals was 7 056 Gg in 2003. The reduction of the removals in 2003 was about 15 % compared to 2002. It is due to the increased wood cut in 2003 while keeping the same growth of the accumulated C in the forests.

The uncertainty in the determination of the removed carbon in the forests has not been defined due to lack of methodology.

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 will asses the possibilities for including sub sectors 5C and 5D in the GHGs inventories.

It was a common stand that data in this area is present and it has to be classified and brought into format suitable for CO_2 emission assessment from forests and forest lands.

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 the 2003 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

	1988	1990	1991	1992	1993	1994	1995	1996
CH_4								
6A Solid waste disposal	661.1	581.1	510.1	491.3	455.8	430.8	399.7	359.0
6B Waste water handling	87.9	66.5	51.7	47.3	40.1	37.3	49.3	46.9
6C Waste incineration	-	-	-	-	-	-	-	-
6D Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
N_2O								
6B Waste water handling	1.0	0.7	0.7	0.6	0.6	0.6	0.6	0.5

	1997	1998	1999	2000	2001	2002	2003
CH_4							
6A Solid waste disposal	293.6	254.1	195.7	201.3	200.0	199.9	200.6
6B Waste water handling	39.8	34.3	30.1	28.3	22.9	21.8	8.9
6C Waste incineration	-	-	-	-	-	-	-
6D Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0
N_2O							
6B Waste water handling	0.5	0.5	0.5	0.5	0.5	0.5	0.5

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

- Methane emissions from solid waste disposal (ranked 6 with more than 6 % 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 keysources 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 2003, and ranked sixth amongst all sources of GHGs emissions in the country. These positions are steady and valid for all inventories in Bulgaria so far.

In accordance to certain criteria like:

- the presence of mechanical cover materials;
- leveling of waste;

and others Bulgarian landfills are classified as managed and unmanaged.

This classification does not correspond exactly to the IPCC classification. The criteria analysis given in the Revised IPCC Guidelines gives us grounds to classify managed landfills to the "managed SWD" category, and the unmanaged landfills – to the "Other" category.

8.2.2 Methodology

Solid wastes disposed in the landfills emit CH_4 as a result of the processes of anaerobic and aerobic decomposition of their organic content. The inventory in 2003 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 give in **Table 8.2**.

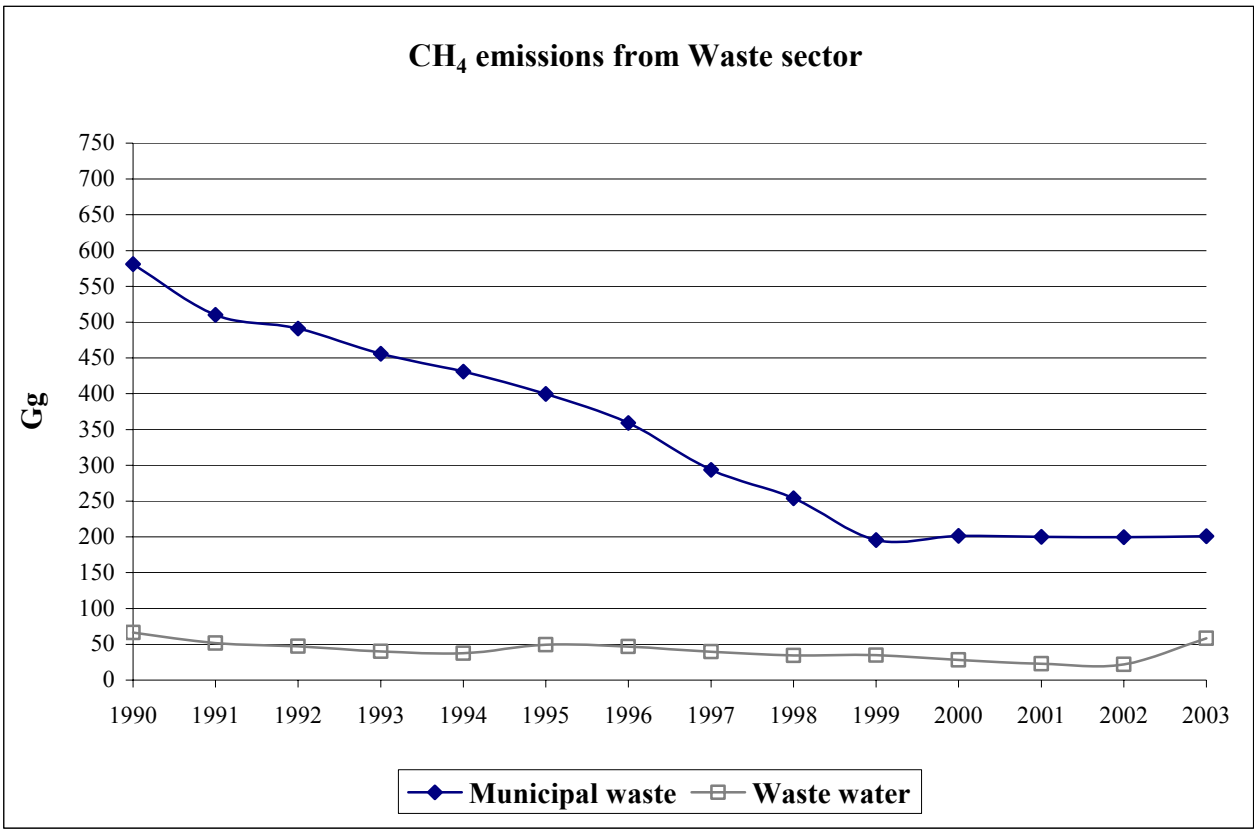
As this is a key source, using the Tier 1 method does not correspond to the good practice requirements. This means that a higher order method should be applied. So far, this is not possible for Bulgaria, due to the fact that there are no sufficient enough historical time series to make an estimation of the collected waste.

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 1988-2003 is given in **Figure 8.1**.

Figure 8.1



Unlike the time series given in the 2002 inventory, this series is consistent and does not show sudden changes in some years. This is due to the recalculation, carried out to eliminate methodological peculiarities, leading to inconsistency. This will be described and discussed in more details in Chapter 10- Recalculations and improvements.

The trend analysis shows that CH_4 emissions from solid waste disposal decrease from 300 to 200 Gg annually for the period 1997-1999 and keep a relatively steady level for the last three years. CH_4 emissions from waste water are significantly smaller and have a trend, which does not change to the same degree as for solid waste.

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 source in the Bulgarian inventory.

N_2O emissions from wastewater handling are a non-key source.

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

Wastewater handling is a CH_4 source only if carried out 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 three 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 1228 Gg in 2003, 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 for 2003.

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.

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 2003. Their increase of 7.7 % compared to 2002 is a result of the higher protein consumption per capita of the population, despite the overall population decline.

8.4 Waste Incineration

Bulgaria has no solid waste incineration for energy production.

There are only sporadic examples of hazardous 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
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
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
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
Fraction of wastes incinerated	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	0.003	0.005
CH_4 oxidation factor	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
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
Number of SWDS recovering CH_4	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
Composition of land filled waste (%)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE				
Paper and paperboard	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	9.0	10.0	11.1	10.3
Food and garden waste	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	40.0	39.0	39.5	39.6
Plastics	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	9.0	9.0	11.1	11.7
Glass	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	5.0	5.0	5.3	5.0
Textiles	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	3.0	4.0	3.8	4.1
Other (specify)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	34.0	33.0	29.2	29.3

Wastewater handling

Table 8.3

	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
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
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
Treated wastewater (%)															
domestic	50	51	53	53	53	56	60	63	68	68	68	69	72	73	73
industrial	60	60	57	49	50	56	61	60	62	60	62	48	44	60	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. This allows each country to report GHG emissions from activities and sources specific for it.

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

Even so, the "Other" category can be commented here, 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 78.46 Gg for the inventory in 2003. It incorporates GHG emissions from all small sources that can not be regarded as part of the remaining 38 entries in this list. The size of this source for the inventory of the base year is bigger and amounts to 1890 Gg. This number sets a trend which moves the source in the leading sixth rank of the list of key sources, defined by Tier 1 method with trend estimation. It is clear that the indefinite factor for this source is large and its 6^{th} ranking is not based on real weight and importance.

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 GHGs emission recalculation for the inventories, carried out during the period 1988-2002, 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;
  - Road transportation;
  - Stationary combustion processes in public sector, household, agriculture and forestry.
- **Industrial Processes**
  - Main GHGs emissions and their precursors from industrial technological processes;
  - New GHGs emissions – PFC, HFC and SF_6 in Industry;
  - Emissions from solvent use.
- **Agriculture**
  - GHGs emissions from technological processes in livestock farming and from crop cultivation for food and fodder;
  - GHGs emissions from agricultural lands;
- **Land-Use Change and Forestry**
  - CO_2 sequestration by forests;
- **Waste**
  - Solid waste collection and treatment;
  - Wastewater handling

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 modeling, activities and emission factors.
B. Changes in the data structuring for fuels and activities, emitting GHGs.
C. Changes concerning errors during data transfer and use of inappropriate parameters and emission factors.

Energy sector

Groups A and B changes were made in the Energy sector. The energy balances published for the period 1990-2002 have been used.

- CO_2 emission accounting from non-energy fuel use – group A.

Emissions from non-energy fuel use have been accounted for only in the Reference approach during the inventories until now. In accordance with the IPCC methodology, the fraction of carbon, which does not burn during the non-energy use, was deducted from the aggregated emissions as stocked carbon. The sectoral approach did not take into account the emitted CO_2, thus introducing some uncertainty when comparing the two approaches (uncertainty of about 1-2 %).

- Proper structuring of solid fuel quantities, used for transformation in energy transforming processes (coke and briquettes production) – groups B and C.

In this case, the change concerns only the years 1998 and 1999. For all other years for the period 1990-2002, these changes have been reported in the preceding inventories and in such aspect one can consider that this change for 1998 and 1999 has the characteristics of group C.

- Corrections in CH_4 and N_2O emissions from biomass in the category "Other transportation" of sub sector "Transport" – group C.

The correction made 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 1990-1997 when there is small wood consumption in this category of emission sources.

- Corrections in emission factors for CO_2 emissions during the combustion of dry gas from petroleum refining, coke gas and blast furnace gas – group A.

In the previous inventories, identical data for the emission factors of these gases has been used - 62.4 kg CO_2/GJ. This value has been defined by an expert estimation even before the proposition of standard values in the Revised IPCC Guidelines. The change consisted of the adoption of standard values by IPCC:

- Dry gas from petroleum refining – 66 kg CO_2/GJ;
- Coke gas - 47 kg CO_2/GJ;
- Blast furnace gas - 237 kg CO_2/GJ

- Accounting fugitive methane emissions from natural gas transit transportation – group A.

In the previous inventories, fugitive methane emissions from the transit transportation of natural gas for the neighboring countries have not been accounted.

- Use of entirely renewed emission factors for fugitive methane emissions from the petrol and gas systems – group A.

Emission factors from the Good Practice Guidance have been adopted.

- Fugitive methane emissions in the petrol and natural gas systems have been added – group B

Fugitive methane emissions have been added from: gas flaring in refineries; flaring in natural gas production and propane butane refueling at gas stations.

Industrial Processes sector

Revision of data for the volume and type of production has been carried out, using structures and classifications from official statistics of NSI from 1990 to 2002.

Available data was changed in the following directions:

- In the CRF category "G. Other" aggregated quantities of the produced plastic, synthetic rubber and adhesives have been included – group A.

This GHGs emission source has not been split into chemical types as has been done for the period after 1998. Therefore, average CH_4 and NMVOCs emission factors have been assigned for the period 1990-1998, calculated using a model, developed on the basis of detailed categorization of chemical types for the inventories after 1998.

The following average emission factor values have been adopted:

- CH_4 – 1.0 kg/t plastics
- NMVOCs – 4.2 kg/t plastics

- Data for food production has been added, which was absent for the period up to 1997 – group B.

Food production (meat, bread, butter, beverages, etc.) is a source of essentially GHG – precursor NMVOCs. Data for the production volume, emitting this GHG was taken from NSI reports for the

period 1988-1997. For the remaining years of the period (1998-2002), this data has not been changed.

- Adding PFCs emissions from aluminum production – group B.

Data for aluminum production for the period 1988-1994, given in the annual NSI reports, allows calculation of the actual emissions of CF_4 and C_2F_6 gases of the PFCs group, using the methodology given in the IPCC Guidelines.

- Adding emission from petroleum refining - group A.

The following process emissions have been added:

- SOx, NOx, CO and NMVOCs emissions from flaring of waste gases;
- NMVOCs emissions from gasoline transportation from refineries;
- NMVOCs emissions during refueling at petrol stations.

- Integrated revision of fugitive emissions from the use of SF_6 in high voltage electrical equipment – group B.

Following wide-ranging consultations with the companies for production, transfer and distribution of power, data for SF_6 volumes, which is used as an isolating and commutating agent in high voltage electrical equipment, have been updated and expanded.

Solvent Use sector

The changes in this sector relate to the addition of emissions from "solvent use by the population" and emission factor correction of NMVOCs emissions during paint production.

- Emission factor correction for GHGs emissions from paint production – group A.

The correction is for the period 1988-1999 making all data, for the period until 2002, identical. This means that EF=18 kg/t has been adopted, used only for the process of paint production. Previous inventories used EF 515 kg/t, which also takes into account the process of use and consumption of paint. In the present recalculation, the two processes – paint production and paint consumption are regarded separately.

- Emission estimation from the use of solvents in the household for the period 1988-1997 г. - group A

Since 1998, this type of emissions are reported by NSI following the CORINAIR methodology. The data is used to determine the emissions in the inventory. Because of this, for the period prior 1998, GHGs emissions have been calculated using average indicators per capita in the country. For the purpose, following expert estimation, an emission factor of 1 kg/person/year solvent use in household, has been adopted.

- Adding emissions from bitumen production and recalculation of non-emission factors for emissions from the production of materials for roofs, soaked with asphalt. – group B

In this case, the structuring of emission from bitumen production is changed, adding them to this sector and removing them from the "Industrial processes" sector.

Sector Agriculture

Revision of data on emission sources and emission factors in sector "Agriculture" is made following the main principle – for the period prior 2000, to use data from the Ministry of Agriculture and Forestry and its belonging agencies and organizations, whenever it is possible. It is known that during that period, official data for agriculture was collected in NSI and not in the Ministry.

The inventory recalculation for this sector takes into account:

- Data for the number of animals in the agricultural sector for the period prior 2000 has not been recalculated using the new methodology for half-year reporting – group B.

This was done due to the fact that is was not possible to form consistent time series for the period 1988-1999.

- Recalculation of the quantities synthetic nitrogenous fertilizers applied to soil – 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.

- The area of arable land – group B.

The area of arable land is determined following methodology applied until the year 2000. The important point here is that areas with all crops have been included and not only areas with field crops, as adopted by the Ministry at present.

- Additional data for crop quantities – group B.

For the period 1988-1997 the following crops are added: sunflower, cotton and tobacco, given in the annual NSI reports.

When no data has been provided for some years (for example peanut crop in 2001), quantities based on expert estimation have been adopted in order to keep the consistency of time series.

Data for peas, soy and lentils crop for 2002-2002 has been recalculated.

Land-Use Change and Forestry sector

Only data on felling has been updated in this sector, after consultations with experts from the National Forestry Directorate at MAF. Following that, double counting of dry and fallen wood for the period 1988-1993 has been avoided. Data for 1994, 1996 and 1997 was corrected eliminating errors from preliminary and inaccurate estimation of the total quantity of cut timber for those years – groups B and C.

Waste sector

Solid Waste Disposed (SWD) quantities have been recalculated for the period 1990-1994 as well as industrial wastewater for the same period.

- Recalculation of SWD - group A.

This recalculation was imposed because of the change in the accounting methodology of SWD collection after 1994. With this change, wrong accounting of disposed waste has been overcome, which was producing unfounded growth of CH_4 emissions for this period. Time series were recalculated following mathematical statistics methodology, using good practices requirements.

- Recalculation of CH_4 emissions from wastewater – group B.

The recalculation is related to the more precise accounting of wastewater from some industrial branches: synthetic fertilizer production, pulp and paper production, textile and rubber production. Due to the lack of specific data in this branches, the wastewater quantities were determined using expert assessment on the basis of the volume of manufactured production.

- Recalculation of the quantity consumed food by the population for the period 1995-2002.- group B

The quantities consumed protein by the population have been recalculated in order to determine N_2O emissions from domestic wastewater.

- Recalculation of data on wastewater in 1998 and 1999 – group B

Recalculation of wastewater has been carried out in NSI for the period 1998-1999, which has been reported in the inventory for these two years.

10.2 Introducing Improvements for GHGs Emissions Levels

The differences between inventories due to the recalculations in the National GHG Inventory Report 2002 (Submission 2004) and the present report (Submission 2005) are given in **Table 10.1**

Differences between NIR 2004 and NIR 2005 for 1988-2002 due to recalculation, %

Table 10.1

Gas/Sector	Source	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Energy	*% NIR-2005 versus NIR-2004*														
CO_2		-4.17	3.60	4.42	4.30	4.39	5.59	6.05	6.26	6.91	5.61	5.99	7.53	5.69	4.65
CH_4		-30.34	-49.81	-49.12	-45.08	-43.18	-43.69	-46.72	-47.56	-43.99	-40.53	-39.10	-37.90	-36.61	-33.31
N_2O		-11.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.04	-0.04	0.00	0.00	0.00
Industrial Processes															
CO_2		0.00	0.00	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		88.61	8.95	7.02	7.20	7.24	6.05	5.91	6.66	6.04	6.39	2.67	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
Solvent and Other Product Use															
NMVOCs		-71.73	-65.05	-46.43	-46.07	-39.05	-40.16	-45.48	-50.69	-51.40	-26.08	46.08	0.00	197.80	186.10
Agriculture															
CH_4		0.04	0.04	0.04	0.05	0.05	0.07	0.09	0.07	0.07	0.33	-0.32	0.34	0.00	0.00
N_2O		5.73	-9.79	-18.16	-10.76	-2.08	8.07	-4.82	-3.95	1.61	-4.21	4.57	0.04	0.07	-0.01
Land-Use Change and Forestry															
CO_2 sink		10.21	6.16	-3.11	-2.93	6.46	4.68	0.07	-9.35	17.43	10.07	8.96	0.00	0.00	0.00
Waste															
CH_4		13.87	-12.27	-26.57	-28.31	-27.48	8.56	0.00	0.72	0.00	0.01	-2.06	0.00	0.00	0.00
N_2O		31.79	0.00	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 without LUCF															
CO_2-eq-without F-gases		-2.48	-1.80	-4.61	-4.70	-3.42	3.03	1.54	1.71	2.82	1.82	2.46	3.28	2.33	1.77
CO_2-eq- total		-2.43	-1.76	-4.58	-4.67	-3.40	3.08	1.54	1.71	2.82	1.83	2.47	3.28	2.33	1.78
CO_2		-3.85	3.30	4.11	4.02	4.11	5.15	5.53	5.71	6.33	5.23	5.52	6.88	5.23	4.28
CH_4		1.98	-16.38	-24.85	-26.10	-26.02	-5.21	-11.80	-12.48	-11.71	-11.10	-11.79	-11.09	-11.21	-9.53
N_2O		-0.38	-5.40	-10.16	-5.43	-0.96	3.46	-1.88	-1.49	0.61	-1.81	2.08	0.01	0.03	0.00

10.2.1 Recalculation of the Base Year - 1988

The inventory of the base 1988 year was the first GHG inventory in Bulgaria. It was drafted in 1994-95 within the framework of the project "Country Study on climate change of Bulgaria".

The results from this inventory were finalized and structured according to the requirements of the standard tables from the old IPCC Guidelines from 1995. For the time until the publication of the Revised IPCC Guidelines in 1996 and the common reporting format (CRF tables), inventory data was enough only to draft aggregated GHG emission estimates in the various sub sectors of the economy and household. There was a clear necessity to correct data, respectively – GHG emissions in accordance with a more precise estimation of fuels and activities for all source categories and emission removals, following the requirements of the CRF tables.

From all sectors, the most difficult one for the inventory was the Energy sector, for which huge amount of data was needed, structured and following the approach of a common energy balance of the country. NSI has not developed energy balances for 1988 and 1989. The research carried out showed that for a number of reasons, it is not possible to draft such balance for the base year. As a result, we had to limit ourselves using data from the material balances for fuel in 1988, which differ significantly from the energy balances. In this case, new data arrays had to be formed, not presented evidently in the material balances. In other words, approaches for comparative estimations, expert assumptions and logical analyses were imposed for the preparation of the necessary fuel data.

Regarding emission inventories from other sectors, i.e. production and consumption technological processes, there were less difficulties. This is due to the fact that data for these processes were included in the statistics in the necessary volume and comprehensiveness.

Bellow, we shall state the main features, which were taken into account during the GHG inventory for the base 1988 year, within the framework of the sectored structure of the IPCC Guidelines and CRF tables.

Energy sector

Drafting fuel quantities used for conversion in power stations and for end use in industry, agriculture, household and services, structures established in the 1990 energy balances were used. This is the closest year to 1988, and in such respect, its use was justified and worthwhile.

When determining jet kerosene quantities for domestic and international flights (bunker), additional clarifications by experts from NSI were taken into account. In this manner, coordination with the present methodology was achieved to differentiate the use of this kind of fuel in correspondence with the expert adopted share of the fuel consumption for domestic flights (including for military purposes).

For the balance of briquettes, produced from local lignite was considered the fact that the entire quantity produced briquettes has been used by the population for household purposes (heating and cooking).

Due to lack of statistical data for the produced and consumed quantities of secondary gases (dry gas from petroleum refining, coke gas and blast furnace gas), they were determined on the basis of expert estimations. The quantities of produced ferrous metal and coke, as well as the volume of refined petrol for 1988 have been used.

Using the ratio between the quantities of secondary gases and the production of ferrous metals and petroleum products in 1990, the corresponding volumes of gas were determined for 1988.

The use of wood for heating has not been recorded by NSI for 1988, so the used quantities by sectors were determined on the basis of expert estimations and the quantity of used wood for 1990.

Sectors with process (non energy) emissions

The changes in these sectors are relatively small and affect only some emission sources that have not been included in inventories so far. Such source was sinter production in the sub sector "Process emissions from metal production". In this case, the determined quantities were based on expert estimation, taking into account the volume of produced ferrous metals.

The estimation of CH_4 emissions from industrial wastewater treatment was made with the wastewater quantities from the sectors, determined on the basis of the corresponding quantities in 1990 and the ratio of the production in these sectors between 1990 and 1988. For example, the ratio production 1990/production 1988 for some sectors is as follows:

- ferrous metals – 0.77;
- non-ferrous metals – 0.62;
- synthetic fertilizers production – 0.95;
- textile – 0.80;
- food – 0.82.

Due to the fact, that for the period 1988-1996 the statistics holds data only for the total volume of wastewater discharged in the public sewerage system, additional estimation had to be made for the portion of the households.

As a result of the recalculation of the GHG emissions for 1988, were obtained estimations showing some differences in the emission levels of all main GHGs and GHG-precursors, compared to the reported estimations in the 2002 inventory (Submission 2004). The analysis of these differences will be carried out in the following cross-sections; total emissions in CO_2–eq, emissions according to gas type - CO_2, CH_4 and N_2O; emissions according to industry and household sectors.

Total GHG emissions

Total aggregated emissions in Bulgaria are 138 376.76 Gg CO_2-eq. (without accounting CO_2 sequestration by the forests) for 1988. The difference with the preceding estimation is 2.4 % lower.

Out of the total emissions, the share of CO_2 is 71 %, of CH_4 18 % and of N_2O 11 % expressed in CO_2–eq.

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

- Energy – 71.0 %;
- Industrial processes – 7.5 %;
- Agriculture – 9.8 %;
- Waste – 11.6 %.

In comparison with the estimations from the preceding inventory there are no significant changes.

CO_2 emissions

The biggest CO_2 emitter is the Energy sector - 90 726 Gg or 65.5 % from the total GHG emissions in Bulgaria (without accounting sequestration by forests).

In total, CO_2 emissions from sector Energy have been reduced by 4.2 %, observing a significant redistribution amongst the sub sectors. For example, CO_2 emission changes compared to the preceding year have been:

- Energy industry – (+16.8 %);
- Processing industry – (-31 %);
- Transport – (+9 %);
- Household and services – (+15.6 %).

It is evident that in the preceding inventory, the contribution of energy, transport and household in the aggregated CO_2 emissions of this sector has been underestimated.

In sector "Industrial processes" there have been no CO_2 emission changes. There is, however, a significant increase of the quantity of sequestrated CO_2 by the forests (about 10.2 %)due to the recalculated values of cut wood.

CH_4 emissions

The total CH_4 emissions are 1 187 Gg, which displays an increase, compared to the preceding inventory by about 2 %. This increase is mainly on behalf of the emissions in sector "Waste" and sector "Agriculture'.

Sector "Industrial processes' has the lowest emissions by absolute value but has the biggest increase – by 89 %. This increase is due to the bigger emissions from metal production (accounting the missing source so far – sinter).

The total emissions of N_2O are 47.8 Gg. This quantity has not been changed in practice compared to the preceding inventory. Changes are observed only in sectors "Energy" and "Agriculture", which have almost mutually balanced each other. While sector "Energy" reduces its emissions by 11.8 %, sector "Agriculture" increases them by 5.7 % compared to the preceding inventory. In absolute values, these percentage changes are almost equal. The biggest increase in percentage is in sector "Waste' – 32 %. This, however, does not influence the total amount as it has a very low absolute value.

10.2.2 Recalculation of GHG Inventories for 1990-2002

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 to 7 %;
- CH_4- from -5 to -25 %;
- N_2O- from -10 to + 3.5 %.

The special features from the recalculation of GHGs emissions for some particular years are given in item 10.1.

10.3 Introduction of Improvements in the GHGs Emissions Trends.

In total, the recalculation of GHGs emissions should lead to improvement of the common trend.

The changes of the common trend 1988-2002 between two consecutive inventory submissions are given in **Table 10.2.**

Difference between NIR 2004 and NIR 2005 for emission trends 1988-2002 (1995 for F- gases)

Table 10.2

Gas, Gg CO_2-eq.	**Trend (absolute)**			**Trend (percentage)**		
	NIR 2004	NIR 2005	Difference	NIR 2004	NIR 2005	Difference
CO_2	-55 763	-49 814	5 949	-54	-51	3.9
CH_4	-15 066	-15 559	-493	-62	-62	-0.8
N_2O	-8 586	-8 530	56	-58	-58	0.2
HFCS	-3	-3	0	-100	-100	0.0
PFCs	-26	-26	-1	-54	-56	-1.6
SF_6	1	1	0		100	99.7
Total	**-79 442**	**-73 930**	**5 512**	**-56**	**-53**	**2.6**

The trends in absolute values are defined as differences between the aggregated GHGs emissions in 2002 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. The positions of some sources were changed, which does not influence significantly the total GHGs emissions.

For example, GHGs emissions from petrol coke were moved from the solid fuels to the liquid fuels category. The location of accounting of process emissions for the bitumen production has also been changed.

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.

On the other hand, due to variations in the classification and file structure of the GHGs emissions calculation following the CORINAIR methodology, differences occur for the emissions, calculated in the inventory, and in particular – for GHGs precursors. This leads to confusion and misunderstanding on behalf of some experts and organizations, and requires additional clarification. An obvious necessity exists for the creation of a special methodology and comparison system, reporting, and estimation of GHGs emissions by the two methodologies.

10.4.2 Source Complexity

GHGs inventories include all sectors and categories from the revised IPCC Guidelines, 1996 with the exception of the following:

- Emissions/removal from category 5B- 5E in sector «Land-Use Change and Forestry»;
- N_2O emissions during fire extinguishers use, aerosol packing and for anesthesia;
- Fugitive CO_2 emissions from coal mining;
- Actual emissions from use of HFC gases;
- Waste incineration.

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 2003. These are:

- Aggregated CRF tables for the base year and for the last 4 years - 2000-2004 (Tables 7A);
- Tables with recalculation for all years of the inventories (Tables 8a 8b);
- CRF tables 10 for the trends of main GHGs;
- GHGs tables – precursors and SOx.

Table 9 for the completeness of the inventory is given in ***Annex 5***.

As mentioned above, all completed CRF inventory tables 1988, 1990-2002 have been prepared in electronic format and will be handed to the UNFCCC Secretariat.

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 propane-butane 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 GHGs Inventories.

GHGs 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;
- High Environmental Expert Council at MOEW (HEEC);

The necessary condition for HEEC 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 GHGs 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;
- Desk review of the 2002 inventory, November 2004.

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:

- *Non-consistency of time series*

For some sector GHGs emissions the sizeable emission changes were observed. The "Waste" sector is such an example. After additional research with expert participation from the Statistics, a new statistical model for methane emission accounting from solid waste disposal for the period up to 1994, has been applied.

- *Lack of comments for zero emission values and other parameters and indicators in CRF tables*

When the value of the particular parameter is much smaller than 1 or is absent at all, the indication system from the IPCC Guidelines is applied. The indications of this system should encompass all empty cells in the tables. Fulfilling this requirement was a matter of criticism by the revisions.

- *Comparison of the inventory data with the corresponding data of international organizations;*

The analysis of data used in the inventory for Bulgaria shows some differences with corresponding data used by international organizations like IEA, FAO, etc. This is due to a number of reasons both in the Bulgarian sources of information and in the international organizations themselves. In

relation to this, the Bulgarian organizations have been made aware of these differences and efforts are put to minimize them.

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. Otherwise there are possibilities for determine key sources that in superior degree are correspondent to the structure of the fuels and the activities in the country – sources of GHG emissions. 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.

In general, by the method from type Tier 1 are arranged emission sources according to the rules mentioned above. 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** supposes 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 (by method Tier 1, Rule A) given in the previous 2004 Submission presents the following:

- Method from type Tier 2 for key sources assessment is additionally applied;
- The source “Fugitive emissions from the petrol and gas systems ” is dropped out from the new list;
- Sources “Methane from Wastewater treatment” and “CO_2 from non-energy use of natural gas” 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.

Table A1.1

Source ranking using IPCC Tier 1 level assessment 2003, Gg CO_2-eq.

IN	IPCC source category	Gas	CO_2-eq. 2003	Share	Cumul. share
1	CO_2 Emissions from Stationary Combustion- Energy Industries, Coal	CO_2	25 051	0.36	0.362
2	Mobile Combustion- road transportation	CO_2	6 267	0.09	0.453
3	CO_2 Emissions from Stationary Combustion- Manufacturing Industries, Coal	CO_2	5 214	0.08	0.528
4	CO_2 Emissions from Stationary Combustion – Gas	CO_2	4 638	0.07	0.595
5	CO_2 Emissions from Stationary Combustion – Oil	CO_2	4 562	0.07	0.661
6	CH_4 Emissions from Solid Waste Disposal Sites	CH_4	4 217	0.06	0.722
7	N_2O Emissions from Stationary Combustion	N_2O	2 606	0.04	0.760
8	CO_2 Emissions from Stationary Combustion- Other Sectors, Coal	CO_2	1 690	0.02	0.784
9	CO_2 Emissions from Steel Production	CH_4	1 640	0.02	0.808
10	CH_4 Emissions from Enteric Fermentation in Domestic Livestock	CH_4	1 502	0.02	0.830
11	Emissions from Wastewater Handling	CH_4	1 228	0.02	0.847
12	Fugitive Emissions from Coal Mining and Handling	CH_4	1 208	0.02	0.865
13	CO_2 Emissions from Cement Production	CO_2	1 189	0.02	0.882
14	N_2O Emissions from Nitric Acid Production	N_2O	1 159	0.02	0.899
15	Direct N_2O Emissions from Agriculture Soils	N_2O	1 036	0.01	0.914
16	CO_2 from Lime Production	CO_2	921	0.01	0.927
17	Mobile Combustion-other transportation	CO_2	685	0.01	0.937
18	Non-energy fuel use- gas	CO_2	656	0.01	0.947
19	N_2O Emissions from Animal Production	N_2O	544	0.01	0.954
20	Indirect N_2O Emissions from Agriculture Soils	N_2O	519	0.01	0.962
21	Fugitive Emissions from Oil and Gas Operations	CH_4	517	0.01	0.969

IN	IPCC source category	Gas	CO_2-eq. 2003	Share	Cumul. share
22	CH_4 Emissions from Manure Management	CH_4	512	0.01	0.977
23	N_2O Emissions from Manure Management	N_2O	395	0.01	0.983
24	CO_2 from Ammonia Production	CO_2	337	0.00	0.987
25	Emissions from Wastewater Handling	N_2O	150	0.00	0.990
26	CO_2 from Soda Ash Production	CO_2	106	0.00	0.991
27	Mobile Combustion-Railways	CO_2	89.14	0.00	0.992
28	CO_2 Emissions from Industrial Processes - others	CO_2	83.77	0.00	0.994
29	Non-energy fuel use- liquid	CO_2	74.07	0.00	0.995
30	Non-energy fuel use- solid	CO_2	52.86	0.00	0.995
31	CH_4 Emissions from Industrial Processes - metal production	CH_4	52.81	0.00	0.996
32	CH_4 Emissions from Rice Production	CH_4	47.73	0.00	0.997
33	Mobile Combustion-road transportation	N_2O	35.13	0.00	0.997
34	CH_4 Emissions from Stationary Combustion	CH_4	32.46	0.00	0.998
35	Mobile Combustion-road transportation	CH_4	23.92	0.00	0.998
36	New gases	PFC, HFC	23.21	0.00	0.999
37	CH_4 Emissions from Agricultural Residue Burning	CH_4	17.11	0.00	0.999
38	N_2O Emissions from Agricultural Residue Burning	N_2O	5.34	0.00	0.999
39	Total others		78.46	0.00	1.000
	TOTALS		**69 167**		

The analysis of the Table A1.1 shows that sum number of the key sources is 19 from total 39 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 36 % of the total emissions in the country, the second one gives 9 % and the third one – 8 %. 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 four 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 decreased with 18 numbers;
- 4 sources have dropped out from the list with key sources and 3 more are included;
- There is a re-arrangement of the key sources – some of them are in upper place (from 5th and 6th relatively to a 2nd and 3rd), others are in lower places (from 2nd and 3rd to a 4th and 9th 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 "Others - total" – from 39th place to a 6th place and "CO_2 from combustion in the transport and other type of transport" – 17th place to a 5th place, etc.

The determination of the key sources according to this rule leads to an accounting of the rate of change of each source for the past period expressed in its trend towards the base year. This brings the opportunity for additional assessments of the quality and value 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.

Table A1.2

Source ranking using IPCC Tier 1 trend assessment 2003, Gg CO_2-eq.

IN	IPCC Source Categories	Gas	CO_2-eq. 1988	CO_2-eq. 2003	Trend assessment	% Contribution to Trend	Cumulative total of Trend	T1- trend
1	CO_2 Emissions from Stationary Combustion- Energy Industries, Coal	CO_2	31 318	25 051	0.27	0.32	0.32	1
5	CO_2 Emissions from Stationary Combustion – Oil	CO_2	19 685	4 562	0.15	0.18	0.50	2
6	CH_4 Emissions from Solid Waste Disposal Sites	CH_4	13 883	4 217	0.08	0.09	0.60	3
2	Mobile Combustion- road transportation	CO_2	7 747	6 267	0.07	0.08	0.68	4
17	Mobile Combustion-other transportation	CO_2	3 998	685	0.04	0.05	0.72	5
39	Total others		1 890	78	0.03	0.03	0.75	6
8	CO_2 Emissions from Stationary Combustion- Other Sectors, Coal	CO_2	4 953	1 690	0.02	0.03	0.78	7
15	Direct N_2O Emissions from Agriculture Soils	N_2O	3 455	1 036	0.02	0.02	0.81	8
3	CO_2 Emissions from Stationary Combustion- Manufacturing Industries, Coal	CO_2	9 272	5 214	0.02	0.02	0.83	9
7	N_2O Emissions from Stationary Combustion	N_2O	4 073	2 606	0.02	0.02	0.84	10
10	CH_4 Emissions from Enteric Fermentation in Domestic Livestock	CH_4	4 049	1 502	0.02	0.02	0.86	11
4	CO_2 Emissions from Stationary Combustion – Gas	CO_2	10 259	4 638	0.01	0.02	0.88	12
9	CO_2 Emissions from Steel Production	CH_4	2 360	1 640	0.01	0.02	0.90	13
16	CO_2 from Lime Production	CO_2	1 118	921	0.01	0.01	0.91	14
20	Indirect N_2O Emissions from Agriculture Soils	N_2O	1 722	519	0.01	0.01	0.92	15
11	Emissions from Wastewater Handling	CH_4	1 845	1 228	0.01	0.01	0.93	16
19	N_2O Emissions from Animal Production	N_2O	1 652	544	0.01	0.01	0.94	17
22	CH_4 Emissions from Manure Management	CH_4	1 524	512	0.01	0.01	0.95	18
24	CO_2 from Ammonia Production	CO_2	1 157	337	0.01	0.01	0.96	19
12	Fugitive Emissions from Coal Mining and Handling	CH_4	1 992	1 208	0.01	0.01	0.96	20
13	CO_2 Emissions from Cement Production	CO_2	2 737	1 189	0.01	0.01	0.97	21

IN	IPCC Source Categories	Gas	CO_2-eq. 1988	CO_2-eq. 2003	Trend assessment	% Contribution to Trend	Cumulative total of Trend	T1- trend
21	Fugitive Emissions from Oil and Gas Operations	CH_4	1 362	517	0.00	0.01	0.98	22
18	Non-energy fuel use- gas	CO_2	990	656	0.00	0.01	0.98	23
23	N_2O Emissions from Manure Management	N_2O	1 056	395	0.00	0.00	0.99	24
29	Non-energy fuel use- liquid	CO_2	354	74	0.00	0.00	0.99	25
27	Mobile Combustion-Railways	CO_2	368	89	0.00	0.00	0.99	26
28	CO_2 Emissions from Industrial Processes - others	CO_2	39	84	0.00	0.00	0.99	27
14	N_2O Emissions from Nitric Acid Production	N_2O	2 422	1 159	0.00	0.00	1.00	28
31	CH_4 Emissions from Industrial Processes - metal production	CH_4	73	53	0.00	0.00	1.00	29
36	New gases	PFC, HFC	76	23	0.00	0.00	1.00	30
30	Non-energy fuel use- solid	CO_2	80	53	0.00	0.00	1.00	31
32	CH_4 Emissions from Rice Production	CH_4	119	48	0.00	0.00	1.00	32
33	Mobile Combustion-road transportation	N_2O	48	35	0.00	0.00	1.00	33
26	CO_2 from Soda Ash Production	CO_2	233	106	0.00	0.00	1.00	34
34	CH_4 Emissions from Stationary Combustion	CH_4	49	32	0.00	0.00	1.00	35
25	Emissions from Wastewater Handling	N_2O	310	150	0.00	0.00	1.00	36
37	CH_4 Emissions from Agricultural Residue Burning	CH_4	42	17	0.00	0.00	1.00	37
35	Mobile Combustion-road transportation	CH_4	54	24	0.00	0.00	1.00	38
38	N_2O Emissions from Agricultural Residue Burning	N_2O	14	5.34	0.00	0.00	1.00	39
	TOTALS		***138 377***	**69 167**	**0.84**			

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 for determine of key sources 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 with 16 numbers;
- 5 sources are out the list of the key sources and two others are included;
- there is a re-order of the key sources – some are at upper place (from 20,15,12 and 14 relatively to a 3,4,5 and 6 place) and others are come down (from 1,2 and 3 to a 7,13 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 the key sources is decreased with 16 numbers;
- 8 sources were come out of the list with the key sources and 5 more are included;
- there is a significant re-order of the sources related to the solid wastes and agricultural soils – from 6, 15 and 20 place, they moved to the first three places;
- significant sources of GHG emissions are come down notably – from 1, 2, and 3 place relatively to a 5, 13, and 22nd 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 the emission 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.

Table A1.3

Sorted Tier 2 level assessment Key sources

IN	IPCC source category	Gas	CO_2-eq. 2003	Share	Comb. Unc. %	T2 Level ass., %	% of Level assessment	Cumul. share	T2-level
7	N_2O Emissions from Stationary Combustion	N_2O	2 606	0.0	200.1	7.5	0.2	0.2	1.0
6	CH_4 Emissions from Solid Waste Disposal Sites	CH_4	4 217	0.1	102.0	6.2	0.1	0.3	2.0
20	Indirect N_2O Emissions from Agriculture Soils	N_2O	519	0.0	500.0	3.8	0.1	0.4	3.0
15	Direct N_2O Emissions from Agriculture Soils	N_2O	1 036	0.0	250.0	3.7	0.1	0.5	4.0
12	Fugitive Emissions from Coal Mining and Handling	CH_4	1 208	0.0	200.2	3.5	0.1	0.6	5.0
14	N_2O Emissions from Nitric Acid Production	N_2O	1 159	0.0	200.2	3.4	0.1	0.7	6.0
1	CO_2 Emissions from Stationary Combustion-Energy Industries, Coal	CO_2	25 051	0.4	8.6	3.1	0.1	0.7	7.0
19	N_2O Emissions from Animal Production	N_2O	544	0.0	250.0	2.0	0.0	0.8	8.0
23	N_2O Emissions from Manure Management	N_2O	395	0.0	300.0	1.7	0.0	0.8	9.0
11	Emissions from Wastewater Handling	CH_4	1 228	0.0	85.4	1.5	0.0	0.9	10.0
10	CH_4 Emissions from Enteric Fermentation in Domestic Livestock	CH_4	1 502	0.0	50.0	1.1	0.0	0.9	11.0
3	CO_2 Emissions from Stationary Combustion-Manufacturing Industries, Coal	CO_2	5 214	0.1	8.6	0.6	0.0	0.9	12.0
2	Mobile Combustion- road transportation	CO_2	6 267	0.1	5.8	0.5	0.0	0.9	13.0
13	CO_2 Emissions from Cement Production	CO_2	1 189	0.0	30.1	0.5	0.0	0.9	14.0
4	CO_2 Emissions from Stationary Combustion – Gas	CO_2	4 638	0.1	7.1	0.5	0.0	0.9	15.0
5	CO_2 Emissions from Stationary Combustion – Oil	CO_2	4 562	0.1	7.1	0.5	0.0	0.9	16.0
21	Fugitive Emissions from Oil and Gas Operations	CH_4	517	0.0	50.2	0.4	0.0	1.0	17.0
22	CH_4 Emissions from Manure Management	CH_4	512	0.0	50.0	0.4	0.0	1.0	18.0
9	CO_2 Emissions from Steel Production	CH_4	1 640	0.0	10.4	0.2	0.0	1.0	19.0
25	Emissions from Wastewater Handling	N_2O	150	0.0	104.4	0.2	0.0	1.0	20.0
16	CO_2 from Lime Production	CO_2	921	0.0	15.8	0.2	0.0	1.0	21.0

IN	IPCC source category	Gas	CO_2-eq. 2003	Share	Comb. Unc. %	T2 Level ass., %	% of Level assessment	Cumul. share	T2-level
8	CO_2 Emissions from Stationary Combustion-Other Sectors, Coal	CO_2	1 690	0.0	8.6	0.2	0.0	1.0	22.0
24	CO_2 from Ammonia Production	CO_2	337	0.0	20.6	0.1	0.0	1.0	23.0
17	Mobile Combustion-other transportation	CO_2	685	0.0	7.1	0.1	0.0	1.0	24.0
18	Non-energy fuel use- gas	CO_2	656	0.0	7.1	0.1	0.0	1.0	25.0
39	Total others		78	0.0	50.0	0.1	0.0	1.0	26.0
33	Mobile Combustion-road transportation	N_2O	35	0.0	100.0	0.1	0.0	1.0	27.0
35	Mobile Combustion-road transportation	CH_4	24	0.0	100.0	0.0	0.0	1.0	28.0
26	CO_2 from Soda Ash Production	CO_2	106	0.0	20.6	0.0	0.0	1.0	29.0
28	CO_2 Emissions from Industrial Processes - others	CO_2	84	0.0	20.6	0.0	0.0	1.0	30.0
34	CH_4 Emissions from Stationary Combustion	CH_4	32	0.0	50.2	0.0	0.0	1.0	31.0
36	New gases	PFC, HFC	23	0.0	51.0	0.0	0.0	1.0	32.0
31	CH_4 Emissions from Industrial Processes – metal production	CH_4	53	0.0	20.6	0.0	0.0	1.0	33.0
38	N_2O Emissions from Agricultural Residue Burning	N_2O	5	0.0	201.6	0.0	0.0	1.0	34.0
32	CH_4 Emissions from Rice Production	CH_4	48	0.0	20.6	0.0	0.0	1.0	35.0
37	CH_4 Emissions from Agricultural Residue Burning	CH_4	17	0.0	55.9	0.0	0.0	1.0	36.0
29	Non-energy fuel use- liquid	CO_2	74	0.0	7.1	0.0	0.0	1.0	37.0
27	Mobile Combustion-Railways	CO_2	89	0.0	5.8	0.0	0.0	1.0	38.0
30	Non-energy fuel use- solid	CO_2	53	0.0	8.6	0.0	0.0	1.0	39.0
	TOTALS		**69 167**			42.3	1.0		

Table A1.4

Sorted Tier 2 trend assessment Key sources

IN	IPCC Source Categories	Gas	CO_2-eq. 1988	CO_2-eq. 2003	Trend assessment	Comb. Unc. %	T2 Trend assessment %	% of Trend assessment	Cumul. of Trend	T2-trend
6	CH_4 Emissions from Solid Waste Disposal Sites	CH_4	13 883	4 217	0	102	8.03	0.23	0.23	1
15	Direct N_2O Emissions from Agriculture Soils	N_2O	3 455	1 036	0	250	5.00	0.14	0.37	2
20	Indirect N_2O Emissions from Agriculture Soils	N_2O	1 722	519	0	500	4.94	0.14	0.51	3
7	N_2O Emissions from Stationary Combustion	N_2O	4 073	2 606	0	200	3.30	0.09	0.61	4
1	CO_2 Emissions from Stationary Combustion- Energy Industries, Coal	CO_2	31 318	25 051	0	9	2.34	0.07	0.68	5
19	N_2O Emissions from Animal Production	N_2O	1 652	544	0	250	2.04	0.06	0.73	6
39	Total others		1 890	78	0	50	1.25	0.04	0.77	7
12	Fugitive Emissions from Coal Mining and Handling	CH_4	1 992	1 208	0	200	1.23	0.04	0.81	8
23	N_2O Emissions from Manure Management	N_2O	1 056	395	0	300	1.16	0.03	0.84	9
5	CO_2 Emissions from Stationary Combustion – Oil	CO_2	19 685	4 562	0	7	1.08	0.03	0.87	10
11	Emissions from Wastewater Handling	CH_4	1 845	1 228	0	85	0.76	0.02	0.89	11
10	CH_4 Emissions from Enteric Fermentation in Domestic Livestock	CH_4	4 049	1 502	0	50	0.75	0.02	0.91	12
2	Mobile Combustion- road transportation	CO_2	7 747	6 267	0	6	0.40	0.01	0.92	13
22	CH_4 Emissions from Manure Management	CH_4	1 524	512	0	50	0.36	0.01	0.93	14
24	CO_2 from Ammonia Production	CO_2	1 157	337	0	50	0.35	0.01	0.94	15
14	N_2O Emissions from Nitric Acid Production	N_2O	2 422	1 159	0	200	0.30	0.01	0.95	16
17	Mobile Combustion-other transportation	CO_2	3 998	685	0	7	0.27	0.01	0.96	17
21	Fugitive Emissions from Oil and Gas Operations	CH_4	1 362	517	0	50	0.24	0.01	0.97	18
8	CO_2 Emissions from Stationary Combustion- Other Sectors, Coal	CO_2	4 953	1 690	0	9	0.20	0.01	0.97	19
16	CO_2 from Lime Production	CO_2	1 118	921	0	16	0.17	0.00	0.98	20

IN	IPCC Source Categories	Gas	CO_2-eq. 1988	CO_2-eq. 2003	Trend assessment	Comb. Unc. %	T2 Trend assessment %	% of Trend assessment	Cumul. of Trend	T2-trend
13	CO_2 Emissions from Cement Production	CO_2	2 737	1 189	0	30	0.16	0.00	0.98	21
3	CO_2 Emissions from Stationary Combustion-Manufacturing Industries, Coal	CO_2	9 272	5 214	0	9	0.14	0.00	0.99	22
9	CO_2 Emissions from Steel Production	CH_4	2 360	1 640	0	10	0.14	0.00	0.99	23
4	CO_2 Emissions from Stationary Combustion – Gas	CO_2	10 259	4 638	0	7	0.10	0.00	0.99	24
28	CO_2 Emissions from Industrial Processes - others	CO_2	39	84	0	21	0.04	0.00	0.99	25
18	Non-energy fuel use- gas	CO_2	990	656	0	7	0.03	0.00	1.00	26
33	Mobile Combustion-road transportation	N_2O	48	35	0	100	0.03	0.00	1.00	27
36	New gases	PFC, HFC	76	23	0	51	0.02	0.00	1.00	28
29	Non-energy fuel use- liquid	CO_2	354	74	0	7	0.02	0.00	1.00	29
27	Mobile Combustion-Railways	CO_2	368	89	0	6	0.02	0.00	1.00	30
25	Emissions from Wastewater Handling	N_2O	310	150	0	104	0.01	0.00	1.00	31
34	CH_4 Emissions from Stationary Combustion	CH_4	49	32	0	50	0.01	0.00	1.00	32
31	CH_4 Emissions from Industrial Processes – metal production	CH_4	73	53	0	21	0.01	0.00	1.00	33
38	N_2O Emissions from Agricultural Residue Burning	N_2O	14	5	0	202	0.01	0.00	1.00	34
35	Mobile Combustion-road transportation	CH_4	54	24	0	100	0.01	0.00	1.00	35
32	CH_4 Emissions from Rice Production	CH_4	119	48	0	21	0.01	0.00	1.00	36
26	CO_2 from Soda Ash Production	CO_2	233	106	0	21	0.01	0.00	1.00	37
37	CH_4 Emissions from Agricultural Residue Burning	CH_4	42	17	0	56	0.01	0.00	1.00	38
30	Non-energy fuel use- solid	CO_2	80	53	0	9	0.00	1.0	2.00	39
	TOTALS		**138 377**	**69 167**			34.9	2.0		

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.

For each the categories mentioned above we will give explanations that are mainly oriented towards the emissions of the most important factor for climate change – carbon dioxide.

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.

The large emission sources mentioned above can determine its emissions by reporting them for different purposes, but not include them officially in the country inventory. At a present moment an automated data base for large combustible sources of GHG emissions is under development. It will facilitate and equalize the methodology for emission assessment at a combustible plant/installation level.

Table A2.1

Default CO_2 emission factors used for Sectoral Approach, 2003

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

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 2002.

CO_2 emissions from international marine and air transport combustion are calculated with the same data and emission factors as for the country's 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 reserved carbon is presented in **Table A2.2**.

The Bulgarian Inventory is worked out by these numbers, 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. With the current inventory, they are accounted at the Sectoral Approach 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

Table A2.2

Carbon storage fractions for energy carriers used as feedstock

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 Solventgasolin	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 and different projects have started 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.

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.

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. The correlation between these two types of methodologies is difficult to be defined correctly because the combinations are different for each singe source.

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;
- Ammonia production;
- Production of calcium soda;
- Other industrial processes.

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. Significant part of the emissions in the category "other industrial processes" is from sulphur oxides cleaning at the electric power plants. Such a 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 2002 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.

In the beginning of the year 2005 studies were carried out for a start-up of the procedure for re-assessment of all the parameters and factors in the Agriculture with a view to the future precession of the country to the EU.

Methane emissions from the deposing of *solid waste* are the biggest GHG source in Bulgaria. They comprise 6 % of the overall emissions in the country for the year 2003. 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. Only the presence of such time series can permit the application of a method from higher rate.

Emissions of nitrogen oxide

N_2O emissions from *fuel combustion* represent the biggest part of the overall emissions from this type GHGs for the year 2003 – around 40 %. The energy sub-sectors – electricity and heat production emit the major part of them.

Certain quantities of N_2O 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 38.7 % from the overall emissions from this type GHG for the year 2003.

The biggest source of N_2O emissions within the sector is the agricultural soils. The parameters and the emission factors that are used for their 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 **Table A3.1** are presented the parameters and the emission factors used in the 2003 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 aluminum 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.

Table A3.1

Parameters and Emission factors for Agriculture

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	0.1
$Frac_{FUEL}$	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 %	43.91 % for 2003
$Frac_{NCRBF}$	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 2003 is 4 015 236 ha which is 36.2 % of the country's territory. The area covered with forests is 3 547 456 ha which defines 32.1 % wooded territories. Compared with the year 2002, the area of the forestry fund has increased with 11 481 ha due to the management of the non-arranged forests till now.

The total wooded surface (including pine-scrub) has increased with 34 866 ha as a result of newly arranged forests and the completed a forestations. The un-afforested area prepared for forestation as well the forestry pastures have decreased respectively with 8 999 ha and 11 172 ha. Non-wood productive forestry area has decreased with 3 181 ha.

The area of the forests by type of property is distributed according to **Table A3.2** as follows:

Table A3.2

Forest Area by type of ownership

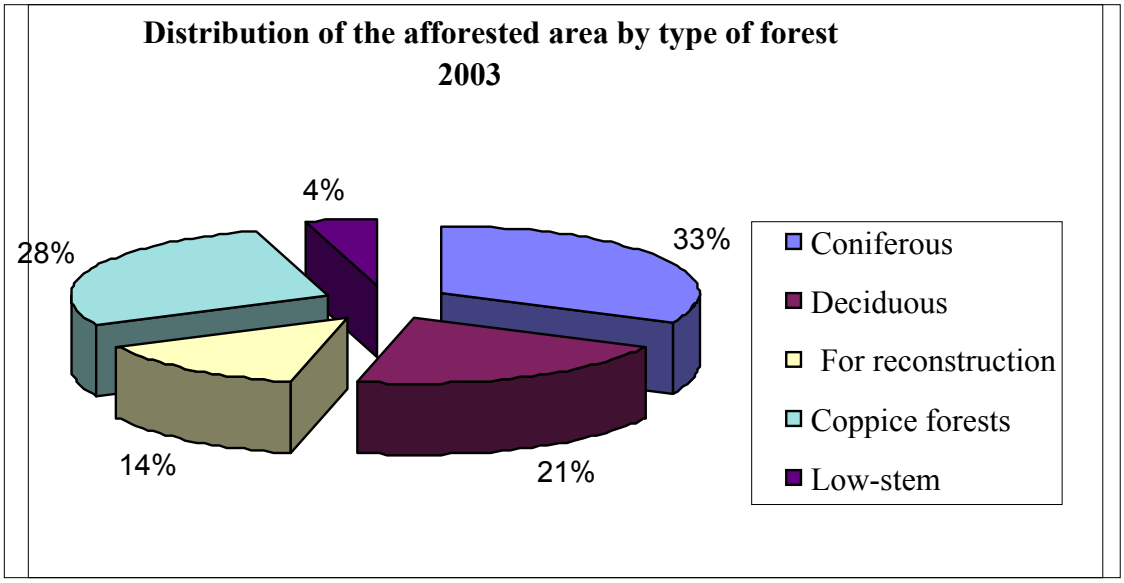
Type	Area – ha		%	
	total	afforested	From total	from afforested
State	3 195 314	2 797 529	79,6	78,9
Municipal	339 273	304 857	8,4	8,6
Private subjects	376 919	351 381	9,4	9,9
Private law subjects	7 604	6 861	0,2	0,2
Religious organizations	33 666	27 393	0,8	0,8
Others	62 460	59 416	1,6	1,6
Total	**4 015 236**	**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 and putting them in possession by court orders.

The wooden reserve exceeds 530 millions m^3 within annaul increase in around 12.3 millions m^3 and usage of the wood – 6 569 918 m^3. The planned usage for the year 2003 according to forestry management projects is 7 637 614 m^3 but it has not been put into practice.

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 2002-2003 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 8 377 ha new forests have been planted and other 2 352.3 ha are fulfilled for recuperation from the losses of forest crops. 69.68 % 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 %. An overall tendency to an increase in the number of the trees at the first grade of defoliation is observed.

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 accomplished analysis of the factors affecting the condition of the forest ecosystems give reasons to consider that the biggest share has the a-biotic factors, followed by the attacks from insects and fungus pathogenesis.

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. They are aimed at the growth and the preservation of the forest's ecosystems in good existing condition. 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.

In the year 2003 a number of important regulation documents in the field of preserving the forests from fires are been adopted – Regulation № 30 of the ministries of Agriculture and Forests and of The Internal Affairs for the conditions and order of carrying out of anti-fire measures at the forestry fund and preserving the forests from fires, Strategy of MAF for preserving the forests from fires as well as the establishment of Interdepartmental coordinating council.

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.

NFPS determines the main strategic priorities and activities for 10 year in future including the sustainable management and running-up of the tree and non-tree forest resources, preserving the biological and landscape diversity, optimal combination between the ecological, social and economical functions of the forests.

NFPS is presented at the National Assembly for discussion and adopting.

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 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. These emissions are estimated using the same conversion and emission factors as for fuels used for energy.

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 1.4 – 1.7 % for the last three 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 %. The presented situation is very different for the period till the year 1997.

Main causes for the difference between Reference and Sectoral Approaches

These differences 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;

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 four National Inventory Reports for the years 1999-2003.

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 higher for the period after 1999 with 5 – 7 % due to the recalculations. For the base year the result is opposite – the emissions are lower with 4 %.

Table A4.1

Comparison of CO_2 emissions: Reference Approach (RA) versus Sectoral Approach (SA) - NIR 2005, Gg

Method/ Year	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
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
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
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
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**
Sectoral Approach															
Liquid	33 795	26 753	18 376	14 699	15 614	14 457	14 645	13 205	11 606	12 261	11 906	10 525	10 473	10 853	11 734
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	32 007
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
Others															
TOTAL - SA	**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, %															
Liquid	3.1	5.9	4.8	4.1	17.3	16.7	13.6	10.4	4.0	-6.9	-1.4	3.4	2.0	9.9	4.0
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	0.5
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
Others															
TOTAL	**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**

Table A4.2

Differences of CO_2 emissions from fuel combustion in the Sectoral Approach due to recalculation

Gas/Sector	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
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
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 four National Inventory Reports.

The analysis of the Table shows overall improvement of the quality assessment of sum CO_2 emissions. It is expressed in reduction of the differences between the two approaches for all the inventory years in 2005 National Inventory Report compared to 2004 National Inventory Report. The year 1991 is the only exception.

Table A4.3

Effect of recalculations on the comparison of CO_2 emissions in the RA versus NA (NIRs 2001-2005), Gg

Gas/Sector	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
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
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
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***
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 2003 GHG Inventory are included all the sectors mentioned in the Revised IPCC Guidance, 1996 with the exception of:

- Emissions from categories 5B-5E from sector Land Use Change and Forestry;
- CO_2 emissions from solid waste combustion;
- 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 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).

Table A5.1

INFORMATION ON NOTATION KEYS

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 Anesthesia	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 Anesthesia	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

The Notation Key "0,00" means the negligible amounts of the emission or parameter

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. Research for development of National System for Anthropogenic GHG emissions Assessment, stage 1 (in process of execution), Energy Institute Archive, Sofia, 2005.

ANNEX 7: SELECTED TABLES FROM THE COMMON REPORTING FORMAT (CRF TABLES)

In this annex are presented some overall tables from the Common Reporting Format which provides a detailed characteristic for the GHG Inventory for the year 2003 as well as for some previous years.

Annex 7.1 – Overall CRF Tables 7 for the base year 1988, 1995 and for the period 2000-2003;

Annex 7.2 – Tables for recalculation of the base year 1988, and for the period 1990-2002 (CRF tables 8a and 8b);

Annex 7.3 – CRF trend tables 10 for GHG CO_2, CH_4, N_2O and F-gases as well as for all gases and source categories expressed in CO_2-eq.

Annex 7.4 – Trend tables for GHG-precursors and SOx.

7.1 IPCC tables 7 A for the Base Year 1988, for the Year 1995 and for the Period 2000-2003

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	**98 571,61**	**-5 132,63**	**1 186,88**	**47,76**	**0,00**	**0,00**	**0,00**	**75,55**	**0,00**	**0,00**	**285,38**	**859,17**	**120,36**	**1 781,85**
1. Energy	**90 725,67**		**161,04**	**13,46**							**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	13,46							262,10	798,05	68,17	1 756,52
1. Energy Industries	43 216,90		0,84	11,40							96,25	10,03	0,77	1 285,57
2. Manufacturing Industries and Construction	24 754,56		0,57	0,92							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	0,81							13,76	174,83	0,05	212,37
5. Other	0,00		0,59	0,00							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	**7 845,94**		**3,89**	**7,81**	**0,00**	**0,00**	**0,00**	**75,55**	**0,00**	**0,00**	**21,69**	**19,40**	**38,57**	**25,33**
A. Mineral Products	4 114,32		0,00	0,00							0,00	0,00	2,92	1,66
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**	**273,01**	**25,48**							1,58	41,71	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	22,03									0,00
E. Prescribed Burning of Savannas			0,00	0,00							NO	NO	NO
F. Field Burning of Agricultural Residues			1,99	0,04							1,58	41,71	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**		**748,95**	**1,00**							**0,00**	**0,00**	**0,00**
A. Solid Waste Disposal on Land	[6] 0,00		661,09									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: 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	**64 730,59**	**-7 524,48**	**678,09**	**26,61**	**62,16**	**2,95**	**0,00**	**46,94**	**0,00**	**1,26**	**151,95**	**609,48**	**86,33**	**1 299,11**
1. Energy	**59 375,81**		**103,87**	**9,76**							**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	9,76							134,27	566,62	49,12	1 285,05
1. Energy Industries	31 571,95		0,56	8,56							56,13	8,98	0,69	1 055,67
2. Manufacturing Industries and Construction	18 023,19		0,34	0,92							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	0,09							4,96	88,45	0,00	90,96
5. Other	315,02		0,57	0,0504							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	**5 354,78**		**3,52**	**6,20**	**62,16**	**2,95**	**0,00**	**46,94**	**0,00**	**1,26**	**16,70**	**15,25**	**24,71**	**14,06**
A. Mineral Products	1 960,14		0,00	0,00							0,00	0,00	2,13	0,62
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**	**121,66**	**10,07**							0,98	27,62	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	8,45									0,00
E. Prescribed Burning of Savannas			0,00	0,00							NO	NO	NO
F. Field Burning of Agricultural Residues			1,32	0,03							0,98	27,62	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**		**449,04**	**0,57**							**0,00**	**0,00**	**0,00**
A. Solid Waste Disposal on Land	[6] 0,00		399,69									0,00	0,00
B. Wastewater Handling			49,34	0,57							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)* [redacted]	**0,00**	**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 A7.3 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	**49 902,79**	**-8 976,23**	**430,38**	**21,69**	**96,02**	**0,00**	**0,00**	**33,14**	**29,40**	**2,23**	**121,19**	**429,42**	**57,04**	**1 044,63**
1. Energy	**45 861,46**		**88,51**	**7,78**							**109,44**	**398,33**	**31,95**	**1 029,34**
A. Fuel Combustion — Reference Approach [2]	46 136,32													
A. Fuel Combustion — Sectoral Approach [2]	45 861,46		2,83	7,78							109,44	398,33	31,95	1 029,34
1. Energy Industries	26 215,75		0,43	7,25							49,07	5,89	0,40	885,80
2. Manufacturing Industries and Construction	11 868,18		0,23	0,20							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	0,21							4,00	65,66	0,00	56,48
5. Other	0,00		0,50	0,0000							1,34	124,07	0,00	0,00
B. Fugitive Emissions from Fuels	0,00		85,68	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		28,58	0,00							0,00	0,00	0,00	0,00
2. Industrial Processes	**4 041,33**		**3,51**	**4,24**	**96,02**	**0,00**	**0,00**	**33,14**	**29,40**	**2,23**	**11,09**	**9,36**	**14,39**	**15,29**
A. Mineral Products	1 988,09		0,00	0,00							0,00	0,00	0,93	0,69
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**	**108,83**	**9,16**							**0,66**	**21,73**	**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	7,76									0,00
E. Prescribed Burning of Savannas			0,00	0,00							NO	NO	NO
F. Field Burning of Agricultural Residues			1,03	0,02							0,66	21,73	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**	**0,51**							**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	0,51							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 A7.4 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	**51 472,32**	**-9 467,15**	**396,18**	**21,38**	**97,50**	**0,00**	**0,00**	**16,29**	**2,39000**	**2,29362**	**128,97**	**373,37**	**57,40**	**1 084,89**
1. Energy	**47 475,34**		**86,61**	**8,54**							**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	8,54							117,37	341,76	28,59	1 081,91
1. Energy Industries	29 035,91		0,47	8,00							59,84	6,34	0,43	956,90
2. Manufacturing Industries and Construction	10 788,11		0,22	0,18							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	0,25							3,10	37,25	0,00	38,51
5. Other	0,00		0,48	0,00							1,31	121,15	0,00	0,00
B. Fugitive Emissions from Fuels	0,00		83,99	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		26,29	0,00							0,00	0,00	0,00	0,00
2. Industrial Processes	**3 996,97**		**2,42**	**4,18**	**97,50**	**0,00**	**0,00**	**16,29**	**2,39**	**2,29**	**10,93**	**7,03**	**11,71**	**2,97**
A. Mineral Products	2 068,30		0,00	0,00							0,00	0,00	1,05	0,69
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**	**84,24**	**8,18**							**0,66**	**24,58**	**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	7,13									0,00	
E. Prescribed Burning of Savannas			0,00	0,00							NO	NO	NO	
F. Field Burning of Agricultural Residues			1,17	0,02							0,66	24,58	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**	**0,47**							**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	0,47							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 A7.5 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	**48 758,05**	**-8 318,06**	**403,89**	**20,24**	**89,59**	**0,00**	**0,00**	**21,42**	**2,39**	**2,51**	**124,41**	**426,43**	**60,73**	**982,88**
1. Energy	**45 054,34**		**85,20**	**7,73**							**114,29**	**392,66**	**30,41**	**966,87**
A. Fuel Combustion — Reference Approach [2]	45 842,68													
A. Fuel Combustion — Sectoral Approach [2]	45 054,34		2,80	7,73							114,29	392,66	30,41	966,87
1. Energy Industries	26 465,57		0,43	7,19							53,99	5,98	0,40	821,53
2. Manufacturing Industries and Construction	10 198,06		0,21	0,21							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	0,22							4,25	58,05	0,00	59,27
5. Other	0,00		0,55	0,00							1,49	138,41	0,00	0,00
B. Fugitive Emissions from Fuels	0,00		82,40	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		23,905	0,00							0,00	0,00	0,00	0,00
2. Industrial Processes	**3 703,71**		**2,19**	**3,51**	**89,59**	**0,00**	**0,00**	**21,42**	**2,39**	**2,51**	**9,26**	**5,37**	**13,19**	**16,00**
A. Mineral Products	2 051,84		0,00	0,00							0,00	0,00	1,89	0,67
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**	**94,85**	**8,54**							**0,86**	**28,40**	**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	7,33									0,00
E. Prescribed Burning of Savannas			0,00	0,00							NO	NO	NO
F. Field Burning of Agricultural Residues			1,35	0,0237							0,86	28,40	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**	**0,45**							**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	0,45							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)* [redacted]	**0,00**	**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 A7.6 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	**53 321,38**	**-7 055,98**	**445,99**	**20,83**	**120,60**	**0,00**	**0,00**	**20,69**	**6,36**	**2,52**	**135,29**	**385,28**	**58,38**	**1 042,71**
1. Energy	**49 035,44**		**84,93**	**8,54**							**124,77**	**362,05**	**30,61**	**1 025,07**
A. Fuel Combustion — Reference Approach [2]	49 824,54													
Sectoral Approach [2]	49 035,44		2,79	8,54							124,77	362,05	30,61	1 025,07
1. Energy Industries	28 329,87		0,45	7,87							57,73	6,04	0,42	866,04
2. Manufacturing Industries and Construction	11 402,14		0,24	0,33							15,85	6,34	0,05	89,89
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	0,21							4,58	55,74	0,00	60,36
5. Other	0,00		0,44	0,00							1,20	111,43	0,00	0,00
B. Fugitive Emissions from Fuels	0,00		82,14	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		24,60	0,00							0,00	0,00	0,00	0,00
2. Industrial Processes	**4 285,94**		**2,79**	**3,74**	**120,60**	**0,00**	**0,00**	**20,69**	**6,36**	**2,52**	**9,89**	**6,12**	**13,23**	**17,64**
A. Mineral Products	2 279,10		0,00	0,00							0,00	0,00	1,02	0,76
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**	**99,01**	**8,06**							0,62	17,11	0,00	0,00
A. Enteric Fermentation			71,54											
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	6,77									0,00	
E. Prescribed Burning of Savannas			0,00	0,00							NO	NO	NO	
F. Field Burning of Agricultural Residues			0,81	0,0172							0,62	17,11	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**	**0,48**							**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	0,48							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)* [redacted]	**0,00**	**0,00**	**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**													

7.2 IPCC Tables 8A and 8B for the Base Year 1988, and for the Period 1990-2002

Table A 7.7 CRF table for recalculation of tables 8a and 8b for the year 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		**97 861,56**	**93 438,98**	**-4,52**	**24 441,41**	**24 924,58**	**1,98**	**14 861,15**	**14 805,01**	**-0,38**
1. Energy		**94 672,59**	**90 725,67**	**-4,17**	**4 854,52**	**3 381,88**	**-30,34**	**4 733,24**	**4 173,95**	**-11,82**
1.A.	Fuel Combustion Activities	94 672,59	90 725,67	-4,17	124,26	111,33	-10,41	4 733,24	4 173,95	-11,82
1.A.1.	Energy Industries	37 001,93	43 216,90	16,80	39,03	17,73	-54,57	2 877,42	3 534,47	22,83
1.A.2.	Manufacturing Industries and Construction	35 754,56	24 754,56	-30,77	4,30	11,91	176,74	1 546,90	286,49	-81,48
1.A.3.	Transport	12 638,68	13 813,97	9,30	63,00	62,60	-0,64	70,90	100,94	42,37
1.A.4.	Other Sectors	7 611,92	8 940,25	17,45	5,32	6,71	26,11	180,73	252,05	39,46
1.A.5.	Other	1 665,50	NO	-100,00	12,60	12,38	-1,77	57,29	0,00	-100,00
1.B.	Fugitive Emissions from Fuels	NE	NE		4 730,27	3 270,55	-30,86	NE	NE	
1.B.1.	Solid fuel	NE	NE		1 929,08	1 991,58	3,24	NE	NE	
1.B.2.	Oil and Natural Gas	NE	NE		2 801,19	1 278,97	-54,34	NE	NE	
2. Industrial Processes		**7 845,94**	**7 845,94**	**0,00**	**43,30**	**81,66**	**88,61**	**2 421,72**	**2 421,72**	**0,00**
2.A.	Mineral Products	4 114,32	4 114,32	0,00	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	42,46	73,20	72,41	NA	NA	
2.D.	Other Production	NO	NO							
2.G.	Other	NO	NO		0,00	7,62	100,00	NO	NO	
3. Solvent and Other Product Use				**0,00**						**0,00**
4. Agriculture		**0,00**	**0,00**	**0,00**	**5 730,84**	**5 733,12**	**0,04**	**7 470,59**	**7 898,85**	**5,73**
4.A.	Enteric Fermentation				4 048,54	4 048,54	0,00			
4.B.	Manure Management				1 523,61	1 523,61	0,00	1 056,05	1 056,05	0,00
4.C.	Rice Cultivation				118,44	119,25	0,68			
4.D.	Agricultural Soils [2]	NA	NA		NE	NE		6 401,77	6 829,22	6,68
4.E.	Prescribed Burning of Savannas						0,00			0,00
4.F.	Field Burning of Agricultural Residues				40,24	41,71	3,67	12,78	13,59	6,35
4.G.	Other				NO	NO		NO	NO	
5. Land-Use Change and Forestry (net) [3]		**-4 656,97**	**-5 132,63**	**10,21**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
5.A.	Changes in Forest and Other Woody Biomass Stocks	-4 656,97	-5 132,63	10,21						
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
	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)	
6. Waste	**0,00**	**0,00**	**0,00**	**13 812,75**	**15 727,92**	**13,87**	**235,60**	**310,49**
6.A. Solid Waste Disposal on Land	NE	NE		12 877,20	13 882,99	7,81		
6.B. Wastewater Handling				935,55	1 844,93	97,20	235,60	310,49
6.C. Waste Incineration	NO	NO		NO	NO		NO	NO
6.D. Other	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**
	NO	NO		NO	NO		NO	NO
Memo Items:								
International Bunkers	**2 053,00**	**1 718,36**	**-16,30**	**1,32**	**1,32**	**-0,30**	**7,13**	**7,52**
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
	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**
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			
Other			0,00			0,00		
Potential Emissions from Consumption of HFCs/PFCs and SF_6	**0,00**	**0,00**	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]	137 239,67	133 244,13	-2,91
Total CO_2 Equivalent Emissions without Land-Use Change and Forestry[3]	141 896,63	138 376,76	-2,48

Table A 7.8 CRF table for recalculation of tables 8a and 8b for the year 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		**77 008,08**	**79 381,53**	**3,08**	**25 584,33**	**21 392,68**	**-16,38**	**13 681,59**	**12 942,96**	**-5,40**
1. Energy		**75 942,09**	**78 672,85**	**3,60**	**4 609,88**	**2 313,90**	**-49,81**	**3 654,59**	**3 654,59**	**0,00**
1.A.	Fuel Combustion Activities	75 942,09	78 672,85	3,60	104,70	104,70	0,00	3 654,59	3 654,59	0,00
1.A.1.	Energy Industries	38 801,40	39 601,23	2,06	19,17	19,17	0,00	2 964,22	2 964,22	0,00
1.A.2.	Manufacturing Industries and Construction	19 890,45	21 821,39	9,71	7,45	7,45	0,00	523,52	523,52	0,00
1.A.3.	Transport	10 863,71	10 863,71	0,00	61,02	61,02	0,00	78,74	78,75	0,01
1.A.4.	Other Sectors	5 380,59	5 380,59	0,00	4,39	4,39	0,00	68,66	68,66	0,00
1.A.5.	Other	1 005,93	1 005,93	0,00	12,67	12,67	0,00	19,44	19,44	0,00
1.B.	Fugitive Emissions from Fuels	0,00	0,00	0,00	4 505,18	2 209,20	-50,96	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		2 913,37	617,39	-78,81	NE	NE	
2. Industrial Processes		**6 865,67**	**6 865,67**	**0,00**	**58,24**	**63,46**	**8,95**	**2 255,50**	**2 255,50**	**0,00**
2.A.	Mineral Products	3 797,38	3 797,38	0,00	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		0,00	5,21	100,00	NO	NO	
3. Solvent and Other Product Use				**0,00**						**0,00**
4. Agriculture		**0,00**	**0,00**	**0,00**	**5 414,16**	**5 416,07**	**0,04**	**7 547,85**	**6 809,22**	**-9,79**
4.A.	Enteric Fermentation				3 783,64	3 783,64	0,00			
4.B.	Manure Management				1 501,24	1 501,24	0,00	1 030,42	1 030,42	0,00
4.C.	Rice Cultivation				88,96	89,56	0,68			
4.D.	Agricultural Soils [2]	NA	NA		NE	NE		6 505,53	5 766,21	-11,36
4.E.	Prescribed Burning of Savannas						0,00			0,00
4.F.	Field Burning of Agricultural Residues				40,32	41,63	3,23	11,91	12,58	5,69
4.G.	Other				NO	NO		NO	NO	
5. Land-Use Change and Forestry (net) [3]		**-5 799,68**	**-6 156,99**	**6,16**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
5.A.	Changes in Forest and Other Woody Biomass Stocks	-5 799,68	-6 156,99	6,16						
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
		CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)	
6. Waste		**0,00**	**0,00**	**0,00**	**15 502,04**	**13 599,24**	**-12,27**	**223,66**	**223,66**
6.A.	Solid Waste Disposal on Land	NE	NE		14 442,40	12 202,42	-15,51		
6.B.	Wastewater Handling				1 059,64	1 396,82	31,82	223,66	223,66
6.C.	Waste Incineration	NO	NO		NO	NO		NO	NO
6.D.	Other	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**
		NO	NO		NO	NO		NO	NO
Memo Items:									
International Bunkers		**1 766,14**	**1 766,14**	**0,00**	**1,16**	**1,16**	**0,00**	6,83	6,83
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
		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**
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		0,00	0,00
	Other	NO	NO		NO	NO		NO	NO
Potential Emissions from Consumption of HFCs/PFCs and SF_6		**0,00**	**0,00**	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]	116 321,31	113 764,48	-2,20
Total CO_2 Equivalent Emissions without Land-Use Change and Forestry[3]	122 120,99	119 921,47	-1,80

Table A 7.9 CRF table for recalculation of tables 8a and 8b for the year 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		**53 821,18**	**57 206,11**	**6,29**	**16 145,83**	**14 239,87**	**-11,80**	**8 405,85**	**8 247,63**	**-1,88**
1. Energy		**55 985,88**	**59 375,81**	**6,05**	**4 093,59**	**2 181,26**	**-46,72**	**3 026,53**	**3 026,56**	**0,00**
1.A.	Fuel Combustion Activities	55 985,88	59 375,81	6,05	75,67	75,68	0,01	3 026,53	3 026,56	0,00
1.A.1.	Energy Industries	31 623,45	31 571,95	-0,16	11,86	11,86	0,00	2 652,74	2 652,74	0,00
1.A.2.	Manufacturing Industries and Construction	14 581,77	18 023,19	23,60	7,09	7,09	0,00	285,09	285,09	0,00
1.A.3.	Transport	6 844,63	6 844,63	0,00	42,50	42,50	0,01	44,16	44,18	0,05
1.A.4.	Other Sectors	2 621,01	2 621,01	0,00	2,17	2,17	0,00	28,93	28,93	0,00
1.A.5.	Other	315,02	315,02	0,00	12,06	12,06	0,00	15,61	15,61	0,00
1.B.	Fugitive Emissions from Fuels	0,00	0,00	0,00	4 017,91	2 105,58	-47,60	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		2 564,43	652,10	-74,57	NE	NE	
2. Industrial Processes		**5 354,78**	**5 354,78**	**0,00**	**69,79**	**73,92**	**5,91**	**1 921,08**	**1 921,08**	**0,00**
2.A.	Mineral Products	1 960,14	1 960,14	0,00	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		0,00	4,12	100,00	NO	NO	
3. Solvent and Other Product Use				**0,00**						**0,00**
4. Agriculture		**0,00**	**0,00**	**0,00**	**2 552,67**	**2 554,91**	**0,09**	**3 281,43**	**3 123,18**	**-4,82**
4.A.	Enteric Fermentation				1 790,77	1 790,77	0,00			
4.B.	Manure Management				724,85	724,85	0,00	495,73	495,73	0,00
4.C.	Rice Cultivation				11,59	11,67	0,68			
4.D.	Agricultural Soils [2]	NA	NA		NE	NE		2 778,40	2 619,07	-5,73
4.E.	Prescribed Burning of Savannas						0,00			0,00
4.F.	Field Burning of Agricultural Residues				25,45	27,62	8,49	7,30	8,38	14,78
4.G.	Other				NO	NO		NO	NO	
5. Land-Use Change and Forestry (net) [3]		**-7 519,48**	**-7 524,48**	**0,07**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
5.A.	Changes in Forest and Other Woody Biomass Stocks	-7 519,48	-7 524,48	0,07						
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
		CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)	
6. Waste		**0,00**	**0,00**	**0,00**	**9 429,78**	**9 429,78**	**0,00**	**176,80**	**176,80**
6.A.	Solid Waste Disposal on Land	NE	NE		8 393,54	8 393,54	0,00		
6.B.	Wastewater Handling				1 036,24	1 036,24	0,00	176,80	176,80
6.C.	Waste Incineration	NO	NO		NO	NO		NO	NO
6.D.	Other	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**
		NO	NO		NO	NO		NO	NO
Memo Items:									
International Bunkers		**1 431,78**	**1 431,78**	**0,00**	**0,69**	**0,69**	**0,00**	6,84	6,84
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
		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**	**0,00**	**1,26**
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		0,00	1,26
	Other			0,00			0,00		
Potential Emissions from Consumption of HFCs/PFCs and SF_6		**62,16**	**62,16**	0,00	**NE**	**NE**		**0,00**	**0,00**

	Previous submission	Latest submission	Difference[1]
	CO_2 equivalent (Gg)		(%)
Total CO_2 Equivalent Emissions with Land-Use Change and Forestry[3]	78 422,76	79 744,76	1,69
Total CO_2 Equivalent Emissions without Land-Use Change and Forestry[3]	85 942,24	87 269,24	1,54

Table A 7.10 CRF table for recalculation of tables 8a and 8b for the year 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		**37 714,19**	**40 926,56**	**8,52**	**10 164,92**	**9 037,99**	**-11,09**	**6 721,68**	**6 722,67**	**0,01**
1. Energy		**42 649,09**	**45 861,46**	**7,53**	**2 993,33**	**1 858,74**	**-37,90**	**2 410,97**	**2 410,97**	**0,00**
1.A.	Fuel Combustion Activities	42 649,09	45 861,46	7,53	59,52	59,52	0,00	2 410,97	2 410,97	0,00
1.A.1.	Energy Industries	26 266,74	26 215,75	-0,19	8,96	8,96	0,00	2 248,33	2 248,33	0,00
1.A.2.	Manufacturing Industries and Construction	8 604,82	11 868,18	37,92	4,90	4,90	0,00	62,37	62,37	0,00
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	65,79	0,00
1.A.5.	Other	NO	NO		10,40	10,40	0,00	NO	NO	
1.B.	Fugitive Emissions from Fuels	0,00	0,00	0,00	2 933,81	1 799,22	-38,67	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		1 734,83	600,24	-65,40	NE	NE	
2. Industrial Processes		**4 041,33**	**4 041,33**	**0,00**	**73,81**	**73,81**	**0,00**	**1 314,42**	**1 314,42**	**0,00**
2.A.	Mineral Products	1 988,09	1 988,09	0,00	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**	**2 277,86**	**2 285,52**	**0,34**	**2 838,09**	**2 839,09**	**0,04**
4.A.	Enteric Fermentation				1 664,90	1 664,90	0,00			
4.B.	Manure Management				568,69	568,69	0,00	429,29	429,29	0,00
4.C.	Rice Cultivation				22,56	30,20	33,85			
4.D.	Agricultural Soils [2]	NA	NA		NE	NE		2 403,19	2 404,16	0,04
4.E.	Prescribed Burning of Savannas						0,00			0,00
4.F.	Field Burning of Agricultural Residues				21,71	21,73	0,09	5,61	5,63	0,42
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
	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**	**158,20**
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	158,20
6.C. Waste Incineration	NO	NO		NO	NO		NO	NO
6.D. Other	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**
	NO	NO		NO	NO		NO	NO
Memo Items:								
International Bunkers	**475,16**	**475,16**	**0,00**	**0,47**	**0,47**	**0,00**	**1,60**	**1,60**
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
	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**	**1,06**	**2,23**
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		1,06	2,23
Other			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**

	Previous submission	Latest submission	Difference[1]
	CO_2 equivalent (Gg)		(%)
Total CO_2 Equivalent Emissions with Land-Use Change and Forestry[3]	54 634,99	56 722,59	3,82
Total CO_2 Equivalent Emissions without Land-Use Change and Forestry[3]	63 611,21	65 698,82	3,28

Table A 7.11 CRF table for recalculation of tables 8a and 8b for the year 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		**39 447,18**	**42 005,17**	**6,48**	**9 370,31**	**8 319,86**	**-11,21**	**6 624,47**	**6 626,36**	**0,03**
1. Energy		**44 917,35**	**47 475,34**	**5,69**	**2 869,38**	**1 818,87**	**-36,61**	**2 648,44**	**2 648,44**	**0,00**
1.A.	Fuel Combustion Activities	44 917,35	47 475,34	5,69	55,07	55,07	0,00	2 648,44	2 648,44	0,00
1.A.1.	Energy Industries	29 070,36	29 035,91	-0,12	9,77	9,77	0,00	2 480,17	2 480,17	0,00
1.A.2.	Manufacturing Industries and Construction	8 195,67	10 788,11	31,63	4,69	4,69	0,00	56,70	56,70	0,00
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	77,12	0,00
1.A.5.	Other	NO	NO		10,16	10,16	0,00	NO	NO	
1.B.	Fugitive Emissions from Fuels	0,00	0,00	0,00	2 814,30	1 763,80	-37,33	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		1 602,51	552,00	-65,55	NE	NE	
2. Industrial Processes		**3 996,97**	**3 996,97**	**0,00**	**50,90**	**50,90**	**0,00**	**1 295,16**	**1 295,16**	**0,00**
2.A.	Mineral Products	2 068,30	2 068,30	0,00	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**	**1 768,95**	**1 769,00**	**0,00**	**2 534,61**	**2 536,50**	**0,07**
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		2 208,33	2 210,17	0,08
4.E.	Prescribed Burning of Savannas						0,00			0,00
4.F.	Field Burning of Agricultural Residues				24,54	24,58	0,19	5,65	5,70	0,86
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
		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**	**146,25**
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	146,25
6.C.	Waste Incineration	NO	NO		NO	NO		NO	NO
6.D.	Other	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**
		NO	NO		NO	NO		NO	NO
Memo Items:									
International Bunkers		**699,16**	**699,16**	**0,00**	**0,69**	**0,69**	**0,00**	**2,38**	**2,38**
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
		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**	**1,10**	**2,29**
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		1,10	2,29
	Other			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**

	Previous submission	Latest submission	Difference[1]
	CO_2 equivalent (Gg)		(%)
Total CO_2 Equivalent Emissions with Land-Use Change and Forestry[3]	55 459,35	56 969,97	2,72
Total CO_2 Equivalent Emissions without Land-Use Change and Forestry[3]	64 926,50	66 437,12	2,33

Table A 7.12 CRF table for recalculation of tables 8a and 8b for the year 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		**38 437,44**	**40 439,99**	**5,21**	**9 375,51**	**8 481,79**	**-9,53**	**6 274,98**	**6 274,80**	**0,00**
1. Energy		**43 051,79**	**45 054,34**	**4,65**	**2 682,87**	**1 789,14**	**-33,31**	**2 397,83**	**2 397,83**	**0,00**
1.A.	Fuel Combustion Activities	43 051,79	45 054,34	4,65	58,70	58,70	0,00	2 397,83	2 397,83	0,00
1.A.1.	Energy Industries	26 495,89	26 465,57	-0,11	8,97	8,97	0,00	2 228,10	2 228,10	0,00
1.A.2.	Manufacturing Industries and Construction	8 165,18	10 198,06	24,90	4,40	4,40	0,00	65,22	65,22	0,00
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	68,97	0,00
1.A.5.	Other	NO	NO		11,61	11,61	0,00	NO	NO	
1.B.	Fugitive Emissions from Fuels	0,00	0,00	0,00	2 624,18	1 730,44	-34,06	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		1 395,75	502,01	-64,03	NE	NE	
2. Industrial Processes		**3 703,71**	**3 703,71**	**0,00**	**46,08**	**46,08**	**0,00**	**1 088,82**	**1 088,82**	**0,00**
2.A.	Mineral Products	2 051,84	2 051,84	0,00	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**	**1 991,88**	**1 991,90**	**0,00**	**2 648,55**	**2 648,36**	**-0,01**
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		2 272,92	2 272,71	-0,01
4.E.	Prescribed Burning of Savannas						0,00			0,00
4.F.	Field Burning of Agricultural Residues				28,38	28,40	0,06	7,32	7,34	0,31
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
	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**	**139,78**
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	139,78
6.C. Waste Incineration	NO	NO		NO	NO		NO	NO
6.D. Other	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**
	NO	NO		NO	NO		NO	NO
Memo Items:								
International Bunkers	**735,38**	**735,38**	**0,00**	**0,75**	**0,75**	**0,00**	**2,62**	**2,62**
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
	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**	**1,10**	**2,51**
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		1,10	2,51
Other			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**

	Previous submission	Latest submission	Difference[1]
	CO_2 equivalent (Gg)		(%)
Total CO_2 Equivalent Emissions with Land-Use Change and Forestry[3]	54 110,45	55 220,51	2,05
Total CO_2 Equivalent Emissions without Land-Use Change and Forestry[3]	62 428,51	63 538,57	1,78

7.3 CRF Trend Tables 10 for the Main GHG

Table A7.13 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
	(Gg)														
1. Energy	**90 725,67**	**78 672,85**	**63 356,62**	**57 197,49**	**59 681,67**	**56 658,23**	**59 375,81**	**57 954,77**	**56 733,02**	**50 812,88**	**46 746,32**	**45 861,46**	**47 475,34**	**45 054,34**	**49 035,44**
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	57 954,77	56 733,02	50 812,88	46 746,32	45 861,46	47 475,34	45 054,34	49 035,44
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
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	11402,14
3. Transport	13813,97	10863,71	6524,57	6435,38	7443,93	6546,95	6844,63	6305,61	5315,21	6475,23	6211,56	5881,45	6013,52	6316,61	7097,83
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
5. Other	0,00	1005,93	881,89	195,86	733,11	809,61	315,02	261,14	112,18	49,12	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
1. Solid Fuels	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
2. Industrial Processes	**7 845,94**	**6 865,67**	**4 598,92**	**3 907,88**	**3 935,89**	**4 619,97**	**5 354,78**	**5 201,65**	**4 842,62**	**3 489,67**	**3 783,61**	**4 041,33**	**3 996,97**	**3 703,71**	**4 285,94**
A. Mineral Products	4 114,32	3 797,38	2 198,62	1 768,55	1 500,71	1 597,62	1 960,14	2 037,44	1 704,85	1 138,20	1 734,43	1 988,09	2 068,30	2 051,84	2 279,10
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
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
D. Other Production	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
3. Solvent and Other Product Use	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**
A. Enteric Fermentation	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
C. Rice Cultivation	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
E. Prescribed Burning of Savannas	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
G. Other	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**
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
B. Forest and Grassland Conversion	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
D. CO_2 Emissions and Removals from Soil	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
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**
A. Solid Waste Disposal on Land	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
C. Waste Incineration	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
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**
	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total Emissions/Removals with LUCF [4]	**93 438,98**	**79 381,53**	**60 319,84**	**53 693,34**	**56 141,80**	**53 976,53**	**57 206,11**	**56 638,97**	**54 704,11**	**47 442,06**	**43 330,16**	**40 926,56**	**42 005,17**	**40 439,99**	**46 265,40**
Total Emissions without LUCF[4]	**98 571,61**	**85 538,52**	**67 955,54**	**61 105,37**	**63 617,56**	**61 278,21**	**64 730,59**	**63 156,43**	**61 575,65**	**54 302,55**	**50 529,93**	**49 902,79**	**51 472,32**	**48 758,05**	**53 321,38**
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**
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
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
Multilateral Operations	**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**

Table A7.14 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
	(Gg)														
Total Emissions	**1 186,88**	**1 018,70**	**894,13**	**831,40**	**748,21**	**694,87**	**678,09**	**626,92**	**538,24**	**497,50**	**423,94**	**430,38**	**396,18**	**403,89**	**445,99**
1. Energy	**161,04**	**110,19**	**95,96**	**98,89**	**99,30**	**97,17**	**103,87**	**102,07**	**91,23**	**91,98**	**80,37**	**88,51**	**86,61**	**85,20**	**84,93**
A. Fuel Combustion (Sectoral Approach)	5,30	4,99	3,25	3,30	3,42	3,37	3,60	3,29	2,82	2,93	3,00	2,83	2,62	2,80	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
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
3. Transport	2,98	2,91	1,41	1,70	1,93	1,88	2,02	1,75	1,27	1,40	1,46	1,30	1,12	1,21	1,24
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
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
B. Fugitive Emissions from Fuels	155,74	105,20	92,71	95,59	95,88	93,80	100,27	98,78	88,41	89,04	77,36	85,68	83,99	82,40	82,14
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
2. Oil and Natural Gas	60,90	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
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**
A. Mineral Products	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
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
D. Other Production	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	0,00
3. Solvent and Other Product Use	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
4. Agriculture	**273,01**	**257,91**	**234,20**	**191,86**	**150,54**	**126,44**	**121,66**	**115,75**	**110,14**	**114,09**	**115,00**	**108,83**	**84,24**	**94,85**	**99,01**
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	71,54
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
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
D. Agricultural Soils	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
F. Field Burning of Agricultural Residues	1,99	1,98	2,09	1,46	1,19	1,26	1,32	0,73	1,21	1,07	1,17	1,03	1,17	1,35	0,81
G. Other	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**
A. Changes in Forest and Other Woody Biomass Stocks	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
C. Abandonment of Managed Lands	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
E. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
6. Waste	**748,95**	**647,58**	**561,76**	**538,55**	**495,93**	**468,04**	**449,04**	**405,83**	**333,37**	**288,42**	**225,81**	**229,52**	**222,91**	**221,65**	**259,27**
A. Solid Waste Disposal on Land	661,09	581,07	510,09	491,30	455,81	430,76	399,69	358,97	293,58	254,09	195,71	201,25	199,98	199,86	200,79
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
C. Waste Incineration	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
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**
	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**
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
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
Multilateral Operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass															

Table A7.15 CRF trend tables 10: N_2O

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year(1)	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
	(Gg)														
Total Emissions	**47,76**	**41,75**	**32,82**	**28,06**	**25,70**	**25,84**	**26,61**	**25,99**	**25,13**	**20,93**	**20,49**	**21,69**	**21,38**	**20,241**	**20,83**
1. Energy	**13,46**	**11,79**	**10,19**	**9,78**	**9,68**	**9,38**	**9,76**	**9,60**	**9,75**	**8,59**	**7,95**	**7,78**	**8,54**	**7,73**	**8,54**
A. Fuel Combustion (Sectoral Approach)	13,46	11,79	10,19	9,78	9,68	9,38	9,76	9,60	9,75	8,59	7,95	7,78	8,54	7,73	8,54
1. Energy Industries	11,40	9,56	8,86	8,77	8,62	8,28	8,56	8,42	8,47	7,72	6,99	7,25	8,00	7,19	7,87
2. Manufacturing Industries and Construction	0,92	1,69	0,92	0,70	0,72	0,74	0,92	0,93	1,11	0,58	0,58	0,20	0,18	0,21	0,33
3. Transport	0,33	0,25	0,15	0,14	0,17	0,14	0,14	0,13	0,12	0,13	0,12	0,11	0,11	0,11	0,13
4. Other Sectors	0,81	0,22	0,18	0,11	0,09	0,18	0,09	0,06	0,04	0,17	0,26	0,21	0,25	0,22	0,21
5. Other	0,00	0,06	0,08	0,06	0,09	0,03	0,05	0,05	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	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
2. Oil and Natural Gas	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**
A. Mineral Products	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
C. Metal Production	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
E. Production of Halocarbons and SF_6	0,00														0,00
F. Consumption of Halocarbons and SF_6	0,00														0,00
G. Other	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**
4. Agriculture	**25,48**	**21,97**	**16,74**	**13,36**	**11,75**	**11,55**	**10,07**	**9,52**	**9,70**	**8,68**	**9,63**	**9,16**	**8,18**	**8,54**	**8,06**
A. Enteric Fermentation	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
C. Rice Cultivation	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
D. Agricultural Soils	22,03	18,60	13,72	10,88	9,77	9,88	8,45	8,02	8,31	7,21	8,10	7,76	7,13	7,33	6,77
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agricultural Residues	0,04	0,04	0,05	0,03	0,02	0,02	0,03	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02
G. Other	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**
A. Changes in Forest and Other Woody Biomass Stocks	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
C. Abandonment of Managed Lands	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
E. Other	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**	**0,57**	**0,54**	**0,47**	**0,53**	**0,54**	**0,51**	**0,47**	**0,45**	**0,48**
A. Solid Waste Disposal on Land	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	0,57	0,54	0,47	0,53	0,54	0,51	0,47	0,45	0,48
C. Waste Incineration	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
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**
	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**
Aviation	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,000	0,00	0,00	NO	NO	NO	0,00
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
Multilateral Operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass															

Table A7.16 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
	(Gg)														
Emissions of HFCs[5] - CO_2 equivalent (Gg)	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**2,95**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
HFC-23	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
HFC-41	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
HFC-125	NE	NE	NE	NE	NE	NE	0,000	NE	NE	NE	NE	NE	NE	NE	NE
HFC-134	NE	NE	NE	NE	NE	NE		NE	NE	NE	NE	NE	NE	NE	NE
HFC-134a	NE	NE	NE	NE	NE	NE	0,002	NE	NE	NE	NE	NE	NE	NE	NE
HFC-152a	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
HFC-143a	NE	NE	NE	NE	NE	NE	0,000	NE	NE	NE	NE	NE	NE	NE	NE
HFC-227ea	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
HFC-245ca	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**
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
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
C_3F_8															
C_4F_{10}															
c-C_4F_8															
C_5F_{12}															
C_6F_{14}															
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**
SF_6							0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

Table A7.17 CRF trend tables 10: Overall trend

GREENHOUSE GAS EMISSIONS	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
	CO_2 equivalent (Gg)														
Net CO_2 emissions/removals	93 438,98	79 381,53	60 319,84	53 693,34	56 141,80	53 976,53	57 206,11	56 638,97	54 704,11	47 442,06	43 330,16	40 926,56	42 005,17	40 439,99	46 265,40
CO_2 emissions (without LUCF) [6]	98 571,61	85 538,52	67 955,54	61 105,37	63 617,56	61 278,21	64 730,59	63 156,43	61 575,65	54 302,55	50 529,93	49 902,79	51 472,32	48 758,05	53 321,38
CH_4	24 924,58	21 392,68	18 776,69	17 459,30	15 712,44	14 592,28	14 239,87	13 165,27	11 303,01	10 447,51	8 902,83	9 037,99	8 319,86	8 481,79	9 365,83
N_2O	14 805,01	12 942,96	10 175,61	8 697,98	7 968,44	8 010,36	8 247,63	8 055,83	7 789,43	6 488,61	6 352,06	6 722,67	6 626,36	6 274,80	6 456,39
HFCs	0,00	0,00	0,00	0,00	0,00	0,00	2,95	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
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
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
Total (with net CO_2 emissions/removals)	**133 244,13**	**113 764,48**	**89 293,45**	**79 878,53**	**79 841,71**	**76 625,01**	**79 744,76**	**77 907,26**	**73 835,56**	**64 449,46**	**58 630,48**	**56 722,59**	**56 969,97**	**55 220,51**	**62 110,83**
Total (without CO_2 from LUCF) [6] [8]	**138 376,76**	**119 921,47**	**96 929,15**	**87 290,56**	**87 317,47**	**83 926,68**	**87 269,24**	**84 424,72**	**80 707,10**	**71 309,95**	**65 830,25**	**65 698,82**	**66 437,12**	**63 538,57**	**69 166,810**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
	CO_2 equivalent (Gg)														
1. Energy	98 281,50	84 641,35	68 529,78	62 305,38	64 768,89	61 607,83	64 583,63	63 073,78	61 672,52	55 408,84	50 899,09	50 131,17	51 942,66	49 241,31	53 466,31
2. Industrial Processes	10 424,87	9 231,93	6 292,75	5 303,43	5 138,96	6 071,30	7 400,94	7 279,75	6 569,78	4 592,75	4 619,67	5 464,93	5 361,62	4 862,54	5 527,071
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
4. Agriculture	13 631,97	12 225,29	10 107,98	8 170,92	6 802,89	6 236,11	5 678,09	5 382,05	5 319,01	5 087,65	5 400,50	5 124,61	4 305,50	4 640,26	4 578,561
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
6. Waste	16 038,41	13 822,90	11 998,64	11 510,83	10 606,74	10 011,44	9 606,59	8 689,14	7 145,80	6 220,72	4 910,98	4 978,11	4 827,34	4 794,46	5 594,87
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

7.3 Trend Tables for GHG-Precursors and SOx

Table A7.18 GHG emissions - precursors: NOx

	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Total National Emissions and Removals	**285,38**	**242,81**	**180,04**	**162,53**	**165,91**	**146,72**	**151,95**	**147,32**	**141,38**	**133,86**	**120,81**	**121,19**	**128,97**	**124,41**	**135,29**
1. Energy	**262,10**	**221,69**	**164,32**	**150,04**	**155,10**	**134,08**	**134,27**	**129,84**	**126,54**	**124,50**	**113,32**	**109,44**	**117,37**	**114,29**	**124,77**
A. Fuel Combustion Reference Approach (2)															
Sectoral Approach (2)	262,10	221,69	164,32	150,04	155,10	134,08	134,27	129,84	126,54	124,50	113,32	109,44	117,37	114,29	124,77
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
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
3. Transport	115,55	97,80	57,59	51,75	56,03	48,86	49,38	47,21	42,00	46,48	42,56	40,98	39,69	41,83	45,41
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
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
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
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**
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
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
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
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
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
3. Solvent and Other Product Use															
4. Agriculture	**1,58**	**1,47**	**1,73**	**1,15**	**0,80**	**0,83**	**0,98**	**0,58**	**0,84**	**0,74**	**0,88**	**0,66**	**0,66**	**0,86**	**0,62**
A. Enteric Fermentation															
B. Manure Management															
C. Rice Cultivation															
D. Agricultural Soils															
E. Prescribed Burning of Savannas															
F. Field Burning of Agricultural Residues	1,58	1,47	1,73	1,15	0,80	0,83	0,98	0,58	0,84	0,74	0,88	0,66	0,66	0,86	0,62
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**
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**
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**

Table A7.19 GHG emissions - precursors: CO

	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Total National Emissions and Removals	**859,17**	**774,10**	**566,39**	**593,22**	**618,70**	**589,09**	**609,48**	**575,54**	**488,85**	**511,06**	**486,78**	**429,42**	**373,37**	**426,43**	**385,28**
1. Energy	**798,05**	**716,00**	**510,00**	**551,91**	**582,98**	**549,71**	**566,62**	**545,53**	**450,62**	**479,46**	**455,42**	**398,33**	**341,76**	**392,66**	**362,05**
A. Fuel Combustion Reference Approach (2)															
Sectoral Approach (2)	798,05	716,00	510,00	551,91	582,98	549,71	566,62	545,53	450,62	479,46	455,42	398,33	341,76	392,66	362,05
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
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
3. Transport	454,34	434,83	215,97	260,37	303,97	296,85	327,57	279,37	194,84	233,92	229,33	198,36	171,78	184,98	182,50
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
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
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
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**
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
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
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
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
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
3. Solvent and Other Product Use															
4. Agriculture	**41,71**	**41,63**	**43,86**	**30,65**	**25,06**	**26,48**	**27,62**	**15,23**	**25,31**	**22,47**	**24,63**	**21,73**	**24,58**	**28,40**	**17,11**
A. Enteric Fermentation															
B. Manure Management															
C. Rice Cultivation															
D. Agricultural Soils															
E. Prescribed Burning of Savannas															
F. Field Burning of Agricultural Residues	41,715	41,63	43,86	30,65	25,06	26,48	27,62	15,23	25,31	22,47	24,63	21,73	24,58	28,40	17,11
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**
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**
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**

Table A7.20 GHG emissions – precursors: NMVOCs

	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Total National Emissions and Removals	**120,36**	**110,06**	**69,56**	**71,36**	**79,76**	**79,37**	**86,33**	**79,36**	**63,79**	**78,50**	**63,08**	**57,04**	**59,04**	**60,74**	**58,38**
1. Energy	**68,17**	**67,34**	**35,32**	**39,99**	**46,65**	**44,66**	**49,12**	**42,65**	**31,26**	**38,31**	**36,97**	**31,95**	**28,59**	**30,41**	**30,61**
A. Fuel Combustion Reference Approach (2)															
Sectoral Approach (2)	68,17	67,34	35,32	39,99	46,65	44,66	49,12	42,65	31,26	38,31	36,97	31,95	28,59	30,41	30,61
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
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
3. Transport	67,08	66,25	34,24	39,11	45,88	44,00	48,22	41,97	30,62	37,78	36,48	31,51	28,12	29,98	30,15
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
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
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
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**	**18,717**	**15,27**	**14,39**	**13,35**	**13,19**	**13,226**
A. Mineral Products	2,92	2,65	1,57	1,20	1,41	1,84	2,13	2,37	1,97	1,57	0,85	0,93	1,05	1,89	1,02
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
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
D. Other Production (3)	22,77	16,10	13,71	11,32	11,93	12,47	12,30	12,57	10,94	8,95	7,15	6,21	5,77	5,71	5,90
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
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**
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**
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**
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**
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**

Table A7.21 GHG emissions – precursors: SOx

	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Total National Emissions and Removals	**1 781,85**	**1 517,49**	**1 313,41**	**1 290,51**	**1 278,60**	**1 261,58**	**1 299,11**	**1 311,00**	**1 310,54**	**1 191,92**	**1 056,37**	**1 044,63**	**1 095,74**	**982,88**	**1 042,71**
1. Energy	**1 756,52**	**1 500,61**	**1 302,41**	**1 279,46**	**1 266,96**	**1 248,88**	**1 285,05**	**1 296,16**	**1 295,46**	**1 178,77**	**1 047,27**	**1 029,34**	**1 081,91**	**966,87**	**1 025,07**
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	1 296,16	1 295,46	1 178,77	1 047,27	1 029,34	1 081,91	966,87	1 025,07
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
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	89,89
3. Transport	57,85	17,99	10,53	9,59	11,02	9,07	8,82	9,78	7,80	8,35	8,00	7,09	7,30	7,47	8,78
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
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
B. Fugitive Emissions from Fuels													0,00	0,00	0,00
1. Solid Fuels															
2. Oil and Natural Gas															
2. Industrial Processes	**25,33**	**16,88**	**11,00**	**11,05**	**11,64**	**12,70**	**14,06**	**14,84**	**15,08**	**13,148**	**9,09**	**15,29**	**13,83**	**16,00**	**17,64**
A. Mineral Products	1,66	1,41	0,71	0,64	0,60	0,57	0,62	0,64	0,50	0,52	0,62	0,69	0,69	0,67	0,76
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
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
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
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
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**
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**
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**
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**