Project «Uzbekistan: Preparation of the Second National Communication under UN Framework Convention on Climate Change (UNFCCC)»

National GHG Inventory Report 2000

Republic of Uzbekistan

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Abbreviation

BOD	– Biochemical Oxygen Demand
CIS	– Commonwealth of Independent States
CO_2-eq	– CO_2 equivalent
COD	– Chemical Oxygen Demand
DOC	– degradable organic carbon
FAO	– Food and Agricultural Organization of the United Nations
GHG	– Greenhouse gases
GOST	– state standards
GPP	– Gas Processing Plant
GWP	– Global Warming Potential
HFC	– hydrofluoracarbon
IEA	– International Energy Agency
INC	– Initial National Communication
IPCC	– Intergovernmental Panel on Climate Change
LULUCF	– sector «Land Use, Land Use Change and Forestry»
MSW	– municipal solid waste
NIR	– National Inventory Report
NMVOC	– Non-Methane Volatile Organic Compounds
PFC	– perfluoracarbon
QA	– Quality Assurance
QC	– Quality Control
SNC	– Second National Communication
SWDS	– Solid Waste Disposal Sites
UNEP	– United Nations Environmental Program
UNFCCC	– United Nations Framework Convention on Climate Change

Units

Decalitre	**–** 10 litres
g	– gram
Gg	– gigagram (10^9 g or 1000 tonnes)
GJ	– gigajoule (10^9 joule)
Hectolitre	– 100 litres
kg	– kilogram
m^2	– square meter
m^3	– cubic meter
mm	– millimeter
PJ	– petajoule (10^{12} joule)
TJ	– terajoule (10^{12} joule)

Chemical formulas

C	– Carbon
CH_4	– Methane
CH_2F_2	– HFC-32
C_2HF_5	– HFC-125
CH_2FCF_3	– HFC-134a
$C_2H_3F_3$	– HFC-143a
CO	– Carbon monoxide
CO_2	– Carbon dioxide
HNO_3	– Nitric acid
H_2SO_4	– Sulphuric acid
N	– Nitrogen
NH_3	– Ammonia
N_2O	– Nitrous oxide
NOx	– Nitrogen oxides
S	– Sulphur
SF_6	– Sulphur hexafluoride
SO_2	– Sulphur dioxide

National GHG Inventory Report

Project «Uzbekistan: Preparation of the Second National Communication under UN Framework Convention on Climate Change (UNFCCC) »

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Preface

Being responsible body on the implementation of the UN Framework Convention on Climate Change and the Kyoto Protocol in Uzbekistan, the Center of Hydrometeorological Service (Uzhydromet) has prepared the national inventory of greenhouse gas emissions for 2000 within the framework of the Second National Communication on Climate Change. This Report has been prepared in accordance with the decision 17/CP.8, item 1a, Article 12 and item 1a, Article 12 of the UN Framework Convention on Climate Change and also in compliance with the *Reporting on Climate Change User Manual for the Guidelines on National Communications from non-Annex 1 Parties* [1]. The draft report was brought up for discussions and comments to different ministries and agencies.

The Report presents the inventory of greenhouse gas emissions in the Republic of Uzbekistan in 2000 and also the review of the GHG emissions trends for the period 1990-2005. The emissions and removals in 2000 are given in the tables 1 and 2 for gases and sectors identified by IPCC (Annex 1 and 2) and also in the Sectoral Tables (Annex 3). The trend for each sector is provided in the relevant chapter.

Inventory comprises the following direct greenhouse gases: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs) as well as the indirect greenhouse gases, such as carbon monoxide (CO), nitrogen oxides (NOx), non-methane volatile organic compounds (NMVOC) and sulphur dioxide (SO_2). To recalculate emissions into CO_2 equivalent in accordance with the recommendations [1] the global warming potentials were used: for CO_2 -1, CH_4 -21, N_2O -310.

In accordance with the IPCC methodology and the standard IPCC software the greenhouse gas inventory was conducted in 5 sectors. The sector “Solvent and Other Product Use” was not considered due to lack of the calculation method.

Structure of Report

The report includes Introduction, 7 Specific Chapters and Annexes. Introduction describes institutional arrangement and process of inventory itself. The Specific Chapters present the emission estimates for 2000, emission trends, emission estimates, trends in separate sectors and estimation of emissions uncertainty.

Introduction

Reference on inventory and climate change

The first inventory of greenhouse gas emissions was made within the framework of the Initial National Communication in 1999 for 1990 and 1994. In 2001 the Phase 2 of the Initial National Communication was prepared where the GHG emissions were calculated for 1999. The Republic of Uzbekistan took part in the Regional Project "Capacity Building for Improving the Quality of the GHG Inventories (Europe/CIS region)" (2003-2006). The UNEP Project "Implementation of UNFCCC Article 6 in Uzbekistan" (2004-2005) and the UNEP/ Uzbekistan Project "Education, Training and Public Awareness" (2005-2006) were implemented in Uzbekistan. For the inventory preparation within the framework of the Second National Communication (2005-2008) the experience was used gained when implementation of the previous projects. In the Second National Communication the inventory includes a larger list of the gases and source/sink categories. The recalculations were made in some source categories. The elements of Good Practice were also used: Quality Assurance/Quality Control Plan, National Manual GHG Inventory Procedures, the system of documentation and archiving of all inventories related data.

The GHG inventory was implemented in the Center of Hydrometeorological Service at the Cabinet of Ministers of the Republic of Uzbekistan (Uzhydromet), which is a responsible body for the implementation of the commitments of Uzbekistan under the UN Framework Convention on Climate Change. National inventory team was built up on the base of the Atmosphere, Surface Water and Soil Pollution Monitoring Service, one of the Uzhydromet's divisions, which was assigned to be the project coordination body. In this Service all information on the GHG inventory is collected, compiled and stored. In order to address the specific objectives the experts were recruited from other organizations, agencies and industrial companies. These experts provided the information on the activity data, emission factors, other parameters and other inventory related information; they also made calculations and prepared documentation. The institutional scheme is shown in the Fig. 1.

The GHG inventory was prepared in conformity with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, the elements of the Good Practice Guidance and Uncertainty Management in National GHG Inventories, IPCC 2003 and the Good Practice Guidance in Land Use, Land Use Change and Forestry, IPCC 2003. As the activity data, both official statistical data on industrial activity in different economic sectors and the data of some big industrial companies were used. In order to estimate emissions the national emission factors and other parameters as well as default factors were utilized. The emissions calculation was made with use of the standard IPCC Software with some modifications on separate sheets, which were introduced in accordance with the national circumstances. The scheme of the inventory process is shown in the Figure 2.

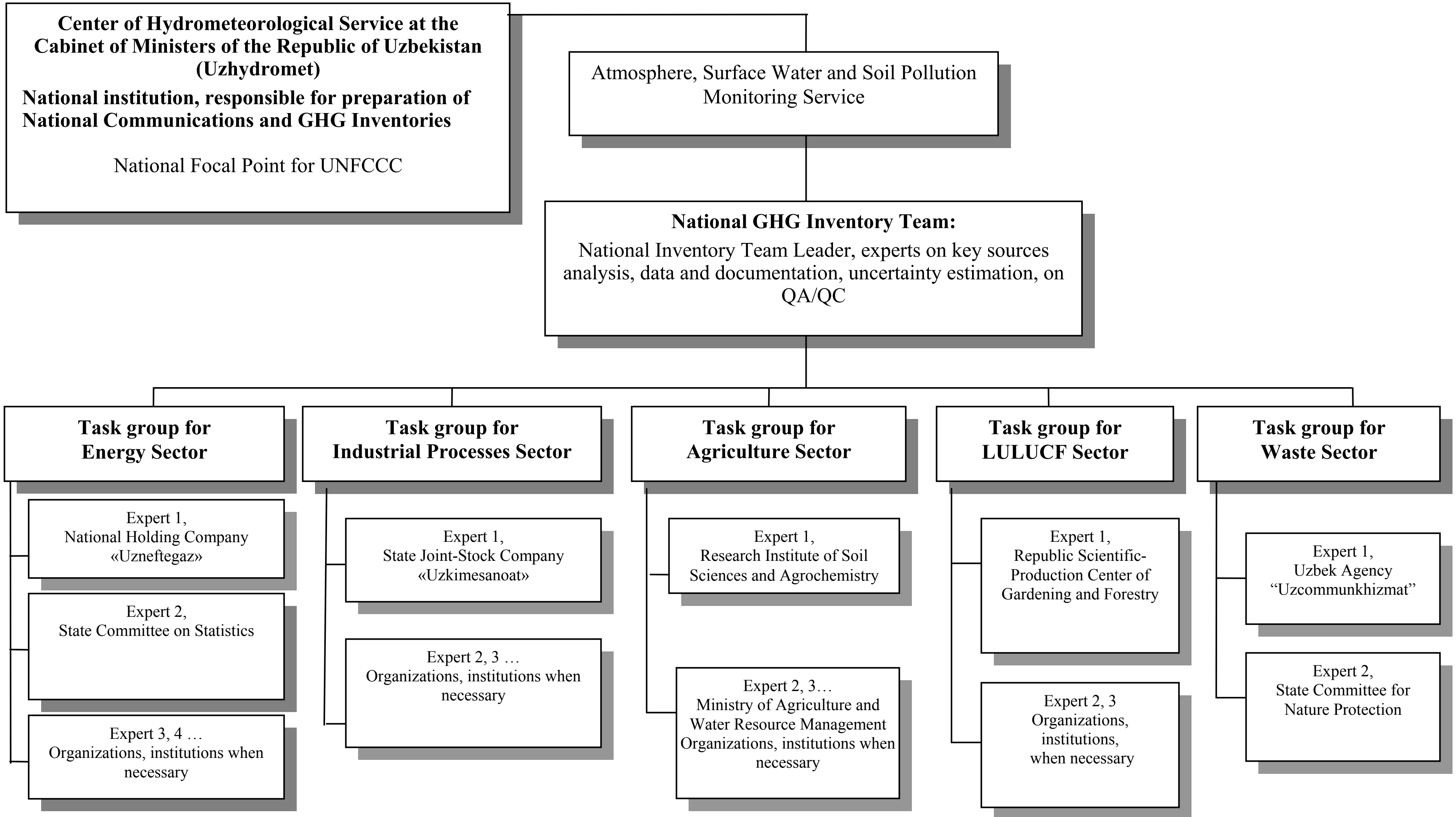

Fig. 1 Organizational structure of the National Inventory System

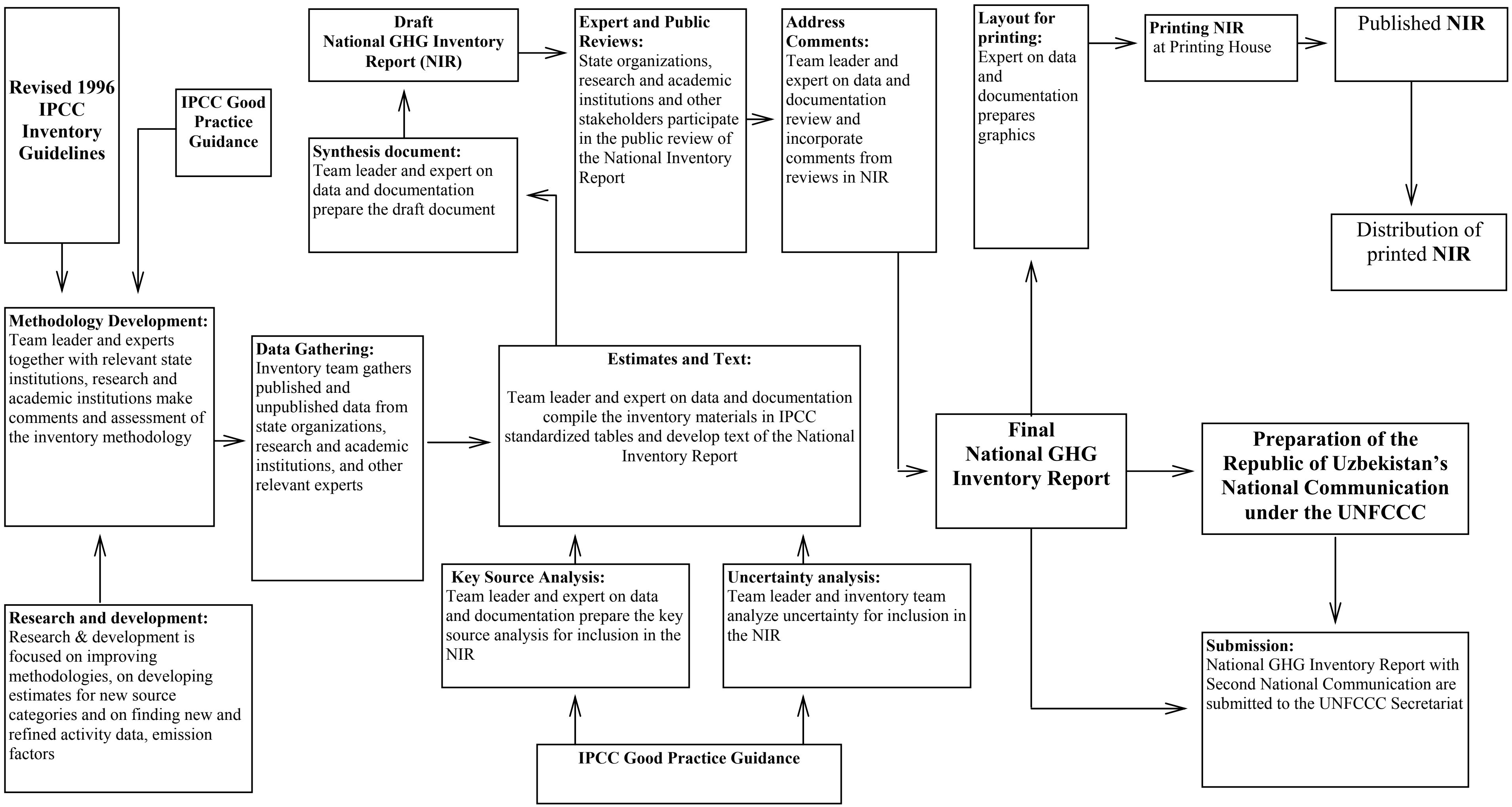

Fig. 2 GHG inventory program and process

QA/QC Plan

The QA/QC procedures were implemented as an element of good practice for improvement of the national inventory quality. Quality control was performed according to the Tier 1- common procedures, mainly in Uzhydromet. The organizations and companies participated in the quality assurance in their relevant source categories.

Quality Control procedure

The quality control procedures were conducted in a while after the activity had been conducted, for the period from several days to 1—2 months, depending on the type of check. In some cases checks repeated if changes in process occur.

The following quality control procedures were implemented for all sectors:

– check for transcription errors of newly data obtained;
– check for transcription errors in data input;
– check of calculation for filling gaps in the activity data with employing mathematical methods;
– check that emission units, parameters or conversion factors are correctly recorded;
– check that emissions are calculated correctly;
– check for consistency in input and calculations in temporal series while changing in tier, emission factors and other parameters or data;
– check that formulas are correctly recorded, calculations are correctly performed etc. in the worksheets modified in accordance with the national circumstances;
– check for correction of calculations when national factors development;
– check that emission sources are properly documented (assumptions and criteria for the selection of activity data, calculation method, emission factors and other parameters);
– check of the documentation on the national factors development;
– check of all references related to the data, coefficients, factors etc.

Quality Assurance procedures

Quality Assurance was performed after all inventory calculations had been completed.
External reviewers were given the Draft National GHG Inventory Report that included all necessary information for quality check:

- calculation method
- activity data;
- factors and other parameters;
- emission data;
- information on quality control performed .

Organizations and companies that reviewed the inventory report:

- State Committee on Statistics
- State Joint-Stock Company «Uzbekenergo»
- National Holding Company «Uzbekneftegaz»
- State Joint-Stock Company «Uzkimesanoat»
- Republic Scientific Production Center of Gardening and Forestry
- Uzbek Agency «Uzcommunkhizmat»

Chapter 1: GHG Emissions in 2000

1.1 Total GHG emissions in 2000

Contributions of individual greenhouse gases to the total emission were as follows: CO_2 – 54% (the most significant contributor), CH4 – 41%, N_2O – 5% and HFC – less than 0.01%.

Table 1.1 Direct greenhouse gases

Emissions	million tonne CO_2-eq
Total	201.2
CO_2	108.6
CH_4	81.7
N_2O	10.8
HFC	0.0

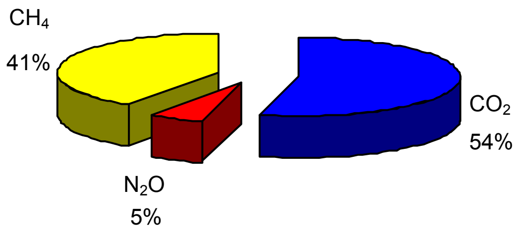

***Fig 1.1** Composition of direct GHG emissions*

As compared to 1990 CO_2 emissions decreased by 4.1%; CH_4 emissions increased by 44.2%; N_2O emissions decreased by 16.3% and total emission increased by 10%.

Table 1.2 Indirect greenhouse gases

Emissions	Gg
CO	1184
NOx	286
NMVOC	251
SO_2	294

Table 1.3 GHG emissions per capita in 2000

Gas	tonne CO2-eq per/capita	Gas	kg / per capita
CO_2	4.4	CO	47.8
CH_4	3.3	NOx	20.1
N_2O	0.4	NMVOC	10.2
HFC	0.0003	SO_2	11.9
Total	8.1		

The volume of CO emission, accounting for the largest proportion of emissions with indirect greenhouse effects, exceeds the volumes of NOx, NMVOC and SO_2 by 4-4.7 times.

As compared to 1990 the emissions of all gases with indirect greenhouse effect declined: CO – by 39.2%; NOx – by 30.5%; NMVOC – by 38.5% and SO_2 – by 56.7%.

The largest volume of the direct GHG emissions per capita falls at CO_2 and indirect GHG emissions – at CO.

1.2 GHG emissions by sectors

The estimates of the 2000 GHG emissions by sectors and categories are given in the tables 1 and 2 in the Annex 1 and 2. The major contributor to 2000 greenhouse gas emission was the energy sector with more than 87% in CO_2 equivalents followed by agriculture (8%). The contributions of the industrial processes and waste sectors are almost similar and amount to 2.5% and 2.3% respectively. Total GHG emission excluding the LULUCF sector is 201.2 million tones in CO_2 equivalent. Increase in the emissions from the energy sector as compared to 1990 amounts to 14.2% and in the waste sector is 11.3%; decline in emissions in the industrial processes sector is 38.3% and in the agriculture sector is 5.3%;

Table 1.4 GHG emissions by sectors

Sector	million tonne CO_2-eq	Share of total emission, %
Total emission	201.2	100
Energy	175.5	87.2
Industrial processes	5.0	2.5
Agriculture	16.1	8.0
Waste	4.5	2.3
LULUCF	-1	0.5

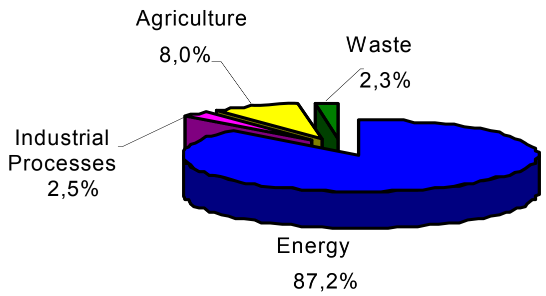

***Fig. 1.2** GHG emissions by sectors*

Contribution of the sectors to GHG emissions is different. Most emissions of CO_2 (97%) and CH_4 (86%) come from the energy sector. The major contributor to the N_2O emissions is the agricultural sector (81%). The largest volume of per capita GHG emission comes from the energy sector.

Table 1.5 GHG emissions by sectors, (Gg CO_2-eq)

Sector	CO_2	CH_4	N_2O
Energy	105016	70391	110
Industrial processes	3590	0	1374
Agriculture	0	7348	8800
Waste	0	4004	528
Total	108606	81742	10812

Table 1.6 Per capita GHG emissions by sectors, 2000

Sector	tonne CO_2-eq /per capita
Energy	7.1
Industrial processes	0.2
Agriculture	0.7
Waste	0.2
Total	8.1

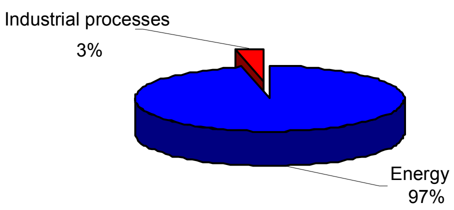

Fig. 1.3 *CO_2 emissions by sectors*

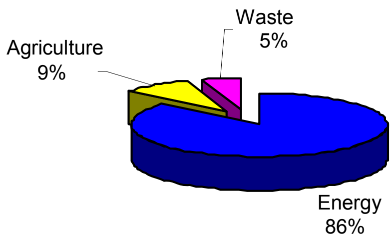

Fig. 1.4 *CH_4. emissions by sectors*

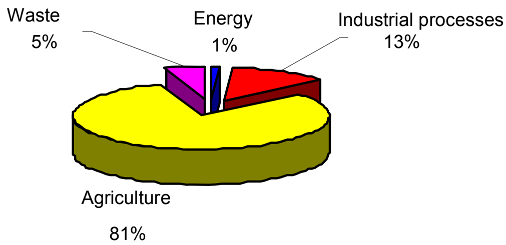

Fig. 1.5 *N_2O emissions by sectors*

1.3 Key source categories

The key sources analysis was conducted with use of the Tier 1 method in accordance with [5], chapter 7, Methodological Choice and Recalculation. The following gases were analyzed: CO_2, CH_4, N_2O and HFCs. PFCs and SF_6 were excluded as there is no data available to estimate these gases emission. All estimated source categories were analyzed excluding emissions and removals in the LULUCF, because their volume does not exceed 0.5% of the country's total emission.

Disaggregation and identification of emission sources were conducted in accordance with [5], chapter 7, Methodological Choice and Recalculation, table 7-1.

The emission level and trend were assessed for 2000 and 2005. The base year was 1990. The key sources analysis is presented in the Annex 5. In the tables below the sources are shown that are defined as the key ones by the emission level and trend.

The number of common key sources for 2000 and 2005 are about the same, only their position in the list (table 1.7 and table 1.8) is different.

Table 1.7 Key GHG emission sources, 2000

IPCC category	Gas	Level	Trend	million tonne CO_2-eq	% of total emission
1.B.2 Fugitive emissions from oil and gas production	CH_4	●	●	70.02	34.8
1.A.4 Residential sector, natural gas combustion	CO_2	●	●	32.64	16.2
1.A.1 Energy Industries	CO_2	●	●	32.35	16.1
4.D Emissions of N_2O from agricultural soils	N_2O	●	●	8.54	4.2
1.A.4 Commercial/institutional sector (natural gas combustion)	CO_2	●	●	6.96	3.5
4.A Enteric Fermentation	CH_4	●		6.59	3.3
1.A.1 Energy Industries (residual fuel oil)	CO_2	●	●	5.76	2.9
1.A.3 Mobile sources: Road Transportation	CO_2	●	●	5.62	2.8
1.A.3 Pipeline Transport	CO_2	●		5.11	2.5
1.A.2 Manufacturing Industry and Construction (natural gas combustion)	CO_2	●	●	4.21	2.1
6. A Solid Waste Disposal on Land	CH_4	●		3.71	1.8
1.A.1 Energy Industries (sub-bituminous coal)	CO_2	●	●	3.09	1.5
1.A.4 Agriculture/Forestry/Fishing (liquid fuel combustion)	CO_2	●	●	2.59	1.3
1.A.1 Energy Industries (crude oil)	CO_2	●	●	2.04	1.0
1.A.4 Commercial sector (liquid fuel combustion)	CO_2	●	●	1.49	0.7
2.A Cement Production	CO_2	●	●	1.48	0.7
2.B Ammonia Production	CO_2		●	1.30	0.7
1.A.2 Manufacturing Industry and Construction (liquid fuel combustion)	CO_2		●	0.74	0.4
1.A.4 Commercial sector (solid fuel combustion)	CO_2		●	0.57	0.3
1.A.3 Mobile sources: Railways	CO_2		●	0.33	0.2
1.A.4 Residential sector (liquid fuel combustion)	CO_2		●	0.05	0.0
1.A.2 Manufacturing Industry and Construction (solid fuel combustion)	CO_2		●	0.03	0.0
1.A.4 Residential sector (solid fuel combustion)	CO_2		●	0.01	0.0
Total emission by the key sources				196.6	97.7

Table 1.8 Key GHG emission sources, 2005

IPCC category	Gas	Level	Trend	million tonne CO_2-eq	% of total emission
1.B.2 Fugitive emissions from oil and gas production	CH_4	●	●	76.33	38.2
1.A.4 Residential sector (natural gas combustion)	CO_2	●	●	30.92	15.5
1.A.1 Energy Industries (natural gas combustion)	CO_2	●	●	29.65	14.9
1.A.4 Commercial sector (natural gas combustion)	CO_2	●	●	9.03	4.5
4.A Enteric Fermentation	CH_4	●	●	7.90	4.0
4.D Emissions of N_2O from agricultural soils	N_2O	●	●	7.42	3.7
1.A.3 Mobile sources: Road Transportation	CO_2	●	●	5.25	2.6
1.A.2 Manufacturing Industry and Construction (natural gas combustion)	CO_2	●	●	4.92	2.5
1.A.3 Pipeline Transport	CO_2	●	●	3.85	1.9
6.A Solid Waste Disposal on Land	CH_4	●		3.81	1.9
1.A.1 Energy Industries (sub-bituminous coal)	CO_2	●	●	2.52	1.3
1.A.1 Energy Industries (residual fuel oil)	CO_2	●	●	2.47	1.2
2.A Cement Production	CO_2	●		2.26	1.1
1.A.4 Agriculture/Forestry/Fshing (liquid fuel combustion)	CO_2	●	●	1.94	1.0
2.B Nitric Acid Production	N_2O	●		1.58	0.8
2.B Ammonia Production	CO_2		●	1.40	0.7
1.A.4 Commercial sector (liquid fuel combustion)	CO_2		●	1.31	0.7
1.A.1 Energy Industries (crude oil)	CO_2		●	1.26	0.6
1.A.3 Mobile Sources: railways	CO_2		●	0.44	0.2
1.A.2 Manufacturing Industry and Construction (solid fuel combustion)	CO_2		●	0.38	0.2
1.A.4 Commercial sector (solid fuel combustion)	CO_2		●	0.35	0.2
1.A.4 Residential sector (liquid fuel combustion)	CO_2		●	0.07	0.0
1.A.4 Residential sector (solid fuel combustion)	CO_2		●	0.01	0.0
Total emission by the key sources				194.9	97.6

1.4 Total uncertainty estimation

This chapter is devoted to the estimating uncertainties of greenhouse gases emissions. The estimation was performed in accordance with [2]. Not all uncertainties were possible to estimate in this work.

In the energy sector only uncertainties associated with CO_2 emissions were estimated, which amount to 59.8% of the total emissions in this sector.

In the sector "Industrial Processes" the CO_2 emissions were estimated from clinker and ammonia production and N_2O emissions from nitric acid production, which amounted to 83.6% of total emissions from industrial processes.

Uncertainties associated with the GHG emissions in other categories were not estimated owing to absence of the default uncertainty values or national uncertainties values associated with activity data or emission factors, or both of them.

Uncertainties estimated are as follows:

CO_2 – 99.3% of total CO_2 emissions from all sectors;

N_2O – 12.7% of total N_2O emissions from all sectors.

All uncertainties estimated covered 54.2% of the total emission in 2000.

Total uncertainty in CO_2 emissions estimates in the energy sector in 2000 amounted to ±11262.6 Gg CO_2 equivalent or ±10.7 %.

Uncertainties in CO_2 emissions estimates from industrial processes in 2000 amounted to ±155.9 Gg CO_2 equivalent or ±5.6 %.

Uncertainties in the estimates of CO_2 emissions over all estimated categories in 2000 amounted to ±11418.5 Gg CO_2 equivalent or ±10.6 %.

Uncertainties in the N_2O emissions from industrial processes in 2000 were estimated only for the category "Nitric Acid Production" and amounted to ±357.5 Gg CO_2 equivalent or ±26 %.

Uncertainties in estimation of all gases emission from industrial processes in 2000 amounted to ±513.4 Gg CO_2 equivalent or ±12.4 %.

Uncertainties in estimation of emission from all categories and gases in 2000 amounted to ±11776.0 Gg CO_2 equivalent or ±10.5 %.

Calculation of the total uncertainty in the above categories is shown in the Annex 13.

1.5 Completeness

The major GHG emissions and removals were inventoried in the country. All major direct greenhouse gases and all indirect greenhouse gases are included in the inventory. The table 1.9 presents the greenhouse gases categories, which were not included, by some reason, in the inventory. Also the gases are presented, emissions of which were not estimated.

Table 1.9 Estimation of inventory completeness

IPCC source category	Category	The reason by which the category was not included in inventory
Gases	Perfluorocarbons, sulphure hexafluoride	Lack of data
1 B 2 a i	Exploration	Lack of data on wells drilled
1 B 2 a iii	Transport	Not available
1 B 2 a v	Distribution of Oil Products	Lack of data
1 B 2 c i	Venting and Flaring – Oil	Lack of data
1 B 2 c iii	Venting and flaring– Combined (in case oil and gas cannot be separated)	Lack of data
2A 3	Limestone and Dolomite	Lack of data
2A 5	Asphalt Roofing	Lack of data
2A 6	Road Paving with Asphalt	Lack of data
2B 3	Adipic Acid Production	No production
2B 4	Carbide Production	Lack of data
2C 2	Ferroalloys Production	No production
2C 3	Aluminum Production	No production
2C 4	SF6 Used in Aluminum and Magnesium Foundries	No production
2D 1	Pulp and Paper	Cellulose production is not available
2E	Production of Halocarbons and Sulphur Hexafluoride	production is not available
3	Solvent and Other Product Use	Lack of generally accepted calculation method
4E	Prescribed Burning of Savannas	Not applicable
5B	Forest and Grassland Conversion	Presently there is no practice of forest and grassland conversion into tillage
6C	Waste Incineration	Lack of data

Chapter 2: Tendencies of GHG Emissions

As compared to the base year, the total emission in 2000 increased by 10%, in 2005 – by 9.3%. At that, the CO_2 and N_2O emissions decreased by 10-20%, and the CH_4 emission rose sharply – more than 50%.
The later was caused by increasing methane leakage from gas production. The most emission was observed in 2002.

Table 2.1 Direct GHG emissions by gases, million tonnes CO_2 equivalent

Year	CO_2	N_2O	CH_4	Total	Year	CO_2	N_2O	CH_4	Total
1990	113.3	12.9	56.7	182.9	**1998**	100.0	11.3	64.5	175.8
1991	113.3	13.5	59.1	185.9	**1999**	104.1	11.0	69.7	184.7
1992	106.3	13.4	59.2	179.0	**2000**	108.6	10.8	81.7	201.2
1993	106.8	12.8	87.5	207.2	**2001**	107.9	10.5	84.8	203.2
1994	101.4	12.0	73.6	187.0	**2002**	111.0	10.7	85.9	207.7
1995	101.0	11.5	74.4	186.9	**2003**	106.8	10.5	87.9	205.3
1996	104.0	11.4	76.3	191.7	**2004**	104.8	10.5	87.1	202.5
1997	101.3	11.2	68.2	180.7	**2005**	100.4	10.0	89.4	199.8

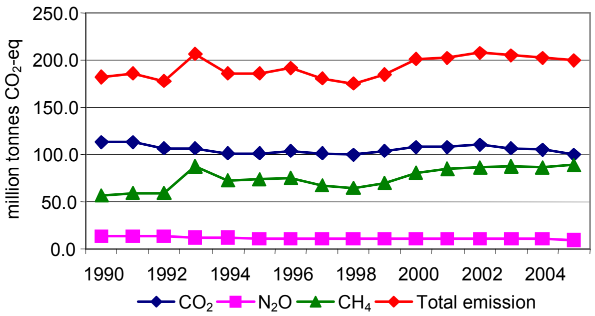

Fig. 2.1 *Trends of emissions by gases*

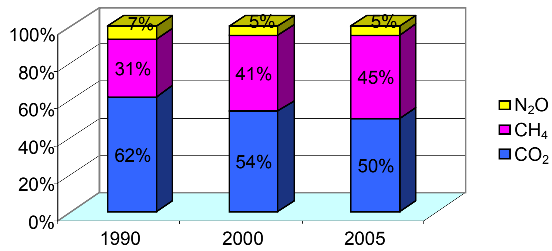

Fig. 2.2 *Change in percentage of GHG emissions*

Change in emissions for the period from 1990 to 2005 was as follows: CO_2 –11.4%; N_2O –22.5%; CH_4 +57.7%; total emission – +9.3%. Noticeable increase in 1993 is caused by a great volume of the transit gas entailing increase in methane leakage from main-line transport of gas.

The figure 2.2 shows the change in percentage of the direct GHG emissions for the considered period.

Emissions by the sectors changed as follows: in the energy sector – increase by more than 10%, in the waste sector – more than 15%. In the same time drop in the emissions from the industrial was 20% and in the agricultural sector – approximately 4%.

Table 2.2 Direct GHG emissions by sectors, million tonnes CO_2 equivalent

Year	Energy	Industrial processes	Agriculture	Waste	Total
1990	153.7	8.1	17.1	4.1	182.9
1991	155.6	8.6	17.6	4.1	185.9
1992	148.5	8.3	18.0	4.2	179.0
1993	177.6	7.4	17.9	4.2	207.2
1994	159.3	5.9	17.5	4.3	187.0
1995	160.6	5.4	16.7	4.3	186.9
1996	165.4	5.6	16.3	4.3	191.7
1997	154.6	5.3	16.3	4.4	180.7
1998	149.7	5.3	16.4	4.5	175.8
1999	159.0	4.8	16.3	4.5	184.7
2000	175.5	5.0	16.1	4.5	201.2
2001	177.7	5.0	15.8	4.6	203.2
2002	181.6	5.1	16.3	4.6	207.7
2003	178.8	5.4	16.5	4.7	205.3
2004	174.8	6.1	16.9	4.7	202.5
2005	172.3	6.4	16.4	4.7	199.8

Change in the direct GHG emissions from 1990 to 2005 was as follows: energy sector +12.1 %; industrial processes -21.0%; agricultural sector -3.6%; waste sector +15.2%; total emission +9.3%.

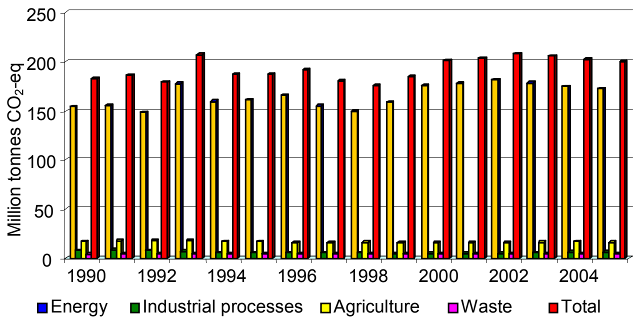

***Fig. 2.3** Trends of direct GHG emissions by sectors*

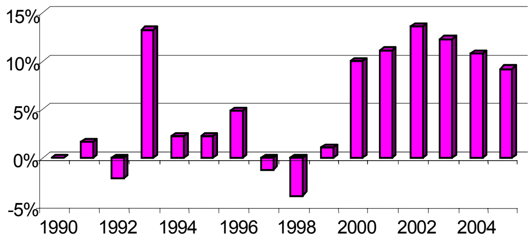

***Fig. 2.4** Change in total emission as compared to 1990*

The highest values of the total emissions as comparison with the base year were recorded in 1993 and 2002 (more than 13%). The lowest values of emissions were in 1998 (-3.9 %).

Table 2.3 Change in total emission as compared to 1990

Year	%	Year	%
1990	0.0	**1998**	-3.9
1991	1.6	**1999**	1.0
1992	-2.2	**2000**	10.0
1993	13.3	**2001**	11.1
1994	2.2	**2002**	13.5
1995	2.2	**2003**	12.5
1996	4.8	**2004**	10.7
1997	-1.2	**2005**	9.3

Table 2.4 Indirect GHG emissions, million tonnes

Year	CO	NOx	NMVOC	SO_2	Year	CO	NOx	NMVOC	SO_2
1990	1.9	0.4	0.4	0.7	**1998**	1.1	0.3	0.2	0.3
1991	1.8	0.4	0.4	0.6	**1999**	1.2	0.3	0.3	0.3
1992	1.4	0.3	0.3	0.5	**2000**	1.2	0.3	0.3	0.3
1993	1.2	0.3	0.3	0.4	**2001**	1.2	0.3	0.3	0.3
1994	1.1	0.3	0.3	0.4	**2002**	1.2	0.3	0.2	0.3
1995	1.0	0.3	0.2	0.4	**2003**	1.1	0.3	0.2	0.2
1996	1.0	0.3	0.2	0.4	**2004**	1.1	0.3	0.2	0.2
1997	1.1	0.3	0.2	0.3	**2005**	1.1	0.3	0.3	0.2

Changes in indirect GHG emissions for the period 1990-2005 were as follows: CO -43%; NOx -38%; NMVOC -46%; SO_2 -75%.

Per capita emissions for the considered period changed as follows: the total emission decreased from 8.9 tonnes CO_2-eq (1990) to 8.1 (2000) and 7.6 (2005); the CO_2 emissions also decreased from 5.5 tonnes CO_2 equivalent to 4.4 и 3.8 tonnes in 2000 and 2005 respectively; and the N_2O emissions – from 0.6 CO_2 equivalent in 1990 to 0.4 CO_2 equivalent in 2000 and 2005. The per capita CH_4 emissions increased from 2.8 to 3.3 and 3.4 tonnes CO_2 equivalent in 2000 and 2005. The most considerable changes in the emissions per inhabitant occurred in the energy sector – drop from 7.5 tonnes CO_2 equivalent in 1990 to 7.1 and 6.6 tonnes in 2000 and 2005.

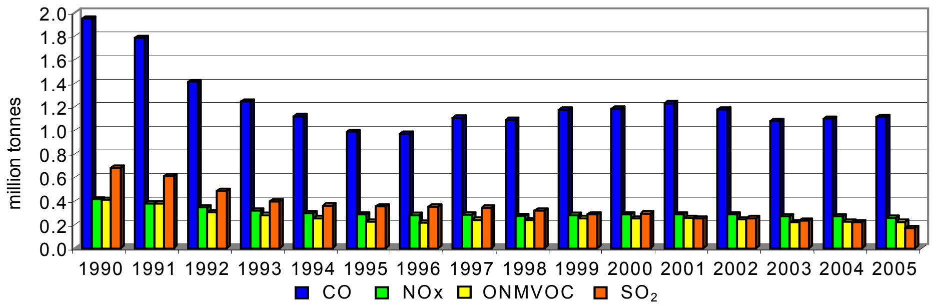

***Fig. 2.5** Trends of indirect GHG emissions*

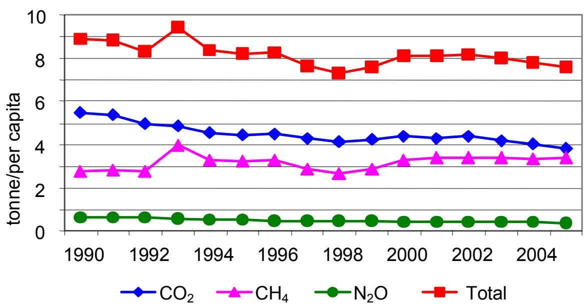

***Fig. 2.6** Trends of GHG emissions per capita by gases*

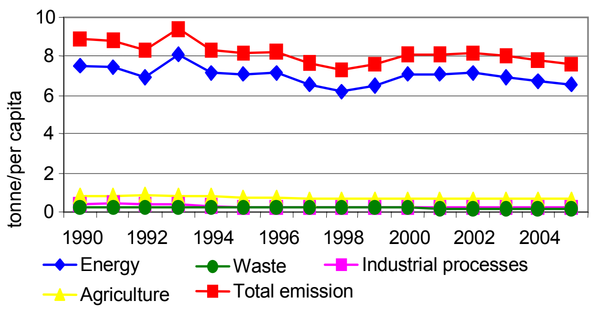

***Fig. 2.7** Trend of GHG emissions per capita by sectors*

Chapter 3: ENERGY

3.1 Sector review

The energy sector includes two sub-sectors:

- Fuel combustion activities (1 A);
- Fugitive emissions from fuels (1 B);

In this sector the inventories of direct greenhouse gases – CO_2, CH_4, N_2O and indirect greenhouse gases – CO, NOx, NMVOC, and SO_2 have been carried out.

Emissions in 2000

Table 3.1 Direct GHG emissions from energy sector, 2000

Gas	Gg CO_2-eq	%
CO_2	105016	59.8
CH_4	70391	40.1
N_2O	110	0.1
Total	175517	100

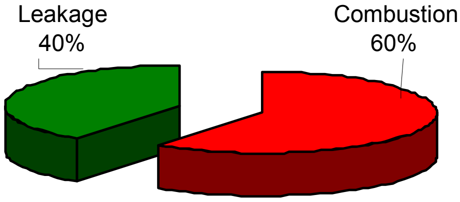

***Fig. 3.1** Percentage of leakage and fuel combustion in 2000*

Table 3.2 Indirect GHG emissions from energy sector, 2000

Gas	Gg
CO	1066
NOx	282
NMVOC	228
SO_2	292

In 2000 the total emissions from fuel combustion accounted to 105273 Gg CO_2 equivalent, the total fugitive emissions – 70245 Gg CO_2 equivalent.

Trends of emissions by gas

Table 3.3 Direct GHG emissions from energy sector, million tonnes CO_2 equivalent

Year	CO_2	CH_4	N_2O	Total	Year	CO_2	CH_4	N_2O	Total
1990	107.0	46.5	0.2	153.7	**1998**	96.3	53.3	0.1	149.7
1991	107.0	48.4	0.2	155.6	**1999**	100.6	58.4	0.1	159.0
1992	100.2	48.1	0.1	148.5	**2000**	105.0	70.4	0.1	175.5
1993	101.3	76.2	0.1	177.6	**2001**	104.3	73.4	0.1	177.7
1994	96.9	62.3	0.1	159.3	**2002**	107.3	74.2	0.1	181.6
1995	97.2	63.2	0.1	60.6	**2003**	102.8	75.8	0.1	178.8
1996	100.0	65.3	0.1	165.4	**2004**	100.2	74.5	0.1	174.8
1997	97.4	57.1	0.1	154.6	**2005**	95.6	76.6	0.1	172.3

The changes occurred in the sector for the period 1990-2005 were as follows: CO_2 -10.7%; CH_4 +65%; N_2O -50%; the total emission from the sector + 12%.

No emissions of N_2O were shown in the fig. 3.2 due to their marginal amounts.

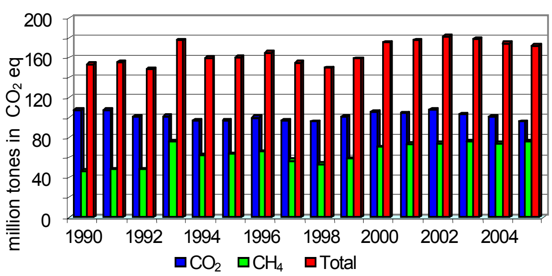

***Fig. 3.2** Trends of direct GHG emissions from energy sector*

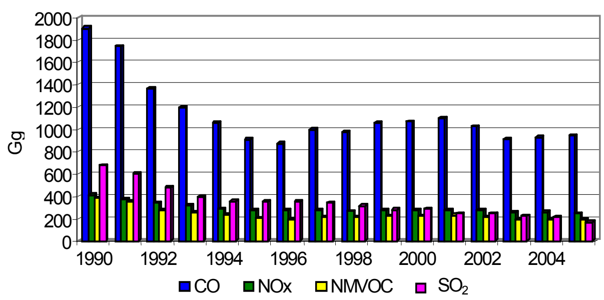

***Fig. 3.3** Trends of indirect emissions from energy sector*

The changes in the emissions from the sector for the period 1990-2005 were as follows: CO -50.7% or halved emissions; NOx -38.8% or decrease by 1.6 times; NMVOC -48.3% or decrease by 1.9 times; SO_2 -75.1% or fall by 4 times.

Table 3.4 Indirect GHG emissions in the energy sector, Gg

Year	CO	NOx	NMVOC	SO_2	Year	CO	NOx	NMVOC	SO_2
1990	1904	410	381	676	**1998**	976	270	218	315
1991	1738	377	351	606	**1999**	1059	276	230	285
1992	1362	344	281	481	**2000**	1066	282	228	292
1993	1192	317	256	392	**2001**	1098	281	232	250
1994	1056	292	233	358	**2002**	1025	280	217	250
1995	905	283	206	353	**2003**	912	262	196	229
1996	874	276	197	349	**2004**	927	264	197	217
1997	1000	281	220	341	**2005**	939	251	197	168

Trends of emissions from fuel combustion and leakage

Table 3.5 Total emissions from fuel combustion and leakage, million tones CO_2 equivalent

Year	Combustion	Leakage	Year	Combustion	Leakage
1990	108	46	**1998**	97	53
1991	108	48	**1999**	101	58
1992	101	48	**2000**	105	70
1993	102	76	**2001**	105	73
1994	97	62	**2002**	108	74
1995	97	63	**2003**	103	76
1996	100	65	**2004**	100	74
1997	98	57	**2005**	96	76

For the period 1990-2005 the changes in the emissions from the fuel combustion amounted to -11.1%; from leakage +65.2%.

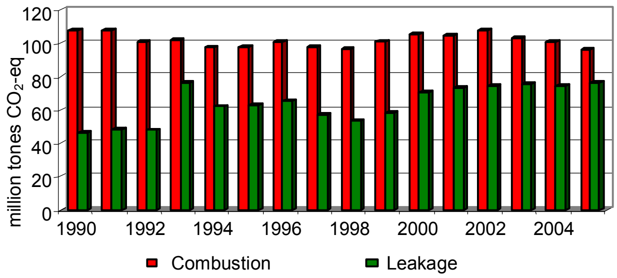

Fig. 3.4 Trends of emissions from combustion and leakage

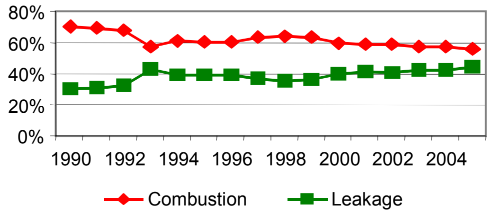

Fig. 3.5 Change in percentage of combustion and leakage in the energy sector

Key sources

The key sources that were used when assessment of emission level or trend, are listed below in order of decreasing emission volumes:

1. Fugitive CH_4 emissions from oil and gas production – level, trend
2. Other sectors. Residential sector, CO_2 emissions from natural gas combustion – level, trend
3. Energy Industries, CO_2 emissions from natural gas combustion – level, trend.
4. Other sectors: Commercial sector, CO_2 emissions from natural gas combustion – level, trend.
5. Energy industries, CO_2 emissions from residual fuel oil – level, trend.
6. Mobile sources: CO_2 emissions from road transportation – level, trend.
7. CO_2 emissions from pipeline transport – level, trend.
8. Manufacturing industries and construction, CO_2 emissions from natural gas combustion – level, trend.
9. Energy industries, CO_2 emissions from brown coal combustion – level, trend.
10. Other sectors: Agriculture, CO_2 emissions from liquid fuel combustion – level, trend.
11. Energy industries, CO_2 emissions from crude oil combustion – level, trend.
12. Other sectors: Commercial sector, CO_2 emissions from liquid fuel combustion – level, trend.
13. Manufacturing industries and construction, CO_2 emissions from liquid fuel combustion – trend.
14. Other sectors: Commercial sector, CO_2 emissions from solid fuel combustion – trend.
15. Mobile sources: CO_2 emissions from railways – level, trend.
16. Other sectors. Residential sector, CO_2 emissions from liquid fuel combustion –trend
17. Manufacturing industries and construction, CO_2 emissions from solid fuel combustion – trend
18. Other sectors. Residential sector, CO_2 emissions from solid fuel combustion – trend.

3.2 1A FUEL COMBUSTION ACTIVITIES

3.2.1 Description of source categories

In this category the emissions of CO_2, CH_4, N_2O, CO, NOx, NMVOC and SO_2 from fuel combustion were estimated. The emissions were estimated by sub-sectors: 1A1 Energy Industries; 1A2 Manufacturing industries and construction; 1A3 Transport (all types of transport 1A3 a (I и ii), 1A3 b, 1A3 c, 1A3 d ii, 1A3 e i); 1A4 a Commercial sector, 1A4 b Residential sector, 1A4 c Agriculture (I и ii). CO_2 emissions were also estimated with employing the reference approach (Annex 4).

Table 3.6 Percentage of direct GHG emissions from fuel combustion, 2000

Gas	Gg CO_2-eq	%
CO_2	105016	99.8
CH_4	146	0.1
N_2O	110	0.1
Total	105273	100.0

Table 3.7 Indirect GHG emissions from fuel combustion, 2000

Gas	Gg
CO	1066
NOx	282
NMVOC	191
SO_2	223

The CO_2 emissions from fuel combustion calculated with employing the reference approach, amounted 106060 Gg in 2000. Difference between the emissions calculated with use of two approaches is 1%.
The CO_2 emissions from biomass combustion amounted to 3001.8 Gg (not included in the total emission).
Emissions from international bunkers amounted to 1126.4 Gg CO_2 equivalent (not included in the total emission).

CO_2 Emissions

The most significant differences in the CO_2 emissions calculated with employing the reference and sectoral approaches were recorded in the beginning of the 90'es.

Table 3.8 CO_2 emissions calculated with employing the reference and sectoral approaches, Gg CO_2 equivalent

Year	Reference approach	Sectoral approach	Difference, %
1990	110495	107009	3.2
1991	110035	107003	2.8
1992	102905	100249	2.6
1993	102497	101318	1.2
1994	97909	96894	1.0
1995	98511	97224	1.3
1996	101114	100069	1.0
1997	99157	98439	0.7
1998	97755	96270	1.5
1999	101353	100575	0.8
2000	106060	105016	1.0
2001	106306	104260	1.9
2002	107950	107260	0.6
2003	103485	102848	0.6
2004	100602	100236	0.4
2005	96076	95648	0.4

The difference in the calculations of the CO_2 emissions by type of fuel is presented in the table 3.9.

Table 3.9 CO_2 emissions from fuels calculated with employing the reference and sectoral approaches, million tonnes of CO_2

Year	Reference approach, million tonnes of CO_2			Sectoral approach, million tonnes of CO_2			Difference, %		
	Oil	Coal	Gas	Oil	Coal	Gas	Oil	Coal	Gas
1990	33.37	13.50	63.62	32.4	13.74	60.64	2.8	-1.7	4.7
1991	28.96	12.86	68.22	28.3	13.07	65.45	2.3	-1.6	4.1
1992	23.39	9.73	69.78	22.6	9.78	67.66	3.3	-0.5	3.0
1993	20.32	5.73	76.45	20.3	5.82	74.99	0.0	-1.6	1.9
1994	19.28	4.64	73.98	18.7	4.73	73.23	2.8	-1.8	1.0
1995	18.96	4.07	75.48	18.3	4.06	74.67	3.5	0.1	1.1
1996	17.97	4.42	78.73	18.1	4.50	77.40	-0.4	-2.0	1.7
1997	18.82	3.71	76.63	19.0	3.80	75.55	-0.8	-2.5	1.4
1998	17.58	3.41	76.76	17.2	3.25	75.68	2.0	4.6	1.4
1999	18.98	3.11	79.27	18.7	3.20	78.56	1.4	-3.1	0.9
2000	19.75	3.73	82.58	19.6	3.85	81.49	0.8	-3.2	1.3
2001	18.21	3.13	84.96	17.5	3.23	83.46	3.6	-3.0	1.8
2002	17.86	3.31	86.78	17.8	3.38	85.97	0.1	-2.2	0.9
2003	16.98	2.55	83.95	16.8	2.62	83.34	1.3	-2.7	0.7
2004	15.66	3.39	81.55	15.7	3.39	81.05	0.0	-0.2	0.6
2005	14.01	2.90	79.16	14.1	2.91	78.55	-0.4	-0.4	0.8

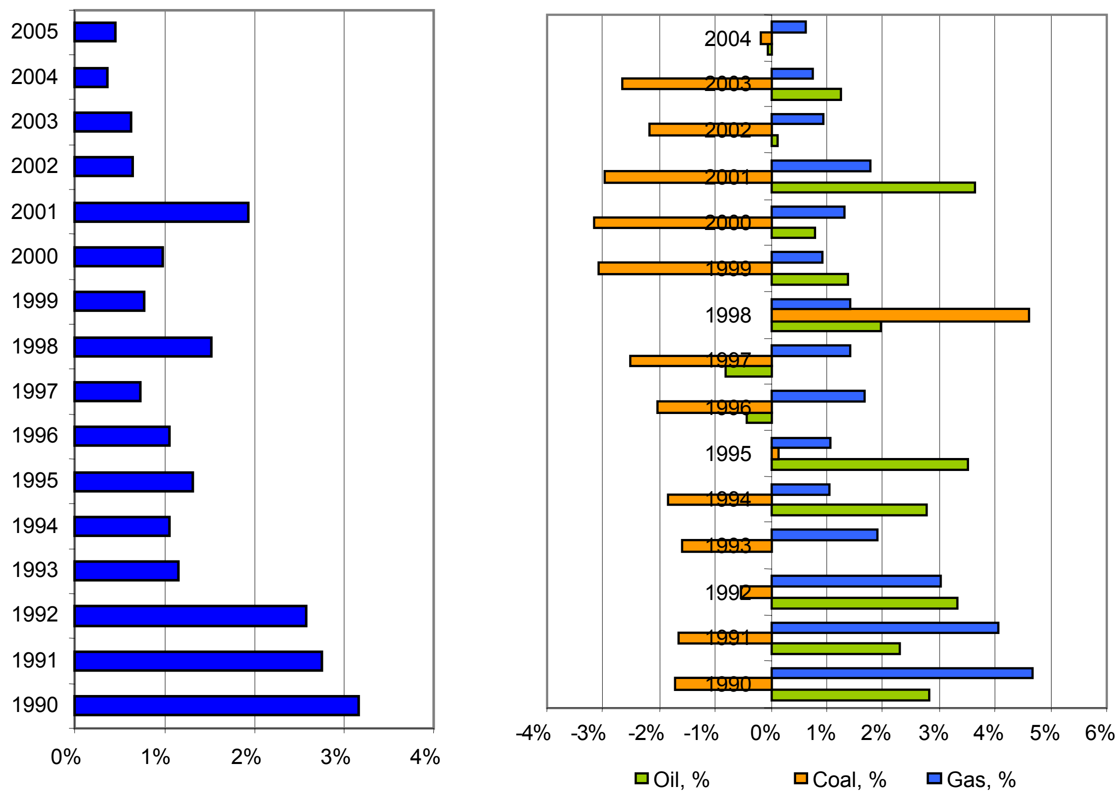

***Fig. 3.6** Difference in estimates made by the reference and sectoral approach*

Trends of emissions by gases

The direct GHG emissions for the period 1990-2005 changed as follows: CO_2 -10.6%; N_2O -48.7%; CH_4 -64.4%; total emission -10.9%; CO_2 from biomass combustion +429% or a rise in emissions by 5.3 times. The emissions from biomass combustion were not included in the total emission.

Table 3.10 Direct GHG emissions from fuel combustion, Gg CO_2 equivalent

Year	CO_2	N_2O	CH_4	Total emission	CO_2 from biomass combustion
1990	107009	177	385	107571	856
1991	107003	166	373	107543	959
1992	100249	139	303	100691	1018
1993	101318	119	233	101669	1208
1994	96894	109	196	97199	1565
1995	97224	105	139	97468	2028
1996	100069	108	139	100316	2434
1997	97439	106	137	97682	2676
1998	96270	100	133	96503	2859
1999	100575	104	144	100822	2957
2000	105016	110	146	105273	3002
2001	104260	103	144	104507	3392
2002	107260	105	144	107510	3902
2003	102848	98	142	103088	4316
2004	100235	99	137	100471	4506
2005	95648	91	137	95876	4532

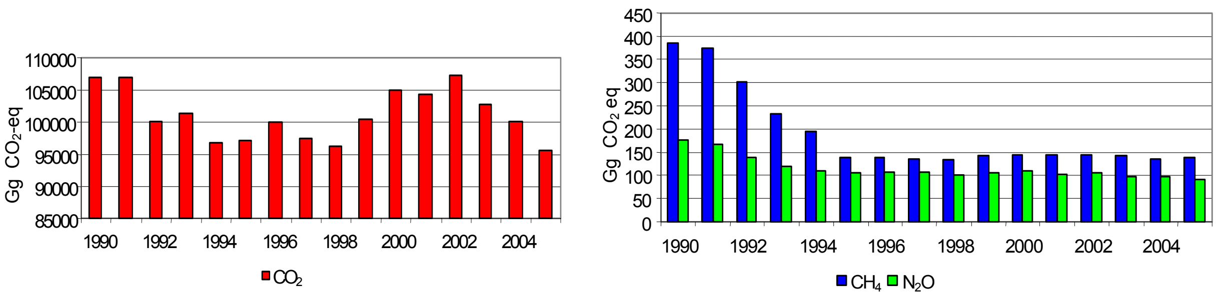

Fig. 3.7 *Trends of direct GHG emissions from fuel combustion.*

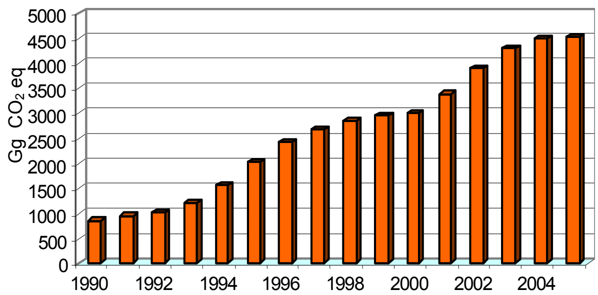

Fig. 3.8 *Trend of CO_2 emissions from biomass combustion*

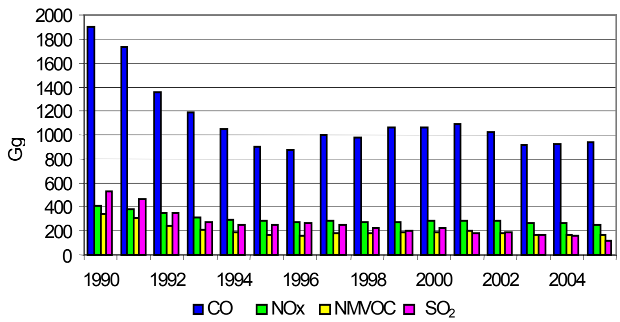

Fig. 3.9 *Trends of indirect GHG emissions*

Table 3.11 Indirect GHG emissions from fuel combustion, Gg

Year	CO	NOx	NMVOC	SO_2	Year	CO	NOx	NMVOC	SO_2
1990	1904	410	337	503	**1998**	975	269	178	220
1991	1738	377	306	443	**1999**	1058	276	192	205
1992	1361	344	243	345	**2000**	1066	282	191	223
1993	1191	317	215	272	**2001**	1097	280	197	182
1994	1055	292	192	249	**2002**	1025	280	184	191
1995	904	282	168	258	**2003**	912	262	164	176
1996	873	275	161	270	**2004**	927	263	166	169
1997	999	280	183	257	**2005**	938	251	168	125

For the period 1990-2005 changes in the indirect GHG emissions were as follows: CO -50.7%; NOx -38.8%; NMVOC -50.1%; SO_2 -75.2%.

GHG emissions by sub-sectors

For all sub-sectors the same emission factors were applied for each type of fuel, therefore all sub-sectors are described in the sub-chapter – Fuel combustion.

Table 3.12 Direct GHG emissions by sub-sectors in 2000, Gg CO_2-eq

Sub-sector	CO_2	CH_4	N_2O	Total
Energy industries	44284	20	54	44359
Manufacturing industries and construction	4982	9	5	4996
Transport	11132	31	16	11179
Commercial	9024	19	10	9053
Residential	32696	62	18	32777
Agriculture	2693	5	7	2704
Other	206	0	0	206
Total	105016	146	110	105272

Table 3.13 Indirect GHG emissions by sub-sectors in 2000, Gg CO_2-eq

Sub-sector	CO	NOx	NMVOC	SO_2
Energy industries	14	120	4	185
Manufacturing industries and construction	3	14	0	4
Transport	929	80	161	6
Commercial	19	9	2	18
Residential	30	29	3	1
Agriculture	72	29	21	8
Total	1066	282	191	223

"Other" means CO_2 emissions from lubricating oils, as they were not distributed among sub-sectors.

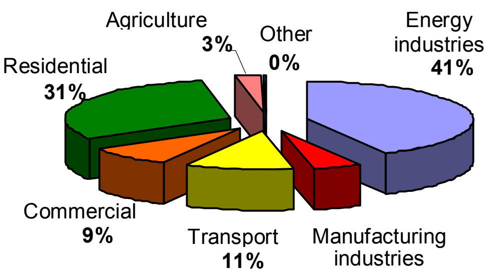

Fig. 3.10 Contribution of sub-sectors to direct GHG emissions from fuel combustion,2000

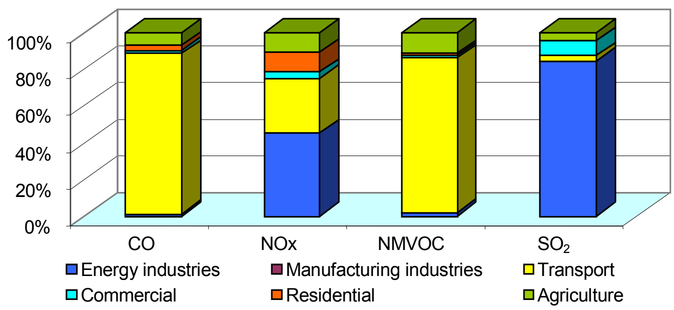

Fig. 3.11 Contribution of sub-sectors to indirect GHG emissions from fuel combustion,2000

The most significant contributors to the GHG emissions are the energy industries and residential sub-sectors.

Trends of the GHG emissions by sub-sectors

Table 3.14 CO_2 emissions from fuel combustion by sub-sectors, Gg

Year	Energy industries	Manufacturing industries and construction	Transport	Commercial	Residential	Agriculture	Others
1990	55100	10168	16491	6841	12240	5667	503
1991	53981	9406	15168	9507	13041	5399	501
1992	50432	8341	11274	10679	13986	5118	420
1993	46921	7725	9803	14646	17421	4445	357
1994	44952	6058	8720	10385	22588	3855	337
1995	44916	6227	8134	9369	24492	3870	216
1996	43249	5808	8358	9723	28961	3757	214
1997	43058	5563	8571	7610	29762	2620	255
1998	40965	5232	9096	7786	30272	2687	232
1999	40916	5042	10385	8470	32408	3151	203
2000	44284	4982	11132	9024	32696	2693	206
2001	42251	5106	12941	9050	31696	3004	213
2002	44912	5150	12569	7968	33833	2649	179
2003	41640	5332	11142	8338	33893	2141	363
2004	43345	5333	10139	9773	29467	2003	175
2005	36695	5327	9588	10689	30991	2024	334

The following changes in the emissions from the sub-sectors occurred for the period 1990-2005: energy industries -33.4%; manufacturing industries and construction -47.6%; transport -41.9%; commercial sub-sector

+56.2%; residential sub-sector +153.2% or increase by 2.5 times; agriculture -64.3%; other (lubricating oils, which were not distributed among the sub-sectors) -33.6 %.

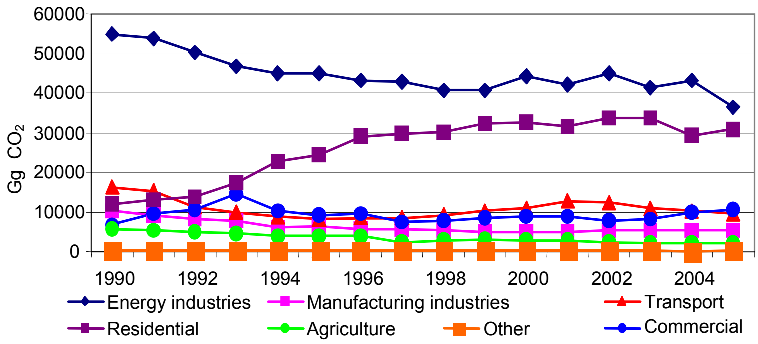

Fig. 3.12 *Trends of CO_2 emissions by sub-sectors*

Considerable rise in the CO_2 emissions from the residential sub-sector was due to the fact that many inhabited localities, including in rural area, were supplied with natural gas for that period within the framework of the state program of gasification.

Table 3.15 CH_4 emissions from fuel combustion by sub-sectors, Gg CO_2 equivalent

Year	Energy industries	Manufacturing industries and construction	Transport	Commercial	Residential	Agriculture
1990	24.2	17.6	50.8	15.4	241.9	34.7
1991	23.1	16.2	45.8	20.1	234.7	33.4
1992	20.9	14.5	35.7	22.0	175.9	34.0
1993	20.2	13.7	31.5	28.5	124.2	14.7
1994	19.5	10.4	27.7	20.5	108.4	9.8
1995	19.8	11.2	23.5	18.5	57.4	8.4
1996	19.2	10.5	22.4	19.4	59.2	7.9
1997	19.3	10.0	26.5	15.4	59.0	6.7
1998	18.1	9.5	26.6	15.9	58.9	4.5
1999	18.5	9.1	30.6	17.3	62.7	5.5
2000	20.2	9.1	31.1	18.8	62.4	4.6
2001	18.6	9.5	31.9	18.3	61.0	5.1
2002	20.0	9.3	29.8	16.5	64.5	4.4
2003	18.7	9.9	27.4	17.1	65.2	3.5
2004	18.8	10.1	27.7	19.9	56.8	3.3
2005	15.5	9.9	28.1	21.7	58.8	3.4

Change in the CH_4 emissions from fuel combustion in the sub-sectors for the period 1990-2005 was as follows: energy industries -36.0%; manufacturing industries and construction -43.7%; transport -44.7%; commercial +40.9%; residential -75.7% or drop by 4.1 times; agriculture -90.2% or drop by 10 times.

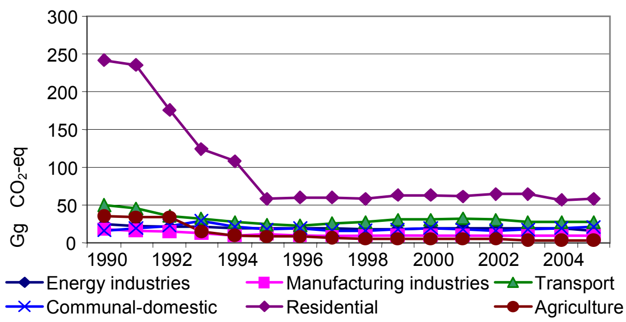

Fig. 3.13 *Trend of CH_4 emissions from fuel combustion by sub-sectors*

Decrease in CH_4 emissions from the residential sector between 1990 and 1995 brought about by less amount of solid fuel used in the sector.

Table 3.16 N_2O emissions from fuel combustion by sub-sectors, Gg CO_2 equivalent

Year	Energy industries	Manufacturing industries and construction	Transport	Commercial	Residential	Agriculture
1990	80.6	13.3	31.9	14.9	22.3	14.0
1991	73.5	11.8	28.5	17.1	22.0	13.3
1992	62.6	9.3	22.0	13.6	18.0	12.4
1993	53.0	8.1	19.5	12.1	16.1	10.2
1994	48.7	6.2	17.4	10.5	17.1	9.0
1995	51.5	5.9	15.2	9.3	14.6	9.0
1996	52.7	5.3	14.0	10.5	16.4	8.7
1997	51.8	5.3	15.2	8.1	16.7	8.7
1998	46.5	4.7	16.1	8.7	17.1	6.5
1999	48.1	4.7	16.1	9.0	18.3	7.8
2000	54.3	4.7	16.1	10.2	18.3	6.5
2001	47.1	4.3	16.4	9.3	18.0	7.4
2002	50.5	4.3	15.5	9.3	18.9	6.5
2003	46.8	4.0	14.6	8.1	19.2	5.3
2004	49.3	4.0	14.6	9.0	16.7	5.0
2005	39.4	4.0	15.2	10.2	17.4	5.0

Change in the N_2O emissions from fuel combustion in the sub-sectors for the period 1990-2005 was as follows: energy industries -51.1% or half decrease; manufacturing industries and construction -69.9% or decrease by 3.3 times; transport -52.4 or half decrease; commercial -31.5%; residential -22.0%; agriculture -64.3 % or decrease by 2.8 times.

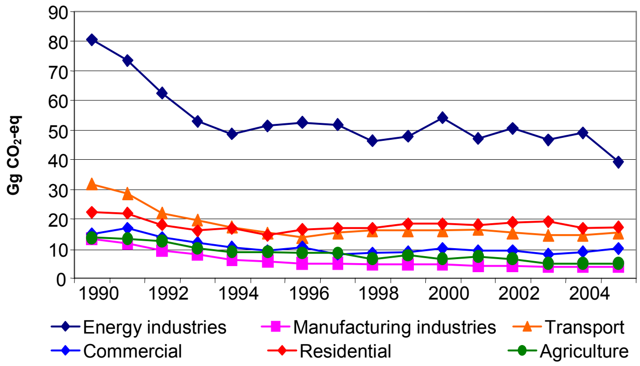

Fig. 3.14 *Trends of N_2O emissions from fuel combustion by sub-sectors*

Considerable drop in the N_2O emissions from energy industries for the period 1990-1994 was caused by decrease in coal utilization.

Table 3.17 CO emissions from fuel combustion by sub-sectors, Gg

Year	Energy industries	Manufacturing industries and construction	Transport	Commercial	Residential	Agriculture
1990	16.9	5.7	1567.6	41.1	78.6	193.6
1991	16.9	5.2	1399.7	52.0	76.6	187.2
1992	16.2	4.4	1090.0	31.2	58.9	160.6
1993	15.2	4.1	970.7	25.1	43.9	132.4
1994	14.6	3.1	854.4	26.2	40.7	116.9
1995	14.4	3.3	721.4	22.7	25.4	117.1
1996	13.7	3.0	693.4	25.6	27.4	109.9
1997	13.7	2.9	832.9	16.1	27.5	106.0
1998	13.2	2.7	843.6	17.0	27.7	70.7
1999	13.0	2.6	912.9	16.1	29.5	84.1
2000	14.0	2.6	928.9	18.7	29.5	72.1
2001	13.7	2.7	953.4	18.8	28.8	80.0
2002	14.5	2.7	887.6	18.6	30.5	71.1
2003	13.4	2.8	796.5	11.0	30.7	57.5
2004	14.0	2.9	817.2	12.1	26.7	53.7
2005	12.1	2.8	825.6	15.9	27.8	54.2

Change in the CO emissions from fuel combustion in the sub-sectors for the period 1990-2005 was as follows: energy industries -28.4 %; manufacturing industries and construction -50.9% or half decrease; transport -47.3 or about half decrease; commercial -61.3% or drop by 2.6 times; residential -64.6% or drop by 2.8 times; agriculture -72.0 % or decrease by 3.6 times.

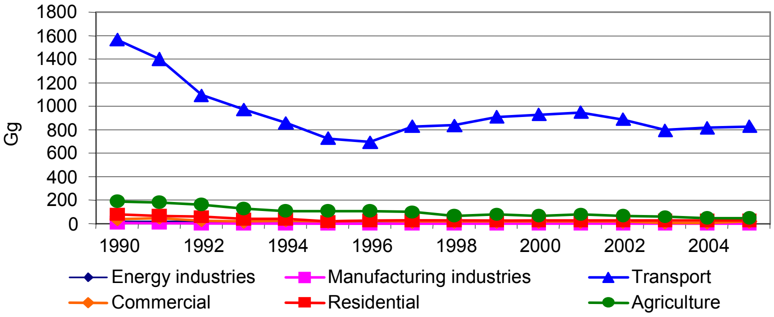

Fig. 3.15 *Trends of CO emissions from fuel combustion by sub-sectors*

Drop in the CO emissions from transport in the first half of the 90-s was brought about by decline in cargo- and passenger transportation, mainly by motor and railway transport.

Table 3.18 NOx emissions from fuel combustion, Gg

Year	Energy industries	Manufacturing industries and construction	Transport	Commercial	Residential	Agriculture
1990	151.0	29.4	158.1	7.3	12.1	51.6
1991	147.7	26.9	144.2	9.6	12.7	35.5
1992	137.8	23.8	112.5	10.5	13.2	45.8
1993	127.2	22.0	97.1	13.6	16.0	41.1
1994	121.5	17.0	86.1	9.8	20.5	37.0
1995	121.5	17.7	74.4	8.8	22.0	37.8
1996	117.4	16.6	69.4	9.2	26.0	36.8
1997	116.8	15.9	75.6	7.3	26.7	38.0
1998	111.0	15.0	79.8	7.6	27.2	28.7
1999	110.9	14.4	79.8	8.3	29.1	33.6
2000	120.4	14.3	80.0	8.9	29.3	28.7
2001	114.8	14.6	81.5	8.7	28.4	32.3
2002	121.9	14.6	76.6	7.9	30.4	28.3
2003	112.7	15.1	72.4	8.1	30.4	22.8
2004	117.8	15.1	72.9	9.5	26.5	21.4
2005	99.8	14.8	76.4	10.3	27.8	21.6

The following changes in NOx emissions from the sub-sectors occurred for the period 1990-2005: energy industries -33.9% or 1.5 time decline; manufacturing industries and construction -49.7% or half decrease; transport -51.7% or half decrease; commercial sub-sector +41.1%; residential sub-sector +129.8% or an increase by 2.3 times; agriculture -58.1% or drop by 2.4 times.

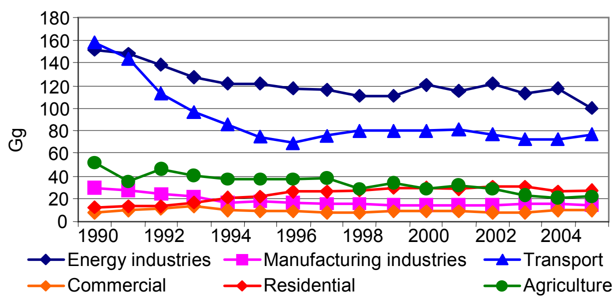

Fig. 3.16 *Trends of NOx emissions from fuel combustion by sub-sectors*

Drop in the NOx emissions from transport in the first half of the 90-s as with drop in the CO emissions was brought about by decline in cargo- and passenger transportation, mainly by motor and railway transport.

Table 3.19 NMVOC emissions from fuel combustion by sub-sectors, Gg

Year	Energy industries	Manufacturing industries and construction	Transport	Commercial	Residential	Agriculture
1990	4.4	1.0	272.4	4.2	7.9	46.7
1991	4.4	0.9	243.2	5.3	7.7	44.7
1992	4.2	0.8	189.3	3.2	5.9	39.8
1993	3.9	0.7	169.2	2.5	4.4	34.3
1994	3.8	0.6	150.7	2.6	4.1	30.7
1995	3.7	0.6	128.2	2.3	2.5	31.0
1996	3.6	0.5	122.5	2.6	2.7	29.6
1997	3.6	0.5	144.7	1.7	2.8	29.7
1998	3.4	0.5	148.7	1.7	2.8	21.1
1999	3.4	0.5	158.5	1.7	3.0	24.9
2000	3.6	0.5	161.0	1.9	3.0	21.3
2001	3.5	0.5	164.7	1.9	2.9	23.9
2002	3.7	0.5	153.3	1.9	3.1	21.0
2003	3.4	0.5	138.9	1.2	3.1	17.0
2004	3.6	0.5	141.8	1.3	2.7	15.9
2005	3.1	0.5	144.4	1.6	2.8	16.0

Change in the NMVOC emissions from fuel combustion in the sub-sectors for the period 1990-2005 was as follows: energy industries -29.5 %; manufacturing industries and construction -50.0% or half decrease; transport -47.0 or decrease by 1.9 times; commercial -61.9% or drop by 2.6 times; residential -64.6% or drop by 2.8 times; agriculture -65.7 % or decrease by 2.9 times.

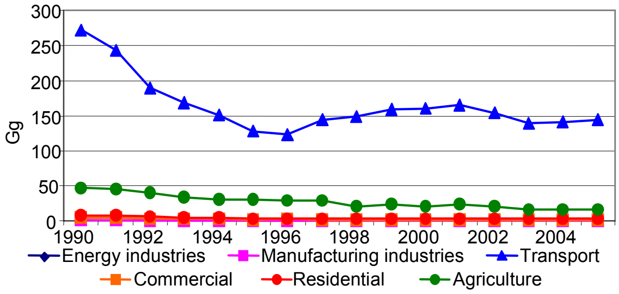

Fig. 3.17 *Trends of NMVOC emissions from fuel combustion by sub-sectors*

Decrease in the NMVOC emissions from transport in the first half of the 90-s was brought about by the same causes as drop in the CO and N_2O emissions, that is, a decline in cargo- and passenger transportation, mainly by motor and railway transport.

Table 3.20 SO_2 emissions from fuel combustion by sub-sectors, Gg

Year	Energy industries	Manufacturing industries and construction	Transport	Commercial	Residential	Agriculture
1990	302.4	27.6	34.6	54.8	44.7	39.4
1991	255.3	23.5	32.3	52.1	44.1	36.1
1992	191.2	17.6	25.2	41.7	33.6	35.2
1993	172.9	12.1	21.4	16.9	20.8	28.2
1994	160.6	8.9	20.1	18.8	15.3	24.9
1995	188.4	7.0	18.3	15.6	3.1	25.1
1996	199.0	6.1	16.2	22.7	1.7	24.6
1997	194.4	6.2	14.3	14.5	1.5	25.8
1998	161.9	6.6	15.9	14.5	1.2	19.8
1999	172.3	3.6	6.3	12.1	1.1	9.8
2000	185.3	3.8	6.1	18.3	0.9	8.3
2001	145.5	2.7	6.1	17.8	1.0	9.4
2002	157.4	3.1	5.8	15.5	0.9	8.2
2003	150.7	2.3	6.1	9.1	1.1	6.6
2004	144.7	1.9	5.9	9.1	1.0	6.2
2005	99.7	1.8	6.8	9.7	0.8	6.3

Change in the SO_2 emissions from fuel combustion in the sub-sectors for the period 1990-2005 was as follows: energy industries -67.0 % or 3 times less; manufacturing industries and construction -93.5% or a decrease by 15 times; transport -80.3% or decrease by 5.1 times; commercial -82.3% or drop by 5.6 times; residential -98.2% or drop by 56 times; agriculture -84.0 % or decrease by 6.3 times.

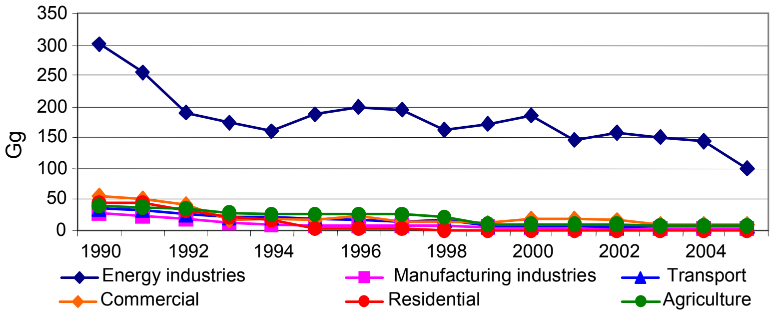

Fig. 3.18 *Trends of SO_2 emissions from fuel combustion by sub-sectors*

Drop in the SO_2 emissions from the energy sector occurred due to an increase in share of gas in the utilized fuel.

GHG emissions from transport

GHG emissions from transport were estimated in more detail – by types of transport.

Table 3.21 GHG emissions from transport by types, 2000

Type of transport	Emissions Gg CO_2-eq	%
Domestic air transport	71.4	< 1
Road transport	5664.7	51
Railways	328.5	3
Navigation	0	0
Pipeline transport	5114.3	46
Total	1178.9	100

Table 3.22 GHG emissions from transport by gases, 2000

Gas	Emissions, Gg CO2-eq	%
CO_2	1132	99.6
CH_4	31.1	0.3
N_2O	16.2	0.1

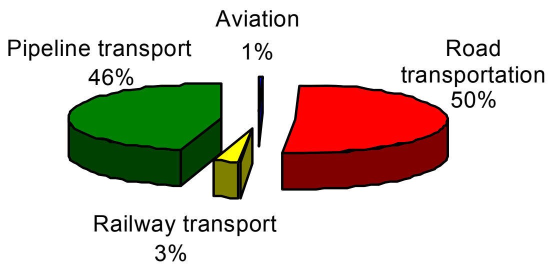

Fig. 3.19 *GHG emissions from transport by types, 2000*

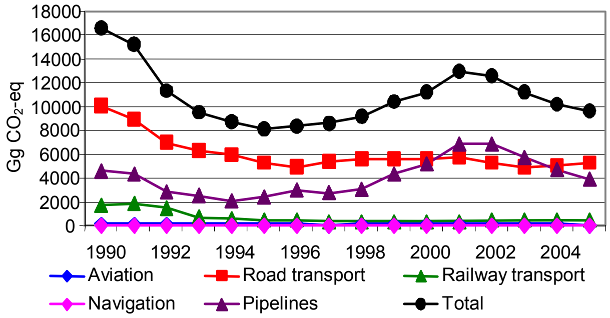

Fig 3.20 *Trends of direct GHG emissions from transport by types*

Change in emissions from transport for the period 1990-2005 was as follows: domestic aviation -65.5% or decline by 2.9 times; road transport -47.2% or drop by 1.9 times; railways -75.0% or decrease by 4 times; navigation – the emissions dropped to zero by 1997 due to degradation of the Aral Sea and complete decline in water transport; pipeline transport -15.3%; total sectoral emission -41.9% or decrease by 1.7 times.

Table 3.23 Direct GHG emissions from transport, Gg CO_2 equivalent

Year	Domestic aviation	Road transport	Railways	Navigation	Pipeline transport	Total
1990	165	10060	1761	13	4575	16574
1991	108	8957	1808	13	4357	15242
1992	75	6959	1436	9	2852	11332
1993	69	6353	648	9	2475	9554
1994	63	6004	579	9	2110	8765
1995	60	5283	441	6	2382	8172
1996	59	4944	404	6	2981	8394
1997	54	5431	379	0	2752	8616
1998	67	5600	388	0	3086	9141
1999	67	5640	350	0	4374	10432
2000	71	5665	328	0	5114	11179
2001	64	5720	375	0	6830	12989
2002	67	5296	416	0	6835	12614
2003	64	4956	438	0	5725	11184
2004	61	5002	503	0	4678	10244
2005	57	5289	441	0	3845	9632

International bunkers

Direct GHG emissions from international air transport in 2000 added up to 1126.4 Gg CO_2 equivalent (in Uzbekistan there is only international air bunker).

The following changes in the emissions from international air bunker took place for the period 1990-2005: CO_2 -68.3%; CH_4 -75.0% or drop by 4 times; N_2O -68.5%; NOx -68.1%; CO -67.5%; NMVOC -70.0%; SO_2 -68.4%. The emissions of all gases, except of methane were decreased by 3.1-3.3 times.

Table 3.24 Direct and indirect GHG emissions from international air bunker, 2000

Direct GHG, Gg CO_2-eq			Indirect GHG, Gg			
CO_2	CH_4	N_2O	CO	NOx	НМУ	SO_2
1116.4	0.17	9.8	1.58	4.7	0.8	0.7

Table 3.25 Direct and indirect GHG from international air bunker

Year	CO_2	CH_4	N_2O	NOx	CO	NMVOC	SO_2	Year	CO_2	CH_4	N_2O	NOx	CO	NMVOC	SO_2
	Gg CO_2-eq			Gg					Gg CO_2-eq			Gg			
1990	2818.5	0.4	24.7	11.9	4.0	2.0	1.9	**1998**	978.0	0.1	8.6	4.1	1.4	0.7	0.6
1991	1745.3	0.3	15.3	7.4	2.5	1.2	1.1	**1999**	1035.7	0.2	9.1	4.4	1.5	0.7	0.7
1992	1125.1	0.2	9.9	4.8	1.6	0.8	0.7	**2000**	1116.4	0.2	9.8	4.7	1.6	0.8	0.7
1993	1078.9	0.2	9.5	4.6	1.5	0.8	0.7	**2001**	1041.4	0.2	9.1	4.4	1.5	0.7	0.7
1994	963.5	0.1	8.4	4.1	1.4	0.7	0.6	**2002**	1144.1	0.2	10.0	4.8	1.6	0.8	0.8
1995	900.1	0.1	7.9	3.8	1.3	0.6	0.6	**2003**	983.7	0.1	8.6	4.2	1.4	0.7	0.6
1996	885.7	0.1	7.8	3.8	1.3	0.6	0.6	**2004**	969.3	0.1	8.5	4.1	1.4	0.7	0.6
1997	793.3	0.1	6.9	3.4	1.1	0.6	0.5	**2005**	894.3	0.1	7.8	3.8	1.3	0.6	0.6

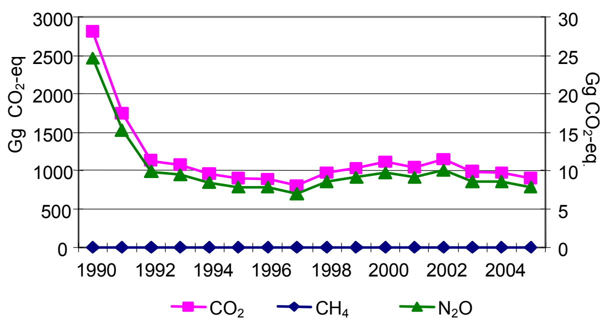

Fig. 3.21 *Trends of direct GHG emissions from international air bunker*

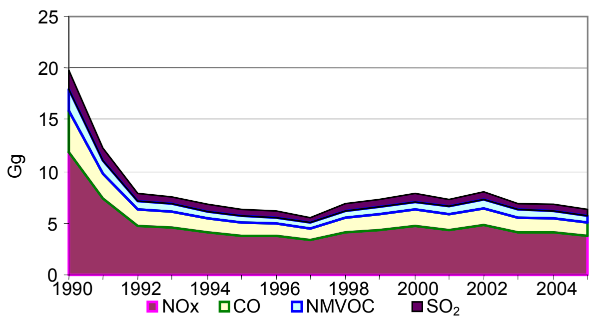

Fig. 3.22 *Trends of indirect GHG emissions from international air bunker*

Decline in both direct and indirect GHG emissions occurred due to decrease in air carriages in the beginning of the 90'es.

3.2.2 Methodology

The estimation of the CO_2 emissions from fuel combustion was performed in accordance with the Revised 1996 IPCC Guidelines for National GHG Inventories, [3] – Tier 1. For the calculations both reference (Annex 4) and sectoral approaches were used. The CO_2 emissions from biomass combustion and emissions of non-CO_2 gases (CH_4, N_2O, NOx, CO, NMVOC, SO_2) were also estimated with use of Tier 1in accordance with [3].

Activity data

The data on the volumes of import and export, changes in storage and use of fuel for the period 1990-2005 were provided by the State Committee on Statistics of the Republic of Uzbekistan (table 3.27). The share of jet kerosene used for domestic air transport amounted to 5% but for international air bunker it came to 95%.

To calculate CO_2 emissions from biomass combustion the following data were used:

1. Amount of crop residues and other agricultural waste on site (sector Agriculture). The data were provided by the State Committee on Statistics of the Republic of Uzbekistan [12].

Table 3.26 Total crop yield in 2000

Wheat thousand tonnes	Barley thousand tonnes	Rye thousand tonnes	Total thousand tonnes
3684.2	91.29	1.78	3777.27

2. Amount of fuel wood harvested from sanitary felling in forests (sector Land-Use Change & Forestry). The data on volume of felling were provided by the Main Forestry Administration. In 2000 the amount of fuel wood amounted to 35.12 thousand tonnes.

Emission factors

For the calculation both national and default emission factors were used.
National factors are energy conversation coefficients for all types of fuel.

Table 3.28 Energy coefficients

Fuel	TJ/thousand tonnes	Fuel	TJ/thousand tonnes
Solid fuel		Jet kerosene	42.900
Uzbek brown coal	13.775	Other kerosene	43.082
Uzbek coal	19.929	Diesel fuel	42.496
Uzbek coal briquettes	22.860	Residual fuel oil	40.151
Coke	26.377	Domestic stove fuel	42.496
Gas		Liquefied gas	46.013
Gas of underground gasification (million m^3)	3.647	Oil refinery gas	43.961
Natural and associated gas (million m^3)	33.997	Bitumen	39.565
Liquid fuel		Petroleum oil	40.151
Crude oil and condensate	41.868	Other oil products	40.151
Gasoline	43.668		

Recalculation coefficients of fuel from natural values into energy ones for calculation of CO_2 emissions were taken in accordance with [8] and [9, 10] excluding for jet kerosene. Calorific values of jet kerosene were provided by the Joint-Stock Company "Uznefteprodukt", that is a part of the National Holding Company "Uzneftegaz".

In the previous years not only uzbek coals but coals from the provinces of former USSR were utilized in the republic. The imported coals are characterized by higher calorific values. Therefore average weighted coefficients for coals were calculated for each year starting since 1990. The calculation was performed in the State Committee on Statistics of the Republic of Uzbekistan.

Import of coals stopped in 1993. In 1998 import was recommenced, but in much less volume. There is no data on their calorific value. The quality of uzbek coals is reducing. In 2006 the calorific value was revised of sub-bituminous coals being in use (Annex 6). Average value of calorific value according to the data of the Open Joint-Stock Company "Ugol" is 2965.0 kcal/kg (or **12.414** GJ/tonne or TJ/thousand tonnes). For 1998 it was decided to use the value **13.158** GJ/tonne, that is averaged value between 1997 (13.901 GJ/tonne) and 1999 (12.414 GJ/tonne) as no data available on calorific values of imported coals.

Table 3.27 Fuel production and consumption in 2000

	Natural gas, million m^3	Gas of underground gasification, million m^3	Crude oil and condensate, thousand tonnes	Gasoline, thousand tonnes	Diesel fuel, thousand tonnes	Residual fuel oil, thousand tonnes	LPG, thousand tonnes	Jet kerosene, thousand tonnes	Other kerosene, thousand tonnes
Produced	56401	247	7536	1709	1972	1709	91	394	67
Including : oil			4170						
condensate			3366						
Import	1621		0	1	0	0	0	0	0
Export	6857		280	74	336	71	18	2	40
Change in storage	123		219	- 40	41	345	0	2	0
Total consumption	51288	247	7475	1596	1677	1983	74	394	27
Non-energy consumption	9257		139			2			
Including as chemical row materials	1619								
Energy sector	17045	247	7336	6	20	1872	3	0	3
Industrial processes	1310			5	197	17	1	0	17
Transport	2754			1471	448	0	11	387	0
Road transport	59			1471	343		11	0	
Railway transport					105			0	
Air transport								387	
Pipeline transport	2695								
Other									
Agriculture	56			4	822	1	0		0
Population	17198			1	1		13		1
Communal and other	3668			109	189	91	46	7	6

Continuation of the table 3.27

	Domestic stove fuel, thousand tonnes	Oil refinery gas, thousand tonnes	Other oil products, thousand tonnes	Bitumen, thousand tonnes	Lubricants, thousand tonnes	Sub-bituminous coal, thousand tonnes	Bituminous coal, thousand tonnes	Patent fuel, thousand tonnes	Coke oven, thousand tonnes
Produced	63	243	125	167	182	2409	92	57	67
Including oil									
condensate									
Import	0	0	0	0	2	12	0	0	0
Export	12	0	0	5	46	0	7	0	40
Change in storage	- 1	0	0	- 8	3	613	16	- 2	0
Total consumption	50	243	125	154	141	3034	101	55	27
Non- energy consumption			121	154	141	2			
Including as chemical row materials									
Energy sector	4	243	0			2646	71	8	3
Industrial processes	1		0			20	2	0	17
Transport	0		4			0	0	0	0
Road transport			0						
Railway transport			0						
Air transport			4						
Pipeline transport			0						
Other			0						
Agriculture	3					1	0	0	0
Population	0					11	0	0	1
Communal and other	42					354	28	47	6

Table 3.29 Averaged weighted coefficients for coal (1990-1997) TJ/ thousand tonnes

Year	Bituminous coal	Sub-bituminous coal
1990	24.703	15.413
1991	24.134	15.252
1992	20.466	14.489
1993	19.929	14.242
1994	19.929	14.124
1995	19.929	13.830
1996	19.929	13.622
1997	19.929	13.901

Table 3.30 Averaged weighted coefficients for coal (1998-2005) TJ/ thousand tones

Year	Sub-bituminous coal
1998	13.158
1999	12.414
2000	12.414
2001	12.414
2002	12.414
2003	12.414
2004	12.414
2005	12.414

Coefficients for bituminous coal remain invariable for the period 1993-2005.

Carbon emission factors and fraction of oxidized carbon are default values that were taken from [3].

Coefficients for calculation of CO_2 emission from biomass burning are as follows:

- ***Fraction of residues burned on fields*** – **0.38.** It is a national coefficient, that is shown in details in the sector Agriculture)
- ***Conversion energy factor*** for biomass – **15.5** TJ/thousand tones (default value) [4].
- ***Carbon emission factor* – 29.9** tonnes C/TJ (default value) [3].
- ***Fraction of oxidized carbon* – 0.90** (default value) [3].

CH_4 emission factors (kg/TJ) are default values in all sectors [4].
N_2O emission factors (kg/TJ) are default values in all sectors [4].

CO emission factors (kg/TJ) are default values in all sectors except of road transportation (1A3b) (gasoline, diesel oil, gas) and mobile sources in the sub-sector Agriculture/Forestry/Fishing (1A4c) (gasoline, diesel oil).

In the sub-sector Road transportation (1A3b), national **CO** emission factor for **gas =3694.6** kg/TJ.
In the sub-sector Road transportation (1A3b) and mobile sources (1A4ii), national **CO** emission factor for **gasoline** = **13740.0** kg/TJ.
In the sub-sector Road transportation (1A3b) and mobile sources (1A4ii), national **CO** emission factor for **diesel oil** = **2353.2** kg/TJ.

NOx emission factors (kg/TJ) are default values in all sectors except of road transportation (gasoline, diesel oil, gas) and mobile sources in the sub-sector Agriculture/Forestry/Fishing (1A4c) (gasoline, diesel oil).
In the sub-sector Road transportation (1A3) national **NOx** emission factor for **gas = 869.3** kg/TJ.
In the sub-sector Road transportation (1A3b) and mobile sources (1A4ii), national **NOx** emission factor for **gasoline** = **916** kg/TJ.
In the sub-sector Road transportation (1A3b) and mobile sources (1A4ii), **NOx** national emission factor for **diesel oil** = **941.3** kg/TJ.

NMVOC emission factors (kg/TJ) are default values in all sectors except of road transportation (1A3b) (gasoline, diesel oil, gas) and mobiles in the sector Agriculture/Forestry/Fishing (1A4c) (gasoline, diesel fuel).
In the sub-sector Road transportation (1A3), national **NMVOC** emission factor for **gas =1304** kg/TJ.
In the sub-sector Road transportation (1A3b) and mobile sources (1A4ii), national **NOx** emission factor for **gasoline** = **2290** kg/TJ.
In the sub-sector Road transportation (1A3b) and mobile sources (1A4ii), national **NOx** emission factor for **diesel oil** = **706** kg/TJ.

Above listed ***national emission factors*** were calculated based on the instructions given in [11]. The calculation is presented in the Annex 7.

***Sulfur content in fuel* –** all values are national (table 3.31).
To estimate SO_2 emissions from solid combustion the average weighted coefficient (calorific value) was calculated taking into account a contribution of different types of solid fuel. For 2000 this coefficient is **12.841** TJ / thousand tones.

S content in ash was taken equal to **0** due to absence of data.

Reduction emission effect was taken equal to **0** due to absence of data.

Table 3.31 Sulfur content in fuel

Fuel	Normative document	Sulfur, %
Coals	Actual content	1
Heavy oil fraction (fuel oil) M-40, M-100	GOST 10585-75	3.5
Light fraction of oil (diesel fuel and domestic furnace fuel)	Temporary permission until putting into operation of the equipment on desulfurization at Fergana Petroleum Refinery	1.2
Since 1999, after putting into operation of the equipment on desulfurization at Fergana Petroleum Refinery	GOST 305-85, since 1.09.01 Uz 989	0.5
Gasoline (motor transport)	Actual content for the Bukhara Petroleum Refinery	0.05
Jet kerosene	GOST 10227-86	0.1
Natural gas	GOST Uz.39.0-1-95	0.02 gram/m^3

3.2.3 Uncertainties and sequence of time series

Only uncertainties of the CO_2 emissions from fuel combustion were estimated in accordance with [2]. To estimate the uncertainty associated with the emission factors the default values were used [5], for estimation of the uncertainties associated with activity data – expert judgment.

Table 3.32 Quantitative uncertainty estimate of the CO_2 emissions from energy sector, 2000

Sub-sector	Uncertainty of data	Uncertainty of emission factors /coefficients	Combined uncertainty	n, Gg CO_2-eq	± E	n + E	n - E
	U_A	U_F	U_T		Gg CO_2-eq		
Energy industries	1%	5%	5%	44284.4	2258.1	46542.5	42026.4
Manufacturing industries and construction	15%	5%	16%	4981.8	787.7	5769.5	4194.1
Road transport	15%	5%	16%	5619.4	888.5	6507.9	4730.9
Domestic aviation	40%	5%	40%	70.7	28.5	99.3	42.2
Railways	1%	5%	5%	327.2	16.7	343.9	310.5
Pipeline transport	1%	5%	5%	5114.3	260.8	5375.1	4853.5
Commercial/Institutional	15%	5%	16%	9023.8	1426.8	10450.6	7597.0
Residential	15%	5%	16%	32695.9	5169.7	37865.6	27526.3
Agriculture/ Forestry/Fishing	15%	5%	16%	2693.2	425.8	3119.1	2267.4
Total				104810.8	11262.6	116073.4	93548.3
Total in %					10.7	10.7	-10.7

Above shown expert judgments show that the uncertainty due to the activity data for CO_2 emissions from energy industries, railways and pipeline transport is low, about 1%. It is resulted from a strict control over fuel consumption and reporting. The uncertainty due to activity data for CO_2 emissions from road transportation, commercial, residential and agriculture sub-sectors are about 15% (data extrapolation in accordance with the ordinary statistical practice in the country). Uncertainty associated with activity data for CO_2 emissions from industrial processes was taken to be 15%. When calculation of the emissions this sector was not divided into energy intensive industry where uncertainty of activity data is low (about 1%) and other industries where the data extrapolation is performed (15%). For all industries the maximal values were taken. Uncertainty of activity data for air transport (40 %) was quantified based on the data of the National Aviation Company "Uzbekistan Havo Yullari" according to which fuel consumed by domestic air transport amounts to 3-7% of the total fuel amount. This figure can vary within 40%.

Combined uncertainty

Combined uncertainty for CO_2 emissions from categories where uncertainty can be estimated, range between ± 11263 Gg of CO_2 or 10.7% of the total emission.

For all years the same method and the same data sets were used.

3.2.4 Quality Assurance/ Quality Control

The QA/QC procedures were implemented in accordance with the general principals of QA/QC and QA/QC plan. There were conducted the checks of: the activity data obtained and input data for transcription errors; correctness of entering the coefficients (electronically) and formulas in the worksheets was checked; if units are properly labels and correctly carried through from beginning to end of calculation; consistency of time series inputs and calculations if data have changed; information sources for input data in Program Software were referenced; all information related to emission sources was documented. Comparison was made of CO_2 emissions estimates performed with employing sectoral and references approaches. Comparison was also made of the CO_2 emissions with the respective data of the International Energy Agency (IEA) [13]. The results obtained differ significantly from the ones of the IEA.

Table 3.33 Comparison of the results with the IEA

million tonnes CO_2	Sectoral approach			Reference approach		
	Uzbekistan	IEA	Difference	Uzbekistan	IEA	Difference
1990	107.0	120.2	-11.0%	110.5	120.6	-8.4%
1995	97.2	101.8	-4.5%	98.5	103.9	-5.2%
2000	105.0	116.7	-10.0 %	106.1	120.9	-12.3 %
2005	95.6	110.1	-13.1%	96.1	113.0	-15.0%

The cause of difference is most likely due to employing different emissions factors and activity data.

3.2.5 Recalculations by categories

The recalculation was implemented in the sub-categories 'Domestic Aviation' and 'International Bunker'. In the framework of the Initial National Communication calculation of CO_2 emissions was conducted assuming that 30% of all jet kerosene is consumed for domestic air carriages, the rest – for international bunker. However, according to the assessments implemented while SNC preparation, based on the data of the National Aviation Company "Havo Yullari", only 3-7% of jet kerosene is used for domestic carriages. For recalculation of emission the following values were taken: 5% – for domestic aviation and 95% – for international bunker.
No recalculations were done in other categories.

3.2.6 Planned improvements by category

Within the framework of the Third National Communication emissions are supposed to estimated in accordance with [7].

3.3 1B FUGITIVE EMISSIONS FROM FUELS

Under this category the CH_4, CO, NOx, NMVOC, SO_2 emissions were estimated from production, processing, transmission and storage of fossil fuel. Emissions were estimated under the categories: 1B1 a Coal Mining, 1B2 a Oil, 1B2 b Natural Gas, 1B2 c Venting and Flaring.

Table 3.34 Fugitive methane emissions, 2000

Category	Gg CO_2-eq	%
Coal mining	225	0.3
Oil	43	0.1
Natural gas	69960	99.6
Venting and flaring	17	0.0
Total	70245	100

Table 3.35 Indirect GHG from oil and gas production, 2000

Gas	Gg
CO	0.6
NOx	0.4
NMVOC	36.8
SO_2	68.9

Trends of fugitive emissions

Change in the methane emissions for the period 1990-2005 was as follows: coal -73.5% or drop by 3.8 times; oil +33.3%; gas +67.1% or rise by 1.7 times; total leakage +65.7% or rise by 1.7 times.

Table 3.36 Fugitive methane emissions, Gg CO_2 equivalent

Year	Coal	Oil	Gas	Venting	Total
1990	469	24	45646	2	46141
1991	424	24	47564	3	48015
1992	368	24	47390	6	47788
1993	342	28	75591	13	75975
1994	274	25	61761	20	62090
1995	257	43	62763	23	63085
1996	254	43	64808	19	65124
1997	226	44	56637	20	56927
1998	260	46	52849	22	53177
1999	243	46	57896	25	58210
2000	225	43	69960	17	70245
2001	235	41	72947	18	73241
2002	201	41	73822	22	74086
2003	165	40	75442	24	75671
2004	207	37	74046	26	74316
2005	132	32	76271	28	76463

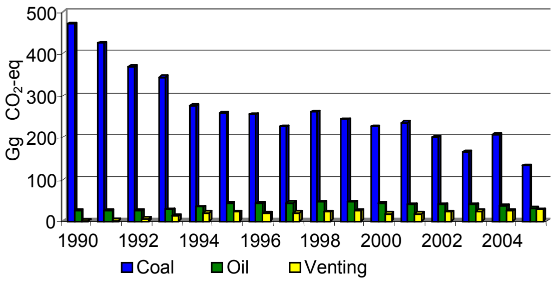

Fig. 3.23 *Trends of fugitive methane emissions (coal, oil, venting and flaring)*

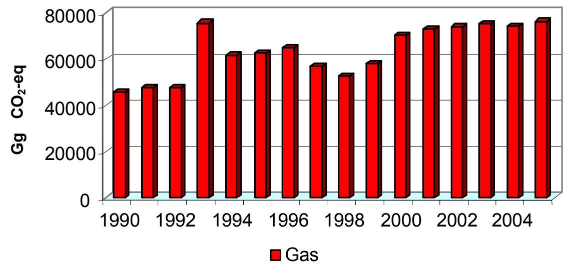

Fig. 3.24 *Trends of fugitive methane emissions (gas)*

Sharp rise in the emissions in 1993 and a drop in 1998 was brought about by change in volume of transit gas.

Table 3.37 Indirect GHG emissions from oil and gas production, Gg

Year	CO	NOx	NMVOC	SO_2	Year	CO	NOx	MNVOC	SO_2	Year	CO	NOx	NMVOC	SO_2
1990	0.7	0.5	44.3	172.1	1996	0.6	0.4	36.0	78.8	**2002**	0.5	0.4	33.3	59.7
1991	0.7	0.5	44.6	162.1	**1997**	0.6	0.4	36.8	83.9	**2003**	0.5	0.4	31.8	53.1
1992	0.6	0.4	37.7	136.1	**1998**	0.7	0.4	39.7	95.2	**2004**	0.5	0.3	31.3	48.4
1993	0.7	0.4	40.8	119.6	**1999**	0.6	0.4	38.3	79.9	**2005**	0.5	0.3	28.6	43.0
1994	0.7	0.4	40.3	109.2	**2000**	0.6	0.4	36.8	68.9					
1995	0.6	0.4	37.6	95.9	**2001**	0.6	0.4	34.3	67.5					

Change in the emissions for the period 1990-2005 was as follows: CO -28.6%; NOx -40.0%; NMVOC -35.4%; SO_2 -75.0% or drop by 4 times.
Due to their marginal amount the CO and NOx emissions are not presented in the diagram.

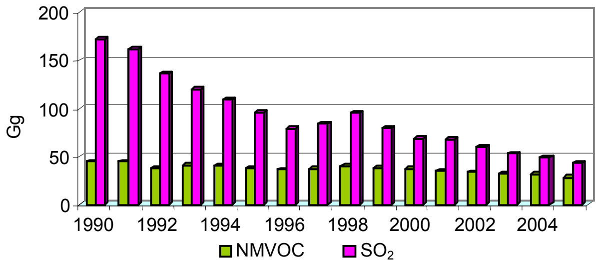

Fig. 3.25 *Trends of indirect GHG emissions from oil and gas production*

3.3.1 Description of the source category Solid Fuels

Fugitive methane emissions were estimated in the following sub-categories 1B1 a Coal Mining: i Underground, (Mines, Mining activities и Post-mining activities); ii Surface Mines, (Mining activities и Post-mining activities) were inventoried.

Table 3.38 Methane emission from coal mining, Gg CO_2 equivalent, 2000

Category		Gg CO_2-eq	%
Underground Mines	Mining activities	140.1	62.3
	Post-mining activities	22.5	10.0
	Total	162.5	72.3
Surface Mines	Mining activities	56.5	25.1
	Post-mining activities	5.7	2.5
	Total	62.2	27.7
Total leakage from coal mining		224.7	100

Table 3.39 Methane emission from coal mining, Gg CO_2 equivalent

Year	Underground			Surface			Leakage from coal mining
	Mining activities	Post-mining activities	Total	Mining activities	Post-mining activities	Total	
1990	251	40	291	162	16	179	469
1991	224	36	259	150	15	164	424
1992	208	33	242	115	12	127	368
1993	209	33	243	90	9	99	342
1994	145	23	168	97	10	106	274
1995	151	24	175	74	7	81	257
1996	155	25	180	67	7	74	254
1997	125	20	145	73	7	80	225
1998	157	25	182	71	7	78	260
1999	141	23	164	72	7	79	243
2000	140	22	163	56	6	62	225
2001	141	23	164	65	7	71	235
2002	108	17	126	68	7	75	201
2003	99	16	115	46	5	51	165
2004	115	18	134	67	7	74	207
2005	37	6	42	81	8	90	132

Change in the emissions for the period 1990-2005 was as follows: total underground coal mining - 85.6% or decline in emissions by 7 times; total surface coal mining - 50.3% or 2 time less; total leakage from coal mining -28.1% or decline by 3.6 times.

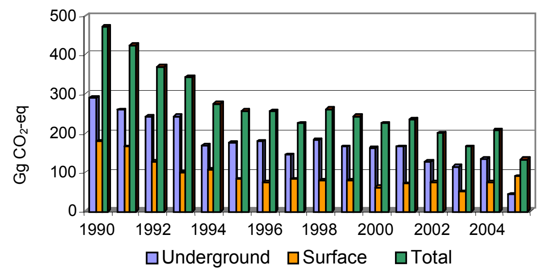

Fig. 3.26 *Trends of methane emissions from coal mining*

3.3.2 Methodology

Estimate of the CH_4 emissions from coal mining was implemented in accordance with [3] – Tier 1.

Activity data

Data on the volumes of coal mining both when surface and underground ways for the period 1990-2005 were provided by the State Committee on Statistics of the Republic of Uzbekistan.

Table 3.40 Coal mining in 2000, thousand tonnes

Produced	2409
Including by: surface way	2011
underground way	398

Emissions factors

For calculation maximal default emission factors were used [3].

Table 3.41 Factors of methane emission from coal mining, m^3/tonne

	Underground mining	Surface mining
Mining activities	25.0	2.0
Post-mining activities	4.0	0.2

3.3.3 Uncertainties and time series consistencies

Uncertainty of CH_4 emissions from coal mining was not estimated.
For all years the same method and the same data sets were used.

3.3.4 Quality Assurance/ Quality Control

The QA/QC procedures were implemented in accordance with the QA/QC principals and QA/QC plan. The check was conducted of the input data for calculations, data transcription and documentation, and whether all information sources of the input data for the program software were referenced.

3.3.5 Recalculation by categories

Recalculations in this category were not conducted.

3.3.6 Planned improvements by categories

Within the framework of the Third National Communication emissions are supposed to estimated in accordance with [7].

3.4.1 Description of source category Oil Operation

Under the category 1B2 Oil and Natural Gas the estimate was implemented for sub-category a ii Production and 1B2 a iv Refining/Storage. In these sub-categories the fugitive methane emissions were estimated as well as NOx, CO, NMVOC and SO_2 emissions from oil processing and storage and the SO_2 emissions from sulfur production while oil refining.

Table 3.42 CH_4 emissions from oil, 2000

Category	Production	Processing	Storage	Total
Gg CO_2-eq	33.2	8.2	1.5	42.8
%	77.5	19.1	3.4	100

Table 3.43 Indirect GHG emissions from oil, 2000

Gas	CO	NOx	MNVOC*	SO_2**
Gg	0.6	0.4	36.8	6.8

* total emission from oil processing and storage
** total emission from oil processing and sulfur production when oil refinement from sulfurous compounds

Changes in the emissions for the period 1990-2005 were as follows: oil production +100 % or the emissions were doubled, oil processing -40 % or drop by 1.7 times; oil storage – 50% or the emissions halved; total leakage from the oil sector +29 %.

Table 3.44 CH_4 emissions from oil, Gg CO_2 equivalent

Year	Production	Processing	Storage	Total	Year	Production	Processing	Storage	Total
1990	12	10	2	24	**1998**	36	9	2	46
1991	12	10	2	24	**1999**	36	9	1	46
1992	14	8	1	24	**2000**	33	8	2	43
1993	18	9	2	28	**2001**	32	8	1	41
1994	24	9	2	35	**2002**	32	7	1	40
1995	33	8	1	43	**2003**	32	7	1	40
1996	34	8	1	43	**2004**	29	7	1	37
1997	35	8	1	44	**2005**	24	6	1	31

Table 3.45 Indirect GHG emissions from oil, Gg

Year	CO	NOx	NMVOC*	SO_2	Year	CO	NOx	NMVOC*	SO_2**
1990	0,7	0,5	44,3	7,5	**1998**	0,7	0,4	39,7	6,7
1991	0,7	0,5	44,6	7,5	**1999**	0,6	0,4	38,3	6,6
1992	0,6	0,4	37,7	6,4	**2000**	0,6	0,4	36,8	6,8
1993	0,7	0,4	40,8	6,9	**2001**	0,6	0,4	34,3	6,1
1994	0,7	0,4	40,3	6,8	**2002**	0,5	0,4	33,3	5,7
1995	0,6	0,4	37,6	6,3	**2003**	0,5	0,4	31,8	5,4
1996	0,6	0,4	36,0	6,1	**2004**	0,5	0,3	31,3	5,4
1997	0,6	0,4	36,8	6,2	**2005**	0,5	0,3	28,6	5,2

* total emission from oil processing and storage
** since 1999 (putting in operation the equipment on oil desulphurization in the Fergana Refinery): total emission from oil processing and sulfur production when oil refinement from sulfurous compounds

Change in the emissions that occurred for the period 1990-2005 was as follows: CO -29%; NOx -40%; NMVOC -35%; SO_2 -30.7%.

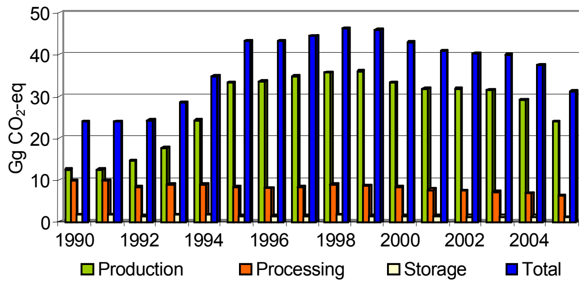

Fig. 3.27 Trends of methane emissions from oil

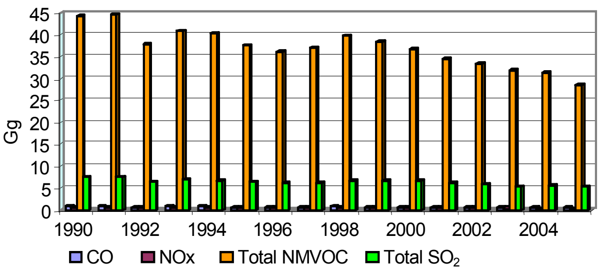

Fig. 3.28 Trends of indirect GHG emissions from oil

3.4.2 Methodology

The CH_4 emissions were estimated following the Revised 1996 IPCC Guidelines for National Greenhouse Inventories [3] – Tier 1. Estimation of the indirect GHG (NOx, CO, NMVOC, and SO_2) was also implemented in accordance with [3].

Activity data

The volumes of oil production and processing for 1990-2005 were provided by the State Committee on Statistics of the Republic of Uzbekistan.

Oil produced	Oil processed
7536 thousand tonnes	6665 thousand tonnes

Emission factors

For the methane emissions calculation the maximum default emission factors were used ("Former USSR and Central and Eastern Europe") [3]. To estimate the indirect GHG emissions the default emission factors were also used [3].

Table 3.46 Methane emission factors and indirect GHG from oil

CH_4 emission	Oil production	5000 kg CH_4 / PJ
	Oil processing	1400 kg CH_4 / PJ
	Oil storage	250 kg CH_4/ PJ
CO emission	Oil processing	0.09 kg CO / tonne of oil
NOx emission	Oil processing	0.06 kg NOx/ tonne of oil
NMVOC emission	Oil processing	0.62 kg NMVOC / tonne of oil
NMVOC emission	Oil storage	4.9 кг NMVOC/ tonne of oil
SO_2 emission	Oil processing	0.93 kg SO_2/ tonne of oil
SO_2 emission	Oil production	139 kg SO_2/tonne S

3.4.3 Uncertainty and time series consistencies

Uncertainty of CH_4 emissions from the oil was not estimated.
For all years the same method and the same data sets were used.

3.4.4 Quality Assurance/ Quality Control by categories and verification

The QA/QC procedures were implemented in accordance with the QA/QC principals and QA/QC plan. The check was conducted of the input data for calculations, correctness of formulas in the worksheets, data transcription and documentation. It was also checked whether all information sources for the input data for the program software were referenced.

3.3.5 Recalculation by categories

Recalculations of fugitive emissions from this category were not conducted.

3.3.6 Planned improvements by categories

Within the framework of the Third National Communication emissions are supposed to estimated in accordance with [7].

3.5.1 Description of source category. Gas Operation

The methane fugitive emissions were estimated in the following sub-categories: 1B2 b i Production/Processing, 1B2 b ii Transmission/ Distribution, 1B2 b iii Other leakage; 1B2 c Venting and Flaring ii. In sub-category 1B2 b i Production /Processing gas processing is considered as a separate source, as in this sub-category the methane leakages were estimated when refining high-sulfur gas, which comes to 70% of total amount of gas produced. The respective changes were inserted in the worksheet of the IPCC Program Software. In this category there were also estimated SO_2 emissions from sulfur production when gas refinement from sulfurous compounds. These emissions were not previously inventoried. The data on this source were inserted in the standard worksheet of the IPCC Program Software.

Table 3.47 CH_4 emissions from gas, 2000

Category		Gg CO_2-eq	%
Production/processing		248.5	3.2
Processing	Mubarek Gas Processing Plant	18412.8	26.3
	Plant «Shurtangaz»	635.7	0.9
	Total	19048.5	27.2
Transmission		39520.1	56.5
Other leakages	Non-residential sector	6791.2	9.7
	Residential sector	2351.6	3.4
	Total	9142.8	13.1
Total leakages from gas operation		69959.8	100

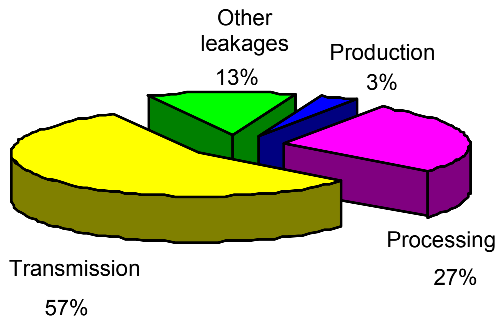

Fig. 3.29 *Emissions by gas activities*

In 2000 the SO_2 emissions from sulfur production (when refinement of high-sulfur gas) amounted to 62.2 Gg.

Table 3.48 CH_4 emissions from gas, Gg CO_2 equivalent

Year	Production	Processing	Transmission	Other leakages	Total	Venting and flaring
1990	1645	15744	20519	7738	45646	2
1991	1689	16348	21069	8458	47564	3
1992	1721	15941	21083	8645	47390	6
1993	1797	16313	48085	9397	75591	13
1994	1870	16520	34514	8856	61761	20
1995	1924	18127	33933	8778	62763	23
1996	1945	18170	35860	8833	64808	19
1997	2035	17976	28116	8510	56637	20
1998	2174	18153	24044	8477	52849	22
1999	2201	18257	28672	8766	57896	25
2000	2248	19048	39520	9143	69960	17
2001	2289	20088	41055	9516	72945	18
2002	2372	20059	41634	9757	73822	22
2003	2306	20151	43610	9375	75442	24
2004	2397	20366	41918	9365	74046	26
2005	2389	20408	44521	8954	76271	28

Change in the emissions for the period 1990-2005 was as follows: production +45.2%; processing +29.6%; transmission +117% or rise by 2.2 times; other leakages +15.7%; the total leakages +67.1%. Emissions from venting and flaring rose by 14 times.
The category Venting and Flaring is not shown in the graph due to the marginal values.

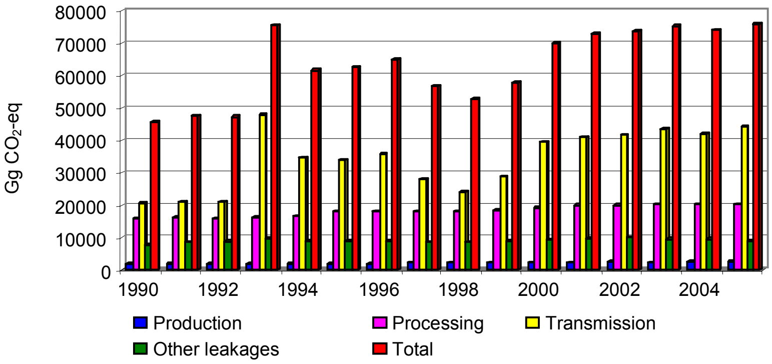

Fig. 3.30 *Trends of CH_4 emissions from gas*

Sharp rise in the emissions from transmissions in 1993 occurred due to a greater volume of transit gas.

Table 3.49 SO_2 emissions from gas sulfur production (when refinement of high-sulfur gas from sulfurous compounds)

Year	Gg	Year	Gg
1990	164.6	**1998**	88.5
1991	154.6	**1999**	73.3
1992	129.7	**2000**	62.2
1993	112.7	**2001**	61.5
1994	102.4	**2002**	54.0
1995	89.6	**2003**	47.7
1996	72.8	**2004**	43.0
1997	77.7	**2005**	37.8

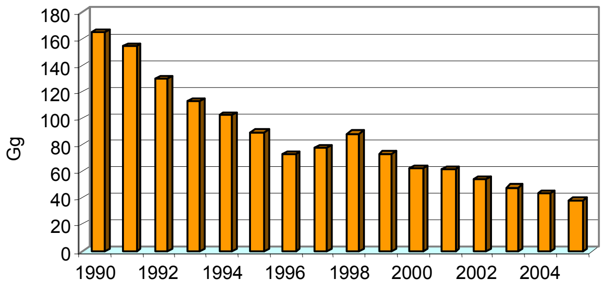

Fig. 3.31 *Trend of SO_2 emission from gas sulfur production*

Change in the emissions for the period 1990-2005 was a follows: SO_2 -77% or drop by 4.4 times.
Decrease in the emissions was brought about by drop in the volumes of sulfur production.

3.5.2 Methodology

Estimation of the CH_4 emissions from gas, venting and flaring when oil and gas production was implemented in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Inventories [3] – Tier 1. These Guidelines do not consider estimation of SO_2 emissions when high-sulfur gas refinement from sulfurous compounds. Therefore SO_2, emissions were calculated by the method used for the calculation of emissions when oil refinement.

Activity data

The data on volumes of oil production, processing and transportation for the period 1990-2005 were provided by the National Holding Company "Uzneftegaz". The volumes of gas consumption in the residential and non-residential sectors were provided by the State Committee on Statistics of the Republic of Uzbekistan.
Almost all amount of associated gas is burned when flaring.

Table 3.50 Data for estimation of fugitive CH_4 emissions from gas, 2000

Natural gas production, million m^3	56401
Including associated gas, million m^3	817
Gas transportation including transit, million m^3	79092
Gas processing, Mubarek GPP, million m^3	25826
Gas processing, Plant «Shurtangaz», million m^3	12442
Gas consumption in non-residential sector, million m^3	42031
Gas consumption in non-residential sector, million m^3	17198

Emission factors

To estimate methane emissions from production, processing (gas refinement from sulfurous compounds) and transportation of natural gas the national methane emission factors were developed within the framework of the Regional Project "Capacity Building for Improving the Quality of National GHG Inventories (region of Europe and CIS)". The calculation of the emissions is presented in the Annex 8.

For the methane emissions calculation from other leakages and venting and flaring maximum default emission factors were used ("Former USSR and Central and Eastern Europe") [3]. To estimate SO_2 emissions a national factor was also used.
The calculation of the emissions is presented in the Annex 8.

Table 3.51 CH_4 and SO_2 emission factors from gas, venting and flaring

CH_4	Production		56 798 kg/PJ
	Processing	Mubarek GPP	1 001 098 kg/ PJ
		Plant "Shurtangaz"	71 733 kg/ PJ
	Transportation		701 615 kg/ PJ
	Other leakage	Non residential sector	384 000 kg/ PJ
		Residential sector	192 000 kg/ PJ
	Venting and flaring		30 000 kg/ PJ

3.5.3 Uncertainty and sequence of time series

Uncertainty of CH_4 emissions from gas was not defined as the limited number of elements in a sample for each of the developed emission factors does not allow estimation of uncertainty associated with national factors. At the same time uncertainty associated with activity data according to expert judgments does not exceed 1-2%. Uncertainty of the other gases emission was not estimated too.
For all years the same method and the same data sets were used.

3.5.4 Quality Assurance/ Quality Control by category and verification

The QA/QC procedures were implemented in accordance with the QA/QC principals and QA/QC plan. The check was conducted of the input data for calculations, data transcription and documentation, correctness of the formulas in the worksheets, modified worksheets, consistency of the calculations in the time series if the coefficients were changed, the calculations of the national factors. It was also checked whether all information sources for the input data for the program software were referenced.

3.5.5 Recalculations by category

As national factors for estimates of the fugitive emissions from gas production, processing and transmission were developed within the framework of the regional project "Capacity Building for Improving the Quality of GHG Inventories (Europe/CIS region)", in the current inventory they were used for the emission recalculation in these sub-categories. In the Initial National Communication only default emission factors were applied. The volume of emissions from gas has turned out to be higher than those in the INC by 1.5-2 times for different years.

3.5.6 Planned improvements by category

While preparation of the Third National Communication the emissions are supposed to estimate in accordance with [7].

Chapter 4: 2 INDUSTRIAL PROCESSES

4.1 Sector review

Gases and categories in industrial processes presented in the tables 4.1 and 4.2 were inventoried.

Table 4.1 Direct GHG emissions from industrial processes, 2000

Category	Emission, Gg CO_2-eq	%
2 A Mineral products	1627.0	32.7
2 B Chemical industry	2672.1	53.8
2 C Metal production	664.6	13.4
4 D Other production	0	0
2 F Consumption of halocarbons	6.3	0.1
Total	4970.0	100

Table 4.2 Share of direct GHG, 2000

Gas	CO_2	N_2O	HFC
Emissions, Gg CO_2-eq	3589.6	1373.9	6.3
%	72.2	27.6	0.1

Trends of emissions by gases

Change in the emissions for the period 1990-2005 was as follows: CO_2 -24.0%; CH_4 – no possibility to calculate as the methanol production started in 1999, polyethylene – in 2003; N_2O -11.3%; HFC – no possibility to calculate as the data are available only for 2000-2005; total emission -21.0%.

Table 4.3 Direct GHG emissions from industrial processes, Gg CO_2 equivalent

Year	CO_2	CH_4	N_2O	HFCs	Total	Year	CO_2	CH_4	N_2O	HFCs	Total
1990	6277.1		1781.9		8058.9	**1998**	3728.9		1541.0		5269.9
1991	6298.6		2319.4		8618.0	**1999**	3477.5		1350.4		4827.9
1992	6057.9		2236.7		8294.5	**2000**	3589.6	0.1	1373.9	6.34	4970.0
1993	5490.3		1931.6		7421.9	**2001**	3614.4	0.1	1420.7	6.34	5041.6
1994	4474.1		1474.7		5948.8	**2002**	3758.8	0.2	1357.8	1.69	5118.4
1995	3797.3		1556.8		5354.1	**2003**	3990.6	1.5	1417.0	9.05	5418.1
1996	3944.4		1668.1		5612.5	**2004**	4585.2	2.3	1510.3	38.16	6136.0
1997	3828.6		1473.4		5302.0	**2005**	4770.9	2.7	1580.7	12.12	6366.4

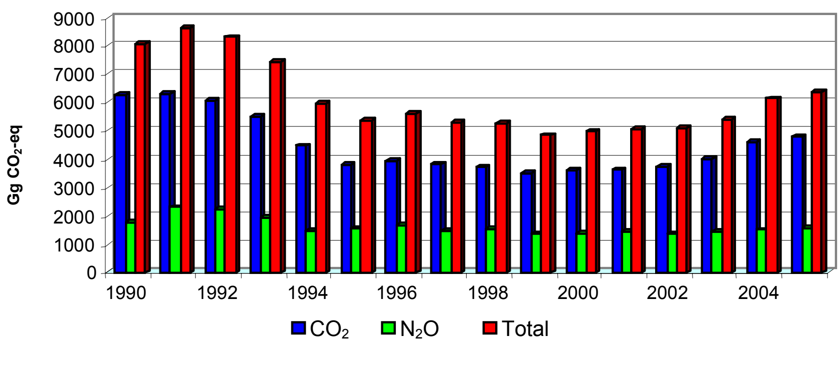

***Fig. 4.1 Trends** of direct GHG emissions from industrial processes*

Note: no trends of CH_4 and HFC emissions are shown on the diagrams due to their small volumes.
The indirect GHG emissions were also calculated.
Changes in the emissions for the period 1990-2005 were as follows: CO -38.7%; NOx -11.1%; NMVOC -15.0%; SO_2 -34.3%.

Table 4.4 Indirect GHG emissions from industrial processes, Gg

Year	CO	NOx	NMVOC	SO_2	Year	CO	NOx	NMVOC	SO_2
1990	13.7	0.9	28.6	5.8	**1998**	8.4	0.8	19.4	2.4
1991	13.7	1.1	27.9	5.7	**1999**	7.6	0.7	23.2	2.4
1992	12.6	1.1	25.0	4.2	**2000**	7.8	0.7	24.0	2.3
1993	10.6	1.0	24.4	3.8	**2001**	6.4	0.7	22.7	2.1
1994	7.8	0.7	19.6	3.3	**2002**	7.2	0.7	24.1	2.5
1995	8.7	0.8	17.6	2.7	**2003**	7.9	0.7	24.7	2.5
1996	9.1	0.8	17.8	2.6	**2004**	8.1	0.7	25.1	2.8
1997	9.1	0.7	19.3	2.4	**2005**	8.4	0.8	24.3	2.7

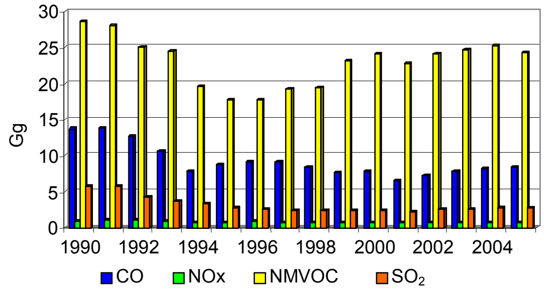

***Fig. 4.2** Trends of indirect GHG emissions*

Trends of emissions by sub-sectors

Changes in the emissions for the period 1990-2005 were as follows: mineral products -22.0%; chemical industry -26.5%; metal production -2.7%; use of HFCs – no possibility to calculate as the data are available only for 2000-2005; the total emission -21.4%.
Key sources in the sector are given below in order of emission volumes diminution.

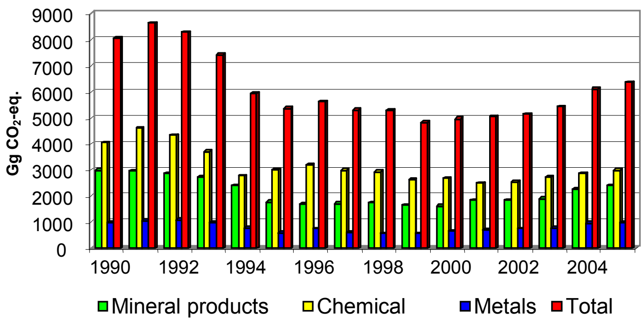

***Fig. 4.3** Trends of direct GHG emissions by category*

1. CO_2 emissions from clinker production – level, trend.
2. CO_2 emissions from ammonia production – trend.

The diagram of the emissions from HFC use is not shown due to their marginal amount.

Table 4.5 Direct GHG emissions from industrial processes by categories, Gg CO_2 equivalent

Year	Mineral products	Chemical industry	Metal production	Use of HFCs	Total emission
1990	2996.6	4064.0	998.4		8058.9
1991	2957.2	4604.8	1056.0		8618.0
1992	2858.8	4334.9	1100.8		8294.5
1993	2742.5	3701.8	977.6		7421.9
1994	2402.5	2771.9	774.4		5948.8
1995	1758.9	3008.0	587.2		5354.1
1996	1677.6	3189.3	745.6		5612.5
1997	1712.2	2983.4	606.4		5302.0
1998	1750.6	2948.0	571.4		5269.9
1999	1638.3	2620.4	569.3		4827.9
2000	1627.0	2672.1	664.6	6.3	4970.0
2001	1830.2	2491.0	714.1	6.3	5041.6
2002	1827.3	2549.9	739.6	1.7	5118.4
2003	1905.8	2726.2	777.0	9.1	5418.1
2004	2268.0	2866.4	963.5	38.2	6136.0
2005	2396.5	2986.1	971.7	12.1	6366.1

4.2 2A MINERAL PRODUCTION

4.2.1 Description of the source category

Under this category the CO_2 emission was estimated from clinker and lime production, use of soda (soda is produced by Solvey process, for which the IPCC methodology does not provide estimate of CO_2 emission [3]) and SO_2 emission from cement production.

Table 4.6 CO_2 и SO_2 emissions from mineral products, 2000

Category	CO_2 emission		SO_2 emission
	Gg	%	Gg
Clinker production (cement)	1475.5	90.7	1.0
Lime production	80.9	5.0	
Use of soda	70.6	4.3	
Total emission	1627.0	100.0	1.0

Table 4.7 CO_2 emission from mineral products, Gg

Year	Clinker production	Lime production	Use of soda	Total emission
1990	2572.2	353.8	70.6	2996.6
1991	2544.2	342.5	70.6	2957.2
1992	2484.1	304.2	70.6	2858.8
1993	2360.6	311.4	70.6	2742.5
1994	2092.7	239.2	70.6	2402.5
1995	1538.2	150.1	70.6	1758.9
1996	1427.5	179.6	70.6	1677.6
1997	1495.9	145.8	70.6	1712.2
1998	1585.1	94.9	70.6	1750.6
1999	1491.5	76.2	70.6	1638.3
2000	1475.5	80.9	70.6	1627.0
2001	1674.8	84.9	70.6	1830.2
2002	1686.0	70.8	70.6	1827.3
2003	1785.0	50.2	70.6	1905.8
2004	2123.5	73.9	70.6	2268.0
2005	2257.4	68.6	70.6	2396.5

Change in CO_2 emission for the period 1990-2005 was as follows: clinker production -12.2%; lime production -80. 6% or drop by 5.16 times; total emission -20.0%.
Drop in emission is caused by decline in production at the beginning of 90-s.
Change in emission for the period 1990-2005 was 20.8%.

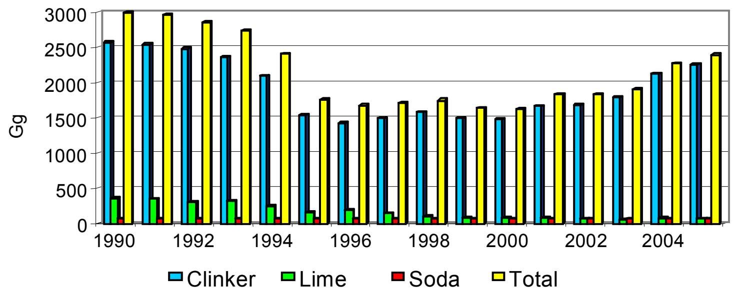

Fig. 4.4 Trend of CO_2 emission from mineral products

Table 4.8 SO_2 emission from cement production

Year	Gg	Year	Gg
1990	1.92	**1998**	1.01
1991	1.86	**1999**	1.00
1992	1.78	**2000**	0.99
1993	1.58	**2001**	1.12
1994	1.43	**2002**	1.18
1995	1.03	**2003**	1.22
1996	0.98	**2004**	1.44
1997	0.99	**2005**	1.52

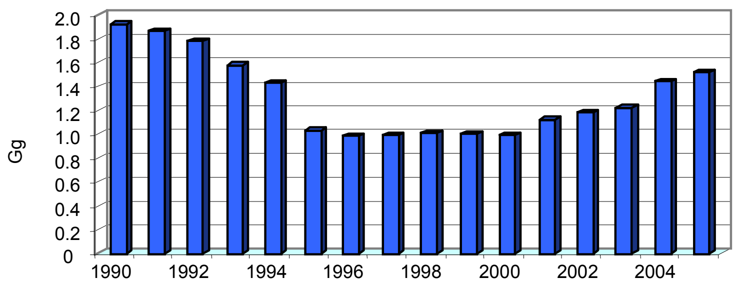

Fig. 4.5 Trend of SO_2 emission from mineral products

4.2.2 Methodology

The estimation of CO_2 emission from clinker and lime production, use of soda and SO_2 emission from cement production was implemented according to [3].

Activity data

The data for estimation of CO_2 emission from clinker production and SO_2 emission from cement production were provided by the National Joint-Stock Company "Uzqurilishmateriallari". The data for estimation of CO_2 emission from use of soda originate from the reports of the Ministry of Economics of the Republic of Uzbekistan on industrial sectors demand in calcined soda.
As there is no precise data by years, it was suggested that annual demand for soda for the period 1990-2005 was the same for each year.

Table 4.9 Mineral products production and use, 2000

Product	Thousand tonnes
Clinker	2909.7
Cement	3284.4
Lime	102.4
Soda	170.0

The data for estimation of CO_2 emission from lime production for the period 1990-1995 were provided by the National Joint-Stock Company "Uzqurilishmateriallari" and for the period 1996-2005 – by the State Committee on Statistics as since 1996 new lime production enterprises started to operate that do not belong the National Joint-Stock Company "Uzqurilishmateriallari".

Emission factors

CO_2 emission from clinker production = **0.5071** tonne CO_2 per tonne of product [3].
CO_2 emission from lime production = **0.79** tonne CO_2 per tonne of product [3]. Calculation was conducted for quick-slaking lime as raw calcite is used.
SO_2 emission from cement production = **0.3** tonne SO_2/ per tonne of product [3].
CO_2 emission from use of soda = **415** kg CO_2 per tonne of used soda [3].

4.2.3 Uncertainty and sequence of time series

The uncertainties of CO_2 emission from clinker production were estimated in accordance with [2]. To estimate uncertainty associated with the emission factors from clinker production the default values were assumed [5]. Uncertainty of SO_2 emission from cement production was not estimated.

Table 4.10 Quantitative estimation of CO_2 emission from industrial processes, 2000

Sub-sector	Data uncertainty	Emission factor uncertainty	Combined uncertainty	n, Gg CO_2-eq	± E	n + E	n - E
	U_A	U_F	U_T		Gg CO_2-eq		
Clinker production	1%	6%	6%	1475.5	89.8	1565.3	1385.8

For all years the same method and the same data set were used.

4.2.4 Quality Assurance/ Quality Control

The QA/QC procedures were implemented in accordance with the QA/QC principals and QA/QC plan. The check was conducted of the input data for calculations, data transcription and documentation. It was also checked whether all information sources for the input data for the program software were referenced.

4.2.5 Recalculations by category

Recalculations were not conducted.

4.2.6 Planned improvements by category

While preparation of the Third National Communication the emissions are supposed to estimate in accordance with [7].

4.3 2 B CHEMICAL INDUSTRY

4.3.1 Description of source category

Under this category the direct GHG emissions were estimated: CO_2 from ammonia production, N_2O emission from nitric acid production and CH_4 emission from methanol (since 1999) and polyethylene (since 2003) production. Indirect GHG emissions were estimated from ammonia and nitric acid production.
The main source of CO_2 emission is ammonia production and N_2O emission – nitric acid production.

Table 4.11 GHG emission from chemical industry, 2000

Category	Gas	Gg CO_2-eq	%
Ammonia production	CO_2	1298.0	48.6
Nitric acid production	N_2O	1373.9	51.4
Methanol production	CH_4	0.1	0.0
Total emission		2672.1	100.0

Table 4.12 Indirect GHG emission from chemical industry, 2000

Category	Gas	Gg
Ammonia production	CO	7.8
Nitric acid production	NOx	0.7
Ammonia production	NMVOC	4.6
Ackrylnitrile production	NMVOC	0.02
Formalin production	NMVOC	0.6
Total NMVOC	NMVOC	5.2
Sulphuric acid production	SO_2	1.3
Ammonia production	SO_2	0.0
Total SO_2	SO_2	1.3

Trends of emission by gases

Changes in the emissions fro the period 1990-2005 were as follows: CO_2 -38.5%; N_2O -11.3%; CH_4 – no possibility to calculate as methanol production started in 1999 and polyethylene – in 2003; the total emission -26.5%.

Table 4.13 Direct emission from chemical industry, Gg CO_2 equivalent

Year	CO_2	N_2O	CH_4	Total emission	Year	CO_2	N_2O	CH_4	Total emission
1990	2282.1	1781.9		4064.0	**1998**	1407.0	1541.0		2948.0
1991	2285.4	2319.4		4604.8	**1999**	1270.0	1350.4	0	2620.4
1992	2098.2	2236.7		4334.9	**2000**	1298.0	1373.9	0.1	2672.1
1993	1770.2	1931.6		3701.8	**2001**	1070.2	1420.7	0.1	2491.0
1994	1297.2	1474.7		2771.9	**2002**	1191.9	1357.8	0.2	2549.9
1995	1451.2	1556.8		3008.0	**2003**	1307.8	1417.0	1.5	2726.2
1996	1521.1	1668.1		3189.2	**2004**	1353.7	1510.3	2.3	2866.4
1997	1509.9	1473.4		2983.4	**2005**	1402.7	1580.7	2.7	2986.1

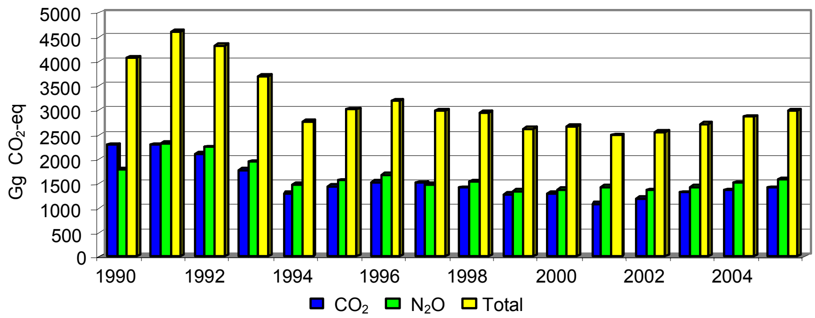

***Fig 4.6** Trends of direct GHG emission from chemical industry*

Trend of CH_4 emission is not shown in the diagram as it is insignificant.

Table 4.14 Indirect GHG emission from chemical industry, Gg

Year	CO	NOx	NMVOC	SO_2	Year	CO	NOx	NMVOC	SO_2
1990	13.7	0.9	8.2	3.9	**1998**	8.4	0.7	5.0	1.4
1991	13.7	1.1	8.2	3.8	**1999**	7.6	0.6	4.5	1.4
1992	12.6	1.1	7.5	2.4	**2000**	7.8	0.7	5.2	1.3
1993	10.6	0.9	6.3	2.2	**2001**	6.4	0.7	4.6	1.0
1994	7.8	0.7	4.6	1.9	**2002**	7.2	0.7	5.1	1.3
1995	8.7	0.7	5.2	1.6	**2003**	7.9	0.7	5.7	1.3
1996	9.1	0.8	5.4	1.6	**2004**	8.1	0.7	6.1	1.3
1997	9.1	0.7	5.4	1.4	**2005**	8.4	0.8	6.4	1.2

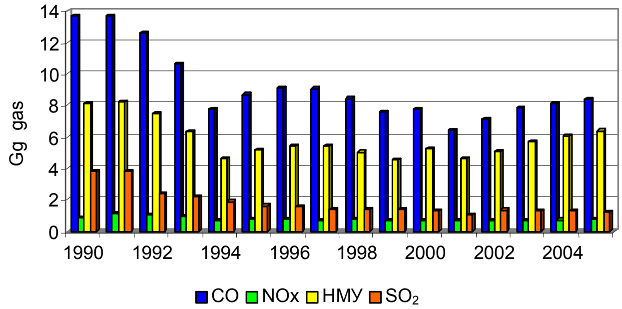

Fig. 4.7 *Trends of indirect emissions from chemical industry*

Change in the emissions for the period 1990-2005 was as follows: CO -38.7%; NOx -11.1%; NMVOC -22%; SO_2 -69.2 %.

4.3.2 Methodology

Direct and indirect emissions in this category were estimated in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories [3]. Emission from ammonia production was estimated using the **Tier 1 b**.

Activity data

The data on ammonia, nitric acid, methanol, ackrylnitrile and formaldehyde production for direct and indirect GHG emission estimation were provided by the National Joint-Stock Company "Uzkimesanoat".

Estimates of direct and indirect GHG emission from polyethylene production were based on official statistics from the Stare Committee for Statistics of the Republic of Uzbekistan.

Table 4.15 Chemical product production, 2000

Production	thousand tonnes
Ammonia	985.60
Nitric acid	1057.00
Methanol	2.40
Ackrylnitrile production	16.50
Formaldehyde	0.58
Polyethlene (production since 2003)	0

Emission factors

For calculations both national and default emission factors were used. National factors for this category were developed within the framework of the Second National Communication.

CO_2 emissions from ammonia production = **1.317** tonne CO_2 per tonne of product, national emission factor (Annex 10).

N_2O emission from nitric acid production = **4.193** kg N_2O per tonne of product, national emission factor (Annex 10).

CH_4 emission from methanol production = **2** kg CH_4 per tonne of product [3].

CH_4 emission from polyethylene production = **1** kg CH_4 per tonne of product [3].

CO emission from ammonia production = **7.9** kg CO per tonne of product [3].

NOx emission from nitric acid production = **0.620** kg NOx per tonne of product, national emission factor (Annex 10).

***NMVOC emission from ammonia production* = 4.7** kg NMVOC per tonne of product [3].

***NMVOC emission from ackrylnitrile production* = 1.0** kg NMVOC per tonne of product [3].

***NMVOC emission from formaldehyde production* = 5.0** kg NMVOC per tonne of product [3].

***NMVOC emission from polyethylene production (low density)* = 3.0** kg NMVOC per tonne of product [3].

SO_2 emission from sulfuric acid production **= 1.567** tonne SO_2 per tonne of product, national emission factor (Annex 10).

SO_2 emissions from ammonia production = **0.03** kg SO_2 per tonne of product [3].

4.3.3 Uncertainty and sequence of time series

Uncertainty was estimated only for two source categories. Estimation of the uncertainty of national CO_2 emission factor for ammonia production and N_2O emission factor for nitric acid production is presented in the Annex 10.

Estimate of the activity data uncertainty was based on national expert judgment.

Table 4.16 Quantitative estimate of uncertainty of emission from industrial processes by gases, 2000

Sub-sector	Data uncertainty	Factor uncertainty	Total uncertainty	n, Gg CO_2-eq	± E	n + E	n - E
	U_A	U_F	U_T		Gg CO_2-eq		
Ammonia production	1%	5%	5%	1298.0	66.2	1364.2	1231.8
Nitric acid production	1%	26%	26%	1373.9	357.5	1731.4	1016.4
Total				2671.9	423.7	3095.6	2248.2
% from total					15.9	15.9	- 15.9

Uncertainty associated with activity data (ammonia and nitric acid production) is low, about 1%, which is resulted from a strict control over the production.
Combined uncertainty in this sub-sector for emission of gases from categories, where uncertainty can be estimated, amounts to ± 423.7 Gg CO_2 equivalent or ± 15.9 % of the total estimated emission. For all years the same method and the same data sets were used.

4.3.4 Quality Assurance/ Quality Control

The QA/QC procedures were implemented in accordance with the QA/QC principals and QA/QC plan. The check was conducted of the input activity data, data transcription and documentation, calculation of national factors. It was also checked whether all information sources for the input data for the program software were referenced.

4.3.5 Recalculations by category

Emissions were recalculated in those categories for which national emission factors were used.
In the Initial National Communication the default emission factors were used.

4.3.6 Planned improvements by category

While preparation of the Third National Communication the emissions are supposed to estimate in accordance with [7].

4.4 2C METAL PRODUCTION

4.4.1 Description of source category

Under this category emissions were estimated only from steel production, namely: CO_2, CO, NOx, NMVOC, SO_2.
Iron, ferroalloys, aluminum and magnesium are not produced in the country. The data on non-ferrous metals are not accessible.

Table 4.17 Direct and indirect GHG emission from metal production, 2000, Gg

CO_2	CO	NOx	NMVOC	SO_2
664.64	0.00042	0.017	0.012	0.019

Table 4.18 CO_2 emission from steel production, Gg

Year	CO_2	Year	CO_2
1990	998.4	**1998**	571.4
1991	1056.0	**1999**	569.3
1992	1100.8	**2000**	664.6
1993	977.6	**2001**	714.1
1994	774.4	**2002**	739.6
1995	587.2	**2003**	777.0
1996	745.6	**2004**	963.5
1997	606.4	**2005**	971.7

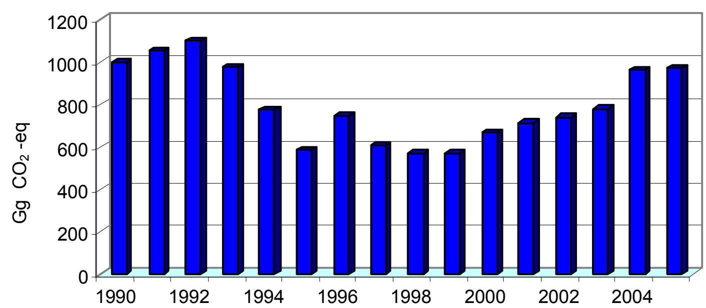

Fig. 4.8 *Trends of CO_2 emission from steel production.*

Change in CO_2 emission for the period 1990-2005 amounted to 2.7 %.
Decrease in emission in the middle of the 90-ies was brought about by total decline of the industrial production in that period.

Table 4.19 Indirect GHG emission from steel production, Gg

Year	CO	NOx	NMVOC	SO_2	Year	CO	NOx	NMVOC	SO_2
1990	0.00062	0.025	0.019	0.028	**1998**	0.00036	0.014	0.011	0.016
1991	0.00066	0.026	0.020	0.030	**1999**	0.00036	0.014	0.011	0.016
1992	0.00069	0.028	0.021	0.031	**2000**	0.00042	0.017	0.012	0.019
1993	0.00061	0.024	0.018	0.027	**2001**	0.00045	0.018	0.013	0.020
1994	0.00048	0.019	0.015	0.022	**2002**	0.00046	0.018	0.014	0.021
1995	0.00037	0.015	0.011	0.017	**2003**	0.00049	0.019	0.015	0.022
1996	0.00047	0.019	0.014	0.021	**2004**	0.00060	0.024	0.018	0.027
1997	0.00028	0.015	0.011	0.017	**2005**	0.00061	0.024	0.018	0.027

Values of indirect GHG emission from steel production are marginal. Change in emission for the period 1990-2005 was as follows: CO -1.6%; NOx -4.0%; NMVOC -5.3%; SO_2 -3.6%.

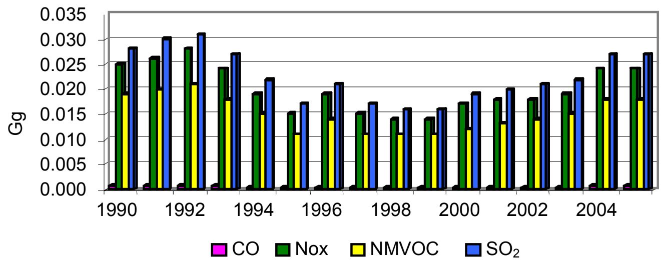

Fig. 4.9 *Trends of indirect GHG emission from steel production*

4.4.2 Methodology

Direct and indirect GHG emissions in this category were estimated in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories [3]. Emission from steel production was estimated using the **Tier 1 b**.

Activity data

Estimation of direct and indirect emissions from steel production was based on the statistical data of the State Committee on Statistics of the Republic of Uzbekistan. Volume of steel produced in 2000 amounted to 415.4 thousand tonnes.

Emission factors

Default emission factors were applied for calculations.

CO_2 emission form steel production = **1.6** tonne CO_2 per tonne of product [3].
CO emission form steel production = **1** gram CO per tonne of product [3].
NOx emission form steel production = **40** grams NOx per tonne of product [3].
NMVOC emission form steel production = **30** grams NMVOC per tonne of product [3].
SO_2 emission form steel production = **45** grams SO_2 per tonne of product [3].

4.4.3 Uncertainty and sequence of time series

Uncertainty of CO_2 and other gases emissions from steel production were not estimated.

For all years the same method and the same data sets were used.

4.4.4 Quality Assurance/ Quality Control

The QA/QC procedures were implemented in accordance with the QA/QC principals and QA/QC plan. The check was conducted of the input data for calculations, data transcription and documentation. It was also checked whether all information sources for the input data for the program software were referenced.

4.4.5 Recalculations in category

Recalculations were not performed.

4.4.6 Planned improvements by category

While preparation of the Third National Communication the emissions are supposed to estimate in accordance with [7].

4.5 2D OTHER PRODUCTION

4.5.1 Description of source category

Under this category NMVOC emission from food and drink production was estimated.

Table 4.20 NMVOC emission from food and drink production, Gg, 2000

Drinks	Food	Total
10.9	7.9	18.7
58%	42%	100%

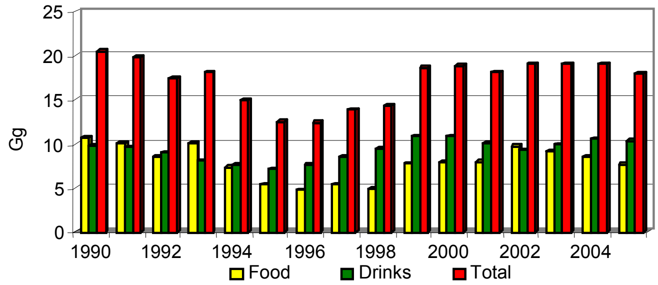

Fig. 4.10 *Trends of NMVOC emission from food and drink production.*

Table 4.21 NMVOC emission from food and drink production, Gg

Year	Drinks	Food	Total	Year	Drinks	Food	Total
1990	9.8	10.7	20.5	**1998**	9.5	4.9	14.3
1991	9.6	10.1	19.7	**1999**	10.9	7.7	18.6
1992	9.0	8.5	17.5	**2000**	10.9	7.9	18.7
1993	8.0	10.1	18.1	**2001**	10.1	8.0	18.1
1994	7.6	7.3	14.9	**2002**	9.3	9.7	19.0
1995	7.1	5.4	12.5	**2003**	9.9	9.1	19.0
1996	7.6	4.7	12.3	**2004**	10.5	8.5	19.0
1997	8.5	5.4	13.8	**2005**	10.3	7.7	17.9

Change in emission for the period 1990-2005 was as follows: drink production +5.2%; food production -28.4%; the total emission -12.3%.
Decrease in emission in the middle of the 90-ies was brought about by total decline of the industrial production in that period.

4.5.2 Methodology

Indirect GHG emissions in this category were estimated in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories [3].

Activity data

Estimation of direct and indirect GHG emission from food and drink production was based on the statistical data from the State Committee on Statistics of the Republic of Uzbekistan.

Table 4.22 Food production, 2000

Production	Thousand tonne
Meat and meat products	124.390
Fish products including canned fish	9.000
Sugar	10.169
Animal fat	0.037
Animal oil	2.180
Margarine	22.453
Bread and bakery	847.231
Confectionery (floury)	55.853
Mixed fodder	666.672

Table 4.23 Drink production, 2000

Production	thousand decalitre	hectoliter
Alcohol	7166	716600
Cognac	131	13100
Wine	5987	598700
Beer	6081	608100

Emission factors

Default emission factors were used for calculations.

NMVOC emission from food production [3], table 2-25, 2-26**:**
***Meat, fish and poultry* = 0.3** kg NMVOC per tonne of product
Sugar = **10.0** kg NMVOC per tonne of product
Margarine and fat = **10.0** kg NMVOC per tonne of product
Cakes, biscuits etc. **= 1.0** kg NMVOC per tonne of product
***Bread* = 8.0** kg NMVOC per tonne of product
Mixed fodder = **1.0** kg NMVOC per tonne of product
***Wine* = 0.08** kg/ hectoliter
***Beer* = 0.035** kg/ hectoliter
***Strong alcohol* = 15** kg/ hectoliter
Cognac **= 3.5** kg/ hectoliter

4.5.3 Uncertainty and sequence of time series

Uncertainty of emissions was not estimated. For all years the same method and the same data sets were used.

4.5.4 Quality Assurance/ Quality Control

The QA/QC procedures were implemented in accordance with the QA/QC principals and QA/QC plan. The check was conducted of the input data for calculations, data transcription and documentation. It was also checked whether all information sources for the input data for the program software were referenced.

4.5.5 Recalculations in category

Recalculations were not performed

4.5.6 Planned improvements by category

While preparation of the Third National Communication the emissions are supposed to estimate in accordance with [7].

4.6 2F CONSUMPTION OF HALOCARBONS AND SULPHUR HEXAFLUORIDE

4.6.1 Description of source category

Under this category potential hydrofluorocarbons emission were estimated for the period 2000-2005.
Hydrofluorocarbons emission in 2000 in CO_2 equivalent came to 6.3 Gg.

Table 4.24 Potential HFCs emission

Year	HFCs Gg CO_2-eq	Year	HFCs Gg CO_2-eq
2000	6.3	2003	9.1
2001	6.3	2004	38.2
2002	1.7	2005	12.1

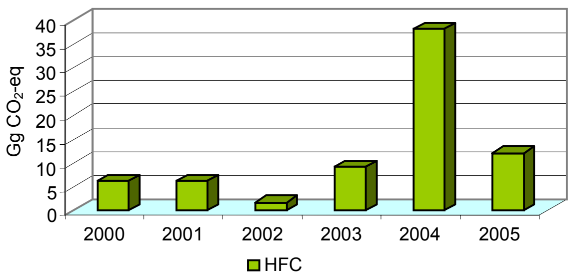

Fig. 4.11 *Trend of potential HFCs emission*

Increase in emission for the period 2000-2005 amounted to 92%. However, according to the available estimates to assess the stability of the emission trend is not possible.

4.6.2 Methodology

Potential HFCs emission in this category was estimated in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, using the **Tier 1 b**. [3].

Activity data

There is no HFCs production in the country and data on their entrapment and demolition are absent. Estimation of potential HFCs emission was implemented using the data on import of fluorides and iodides provided by the State Committee on Statistics and the data on import of the HFCs from the State Committee for Nature Protection. Unfortunately, these data are incomplete. Data for the period until 2000 are not available at all. State Committee on Statistics has provided the total amount of fluorides and iodides imported for the period 2002-2005. State Committee for Nature Protection has provided total amount of HFCs imported for the period 2000-2004.

Table 4.25 Import of fluorides and iodides, tonne

2002	2003	2004	2005
1.1	5.9	24.9	7.9

Table 4.26 Import of fluorides in 2000-2004, tonne

R-407c	R-404a	R-134a
1.9408	4.7647	33.45716

Emissions were estimated assuming that:

1. having no detailed information on fluorides and iodides, we consider the sum of fluorides and iodides as HFCs;
2. composition of HFCs for each year is the same;
3. share of each HFC in total amount remains unchangeable for each year;
4. amount of HFCs is equal for 2000 and 2001.

Following these assumptions the amount of each HFCs was calculated for each year (calculation is shown in the Annex 11).
For 2000 HFCs were estimated in tonnes of gas and in tonnes of CO_2 equivalent.

	HFC-32	HFC-125	HFC-134a	HFC-143a
Tonnes, gas	0.05	0.30	3.57	0.22
Tonnes, CO_2-eq	29.8	853.4	4634.5	819.7

Emission factors

For calculation of potential HFCs emission in CO_2 equivalent GWPs were used, that are based on greenhouse gases impact for 100 year period [4].

HFC-32	HFC-125	HFC-134a	HFC-143a
650	2 800	1 300	3 800

4.6.3 Uncertainty and sequence of time series

Uncertainty of potential HFCs emissions was not estimated, it was suggested to be of high value as the data available were incomplete and invalid and also many assumptions were used.

4.6.4 Quality Assurance/ Quality Control

The QA/QC procedures were implemented in accordance with the QA/QC principals and QA/QC plan. The check was conducted of the input data for calculations, data transcription and documentation. It was also checked whether all information sources for the input data for the program software were referenced.

4.6.5 Recalculations in category

In previous years emissions in this category were not estimated.

4.6.6 Planned improvements by category

While preparation of the Third National Communication the emissions are supposed to estimate in accordance with [7].

Chapter 5: AGRICULTURE

5.1 Sector review

Table 5.1 Direct GHG emission, 2000

Category	Emission, Gg CO_2-eq	%
4 A Enteric fermentation	6592.1	40.8
4 B Manure management	709.4	4.4
4 C Rice cultivation	187.9	1.2
4 D Agricultural soils	8538.9	52.9
4 F Field burning of agricultural resides	119.3	0.7
Other		
Total in sector	16147.6	100

Inventory in the agricultural sector covers emission of methane and nitrous oxide (direct effect) and carbon oxide and nitrogen oxides (indirect effect) in the category 4F Field Burning of Agricultural Residues and from the activities listed in the table 5.1. Major emission sources are enteric fermentation and agricultural soils.

Table 5.2 Direct GHG emission by gas, 2000

Gas	CH_4	N_2O
Emission, Gg CO_2-eq	7347.8	8800.0
%	45.5	54.5

Trends of emission by gases and categories

Table 5.3 Direct GHG emission from agriculture by gases, Gg CO_2 equivalent

Year	CH_4	N_2O	Total	Year	CH_4	N_2O	Total
1990	6538.0	10517.1	17054.9	**1998**	7284.9	9138.2	16423.1
1991	7028.3	10529.5	17557.7	**1999**	7323.8	9008.9	16332.7
1992	7414.5	10599.2	18013.7	**2000**	7347.8	8800.0	16147.6
1993	7571.3	10309.4	17880.7	**2001**	7392.0	8427.0	15819.0
1994	7522.2	9980.1	17502.3	**2002**	7632.2	8700.8	16333.0
1995	7345.6	9333.2	16678.8	**2003**	8024.7	8466.1	16490.8
1996	7220.0	9122.7	16342.7	**2004**	8504.6	8383.0	16887.6
1997	7200.7	9136.3	16337.0	**2005**	8701.8	7740.1	16441.9

Change in emission for the period 1990-2005 was as follows: CH_4 +33.1%; N_2O -26.4%; the total emission -3.6%.

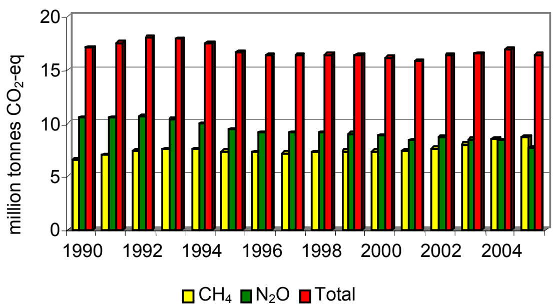

Fig. 5.1 Trends of direct GHG emission from agriculture by gases

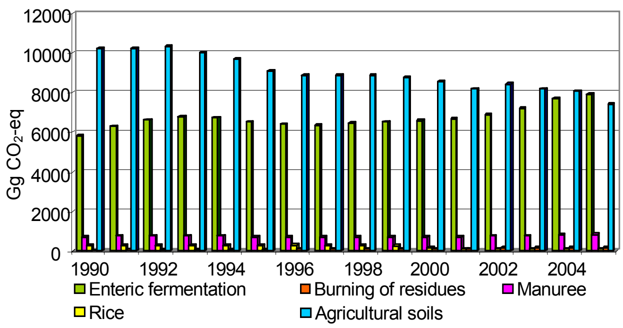

Fig. 5.2 Trends of direct GHG emission from agriculture by categories

Change in emission for the period 1990-2005 was as follows: enteric fermentation +35.5 %; manure management +19.3%; rice cultivation -62.0 %; field burning of agricultural residues – rise in emission by 4.7; agricultural soils -27.4 %.

The key emission sources in the sector are as follows:

1. N_2O emission from agricultural soils – level, trend
2. CH_4 from enteric fermentation – level, trend

Table 5.4 Direct GHG emission from agriculture by categories, Gg CO_2 equivalent

Year	Enteric fermentation	Manure management	Rice cultivation	Field burning of agricultural residues	Agricultural soils
1990	5833.4	706.7	261.7	32.0	10221.7
1991	6276.9	741.4	273.4	36.1	10230.0
1992	6619.2	762.3	292.5	38.4	10301.3
1993	6755.7	762.9	296.7	46.2	10019.2
1994	6707.3	744.1	287.7	60.3	9703.0
1995	6524.7	713.7	290.2	79.6	9070.6
1996	6379.8	688.9	306.0	95.9	8872.2
1997	6363.0	684.5	296.1	105.7	8887.7
1998	6447.0	693.6	284.3	113.5	8884.6
1999	6514.2	700.9	248.9	117.4	8751.3
2000	6592.1	709.4	187.9	119.3	8538.9
2001	6673.8	718.8	132.1	135.2	8159.2
2002	6890.1	741.2	126.0	156.1	8419.6
2003	7232.4	776.4	140.9	172.6	8168.5
2004	7683.9	826.0	134.2	180.5	8063.1
2005	7902.3	843.1	99.5	181.6	7415.2

5.2 4A ENTERIC FERMENTATION

5.2.1 Description of source category

Emissions were estimated in the following IPCC categories: 4 A 1 a , 4 A 1 b, 4 A 3, 4 A 4, 4 A 5, 4 A 6, 4 A 7, 4 A 8.

Table 5.5 CH_4 emission from enteric fermentation by category, 2000

Category	Gg CO_2-eq	%
Cattle	5533.1	83.9
Dairy	2750.0	41.7
Non-dairy	2783.1	42.2
Sheep	818.2	12.4
Goats	120.4	1.8
Camels	15.0	0.2
Horses	55.4	0.8
Asses	48.4	0.7
Swine	1.7	0.0
Total	6592.0	100.0

Table 5.6 CH_4 emission from enteric fermentation by provinces, 2000

Province	Gg CO_2-eq	%
Republic of Karakalpakstan	452.7	6.9
Andijan	509.8	7.7
Bukhara	538.7	8.2
Jizak	386.6	5.9
Kashkadarya	814.1	12.3
Navoi	310.9	4.7
Namangan	409.7	6.2
Samarkand	933.5	14.2
Surkhandarya	576.9	8.7
Syrdarya	191.0	2.9
Tashkent	457.1	6.9
Fergana	523.2	7.9
Khoresm	490.0	7.4

The 2000 methane emission was estimated for the provinces of Uzbekistan. The calculation of emissions for each province was performed with application of the method offered in [3] in a separate file. Total emission from the provinces differs from that calculated for the entire country by 2 Gg.

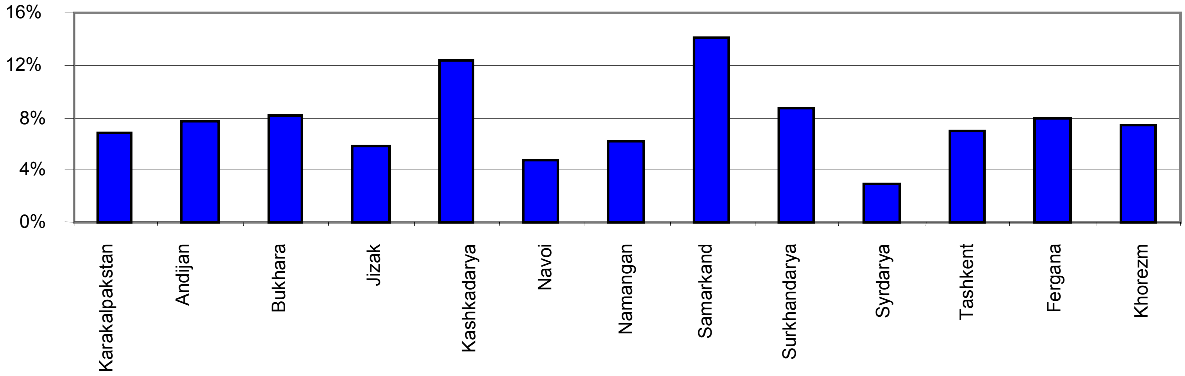

Fig. 5.3 *CH_4 emission from enteric fermentation by provinces*

Trends of emission

Table 5.7 CH_4 emissions from enteric fermentation

Year	Gg CO_2-eq	Year	Gg CO_2-eq
1990	5833.4	**1998**	6447.0
1991	6276.9	**1999**	6514.2
1992	6619.2	**2000**	6592.0
1993	6755.7	**2001**	6673.8
1994	6707.3	**2002**	6890.1
1995	6524.7	**2003**	7232.4
1996	6379.8	**2004**	7683.9
1997	6363.0	**2005**	7902.3

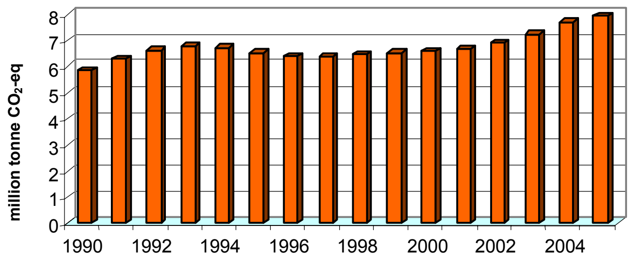

Fig. 5.4 *Trends of CH_4 emission from enteric fermentation*

Change in emission for the period 1990-2005: +35.5%.
Change in emission is brought about by change in livestock, especially in cattle population.

5.2.2 Methodology

Estimation of CH_4 emission from enteric fermentation was implemented in accordance with [3].

Activity data

For the emission estimation the data of the state statistics on domestic livestock population was used. As it is recommended by [3] three year averages of activity data were used for calculation.

Table 5.8 Domestic livestock population by provinces, thousand heads, 2000

Province	Cattle	Dairy cattle	Sheep	Goats	Camels	Horses	Asses	Swine	Poultry
Republic of Karakalpakstan	382.6	161.3	379.9	55.9	4.6	16.2	9.6	7.8	687.5
Andijan	441.0	185.3	442.2	65.1	0	5.8	0.5	1.2	1353.9
Bukhara	428.0	184.7	709.5	104.4	2.8	3.0	34.8	5.1	770.9
Jizak	283.0	128.7	700.7	103.1	0	14.8	12.0	3.1	409.4
Kashkadarya	581.8	254.7	1627.0	239.3	0.9	18.8	39.2	5.5	1099.3
Navoi	174.4	89.0	921.0	135.5	6.7	11.1	25.9	12.7	611.9
Namangan	348.7	136.8	418.1	61.5	0	5.9	2.1	0.3	596.5
Samarkand	794.0	353.5	778.8	114.5	0.3	16.0	49.5	12.9	2382.9
Surkhandarya	446.4	215.1	850.1	125.0	0	13.0	13.6	1.4	941.7
Syrdarya	171.1	71.5	96.5	14.2	0.1	5.7	4.5	4.7	275.2
Tashkent	387.5	180.1	339.3	49.9	0	26.9	10.3	20.7	3259.3
Fergana	464.9	196.2	341.8	50.3	0	5.0	4.9	4.2	927.8
Khirezm	450.0	186.3	182.1	26.8	0	4.1	17.5	6.2	1193.7

Emission factors

For each animal type a default factor from [3] was used:
Table 4-2, page 4.3, column «Developing countries», table 4-3, page 4.5, line «Asia» – as most similar in value of milk production of dairy cattle from 1875 kg/head/yr at the beginning of the 90-ies to 1550 kg/heady/yr in 2000 (the data of the State Committee on Statistics of the Republic of Uzbekistan).

5.2.3 Uncertainty and sequence of time series

Uncertainty of methane emission was not estimated.
For all years the same method and the same data set was used.

5.2.4 Quality Assurance/ Quality Control

The QA/QC procedures were implemented in accordance with the QA/QC principals and QA/QC plan. The check was conducted of the modified worksheets, the data transcription and documentation. It was also checked whether all information sources for the input data for the program software were referenced.

5.2.5 Recalculations in category

Recalculations were not implemented.

5.2.6 Planned improvements by category

While preparation of the Third National Communication the emissions are supposed to estimate in accordance with [7].

5.3 4B MANURE MANAGEMENT

5.3.1 Description of source category

Methane emission was estimated in the following categories: 4 A 1 a, 4 A 1 b, 4 A 3, 4 A 4, 4 A 5, 4 A 6, 4 A 7, 4 A 8, 4 B 9. Nitrous oxide emission – in the categories: B 10, 4 B 11, 4 B 12.

Table 5.9 Direct GHG emission from manure management, 2000

Category	Emission, Gg CO_2-eq	%
CH_4 emission from manure management	480.4	67.7
N_2O emission from manure management	229.0	32.3
Total emission from manure management	709.4	100.0

Table 5.11 N_2O emission from manure management by categories, 2000

Category	Gg CO_2-eq	%
Anaerobic	4.2	1.8
Liquid systems	3.1	1.3
Solid storage	171.2	74.8
Other	50.6	22.1
Total	229.0	100.0

Table 5.10 CH_4 emission from manure management by categories, 2000

Category	Gg CO_2-eq	%
Cattle	447.7	93.2
dairy	384.4	80.0
non dairy	63.3	13.2
Sheep	17.4	3.6
Goats	2.8	0.6
Camels	0.4	0.1
Horses	3.5	0.7
Asses	3.0	0.6
Swine	1.8	0.4
Poultry	3.8	0.8
Total	480.4	100.0

Table 5.12 CH_4 emission from manure management by provinces

Province	Gg CO_2-eq	%
Republic of Karakalpakstan	30.2	6.3
Andijan	34.2	7.1
Bukhara	34.9	7.2
Jizak	24.6	5.1
Kashkadarya	49.6	10.3
Navoi	18.3	3.8
Namangan	25.9	5.4
Samarkand	65.0	13.5
Surkhandarya	81.6	17.0
Syrdarya	13.2	2.7
Tashkent	33.7	7.0
Fergana	35.8	7.4
Khorezm	34.1	7.1

The 2000 methane emission from manure management was estimated for the provinces of Uzbekistan. The calculation of emissions for each province was performed with application of the method offered in [3] in a separate file. Total emission from the provinces differs from that calculated for the entire country by 2 Gg.

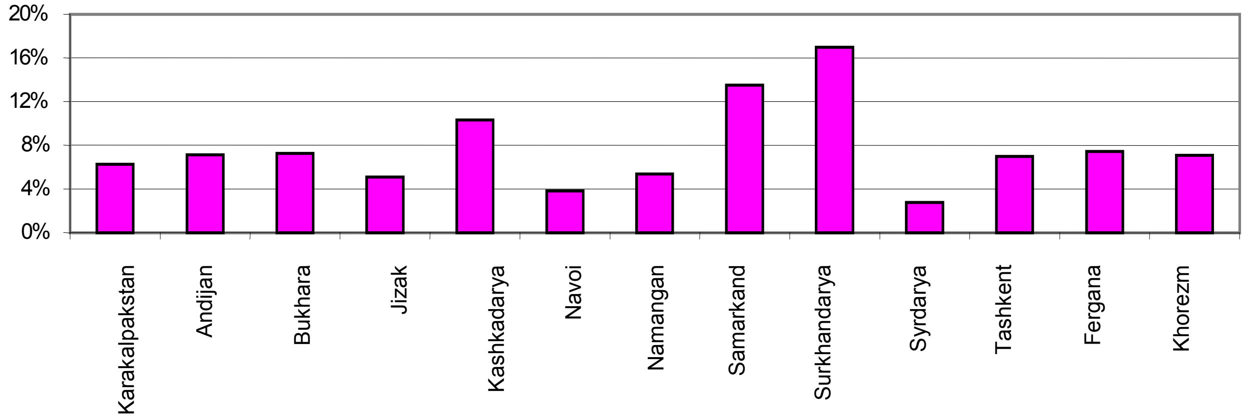

Fig. 5.5 *CH_4 emission from manure management by provinces.*

Trends of emission

Table 5.13 Direct emission from manure management, Gg CO_2 equivalent

Year	CH_4	N_2O	Total emission	Year	CH_4	N_2O	Total emission
1990	420.0	286.8	706.7	**1998**	470.4	223.2	693.6
1991	451.5	289.9	741.4	**1999**	474.6	226.3	700.9
1992	474.6	287.7	762.3	**2000**	480.4	229.0	709.4
1993	485.1	277.8	762.9	**2001**	487.2	231.6	718.8
1994	483.0	261.1	744.1	**2002**	501.9	239.3	741.2
1995	472.5	241.2	713.7	**2003**	525.0	251.4	776.4
1996	464.1	224.8	688.9	**2004**	554.4	271.6	826.0
1997	464.1	220.4	684.5	**2005**	567.0	276.1	843.1

Change in emission for the period 1990-2005 was as follows: CH_4 +35 %; N_2O -3.7 %; total emission +19.3%.

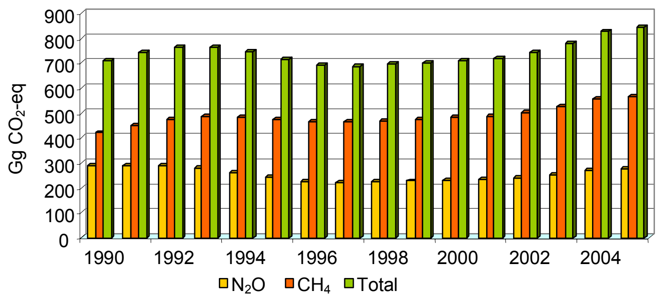

Fig. 5.6 *Trends of direct GHG from manure management*

5.3.2 Methodology

The CH_4 and N_2O emissions from manure management were estimated in accordance with [3].

Activity data

For the emission estimation the data of the state statistics on domestic livestock population was used (table 5.5). As it is recommended by [3] three year averages of activity data were used for calculation.

Emission factors

For each animal type a default factor from [3] was used:

CH_4 emission factor for manure – table 4-4, «Developing countries», page 4.6, table 4-5, region «Asia», page 4.7. Emission factors for the Surkhandarya province were taken from the column «Temperate climate» (annual average temperature is greater than 15°), for the rest of the provinces – the column «Cool climate» (annual average temperature is less than 15°).
N_2O emission factor for manure – table 4-6, page 4.10, line «Asia and Far East».
The portion of nitrogen in manure for each AWMS (Animal Waste Management System) was taken from table 4-7, page 4.13, region "Asia and Far East".
N_2O emission factor for each AWMS – (EF_3) was taken from table 4-8, page 4.14.
Conversion factor = 44/28.

5.3.3 Uncertainty and sequence of time series

Uncertainty of methane and nitrous oxides emissions were not estimated.
For all years the same method and the same data set was used.

5.3.4 Quality Assurance/ Quality Control

The QA/QC procedures were implemented in accordance with the QA/QC principals and QA/QC plan. The check was conducted of the modified worksheets, the data transcription and documentation. It was also checked whether all information sources for the input data for the program software were referenced.

5.3.5 Recalculations in category

The given estimates of CH_4 emission are recalculated ones. Recalculation was implemented due to change in the factors in whole time series (in the Initial National Communication the factors for temperate climate were applied for the whole country).

5.3.6 Planned improvements by category

While preparation of the Third National Communication the emissions are supposed to estimate in accordance with [7].

5.3.5 Recalculations by categories

5.4 4C RICE CULTIVATION

5.4.1 Description of source category

Emission from rice cultivation in 2000 amounted to 187.93 Gg CO_2 equivalent.

Table 5.14 CH_4 emission from rice cultivation

Year	Gg CO_2-eq	Year	Gg CO_2-eq
1990	261.7	**1998**	284.3
1991	273.4	**1999**	248.9
1992	292.5	**2000**	187.9
1993	296.7	**2001**	132.1
1994	287.7	**2002**	126.0
1995	290.2	**2003**	140.9
1996	306.0	**2004**	134.2
1997	296.1	**2005**	99.5

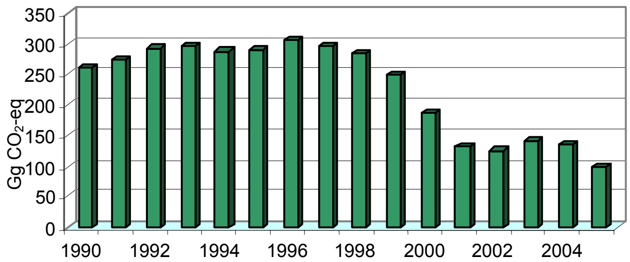

Fig. 5.7 *Trends of CH_4 emission from rice cultivation*

Change in the emission for the period 1990-2005 was as follows: – drop by 62% or by 2.93 times.
Change in emission after 1999-2000 was brought about by a sharp decline in areas under rice.

5.4.2 Methodology

The CH_4 emission from rice cultivation was estimated in accordance with [3].

Activity data

For the calculation the data were used of the state statistics on the areas occupied by rice – 1999 – 164.21 thousand hectares, 2000 – 131.84 thousand hectares; 2001 – 39.52 thousand hectares (Year book «Totals of counting of area under crop for 2000 yield (on all lands)", the similar year books for 1999 and 2001). For calculations three year averages recommended by [3] were used.

Emission factors

In Uzbekistan under conditions when fertilizers are applied to the rice fields and they are intermittently flooded with multiple aerations, the relevant default factors from [3] are employed, such as:
***Scaling factor* – 0.2** (Table 4-10, page 4.21).
Default correction factor – **2** (page 4.16, Item 3).
Default seasonally integrated factor – **20 g/m²** (Table 4-11, page 4.22, line «Arithmetic average»).

5.4.3 Uncertainty and sequence of time series

Uncertainty of methane was not estimated. For all years the same method and the same data set was used.

5.4.4 Quality Assurance/ Quality Control

The QA/QC procedures were implemented in accordance with the QA/QC principals and QA/QC plan. The check was conducted of the data transcription and documentation. It was also checked whether all information sources for the input data for the program software were referenced.

5.4.5 Recalculations in category

Recalculations were not implemented.

5.4.6 Planned improvements by category

While preparation of the Third National Communication the emissions are supposed to estimate in accordance with [7].

5.5 4D AGRICULTURAL SOILS

5.5.1 Description of source category

Under this category direct and indirect N_2O emission from agricultural soils and animal grazing were estimated.

Table 5.15 N_2O emission from agricultural soils, 2000

Category	Gg CO_2-eq
Indirect emission	2910.4
Direct emission	4112.9
Grazing animals	1516.5
Total emission	8538.9

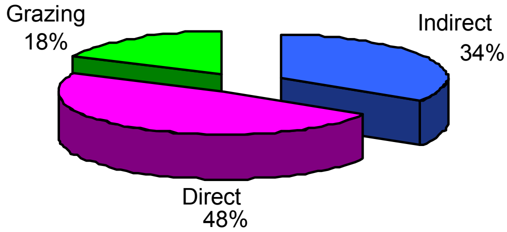

Fig. 5.8 *N_2O emission from agricultural soils, 2000*

Table 5.16 N_2O emission from agricultural soils, Gg CO_2-equivalent

Year	Indirect	Direct	Grazing	Total emission	Year	Indirect	Direct	Grazing	Total emission
1990	3530.9	5155.3	1535.5	10221.7	**1998**	3065.9	4327.6	1488.0	8881.5
1991	3503.0	5111.9	1618.2	10233.1	**1999**	3007.0	4240.8	1503.5	8751.3
1992	3515.4	5108.8	1680.2	10304.4	**2000**	2909.4	4112.9	1516.5	8538.9
1993	3406.9	4929.0	1683.3	10019.2	**2001**	2740.4	3887.4	1531.4	8159.2
1994	3306.7	4754.4	1642.0	9703.0	**2002**	2821.0	4020.7	1577.9	8419.6
1995	3096.9	4420.6	1556.2	9073.7	**2003**	2672.2	3844.0	1652.3	8168.5
1996	3053.5	4327.6	1491.1	8872.2	**2004**	2793.1	4011.4	1701.9	8506.4
1997	3087.6	4333.8	1466.3	8887.7	**2005**	2290.9	3323.2	1801.1	7415.2

Change in emission for the period 1990-2005 was as follows: indirect emission -35.1%; direct emission -35.5%; grazing +17.4%; total emission -27.5%.

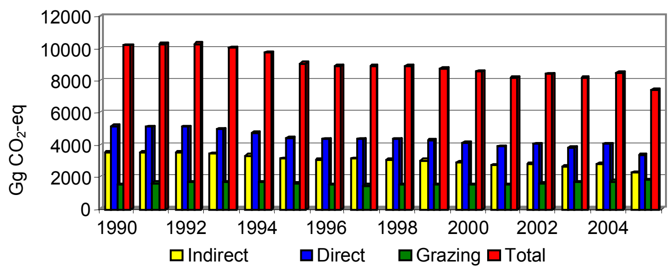

Fig. 5.9 *Trends of N_2O emission from agricultural soils*

5.5.2 Methodology

N_2O emissions from agricultural soils were estimated in accordance with [3].

Activity data

1. The data on nitrogen fertilizer applied to agricultural fields totaled 424.1 thousand tonnes in 1999; 421.05 thousand tonnes – in 2000; 399.2 thousand tonnes – in 2001 were provided by the State Committee for Statistics.
2. The data on livestock population from the State Committee on Statistics are given in the table 5.5.
3. The data on agricultural crop production were taken from the yearbook "Gross yield of agricultural in 2000" and from the yearbooks for 1999 and 2001.

For calculations three year averages recommended by [3] were used.

Table 5.17 Crop production, thousand tonnes

Crop	1999	2000	2001
Leguminous plants	112.7	92.8	104.4
Cereal crops	45073.1	40921.6	42297.0
Technical crops	38519.3	31285.2	33546.2
Oil bearing plants (without soya)	225.3	196.7	142.3
Soya	3.8	4.6	0.7
Vegetables	38555.0	38277.0	39885.1
Feed crop	34701.9	31132.1	27181.8
Grass (haying)	19637.7	14683.1	13502.0

Emission factors

1. ***To convert initial data in units of dry biomass*** – *default* factor **(0.85 = 1 – 0.15)** from [3], page 4.36
2. ***Nitrogen emission factor*** **EF_1 = 0.0125** (0.0025 – 0.0225) kg N_2O-N/kg N applied, [3], table. 4.18, page 4.37
3. ***Emission factor*** **EF_4 = 0.01** (0.002 – 0.02) kg N_2O-N/kg emitted NH_3-N+NO_x–N, [3], table 4-18, page 4.37
4. ***Emission factor*** **EF_5 = 0.025** (0.002 – 0.12) kg N_2O-N/kg N from leaching /washout [3], table 4-18, page 4.37
5. **$Frac_{NCRBF}$ = 0.03** kg N/ kg of dry biomass from [3], table 4-17, page 4.35.
6. **$Frac_{GASF}$ = 0.1** kg NH_3-N + NOx-N/kg N input, [3], table 4-17, page 4.35.
7. **$Frac_{FUEL}$ = 0** kg N / kg N totally extracted, [3], table 4-17, page 4.35.
8. **$Frac_{GASM}$ = 0.2** kg NH_3-N+NOx-N/kg N excreted, [3], table 4-17, page 4.35.
9. **$Frac_{NCR0}$ = 0.015** kg N / kg of dry biomass, [3], table 4-17, page 4.35.
10. **$Frac_{LEACH}$ = 0.3** kg N/kg of fertilizer or manure N [3], table 4-17, page 4.35.
11. ***Total nitrogen excretion*** **(Nex)** [3], table 4-6, page 4.10, line «Asia and Far East»;
12. ***Fraction of nitrogen in manure for each AWMS*** (Animal Waste Management System) was taken from table 4-7, page 4.13, region "Asia and Far East".
13. ***Fraction of nitrogen*** emitted from ***dung and urine deposits of grazing animals*** = **0.02** kg N / kg N [3], Annex A, table A-1, page 4.47, column « Pasture range and paddock"
14. ***Fraction of crop residue removed from the field*** **= 0.75** kg N/kg crop-N (National coefficient provided by the Research Center at the Interstate Commission for Water Coordination).
15. ***Fraction of burned residues*** = **0.05** kg N/kg plant nitrogen (national factor provide by the Research Institute of Water Economy commission).
16. ***Conversion factor*** **=44/28** [3].

5.5.3 Uncertainty and sequence of time series

Uncertainty of N_2O emission was not estimated. For all years the same method and the same data set was used.

5.5.4 Quality Assurance/ Quality Control

The QA/QC procedures were implemented in accordance with the QA/QC principals and QA/QC plan. The check was conducted of correctness of formulas in the worksheets, the data transcription and documentation. It was also checked whether all information sources for the input data for the program software were referenced.

5.5.5 Recalculations in category

Recalculations were not implemented.

5.5.6 Planned improvements by category

While preparation of the Third National Communication the emissions are supposed to estimate in accordance with [7].

5.6 4F FIELD BURNING OF AGRICULTURAL RESIDUES

5.6.1 Description of source category

Emission of non-CO_2 greenhouse gases only from burning of crop stubble on field (4F 1Cereals) was inventoried. Under this category greenhouse gas emissions presented in the table 5.18 were estimated.

Table 5.18 Non-CO_2 emission from field burning of agricultural residues

Direct gases	Gg CO_2-eq	%
CH_4	87.4	73.2
N_2O	31.9	26.8
Total	119.3	100.0
Indirect gases	**Gg**	
CO	109.3	
NOx	3.7	

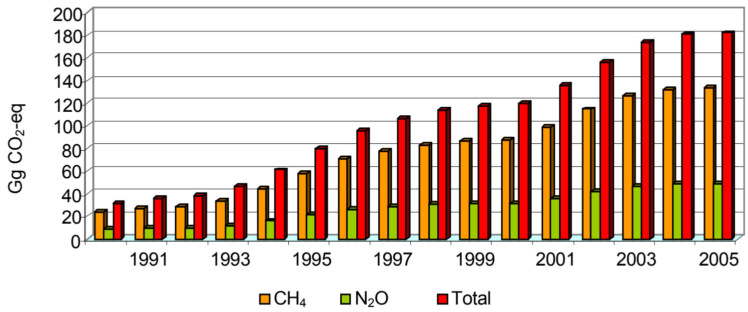

Fig. 5.10 *Trends of direct GHG emission from field burning of agricultural residues*

Table 5.19 Direct GHG emission from field burning of agricultural residues

Year	CH_4	N_2O	Total	Year	CH_4	N_2O	Total
1990	23.3	8.7	32.0	**1998**	83.2	30.4	113.5
1991	22.5	9.6	36.1	**1999**	86.1	31.3	117.4
1992	28.1	10.2	38.4	**2000**	87.4	31.9	119.3
1993	33.8	12.4	46.2	**2001**	98.9	36.3	135.2
1994	44.3	16.1	60.3	**2002**	114.2	41.9	156.1
1995	58.2	21.4	79.6	**2003**	126.4	46.2	172.6
1996	70.1	25.7	95.9	**2004**	132.1	48.4	180.5
1997	77.5	28.2	105.7	**2005**	132.9	48.7	181.6

Change in emission for the period 1990-2005 was as follows: CH_4 – rise by 5.70 times; N_2O – rise by 5.60 times; total emission increased by 5.68 times.

Table 5.20 Indirect GHG emission from on-site burning of agricultural residues, Gg

Year	CO	NOx	Year	CO	NOx
1990	29.3	1.0	**1998**	104.0	3.5
1991	33.1	1.1	**1999**	107.7	3.7
1992	35.3	1.2	**2000**	109.3	3.7
1993	42.3	1.4	**2001**	123.8	4.2
1994	55.5	1.9	**2002**	142.7	4.9
1995	72.7	2.5	**2003**	158.0	5.4
1996	87.8	3.0	**2004**	165.1	5.6
1997	96.7	3.3	**2005**	166.0	5.7

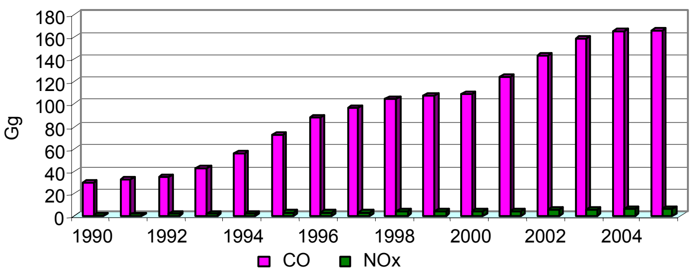

Fig. 5.11 *Trends of indirect GHG emission from on-site burning of agricultural residues*

Change in emission for the period 1990-2005 was as follows: CO – rose by 5. 67 times; NOx rose by 5.66 times. Rise in emission was brought about by increase in area under crops and crop yield in the country.

5.6.2 Methodology

Non-CO_2 emissions from on-site burning of agricultural residues were estimated in accordance with [3].

Activity data

Only cereal residues are burnt on fields (wheat, barley, rye). For calculations the data of the state statistics on crop production were used (the yearbooks “Gross yield of agricultural crops on all lands”).

Table 5.21 Crop production, thousand tonnes

Crop	1999	2000	2001	% for 2000
Wheat	3757.1	3684.2	3843.5	97.54
Burley	119.4	91.3	140.8	2.42
Rye	2.3	1.8	0.9	0.05
Total	3878.8	3777.3	3985.2	100.00

For calculations three year averages recommended by [3] were used.

Emission factors

Emission factors are given for wheat (barley and rye residues were burned on fields too but their share in total crop production is marginal (table 5.21) so the magnitudes of wheat emission factors were applied to all crops).
***Residues/production* ratio = 1.575** [16].
Dry biomass/total biomass ratio = **0.83** (in range of 0.78-0.88), [3], page 4.29, table 4-15, line «Wheat».
***Portion of biomass burned on fields* = 0.38** [16].
***Fraction oxidized* = 0.9** [3]
***Portion of carbon in dry biomass* = 0.45** [16].
***Nitrogen/carbon ratio* = 0.012**, [3], page 4.29, table 4-15, line «Wheat».
***Emission ratios*:** CH_4 = 0.004; CO = 0.06; N_2O = 0.007; NOx = 0.121 [3], page 4.31, table 4-16.

5.6.3 Uncertainty and sequence of time series

Uncertainty of non-CO_2 emission was not estimated. For all years the same method and the same data set was used.

5.6.4 Quality Assurance/ Quality Control

The QA/QC procedures were implemented in accordance with the QA/QC principals and QA/QC plan. The check was conducted of the data transcription and documentation. It was also checked whether all information sources for the input data for the program software were referenced.

5.6.5 Recalculations in category

Before now emissions in this category were not estimated.

5.6.6 Planned improvements by category

While preparation of the Third National Communication the emissions are supposed to estimate in accordance with [7].

5.7 4G OTHER

Category «CO_2 emissions and removals from cultivated agricultural fields” is not included in the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories and IPCC software. The results obtained were not included in the national GHG inventory. The calculation was made by the specialists of the State Research Institute of Soil Science and Agrochemistry at the Academy of Science of the Republic of Uzbekistan.
The method of the calculation was developed by A. Banaru, the Research Institute for Pedology, Agrochemistry and Hydrology “N.Dimo”, Moldova) [14, 15].
The calculation is given in the Annex 12.

5.7.1 Description of source category

Emissions and removals of CO_2 were estimated from irrigated areas under cotton, wheat and alfalfa that constitute 93% of the total irrigated area.
In 2000 removals amounted to 3090.4 Gg CO_2 equivalent. Three year averages were used.

Table 5.22 CO_2 emissions and removals from agricultural soils

Year	Gg CO_2	Year	Gg CO_2
1990	4545.6	**1998**	-1267.9
1991	2169.5	**1999**	-421.8
1992	-217.8	**2000**	-3090.4
1993	-1327.5	**2001**	-4731.2
1994	-375.7	**2002**	-6510.6
1995	-259.2	**2003**	-7223.1
1996	-2286.3	**2004**	-7212.1
1997	-1830.3	**2005**	-6189.0

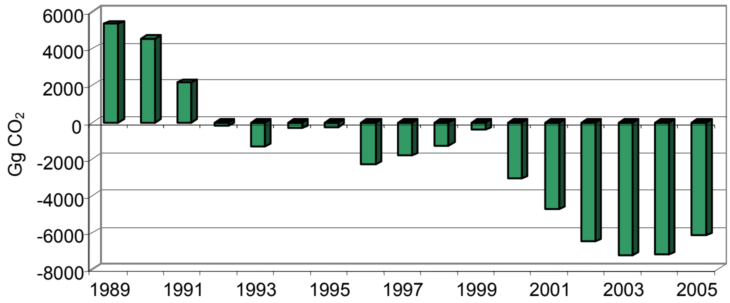

Fig. 5.12 *Trend of CO_2 emissions and removals from agricultural soils*

5.7.2 Methodology

The method of the estimation is described in the following publications:
Anatol Banaru. "The greenhouse CO_2 emissions from the arable soils of the Republic of Moldova. CLIMATE CHANGE. Researches, studies, solutions. Chisinau, 2000" [7].
Anatol Banaru. "The methodology for the assessment of greenhouse CO_2 emissions from the arable soils. CLIMATE CHANGE. Researches, studies, solutions. Chisinau, 2000" [8].

The methodology of the calculations of emissions/removals of CO_2 is based on the assessment of carbon cycle in tillable soils. Carbon stocks in soils are made up of humified plant residues and organic substances entering the soil with organic fertilizers. Carbon stocks are calculated with application of the humification coefficients.

Emissions/removals of CO_2 depend on mineralization of organic matter and are estimated based on the magnitude of nitrogen removed with yield as the ratio carbon/nitrogen in soil humus is a constant.

Activity data

The calculations were based on the state statistics on crop production – the 1999 -2001 yearbooks "Gross yield of agricultural crops on all lands" and "Gross yield of agricultural crops on irrigated lands". The data on the amount of the mineral and organic fertilizers applied were provided by the Ministry of Agriculture and Water Management.
There are no any statistics on alfalfa production so approximate data from the Ministry of Agriculture and Water Management were used.
According to the data of the Ministry of Agriculture and Water Management fertilizers are not applied to area under alfalfa.

Table 5.23 Crop yield, thousand tonnes

Year	Cotton	Wheat	Alfalfa
1999	3599.99	3551.91	1.50
2000	3001.84	3623.00	1.50
2001	3270.18	3802.23	1.50

Table 5.24 Fertilizers application, thousand tonnes

Year	Manure thousand tonnes		Nitrogen fertilizers thousand tonnes	
	Cotton	Wheat	Cotton	Wheat
1999	6069.6	4020.5	291.34	201.12
2000	7222.1	6420.2	295.81	203.02
2001	10163.3	9320.1	281.67	196.10

Emission factors

The national factors and some generally known coefficients were used for calculation.

Table 5.25 Coefficients for calculation of emissions/removals of CO_2 in tillable soils

Coefficient	Crop	Magnitude
Coefficient of plant residues accumulation	Alfalfa	0.5
Coefficient of plant residues accumulation	Cotton	0.85
Coefficient of plant residues accumulation	Wheat	1.17
Coefficient of plant residues humification	Alfalfa	0.18
Coefficient of plant residues humification	Cotton	0.21
Coefficient of plant residues humification	Wheat	0.19
Coefficient of nitrogen removal	Alfalfa	0.025
Coefficient of nitrogen removal	Cotton	0.050
Coefficient of nitrogen removal	Wheat	0,035
Nitrogen content in plant residues	Alfalfa	0.028
Nitrogen content in plant residues	Cotton	0.0064
Nitrogen content in plant residues	Wheat	0.005
Coefficient of utilization of nitrogen from mineral fertilizers	Cotton	0.40
Coefficient of utilization of nitrogen from mineral fertilizers	Wheat	0.36
Coefficient of humus conversion into carbon		0.58
Coefficient of manure conversion into carbon		0.58
Coefficient of manure humification		0,22
Portion of nitrogen in manure		0.005
Coefficient of nitrogen removed with yield		0.3
Coefficient of soil texture		1.2
Coefficient of technological effectiveness	Alfalfa	1.5
Coefficient of technological effectiveness	Cotton	1.5
Coefficient of technological effectiveness	Wheat	1.85
Coefficient of nitrogen conversion into carbon		10.7
Conversion factor for recalculation of carbon into CO_2		3.67

Sources are as follows: [17, 18, 19, 20, 21, 22, 23, 24, 25, and 26].

5.7.3 Uncertainty and sequence of time series

Uncertainties were not estimated despite they are probably high. To comprehensively estimate emissions/removals of CO_2 in tillable soils the data on all crops sown all over the whole country's territory are required. There are no statistical data on non-widespread crops, majority of which is sown in small farms. In particular, the data are not available on application of mineral and organic fertilizers to each crop.

For all years the same method and the same data set was used.

5.7.4 Quality Assurance/ Quality Control

The QA/QC procedures were implemented in accordance with the QA/QC principals and QA/QC plan. The check was conducted of the data transcription and documentation. It was also checked whether all information sources for the input data for the program software were referenced. The calculations were checked by the developers of the method from Moldova.

5.7.5 Recalculations in category

Before now emissions in this category were not estimated.

Chapter 6: 5 LAND-USE CHANGE & FORESTRY

6.1 Sector review

Under this sector emissions/removals were estimated under the categories «Changes in forest and other woody biomass stocks», «Abandonment of managed lands», «CO_2 emissions and removals from soil associated with land-use change». The estimates of the removals are shown n the table.

Removals account to 0.94% from the CO_2 emissions and 0.51% from the total GHG emission.

Table 6.1 Removals in the sector «Land-use change and forestry», 2000

Category	Removals Gg CO_2	%
5 A Changes in forest and other woody biomass stocks	-751.0	73.8
5 C Abandonment of managed lands	0	0
5 D Emissions and removals of CO_2 from soils associated with land-use change	-267.4	26.3
Total	-1018.4	100

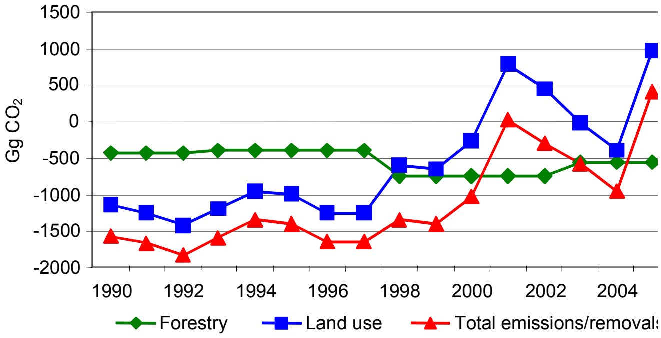

***Fig 6.1** Trends of CO_2 removals in the sector «Land-Use Change and Forestry»*

In the category «Changes in forest and other woody biomass stocks» removals are estimated once in every 5 years in compliance with frequency of the state accounting for forest resources. Values of removals and emissions in the following 4 years are taken equal by default. The closest in time to 1990 state forest resources inventories were conducted in 1988, 1993 and 2003. The categories in this sector were not estimated as the key ones.

Table 6.2 Emissions/removals in the sector «Land-Use Change and Forestry», Gg CO_2

Year	Change in forests	Land use	Total	Year	Change in forests	Land use	Total
1990	-420.8	-1145.4	-1566.3	**1998**	-751.0	-597.5	-1348.5
1991	-420.8	-1246.2	-1667.0	**1999**	-751.0	-646.7	-1397.7
1992	-420.8	-1418.6	-1839.4	**2000**	-751.0	-267.4	-1018.4
1993	-399.4	-1196.1	-1595.5	**2001**	-751.0	+781.5	+30.5
1994	-399.4	- 53.1	-1352.5	**2002**	-751.0	+454.9	-296.1
1995	-399.4	-998.0	-1397.5	**2003**	-562.4	-23.3	-585.7
1996	-399.4	-1247.7	-1647.1	**2004**	-562.4	-390.2	-952.7
1997	-399.4	-1249.2	-1648.7	**2005**	-562.4	+979.9	+417.4

6.2 5A CHANGES IN FOREST AND OTHER WOODY BIOMASS STOCKS

6.2.1 Description of source category

Table 6.3 CO_2 removals in the category «Changes in forest and other woody biomass stocks»

Year	**1988**	**1993**
Gg CO_2	-420.8	-399.4
Year	**1998**	**2003**
Gg CO_2	-751.0	-562.4

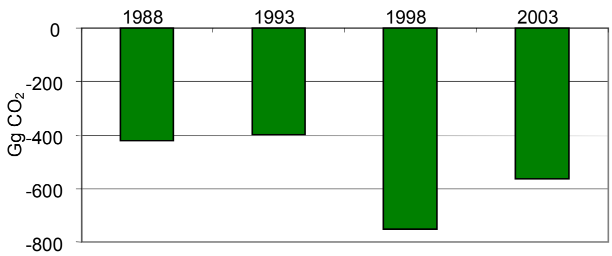

***Fig. 6.2** Trends of CO_2 removals in the category «Changes in forest and other woody biomass stocks»*

Removals in this category are estimated once in every 5 years in compliance with frequency of the state accounting for forest resources and only for areas under forest of the state forest resources as for others no data are available.

Values of removals and emissions in the following 4 years are taken equal by fault. The closest in time to 1990 state forest resources inventories were conducted in 1988, 1993 and 2003.

6.2.2 Methodology

Estimation of the CO_2 removals in the category was carried out based on Revised 1996 IPCC Guidelines for national greenhouse gas inventories [3].

Considerable increase is featured for juniper, saxaul, poplar, tamarisk, saltwort and other shrubs and for other species increase is within rounding so plants were grouped by natural zones:

I. Mountain forests
   1) Juniper arboreal;
   2) Other woody species growing mainly in mountains: (maple, birch, apricot, hackberry, almond, walnut, mountain ash, cherry plum, pistachio, bird cherry tree, apple);

II. Valley-flood-plain forests
   1) Poplar (Asiatic poplar);
   2) Other arboreal species growing mainly in valleys and flood-plains: (ash tree, elm, locust, bastard acacia, willow arboreal, mulberry, other arboreal species);

III. Desert forests
   1) Saxaul

IV. Shrubs

Biomass gain was calculated with application of the national factors in compliance with the instruction on state forest resources inventory [27, 28].

Activity data

The data on areas under forests were taken from the state forest resources inventory [29, 30]. It should be mentioned that not all areas under forest in the country are inventoried.
The data on wood produced, wood fuel consumption and other wood usage were taken from the materials of the state accounting for forests.
To estimate CO_2 removals in 2000 the data of 1998 were used.

Table 6.4 Area under forest by prevailing species, thousand hectares

Type of vegetation	Species groups	Area, thousand hectares
Mountain forests	Juniper arboreal	194.24
	Other arboreal species growing in mountains	67.21
Flood-plain forests	Poplar (Asiatic poplar)	27.22
	Other arboreal species growing in valleys and flood-plains	5.31
Desert forests	Saxaul	2398.98
	Shrubs	340.54

Table 6.5 Data on wood utilization, thousand m^3

Wood utilization	Species group	Amount, thousand m^3
Amount of wood produced	Poplar (asiatic poplar)	3.35
Total wood fuel consumption	Poplar (asiatic poplar)	4.56
	Saxaul	46.11
Other wood utilization	Poplar (asiatic poplar)	0.10
	Saxaul	0.36

Emission factors

For the calculation of the CO_2 removals the national factors were used.
Volume shrinkage and density of dry wood matter were calculated in accordance to [31].
Average gain in damp wood was calculated based on the data of the state accounting for forests.

Table 6.6 National factors for calculation of CO_2 removals

Species group	Average gain in damp wood, m^3/hectare	Volume shrinkage %	Density of dry wood matter kg/m^3
Juniper arboreal	0.206	9.9	440
Other arboreal species growing in mountains	0.223	13.2	545
Poplar (asiatic poplar)	1.933	10.2	395
Other arboreal species growing in valleys and flood-plains	1.364	17.1	710
Saxaul	0.199	16.2	867
Shrubs	0.361	14.7	510

6.2.3 Uncertainty and sequence of time series

Uncertainties were not estimated. Judging from the fact that averaged coefficients were used and the activity data were incomplete, it is possible to assume that uncertainty is of high value.
For all years the same method and the same data set was used.

6.2.4 Quality Assurance/ Quality Control

The QA/QC procedures were implemented in accordance with the QA/QC principals and QA/QC plan. The check was conducted of the data transcription and documentation. It was also checked whether all information sources for the input data for the program software were referenced.

6.2.5 Recalculations in category

The test calculation of the CO_2 removals was made for 2003 in accordance with Good Practice Guidance for Land Use Change & Forestry IPCC 2003 [6], that was not included in the inventory.
The result obtained differs considerably from that calculated in accordance to [3].

Table 6.7 Comparison of removals in the category «Changes in forest and other woody biomass stocks», calculated by two methods, Gg CO_2

Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories	Good Practice Guidance for the sectors Land Use Change & Forestry IPCC 2003
- 562.46	- 1310.0

6.2.6 Planned improvements by category

While preparation of the Third National Communication removals are supposed to estimate in accordance with [7].

6.3 5C ABANDONMENT OF MANAGED LAND

6.3.1 Description of source category

The data on the abandoned lands were provided by the State Committee on Land Resources, Geodesy, Cartography and State Cadastre. Analysis of the data obtained has shown that natural conditions of all abandoned lands are not fit for natural reforestation even in the case when these abandoned lands were previously forest areas. On these lands only herbaceous vegetation is restored. Annual growth rate of surface biomass of herbaceous vegetation is equal to “0” [3]. Removals in this category for Uzbekistan are equal “0”, respectively.
In the future calculations in this category are not envisaged.

6.4 5D EMISSIONS AND REMUVALS FROM SOIL

6.4.1 Description of source category

While estimating CO_2 emissions and removals under change in land use and management the following land-use systems were taken into consideration:

- Tillable lands
- Perennial arboreal plants (gardens, garden nurseries, mulberries, vineyards etc.)
- Fallow lands and lands under meliorative development
- Hayfields
- Pastures
- Household lands and lands of horticultural and vegetable raising farms.

According to [32, 33, 34, and 35] the majority of soils in Uzbekistan belong to the group of soils containing minerals of highly active alumina. There are no soils containing minerals of low active alumina, volcanic and podzol soils in Uzbekistan. Sandy soils occupy only 3.5% of the total area (they are named desert sandy soils according to the classification adopted in Uzbekistan). Soils of wetlands (marsh soils according to the classification adopted in Uzbekistan) occupy small areas and are used for rice cultivation.
Removals in 2000 in this category amounted to 267.36 Gg CO_2.

Table 6.8 CO_2 emissions and removals from soils under change in land use and management

Year	Gg CO_2	Year	Gg CO_2
1990	-1145.4	**1998**	-597.5
1991	-1246.2	**1999**	-646.7
1992	-1418.6	**2000**	-267.4
1993	-1196.1	**2001**	+781.5
1994	-953.1	**2002**	+454.9
1995	-998.0	**2003**	-23.3
1996	-1247.7	**2004**	-390.2
1997	-1249.2	**2005**	+979.9

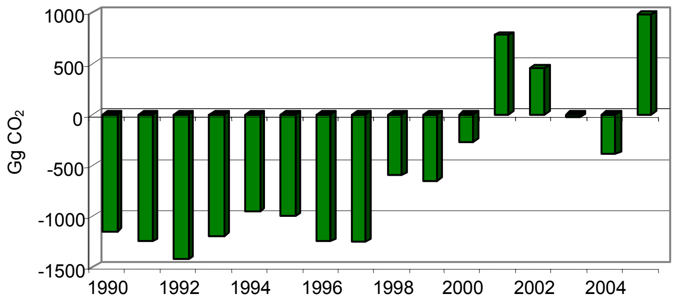

***Fig. 6.3** Trends of CO_2 emissions and removals from soils under change in land use and management*

Top emissions in 2001 and 2005 were brought about by sharp reduction in cultivated wetlands.

6.4.2 Methodology

The CO_2 removals in this category were estimated in accordance with [3].

Activity data

The data on the lands under different land-use systems were provided by the State Committee on Land Resources, Geodesy, Cartography and State Cadastre.
The 2000 data are given in the table. The total lands under all land-use systems per year t and year t-20 are not equal so, following the instructions given in [3], the areas of 1980 were reduced to the total area of 2000.

Table 6.9 Areas of land-use systems, thousand hectares

Land-use systems	1980	2000	Reduced data, 1980
Tillable lands (without area under rice)	3832.3	3926.9	3697.9
Area under rice	104.1	131.8	100.4
Perennial plants	269.9	346.9	260.4
Fallow lands	158.1	165.6	152.6
Hayfields	117.0	112.3	112.9
Pastures	23782.1	22134.1	22948.1
Household land	201.5	649.2	194.4
Total	28465.0	27466.8	27466.8

Emission factors

The Uzbekistan's territory is located in the temperate-warm dry zone with mean annual temperature of 13.4 C°, that is, within the range 10-20°C. Mean annual precipitation is less than 600 mm.
Corresponding to above mentioned climate conditions default magnitudes of carbon stocks under native vegetation were used [6], page 3.83, and table 3.3.3. Factors used are as follows: base factor, tillage factor, input factor.

Table 6.10 Factors for calculation of emissions/removals from soils under land use change

Land use systems	Base factor	Tillage factor	Input factor
Tillable lands (highly active soils)	0.82	1.0	1.34
Tillable lands (waterlogged)	1.10	-	-
Perennial plants	0.82	1.0	1.00
Fallow lands	0.82	1.10	0.92
Hayfield	1.00	-	-
Pastures	1.00	0.95	-
Household land	0.82	1.00	1.07

6.4.3 Uncertainty and sequence of time series

Uncertainty was not estimated. It is assumed of high value. One of the causes is that even a choice of factors for a specific land use system is a problem. For instance, it is an ordinary practice to remove residues from fields (area under cotton) and burn stubble (area under wheat). That is why it is necessary to select a low input factor. However, it is also an ordinary practice to apply every year organic fertilizers both to cotton and wheat.
For all years the same method and the same data set was used.

6.4.4 Quality Assurance/ Quality Control

The QA/QC procedures were implemented in accordance with the QA/QC principals and QA/QC plan. The check was conducted of the input data for areas, the data transcription and documentation. It was also checked whether all information sources for the input data for the program software were referenced.

6.4.5 Recalculations in category

Before now emissions and removals were not estimated in this category.

6.4.6 Planned improvements by category

While preparation of the Third National Communication the emissions/removals are supposed to estimate in accordance with [7].

Chapter 7: 6 WASTE

7.1 Sector review

The waste sector covers the categories 6A and 6B (1 and 2) indicated in the table 7.1 as well as CH_4 and N_2O emissions. The waste incineration category was not inventoried due to absence of any data.

Table 7.1 GHG emissions, 2000

Category	Gg CO_2-eq	%
6 A Solid waste disposal on land	3705.1	81.8
6 B 1 Industrial wastewaters	33.3	0.7
6 B 2 Domestic and commercial wastewaters	793.5	17.,5
Total	4531.9	100

Table 7.2 Share of greenhouse gases in waste sector, 2000

Gas	CH_4	N_2O
Gg CO_2-eq	4003.8	528.0
%	88.4	11.6

Table 7.3 Greenhouse gas emissions from waste sector, CO_2 equivalent

Year	CH_4	N_2O	Total emission	Year	CH_4	N_2O	Total emission
1990	3635.5	437.7	4073.2	**1998**	3948.0	514.6	4462.6
1991	3674.6	446.4	4121.0	**1999**	3988.9	520.8	4509.7
1992	3716.7	458.8	4175.5	**2000**	4003.8	528.0	4531.9
1993	3753.2	468.1	4221.3	**2001**	4033.4	533.2	4566.6
1994	3779.2	477.6	4256.7	**2002**	4079.2	542.5	4621.7
1995	3805.5	486.7	4292.2	**2003**	4101.1	548.7	4649.8
1996	3852.2	496.0	4348.2	**2004**	4115.6	554.9	4670.5
1997	3900.4	505.3	4405.7	**2005**	4130.0	561.1	4691.1

Change in emissions for the period 1990-2005 was as follows: CH_4 +13.6 %; N_2O +28.4 %; total emission +15.2 %.

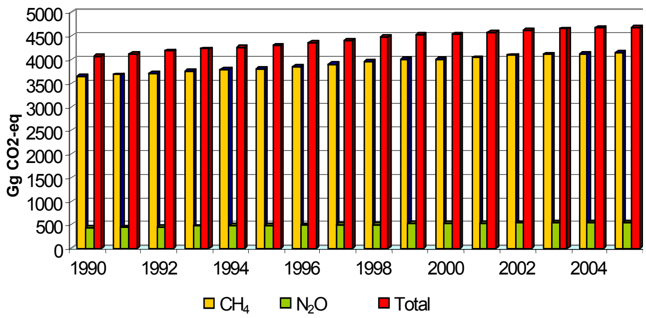

***Fig. 7.1** Trends of greenhouse gas emissions from waste*

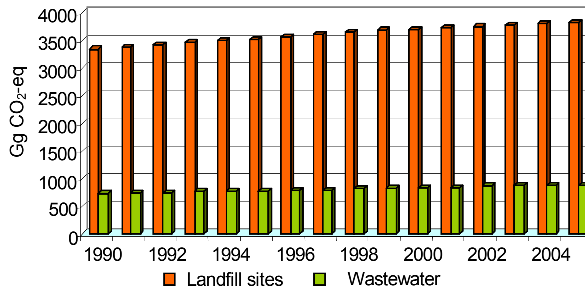

***Fig. 7.2** Trends of greenhouse gas emissions from waste by sub-sectors*

Table 7.4 Greenhouse gas emissions from waste sector by category, Gg CO_2

Year	Disposal sites	Wastewaters	Year	Disposal sites	Wastewaters
1990	3343.3	729.2	**1998**	3654.0	808.6
1991	3383.7	737.3	**1999**	3688.7	821.0
1992	3427.2	748.3	**2000**	3705.1	826.7
1993	3461.4	759.9	**2001**	3729.4	837.2
1994	3491.7	765.0	**2002**	3752.5	869.2
1995	3522.5	769.7	**2003**	3771.4	878.4
1996	3565.0	783.2	**2004**	3791.6	878.9
1997	3610.5	795.2	**2005**	3814.2	876.9

Change in emissions for the period 1990-2005 was as follows: disposal sites +14.1%; wastewaters +20.3%.
Key category while estimating a level of emissions in this sector is only methane emission from solid waste disposal sites.

7.2 6A SOLID WASTE DISPOSAL ON LAND

7.2.1 Description of source category

CH_4 emission from solid waste disposal sites in 2000 amounted to 3705.1 Gg CO_2 equivalent

Table 7.5 CH_4 emission from solid waste disposal sites

Year	Gg CO_2-eq	Year	Gg CO_2-eq
1990	3343.3	**1998**	3654.0
1991	3383.7	**1999**	3688.7
1992	3427.2	**2000**	3705.0
1993	3461.4	**2001**	3729.4
1994	3491.7	**2002**	3752.5
1995	3522.5	**2003**	3771.4
1996	3565.0	**2004**	3791.6
1997	3610.5	**2005**	3814.2

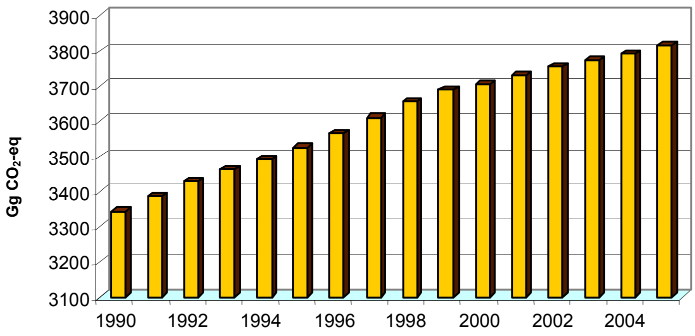

Fig. 7.3 *Trend of CH_4 emission from solid waste disposal sites*

Change in emission for the period 1990-2005 was +14.1 %.
Rise in emission was caused by increase in urban population growth.

7.2.2 Methodology

Estimation of the CH_4 emission from solid waste disposal sites was implemented following the instructions offered in [3]. Industrial waste dumped to disposal sites were not taken into consideration due to absence of the data on their amount.

Activity data

For the calculations there were used the data of the state statistics on mean annual urban population in 2000 that amounted to 9265.3 thousand person.

Emission factors

Municipal solid waste (MSW) generation rate = **1.2** kg/cap/day [36], page 8, table 3. The values given in the table were obtained by direct measurements conducted by the Institute of Sanitary and Hygiene in 1989.
Fraction of MSW disposed to SWDS = **1** (presented by the Tashkent Department on Heat Supply "Issikliq Manbai").
Fraction of MSW on each type of disposal sites (presented by the Tashkent Department on Heat Supply "Issikliq Manbai"):

Managed	0.17
Unmanaged - deep (>=5 m of wastes)	0.04
Unmanaged - shallow (< 5 m of wastes)	0.79

Methane correction factor (MCF) = 0.52.
Fraction of DOC (degradable organic carbon) in MSW = 16.35%. It was calculated (equation 2, Chapter «Waste», [3]) using the values of the data on morphological composition of wastes that is presented in the normative document [36], page 5, table 1.

Table 7.6 Percentage of waste containing DOC in total amount of waste disposed to disposal site

Paper and textile	22.8% by weight
Garden and park waste	0% by weight
Food waste	38.4% by weight
Wood and straw waste	4.9% by weight

The values presented in the table are derived from direct measurements that were implemented by the Institute of Sanitary and Hygiene in 1989. Mean annual data were used for the calculation.

Fraction of DOC, which actually degrades = **0.77** [3], page 6.10.
Fraction of carbon released as methane = **0.5** [3], page 6.10.
Conversion factor = **16/12** [3], page 6.10.
Methane correction factor = **0** [3], page 6.10.

7.2.3 Uncertainty an sequence of time series

Uncertainty of methane emissions from municipal wastes was not estimated.
For all years the same method and the same data set was used.

7.2.4 Quality Assurance/ Quality Control

The QA/QC procedures were implemented in accordance with the QA/QC principals and QA/QC plan. The check was conducted of the additional worksheet for the calculation of national DOC, data transcription and documentation. It was also checked whether all information sources for the input data for the program software were referenced.

7.2.5 Recalculations in category

The results presented are recalculated values of the inventory that were reported in the Initial National Communication. In the current inventory unlike the previous one the national factor (waste generation) was used and the DOC and MSW factors calculated on the base of the national data.

7.2.6 Planned improvements by category

While preparation of the Third National Communication the emissions are supposed to estimate in accordance with [7].

7.3 6B WASTEWATER HANDLING

In the category the CH_4 emission was estimated from industrial, domestic and commercial wastewaters handling as well as N_2O emission from human waste.
Approximately one third of industrial wastewater is disposed to sewage system. Where central sewage system is in place, all domestic/commercial wastewaters are disposed to treatment system.

Table 7.7 GHG emissions from wastewaters, 2000

Category	Gas	Gg CO_2-eq	%
6 B1 Industrial wastewater	CH_4	33.3	4.0
6 B2 Domestic/commercial wastewater	CH_4	265.4	32.1
6 B2 Domestic/commercial wastewater	N_2O	528.0	63.9
Total		826.7	100.0

7.3.1 Description of source category Industrial Wastewater

In 2000 the CH_4 emission from industrial wastewater amounted to 33.26 Gg CO_2 equivalent.

Table 7.8 CH_4 emissions from industrial wastewater

Year	Gg CO_2-eq	Year	Gg CO_2-eq
1990	59.6	**1998**	29.4
1991	54.2	**1999**	33.5
1992	50.5	**2000**	33.3
1993	49.5	**2001**	36.9
1994	44.1	**2002**	59.0
1995	37.7	**2003**	61.2
1996	34.6	**2004**	51.9
1997	33.3	**2005**	40.5

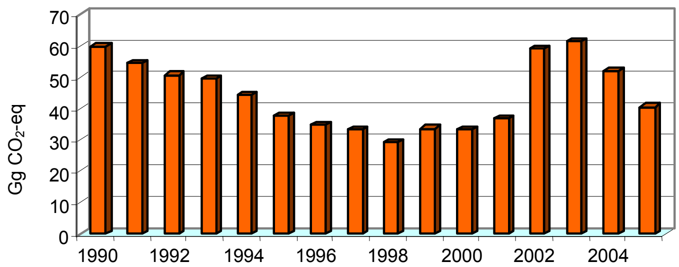

Fig. 7.4 *Trend of CH_4 emission from industrial wastewaters*

Change in emission for the period1990-2005 was 32.0 %.
The dynamics of methane emission from industrial wastewater is conditioned by the dynamics of industrial production.

7.3.2 Methodology

The CH_4 emissions from industrial wastewater were estimated following the instructions given in [3].

Activity data

Calculations were based on official statistics on industrial production.

Table 7.9 Industrial production, 2000

№	Production	Unit of measurement	Amount
1	Nitrogen fertilizers	Thousand tonnes	716.8
2	Canned food, total	Million cans	492.088
3	Beer	thousand deca-liters	6081
4	Grape vine	thousand deca-liters	5987
5	Cognac	thousand deca-liters	131
6	Alcohol and alcohol drinks	thousand deca-liters	7166
7	Meat semi-prepared products	thousand tonnes	0.196
8	Sausages	thousand tonnes	2.883
9	Dairy products	thousand tonnes	182.594
10	Sugar	tonnes	10169
11	Mixed feed	tonnes	666672
12	Animal oil	thousand tonnes	2.18
13	Animal fat	thousand tonnes	0.037
14	Margarine	thousand tonnes	22.453
15	Vegetable oil	thousand tonnes	245.859
16	Beverage	thousand deca-liters	17547
17	Paper	thousand tonnes	9.7
18	Petroleum products	thousand tonnnes	6665
19	Cotton cloth	thousand m^2	358896
20	Silk cloth	thousand m^2	5385
21	Paints and varnishes	tonnes	35939

Emission factors

Amount of organic matter was estimated based on the norms of wastewater formation and COD concentration that are indicated in the document "Increased norms of water supply and water allocation for different industrial sectors" [37].

Table 7.10 Factors used for estimation of CH_4 emission from industrial wastewaters

Product	Norms of wastewaters formation	Concentration COD, mg/ liter
Nitrogen fertilizers	480 m^3/ tonnes of products	0.035 (0.02-0.05)
Canned food, total	5.67 m^3/1000 cans	0.233
Beer	76.4 m^3/1000 deca-liters	1.5
Grape vine	28.15 m^3/1000 deca-liters	13.0
Cognac	164.56 m^3/1000 deca-liters	17.0
Alcohol and alcohol drinks	259 m^3/1000 deca-liters	0.6
Meat products	19.3 m^3/ tonnes	1.0
Dairy products	5.2 m^3/ tonnes	1.4
Sugar	16.2 m^3/ tonnes	4.5
Mixed feed	0.38 m^3/ tonnes	0.6
Animal oil and fat	1.74 m^3/ tonnes	0.25
Margarine	3.14 m^3/ tonnes	15.0
Vegetable oil	1.31 m^3/ tonnes	1.5
Beverages	38.05 m^3/1000 deca-liters	1.0
Paper	43.75 m^3/ tonnes	0.12
Petroleum products	0.215 m^3/ tonnes	0.6
Cotton cloth	42.6 m^3/1000 m^2	0.675 (0.35-1.0)
Silk cloth	76.5 m^3/1000 m^2	0.8 (0.6 – 1.0)
Paints and varnishes	58.0 m^3/ tonnes	0.02

***Fraction of wastewater treated by certain handling system* = 0.3** (data of the Ministry of Agriculture and Water Management)
***Methane conversion factor* = 0.9** [3], table 6-8, page 6.19, line "Other countries of Asia".
Maximum methane producing capacity = **0.25** kg CH_4/ kg BOD [3].

7.3.3 Uncertainty and sequence of time series

Uncertainty of the CH_4 emission from industrial wastewaters was not estimated.
For all years the same method and the same data set was used.

7.3.4 Quality Assurance/ Quality Control

The QA/QC procedures were implemented in accordance with the QA/QC principals and QA/QC plan. The check was conducted of input production data, data transcription and documentation. It was also checked whether all information sources for the input data for the program software were referenced.

7.3.5 Recalculations in category

The results presented are recalculated values of the inventory that were reported in the Initial National Communication. In the current inventory a greater list of the enterprises wastewaters of which emit methane were taken into consideration. The norms of wastewater formation and COD values were also refined.

7.3.6 Planned improvements by category

While preparation of the Third National Communication the emissions are supposed to estimate in accordance with [7].

7.4.1 Description of source category Domestic and Commercial Wastewater

In this category the CH_4 emission from domestic and commercial wastewaters as well as N_2O emissions from human wastes was estimated.

Table 7.11 Direct GHG emission from domestic and commercial wastewaters, 2000

Category	Emission, CO_2-eq	%
CH_4 emission from domestic and commercial wastewater	265.4	33.5
N_2O emission from domestic and commercial wastewater	528.0	66.5
Total	793.4	100.0

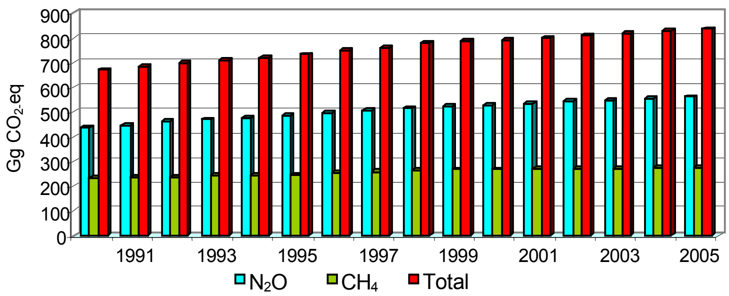

Fig. 7.5 Trends of GHG from domestic and commercial wastewaters

Change in the emission for the period 1990-2005 was as follows: CH_4 +18.4 %; N_2O +28.4 %; total +24.9 %.

Table 7.12 GHG emission from domestic and commercial wastewater, Gg CO_2 equivalent

Year	CH_4	N_2O	Total	Year	CH_4	N_2O	Total
1990	232.6	437.7	670.3	**1998**	264.6	514.6	779.2
1991	236.7	446.4	683.1	**1999**	266.7	520.0	787.5
1992	239.0	458.8	697.8	**2000**	265.4	528.0	793.4
1993	242.3	468.1	710.4	**2001**	267.1	533.2	800.3
1994	243.4	477.5	720.8	**2002**	267.8	542.5	810.3
1995	245.3	486.7	732.0	**2003**	268.6	548.7	817.3
1996	252.6	496.0	748.6	**2004**	272.2	554.9	827.1
1997	256.6	505.3	761.9	**2005**	275.3	560.4	835.6

Table 7.13 CH_4 emission from domestic and commercial wastewaters by provinces

Province	Gg CO_2-eq	%
Republic of Karakalpakstan	5.605	2.11
Andijan	11.059	4.17
Bukhara	9.399	3.54
Djizak	3.974	1.50
Kashkadarya	13.488	5.08
Navoi	4.484	1.69
Namangan	8.228	3.10
Samarkand	20.113	7.58
Surkhandarya	3.928	1.48
Syrdarya	3.686	1.39
Tashkent	23.146	8.72
Fergana	21.019	7.92
Khorezm	5.849	2.20
Tashkent city	131.474	49.53
Total	265.463	100.0

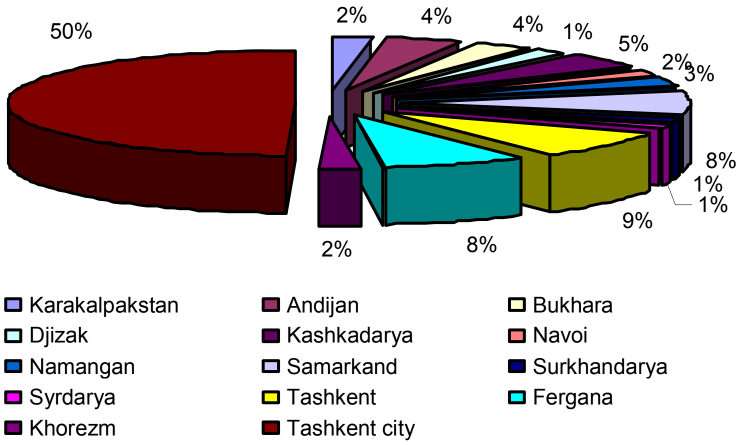

Fig. 7.6 *CH_4 emission from domestic and commercial wastewaters by provinces, 2000*

7.4.2 Methodology

The estimation of the CH_4 emission from domestic and commercial wastewaters and N_2O emission from human waste was implemented in accordance with [3].

Activity data

Estimates of CH_4 emission from domestic and commercial wastewaters were based on official statistics from the Uzbek Agency "Uzcommunkhizmat" that was based on the data provided by the provincial and district authorities on urban and rural population having an access to central sewage system. For the Syrdarya and Navoi provinces this population was estimated as averaged for the period 1990-2005 portion of population with an access to sewage system. Estimates of N_2O emission from human wastes were based on official statistics on mean annual population for 2000 (24745.5 thousand persons).

Table 7.14 Population having access to sewage system, 2000

Province	Population, thousand persons
Republic of Karakalpakstan	78.0
Andijan	153.9
Bukhara	130.8
Djizak	55.3
Kashkadarya	187.7
Navoi	62.4
Namangan	114.5
Samarkand	279.9
Surkhandarya	54.8
Syrdarya	51.3
Tashkent	322.1
Fergana	292.5
Khorezm	81.4
Tashkent city	1829.6

Emission factors

To calculate CH_4 emission the following coefficients and factors were used:
***Biochemical oxygen demand (BOD_5)* = 18250** kg/1000 cap/year [3], table 6-5, page 6.12, line «former USSR».
***Fraction of wastewater treated by certain handling system* = 1.0** (data of the State Committee for Nature Protection)
***Methane conversion factor* = 0.75** [3], table 6-7, page 6.18, line "Other countries of Asia".
Maximum methane producing capacity = **0.25** kg CH_4/ kg BOD [3].

To calculate N_2O emission the following coefficients and factors were used:
***Annual per capita protein intake* = 75** gram/person/day, averaged for the period 1997-1999 value over the world, as no FAO data available for Central Asia but the rest regions are characterized by different nutrition pattern [38]. The coefficient was converted in 27.375 kg /person/yr.

Fraction of nitrogen in protein ($Frac_{NPR}$) = **0.16** kg N/ kg protein [3], page 4.41, table 4-19.
Emission factor EF_6 = **0.01** (0.002-0.12) kg N_2O-N/kg sewage N produced [3], page 4.37, table 4-18.

7.4.3 Uncertainty and sequence of time series

Uncertainties of CH_4 and N_2O emission were not estimated.
For all years the same method and the same data set was used.

7.4.4 Quality Assurance/ Quality Control

The QA/QC procedures were implemented in accordance with the QA/QC principals and QA/QC plan. The check was conducted of the created worksheets for calculation of CH_4 emissions by provinces, the data transcription and documentation. It was also checked whether all information sources for the input data for the program software were referenced.

7.4.5 Recalculations in category

The results presented are recalculated values of the inventory that was reported in the Initial National Communication. In the current inventory the data on population having an access to central sewage system was taken into consideration, unlike the previous inventory where all urban population was considered. The fraction of wastewater treated by certain handling system was refined. Before now the N_2O emission from human wastes was not estimated.

7.4.6 Planned improvements by category

While preparation of the Third National Communication the emissions are supposed to estimate in accordance with [7].

References

1. Reporting on Climate Change User Manual for the Guidelines on National Communications from non-Annex 1 Parties.
2. Revised 1996 IPCC Guidelines for Greenhouse Gas Inventories, Greenhouse Gas Inventory Reporting Instructions, IPCC, 1996, Volume 1.
3. Revised 1996 IPCC Guidelines for Greenhouse Gas Inventories, Workbook, IPCC, 1996, Volume 2.
4. Revised 1996 IPCC Guidelines for Greenhouse Gas Inventories, Greenhouse Gas Inventory Reference Manual, IPCC, 1996, Volume 3.
5. Good Practice and Uncertainty Management in National Greenhouse Gas Inventories IPCC, 2003.
6. Good Practice Guidance for Land-Use Change and Forestry IPCC, 2003.
7. 2006 IPCC Guidelines for National Greenhouse Gas Inventories.
8. Instruction of State Commission for Statistics of USSR № 240, 29 December 1989, on Making Up Fuel-Energy Balance for 1990. - Izhevsk: Soyuzblankizdat, 1990.
9. Statistical Report according to the form № 1-PS (gas) for 1990-1999.
10. Statistical Report according to the form № 1-PS (coal) for 1990-1999.
11. Instruction on Making Report on Atmospheric Air Pollution according to the form № 2-TP (2-E) (transport), Annex 1, approved by the Decree № 29 of the State Committee on Statistics of the Republic of Uzbekistan, 20 September, 1994.
12. Statistic yearbook "Gross yield of agricultural crops in 2000 on all lands".
13. IEA STATISTICS. CO_2 emissions from fuel combustion 1971-2005. 2007.
14. A. Banaru. CO_2 emissions from the arable soils in the Republic of Moldova. CLIMATE CHANGE. Researches, studies, solutions. Chisinau, 2000.
15. A. Banaru. The methodology for the assessment of CO_2 emissions from the arable soils. CLIMATE CHANGE. Researches, studies, solutions. Chisinau, 2000.
16. Recommendations for estimation of fertility damage from burning stubble of cereal crops». Tashkent, 2002.
17. Agrochemistry / Edited by B.A. Yagodin, 1982.
18. A. Al Dalfi. Mineral Fertilizers Impact on Spring Wheat Yield Depending on Soil Conditions and Sort. Author's abstract of dissertation. - Tashkent, 1984.
19. M.A. Belousov. Physiological Fundamentals of Cotton Root Nutrition. - Tashkent, 1975.
20. V.V Lapa., N.A. Ivanenko. Using Nutrients of Fertilizers and Soils by Agricultural Crops// Agrochemistry. - № 7. - Moscow, 1989.
21. E.N. Masharipov. Balance of Manure Nitrogen and Mineral Fertilizers when their Separate and Joint Application to Cotton. Author's abstract of dissertation. - Tashkent, 1984.
22. Methods of Agrochemical and Agrophysical Research in Soil. - Tashkent: SoyuzNIKI, 1978.
23. Irrigated Farming / Edited by S.N. Ryzhov. - Tashkent, 1965.
24. D.S. Satarov. Sort, Soil, Fertilizer and Yield. - Tashkent, 1988.
25. S. Siddikov. Relationship between Qualitative and Quantitative Composition of Humus in Irrigated Soils and Agrotechnique and Kinds of Plant Residues. Author's abstract of dissertation. - Tashkent, 1987.
26. Z. Umarov, Kh. N. Atabaeva. Wheat and Barley Productivity when Fall Sowing and a Possibility of Having the Second Yield // Information Leaflet. - Tashkent, 1994.
27. Manual on State Forest Inventory. - Moscow, 1982. - 96 p.
28. Peculiarities of Forest Management in Central Asia (Annex to the Manual on Forest Management in Unified State Forest Resources of USSR). - Tashkent, 1989.
29. State Forest Inventory, Form 2 «Forest Distribution by Prevailing Species and Age Groups, Sheet A», 1998.
30. State Forest Inventory, Form 2 «Forest Distribution by Prevailing Species and Age Groups, Sheet B», 1998.
31. D.M. Fuzailov. Wood Stock of Uzbekistan (Scientific-Technical Basics for Utilization). -Tashkent: Fan, 1983. - 135 p.
32. G.M. Konobeeva. Soils of Uzbekistan, their zoning and qualitative assessment. -Tashkent: Mekhnat, 1985.
33. Handbook on Cotton Growing. -Tashkent: Uzbekistan, 1981.
34. Agrochemistry /Under edition of Prof. I.S. Kauricheva. -Moscow: "Kolos", 1975.
35. Soil map of Uzbekistan, 1970.
36. «Sanitary Rules and Norms» (RUz, № 0068-96), Tashkent, 1996.
37. "Increased norms of water supply and water allocation for different industrial sectors" - Moscow, 1982.
38. Site FAO: http://www.fao.org/DOCREP/005/Y3800M/y3800m07.htm

Annex 1

Table 1. National greenhouse gas inventory of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by Montreal[a] Protocol and greenhouse gases precursors

GREENHOUSE GAS SOURCE AND SINK CATEGORY	CO_2 emissions (Gg)	CO_2 removals (Gg)	CH_4 (Gg)	N_2O (Gg)	CO (Gg)	NOx (Gg)	NMVOCs (Gg)	SOx (Gg)
Total national emission and removals	108 606	- 1 018	3 892	35	1 184	286	251	295
1. Energy	105 016	NO	3 352	0	1 066	282	228	292
A. Fuel combustion (sectoral approach)	105 016		7	0	1 066	282	191	223
1. Energy industries	44 284		1	0	14	120	4	185
2. Manufacturing industries and construction	4 982		0	0	3	14	0	4
3. Transport	11 132		1	0	929	80	161	6
4. Other sectors	44 413		4	0	120	67	26	28
5. Other (Labricants)	206		NA	NA	NA	NA	NA	NA
B. Fugitive emissions fuels	NE		3 345		1	0	37	69
1. Solid fuels			11		NO	NO	NO	NO
2. Oil and natural gas			3 334		1	0	37	69
2. Industrial processes	3 590	NO	0	4	8	1	23	4
A. Mineral products	1627				0	0	0	1
B. Chemical industry	1298		0	4	8	1	5	3
C. Metal production	665		0	0	0	0	0	0
D. Other production	NA				NA	NA	19	NA
E. Production of halocarbons and sulphur hexafluoride								
F. Consumption of halocarbons and sulphur hexafluoride								
G. Other (please specify)								
3. Solvent and other product use	NE			NE			NE	
4. Agriculture			350	28	109	4		
A. Enteric fermentation			314					
B. Manure management			23	1			NA	
C. Rice cultivation			9				NA	
D. Agricultural soils			NE	28			NA	
E. Prescribed burning of savannas			NO	NO	NO	NO	NO	
F. Field burning of agricultural residues			4	0	109	4	NA	
G. Other (please specify)								
5. Land-use change and forestry		- 1 018	NO	NO	NO	NO	NO	NO
A. Changes in forest and other woody biomass stocks		- 751						
B. Forest and grassland conversion	NO	NO	NO	NO	NO	NO		
C. Abandonment of management lands		0						
D. CO_2 emissions and removals from soil		- 267						
E. Other (please specify)								

GREENHOUSE GAS SOURCE AND SINK CATEGORY	CO_2 emissions (Gg)	CO_2 removals (Gg)	CH_4 (Gg)	N_2O (Gg)	CO (Gg)	NOx (Gg)	NMVOCs (Gg)	SOx (Gg)
6. Waste			191	2	NO	NO	NO	NO
A. Solid waste disposal on land			176		NO		NO	
B. Wastewater handing			14	2	NO	NO	NO	
C. Waste incineration					NE	NE	NE	NE
D. Other (please specify)								
7. Other (please specify)								
Memo items								
International bunkers	1 116		0	0	2	5	1	1
Aviation	1 116		0	0	2	5	1	1
Marine	NO		NO	NO	NO	NO	NO	NO
CO_2 emissions from biomass	3 002							

Notes: Shaded cells do not require entries.
[a] The following standard indicators should be used, as appropriate, for emissions by sources and removals by sinks of GHGs:

NO (not occurring) for activities and processes that do not occur for a particular gas or source/sink category within a country;

NE (not estimated) for existing emissions and removals which have not been estimated;

NA (not applicable) for activities in a given source/sink category which do not result in emissions and removals of a specific gas;

IE (included elsewhere) for emissions and removals estimated but included elsewhere in the inventory (Parties should indicate where the emissions and removals have been included);

C (confidential) for emissions and removals which could lead to the disclosure of confidential information.

[b] Do not provide an estimate of both CO_2 emissions and CO_2 removals. "Net" emissions (emissions-removals) of CO_2 should be estimated and a single number placed in either the CO_2 emissions or CO_2 removals column, as appropriate. Note that for the purposes of reporting, the signs for removals are always (-) and for emissions (+).

Annex 2

Table 2. National greenhouse gas inventory of anthropogenic emissions of HFCs, PFCs and SF_6.

GREENHOUSE GAS SOURCE AND SINK CATEGORY	HFCs[a,b] (Gg)					PFCs[a,b] (Gg)		SF_6 (Gg)
	HFC-32	HFC-125	HFC-134a	HFC-143a	Other (to be added)	CF4	Other (to be added)	
Total national emission and removals	0.00005	0.00030	0.00357	0.00022	NE	NE	NE	NE
1. Energy								
A. Fuel combustion (sectoral approach)								
1. Energy industries								
2. Manufacturing industries and construction								
3. Transport								
4. Other sectors								
5. Other (please specify)								
B. Fugitive emissions fuels								
1. Solid fuels								
2. Oil and natural gas								
2. Industrial processes	0.00005	0.00030	0.00357	0.00022	NE	NE	NE	NE
A. Mineral products								
B. Chemical industry								
C. Metal production	NO	NO	NO	NO	NO	NO	NO	NO
D. Other production								
E. Production of halocarbons and sulphur hexafluoride	NO	NO	NO	NO	NO	NO	NO	NO
F. Consumption of halocarbons and sulphur hexafluoride	0.00005	0.00030	0.00357	0.00022	NE	NE	NE	NE
G. Other (please specify)								
3. Solvent and other product use								
4. Agriculture								
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 (please specify)								
5. Land-use change and forestry								
A. Changes in forest and other woody biomass stocks								
B. Forest and grassland conversion								
C. Abandonment of management lands								
D. CO_2 emissions and removals from soil								
E. Other (please specify)								

GREENHOUSE GAS SOURCE AND SINK CATEGORY	HFCs[a,b] (Gg)					PFCs[a,b] (Gg)		SF_6 (Gg)
	HFC-32	HFC-125	HFC-134a	HFC-143a	Other (to be added)	CF4	Other (to be added)	
6. Waste								
A. Solid waste disposal on land								
B. Wastewater handing								
C. Waste incineration								
D. Other (please specify)								
7. Other (please specify)								
Memo items								
International bunkers								
Aviation								
Marine								
CO_2 emissions from biomass								

[a] Parties may wish to express HFC, PFC and SF_6 emissions as either potential or actual. Potential emissions should be estimated using the tier 1 approach of the IPCC Guidelines. Actual emissions should be estimated using the tier 2 approach of the IPCC Guidelines.

[b] Parties reporting HFCs and PFCs should provide emission estimates on a gas-by-gas basis, that is, disaggregated estimates by chemical expressed in units of mass (Gg), as indicated in the table (e.g. HFC-23), where information is available. This should be done by inserting a column for each HFC and PHC gas for which emissions do occur in the country. The gases in the column headings are given as examples only. Other gases to be reported in this table include HFC-32, HFC-41, HFC-43-10, HFC-125, HFC-134a, HFC-152a, HFC-43-10mee, HFC-143a, HFC-227ea, HFC-236fa, HFC-245ca, C_3F_8,C_4F_{10},c-C_4F_8, C_5F_{12}, C_6F_{14} and any other GHG with high global warming potential not covered in this list.

Annex 3

Sectoral tables

TABLE 1 SECTORAL REPORT FOR ENERGY (Uzbekistan, 2000)
(Sheet 1 of 2)

SECTORAL REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (Gg)							
GREENHOUSE GAS SOURSE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
Total Energy	**105 016**	**3 352**	**0**	**282**	**1 066**	**228**	**292**
A Fuel Combustion Activities (Sectoral Approach)	**105 016**	**7**	**0**	**282**	**1 066**	**191**	**223**
1 Energy Industries	**44 284**	**1**	**0**	**120**	**14**	**4**	**185**
a Public Electricity and Heat Production							
b Petroleum Refining							
c Manufacture of Solid Fuels and Other Energy Industries							
2 Manufacturing Industries and Construction	**4 982**	**0**	**0**	**14**	**3**	**0**	**4**
a Iron and steel							
b Non-Ferrous Metals							
c Chemicals							
d Pulp, Paper and Print							
e Food Processing, Beverages and Tobacco							
f Other (please specify)							
3 Transport	**11 132**	**1**	**0**	**80**	**929**	**161**	**6**
a Civil Aviation	71	0	0	0	0	0	
b Road Transportation	5 619	1	0	74	924	160	
c Railways	327	0	0	5	4	1	
d Navigation	0	0	0	0	0	0	
e Other - Pipeline transport	5 114						
4 Other Sectors	**44 413**	**4**	**0**	**67**	**120**	**26**	**28**
a Commercial/ Institutional	9 024	1	0	9	19	2	18
b Residential	32 696	3	0	29	30	3	1
c Agriculture/Forestry/Fishing	2 693	0	0	29	72	21	8
5 Other - Lubricants	**206**	**0**	**0**	**0**	**0**	**0**	

TABLE 1 SECTORAL REPORT FOR ENERGY (Uzbekistan, 2000)
(Sheet 2 of 2)

SECTORAL REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (Gg)

GREENHOUSE GAS SOURSE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2 (1)
B Fugitive Emissions from Fuels	**0**	**3 345**	**0**	**0**	**1**	**37**	**69**
1 Solid Fuels	**0**	**11**	**0**	**0**	**0**	**0**	**0**
a Coal Mining		11					
b Solid Fuel Transformation							
c Other (please specify)							
2 Oil and Natural Gas	**0**	**3 334**	**0**	**0**	**1**	**37**	**69**
a Oil		2		0	1	37	7
b Natural Gas		3 331					62
c Venting and Flaring		1					
Memo Items							
International Bunkers	**1 116**	**0**	**0**	**5**	**2**	**1**	**1**
Aviation	1 116	0	0	5	2	1	1
Marine	0	0	0	0	0	0	0
CO_2 Emissions from Biomass	**3 002**						

TABLE 2 SECTORAL REPORT FOR INDUSTRIAL PROCESSES (Uzbekistan, 2000)

(Sheet 1 of 2)

SECTORAL REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (Gg)

GREENHOUSE GAS SOURSE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2	HFCs		PFCs		SF_6	
								P	A	P	A	P	A
Total Industrial Processes	**3 590**	**0**	**4**	**1**	**8**	**23**	**2**	**0**	**0**	**0**	**0**	**0**	**0**
A Mineral Products	**1 627**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**
1 Cement Production	1 476						1						
2 Lime Production	81												
3 Limestone and Dolomite Use	0												
4 Soda Ash Production an Use	71												
5 Asphalt Roofing					0	0							
6 Road Paving with Asphalt						0							
7 Other (please specify)	0	0	0	0	0	0	0	0	0	0	0	0	0
Glass Production						0							
Concrete Pumice Stone							0						
B Chemical Industry	**1 298**	**0**	**4**	**1**	**8**	**5**	**1**	**0**	**0**	**0**	**0**	**0**	**0**
1 Ammonia Production	1 298				8	5	0						
2 Nitric Acid Production			4	1									
3 Adipic Acid Production			0	0	0	0							
4 Carbide Production	0	0											
5 Other (Sulphuric Acid Production)		0		0	0	0	1						
C Metal Production	**665**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
1 Iron and Steel Production	665			0	0	0	0						
2 Ferroalloys Production	0												
3 Aluminium Production	0			0	0		0				0		
4 SF_6 Used in Aluminium and Magnesium Foundries													0
5 Other (please specify)	0												

P = Potential emissions based on Tier 1 Approach. A = Actual emissions based on Tier 2 Approach. This only applies in sectors where methods exist for both tiers.

TABLE 2 SECTORAL REPORT FOR INDUSTRIAL PROCESSES (Uzbekistan, 2000)

(Sheet 2 of 2)

SECTORAL REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (Gg)													
GREENHOUSE GAS SOURSE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2	HFCs		PFCs		SF_6	
								P	A	P	A	P	A
D Other Production	**0**	**0**	**0**	**0**	**0**	**19**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
1 Pulp and Paper				0	0	0	0						
2 Food and Drink						19							
E Production of Halocarbons and Sulphur Hexafluoride	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
1 By-product Emissions									0		0		
2 Fugitive Emissions									0		0		
3 Other (please specify)													
F Consumption of Halocarbons and Sulphur Hexafluoride	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
1 Refrigeration and Air Conditioning Equipment									0		0		
2 Foam Blowing									0		0		
3 Fie Extinguishers									0		0		0
4 Aerosols									0		0		
5 Solvents									0		0		
6 Other (please specify)									0		0		0
G Other (please specify)													

P = Potential emissions based on Tier 1 Approach. A = Actual emissions based on Tier 2 Approach. This only applies in sectors where methods exist for both tiers.

TABLE 4 SECTORAL REPORT FOR AGRICULTURE (Uzbekistan, 2000)

(Sheet 1 of 2)

SECTORAL REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (Gg)					
GREENHOUSE GAS SOURSE AND SINK CATEGORIES	**CH_4**	**N_2O**	**NO_x**	**CO**	**NMVOC**
Total Agriculture	**350**	**28**	**4**	**109**	**0**
A Enteric Fermentation	**314**				
1 Cattle	263				
2 Buffalo	0				
3 Sheep	39				
4 Goats	6				
5 Camels and Llamas	1				
6 Horses	3				
7 Mules and Asses	2				
8 Swine	0				
9 Poultry	0				
10 Other (please specify)					
B Manure Management	**23**	**1**			
1 Cattle	21				
2 Buffalo	0				
3 Sheep	1				
4 Goats	0				
5 Camels and Llamas	0				
6 Horses	0				
7 Mules and Asses	0				
8 Swine	0				
9 Poultry	0				

TABLE 4 SECTORAL REPORT FOR AGRICULTURE (Uzbekistan, 2000)

(Sheet 2 of 2)

SECTORAL REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (Gg)					
GREENHOUSE GAS SOURSE AND SINK CATEGORIES	**CH_4**	**N_2O**	**NO_x**	**CO**	**NMVOC**
B Manure Management (cont….)					
10 Anaerobic		0			
11 Liquid Systems		0			
12 Solid Storage and Dry Lot		1			
13 Other (please specify)		0			
C Rice Cultivation	**9**				
1 Irrigated	9				
2 Painfed	0				
3 Deep Water	0				
4 Other (please specify)					
D Agricultural Soils		**28**			
E Prescribed Burning of Savannas	**0**	**0**	**0**	**0**	
F Field Burning of Agricultural Residues	**4**	**0**	**4**	**109**	
1 Cereals	4	0	4	109	
2 Pulse					
3 Tuber and Root					
4 Sugar Cane					
5 Other (please specify)					
G Other (please specify)					

TABLE 5 SECTORAL REPORT FOR LAND-USE CHENGE AND FORESTRY (Uzbekistan, 2000)

(Sheet 1 of 1)

SECTORAL REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (Gg)						
GREENHOUSE GAS SOURSE AND SINK CATEGORIES	**CO_2 Emissions**	**CO_2 Removals**	**CH_4**	**N_2O**	**NO_x**	**CO**
Total Land-Use Change and Forestry	(1) **0**	(1) **-1 018**	**0**	**0**	**0**	**0**
A Changes in Forest and Other Woody Biomass Stocks	(1) **0**	(1) **-751**				
1 Tropical Forests						
2 Temperate Forests						
3 Boreal Forests						
4 Grassland / Tundra						
5 Other (please specify)						
B Forest and Grassland Conversion	**0**		**0**	**0**	**0**	**0**
1 Tropical Forests	0					
2 Temperate Forests	0					
3 Boreal Forests	0					
4 Grassland / Tundra	0					
5 Other (please specify)	0					
C Abandonment of Managed Lands		**0**				
1 Tropical Forests		0				
2 Temperate Forests		0				
3 Boreal Forests		0				
4 Grassland / Tundra		0				
5 Other (please specify)		0				
D CO_2 Emissions and Removals from Soil	(1) **0**	(1) **-267**				
E Other (please specify)						

(1) The formula does not provide a total estimate of both CO_2 emissions and CO_2 removals. It estimates “net” emissions of CO_2 and places a single number in either the CO_2 emissions or CO_2 removals column, as appropriate. Please note that the purposes of reporting, the signs for removals are always (-) and for emissions (+).

TABLE 6 SECTORAL REPORT FOR WASTE (Uzbekistan, 2000)

(Sheet 1 of 1)

SECTORAL REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (Gg)						
GREENHOUSE GAS SOURSE AND SINK CATEGORIES	**CO_2 (1)**	**CH_4**	**N_2O**	**NO_x**	**CO**	**NMVOC**
Total Waste	**0**	**191**	**2**			
A Solid Waste Disposal on Land	**0**	**176**	**0**			
1 Managed Waste Disposal on Land						
2 Unmanaged Waste Disposal Sites						
3 Other (please specify)						
B Wastewater Handling	**0**	**14**	**2**			
1 Industrial Wastewater		2				
2 Domestic and Commercial Wastewater		13	2			
3 Other (please specify)						
C Waste Incineration						
D Other (please specify)						

(1) Note that CO_2 from waste disposal and incineration should only be included if it stems from non-biological or inorganic waste sources.

TABLE 7A SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (Uzbekistan, 2000)

(Sheet 1 of 2)

SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (Gg)														
GREENHOUSE GAS SOURSE AND SINK CATEGORIES	CO_2 Emissions	CO_2 Removals	CH_4	N_2O	NO_x	CO	NMVOC	SO_2	HFCs		PFCs		SF_6	
									P	A	P	A	P	A
Total National Emissions and Removals	**108 606**	**-1 018**	**3 892**	**35**	**286**	**1 184**	**251**	**294**	**0**	**0**	**0**	**0**	**0**	**0**
1 Energy	**105 016**	**0**	**3 352**	**0**	**282**	**1 066**	**228**	**292**						
A Fuel Combustion (Sectoral Approach)	105 016		7	0	282	1 066	191	223						
1 Energy Industries	44 284		1	0	120	14	4	185						
2 Manufacturing Industries and Construction	4 982		0	0	14	3	0	4						
3 Transport	11 132		1	0	80	929	161	6						
4 Other Sectors	44 413		4	0	67	120	26	28						
5 Other (Lubricants)	206		0	0	0	0	0	0						
B Fugitive Emissions from Fuel	0		3 345		0	1	37	69						
1 Solid Fuels			11											
2 Oil and Natural Gas			3 334		0	1	37	69						
2 Industrial Processes	**3 590**	**0**	**0**	**4**	**1**	**8**	**23**	**2**	**0**	**0**	**0**	**0**	**0**	**0**
A Mineral Products	1 627					0	0	1						
B Chemical Industry	1 298		0	4	1	8	5	1						
C Metal Production	665		0	0	0	0	0	0	0	0	0	0	0	0
D Other Production	0				0	0	19	0						
E Production of Halocarbons and Sulphur Hexafluoride									0	0	0	0	0	0
F Consumption of Halocarbons and Sulphur Hexafluoride									0	0	0	0	0	0
G Other (please specify)	0		0	0	0	0	0	0				0		0

P = Potential emissions based on Tier 1 Approach. A = Actual emissions based on Tier 2 Approach.

TABLE 7A SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (Uzbekistan, 2000)

(Sheet 2 of 2)

SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (Gg)														
GREENHOUSE GAS SOURSE AND SINK CATEGORIES	**CO_2 Emissions**	**CO_2 Removals**	**CH_4**	**N_2O**	**NO_x**	**CO**	**NMVOC**	**SO_2**	**HFCs**		**PFCs**		**SF_6**	
									P	**A**	**P**	**A**	**P**	**A**
3 Solvent and Other Product Use	**0**			**0**			**0**							
4 Agriculture			**350**	**28**	**4**	**109**								
A Enteric Fermentation			314											
B Manure Management			23	1										
C Rice Cultivation			9											
D Agricultural Soils				28										
E Prescribed Burning of Savannas			0	0	0	0								
F Field Burning of Agricultural Residues			4	0	4	109								
G Other (please specify)			0	0										
5 Land-Use Change & Forestry	**(1) 0**	**(1) -1 018**	**0**	**0**	**0**	**0**								
A Changes in Forest and Other Woody Biomass Stocks	(1) 0	(1) -751												
B Forest and Grassland Conversion	0		0	0	0	0								
C Abandonment of Managed Lends		0												
D CO_2 Emissions and Removals from Soil	(1) 0	(1) -267												
E Other (please specify)	0	0	0	0	0	0								
6 Waste			**191**	**2**	**0**	**0**	**0**	**0**						
A Solid Waste Disposal on Land			176											
B Wastewater Handling			14	2										
C Waste Incineration														
D Other (please specify)			0	0										
7 Other (please specify)														
Memo Items:														
International Bunkers	**1 116**		**0**	**0**	**5**	**2**	**1**	**1**						
Aviation	1 116		0	0	5	2	1	1						
Marine	0		0	0	0	0	0	0						
CO_2 Emissions from Biomass	**3 002**													

(1) The formula does not provide a total estimate of both CO_2 emissions and CO_2 removals. It estimates "net" emissions of CO_2 and places a single number in either the CO_2 emissions or CO_2 removals column, as appropriate. Please note that the purposes of reporting, the signs for removals are always (-) and for emissions (+).

TABLE 7B SHORT SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (Uzbekistan, 2000)

(Sheet 1 of 1)

SHORTSUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (Gg)

GREENHOUSE GAS SOURSE AND SINK CATEGORIES		CO_2 Emissions	CO_2 Removals	CH_4	N_2O	NO_x	CO	NMVOC	SO_2	HFCs		PFCs		SF_6	
										P	A	P	A	P	A
Total National Emissions and Removals		**108 606**	**-1 018**	**3 892**	**35**	**286**	**1 184**	**251**	**294**	**0**	**0**	**0**	**0**	**0**	**0**
1 Energy	Reference Approach[1]	**106 060**													
	Sectoral Approach[1]	**105 016**		**3 352**	**0**	**282**	**1 066**	**228**	**292**						
A Fuel Combustion		105 016		7	0	282	1 066	191	**223**						
B Fugitive Emissions from Fuels		0		3 345		0	1	37	69						
2 Industrial Processes		**3 590**		**0**	**4**	**1**	**8**	**23**	**2**	**0**	**0**	**0**	**0**	**0**	**0**
3 Solvent and Other Product Use		**0**			**0**			**0**							
4 Agriculture				**350**	**28**	**4**	**109**								
5 Land-Use Change & Forestry		(2) **0**	(2) **-1 018**	**0**	**0**	**0**	**0**								
6 Waste				**191**	**2**										
7 Other (please specify)		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**						
Memo Items:															
International Bunkers		**1 116**		**0**	**0**	**5**	**2**	**1**	**1**						
Aviation		1 116		0	0	5	2	1	1						
Marine		0		0	0	0	0	0	0						
CO_2 Emissions from Biomass		**3 002**													

P = Potential emissions based on Tier 1 Approach. A = Actual emissions based on Tier 2 Approach.

(1) For verification purposes, countries are asked to report the results of their calculations using the Reference Approach and explain any differences with the Sectoral Approach. Do not include the results of both the Reference Approach and the Sectoral Approach in national totals.

(2) The formula does not provide a total estimate of both CO_2 emissions and CO_2 removals. It estimates “net” emissions of CO_2 and places a single number in either the CO_2 emissions or CO_2 removals column, as appropriate. Please note that the purposes of reporting, the signs for removals are always (-) and for emissions (+).

TABLE 8A OVEVIEW TABLE FOR NATIONAL GREENHOUSE GAS INVENTORIES (Uzbekistan, 2000)
(Sheet 1 of 3)

GREENHOUSE GAS SOURSE AND SINK CATEGORIES			CO_2		CH_4		N_2O		NO_x		CO		NMVOC		SO_2		HFCs		PFCs		SF_6		Documentation	Disaggregation-
			Estimate	Quality	Estimate	Quality	Estimate	Quality	Estimate	Quality	Estimate	Quality	Estimate	Quality	Estimate	Quality	Estimate	Quality	Estimate	Quality	Estimate	Quality		
Total National Emissions and Removals																								
1	**Energy**																							
	A	Fuel Combustion Activities																						
		Reference Approach	ALL	H																			H	1
		Sectoral Approach	ALL	H	ALL	H	ALL	H	ALL	H	ALL	H	ALL	H	ALL	H	NA		NA		NA		H	3
		1 Energy Industries	ALL	H	ALL	H	ALL	H	ALL	H	ALL	H	ALL	H	ALL	H	NA		NA		NA		H	3
		2 Manufacturing Industries and Construction	ALL	H	ALL	H	ALL	H	ALL	H	ALL	H	ALL	H	ALL	H	NA		NA		NA		H	3
		3 Transport	ALL	H	ALL	H	ALL	H	ALL	H	ALL	H	ALL	H	ALL	H	NA		NA		NA		H	3
		4 Other sectors	ALL	H	ALL	H	ALL	H	ALL	H	ALL	H	ALL	H	ALL	H	NA		NA		NA		H	3
		5 Other (Lubricants)	ALL	M	NE		NE		NE		NE		NE		NE		NA		NA		NA		H	1
	B	Fugitive Emissions from Fuels																						
		1 Solid Fuels	NA		ALL	M	NA		NA		NA		NA		NA		NA		NA		NA		H	3
		2 Oil and Natural Gas	NE		ALL	M	NE		ALL	H	ALL	H	ALL	H	ALL	H	NA		NA		NA		H	3
2	**Industrial Processes**																							
	A	Mineral Products	PART	H	NA		NE		NE		NE		NE		PART	H	NA		NA		NA		H	3
	B	Chemical Industry	PART	H	PART	H	ALL	M	PART	M	PART	H	PART	H	ALL	H	NA		NA		NA		H	3
	C	Metal Production	PART	H	NE		NE		PART	H	PART	H	PART	H	PART	H	NO		NO		NO		H	3
	D	Other Production	NE		NE		NE		NE		NE		ALL	H	NE		NA		NA		NA		H	3
	E	Production of Halocarbons and Suphur Hexafluoride	NA		NA		NA		NA		NA		NA		NA		NO		NO		NO			

TABLE 8A OVEVIEW TABLE FOR NATIONAL GREENHOUSE GAS INVENTORIES (Uzbekistan, 2000) (Sheet 2 of 3)

GREENHOUSE GAS SOURSE AND SINK CATEGORIES			CO_2		CH_4		N_2O		NO_x		CO		NMVOC		SO_2		HFCs		PFCs		SF_6		Documentation	Disaggregation
			Estimate	Quality	Estimate	Quality	Estimate	Quality	Estimate	Quality	Estimate	Quality	Estimate	Quality	Estimate	Quality	Estimate	Quality	Estimate	Quality	Estimate	Quality		
Industrial Processes (cont…)																								
	F	Consumption of Halocarbons and Suphur Hexafluoride	NA		NA		NA		NA		NA		NA		NA									
		Potential [1]															PART	L	NE		NE			M
		Actual [2]															NO		NO		NO			
	G	Other (please specify)																						
3	**Solvent and Other Product Use**		NA		NA		NA		NA		NA		NE		NA		NA		NA		NA			
4	**Agriculture**																							
	A	Enteric Fermentation	NA		ALL	H	NA		NA		NA		NA		NA		NA		NA		NA		H	3
	B	Manure Management	NA		ALL	H	ALL	H	NA		NA		NA		NA		NA		NA		NA		H	3
	C	Rice Cultivation	NA		ALL	H	NA		NA		NA		NA		NA		NA		NA		NA		H	2
	D	Agricultural Soils	NA		NA		ALL	M	NA		NA		NA		NA		NA		NA		NA		H	1
	E	Prescribed Burning of Savannas	NO		NO		NO		NO		NO		NO		NO		NA		NA		NA			
	F	Field Burning of Agricultural Residues	IE	M	PART	M	PART	M	PART	M	PART	M	NA		NE		NA		NA		NA		H	2
	G	Other (please specify)																						
5	**Land-Use Change & Forestry**																							
	A	Changes in Forest and Other Woody Biomass Stocks	PART	M	NE		NE		NE		NE		NE		NE		NA		NA		NA		H	2
	B	Forest and Grassland Conversion	NE		NE		NE		NE		NE		NE		NE		NA		NA		NA			

(1) Potential emissions based on Tier 1 Approach.
(2) Actual emissions based on Tier 2 Approach.

TABLE 8A OVEVIEW TABLE FOR NATIONAL GREENHOUSE GAS INVENTORIES (Uzbekistan, 2000) (Sheet 3 of 3)

	GREENHOUSE GAS SOURSE AND SINK CATEGORIES	CO_2		CH_4		N_2O		NO_x		CO		NMVOC		SO_2		HFCs		PFCs		SF_6		Documentation	Disaggregation
		Estimate	Quality	Estimate	Quality	Estimate	Quality	Estimate	Quality	Estimate	Quality	Estimate	Quality	Estimate	Quality	Estimate	Quality	Estimate	Quality	Estimate	Quality		
5	**Land-Use Change & Forestry (cont…)**																						
	C Abandonment of Managed Land	ALL	M	NA		NA		NA		NA		NA		NA		NA		NA		NA		H	2
	D CO_2 Emissions and Removals from Soil	ALL	M	NA		NA		NA		NA		NA		NA		NA		NA		NA		H	2
	E Other (please specify)																						
6	**Waste**																	NA		NA			
	A Solid Waste Disposal on Land	NA		ALL	M	NA		NA		NA		NA		NA		NA		NA		NA		H	2
	B Wastewater Handling	NA		ALL	M	ALL	M	NA		NA		NA		NA		NA		NA		NA		H	2
	C Waste Incineration	NE		NE		NE		NE		NE		NE		NE		NA		NA		NA			
	D Other (please specify)																						
7	**Other (please specify)**																						
Memo Items:																							
International Bunker																							
	Aviation	ALL	H	ALL	H	ALL	H	ALL	H	ALL	H	ALL	H	ALL	H	NA		NA		NA		H	3
	Marine	NO		NO		NO		NO		NO		NO		NO		NA		NA		NA			
CO_2 Emissions from Biomass		PART	M																			H	1

Estimate
PART - Partly estimated
ALL - Full estimate of all possible sources
NE - Not estimated
IE - Estimated but included elsewhere
NO - Not occurring
NA - Not applicable

Quality
H - High confidence in estimation
M - Medium confidence in estimation
L - Low confidence in estimation

Documentation
H - High (all background information included)
M - Medium (some background information included)
L - Low (only emission estimates included)

Disaggregation
1 - Total emission estimated
2 - Sectoral split
3 - Sub-sectoral split

Annex 4

Worksheet 1 CO_2 Emissions from Energy (Reference Approach)

		MODULE	ENERGY					
		SUBMODULE	CO_2 FROM ENERGY SOURCES (REFERENCE APPROACH)					
		WORKSHEET	1-1					
		SHEETS	1 OF 5					
		CUUNTRY	UZBEKISTAN					
		YEAR	2000					
			STEP 1					
			A Production (10^3 t) (gas-10^6 m^3)	B Import (10^3 t) (gas-10^6 m^3)	C Export (10^3 t) (gas-10^6 m^3)	D International Bunkers (10^3 t) (gas-10^6 m^3)	E Stock Change (10^3 t) (gas-10^6 m^3)	F Apparent Consumption (10^3 t) (gas-10^6 m^3)
FUEL TYPES								F=(A+B-C-D-E)
Liquid Fossil	Primary Fuels	Crude Oil	7536	0	280		-219	7 475.00
		Natural Gas Liquids						0.00
	Secondary Fuels	Gasoline		1	74		40	-113.00
		Jet Kerosene		0	2	374.3	-2	-374.30
		Other Kerosene		0	40		0	-40.00
		Gas/ Diesel Oil		0	336		-41	-295.00
		Stove Domestic Fuel		0	12		1	-13.00
		Residual Fuel Oil		0	71		-345	274.00
		LPG		0	18		0	-18.00
		Bitumen		0	5		8	-13.00
		Lubricants		2	46		-3	-41.00
		Petroleum Coke						0.00
		Refinery gas		0	0		0	0.00
		Other Oil		0	0		0	0.00
Liquid Fossil Totals								
Solid Fossil	Primary Fuels	Anthracite [(a)]						0.00
		Coking Coal						0.00
		Other Bituminous Coal	92	0	7		-16	101.00
		Sub-Bituminous Coal	2409	12	0		-613	3 034.00
		Lignite						0.00
		Oil Shale						0.00
		Peat						0.00
	Secondary Fuels	BKB & Patent Fuel		0	0		2	-2.00
		Coke Oven /Gas Coke		39	0		4	35.00
Solid Fossil Totals								
Gaseous Fossil		Natural Gas (Dry)	49871.3	1621	6857		-123	44 758.26
Total								
Biomass Total								
		Solid Biomass	1962.75					1 962.75
		Liquid Biomass						0.00
		Gas Biomass						0.00

(a) If anthracite is not separately available, include with Other Bituminous Coal.

		MODULE	**ENERGY**				
		SUBMODULE	**CO_2 FROM ENERGY SOURCES (REFERENCE APPROACH)**				
		WORKSHEET	**1-1**				
		SHEETS	**2 OF 5**				
		COUNTRY	**UZBEKISTAN**				
		YEAR	**2000**				
			STEP 2		**STEP 3**		
			G [b] Conversion factor ($TJ/10^3$ t) (gas-$TJ/10^6$ m^3)	H Apparent Consumption (TJ)	I Carbon Emission Factor (t C/TJ)	J Carbon Content (t C)	K Carbon Content (Gg C)
FUEL TYPES				H=(FxG)		J=(HxI)	K=(J/1000)
Liquid Fossil	Primary Fuels	Crude Oil	41.868	312 963.30	20.0	6 259 266.00	6 259.27
		Natural Gas Liquids		0.00		0.00	0.00
	Secondary Fuels	Gasoline	43.668	-4 934.48	18.9	-93 261.75	-93.26
		Jet Kerosene	42.900	-16 057.47	19.5	-313 120.67	-313.12
		Other Kerosene	43.082	-1 723.28	19.6	-33 776.29	-33.78
		Gas/ Diesel Oil	42.496	-12 536.32	20.2	-253 233.66	-253.23
		Stove Domestic Fuel	42.496	-552.45	20.2	-11 159.45	-11.16
		Residual Fuel Oil	40.151	11 001.37	21.1	232 128.99	232.13
		LPG	46.013	-828.23	17.2	-14 245.62	-14.25
		Bitumen	39.565	-514.35	22.0	-11 315.59	-11.32
		Lubricants	40.151	-1 646.19	20.0	-32 923.82	-32.92
		Petroleum Coke		0.00		0.00	0.00
		Refinery gas		0.00		0.00	0.00
		Other Oil	40.151	0.00	20	0.00	0.00
Liquid Fossil Totals				285 171.90		5 728 358.14	5 728.36
Solid Fossil	Primary Fuels	Anthracite [a]		0.00		0.00	0.00
		Coking Coal		0.00		0.00	0.00
		Other Bituminous Coal	19.929	2 012.83	25.8	51 930.99	51.93
		Sub-Bituminous Coal	12.414	37 664.08	26.2	986 798.79	986.80
		Lignite		0.00		0.00	0.00
		Oil Shale		0.00		0.00	0.00
		Peat		0.00		0.00	0.00
	Secondary Fuels	BKB & Patent Fuel	22.86	-45.72	25.8	-1 179.58	-1.18
		Coke Oven /Gas Coke	26.377	923.20	29.5	27 234.25	27.23
Solid Fossil Totals				40 554.38		1 064 784.46	1 064.78
Gaseous Fossil		Natural Gas (Dry)	33.997	1 521 646.57	15.3	23 281 192.45	23 281.19
Total				**1 847 372.85**		**30 074 335.05**	**30 074.34**
Biomass Total				30 422.63		909 636.49	909.64
		Solid Biomass	15.5	30 422.63	29.9	909 636.49	909.64
		Liquid Biomass		0.00		0.00	0.00
		Gas Biomass		0.00		0.00	0.00

(a) If anthracite is not separately available, include with Other Bituminous Coal.
(b) Please specify units.

MODULE	**ENERGY**
SUBMODULE	**CO_2 FROM ENERGY SOURCES (REFERENCE APPROACH)**
WORKSHEET	**1-1**
SHEETS	**3 OF 5**
COUNTRY	**UZBEKISTAN**
YEAR	**2000**

			STEP 4		**STEP 5**		**STEP 6**
			L Carbon Stored (Gg C)	M Net Carbon Emissions (Gg C)	N Fraction Carbon Oxidized	O Actual Carbon Emissions (Gg C)	P Actual CO_2 Emissions (Gg CO_2)
FUEL TYPES			M=(K-L)			O=(MxN)	P=(Ox[44/12])
Liquid Fossil	Primary Fuels	Crude Oil		6 259.27	0.99	6 196.67	22 721.14
		Natural Gas Liquids		0.00		0.00	0.00
	Secondary Fuels	Gasoline		-93.26	0.99	-92.33	-338.54
		Jet Kerosene		-313.12	0.99	-309.99	-1 136.63
		Other Kerosene		-33.78	0.99	-33.44	-122.61
		Gas/ Diesel Oil	0.00	-253.23	0.99	-250.70	-919.24
		Stove Domestic Fuel	0.00	-11.16	0.99	-11.05	-40.51
		Residual Fuel Oil		232.13	0.99	229.81	842.63
		LPG	0.00	-14.25	0.99	-14.10	-51.71
		Bitumen	134.05	-145.36	0.99	-143.91	-527.66
		Lubricants	56.61	-89.54	0.99	-88.64	-325.02
		Petroleum Coke		0.00		0.00	0.00
		Refinery gas		0.00		0.00	0.00
		Other Oil	97.17	-97.17	0.99	-96.19	-352.71
Liquid Fossil Totals			287.82	5 440.53		5 386.13	19 749.14
Solid Fossil	Primary Fuels	Anthracite [(a)]		0.00		0.00	0.00
		Coking Coal	0.00	0.00		0.00	0.00
		Other Bituminous Coal		51.93	0.98	50.89	186.61
		Sub-Bituminous Coal		986.80	0.98	967.06	3 545.90
		Lignite		0.00		0.00	0.00
		Oil Shale		0.00		0.00	0.00
		Peat		0.00		0.00	0.00
	Secondary Fuels	BKB & Patent Fuel		-1.18	0.98	-1.16	-4.24
		Coke Oven /Gas Coke	25.68	1.56	0.98	1.53	5.59
Solid Fossil Totals			25.68	1 039.11		1 018.32	3 733.86
Gaseous Fossil		Natural Gas (Dry)	647.00	22 634.20	0.995	22 521.02	82 577.09
Total			**960.50**	**29 113.84**		**28 925.48**	**106 060.08**
Biomass Total			0.00	909.64		818.67	3 001.80
		Solid Biomass		909.64	0.9	818.67	3 001.80
		Liquid Biomass		0.00		0.00	0.00
		Gas Biomass		0.00		0.00	0.00

	MODULE	**ENERGY**					
	SUBMODULE	**CO_2 FROM ENERGY SOURCES (REFERENCE APPROACH)**					
	WORKSHEET	**1-1**					
	SHEETS	**4 OF 5 EMISSIONS FROM INTERNATIONAL BUNKERS (INTERNATIONAL MARINE AND AIR TRANSPORT)**					
	COUNTRY	**UZBEKISTAN**					
	YEAR	**2000**					
		STEP 1	**STEP 2**		**STEP 3**		
		A Quantities Delivered[a] (10^3 t)	B Conversion Factor (TJ/10^3 t)	C Quantities Delivered (TJ)	D Carbon Emission Factor (t C/ TJ)	E Carbon Content (t C)	F Carbon Content (Gg C)
FUEL TYPES				C=(AxB)		E=(CxD)	F=(E/1000)
Solid Fossil	Other Bituminous Coal	0.00	19.93	0.00	25.80	0.00	0.00
	Sub-Bituminous Coal	0.00	12.41	0.00	26.20	0.00	0.00
Liquid Fossil	Gasoline	0.00	43.67	0.00	18.90	0.00	0.00
	Jet Kerosene	374	42.90	16 057	19.50	313 121	313
	Gas/ Diesel Oil	0.00	42.50	0.00	20.20	0.00	0.00
	Residual Fuel Oil	0.00	40.15	0.00	21.10	0.00	0.00
	Lubricants	0.00	40.15	0.00	20.00	0.00	0.00
			Total	**16 057**			

(a) Quantities taken from column "International Bunkers" from Worksheet 1-1, Sheet 1 of 5.

	MODULE	**ENERGY**					
	SUBMODULE	**CO_2 FROM ENERGY SOURCES (REFERENCE APPROACH)**					
	WORKSHEET	**1-1**					
	SHEETS	**5 OF 5 EMISSIONS FROM INTERNATIONAL BUNKERS (INTERNATIONAL MARINE AND AIR TRANSPORT)**					
	COUNTRY	**UZBEKISTAN**					
	YEAR	**2000**					
		STEP 4			**STEP 5**		**STEP 6**
		G Fraction of Carbon Stored	H Carbon Stored (Gg C)	I Net Carbon Stored (Gg C)	J Fraction of Carbon Oxidized	K Actual Carbon Emissions (Gg C)	L Actual CO_2 Emissions (Gg CO_2)
FUEL TYPES			H=(FxG)	I=(F-H)		K=(IxJ)	L=(Kx[44/12])
Solid Fossil	Other Bituminous Coal		0.00	0.00		0.00	0.00
	Sub-Bituminous Coal		0.00	0.00		0.00	0.00
Liquid Fossil	Gasoline		0.00	0.00		0.00	0.00
	Jet Kerosene		0.00	313	0.99	310	1 137
	Gas/ Diesel Oil		0.00	0.00		0.00	0.00
	Residual Fuel Oil		0.00	0.00		0.00	0.00
	Lubricants	0.5	0.00	0.00		0.00	0.00
						Total [a]	**1 137**

(a) The bunkers emissions are not to be added to national totals.

Annex 5

KEY SOURCES ANALYSIS

Level Assessment for 1990

	Sector	Categories	Gas	Gg CO_2-eq	% of total	Cumulative Total %
		Total:		182899		
1.B.2	Energy	Fugitive CH_4 Emissions from Oil and Gas Operation	CH_4	45672	24.0%	24.0%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Natural Gas)	CO_2	37147	20.3%	45.3%
4.D	Agriculture	N_2O Emissions from Agricultural Soils	N_2O	10222	5.6%	50.9%
1.A.3	Energy	Mobile Combustion: CO_2 Emissions from Road Transportation	CO_2	9986	5.5%	56.3%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Residual Fuel Oil)	CO_2	8814	4.8%	61.1%
1.A.4	Energy	Other Sectors: CO_2 Emissions from Residential (Natural Gas)	CO_2	8048	4.4%	65.5%
1.A.2	Energy	CO_2 Emissions from Manufacturing Industries and Construction (Natural Gas)	CO_2	7239	4.0%	69.5%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Sub-Bituminous Coal)	CO_2	7158	3.9%	73.4%
4.A	Agriculture	CH_4 Emissions from Enteric Fermentation	CH_4	5833	3.2%	76.6%
1.A.4	Energy	Other Sectors: CO_2 Emissions from Agriculture / Forestry/ Fishing (Liquid Fuels)	CO_2	4799	2.6%	79.2%
1.A.3	Energy	CO_2 Emissions from Pipeline Transport	CO_2	4575	2.5%	81.7%
6.A	Waste	CH_4 Emissions from Solid Waste Disposal Sites	CH_4	3343	1.8%	83.6%
1.A.4	Energy	Other Sectors: CO_2 Emissions from Residential (Solid Fuels)	CO_2	3338	1.8%	85.4%
1.A.4	Energy	Other Sectors: CO_2 Emissions from Commercial/ Institutional (Natural Gas)	CO_2	3036	1.7%	87.0%
2.A	Industrial processes	CO_2 Emissions from Cement Production	CO_2	2572	1.4%	88.5%
2.B	Industrial processes	CO_2 Emissions from Ammonia Production	CO_2	2282	1.25%	89.7%
1.A.2	Energy	CO_2 Emissions from Manufacturing Industries and Construction (Liquid Fuels)	CO_2	2187	1.2%	90.9%
1.A.4	Energy	Other Sectors: CO_2 Emissions from Commercial/ Institutional (Liquid Fuels)	CO_2	2030	1.1%	92.0%
2.B	Industrial processes	N_2O Emissions from Nitric Acid Production	N_2O	1782	1.0%	93.0%
1.A.4	Energy	Other Sectors: CO_2 Emissions from Commercial/ Institutional (Solid Fuels)	CO_2	1774	1.0%	94.0%
1.A.3	Energy	Mobil Combustion: CO_2 Emissions from Railways	CO_2	1754	1.0%	94.9%
2.C	Industrial processes	CO_2 Emissions from Steel Production	CO_2	998	0.5%	95.5%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Refinery Gas)	CO_2	865	0.5%	95.9%
1.A.4	Energy	Other Sectors: CO_2 Emissions from Residential (Liquid Fuels)	CO_2	853	0.5%	96.4%
1.A.2	Energy	CO_2 Emissions from Manufacturing Industries and Construction (Solid Fuels)	CO_2	742	0.4%	96.8%
1.A.4	Energy	Other Sectors: CO_2 Emissions from Agricultural/ Forestry/ Fishing (Natural Gas)	CO_2	509	0.3%	97.1%
1.A.5	Energy	Other: (Lubricants)	CO_2	503	0.3%	97.4%
1.B.1	Energy	Fugitive CH_4 Emissions from Coal Mining and Handling	CH_4	469	0.3%	97.6%
6.B	Waste	N_2O Emissions from Wastewater Handling	N_2O	438	0.2%	97.9%
4.B	Agriculture	CH_4 Emissions from Manure Management	CH_4	420	0.2%	98.1%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Other Bituminous Coal)	CO_2	364	0.2%	98.3%
1.A.4	Energy	Other Sectors: CO_2 Emissions from Agricultural/ Forestry/ Fishing (Solid Fuels)	CO_2	359	0.2%	98.5%
2.A	Industrial processes	CO_2 Emissions from Lime Production	CO_2	354	0.2%	98.7%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Crude Oil)	CO_2	313	0.2%	98.8%
6.B	Waste	CH_4 Emissions from Wastewater Handling	CH_4	292	0.2%	99.0%

	Sector	Categories	Gas	Gg CO_2-eq	% of total	Cumulative Total %
4.B	Agriculture	N_2O Emissions from Manure Management	N_2O	287	0.2%	99.2%
4.C	Agriculture	CH_4 Emissions from Rice Cultivation	CH_4	262	0.1%	99.3%
1.A.4	Energy	Other Sectors: CH_4 Emissions from Residential	CH_4	242	0.1%	99.4%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Gas of Underground Gasification)	CO_2	192	0.1%	99.5%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Stave Domestic Fuel)	CO_2	168	0.1%	99.6%
1.A.3	Energy	Mobile Combustion: CO_2 Emissions from Aviation	CO_2	163	0.1%	99.7%
1.A.1	Energy	N_2O (Non-CO_2) Emissions from Stationary Combustion	N_2O	81	0.0%	99.8%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Gas/Diesel Oil)	CO_2	78	0.0%	99.8%
2.A	Industrial processes	CO_2 Emissions from Soda Ash Use	CO_2	71	0.0%	99.8%
1.A.3	Energy	Mobile Combustion: CH_4 Emissions from Road Transportation	CH_4	48	0.0%	99.9%
1.A.4	Energy	Other Sectors: CH_4 Emissions from Agriculture/ Forestry/ Fishing	CH_4	35	0.0%	99.9%
1.A.3	Energy	Mobile Combustion: N_2O Emissions from Road Transportation	N_2O	26	0.0%	99.9%
1.A.1	Energy	CH_4 (Non-CO_2) Emissions from Stationary Combustion	CH_4	24	0.0%	99.9%
4.F	Agriculture	CH_4 Emissions from Field Burning of Agricultural Residues	CH_4	23	0.0%	99.9%
1.A.4	Energy	Other Sectors: N_2O Emissions from Residential	N_2O	22	0.0%	99.9%
1.A.2	Energy	CH_4 Emissions from Manufacturing Industries and Construction	CH_4	18	0.0%	100.0%
1.A.4	Energy	Other Sectors: CH_4 Emissions from Commercial/ Institutional	CH_4	15	0.0%	100.0%
1.A.4	Energy	Other Sectors: N_2O Emissions from Commercial/ Institutional	N_2O	15	0.0%	100.0%
1.A.4	Energy	Other Sectors: N_2O Emissions from Agriculture/ Forestry/ Fishing	N_2O	14	0.0%	100.0%
1.A.2	Energy	N_2O Emissions from Manufacturing Industries and Construction	N_2O	13	0.0%	100.0%
1.A.3	Energy	Mobile Combustion: CO_2 Emissions from Navigation	CO_2	12	0.0%	100.0%
4.F	Agriculture	N_2O Emissions from Field Burning of Agricultural Residues	N_2O	9	0.0%	100.0%
1.A.3	Energy	Mobile Combustion: N_2O Emissions from Railways	N_2O	4	0.0%	100.0%
1.A.3	Energy	Mobile Combustion: CH_4 Emissions from Railways	CH_4	3	0.0%	100.0%
1.A.3	Energy	Mobile Combustion: N_2O Emissions from Aviation	N_2O	1	0.0%	100.0%
1.A.3	Energy	Mobile Combustion: N_2O Emissions from Navigation	N_2O	0	0.0%	100.0%
1.A.3	Energy	Mobile Combustion: CH_4 Emissions from Aviation	CH_4	0	0.0%	100.0%
1.A.3	Energy	Mobile Combustion: CH_4 Emissions from Navigation	CH_4	0	0.0%	100.0%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Patent fuel)	CO_2	0	0.0%	100.0%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Gasoline)	CO_2	0	0.0%	100.0%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Other Kerosene)	CO_2	0	0.0%	100.0%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (LPG)	CO_2	0	0.0%	100.0%
2.G	Industrial processes	Consumption of Halocarbons and Sulphur Hexafluoride	HFC	0	0.0%	100.0%

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	Sector	Categories	Gas	Gg CO_2-eq	% of total	Cumulative Total %
		Total:		**201167**		
1.B.2	Energy	Fugitive CH_4 Emissions from Oil and Gas Operation	CH_4	70020	34,8%	34,8%
1.A.4	Energy	Other Sectors: CO_2 Emissions from Residential (Natural Gas)	CO_2	32637	16.2%	51.0%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Natural Gas)	CO_2	32346	16.1%	67.1%
4.D	Agriculture	N_2O Emissions from Agricultural Soils	N_2O	8539	4.2%	71.4%
1.A.4	Energy	Other Sectors: CO_2 Emissions from Commercial/ Institutional (Natural Gas)	CO_2	6961	3.5%	74.8%
4.A	Agriculture	CH_4 Emissions from Enteric Fermentation	CH_4	6592	3.3%	78.1%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Residual Fuel Oil)	CO_2	5757	2.9%	81.0%
1.A.3	Energy	Mobile Combustion: CO_2 Emissions from Road Transportation	CO_2	5619	2.8%	83.7%
1.A.3	Energy	CO_2 Emissions from Pipeline Transport	CO_2	5114	2.5%	86.3%
1.A.2	Energy	CO_2 Emissions from Manufacturing Industries and Construction (Natural Gas)	CO_2	4210	2.1%	88.4%
6.A	Waste	CH_4 Emissions from Solid Waste Disposal Sites	CH_4	3705	1.8%	90.2%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Sub-Bituminous Coal)	CO_2	3092	1.5%	91.8%
1.A.4	Energy	Other Sectors: CO_2 Emissions from Agriculture / Forestry/ Fishing (Liquid Fuels)	CO_2	2586	1.3%	93.0%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Crude Oil)	CO_2	2040	1.0%	94.1%
1.A.4	Energy	Other Sectors: CO_2 Emissions from Commercial/ Institutional (Liquid Fuels)	CO_2	1498	0.7%	94.8%
2.A	Industrial processes	CO_2 Emissions from Cement Production	CO_2	1476	0.7%	95.5%
2.B	Industrial processes	N_2O Emissions from Nitric Acid Production	N_2O	1374	0.7%	96.2%
2.B	Industrial processes	CO_2 Emissions from Ammonia Production	CO_2	1298	0.6%	96.9%
1.A.2	Energy	CO_2 Emissions from Manufacturing Industries and Construction (Liquid Fuels)	CO_2	739	0.4%	97.2%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Refinery Gas)	CO_2	706	0.4%	97.6%
2.C	Industrial processes	CO_2 Emissions from Steel Production	CO_2	665	0.3%	97.9%
1.A.4	Энергетика	Other Sectors: CO_2 Emissions from Commercial/ Institutional (Solid Fuels)	CO_2	565	0.3%	98.2%
6.B	Waste	N_2O Emissions from Wastewater Handling	N_2O	528	0.3%	98.5%
4.B	Agriculture	CH_4 Emissions from Manure Management	CH_4	480	0.2%	98.7%
1.A.3	Energy	Mobil Combustion: CO_2 Emissions from Railways	CO_2	327	0.2%	98.9%
6.B	Waste	CH_4 Emissions from Wastewater Handling	CH_4	299	0.1%	99.0%
4.B	Agriculture	N_2O Emissions from Manure Management	N_2O	229	0.1%	99.1%
1.B.1	Energy	Fugitive CH_4 Emissions from Coal Mining and Handling	CH_4	225	0.1%	99.2%
1.A.5	Energy	Other: (Lubricants)	CO_2	206	0.1%	99.3%
4.C	Agriculture	CH_4 Emissions from Rice Cultivation	CH_4	188	0.1%	99.4%
1.A.1	Energy	CO_2 Emission from Stationary Combustion (Other Bituminous Coal)	CO_2	131	0.1%	99.5%
1.A.4	Energy	Other Sectors: CO_2 Emissions from Agriculture/ Forestry/Fishing (Natural Gas)	CO_2	106	0.1%	99.5%
4.F	Agriculture	CH_4 Emissions from Field Burning Agricultural Residues	CH_4	87	0.0%	99.6%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Gas of Underground Gasification)	CO_2	85	0.0%	99.6%
2.A	Industrial processes	CO_2 Emissions from Lime Production	CO_2	81	0.0%	99.7%
1.A.3	Energy	Mobil Combustion: CO_2 Emissions from Aviation	CO_2	71	0.0%	99.7%
2.A	Industrial processes	CO_2 Emissions from Soda Ash Use	CO_2	71	0.0%	99.7%
1.A.4	Energy	Other Sectors: CH_4 Emissions from Residential	CH_4	62	0.0%	99.8%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Gas/ Diesel Oil)	CO_2	62	0.0%	99.8%

	Sector	Categories	Gas	Gg CO_2-eq	% of total	Cumulative Total %
1.A.1	Energy	N_2O (Non-CO_2) Emissions from Stationary Combustion	N_2O	54	0.0%	99.8%
1.A.4	Energy	Other Sectors: CO_2 Emissions from Residential (Liquid Fuels)	CO_2	47	0.0%	99.9%
1.A.2	Energy	CO_2 Emission from Manufacturing Industries and Construction (Solid Fuel)	CO_2	33	0.0%	99.9%
4.F	Agriculture	N_2O Emissions from Field Burning Agricultural Residues	N_2O	32	0.0%	99.9%
1.A.3	Energy	Mobil Combustion: CH_4 Emissions from Road Transportation	CH_4	31	0.0%	99.9%
1.A.1	Energy	CH_4 (Non-CO_2) Emissions from Stationary Combustion	CH_4	20	0.0%	99.9%
1.A.4	Energy	Other Sectors: CH_4 Emissions from Commercial/ Institutional	CH_4	19	0.0%	99.9%
1.A.4	Energy	Other Sectors: N_2O Emission from Residential	N_2O	18	0.0%	99.9%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Gasoline)	CO_2	18	0.0%	99.9%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Patent Fuel)	CO_2	17	0.0%	99.9%
1.A.3	Energy	Mobil Combustion: N_2O Emissions from Road Transportation	N_2O	15	0.0%	100.0%
1.A.4	Energy	Other Sectors: CO_2 Emissions from Residential (Solid Fuels)	CO_2	13	0.0%	100.0%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Stove Domestic Fuel)	CO_2	12	0.0%	100.0%
1.A.4	Energy	Other Sectors: N_2O Emissions from Commercial/ Institutional	N_2O	10	0.0%	100.0%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Other Kerosene)	CO_2	9	0.0%	100.0%
1.A.2	Energy	CH_4 Emissions from Manufacturing Industries and Construction	CH_4	9	0.0%	100.0%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (LPG)	CO_2	9	0.0%	100.0%
1.A.4	Energy	Other Sectors: N_2O Emissions from Agriculture/ Forestry/Fishing	N_2O	7	0.0%	100.0%
2.G	Industrial processes	Consumption Halocarbons and Sulphur Hexafluoride	HFC	6	0.0%	100.0%
1.A.4	Energy	Other Sectors: CH_4 Emissions from Agriculture/ Forestry/Fishing	CH_4	5	0.0%	100.0%
1.A.2	Energy	N_2O Emissions from Manufacturing Industries and Construction	N_2O	5	0.0%	100.0%
1.A.4	Energy	Other Sectors: CO_2 Emissions from Agriculture/ Forestry/Fishing (Solid Fuel)	CO_2	1	0.0%	100.0%
1.A.3	Energy	Mobil Combustion: N_2O Emissions from Railways	N_2O	1	0.0%	100.0%
1.A.3	Energy	Mobil Combustion: N_2O Emissions from Aviation	N_2O	1	0.0%	100.0%
1.A.3	Energy	Mobil Combustion: CH_4 Emission from Railways	CH_4	0	0.0%	100.0%
2.B	Industrial processes	CH_4 Emissions from Chemical Industry	CH_4	0	0.0%	100.0%
1.A.3	Energy	Mobil Combustion: CH_4 Emissions from Aviation	CH_4	0	0.0%	100.0%
1.A.3	Energy	Mobil Combustion: CO_2 Emissions from Navigation	CO_2	0	0.0%	100.0%
1.A.3	Energy	Mobil Combustion: CH_4 Emissions from Navigation	CH_4	0	0.0%	100.0%
1.A.3	Energy	Mobil Combustion: N_2O Emissions from Navigation	N_2O	0	0.0%	100.0%

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	Sector	Categories	Gas	Gg CO_2-eq	% of total	Cumulative Total %
		Total:		**199839**		
1.B.2	Energy	Fugitive CH_4 Emissions from Oil and Gas Operation	CH_4	76331	38.2%	38.2%
1.A.4	Energy	Other Sectors: CO_2 Emissions from Residential (Natural Gas)	CO_2	30915	15.5%	53.7%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Natural Gas)	CO_2	29648	14.8%	68.5%
1.A.4	Energy	Other Sectors: CO_2 Emissions from Commercial/ Institutional (Natural Gas)	CO_2	9031	4.5%	73.0%
4.A	Agriculture	CH_4 Emissions from Enteric fermentation	CH_4	7903	4.0%	77.0%
4.D	Agriculture	N_2O Emissions from Agricultural Soil	N_2O	7416	3.7%	80.7%
1.A.3	Energy	Mobil Combustion: CO_2 Emissions from Road Transportation	CO_2	5248	2.6%	83.3%
1.A.2	Energy	CO_2 Emissions from Manufacturing Industries and Construction (Natural Gas)	CO_2	4921	2.5%	85.8%
1.A.3	Energy	CO_2 Emissions from Pipeline Transport	CO_2	3845	1.9%	87.7%
6.A	Waste	CH_4 Emissions from Solid Waste Disposal Sites	CH_4	3814	1.9%	89.6%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Sub-Bituminous Coal)	CO_2	2522	1.3%	90.9%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Residual Fuel Oil)	CO_2	2473	1.2%	92.1%
2.A	Industrial processes	CO_2 Emissions from Cement Production	CO_2	2257	1.1%	93.2%
1.A.4	Energy	Other Sectors: CO_2 Emissions from Agriculture /Forestry / Fishing (Liquid Fuels)	CO_2	1944	1.0%	94.2%
2.B	Industrial processes	N_2O Emissions from Nitric Acid Production	N_2O	1581	0.8%	95.0%
2.B	Industrial processes	CO_2 Emissions from Ammonia Production	CO_2	1403	0.7%	95.7%
1.A.4	Energy	Other Sectors: CO_2 Emissions from Commercial/ Institutional (Liquid Fuels)	CO_2	1310	0.7%	96.4%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Crude Oil)	CO_2	1264	0.6%	97.0%
2.C	Industrial processes	CO_2 Emissions from Iron and Steel Production	CO_2	972	0.5%	97.5%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Refinery Gas)	CO_2	607	0.3%	97.8%
4.B	Agriculture	CH_4 Emissions from Manure Management	CH_4	568	0.3%	98.1%
6.B	Waste	N_2O Emissions from Wastewater Handling	N_2O	560	0.3%	98.3%
1.A.3	Energy	Mobil Combustion: CO_2 Emissions from Railways	CO_2	439	0.2%	98.6%
1.A.2	Energy	CO_2 Emissions from Manufacturing Industries and Construction (Liquid Fuels)	CO_2	382	0.2%	98.8%
1.A.4	Energy	Other Sectors: CO_2 Emissions from Commercial/ Institutional (Solid Fuels)	CO_2	347	0.2%	98.9%
1.A.5	Energy	Other: (Lubricants)	CO_2	334	0.2%	99.1%
6.B	Отходы	CH_4 Emissions from Wastewater Handling	CH_4	316	0.2%	99.3%
4.B	Agriculture	N_2O Emissions from Manure Management	N_2O	276	0.1%	99.4%
4.F	Agriculture	CH_4 Emissions from Field Burning Agricultural Residues	CH_4	133	0.1%	99.5%
1.B.1	Energy	Fugitive CH_4 Emissions from Coal Mining and Handling	CH_4	132	0.1%	99.5%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Gas of Underground Gasification)	CO_2	124	0.1%	99.6%
4.C	Agriculture	CH_4 Emissions from Rice Cultivation	CH_4	100	0.0%	99.6%
1.A.4	Energy	Other Sectors: CO_2 Emissions from Agriculture/ Forestry/Fishing (Natural Gas)	CO_2	80	0.0%	99.7%
2.A	Industrial processes	CO_2 Emissions from Soda Ash Use	CO_2	71	0.0%	99.7%
1.A.4	Energy	Other Sectors: CO_2 Emissions from Residential (Liquid Fuels)	CO_2	70	0.0%	99.7%
2.A	Industrial processes	CO_2 Emissions from Lime Production	CO_2	69	0.0%	99.7%
1.A.4	Energy	Other Sectors: CH_4 Emissions from Residential	CH_4	59	0.0%	99.8%
1.A.3	Energy	Mobil Combustion: CO_2 Emissions from Aviation	CO_2	56	0.0%	99.8%

	Sector	Categories	Gas	Gg CO_2-eq	% of total	Cumulative Total %
4.F	Agriculture	N_2O Emissions from Filed Burning Agricultural Residues	N_2O	49	0.0%	99.9%
1.A.1	Energy	N_2O (Non-CO_2) Emissions from Stationary Combustion	N_2O	39	0.0%	99.9%
1.A.3	Energy	Mobil Combustion: CH_4 Emissions from Road Transportation	CH_4	27	0.0%	99.9%
1.A.2	Energy	CO_2 Emissions from Manufacturing Industries and Construction (Solid Fuels)	CO_2	25	0.0%	99.9%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Gas/ Diesel Oil)	CO_2	22	0.0%	99.9%
1.A.4	Energy	Other Sectors: CH_4 emissions from Commercial/ Institutional	CH_4	22	0.0%	99.9%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Gasoline)	CO_2	18	0.0%	99.9%
1.A.4	Energy	Other Sectors: N_2O Emissions from Residential	N_2O	17	0.0%	100.0%
1.A.1	Energy	CH_4 (Non-CO_2) Emissions from Stationary Combustion	CH_4	15	0.0%	100.0%
1.A.3	Energy	Mobil Combustion: N_2O Emissions from Road Transportation	N_2O	14	0.0%	100.0%
2.G	Industrial processes	Consumption of Halocarbons and Sulphur Hexafluoride	HFC	12	0.0%	100.0%
1.A.4	Energy	Other sectors: N_2O Emissions from Commercial/ Institutional	N_2O	10	0.0%	100.0%
1.A.2	Energy	CH_4 Emissions from Manufacturing Industries and Construction	CH_4	10	0.0%	100.0%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Other Bituminous Coal)	CO_2	9	0.0%	100.0%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (LPG)	CO_2	9	0.0%	100.0%
1.A.4	Energy	Other Sectors: CO_2 Emissions from Residential (Solid Fuels)	CO_2	6	0.0%	100.0%
1.A.4	Energy	Other Sectors: N_2O Emissions from Agricultural / Forestry/ Fishing	N_2O	5	0.0%	100.0%
1.A.2	Energy	N_2O Emissions from Manufacturing Industries and Construction	N_2O	4	0.0%	100.0%
1.A.4	Energy	Other Sectors: CH_4 Emissions from Agricultural / Forestry/ Fishing	CH_4	3	0.0%	100.0%
2.B	Industrial processes	CH_4 Emissions from Chemical Industry	CH_4	3	0.0%	100.0%
1.A.3	Energy	Mobil Combustion: N_2O Emissions from Railways	N_2O	1	0.0%	100.0%
1.A.3	Energy	Mobil Combustion: CH_4 Emissions from Railways	CH_4	1	0.0%	100.0%
1.A.3	Energy	Mobil Combustion: N_2O Emissions from Aviation	N_2O	0	0.0%	100.0%
1.A.3	Energy	Mobil Combustion: CH_4 Emissions from Aviation	CH_4	0	0.0%	100.0%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Patent Fuel)	CO_2	0	0.0%	100.0%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Other Kerosene)	CO_2	0	0.0%	100.0%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Stove Domestic Fuel)	CO_2	0	0.0%	100.0%
1.A.3	Energy	Mobil Combustion: CO_2 Emissions from Navigation	CO_2	0	0.0%	100.0%
1.A.3	Energy	Mobil Combustion: CH_4 Emissions from Navigation	CH_4	0	0.0%	100.0%
1.A.3	Energy	Mobil Combustion: N_2O Emissions from Navigation	N_2O	0	0.0%	100.0%
1.A.4	Energy	Other Sectors: CO_2 Emissions from Agricultural / Forestry/ Fishing (Solid Fuels)	CO_2	0	0.0%	100.0%

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Trend Assessment for 1990-2000

	Sector	Category	Gas	Base Year Emission, Gg CO_2-eq	Currently Year Emission Gg CO_2-eq	Relative change 1990-2000, %	Trend Assessment	% Contribution to Trend	Cumulative Total %
				1990	2000				
		Total:		182899	201167	10.0%			
1.A.4	Energy	Other Sectors: CO_2 Emissions from Residential (Natural Gas)	CO_2	8048	32637	305.5%	0.107	24.1%	24.1%
1.B.2	Energy	Fugitive CH_4 Emissions from Oil and Gas Operation	CH_4	45672	70020	53.3%	0.089	20.0%	44.1%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Natural Gas)	CO_2	37147	32346	-12.9%	0.038	8.6%	52.7%
1.A.3	Energy	Mobil Combustion: CO_2 Emissions from Road Transportation	CO_2	9986	5619	-43.7%	0.024	5.4%	58.2%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Sub-Bituminous Coal)	CO_2	7158	3092	-56.8%	0.022	4.8%	63.0%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Residual Fuel Oil)	CO_2	8814	5757	-34.7%	0.018	4.0%	67.0%
1.A.2	Energy	CO_2 Emissions from Manufacturing Industries and Construction (Natural Gas)	CO_2	7239	4210	-41.8%	0.017	3.8%	70.8%
1.A.4	Energy	Other Sectors: CO_2 Emissions from Residential (Solid Fuels)	CO_2	3338	13	-99.6%	0.017	3.7%	74.5%
1.A.4	Energy	Other Sectors: CO_2 Emissions from Commercial/ Institutional (Natural Gas)	CO_2	3036	6961	129.3%	0.016	3.7%	78.2%
4.D	Agriculture	N_2O Emissions from Agricultural Soils	N_2O	10222	8539	-16.5%	0.012	2.7%	80.9%
1.A.4	Energy	Other Sectors: CO_2 Emissions from Agriculture/Forestry /Fishing (Liquid Fuels)	CO_2	4799	2586	-46.1%	0.012	2.7%	83.6%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Crude Oil)	CO_2	313	2040	551.5%	0.008	1.7%	85.4%
1.A.2	Energy	CO_2 Emissions from Manufacturing Industries and Construction (Liquid Fuel)	CO_2	2187	739	-66.2%	0.008	1.7%	87.0%
1.A.3	Energy	Mobil Combustion: CO_2 Emissions from Railways	CO_2	1754	327	-81.3%	0.007	1.6%	88.7%
1.A.4	Energy	Other Sectors: CO_2 Emissions from Commercial/ Institutional (Solid Fuels)	CO_2	1774	565	-68.2%	0.006	1.4%	90.1%
2.A	Industrial processes	CO_2 Emissions from Cement Production	CO_2	2572	1476	-42.6%	0.006	1.4%	91.4%
2.B	Industrial processes	CO_2 Emissions from Ammonia Production	CO_2	2282	1298	-43.1%	0.005	1.2%	92.7%
1.A.4	Energy	Other Sectors: CO_2 Emissions from Residential (Liquid Fuels)	CO_2	853	47	-94.5%	0.004	0.9%	93.6%
1.A.2	Energy	CO_2 Emissions from Manufacturing Industries and Construction (Solid Fuels)	CO_2	742	33	-95.6%	0.004	0.8%	94.4%
1.A.4	Energy	Other Sectors: CO_2 Emissions from Commercial/ Institutional (Liquid Fuels)	CO_2	2030	1498	-26.2%	0.003	0.7%	95.1%
2.B	Industrial processes	N_2O Emissions from Nitric Acid Production	N_2O	1782	1374	-22.9%	0.003	0.6%	95.7%
1.A.4	Energy	Other Sectors: CO_2 Emissions from Agriculture/Forestry/ Fishing (Natural Gas)	CO_2	509	106	-79.1%	0.002	0.5%	96.2%
2.C	Industrial processes	CO_2 Emissions from Iron and Steel Production	CO_2	998	665	-33.4%	0.002	0.4%	96.6%
1.A.4	Energy	Other Sectors: CO_2 Emissions from Agriculture/Forestry/ Fishing (Solid Fuels)	CO_2	359	1	-99.7%	0.002	0.4%	97.0%
1.A.5	Energy	Other: (Lubricants)	CO_2	503	206	-59.1%	0.002	0.4%	97.3%
2.A	Industrial processes	CO_2 Emissions from Lime Production	CO_2	354	81	-77.1%	0.001	0.3%	97.7%

	Sector	Category	Gas	Base Year Emission, Gg CO_2-eq	Currently Year Emission Gg CO_2-eq	Relative change 1990-2000, %	Trend Assessment	% Contribution to Trend	Cumulative Total %
1.B.1	Energy	Fugitive CH_4 Emissions from Coal Mining and Handling	CH_4	469	225	-52.1%	0.001	0.3%	98.0%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Other Bituminous Coal)	CO_2	364	131	-64.0%	0.001	0.3%	98.2%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Refinery Gas)	CO_2	865	706	-18.5%	0.001	0.2%	98.5%
1.A.4	Energy	Other Sectors: CH_4 Emissions from Residential	CH_4	242	62	-74.2%	0.001	0.2%	98.7%
4.A	Agriculture	CH_4 Emissions from Enteric Fermentation	CH_4	5833	6592	13.0%	0.001	0.2%	98.9%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Stove Domestic Fuel)	CO_2	168	12	-92.6%	0.001	0.2%	99.0%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Gas of Underground Gasification)	CO_2	192	85	-55.7%	0.001	0.1%	99.2%
1.A.3	Energy	Mobil Combustion: CO_2 Emissions from Aviation	CO_2	163	71	-56.7%	0.000	0.1%	99.3%
4.C	Agriculture	CH_4 Emissions from Rice Cultivation	CH_4	262	188	-28.2%	0.000	0.1%	99.4%
4.B	Agriculture	N_2O Emissions from Manure Management	N_2O	287	229	-20.1%	0.000	0.1%	99.5%
1.A.3	Energy	CO_2 Emissions from Pipeline Transport	CO_2	4575	5114	11.8%	0.000	0.1%	99.5%
4.F	Agriculture	CH_4 Emissions from Field Burning Agricultural Residual	CH_4	23	87	273.5%	0.000	0.1%	99.6%
6.B	Waste	N_2O Emissions from Wastewater Handling	N_2O	438	528	20.6%	0.000	0.0%	99.7%
1.A.1	Energy	N_2O (Non-CO_2) Emissions from Stationary Combustion	N_2O	81	54	-32.5%	0.000	0.0%	99.7%
1.A.4	Energy	Other Sectors: CH_4 Emissions from Agriculture/Forestry /Fishing	CH_4	35	5	-86.9%	0.000	0.0%	99.7%
6.A	Отходы	CH_4 Emissions from Solid Waste Disposal Sites	CH_4	3343	3705	10.8%	0.000	0.0%	99.8%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Gas/Diesel Oil)	CO_2	78	62	-20.0%	0.000	0.0%	99.8%
6.B	Отходы	CH_4 Emissions from Wastewater Handling	CH_4	292	299	2.2%	0.000	0.0%	99.8%
4.F	Agriculture	N_2O Emissions from Field Burning Agricultural Residual	N_2O	9	32	273.5%	0.000	0.0%	99.8%
1.A.3	Energy	Mobil Combustion: CH_4 Emissions from Road Transportation	CH_4	48	31	-36.5%	0.000	0.0%	99.8%
4.B	Agriculture	CH_4 Emissions from Manure Management	CH_4	420	480	14.5%	0.000	0.0%	99.9%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Gasoline)	CO_2	0	18	7090.2%	0.000	0.0%	99.9%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Patent Fuel)	CO_2	0	17	6681.8%	0.000	0.0%	99.90
1.A.3	Energy	Mobil Combustion: N_2O Emissions from Road Transportation	N_2O	26	15	-43.2%	0.000	0.0%	99.9%
1.A.2	Energy	CH_4 Emissions from Manufacturing Industries and Construction	CH_4	18	9	-48.6%	0.000	0.0%	99.92
1.A.2	Energy	N_2O Emissions from Manufacturing Industries and Construction	N_2O	13	5	-65.9%	0.000	0.0%	99.9%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Other Kerosene)	CO_2	0	9	3578.2%	0.000	0.0%	99.94
1.A.4	Energy	Other Sectors: N_2O Emissions from Agriculture/Forestry /Fishing	N_2O	14	7	-52.6%	0.000	0.0%	99.9%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (LPG)	CO_2	0	9	3347.4%	0.000	0.0%	100.0%
2.A	Industrial processes	CO_2 Emissions from Soda Ash Use	CO_2	71	71	0.0%	0.000	0.0%	100.0%
1.A.1	Energy	CH_4 (Non-CO_2) Emissions from Stationary Combustion	CH_4	24	20	-16.7%	0.000	0.0%	100.0%
1.A.4	Energy	Other Sectors: N_2O Emissions from Residential	N_2O	22	18	-18.2%	0.000	0.0%	100.0%
1.A.4	Energy	Other Sectors: N_2O Emissions from Commercial/ Institutional	N_2O	15	10	-30.7%	0.000	0.0%	100.0%
2.G	Industrial processes	Consumption Halocarbon and Sulphur Hexaflouride	HFC	0	6	2435.0%	0.000	0.0%	100.0%
1.A.3	Energy	Mobil Combustion: N_2O Emissions from Railways	N_2O	4	1	-81.3%	0.000	0.0%	100.0%
1.A.3	Energy	Mobil Combustion: CH_4 Emissions from Railways	CH_4	3	0	-81.3%	0.000	0.0%	100.0%
1.A.4	Energy	Other Sectors: CH_4 Emissions from Commercial/ Institutional	CH_4	15	19	21.7%	0.000	0.0%	100.0%
1.A.3	Energy	Mobil Combustion: N_2O Emissions from Aviation	N_2O	1	1	-56.6%	0.000	0.0%	100.0%

	Sector	Category	Gas	Base Year Emission, Gg CO_2-eq	Currently Year Emission Gg CO_2-eq	Relative change 1990-2000, %	Trend Assessment	% Contribution to Trend	Cumulative Total %
1.A.3	Energy	Mobil Combustion: CH_4 Emissions from Aviation	CH_4	0	0	-56.6%	0.000	0.0%	100.0%
1.A.3	Energy	Mobil Combustion: CO_2 Emissions from Navigation	CO_2	12	0	-98.0%	0.000	0.0%	100.0%
1.A.3	Energy	Mobil Combustion: CH_4 Emissions from Navigation	CH_4	0	0	0.0%	0.000	0.0%	100.0%
1.A.3	Energy	Mobil Combustion: N_2O Emissions from Navigation	N_2O	0	0	0.0%	0.000	0.0%	100.0%
2.B	Industrial processes	CH_4 Emissions from Chemical Industry	CH_4	0	0	-59.7%	0.000	0.0%	100.0%

Trend Assessment for 1990-2005

	Sector	Category	Gas	Base Year Emission, Gg CO_2-eq	Currently Year Emission Gg CO_2-eq	Relative change 1990-2005, %	Trend Assessment	% Contribution to Trend	Cumulative Total %
				1990	2005				
		Total:		**182899**	**199839**	**9.26%**			
1.B.2	Energy	Fugitive CH_4 Emissions from Oil and Gas Operation	CH_4	45672	76331	67.1%	0.121	23.2%	23.2%
1.A.4	Energy	Other Sectors: CO_2 Emissions from Residential (Natural Gas)	CO_2	8048	30915	284.1%	0.101	19.4%	42.6%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Natural Gas)	CO_2	37147	29648	-20.2%	0.050	9.6%	52.2%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Residual Fuel Oil)	CO_2	8814	2473	-71.9%	0.033	6.3%	58.5%
1.A.4	Energy	Other Sectors: CO_2 Emissions from Commercial/ Institutional (Natural Gas)	CO_2	3036	9031	197.4%	0.026	5.0%	63.5%
1.A.3	Energy	Mobile Combustion: CO_2 Emissions from Road Transportation	CO_2	9986	5248	-47.4%	0.026	5.0%	68.5%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Sub-Bituminous Coal)	CO_2	7158	2522	-64.8%	0.024	4.7%	73.1%
4.D	Agriculture	N_2O Emissions from Agricultural Soils	N_2O	10222	7416	-27.4%	0.017	3.3%	76.4%
1.A.4	Energy	Other Sectors: CO_2 Emissions from Residential (Solid Fuels)	CO_2	3338	6	-99.8%	0.017	3.2%	79.6%
1.A.4	Energy	Other Sectors: CO_2 Emissions from Agriculture/Forestry / Fishing (Liquid Fuels)	CO_2	4799	1944	-59.5%	0.015	2.9%	82.5%
1.A.2	Energy	CO_2 Emissions from Manufacturing Industries and Construction (Natural Gas)	CO_2	7239	4921	-32.0%	0.014	2.6%	85.1%
1.A.2	Energy	CO_2 Emissions from Manufacturing Industries and Construction (Liquid Fuels)	CO_2	2187	382	-82.5%	0.009	1.8%	86.9%
1.A.4	Energy	Other Sectors: CO_2 Emissions from Commercial/ Institutional (Solid Fuels)	CO_2	1774	347	-80.4%	0.007	1.4%	88.3%
4.A	Agriculture	CH_4 Emissions from Enteric Fermentation	CH_4	5833	7903	35.5%	0.007	1.3%	89.6%
1.A.3	Energy	Mobile Combustion: CO_2 Emissions from Railways	CO_2	1754	439	-75.0%	0.007	1.3%	90.9%
1.A.3	Energy	CO_2 Emissions from Pipeline Transport	CO_2	4575	3845	-16.0%	0.005	1.0%	92.0%
2.B	Industrial processes	CO_2 Emissions from Ammonia Production	CO_2	2282	1403	-38.5%	0.005	1.0%	92.9%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Crude Oil)	CO_2	313	1264	303.9%	0.004	0.8%	93.7%
1.A.4	Energy	Other Sectors: CO_2 Emissions from Commercial/ Institutional (Liquid Fuels)	CO_2	2030	1310	-35.5%	0.004	0.8%	94.5%
1.A.4	Energy	Other Sectors: CO_2 Emissions from Residential (Liquid Fuels)	CO_2	853	70	-91.8%	0.004	0.8%	95.3%
1.A.2	Energy	CO_2 Emissions from Manufacturing Industries and Construction (Solid Fuels)	CO_2	742	25	-96.7%	0.004	0.7%	96.0%
2.A	Industrial processes	CO_2 Emissions from Cement Production	CO_2	2572	2257	-12.2%	0.003	0.5%	96.5%
1.A.4	Energy	Other Sectors: CO_2 Emissions from Agriculture/Forestry / Fishing (Natural Gas)	CO_2	509	80	-84.3%	0.002	0.4%	96.9%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Other Bituminous Coal)	CO_2	364	9	-97.5%	0.002	0.3%	97.2%
1.B.1	Energy	Fugitive CH_4 Emissions from Coal Mining and Handling	CH_4	469	132	-71.8%	0.002	0.3%	97.5%
2.B	Industrial	N_2O Emissions from Nitric Acid Production	N_2O	1782	1581	-11.3%	0.002	0.3%	97.9%

	Sector	Category	Gas	Base Year Emission, Gg CO_2-eq	Currently Year Emission Gg CO_2-eq	Relative change 1990-2005, %	Trend Assessment	% Contribution to Trend	Cumulative Total %
	processes								
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Refinery Gas)	CO_2	865	607	-29.9%	0.002	0.3%	98.2%
2.A	Industrial processes	CO_2 Emissions from Lime Production	CO_2	354	69	-80.6%	0.001	0.3%	98.4%
1.A.5	Energy	Other: (Lubricants)	CO_2	503	334	-33.6%	0.001	0.2%	98.6%
1.A.4	Energy	Other Sectors: CH_4 Emissions from Residential	CH_4	242	59	-75.7%	0.001	0.2%	98.8%
4.C	Agriculture	CH_4 Emissions from Rice Cultivation	CH_4	262	100	-61.9%	0.001	0.2%	99.0%
6.A	Отходы	CH_4 Emissions from Solid Waste Disposal Sites	CH_4	3343	3814	14.1%	0.001	0.1%	99.1%
1.A.3	Energy	Mobil Combustion: CO_2 Emissions from Aviation	CO_2	163	56	-65.7%	0.001	0.1%	99.2%
2.C	Industrial processes	CO_2 Emissions from Iron and Steel Production	CO_2	998	972	-2.7%	0.001	0.1%	99.3%
4.B	Agriculture	CH_4 Emissions from Manure Management	CH_4	420	568	35.3%	0.001	0.1%	99.4%
4.F	Agriculture	CH_4 Emissions from Field Burning Agricultural Residues	CH_4	23	133	467.5%	0.000	0.1%	99.5%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Gas of Underground Gasification)	CO_2	192	124	-35.5%	0.001	0.1%	99.6%
6.B	Waste	N_2O Emissions from Wastewater Handling	N_2O	438	560	28.0%	0.000	0.1%	99.7%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Gas/ Diesel Oil)	CO_2	78	22	-72.0%	0.000	0.1%	99.7%
1.A.1	Energy	N_2O (Non-CO_2) Emissions from Stationary Combustion	N_2O	81	39	-51.3%	0.001	0.0%	99.8%
4.F	Agriculture	N_2O Emissions from Field Burning Agricultural Residues	N_2O	9	49	467.5%	0.000	0.0%	99.8%
4.B	Agriculture	N_2O Emissions from Manure Management	N_2O	287	276	-3.7%	0.000	0.0%	99.8%
1.A.4	Energy	Other Sectors: CH_4 Emissions from Agriculture/Forestry/ Fishing	CH_4	35	3	-90.3%	0.000	0.0%	99.9%
1.A.3	Energy	Mobil Combustion: CH_4 Emissions from Road Transportation	CH_4	48	27	-43.1%	0.000	0.0%	99.9%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Gasoline)	CO_2	0	18	7090.2%	0.000	0.0%	99.9%
1.A.3	Energy	Mobil Combustion: N_2O Emissions from Road Transportation	N_2O	26	14	-47.4%	0.000	0.0%	99.9%
2.G	Industrial processes	Consumption Halocarbons and sulphur hexafluoride	HFC	0	12	4747.3%	0.000	0.0%	99.9%
1.A.1	Energy	CH_4 (Non-CO_2) Emissions from Stationary Combustion	CH_4	24	15	-36.1%	0.000	0.0%	99.9%
1.A.2	Energy	N_2O Emissions from Manufacturing Industries and Construction	N_2O	13	4	-70.6%	0.000	0.0%	99.9%
1.A.4	Energy	Other Sectors: N_2O Emissions from Agriculture/Forestry/ Fishing	N_2O	14	5	-64.4%	0.000	0.0%	100.0%
1.A.2	Energy	CH_4 Emissions from Manufacturing Industries and Construction	CH_4	18	10	-43.8%	0.000	0.0%	100.0%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (LPG)	CO_2	0	9	3347.4%	0.000	0.0%	100.0%
1.A.4	Energy	Other Sectors: N_2O Emissions from Residential	N_2O	22	17	-22.3%	0.000	0.0%	100.0%
2.A	Industrial processes	CO_2 Emissions from Soda Ash Use	CO_2	71	71	0.0%	0.000	0.0%	100.0%
1.A.4	Energy	Other Sectors: N_2O Emissions from Commercial/ Institutional	N_2O	15	10	-32.4%	0.000	0.0%	100.0%
1.A.4	Energy	Other Sectors: CH_4 Emissions from Commercial/ Institutional	CH_4	15	22	40.9%	0.000	0.0%	100.0%
1.A.3	Energy	Mobil Combustion: N_2O Emissions from Railways	N_2O	4	1	-75.0%	0.000	0.0%	100.0%
6.B	Waste	CH_4 Emissions from Wastewater Handling	CH_4	292	316	8.0%	0.000	0.0%	100.0%
1.A.3	Energy	Mobil Combustion: CH_4 Emissions from Railways	CH_4	3	1	-75.0%	0.000	0.0%	100.0%
1.A.3	Energy	Mobil Combustion: N_2O Emissions from Aviation	N_2O	1	0	-65.6%	0.000	0.0%	100.0%
1.A.3	Energy	Mobil Combustion: CH_4 Emissions from Aviation	CH_4	0	0	-65.6%	0.000	0.0%	100.0%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Patent Fuel)	CO_2	0	0	0.0%	0.000	0.0%	100.00%

	Sector	Category	Gas	Base Year Emission, Gg CO_2-eq	Currently Year Emission Gg CO_2-eq	Relative change 1990-2005, %	Trend Assessment	% Contribution to Trend	Cumulative Total %
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Other Kerosene)	CO_2	0	0	0.0%	0.000	0.0%	100.0%
1.A.1	Energy	CO_2 Emissions from Stationary Combustion (Stove Domestic Fuel)	CO_2	168	0	-99.9%	0.000	0.0%	100.0%
1.A.3	Energy	Mobil Combustion: CO_2 Emissions from Navigation	CO_2	12	0	-98.0%	0.000	0.0%	100.0%
1.A.3	Energy	Mobil Combustion: CH_4 Emissions from Navigation	CH_4	0	0	1300.7%	0.000	0.0%	100.0%
1.A.3	Energy	Mobil Combustion: N_2O emissions from Navigation	N_2O	0	0	690.7%	0.000	0.0%	100.0%
1.A.4	Energy	Other Sectors: CO_2 Emissions from Agriculture/Forestry/ Fishing (Solid Fuels)	CO_2	359	0	-99.9%	0.000	0.0%	100.0%
2.B	Industrial processes	CH_4 Emissions from Chemical Industry	CH_4	0	3	+965.0%	0.000	0.0%	100.0%

Source Category Analysis Summary

Quantitative Method Tier 1

Level Assessment for 2000, Trend Assessment for 1990-2000.

A	B	C	D
IPCC Source Categories	**Direct Greenhouse Gas**	**Key Source Category Flag**	**Criteria for Identification Kay Source Category**
1.A.1 CO_2 Emissions from Stationary Combustion (Other Bituminous Coal)	CO_2	No	
1.A.1 CO_2 Emissions from Stationary Combustion (Sub-Bituminous Coal)	CO_2	Yes	Level, Trend
1.A.1 CO_2 Emissions from Stationary Combustion (Patent Fuel)	CO_2	No	
1.A.1 CO_2 Emissions from Stationary Combustion (Crude Oil)	CO_2	Yes	Level, Trend
1.A.1 CO_2 Emissions from Stationary Combustion (Gasoline)	CO_2	No	
1.A.1 CO_2 Emissions from Stationary Combustion (Other Kerosene)	CO_2	No	
1.A.1 CO_2 Emissions from Stationary Combustion (Gas/ Diesel Oil)	CO_2	No	
1.A.1 CO_2 Emissions from Stationary Combustion (Residual Fuel Oil)	CO_2	Yes	Level, Trend
1.A.1 CO_2 Emissions from Stationary Combustion (LPG)	CO_2	No	
1.A.1 CO_2 Emissions from Stationary Combustion (Refinery Gas)	CO_2	No	
1.A.1 CO_2 Emissions from Stationary Combustion (Stove Domestic Fuel)	CO_2	No	
1.A.1 CO_2 Emissions from Stationary Combustion (Natural Gas)	CO_2	Yes	Level, Trend
1.A.1 CO_2 Emissions from Stationary Combustion (Gas of Underground Gasification)	CO_2	No	
1.A.1 CH_4 (Non-CO_2) Emissions from Stationary Combustion	CH_4	No	
1.A.1 N_2O (Non-CO_2) Emissions from Stationary Combustion	N_2O	No	
1.A.2 CO_2 Emissions from Manufacturing Industries and Construction (Solid Fuels)	CO_2	Yes	Trend
1.A.2 CO_2 Emissions from Manufacturing Industries and Construction (Liquid Fuels)	CO_2	Yes	Trend
1.A.2 CO_2 Emissions from Manufacturing Industries and Construction (Natural Gas)	CO_2	Yes	Level, Trend
1.A.2 CH_4 Emissions from Manufacturing Industries and Construction	CH_4	No	
1.A.2 N_2O Emissions from Manufacturing Industries and Construction	N_2O	No	
1.A.3 Mobil Combustion: CO_2 Emissions from Road Transportation	CO_2	Yes	Level, Trend
1.A.3 Mobil Combustion: CH_4 Emissions from Road Transportation	CH_4	No	
1.A.3 Mobil Combustion: N_2O Emissions from Road Transportation	N_2O	No	
1.A.3 Mobil Combustion: CO_2 Emissions from Navigation	CO_2	No	
1.A.3 Mobil Combustion: CH_4 Emissions from Navigation	CH_4	No	
1.A.3 Mobil Combustion: N_2O Emissions from Navigation	N_2O	No	
1.A.3 Mobil Combustion: CO_2 Emissions from Aviation	CO_2	No	
1.A.3 Mobil Combustion: CH_4 Emissions from Aviation	CH_4	No	
1.A.3 Mobil Combustion: N_2O Emissions from Aviation	N_2O	No	
1.A.3 Mobil Combustion: CO_2 Emissions from Railways	CO_2	Yes	Trend
1.A.3 Mobil Combustion: CH_4 Emissions from Railways	CH_4	No	
1.A.3 Mobil Combustion: N_2O Emissions from Railways	N_2O	No	
1.A.3 CO_2 Emissions from Pipeline Transport	CO_2	Yes	Level
1.A.4 Other Sectors: CO_2 Emissions from Commercial/Institutional (Solid Fuels)	CO_2	Yes	Trend
1.A.4 Other Sectors: CO_2 Emissions from Commercial/Institutional (Liquid Fuels)	CO_2	Yes	Level, Trend
1.A.4 Other Sectors: CO_2 Emissions from Commercial/Institutional (Natural Gas)	CO_2	Yes	Level, Trend
1.A.4 Other Sectors: CH_4 Emissions from Commercial/Institutional	CH_4	No	
1.A.4 Other Sectors: N_2O Emissions from Commercial/Institutional	N_2O	No	
1.A.4 Other Sectors: CO_2 Emissions from Residential (Solid Fuels)	CO_2	Yes	Trend
1.A.4 Other Sectors: CO_2 Emissions from Residential (Liquid Fuels)	CO_2	Yes	Trend
1.A.4 Other Sectors: CO_2 Emissions from Residential (Natural Gas)	CO_2	Yes	Level, Trend
1.A.4 Other Sectors: CH_4 Emissions from Residential	CH_4	No	
1.A.4 Other Sectors: N_2O Emissions from Residential	N_2O	No	

A	B	C	D
IPCC Source Categories	**Direct Greenhouse Gas**	**Key Source Category Flag**	**Criteria for Identification Kay Source Category**
1.A.4 Other Sectors: CO_2 Emissions from Agriculture/Forestry/Fishing (Solid Fuels)	CO_2	No	
1.A.4 Other Sectors: CO_2 Emissions from Agriculture/Forestry/Fishing (Liquid Fuels)	CO_2	Yes	Level, Trend
1.A.4 Other Sectors: CO_2 Emissions from Agriculture/Forestry/Fishing (Natural Gas)	CO_2	No	
1.A.4 Other Sectors: CH_4 Emissions from Agriculture/Forestry/Fishing	CH_4	No	
1.A.4 Other Sectors: N_2O Emissions from Agriculture/Forestry/Fishing	N_2O	No	
1.A.5 Other: (Lubricants)	CO_2	No	
1.B.1 Fugitive CH_4 Emissions from Coal Mining and Handling	CH_4	No	
1.B.2 Fugitive CH_4 Emissions from Oil and Gas Operation	CH_4	Yes	Level, Trend
2.A CO_2 Emissions from Cement Production	CO_2	Yes	Level, Trend
2.A CO_2 Emissions from Lime Production	CO_2	No	
2.A CO_2 Emissions from Soda Ash Use	CO_2	No	
2.C CO_2 Emissions from Iron and Steel Production	CO_2	No	
2.B N_2O Emissions from Nitric Acid Production	N_2O	No	
2.B CO_2 Emissions from Ammonia Production	CO_2	Yes	Trend
2.B CH_4 Emissions from Chemical Industry	CH_4	No	
2.G Consumption Halocarbon and Sulphur Hexafluoride	HFC	No	
4.A CH_4 Emissions from Enteric Fermentation	CH_4	Yes	Level
4.B CH_4 Emissions from Manure Management	CH_4	No	
4.B N_2O Emissions from Manure Management	N_2O	No	
4.F CH_4 Emissions from Filed Burning Agricultural Residues	CH_4	No	
4.F N_2O Emissions from Filed Burning Agricultural Residues	N_2O	No	
4.D N_2O Emissions from Agricultural Soils	N_2O	Yes	Level, Trend
4.C CH_4 Emissions from Rice Cultivation	CH_4	No	
6.A CH_4 Emissions from Solid Waste Disposal Sites	CH_4	Yes	Level
6.B CH_4 Emissions from Wastewater Handling	CH_4	No	
6.B N_2O Emissions from Wastewater Handling	N_2O	No	

Source Category Analysis Summary
Quantitative Method Tier 1
Level Assessment for 2005, Trend Assessment for 1990-2005.

A	B	C	D
IPCC Source Categories	**Direct Greenhouse Gas**	**Key Source Category Flag**	**Criteria for Identification Kay Source Category**
1.A. CO_2 Emissions from Stationary Combustion (Other Bituminous Coal)	CO_2	No	
1.A. CO_2 Emissions from Stationary Combustion (Sub-Bituminous Coal)	CO_2	Yes	Level, Trend
1.A. CO_2 Emissions from Stationary Combustion (Patent Fuel)	CO_2	No	
1.A. CO_2 Emissions from Stationary Combustion (Crude Oil)	CO_2	Yes	Trend
1.A. CO_2 Emissions from Stationary Combustion (Gasoline)	CO_2	No	
1.A.1 CO_2 Emissions from Stationary Combustion (Other Kerosene)	CO_2	No	
1.A.1 CO_2 Emissions from Stationary Combustion (Gas/ Diesel Oil)	CO_2	No	
1.A.1 CO_2 Emissions from Stationary Combustion (Residual Fuel Oil)	CO_2	Yes	Level, Trend
1.A.1 CO_2 Emissions from Stationary Combustion (LPG)	CO_2	No	
1.A.1 CO_2 Emissions from Stationary Combustion (Refinery Gas)	CO_2	No	
1.A.1 CO_2 Emissions from Stationary Combustion (Stove Domestic Fuel)	CO_2	No	
1.A.1 CO_2 Emissions from Stationary Combustion (Natural Gas)	CO_2	Yes	Level, Trend
1.A.1 CO_2 Emissions from Stationary Combustion (Gas of Underground Gasification)	CO_2	No	
1.A.1 CH_4 (Non-CO_2) Emissions from Stationary Combustion	CH_4	No	
1.A.1 N_2O (Non-CO_2) Emissions from Stationary Combustion	N_2O	No	
1.A.2 CO_2 Emissions from Manufacturing Industries and Construction (Solid Fuels)	CO_2	No	
1.A.2 CO_2 Emissions from Manufacturing Industries and Construction (Liquid Fuels)	CO_2	Yes	Trend
1.A.2 CO_2 Emissions from Manufacturing Industries and Construction (Natural Gas)	CO_2	Yes	Level, Trend
1.A.2 CH_4 Emissions from Manufacturing Industries and Construction	CH_4	No	
1.A.2 N_2O Emissions from Manufacturing Industries and Construction	N_2O	No	
1.A.3 Mobil Combustion: CO_2 Emissions from Road Transportation	CO_2	Yes	Level, Trend
1.A.3 Mobil Combustion: CH_4 Emissions from Road Transportation	CH_4	No	
1.A.3 Mobil Combustion: N_2O Emissions from Road Transportation	N_2O	No	
1.A.3 Mobil Combustion: CO_2 Emissions from Navigation	CO_2	No	
1.A.3 Mobil Combustion: CH_4 Emissions from Navigation	CH_4	No	
1.A.3 Mobil Combustion: N_2O Emissions from Navigation	N_2O	No	
1.A.3 Mobil Combustion: CO_2 Emissions from Aviation	CO_2	No	
1.A.3 Mobil Combustion: CH_4 Emissions from Aviation	CH_4	No	
1.A.3 Mobil Combustion: N_2O Emissions from Aviation	N_2O	No	
1.A.3 Mobil Combustion: CO_2 Emissions from Railways	CO_2	Yes	Trend
1.A.3 Mobil Combustion: CH_4 Emissions from Railways	CH_4	No	
1.A.3 Mobil Combustion: N_2O Emissions from Railways	N_2O	No	
1.A.3 CO_2 Emissions from Pipeline Transport	CO_2	Yes	Level, Trend
1.A.4 Other Sectors: CO_2 Emissions from Commercial/Institutional (Solid Fuels)	CO_2	Yes	Trend
1.A.4 Other Sectors: CO_2 Emissions from Commercial/Institutional (Liquid Fuels)	CO_2	Yes	Trend
1.A.4 Other Sectors: CO_2 Emissions from Commercial/Institutional (Natural Gas)	CO_2	Yes	Level, Trend
1.A.4 Other Sectors: CH_4 Emissions from Commercial/Institutional	CH_4	No	
1.A.4 Other Sectors: N_2O Emissions from Commercial/Institutional	N_2O	No	
1.A.4 Other Sectors: CO_2 Emissions from Residential (Solid Fuels)	CO_2	Yes	Trend
1.A.4 Other Sectors: CO_2 Emissions from Residential (Liquid Fuels)	CO_2	Yes	Trend
1.A.4 Other Sectors: CO_2 Emissions from Residential (Natural Gas)	CO_2	Yes	Level, Trend
1.A.4 Other Sectors: CH_4 Emissions from Residential	CH_4	No	

A	B	C	D
IPCC Source Categories	Direct Greenhouse Gas	Key Source Category Flag	Criteria for Identification Kay Source Category
1.A.4 Other Sectors: N_2O Emissions from Residential	N_2O	No	
1.A.4 Other Sectors: CO_2 Emissions from Agriculture/Forestry/Fishing (Solid Fuels)	CO_2	No	
1.A.4 Other Sectors: CO_2 Emissions from Agriculture/Forestry/Fishing (Liquid Fuels)	CO_2	Yes	Level, Trend
1.A.4 Other Sectors: CO_2 Emissions from Agriculture/Forestry/Fishing (Natural Gas)	CO_2	No	
1.A.4 Other Sectors: CH_4 Emissions from Agriculture/Forestry/Fishing	CH_4	No	
1.A.4 Other Sectors: N_2O Emissions from Agriculture/Forestry/Fishing	N_2O	No	
1.A.5 Other: (Lubricants)	CO_2	No	
1.B.1 Fugitive CH_4 Emissions from Coal Mining and Handling	CH_4	No	
1.B.2 Fugitive CH_4 Emissions from Oil and Gas Operation	CH_4	Yes	Level, Trend
2.A CO_2 Emissions from Cement Production	CO_2	Yes	Level
2.A CO_2 Emissions from Lime Production	CO_2	No	
2.A CO_2 Emissions from Soda Ash Use	CO_2	No	
2.C CO_2 Emissions from Iron and Steel Production	CO_2	No	
2.B N_2O Emissions from Nitric Acid Production	N_2O	Yes	Level
2.B CO_2 Emissions from Ammonia Production	CO_2	Yes	Trend
2.B CH_4 Emissions from Chemical Industry	CH_4	No	
2.G Consumption Halocarbon and Sulphur Hexafluoride	HFC	No	
4.A CH_4 Emissions from Enteric Fermentation	CH_4	Yes	Level, Trend
4.B CH_4 Emissions from Manure Management	CH_4	No	
4.B N_2O Emissions from Manure Management	N_2O	No	
4.F CH_4 Emissions from Filed Burning Agricultural Residues	CH_4	No	
4.F N_2O Emissions from Filed Burning Agricultural Residues	N_2O	No	
4.D N_2O Emissions from Agricultural Soils	N_2O	Yes	Level, Trend
4.C CH_4 Emissions from Rice Cultivation	CH_4	No	
6.A CH_4 Emissions from Solid Waste Disposal Sites	CH_4	Yes	Level
6.B CH_4 Emissions from Wastewater Handling	CH_4	No	
6.B N_2O Emissions from Wastewater Handling	N_2O	No	

Annex 6

Calorific value of sub-bituminous coal

In 2006 when preparation of the greenhouse gas inventory within the framework of the Second National Communication on Climate Change, the national conversion factor for uzbek sub-bituminous coals were revised for the period 1999-2005.

To calculate the averages the data on the lowest calorific values provided by the Open Joint-Stock Company «Ugol» were used.

Table A1 Data of the Open Joint-Stock Company «Ugol»

Rank of coal	Lowest calorific value	Measurement unit	Normative document
2BPK	3200	kcal /kg	GOST 8302-87
2BR, BOMSSh	3200	kcal /kg	GOST 8298-89
2BOMSSh-B1	2700	kcal /kg	TSh12-18:2001
2BR-B1	2760	kcal /kg	TSh12-18:2001

Average calorific value for a sample = 2965.0 kcal /kg (or **12.414** GJ/tonne).
Limited number of elements in the sample does not allow estimation of uncertainty of the averages. Only deviation of the data available can be estimated.
Standard square deviation $\sigma = \pm 272.5$ kcal/kg.
Relative maximal deviation = ± 9.19 %.

In the previous years not only uzbek coals but coals from the provinces of former USSR were utilized in the republic. The imported coals are characterized by higher calorific values. Therefore average weighted coefficients for coals were calculated for each year for the period 1990-1997. The calculation was performed in the State Committee for Statistics of the Republic of Uzbekistan.

For 1998 it was decided to use the value **13.158** GJ/tonne, that is averaged value of 1997 (13.901 GJ/tonne) and 1999 (12.414 GJ/tonne) as no data available on calorific values of imported coals.

Average calorific value of rank of coals (2965.0 kcal /kg (or **12.414** GJ/tonne)) was used for the period 1999-2005.

Table A2 Weighted average coefficients for coals by years

Year	Sub-bituminous coal	Year	Sub-bituminous coal
1990	15.413	**1994**	14.124
1991	15.252	**1995**	13.830
1992	14.489	**1996**	13.622
1993	14.242	**1997**	13.901

Table A3 Weighted average coefficients for coals by years

Year	Sub-bituminous coal	Year	Sub-bituminous coal
1998	13.158	**2002**	12.414
1999	12.414	**2003**	12.414
2000	12.414	**2004**	12.414
2001	12.414	**2005**	12.414

Annex 7

Calculation of national indirect GHG emission factors for transport in the sector “Energy” in Uzbekistan

In 2007 when preparation of the GHG inventory for the Second National Communication, the national factors were recalculated for emissions of:

- CO from fuel combustion for transport activity
- NOx from fuel combustion for transport activity
- NMVOC from fuel combustion for transport activity

All factors were calculated using the same way based on the “Instruction on Making Report on Atmospheric Air Pollution” , Annex 1, approved by the Decree of the State Committee on Statistics of the Republic of Uzbekistan from 20.09.94, № 29 (Table A4).

Table A4 Polluting substances emissions from combustion of 1 tonne of fuel, tonne/tonne

Polluting substance	Polluting substances emissions		
	Gasoline engine	Diesel engine	Gas-engine
Carbon oxide	0.6	0.1	0.17
Hydrocarbons	0.1	0.03	0.06
Nitrogen oxides (converted into nitrogen dioxide)	0.04	0.04	0.04
Sulfurous gas	0.002	0.02	
Soot		0.016	
Aldehydes	0.04	0.0025	
Benzpyrene	$0.23*10^{-6}$	$0.31*10^{-6}$	
Lead compounds	0.0003		

As the emission factors should be expressed in kg gas / TJ, fuel data is converted to energy units.

Table A5 Calorific value of fuel

Fuel	Gasoline	Diesel fuel	Liquefied gas
Calorific value	0.043668 TJ/tonne	0.042496 TJ/tonne	0.046013 TJ/tonne

Calculation of emissions in kg gas/ TJ was made based on the following:

X = n kg газа * 1 TJ / tonne of fuel expressed in TJ

X – emission factor (kg/TJ)

N – gas emission from combustion of 1 tonne of fuel

Taking into account the fuel quality and condition of car fleet, it is preferably to use national factors for emission calculation but not default ones.

Calculations of each of the developed factors follow.

7.1. National CO emission factor for fuel combustion in transport

In accordance with the “Instruction on Making Report on Atmospheric Air Pollution”, there are given below the gas emission per tonne of fuel, expressed in energy units.

Table A6 Specific CO emission

Fuel	Gasoline	Diesel fuel	Liquefied gas
1 tonne of fuel in energy units	0.043668 TJ	0.042496 TJ	0.046013 TJ
Specific CO emission, kg	600	100	170

Calculation of emission, kg CO/ TJ:

Gasoline X = 600 * 1 / 0.043668 = 13740.0 kg/TJ
Diesel fuel X = 100 * 1 / 0.042496 = 2353.2 kg/TJ
Liquefied gas X = 170 * 1 / 0.046013 = 3694.6 kg/TJ

Table A7 Calculated CO emission factors

Gasoline	Diesel fuel	Liquefied gas
13740.0 kg/TJ	2353.2 kg/TJ	3694.6 kg/TJ

7.2 NOx emission factor for fuel combustion in transport

In accordance with the "Instruction on Making Report on Atmospheric Air Pollution", there are given below the gas emission per tonne of fuel, expressed in energy units.

Table A8 Specific NOx emission

Fuel	Gasoline	Diesel fuel	Liquefied gas
1 tonne of fuel in energy units	0.043668 TJ	0.042496 TJ	0.046013 TJ
Specific NOx emission, kg	40	40	40

Calculation of emission, kg NOx / TJ:

Gasoline X = 40 * 1 / 0.043668 = 916.0 kg/TJ
Diesel fuel X = 40 * 1 / 0.042496 = 941.3 kg/TJ
Liquefied gas X = 40 * 1 / 0.046013 = 869.3 kg/TJ

Table A9 Calculated NOx emission factors

Gasoline	Diesel fuel	Liquefied gas
916.0 kg/TJ	941.3 kg/TJ	869.3 kg/TJ

7.3 NMVOC emission factor for fuel combustion in transport

In accordance with the "Instruction on Making Report on Atmospheric Air Pollution", there are given below the gas emission per tonne of fuel, expressed in energy units.

Table A10 Specific NMVOC emission

Fuel	Gasoline	Diesel fuel	Liquefied gas
1 tonne of fuel in energy units	0.043668 TJ	0.042496 TJ	0.046013 TJ
Specific NMVOC emission, kg	100	30	60

Calculation of emission, kg NMVOC / TJ:

Gasoline X = 100 * 1 / 0.043668 = 2290.0 kg/TJ
Diesel fuel X = 30 * 1 / 0.042496 = 705.9 kg/TJ
Liquefied gas X = 60 * 1 / 0.046013 = 1304.0 kg/TJ

Table A11 Calculated NMVOC emission factors

Gasoline	Diesel fuel	Liquefied gas
2290.0 kg/TJ	705.9 kg/TJ	1304.0 kg/TJ

Annex 8

Calculation of national factors for fugitive methane emission from gas operation in Uzbekistan

Within the framework of the Regional Project “Capacity Building for Improving the Quality of the GHG Inventories (Europe/CIS region)” (2003-2006) the national factors were developed for fugitive methane emissions from the following gas activities:

- production
- transmission
- processing (gas treatment from sulfurous compounds)

Calculation was made based on the data of the National Holding Company «Uzneftegaz» and the Joint-Stock Company «Uztransgaz».

Limited number of elements in the sample for each developed factor does not allow estimation of uncertainty of the national factors. Only deviation of the data available can be estimated.

While preparation of the GHG inventory within the framework of the Second National Communication, the national emission factors for methane emission from gas production and transmission were used as they meet the national circumstances to a greater extent than default factors. Besides, the average factors developed for two enterprises with different treatment technology were employed for estimation of methane emission from gas processing (treatment from sulfurous compounds). This emission source was not covered in the previous inventory.

Calculations for each of developed factors follow.

8.1 Calculation of national methane emission factors for gas production

The general scheme of emission factors calculation is as follows:

$$\mathbf{K = V_{NL} / V_{AD} * 1000} \qquad (1)$$

Where:
К – emission factor, kg/thousand m^3
V_{NL} – amount of gas emitted into the atmosphere when gas losses and consumption for own needs, tonnes;
V_{AD} – activity data (gas production and preparation), thousands m^3.

Calculation of methane amount:

$$\mathbf{V_{NL} = V*C*\rho_i/1000} \qquad (2)$$

Where:
V – volume of gas, m^3
C – fraction of methane in natural gas
ρ – density of methane, 0.668 kg/m^2 – under 20° C and 760 millimeter of mercury
1000 – conversion factor, that converts kg to tonne

Calculation of emission factor, kg/PJ

$$K\ kg/PJ = K\ kg/thousand\ m^3 * 8\ 100\ 000\ cal/m^3 * 4.1868\ J/cal/\ 10^{15} \qquad (3)$$

Annual factors were calculated for the period 1999-2004.

Volumes of own needs and losses were calculated using “Method of calculation of gas consumption for own needs while gas production and preparation”, that was developed by the Ukraine Research Institute of Gas in 1981 and Work Document 39.2-140-95 (“Method of calculation of hazardous substances emission into the atmosphere for oil &gas production enterprise and oil &gas refinery”, Tashkent, 1995)

Activity data were provided by the National Holding Company «Uzneftegaz».

Table A12 Data on natural gas production and leaks

	1999	2000	2001	2002	2003	2004
Total gas production, thousand m^3	55581000	56400000	57414000	58430000	58060000	60428000
Natural gas leaks, thousand m^3	180439	153085	224747	188729	175234	143846

Methane fraction in natural gas is taken equal to 0.935 in volume units (averaged data of regular analyses of gas produced).

Calculation of methane emission

According to the formula (2)
CH_4 = 143846 thousand m^3 * 0.935 * 0.668*1000/1000 = 89843 tonne
(The example of calculation for 2004)

Calculation of annual aggregated methane emission factor

Specific CH_4 emission = 89843 tonne/ 60428000 thousand m^3 * 1000 = 1.49 kg/thousand m^3.
Specific CH_4 emission = 89843tonne / (60428000 thousand m^3 * 1000 * 8 100 000 cal/m^3 * 4.1868 J/cal/ 10^{15}) = 43841 kg/PJ.
(The example of calculation for 2004)

For six years taken for calculation of methane emission factors (1999-2004*)* as the most reliable for accounting all gas lost, the annual emission factors were calculated.

Table A13 Annual factors of methane emission from gas production, kg/PJ

1999	2000	2001	2002	2003	2004
59789	49989	72094	59487	55586	43841

Calculation of average factor

Based on the above presented aggregated factors of methane emission from gas production and preparation for the period 1999-2004, the average factor was calculated – **56798 kg/PJ.**

Estimation of available data deviation.
Standard square deviation $\sigma = \pm$ 9652.5 kg CH_4/PJ.
Maximal relative deviation (coefficient of variation) = ± 17.0 %.

8.2. Calculation of national factors of methane emissions from gas transmission pipelines

General scheme of emission factors calculation is as follow:

$$\mathbf{K = V_{NL} / V_{AD} * 1000} \quad (1)$$

Where:
К – emission factor, kg/thousand m^3
V_{NL}- amount of gas emitted into the atmosphere when gas losses and consumption for own needs, tonnes;
V_{AD} – activity data (volumes of gas transported), thousand m^3.

Calculation of methane amount:

$$\mathbf{V_{NL} = V*C*\rho_i/1000} \quad (2)$$

Where:
V – volume of gas, m^3
C – methane fraction in natural gas
ρ – density of methane – 0.668 kg/m^2 - under 20° C and 760 mm of mercury column.
1000 - conversion factor, that converts kg to tonne

Calculation of emission factor, kg/PJ

$$K\ kg/PJ = K\ kg/thousand\ m^3 * 8\,100\,000\ cal/m^3 * 4.1868\ J/cal/ 10^{15} \quad \mathbf{(3)}$$

Annual factors were calculated for the period 1999-2003.

The volumes of own needs and losses were calculated based on the method of gas discharge calculation for own needs and losses applied in the system of the gas transmission pipelines in the Republic of Uzbekistan. This method was developed basing on the Guidance on Control of Polluting Substances Emission from Transport and Gas Storage Facilities (Research Institute of Gas, Moscow, 1985).

Activity data were provided by the Joint-Stock Company «Uztransgaz».

Table A14 Data on the volumes of gas transmission and leaks

	1999	2000	2001	2002	2003
Gas intake in the pipe-lines of «Uztransgaz» (including transit of Turkmen gas), thousand m^3	57381533	79092548	82164489	83321929	87277265
Natural gas leaks, thousand m^3	2195345	2303959	2912861	3674561	3943376

Methane fraction in natural gas is taken equal to 0.927 in volume units (averaged data of regular analyses of gas produced).

Calculation of methane emission

According to the formula (2)
CH_4 = 2195345 thousand m^3 * 0.927 * 0.668 * 1000/1000 = 1359437 tonne
(The example of calculation for 1999)

Calculation of annual aggregated methane emission factor

Specific CH_4 emission = 1 359 437 tonne/ 57 381 533 thousand m^3 * 1000 = 23.69 kg/thousand m^3.
Specific CH_4 emission = 1 359 437 tonne / (57 381 533 thousand m^3 * 1000*8 100 000 cal/m^3 * 4.1868 J/cal/ 10^{15}) = 698 586 kg/PJ.
(The example of calculation for 1999)

For five years taken for calculation of methane emission factors (1999-2003*)* as the most reliable for accounting all gas lost, the annual emission factors were calculated.

Table A15 Annual factors of methane emission from gas transmission, kg/PJ

1999	2000	2001	2002	2003
698586	531898	647328	805258	825004

Calculation of average factor

Based on the above presented aggregated factors of methane emission from gas transmission for the period 1999-2003, the average factor was calculated – **701615 kg/PJ.**

Estimation of available data deviation.
Standard square deviation $\sigma = \pm$ 120132.1 kg CH_4/PJ.
Maximal relative deviation (coefficient of variation) = ± 17.1 %.

8.3. Calculation of national factor of methane emission from natural gas processing (refinement from sulfurous compounds)

General scheme of emission factors calculation is as follow:

$$K = V_{NL} / V_{AD} * 1000 \qquad (1)$$

Where:
К – emission factor, kg/thousand m^3
V_{NL} **-** amount of gas emitted into the atmosphere when gas losses and consumption for own needs, tonne;
V_{AD} **–** activity data (volumes of gas processed), thousand m^3.

Calculation of methane amount:

$$V_{NL} = V*C*\rho_i/1000 \qquad (2)$$

Where:
V – volume of gas, m^3
C – methane fraction in natural gas
ρ – density of methane – 0.668 kg/m^2 - under 20° C and 760 mm of mercury column.
1000 - conversion factor, that converts kg to tonne

Calculation of emission factor, kg/PJ

$$K\ kg/PJ = K\ kg/thousand\ m^3 * 8\,100\,000\ cal/m^3 * 4.1868\ J/cal/ 10^{15} \qquad (3)$$

Annual factors were calculated for two period 1999-2004 (Mubarek Gas Processing Plant) and 1995-1998 (Gas Production Plant "Shurtanneftegaz").

The volumes of own needs and losses were calculated based on "The method of gas discharge calculation for own needs and technological losses for gas processing plants" developed by the Uzbek Research Institute of Oil &Gas in 2004. This method was based on the "The Method of calculation of Polluting Substances Emission for Oil &Gas Production and Processing Enterprises", Tashkent, 1995.

Activity data were provided by the National Holding Company «Uzneftegaz».

Table A16 Data on volumes of gas processed and lost at the Mubarek Gas Processing Plant

	1999	2000	2001	2002	2003	2004
Intake for processing, thousand m^3	24678410	25825880	27298000	27323451	27521672	27801264
Natural gas leaks, thousand m^3	1506400	1544817	1467033	1444064	1394659	1334942

Methane fraction in natural gas is taken equal to 0.935 in volume units (averaged data of regular analyses of gas processed).

Table A17 Volumes of natural gas processed and lost at the Gas Production Plant «Shurtanneftegaz»

	1995	1996	1997	1998
Intake for processing, thousand m^3	12668530	13340360	13380740	13262590
Natural gas leaks, thousand m^3	132208	75701	60374	36433

Calculation of methane emission

According to the formula (2)
CH_4 = 1334942 thousand m^3 * 93.5/100 * 0.668 * 1000/1000 = 833778 tonne
(The example of calculation for 2004, Mubarek Gas Plant)
CH_4 = 132208 thousand m^3 * 93.5/100 * 0.668 * 1000/1000 = 82574 tonne
(The example of calculation for 1995, Gas Production Plant "Shurtanneftegaz")

Calculation of annual aggregated methane emission factor

Specific CH_4 emission = 833778 tonne/ 27801264 thousand m^3 * 1000 = 23.99 kg/thousand m^3.
Specific CH_4 emission = 833778 tonne / (27801264 thousand m^3 * 1000 * 8 100 000 cal/m^3 * 4.1868 J/cal/ 10^{15}) = 884339 kg/PJ.
(The example of calculation for 2004, Mubarek Gas Processing Plant)

Specific CH_4 emission = 82574 tonne/ 12668530 thousand m^3 * 1000 = 6.52 kg/thousand m^3.
Specific CH_4 emission = 82574 tonne / (12668530 thousand m^3 * 1000 * 8 100 000 cal/m^3 * 4.1868 J/cal/ 10^{15}) = 192200 kg/PJ.
(The example of calculation for 1995, Gas Production Plant "Shurtanneftegaz")

For six years taken for calculation of methane emission factors (1999-2004*)* as the most reliable for accounting all gas lost, the annual emission factors were calculated (Mubarek Gas Processing Plant)

Table A18 Annual factors of methane emission from processing (Mubarek Gas Processing Plant), kg/PJ

1999	2000	2001	2002	2003	2004
1124201	1101648	989760	973356	933285	884339

For four years taken for calculation of methane emission factors (1995-1998) the annual emission factors were получены, kg/PJ (Gas Production Plant "Shurtangaz")

Table A19 Annual methane emission factors from processing (Gas Production Plant "Shurtanneftegaz"), kg/PJ

1995	1996	1997	1998
1992200	104509	83098	50593

Calculation of average factor

Based on the above presented aggregated factors of methane emission from gas processing the average factors were calculated – **1001098 kg/PJ** for Mubarek Gas Processing Plant and **71733** for Gas Production Plant "Shurtanneftegaz"

A great difference in the factors is caused by difference in the technology of gas processing: Mubarek Gas Processing Plant - amine gas treating; Gas Production Plant "Shurtanneftegaz" - amine and zeolitic gas treating.

Estimation of available data deviation.
Mubarek Gas Refinery
Standard square deviation σ = ± 94227.5 kg CH_4/PJ.
Maximal relative deviation (coefficient of variation) = ± 9.4 %.

Gas Production Plant "Shurtangaz"
Standard square deviation σ = ± 60599.3 kg CH_4/PJ.
Maximal relative deviation (coefficient of variation) = ± 84.3 %.

Reference

1. The methods of calculation of gas consumption for own needs when gas production and field processing, Ukraine Research Institute of Gas, 1981.
2. RD 39.2-140-95. The method of calculation of polluting substances emissions in oil &gas production and oil &gas refinery, Tashkent, 1995.
3. RD 51-100-85. Guidance on regulation of polluting substances emissions from transport and gas storage facilities, Research Institute of Gas, Moscow, 1985.
4. The method of calculation of gas consumption rates for own needs and technological losses for gas refinery units, Uzbek Research Institute of Oil &Gas, Tashkent, 2004.

Annex 9

Calculation of national SO_2 emission factor from gas operation in Uzbekistan

In 2001 with the framework of the project “Uzbekistan: Country Study on Climate Change, Phase 2” the national SO_2 emission factor from gas operation was developed.

In Uzbekistan about 70% of gas produced contains up to 5% (in volume) of sulfurous compounds. Gas is treated from these compounds at the enterprises of the National Holding Company “Uzneftegaz”. Then sulfur is separated from these compounds.

The calculation was made based on the data of the National Holding Company “Uzneftegaz”. Limited number of the elements of the sample does not allow estimation of uncertainty of the national factor. Only deviation in the data available can be estimated.

The developed SO_2 emission factor from natural gas treatment from sulfurous compounds was used in the GHG inventory prepared within the framework of the Second National Communication as before this emission source was not inventoried and the default factors are not available in the Revised 1996 IPCC Guidelines for Greenhouse Gas Inventories, Greenhouse Gas Inventory Reporting Instructions, IPCC, 1996

General scheme of emission factors calculation is as follow:

$$К = V_{SO2} / V_{AD} \quad (1)$$

Where:

К – emission factor, tonne SO_2/tonne of sulfur produced;
V_{SO2}- SO_2 emissions, tonne;
V_{AD} – activity data (amount of sulfur processed), tonne.

Annual factors were calculated for the period 1998-2000.

The volumes of SO_2 emissions were calculated based on the RD 39.2-140-95 (Method of polluting substances emission calculation for oil &gas production and oil &gas processing enterprises of the oil &gas branch, Tashkent, 1995)

The activity data were provided by the National Holding Company “Uzneftegaz”.

Table A20 Data on gas sulfur production and sulfurous gas (SO_2) emissions from gas treatment

	1998	1999	2000
Sulfur production, tonnes	280000	273600	260000
SO_2 emissions, tonnes	91737	73507	62564

Calculation of annual aggregated SO_2 emission factor

SO_2 emission factor = 62564 tonne / 260000 tonne = 0.241 tonne SO_2/tonne of sulfur produced.

(Example of calculation for 2000)

For three years taken for calculation of SO_2 emission factors (1998-2000) the annual emission factors were calculated.

Table A21 Annual sulfur dioxide emissions from sulfur production, SO_2 tonne /tonne of sulfur produced

1998	1999	2000
0.328	0.269	0.241

Calculation of average factor

Based on the above presented aggregated factors of SO_2 emission from treatment of gas from sulfur-bearing compounds for 1998 – 2000 the average coefficient was calculated **0.279 SO_2 tonne / tonne** of sulfur produced. This emission factor was applied for SO_2 emission from gas operations within the preparation of the Second National Communication.

Estimation of available data deviation.
Standard square deviation $\sigma = \pm$ 0.044 tonne SO_2/ tonne of sulfur.
Maximal relative deviation (coefficient of variation) = ± 15.9 %.

References

1. RD 39.2-140-95 (Method of polluting substances emission calculation for oil &gas production and oil &gas processing enterprises of the oil &gas branch, Tashkent, 1995).
2. Revised 1996 IPCC Guidelines for Greenhouse Gas Inventories.

Annex 10

Calculation of national emission factors in the sector "Industrial processes" in Uzbekistan

In 2006 within the framework of the Second National Communication while the preparation of the greenhouse gas inventories the national emission factors were developed:

- CO_2 emission factor for ammonia production
- N_2O emission factor for nitric acid production
- NOx emission factor for nitric acid production
- SO_2 emission factor for sulphuric acid

The method of calculation of all factors was based on the production data and annual sum of the relevant emissions. Annual emissions were calculated on the industrial enterprises in accordance with the sectoral methods of calculation of polluting substances emissions, technological regulations or based on direct measurements.

Basing on these data the annual emission factors were calculated for each enterprise. In its turn, the average national emission factor for each gas was calculated using the annual emission factors.

Uncertainty of each factor (coefficient of variation) was calculated by the method of mathematical statistics.

Coefficient of variation (variability) Cv was calculated using the following formula:

$$Cv = \frac{\sigma}{\overline{X_i}} \cdot 100\%$$

where σ – standard deviation; $\overline{X}_i$ - average value for the given series of data

Standard deviation σ was calculated by the formula:

$$\sigma = \sqrt{\frac{\sum_{i=1}^{n}(X_i - \overline{X_i})^2}{(n-1)}}$$

where X_i – i- variable (value of emission factor); $\overline{X}_i$ - average for the given series; n – a number of terms in a series.

The data and the calculations for each of the developed factors are presented below.

10.1. National CO_2 emission factor for ammonia production

Ammonia is produced at the following enterprises of the State Joint-Stock Company «Uzkimesanoat»: «Elektrokimesanoat», «Navoiazot», and «Ferganaazot».

The data for ammonia production (thousands tonnes) from 1990 to 2005 and the annual CO_2 emissions from ammonia production for each enterprise were provided by the State Joint-Stock Company «Uzkimesanoat».

Table A22 Data for calculation of national factor

Year	Ammonia production, thousand tonnes	CO_2 emissions, thousand tonnes	Ammonia production, thousand tonnes	CO_2 emissions, thousand tonnes	Ammonia production, thousand tonnes	CO_2 emissions, thousand tonnes
	«Elektrokimesanoat»		«Navoiazot»		«Ferganaazot»	
1990	731.7	968.6	449.1	600.6	552.0	777.1
1991	713.6	946.7	469.7	627.6	552.0	777.1
1992	678.1	902.6	479.2	637.5	435.9	665.4
1993	563.7	758.6	378.0	504.9	402.4	614.3
1994	400.4	523.0	309.7	418.2	274.9	341.3
1995	477.3	631.0	332.6	442.4	292.0	362.5
1996	532.9	700.4	350.8	469.3	271.3	336.8
1997	481.6	636.6	385.0	516.8	279.9	347.5
1998	436.8	569.6	423.9	568.3	207.6	257.7
1999	404.1	532.9	411.1	550.4	149.1	185.1
2000	330.7	431.1	426.6	572.5	228.3	283.4
2001	240.3	315.3	442.2	595.0	130.1	161.5
2002	333.8	431.6	427.3	574.7	143.9	178.6
2003	351.6	449.4	428.8	575.7	212.6	263.9
2004	345.1	446.4	432.7	581.6	250.1	310.5
2005	372.4	484.2	405.6	545.4	287.1	356.4

Based on these data the emissions factors were calculated for each enterprise and average national CO_2 emission factor for ammonia production.

Table A23 CO2 (tonne/tonne) emission factors for ammonia production

Enterprise		«Elektrokimesanoat»	«Navoiazot»	«Ferganaazot»
1990		1.324	1.337	1.408
1991		1.327	1.336	1.408
1992		1.331	1.330	1.527
1993		1.346	1.336	1.527
1994		1.306	1.350	1.241
1995		1.322	1.330	1.241
1996		1.314	1.338	1.241
1997		1.322	1.342	1.241
1998		1.304	1.341	1.241
1999		1.319	1.339	1.241
2000		1.304	1.342	1.241
2001		1.312	1.345	1.241
2002		1.293	1.345	1.241
2003		1.278	1.343	1.241
2004		1.294	1.344	1.241
2005		1.300	1.345	1.241
Average value		**1.312**	**1.340**	**1.298**
Cv, %		**1.3**	**0.4**	**8,1**
σ, ±		**0.017**	**0.005**	**0,106**
Total	**Average value**	**1.317**		
	Cv. %	**4.8**		
	σ. ±	**0.063**		

Thus the national CO_2 emission factor for ammonia production is **1. 317 tonne CO_2/tonne** ammonia, its uncertainty is **4.8 %.**
Total CO_2 emission calculated using the national factor (1.317) and the default factor (1.5) [1, p. 2.13] for 2000 differ (table A24).

Table A24 Change in CO_2, emission (Gg) (at the moment of the national factor calculation)

Category	When using:		Change in CO_2 emission, %
	Default emission factor	National emission factor	
Ammonia production	1478.55	1298.17	- 12.2
Industrial processes	3700	3519	- 4.88
National CO_2 emission	109491.04	109310.66	- 0.16
National GHG emission (Gg CO_2 equivalent)	204135.9	203955.5	- 0.09

10.2. National N_2O emission factor for weak nitric acid production

Weak nitric acid is produced at the following enterprises of the State Joint-Stock Company «Uzkimesanoat»: «Elektrokimesanoat», «Navoiazot», and «Ferganaazot». The weak acid is produced the combined way, that is, each enterprise is equipped with the units working under both increased pressure and atmospheric pressure.

The data for weak nitric acid production (thousands tonnes) from 1990 to 2005 and the annual N_2O emissions from weak acid production for each enterprise were provided by the State Joint-Stock Company «Uzkimesanoat».

Table A25 Data for calculation of national factor

Year	Weak acid production, thousand tonnes	N_2O emissions, tonnes	Weak acid production, thousand tonnes	N_2O emissions, tonnes
	«Elektrokimesanoat»		«Navoiazot»	
1990	558.8	2304.8	812.1	3971.4
1991	538.2	2410.7	840.4	4027.3
1992	494.7	2022.0	831.2	4017.9
1993	447.8	1483.3	637.1	3048.6
1994	301.8	669.3	526.8	2529.4
1995	356.5	1573.2	565.3	2674.0

Year	Weak acid production, thousand tonnes	N_2O emissions, tonnes	Weak acid production, thousand tonnes	N_2O emissions, tonnes
	«Elektrokimesanoat»		«Navoiazot»	
1996	403.4	684.4	591.7	2779.6
1997	380.9	1147.4	363.1	2942.3
1998	373.4	1436.1	709.1	3258.7
1999	330.2	380.1	708.0	3300.2
2000	329.3	1374.9	727.7	3377.8
2001	379.3	1047.4	713.6	3279.4
2002	349.1	1269.8	695.4	3271.5
2003	367.7	2437.7	688.0	3208.6
2004	348.3	1324.6	653.7	3108.3
2005	344.2	1833.3	651.3	3080.5

N_2O emissions were calculated based on instrumental measurements in waste gases released from weak nitric acid production units. At the «Ferganaazot» such measurements were not conducted.

Based on these data the emissions factors were calculated for each year, each enterprise and average national N_2O emission factor for weak nitric acid production.

Table A26 N_2O (kg/tonne) emission factors for weak nitric acid production

Enterprise		«Elektrokimesanoat»	Navoiazot»
1990		4.125	4.890
1991		4.479	4.792
1992		4.087	4.834
1993		3.212	4.785
1994		2.217	4.801
1995		4.413	4.730
1996		1.697	4.698
1997		3.012	4.626
1998		3.846	4.595
1999		1.151	4.661
2000		4.175	4.642
2001		2.761	4.596
2002		3.637	4.704
2003		6.630	4.664
2004		3.803	4.755
2005		5.326	4.730
Average value		**3.667**	**4.719**
Cv, %		**36.7**	**1.8**
σ, ±		**1.345**	**0.087**
Total	**Average value**	**4.193**	
	Cv, %	**25.7**	
	σ, ±	**1.079**	

Thus the national N_2O emission factor for weak nitric acid production is **4. 193 kg N_2O /tonne** nitric acid, its uncertainty is **25.7 %.**
Total N_2O $_{emission}$ calculated using the national factor **(4. 193)** and the default factor 7.5 [1, Table 2-5, page 2.16] for 2000 differ (table A27).

Table A27 Change in N_2O emission (Gg) (at the moment of the national factor calculation)

Category	When using: Default emission factor	When using: National emission factor	Change in N_2O emission, %
Weak nitric acid production	7.93	4.43	- 44.1
Industrial processes	7.93	4.43	- 44.1
Nation N_2O emission	36.256	32.758	- 9.6
National GHG emission (Gg CO_2 equivalent)	203955.5	202620.7	- 0.65

10.3. National NOx emission factor for weak nitric acid production

Weak nitric acid is produced at the following enterprises of the State Joint-Stock Company «Uzkimesanoat»: «Elektrokimesanoat», «Navoiazot», and «Ferganaazot».

The data for weak nitric acid production (thousands tonnes) from 1990 to 2005 and the annual NOx emissions from weak acid production for each enterprise were provided by the State Joint-Stock Company «Uzkimesanoat».

Table A28 Data for calculation of national factor

Year	Weak acid production, thousand tonnes	NOx emissions, tonnes	Weak acid production, thousand tonnes	NOx emissions, tonnes	Weak acid production, thousand tonnes	NOx emissions, tonnes
	«Elektrokimesanoat»		«Navoiazot»		"Ferganaazot"	
1990	558.8	183.2	812.1	501.9	*	*
1991	538.2	200.5	840.4	505.2	405.7	247.5
1992	494.7	459.2	831.2	513.7	394.8	240.8
1993	447.8	265.9	637.1	379.9	401.2	244.7
1994	301.8	29.0	526.8	362.1	305.9	208.0
1995	356.5	157.7	565.3	376.9	276.0	193.2
1996	403.4	207.0	591.7	375.3	288.2	169.0
1997	380.9	138.1	363.1	357.6	116.5	87.4
1998	373.4	149.9	709.1	434.6	103.1	82.5
1999	330.2	168.7	708.0	459.6	0.71	0.6
2000	329.3	166.3	727.7	486.7	**	**
2001	379.3	167.2	713.6	482.7	**	**
2002	349.1	191.2	695.4	522.5	**	**
2003	367.7	105.5	688.0	591.7	34.4	15.1
2004	348.3	584.5	653.7	650.6	159.9	150.8
2005	344.2	315.1	651.3	506.2	220.5	177.1

*- no data available or not defined
** - production was ceased

NOx emissions were calculated using the departmental methods of definition of polluting substances emissions.

Based on these data the emissions factors were calculated for each year, each enterprise and average national NOx mission factor for weak nitric acid production.

Table A29 NOx (kg/tonne) emission factors for weak nitric acid production

Enterprise		«Elektrokimesanoat»	«Navoiazot»	"Ferganaazot"
1990		0.328	0.618	
1991		0.373	0.601	0.610
1992		0.928	0.618	0.610
1993		0.594	0.596	0.610
1994		0.096	0.687	0.680
1995		0.442	0.667	0.700
1996		0.513	0.634	0.680
1997		0.363	0.562	0.750
1998		0.401	0.613	0.800
1999		0.511	0.649	0.845
2000		0.505	0.669	
2001		0.441	0.676	
2002		0.548	0.751	
2003		0.287	0.860	0.439
2004		0.592	0.995	0.943
2005		0.915	0.777	0.803
Average value		**0.490**	**0.686**	**0.706**
Cv, %		**43.0**	**16.3**	**18.9**
σ, ±		**0.210**	**0.112**	**0.134**
Total	**Average value**	**0.620**		
	Cv. %	**29.9**		
	σ. ±	**0.185**		

Thus the national NOx emission factor for nitric acid production is **0. 620 kg NOx /tonne** nitric acid, its uncertainty is **29.9 %.**
Total NOx emission calculated using the national factor **(0. 620**) and the default factor 12 [1, page 2.16] for 2000 differ (table A30).

Table A30. Change in NOx emission (Gg) (at the moment of the national factor calculation)

Category	When using:		Change in NOx emission, %
	Default emission factor	National emission factor	
Weak nitric acid production	12.68	0.66	- 94.8
Industrial processes	12.70	0.67	- 94.7
Nation NOx emission	287.30	275.27	- 4.2

10.4 SO_2 emission factor for sulphuric acid production

Sulphuric acid is produced at the following enterprises of the State Joint-Stock Company «Uzkimesanoat»: «Ammofos», Samarkand chemical plant (up to 2002), «Elektrokimesanoat» (plant «Kaproloktam»).

The data on sulphuric acid production (thousand tonnes) for the period 1990 – 2005 and the annual SO_2 emissions from sulphuric acid production for each enterprise were provided by the State Joint-Stock Company «Uzkimesanoat». Some sulphuric acid production enterprises do not belong to the State Joint-Stock Company «Uzkimesanoat». These enterprises were not taken into account while the national emission factor calculation due to lack of necessary data on the annual sulphuric gas emissions.

The production conditions at these enterprises are assumed to be the same as at the State Joint-Stock Company «Uzkimesanoat". This calculated emission factor was employed for the calculation of the national emissions.

Table A31 Data for national factor calculation

Year	Sulphuric acid production, thousand tonnes	SO_2, emissions, tonnes	Sulphuric acid production, thousand tonnes	SO_2, emissions, tonnes	Sulphuric acid production, thousand tonnes	SO_2, emissions, tonnes
	«Ammofos»		Samarkand chemical plant		Plant «Kaproloktam»	
1990	*	*	*	*	208.3	159.2
1991	489.6	*	636.2	503.2	224.7	138.4
1992	195.6	*	347.2	380.2	187.5	131.7
1993	256.9	*	337.4	101.5	138.9	84.4
1994	78.4	73.8	93.3	*	147.1	93.1
1995	157.2	274.8	190.3	*	157.7	83.2
1996	226.7	356.2	268.1	120.6	131.9	40.1
1997	106.3	256.9	185.0	454.5	154.0	53.7
1998	186.8	417.3	145.0	494.4	91.6	53.9
1999	243.2	627.3	152.7	651.6	151.5	45.2
2000	164.0	353.5	95.8	424.0	106.5	51.6
2001	84.7	164.1	43.1	291.7	61.7	45.3
2002	279.4	764.7	**	**	56.5	36.8
2003	184.5	486.9	**	**	35.4	31.5
2004	180.2	231.1	**	**	67.8	50.4
2005	112.0	382.5	**	**	72.0	55.3
2006					58.9	16.2

* -no data available or they were not defined
** - production was stopped

Based on these data the emission factors were calculated for each year and for each enterprise as well as average national SO_2 emission factor from sulphuric acid production.

Table A32 SO_2 (kg/tonne) emission factors for sulphuric acid production

	Enterprise	«Ammofos»	Samarkand chemical plant	Plant «Kaprolaktam»
	1990			0.764
	1991		0.791	0.616
	1992		1.095	0.703
	1993		0.301	0.608
	1994	0.942		0.633
	1995	1.748		0.528
	1996	1.571	0.450	0.304
	1997	2.417	2.457	0.349
	1998	2.234	3.410	0.588
	1999	2.579	4.267	0.298
	2000	2.155	4.425	0.485
	2001	1.937	6.768	0.735
	2002	2.727		0.651
	2003	2.639		0.890
	2004	1.282		0.744
	2005	3.415		0.768
	2006			0.276
	Average value	**2.138**	**2.663**	**0.585**
	Cv, %	**32.2**	**83.5**	**29.7**
	σ, ±	**0.687**	**2.224**	**0.174**
Total	**Average value**	**1.567**		
	Cv, %	**91.7**		
	σ, ±	**1.437**		

Thus, the national SO_2 emission factor from sulphuric production – **1.567 kg SO_2 /tonne** of sulphuric acid, its uncertainty is high and equal **91.7 %.**

Total SO_2 emission calculated with use of the factor 1.567 as comparison with the total emission calculated with use of the default emission factor 17.5 [1, Table 2-10, p. 2.23] for 2000 change as follows:

Table A33 Change in SO_2 emission, Gg (at the moment of the national factor calculation)

Category	When using: Default emission factor	When using: National emission factor	Change in SO_2 emission, %
Sulphuric acid production	14.41	1.29	- 90.0
Industrial processes	15.423	2.666	- 82.7
Nation SO_2 emission	311.816	288.839	- 7.4

References

1. Revised 1996 IPCC Guidelines for Greenhouse Gas Inventories, Volume 2.

Annex 11

Calculation of imported HFCs

Due to incomplete data available on HFCs import in Uzbekistan to estimate possible HFC emissions the calculation was made of the amount of HFCs imported for the period 2000 – 2005 based on the following data and assumptions.

Data:

The data of the State Committee on Statistics of the Republic of Uzbekistan.

Table A34 Import of fluorides and iodide

2002	2003	2004	2005
1.1 tonnes	5.9 tonnes	24.9 tonnes	7.9 tonnes

The data of the State Committee for Nature Protection of the Republic of Uzbekistan.

Table A35 Import of fluorocarbon for the period 2000-2004

R-407c	R-404a	R-134a
1.9408 tonnes	4.7647 tonnes	33.45716 tonnes

Assumptions

1. Having no detailed information on fluorides and iodides, we consider the sum of fluorides and iodides as HFCs;
2. Composition of HFCs for each year is the same;
3. Share of each HFC in total amount remains unchangeable for each year;
4. Amount of HFCs is equal for 2000 and 2001.

The calculation of HFCs amount for each year is presented below.

Calculation of the HFC import for each year.

Calculation of the total amount

Total HFCs for 2000-2004 = R-407c + R-404a + R-134a = (1)
1.9408 + 4.7647 + 33.45716 = 40.16266 tonne

Total HFCs for 2002-2004 = 1.1 + 5.9 + 24.9 = 31.9 tonne (2)

Total HFCs for 2000-2001 = 40.16266 – 31.9 = 8.26266 tonne / 2 = 4.13133 for each year (3)

Table A36 Fraction of each HFC including multi-component ones for each year

HFC	Amount, tonne	Fraction
R-407c	1.9408	0.048
R-404a	4.7647	0.119
R-134a	33.45716	0.833
Total	40.16266	1.000

Amount of each HFC including multi-component ones for each year

In accordance with the formula
Amount of each HFC = Σ HFC for each year x HFC fraction (4)
The amount of HFC was calculated for each year:

Table A37 Annual amount of imported HFC

Year	R-407c, tonne	R-404a, tonne	R-134a, tonne
2000	0.19964	0.490121	3.441569
2001	0.19964	0.490121	3.441569
2002	0.053156	0.130499	0.916346
2003	0.285109	0.699947	4.914944
2004	1.203255	2.954013	20.74273
2005	0.381756	0.937217	6.581027

Taking multi-component HFC into account

It should be taken into account that above indicated HFCs are of complex composition.

Table A38 HFC composition

HFC	Composition	Fraction	HFC	Composition	Fraction
R-407c	HFC-32	0.23	R-404a	HFC-143a	0.44
	HFC-125	0.25		HFC-125	0.52
	HFC-134a	0.52		HFC-134a	0.04

Information on the composition of each multi-component HFCs were taken from the site of the producer AlChem, Ukraine: alchemi.com.

Amount of each HFC for each year

As a result of the calculations the following amount of HFCs were obtained for each year:

Table A39 Annual amount of separate HFCs, tonne

Year	HFC-32	HFC-125	HFC-134a	HFC-143a	Total
2000	0.0459	0.3048	3.5650	0.2157	4.13
2001	0.0459	0.3048	3.5650	0.2157	4.13
2002	0.0122	0.0811	0.9492	0.0574	1.10
2003	0.0656	0.4352	5.0912	0.3080	5.90
2004	0.2767	1.8369	21.4866	1.2998	24.90
2005	0.0878	0.5828	6.8170	0.4124	7.90

Recalculation into CO_2 equivalent.

For recalculation the following values of the global warming potential were used:

Table A40 Global warming potentials

HFC-32	HFC-125	HFC-134a	HFC-143a
650	2800	1300	3800

The following estimates of the possible HFC emission were obtained.

Table A41 HFC emissions in CO_2 equivalent

Year	HFC-32	HFC-125	HFC-134a	HFC-143a	Total
2000	29.85	853.36	4634.48	819.48	6337.17
2001	29.85	853.36	4634.48	819.48	6337.17
2002	7.95	227.22	1233.97	218.19	1687.32
2003	42.62	1218.70	6618.56	1170.31	9050.19
2004	179.89	5143.32	27932.56	4939.11	38194.88
2005	57.07	1631.82	8862.14	1567.03	12118.05

Annex 12

Calculation of CO_2 emission/removals from agricultural soils

Developer of the method of the calculation of CO_2 emission/removals from agricultural soils is Dr. Anatol Banaru, The Research Institute for Pedology, Agrochemistry and Hydrology “N.Dimo”, Moldova.
The methodology is based on the assessment of the carbon cycle of the arable soils. The carbon storage results from the humification of vegetable residues and organic nutrients and is assessed through the calculation of the humification coefficients. The CO_2 emissions depend on the organic matters mineralization and are calculated as nitrogen export with yield, because there is a constant ration between carbon and nitrogen in soil’s humus
The national coefficients used for the calculations were taken from the listed below sources.

Reference

1. Anatol Banaru. The greenhouse CO_2 emissions from the arable soils of the Republic of Moldova. CLIMATE CHANGE. Researches, studies, solutions. Chisenau, 2000.
2. Anatol Banaru. The methodology for the assessment of greenhouse CO_2 emissions from the arable soils. CLIMATE CHANGE. Researches, studies, solutions. Chisenau, 2000.
3. Agrochemistry / Edited by B.A. Yagodin, 1982.
4. Al Dalfi. Mineral Fertilizers Impact on Spring Wheat Yield Depending on Soil Conditions and Sort. Author's abstract of dissertation. - Tashkent, 1984.
5. M.A. Belousov. Physiological Fundamentals of Cotton Root Nutrition. - Tashkent, 1975.
6. V.V Lapa., N.A. Ivanenko. Using Nutrients of Fertilizers and Soils by Agricultural Crops// Agrochemistry. - № 7. - Moscow, 1989.
7. E.N. Masharipov. Balance of Manure Nitrogen and Mineral Fertilizers when their Separate and Joint Application to Cotton. Author's abstract of dissertation. - Tashkent, 1984.
8. Methods of Agrochemical and Agrophysical Research in Soil. - Tashkent: SoyuzNIKI, 1978.
9. Irrigated Farming / Edited by S.N. Ryzhov. - Tashkent, 1965.
10. D.S. Satarov. Sort, Soil, Fertilizer and Yield. - Tashkent, 1988.
11. S. Siddikov. Dependence of Qualitative and Quantitative Composition of Humus of Irrigated Soils on Agrotechnics and Kinds of Plant Recidues. Author's abstract of dissertation. - Tashkent, 1987.
12. Z. Umarov, Kh. N. Atabaeva. Wheat and Barley Productivity when Fall Sowing and a Possibility of Having the Second Yield // Information Leaflet. - Tashkent, 1994.

MODULE	AGRICULTURE									
SUBMODULE	AGRICULTURAL SOILS									
	1-2									
WORKSHEET	ESTIMATE OF CARBON INPUT TO SOIL WITH PLANT RESIDUES AND ORGANIC FERTILIZRES									
2000	STEP 1						STEP 2			
	A	B	C	D	E	F	G	H	I	J
Crop, years and land area, thousand hectares	Gross yield	Coefficient of plant residues accumulation	Amount of plant residues	Coefficient of plant residues humification	Amount of humus	Amount of carbon input with plant residues	Amount of manure applied	Humified manure	Amount of carbon input with manure	Total amount of carbon
	thousand tonnes		**thousand tonnes**		**thousand tonnes**	**thousand tonnes**	**thousand tonnes**	**thousand tonnes**	**thousand tonnes**	**thousand tonnes**
			C = A x B		**E = (C x D)**	**F = E x 0.58**		**G x 0.22**	**I=H x 0.58**	**J = F+I**
COTTON		0.85		0.21						
2001	3270.18	0.85	2779.7	0.21	583.7	338.6	10163.3	2235.9	1296.8	1635.4
2000	3001.53	0.85	2551.3	0.21	535.8	310.7	7222.05	1588.9	921.5	1232.3
1999	3599.99	0.85	3060.0	0.21	642.6	372.7	6069.6	1335.3	774.5	1147.2
Average	3290.57	0.85	2797.0	0.21	587.4	340.7	7818.3	1720.0	997.6	1338.3
WHEAT		1.17		0.19						
2001	3802.2	1.17	4448.6	0.19	845.2	490.2	9320.1	2050.4	1189.2	1679.5
2000	3623.0	1.17	4238.9	0.19	805.4	467.1	6420.2	1412.4	819.2	1286.3
1999	3551.9	1.17	4155.7	0.19	789.6	458.0	4020.5	884.5	513.0	971.0
Average	3659.0	1.17	4281.1	0.19	813.4	471.8	6586.9	1449.1	840.5	1312.3
ALFALFA		0.5		0.18						
2001	1.500	0.5	0.750	0.18	0.135	0.078				0.078
2000	1.500	0.5	0.750	0.18	0.135	0.078				0.078
1999	1.500	0.5	0.750	0.18	0.135	0.078				0.078
Average	1.500	0.5	0.750	0.18	0.135	0.078				0.078
Total:										

MODULE	AGRICULTURE			
SUBMODULE	AGRICULTURAL SOILS			
	3-4			
WORKSHEET	ESTIMATE OF NITROGEN REMOVAL WITH PLANT RESIDUES			
2000	STEP 3		STEP 4	
Crop, years	K	L	M	N
	Coefficient of nitrogen removal	Total nitrogen removed from soil with yield	Nitrogen content in plant residues (leaves and root)	Nitrogen returned to soil with plant residues
		thousand tonnes		thousand tonnes
		L=A x K		N=C x M
COTTON	0.05		0.0064	
2001	0.05	163.51	0.0064	17.79
2000	0.05	150.08	0.0064	16.33
1999	0.05	180.00	0.0064	19.58
Average	0.05	164.53	0.0064	17.90
WHEAT	0.035		0.005	
2001	0.035	133.08	0.005	22.24
2000	0.035	126.81	0.005	21.19
1999	0.035	124.32	0.005	20.78
Average	0.035	128.07	0.005	21.41
ALFALFA	0.025		0.028	
2001	0.025	0.038	0.028	0.021
2000	0.025	0.038	0.028	0.021
1999	0.025	0.038	0.028	0.021
Average	0.025	0.038	0.028	0.021
Total:				

MODULE	**AGRICULTURE**						
SUBMODULE	**AGRICULTURAL SOILS**						
	5-6-7						
WORKSHEET	**ESTIMATION OF NITROGEN INPUT TO SOIL WITH MINERAL AND ORGANIC FERTILIZERS**						
2000	**STEP 5**		**STEP 6**		**STEP 7**		
	O	P	Q	R	S	T	U
Crop, years	Nitrogen input to soil with mineral fertilizers	Nitrogen removed from mineral fertilizers by plants	Nitrogen input to soil with organic fertilizers	Manure nitrogen removed with yield	Coefficient of nitrogen fixation by legumes	Symbiotic nitrogen kept in soil	Symbiotic nitrogen removed from soil
	thousand tonnes	**thousand tonnes**	**thousand tonnes**	**thousand tonnes**		**thousand tonnes**	**thousand tonnes**
		P=O x 0.40	**Q=G x 0.005**	**R=Q x 0.3**			
COTTON		0.40	0.005	0.3			
2001	281.67	112.67	50.8	15.2			
2000	295.81	118.32	36.1	10.8			
1999	291.34	116.54	30.3	9.1			
Average	289.61	115.84	39.1	11.7			
WHEAT		**P=O x 0.36**					
2001	196.1	70.60	46.6	14.0			
2000	203.02	73.09	32.1	9.6			
1999	201.12	72.40	20.1	6.0			
Average	200.08	72.03	32.9	9.9			
ALFALFA						**T=C x M**	**U=A x K**
2001						0.021	0.038
2000						0.021	0.038
1999						0.021	0.038
Average						0.021	0.038
Total:							

MODULE	**AGRICULTURE**				
SUBMODULE	**AGRICULTURAL SOILS**				
	8				
WORKSHEET	**ESTIMATION OF CARBON REMOVAL FROM SOIL**				
2000	**STEP 8**				
	V	W	X	Y	Z
Crop, years	Nitrogen input to soil with plant residues, mineral and organic fertilizers	Nitrogen removed from soil (soil nitrogen)	Coefficient of soil texture	Coefficient of crop technological effectiveness	Carbon removed from soil
	thousand tonnes	**thousand tonnes**			**thousand tonnes**
	V=N+O+Q	**W=L-(P+R)**			**Z=W x X x Y x 10,7**
COTTON			1.2	1.5	
2001	350.28	35.60	1.2	1.5	685.58
2000	348.25	20.92	1.2	1.5	402.91
1999	341.27	54.36	1.2	1.5	1046.96
Average	346.60	36.96	1.2	1.5	711.81
WHEAT			1.2	1.85	
2001	264.94	48.50	1.2	1.85	1152.11
2000	256.32	44.09	1.2	1.85	1047.25
1999	242.00	45.88	1.2	1.85	1089.90
Average	254.42	46.16	1.2	1.85	1096.42
ALFALFA	**V=N**	**W=L-V**	1.2	1.5	
2001	0.021	0.017	1.2	1.5	0,318
2000	0.021	0.017	1.2	1.5	0,318
1999	0.021	0.017	1.2	1.5	0,318
Average	0.021	0.017	1.2	1.5	0,318
Total:					

MODULE	AGRICULTURE	
SUBMODULE	AGRICULTURAL SOILS	
	9	
WORKSHEET	ESTIMATION OF CARBON BALANCE	
2000	**STEP 9**	
Crop, years	Aa	Ab
	Carbon balance	CO_2 emission
	thousand tonnes	**thousand tonnes**
	Aa=J-Z	**Ab=-(Aa x 3.67)**
COTTON		
2001	949.82	-3485.84
2000	829.37	-3043.80
1999	100.23	-367.85
Average	626.47	-2299.16
WHEAT		
2001	527.37	-1935.44
2000	239.09	-877.46
1999	-118.92	436.45
Average	215.84	-792.15
ALFALFA		
2001	-0.239	0.879
2000	-0.239	0.879
1999	-0.239	0.879
Average	-0.239	0.879
Total:	**842.080**	**-3090.433**

Annex 13

Quantitative estimates of uncertainties by separate gases and sectors

Table A42 Quantitative estimate of uncertainties associated with CO_2 emission from the sector "Energy", 2000

Sub-sectors	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	n, Gg CO_2-eq	±E	n+E	n-E
	U_A	U_F	U_T		Gg CO_2-eq		
Energy Industries	1%	5%	5%	44284.4	2258.1	46542.5	42026.4
Manufacturing Industries and Construction (all)	15%	5%	16%	4981.8	787.7	5769.5	4194.1
Road Transportation	15%	5%	16%	5619.4	888.5	6507.9	4730.9
Civil Aviation (domestic)	40%	5%	40%	70.7	28.5	99.3	42.2
Railways	1%	5%	5%	327.2	16.7	343.9	310.5
Pipeline Transport	1%	5%	5%	5114.3	260.8	5375.1	4853.5
Commercial/Institutional	15%	5%	16%	9023.8	1426.8	10450.6	7597.0
Residential	15%	5%	16%	32695.9	5169.7	37865.6	27526.3
Agriculture /Forestry/Fishing	15%	5%	16%	2693.2	425.8	3119.1	2267.4
Total				104810.8	11262.6	116073.4	93548.3
% of total					10.7	10.7	-10.7

Table A43 Quantitative estimate of uncertainties associated with CO_2 emission from the sector "Industrial Processes", 2000

Sub-sectors	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	n, Gg CO_2-eq	±E	n+E	n-E
	U_A	U_F	U_T		Gg CO_2-eq		
Clinker production	1%	6%	6%	1475.5	89.8	1565.3	1385.8
Ammonia production	1%	5%	5%	1298.0	66.2	1364.2	1231.8
Total				2773.5	155.9	2929.5	2617.6
% of total					5.6	5.6	-5.6

Table A44 Quantitative estimate of uncertainties associated with CO_2 emission by categories, 2000

Sub-sectors	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	n, Gg CO_2-eq	±E	n+E	n-E
	U_A	U_F	U_T		Gg CO_2-eq		
Energy Industries	1%	5%	5%	44284.4	2258.1	46542.5	42026.4
Manufacturing Industries and Construction	15%	5%	16%	4981.8	787.7	5769.5	4194.1
Road Transportation	15%	5%	16%	5619.4	888.5	6507.9	4730.9
Civil Aviation (domestic)	40%	5%	40%	70.7	28.5	99.3	42.2
Railways	1%	5%	5%	327.2	16.7	343.9	310.5
Pipeline Transport	1%	5%	5%	5114.3	260.8	5375.1	4853.5
Commercial/ Institutional	15%	5%	16%	9023.8	1426.8	10450.6	7597.0
Residential	15%	5%	16%	32695.9	5169.7	37865.6	27526.3
Agriculture	15%	5%	16%	2693.2	425.8	3119.1	2267.4
Clinker production	1%	6%	6%	1475.5	89.8	1565.3	1385.8
Ammonia Production	1%	5%	5%	1298.0	66.2	1364.2	1231.8
Total				107584.4	11418.5	119002.9	96165.9
% of total					10.6	10.6	-10.6

Table A45 Quantitative estimate of uncertainties in the sector «Industrial Processes», 2000

Sub-sectors	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	n, Gg CO_2-eq	±E	n+E	n-E
	U_A	U_F	U_T		Gg CO_2-eq		
Clinker production	1%	6%	6%	1475.5	89.8	1565.3	1385.8
Ammonia Production	1%	5%	5%	1298.0	66.2	1364.2	1231.8
Nitric Acid Production	1%	26%	26%	1373.9	357.5	1731.4	1016.4
Total				4147,4	513.4	4660.9	3634.0
% of total					12.4	12.4	-12.4

Table A46 Quantitative estimate of uncertainties associated with emissions from all categories, 2000

Sub-sectors	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	n, Gg CO_2-eq	±E	n+E	n-E
	U_A	U_F	U_T		$GgCO_2$-eq		
Energy Industries	1%	5%	5%	44284.4	2258.1	46542.5	42026.4
Manufacturing Industries and Construction	15%	5%	16%	4981.8	787.7	5769.5	4194.1
Road Transportation	15%	5%	16%	5619.4	888.5	6507.9	4730.9
Civil Aviation (domestic)	40%	5%	40%	70.7	28.5	99.3	42.2
Railways	1%	5%	5%	327.2	16.7	343.9	310.5
Pipeline Transport	1%	5%	5%	5114.3	260.8	5375.1	4853.5
Commercial/Institutional	15%	5%	16%	9023.8	1426.8	10450.6	7597.0
Residential	15%	5%	16%	32695.9	5169.7	37865.6	27526.3
Agriculture	15%	5%	16%	2693.2	425.8	3119.1	2267.4
Clinker production	1%	6%	6%	1475.5	89.8	1565.3	1385.8
Ammonia Production	1%	5%	5%	1298.0	66.2	1364.2	1231.8
Nitric Acid Production	1%	26%	26%	1373.9	357.5	1731.4	1016.4
Total				108958.3	11775.0	120734.3	97182.3
% of total					10.8	10.8	-10.8

References

1. Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 1.
2. Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, IPCC, 2003.