TURKEY Greenhouse Gas Inventory,1990 to 2007

Annual Report for submission under the Framework Convention on Climate Change

National Inventory Report

TURKISH STATISTICAL INSTITUTE

Ankara, 2009

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Data sheet

Title: Turkish National Inventory Report 2007 – submitted under the United Nations Convention on Climate Change

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Note: The sections pertaining to the related sectors in this report and the CRF tables are prepared by the related organizations.

Executive Summary

The United Nations Framework Convention on Climate Change (UNFCCC) was ratified by TURKEY in 2004. As a party to the convention, TURKEY prepared its first national inventory report (NIR) and CRF tables for the period 1990 – 2004 and submitted to UNFCCC in 2006. Turkey has, now, prepared its fourth NIR for the year 2007.

TURKEY is committed to develop, periodically update and make available national inventories of anthropogenic GHG emissions by sources and removals by sinks of greenhouse gases not controlled by the *Montreal Protocol* using the comparable methodologies.

This report presents the national inventory of greenhouse gas (GHG) emissions and removals from 1990 to 2007. Emissions of the five direct greenhouse gases were covered in the report. These were:

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

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

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

The Turkish Greenhouse Gas Inventory is, now, submitted to the UNFCCC in the form of the Common Reporting Format which was attached to this report in the form of XLS, XML (as export) and MDB (as backup) files. It should be noted that in this report, carbon dioxide emissions and removals were reported separately and removals were reported with a negative sign.

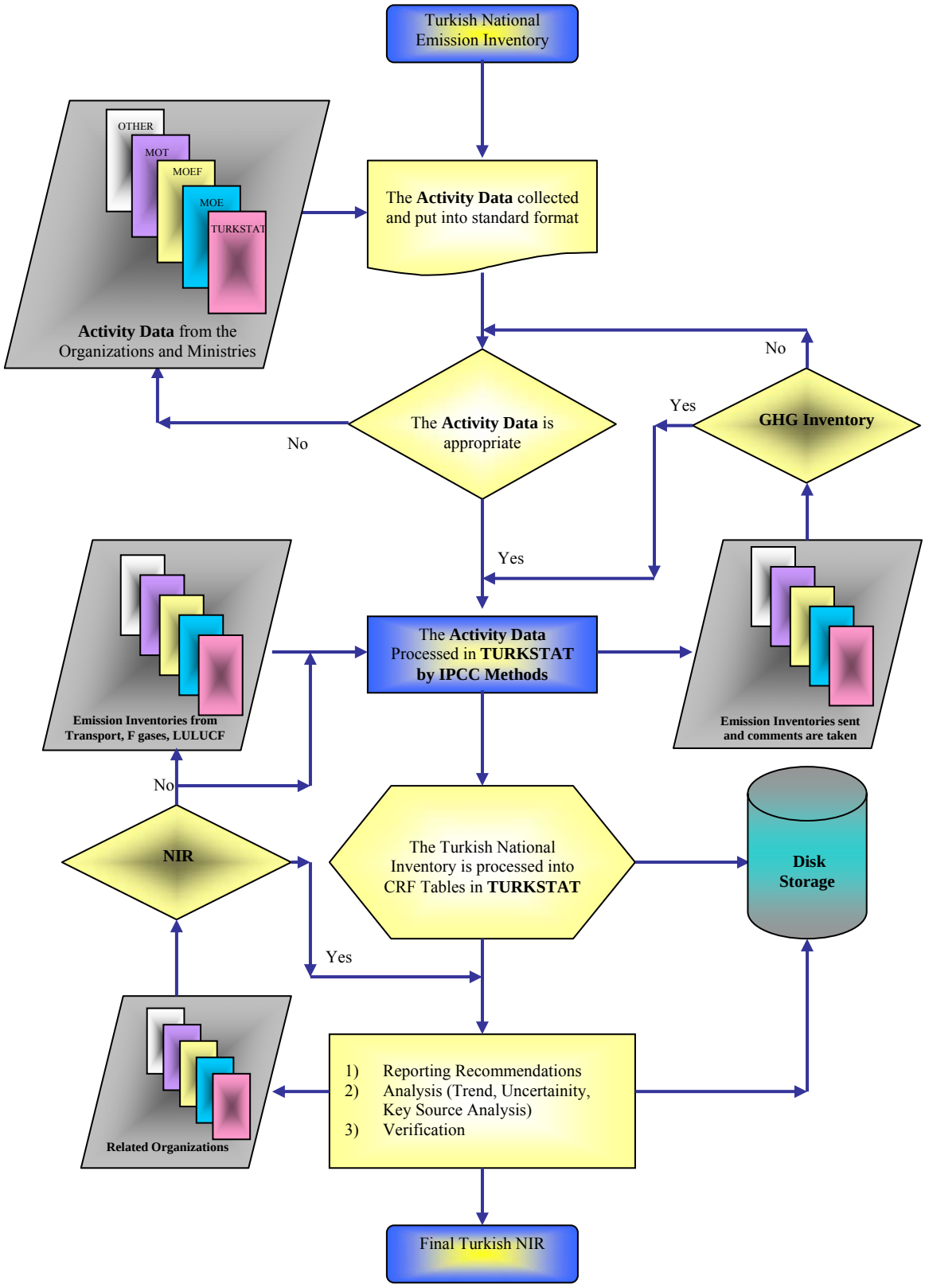
In this National Inventory Report, the source categories according to the IPCC methodology, i.e. energy, industrial processes, agriculture, land-use, land use change and forestry (LULUCF), and wastes were considered. Solvent and other product use were not considered due to the lack of activity data.

The Ministry of Environment and Forestry (MOEF) is designated to be responsible for the national inventory of greenhouse gases in Turkey, The inventory was prepared as a joint work by Turkish Statistical Institute, Ministry of Agriculture and Rural Affairs, Ministry of Environment and Forestry, Ministry of Transportation, Ministry of Energy and Natural

Resources and some universities. The CRF reporter for each source categories were prepared by related organizations and combined by MOEF.

The CRF data sets also contain key source, trend and uncertainty analysis. The key source category is one that is prioritised within the national inventory system because its estimate has a significant influence on a country's total inventory of direct greenhouse gases in terms of the absolute level of emissions and removals. In addition to key source analysis, the emission estimates have been prepared through the investigation of emissions trends. This trend assessment identifies source categories for which significant uncertainty in the estimate would have considerable affected on overall emission trends, and therefore identifies source categories that diverge from the overall trend in national emissions. Quantitative estimates of the uncertainties in the emissions were calculated using direct expert judgement. The total uncertainty is 10.9%, because of the high uncertain data of CO_2 uptake by forest.

NATIONAL EMISSION INVENTORY SYSTEM



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List of Abbreviations

COP	Conference of the Parties
CRF	Common Reporting Format
EEA	European Environmental Agency
EF	Emission Factor
GHG	Greenhouse Gas
GPG	Good Practice Guidance
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
ITU	İstanbul Technical University
LULUCF	Land Use and Land Use Change and Forestry
MARA	Ministry of Agriculture and Rural Affairs
MENR	Ministry of Energy and Natural Resources
MOEF	Ministry of Environment and Forestry
MOT	Ministry of Transport
NSCR	Non-Selective Catalytic Reduction
OSD	Turkish Automotive Manufacturers Association
PETDER	Petroleum Manufacturers Association of Turkey
QA	Quality Assurance
QC	Quality Control
SHW	State Hydraulic Works
TCMA	Turkish Cement Manufacturers' Association
TTGV	Turkish Technology Development Foundations
TurkStat	Turkish Statistical Institute
UNFCCC	United Nations Framework Convention on Climate Change

Chapter 1

1. Introduction

The United Nations Framework Convention on Climate Change (UNFCCC) was ratified by Turkey in 2004. As a Party to the Convention, Turkey has prepared its third national inventory report and CRF tables for the year 2007. As an Annex I party to Convention, Turkey is required to develop annual inventories on greenhouse gas (GHG) emissions by sources and removals by sinks of greenhouse gases not controlled by the *Montreal Protocol* using the methodology approved by the UNFCCC.

In Turkey, the major actor of the GHG inventory is the Turkish Statistical Institute (TurkStat). National emission inventory and Common Reporting Format Reporter (CRFR) tables have been prepared in accordance with the UNFCCC Reporting Guidelines on Annual Inventories as adopted by the Conference of the Parties to the Convention (COP). The methodologies used in the calculation of emissions are based on the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* (IPCC Guidelines) and the *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* (Good Practice Guidance) prepared by the Intergovernmental Panel on Climate Change (IPCC). As recommended by the IPCC Guidelines, country specific methods have been used in electricity production and road transportation.

The inventory does not cover all the sources required by the IPCC guidelines.

Emissions and removals from land use change and forestry are provided by the Ministry of Agriculture and Rural Affairs (MARA), and the Ministry of Environment and Forestry (MOEF).

This National GHG Inventory Report presents on the basic GHGs – carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), GHG precursors (NOx, CO, NMVOCs), sulphur dioxide (SO_2), and the emissions of Hydrofluorocarbons (HFCs), Perflurocarbons (PFCs) and Sulphur hexafluoride (SF_6).

This report presents greenhouse gas emissions for the years 1990-2007, and discusses the trends, fluctuations and changes in the estimates. The annexes containing source categories, fuel types, emission factors and references, describe in detail the methodology of the estimates and how the Greenhouse Gas Inventory relates to the IPCC Guidelines. The annexes also include sections on the estimation of uncertainties, key source and trend analysis.

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

According to the IPCC Good Practice Guidance, a key source category is one that is prioritised within the national inventory system because its estimation has a significant

influence on a country's total inventory of direct greenhouse gases in terms of the absolute level of emissions. The results of this study has shown that Public Electricity and Heat Production (Electricity Production) (CO_2), Other industries (CO_2), Road Transportation (CO_2), Cement Industry (CO_2), Residential usage of natural gas (CO_2), Solid Waste Disposal (CH_4), Enteric Fermentation (CH_4), Residential usage of LPG, lignite and hard coal (CO_2), Manufacture of solid fuels and other energy industries (CO_2), Iron and Steel Industry (CO_2), Chemical industry (CO_2), Petroleum refining (CO_2), Civil Aviation (Transport) (CO_2), Non-Ferrous Metal Industry (CO_2), Agricultural Soil (N_2O), Manure Management (N_2O), Manure Management (CH_4) and Navigation (CO_2) were determined as key sources in 2007 according to the IPCC GPG (2000).

In addition to key source analysis, the emissions trends have been estimated for the year of 2006. This trend assessment identifies source categories for which significant uncertainty in the estimate would have considerable affected on overall emission trends, and therefore identifies source categories that diverge from the overall trend in national emissions. According to the base year considerations, the highest trends were seen in fuel combustion and industrial sectors. The percentage change of emissions according to the fuel combustion and industrial activities were seen to have increased throughout the years.

Quantitative estimates of the uncertainties in the emissions were calculated using direct expert judgement. It can be concluded that the total uncertainty is 10.9% because of the high uncertain data of CO_2 uptake by forest.

The general procedure for uncertainty analysis was due to expert judgement:

- Uncertainties of each activity were allocated by using emission factor and activity rate uncertainties.
- A calculation was set up to estimate the emission of each CO_2, CH_4, N_2O, HFCs, PFCs and SF_6 gases.
- The uncertainties used for the industrial processes data were estimated by TurkStat.
- The uncertainties for sectoral energy usage were estimated by MENR.
- The uncertainties of agricultural activities were estimated by TurkStat experts.
- The uncertainties of transport sectors were estimated by ITU.

Chapter 2

2. Greenhouse Gas Emissions

The national GHG inventory preparation was divided into the following basic activities:

- Collecting the data,
- Processing the activity data,
- Choosing the emission factors for estimating,
- Determination of the key GHG emission sources,
- Evaluation of the result (uncertainty and trend analysis).

The inventory can be modified in regard to the country specific circumstances. Every year, some changes occur that affect directly the activities above listed.

As the input data collection was considered, the inventory reflects the changes in the organization and management of data sources. These sources are as follows:

- Energy balance tables from the Ministry of Energy and Natural Resources,
- Industrial Production from Industry and Business Statistics Department in TurkStat,
- Agricultural Production from the Agriculture and Environment Statistics Department in TurkStat and land use and land use change data from Ministry of Agriculture and Rural Affairs,
- Data on the forest from the Ministry of Environment and Forestry
- Data on solid waste from the Environmental Statistics Group in TurkStat,
- Transport data from General Directorate of Railways, Harbors and Airports,
- Data on HFCs and SF_6 from Ministry of Environment and Forestry

Some organizations and universities should also be added to the above institutions. Because, the emission estimations, CRF table preparation and reports submission were done in cooperation with related Ministries. These were İstanbul University (Prof. Dr.Ünal Asan) for forestry and İstanbul Technical University (Prof. Dr. Cem Soruşbay and Prof. Dr. Metin Ergeneman) for transportation.

The basic source for emission factors for these inventories was the 1996 IPCC Revised Guidelines.

The data confidentiality was one of the important problems. This problem was tried to be solved by aggregated reporting for some categories, without mentioning the quantities or production. This approach was quite uncertain.

Table 2.1 gives summary data for greenhouse gas emissions for the years 1990-2007. The inventory for the year 1990 and 2007 revealed that the overall GHG emissions expressed in

CO_2 equivalent were correspondingly 170.06 and 372.64 million tones not taking into account the sector Land use Change and Forestry (LUCF).

Table 2.1 represents the emission trends of the basic GHGs, the overall emissions (not taking into account the LUCF) and the relative share of the overall emissions to the emissions from the year 1990 (referred to as 100 %).

Table 2.1. Aggregated GHG emissions by sectors (CO_2 eq.)

Total (million tones)	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Energy	132.13	137.96	144.27	150.78	148.62	160.79	178.96	191.39	190.62	190.61	212.55	196.02	204.02	218.00	227.43	241.45	258.21	288.33
Industrial Processes	13.07	15.22	17.23	18.59	16.93	21.64	22.45	22.17	22.62	21.45	22.23	21.20	23.42	24.12	26.45	25.39	28,04	26.18
Solvent and Other Product Use	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Agriculture	18.47	19.04	18.84	18.62	18.32	17.97	17.98	16.84	16.70	16.74	16.13	15.77	14.77	14.80	15.18	15.82	16.37	26.28
Waste	6.39	9.74	13.29	15.99	16.59	20.31	22.69	25.12	26.69	27.97	29.04	29.11	28.41	29.36	27.55	29.75	30.06	31.85
Total (w/o land use)	**170.06**	**181.96**	**193.64**	**203.98**	**200.46**	**220.72**	**242.09**	**255.51**	**256.63**	**256.78**	**279.96**	**262.10**	**270.62**	**286.28**	**296.60**	**312.42**	**332.67**	**372.64**
Change Comp.to 1990 % (w/o land use)	**-**	**7.0**	**13.9**	**19.9**	**17.9**	**29.8**	**42.4**	**50.3**	**50.9**	**51.0**	**64.6**	**54.1**	**59.1**	**68.3**	**74.4**	**83.7**	**95.6**	**119.1**
Land use and land use change	**-44.87**	**-56.31**	**-60.65**	**-60.26**	**-62.20**	**-61.84**	**-62.43**	**-64.34**	**-65.64**	**-66.45**	**-67.56**	**-72.12**	**-68.80**	**-67.56**	**-75.10**	**-69.53**	**-75.94**	**-76.27**

Unit: Million tones

The analysis of Table 2.1 shows that in 2007, the emissions from the energy sector was the largest portion with 77.4%, the emissions from the waste disposal was the second largest one with a value of 8.5%, and the emissions from agriculture with an 7.1% shares the third place.

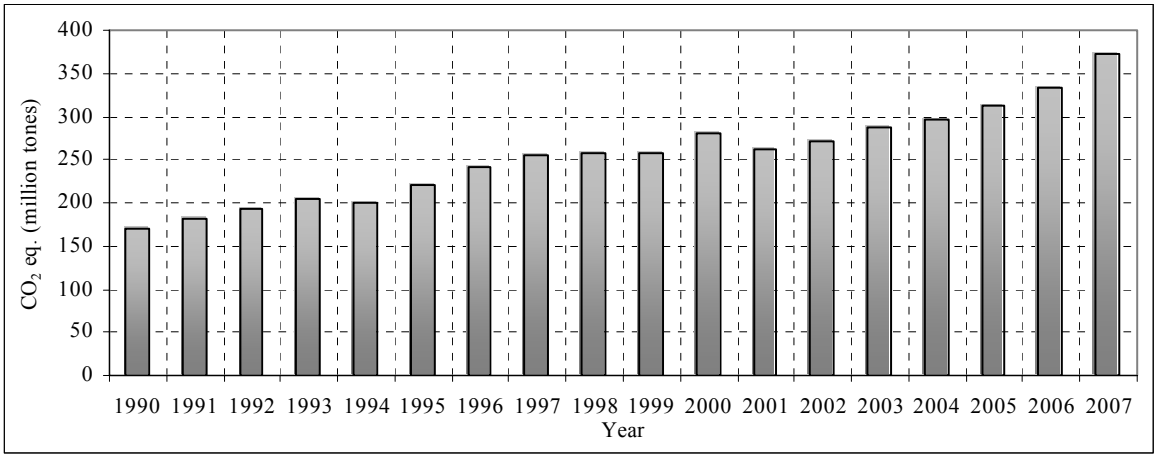


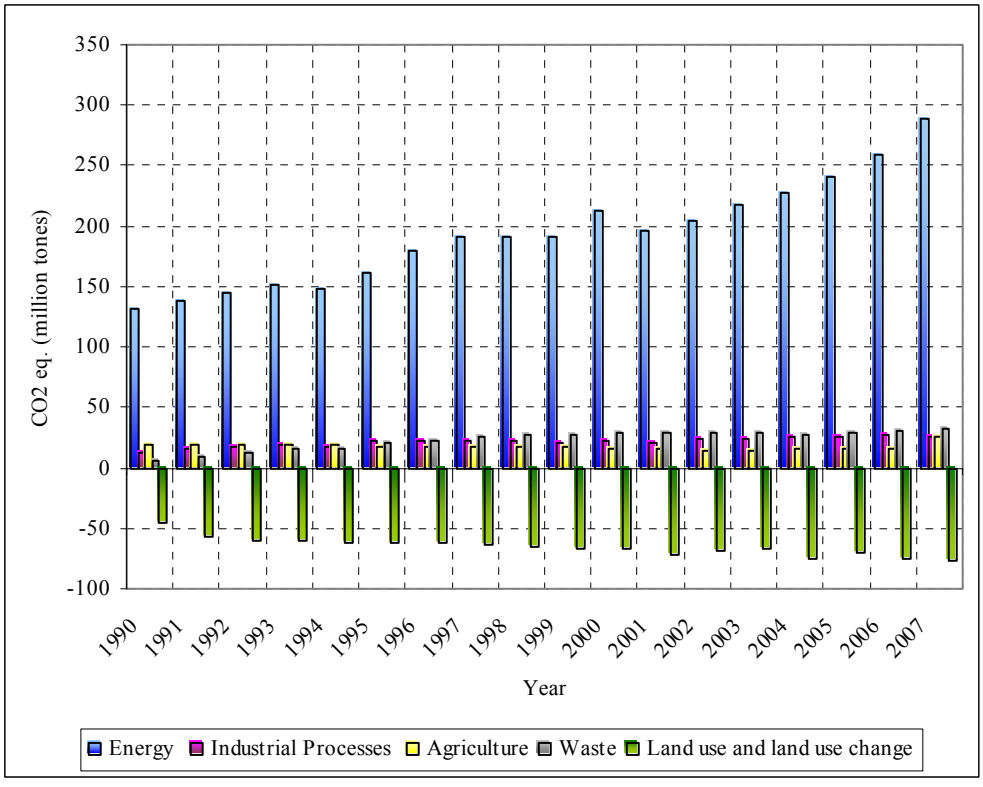
Figure 2.1. Overall greenhouse gases emission trend (without LUCF)

Figure 2.1 presents the trend of the overall emissions during the period 1990-2007. It can be seen that the emissions for the year 2007 were 119.1% more than the emission of year 1990.

Table 2.2. Aggregated GHG emissions without LUCF (CO_2 eq.)

Total	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
CO_2	139.59	146.55	152.93	160.91	159.10	171.85	190.67	203.72	202.71	201.71	223.81	207.38	216.43	230.99	241.88	256.43	273.70	304.47
CH_4	29.21	33.17	36.66	38.98	39.19	42.54	44.99	46.45	47.71	48.83	49.27	48.70	46.87	47.76	46.29	49.32	50.33	54.38
N_2O	1.26	2.25	4.04	4.09	2.17	6.33	6.07	4.73	5.56	5.72	5.74	4.84	5.41	5.25	5.49	3.43	4.59	9.65
HFCs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.82	0.87	1.42	1.81	2.23	2.38	0.40	0.00
PFC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.73	3.17
SF_6	0.00	0.00	0.00	0.00	0.00	0.00	0.37	0.61	0.66	0.52	0.32	0.31	0.48	0.48	0.70	0.86	0.91	0.95
Total (without LUCF)	**170.06**	**181.96**	**193.64**	**203.98**	**200.46**	**220.72**	**242.09**	**255.51**	**256.63**	**256.78**	**279.96**	**262.10**	**270.62**	**286.28**	**296.60**	**312.42**	**332.67**	**372.64**

Unit: Million tones



Unit: Million tones

Figure 2.2 Greenhouse gases emission trend by sectors

Figure 2.2 presents the energy sector that forms the largest share of the overall emissions between the year 1990 and 2007.

Table 2.3. Contribution of sectors to the total emission (CO_2 eq.)

%	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Energy	105,5	109,8	108,5	104,9	107,5	101,2	99,6	100,1	99,8	100,1	100,1	103,2	101,1	99,7	102,7	99,4	100,6	97,3
Industrial Processes	10,4	12,1	13,0	12,9	12,2	13,6	12,5	11,6	11,8	11,3	10,5	11,2	11,6	11,0	11,9	10,5	10,9	8,8
Agriculture	14,8	15,2	14,2	13,0	13,2	11,3	10,0	8,8	8,7	8,8	7,6	8,3	7,3	6,8	6,9	6,5	6,4	8,9
Waste	5,1	7,8	10,0	11,1	12,0	12,8	12,6	13,1	14,0	14,7	13,7	15,3	14,1	13,4	12,4	12,2	11,7	10,7
LUCF	-35,8	-44,8	-45,6	-41,9	-45,0	-38,9	-34,7	-33,7	-34,4	-34,9	-31,8	-38,0	-34,1	-30,9	-33,9	-28,6	-29,6	-25,7

Unit: (%)

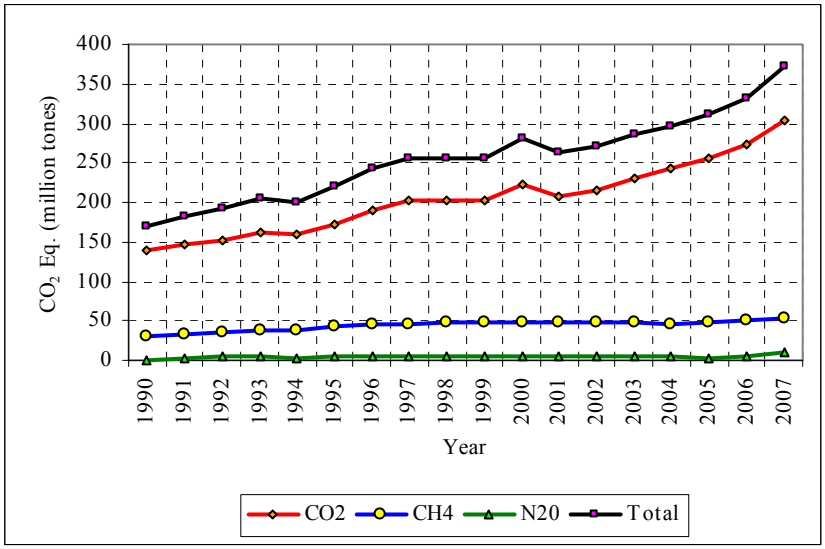


Figure 2.3. Emission trend of main GHGs (CO_2 eq.)

It can be seen from Figure 2.3 that the trend of the basis GHGs show an increase up to the year 2007. This change was mainly the result of the changes accuring in energy sector and industrial processes. The emission from the waste was constant compared to other sector. However, the agricultural emission was reversely decreasing throughout the years. The result may be inferred in Table 2.3 and Figure 2.2.

There were some points in the methodology and the input data, which were;

- The emission from the combustion of biomass was separated in 2005, 2006 and 2007.
- Certain parts were presented as aggregated quantities due to data confidentiality of the industrial sector such as limestone and dolomite use. The production data is confidential in accordance with law.
- The solid waste data were gathered from all municipalities. However, the annual survey has been done discontinously. Only the data for years 1994, 1995, 1996, 1997, 1998, 2001, 2002, 2003, 2004, 2005 and 2006 were available. Others were estimated.
- The local energy conversion factors were applied for the reference approach on calculations of domestic lignite, hard coal and petroleum products. Average conversion factors for lignite and hardcoal were changing for each year owing to the quality and quantity of these fuels and quantity for petroleum products.

- Emissions from *International Bunkers* were not included in the emissions owing to the lack of data.
- The transport of fuels was not a part of the energy balance of Turkey and emissions were not estimated.
- The emission from the combustion of fuels in iron and steel industry was only the result of burning of fuels in large scale iron and steel production industries. The emission from the small and medium scale enterprises were included in other industries since their fuel combustion can not be obtained separately.

Chapter 3

3. Energy

3.1. Fuel Combustion

The major source of GHGs in Turkey was the fossil fuel combustion. For that reason, this sector was evaluated carefully. The uncertainties and the possible errors in collecting activity data, in selecting emission factors and in estimating emissions were decreased with expert groups' studies. The emission factors (given in annex) for energy consumption are consistent with the IPCC methodology. Some uncertainty was introduced in emission factors and in activity data owing to the variations of the content, process and consumption of fuels. Fuel consumption data were taken from the Ministry of Energy and Natural Resources (MENR; 2007) which is compatible with the IEA system of international energy statistics though there were some small differences in reporting conventions.

According to the IPCC, the emission from the energy sector mainly comprises the fuel combustion. As can almost be seen in all countries, the energy sector in Turkey has also the key position for the emission of GHGs. Approximately 90% of the total CO_2 emission was emitted from the energy consumptions. During the calculation of GHGs emissions in energy sector, the sub-sectors were categorized owing to the energy balance tables. These sectors were energy industries, manufacturing industries, transport and other sectors (including residential, agriculture). The emission from the energy sector except for transport sectors and public electricity production were estimated by IPCC Tier 1 approach. However, for these two sectors, the tier 2/3 methodology for computations on a fuel consumption basis in different activities has been compiled.

The results (for transport) were indicating effects of certain improvements in near and long term transportation technologies and strategies for future reductions in transport based GHG emissions. Transportation sector consists of road transportation, domestic civil aviation, railways and national navigation. Emissions from international aviation that cannot be allocated to the national inventory were usually reported separately as unallocated emissions. The fuel consumption data related to aviation was provided only for the domestic consumption. Therefore no results were provided in this work for unallocated emissions resulting from international aviation. The limitation of the available data was not allow any estimation for navigation sector using methodology other than Tier 1. Methods of calculation were based on the IPCC recommendations. Some modifications were made for road transportation according to country specific conditions. The received data was verified and examined for consistencies. Fuel consumption data was obtained from the Ministry of Energy and Natural Resources which was considered as the most accurate data and used for the computations to estimate GHG emissions. Other information was received from Turkish Automotive Manufacturers Association (OSD), Petroleum Manufacturers

Association of Turkey (PETDER) and Turkish State Railways Research Planning and Coordination Department (Soruşbay and Ergeneman, 2007).

Carbon Dioxide (CO_2): CO_2 is the most important GHG owing to the overall responsibilities of 60% Earth's Greenhouse effect. As can be seen from Figure 3.1, the distribution of CO_2 emission from the combustion of fuels by sectors is not changing considerably until the year 1994. There was a slow increase. However, between the year 1995 and 1997, the increase was sharp. While, the trend involves a position steady for the years 1997, 1998 and 1999 and it reaches its highest value in 2000 with a 207 million tones value. After this year, the CO_2 emission decreases then it shows a steady increase until 2007 with a value of 282 million tones.

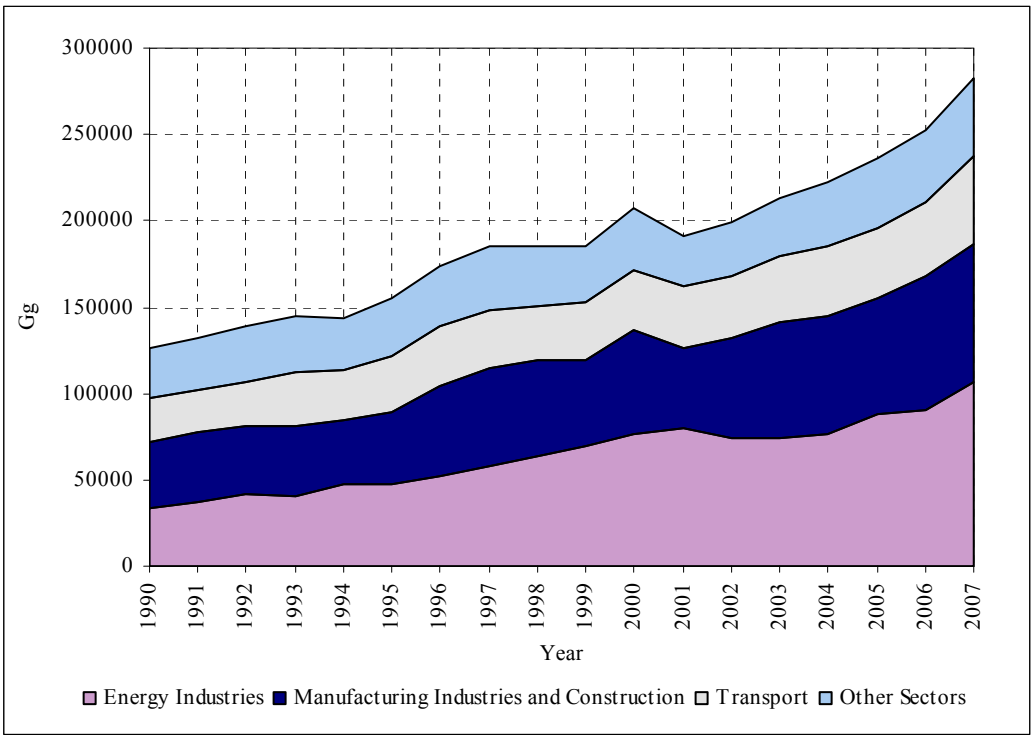


Figure 3.1. CO_2 emission from the combustion of fuels by sectors

In Turkey, the highest emission increase was observed in energy industries with 213.4%. Then it was followed by manufacturing industries with 113.2%, transport with 96.5% and others with 53.6%. The total CO_2 increase in 2007 compared to year 1990 was 122.9%. The CO_2 emission distribution was given in Figure 3.2. The increase in CO_2 emissions was closely linked to the increase in the population.

The CO_2 emission and conversion factors which is consistent with IPCC were used in calculations (Table 3.1).

Nitrous Oxides (N_2O): N_2O emission from fuel combustion was increased approximately 59.6% during the period under considerations as seen in Figure 3.3. The highest increase

compared to 1990 was observed in transport sector with a value of 149.6%. The increase in manufacturing industries was around 101.2%. As a result, the increase in energy demand causes the increase in N_2O emission.

Table 3.1. Emission and Conversion Factors for CO_2

CO_2 Emission	CO_2 EF Unit: tC/TJ	Efficiency	C-CO_2
Hard Coal	25,8	0,980	3,6667
Lignite	27,6	0,980	3,6667
Asphaltt	25,8	0,980	3,6667
Second Fuel Coal	25,8	0,980	3,6667
Petroleum Coke	25,8	0,980	3,6667
Natural Gas	15,3	0,995	3,6667
Petroleum	20,0	0,990	3,6667
(Residual Fuel Oil)	21,1	0,990	3,6667
(Gas / Diesel Oil)	20,2	0,990	3,6667
(Gasoline)	18,9	0,990	3,6667
(LPG)	17,2	0,990	3,6667
(Refinery Gas)	20,0	0,990	3,6667
(Jet Kerosene)	19,5	0,990	3,6667
(Naphta)	20,0	0,990	3,6667

Methane (CH_4): CH_4 emission from fuel combustion was decreased considerably during the time. The total decreased amount was around 19.0%. The main reason was the shifting up hard coal and lignite usage into natural gas as fuel consumption of residential areas.

It can be seen from Figure 3.3 that the other gases emission trend involves a peak in 1998 and then it shows a decline until the year of 2007. The main reason, as explained above, was the shifting of fuel coal to natural gas in residential consumption. In the transport sector, some type of emission (as CO) also shows a decline trend due to increasing usage of LPG.

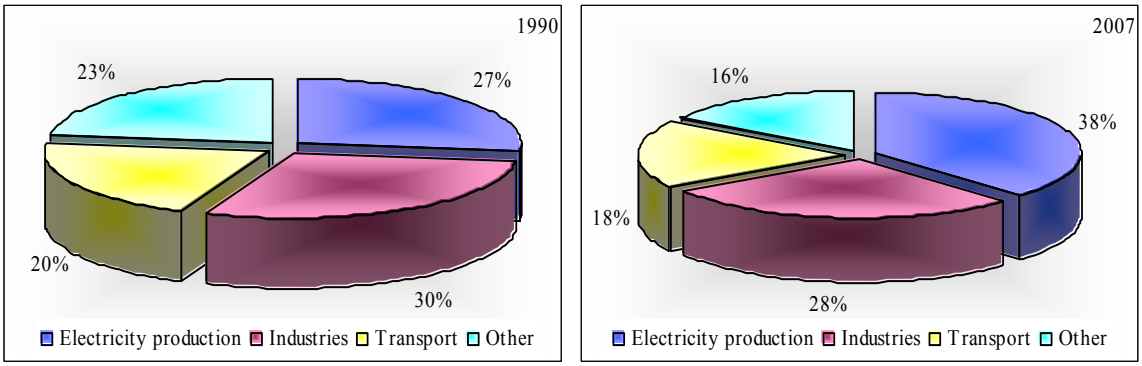


Figure 3.2. CO_2 emission distribution by sectors

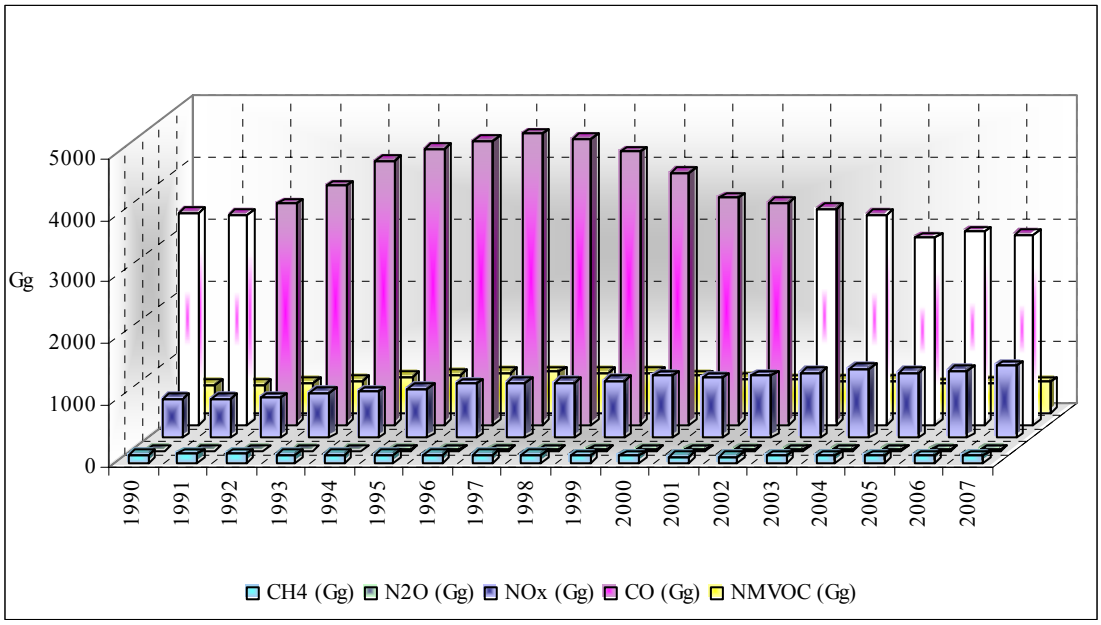


Figure 3.3. CH_4, N_2O, NO_X, CO, NMVOC emissions from fuel combustion

The activity data were gathered from the energy balance tables prepared by Ministry of Energy and Natural Resources (MENR). The experts of MENR construct energy balance tables in energy conversion units and original mass units. The experts consider the imported and exported fuel materials significantly. However, there were some small inconsistencies in tables compared with those provided to international organisations. The main reason was the updated energy balance tables which were used for preparing the Turkish National Emission Inventories and Turkish National Inventory Reports.

3.1.1 Energy Industries (1.A.1)

Source Category Description: This source category mainly includes the electricity generation and the use of fossil fuels for petroleum refining. The main fossil fuels used by Turkey were the hard coal, lignite and natural gas. For this sector general fuel consumption data were taken from Energy Balance Tables (MENR, 2007).

Methodological Issues: The fuel consumption data was applied to emission factors (EF) to give an estimation of the direct and indirect greenhouse gas emission. For thermal power plants, the individual emission data were calculated by Electricity Generation Corporation. In order to make estimation for these sectors, the characteristics of each type of fuel consumption was considered separately. The aggregated emission data, were, then compared with the emission estimated by simple multiplication of consumption and EF. The main aim was to increase the quality of the emission estimation and to obtain the country specific emission factors.

Uncertainties and time-series consistency: The activity data for energy sectors were, completely gathered from Energy Balance Tables. After calculating the emissions from all sectors, the GWP weighted emission of CO_2, N_2O and CH_4 were multiplied by source

specific data uncertainty to obtain overall uncertainty. The approach to produce quantitative uncertainty estimates was to use expert judgement as described in IPCC Good Practice Guidance and Uncertainty Management (2000) Reference. Sectoral expert calculated the uncertainty and combined with their judgement to minimise the risk of bias. The main judgement of the activity data was depending on mass balance considerations. The combine uncertainties in emission factors and activity data were explained in annex in detail.

Table 3.2. Time series consistency of emission factor for (1.A.1)

Source Category	GHGs	Fuel Type	Comments on time series consistency
1.A.1	CO_2	All Fuels	* EF were not vary until 2004 for (1.A.1.a). For 2007, Country Specific EFs have been used for (1.A.1.a) and Electricity Generation Corporation have been responsible for (1.A.1.a) calculations. Others were all constant over the entire time series.
1.A.1	N_2O, CH_4	All Fuels	* EF were not vary until 2004 for (1.A.1.a). For 2007, Country Specific EFs have been used for (1.A.1.a) and Electricity Generation Corporation have been responsible for (1.A.1.a) calculations. Others were all constant over the entire time series.

Source-specific QA/QC and verification: Turkish emission inventory working group had the same mind as to implement quality assurance and quality control (QA/QC) procedures with good practice. However, some sub-sectors as thermal power plants data were source-specific and in detail. Therefore more advance methodology was selected for this sector. For (1.A.1) group, fuel supply statistics were available and collected from energy balance tables. The reference approaches with correcting for stock change, import and exports was calculated. Except for "Thermal Power Plants", which "bottom-up" approach was selected for emission estimation, fuel combustion by source category was not available. The fuel delivery statistics for (1.A.1.b) was available by source category. Therefore, GHGs emissions were estimated by using Tier 1 approach by using IPCC Good Practice Guidance (2000).

Recalculation: There was no change in sector 1.A.1 per pollutant for 1990-2007.

3.1.1.1 Public Electricity and Heat Production (1.A.1.a)

Source Category Description: In terms of emissions levels and trends, the source category "Public electricity and heat production" (1.A.1.a) is a key category for CO_2 emissions and had a share of 27% in 2007 total emissions. Under source category 1.A.1.a, "Public electricity and heat production", the data includes electricity and heat production of all power plants in operation and the use of fossil fuels for petroleum refining. For this sector fuel consumption data were taken from the Energy Balance Tables (MENR, 2007). The total fuel input for electricity generation is given in the 8^{th} line of the energy balance tables.

In 2007, electricity production kept its major role in GHG emissions. The generation capacity reached to 40,8 GW with 1% increase from the previous year and almost 150% from the 1990 values. As it was the case in past years, demand for electricity has grown rapidly in this year too, increasing from 176.3 TWh in 2006 to 190 TWh in 2007, with an annual growth rate of 9%. The production in 1990 was 57.5 TWh. Natural gas had a very high share of 50% in electricity production, which was followed by coal (28%), hydro and geothermal (19%), other renewables %0.2 and oil 3.4%.

Ever increasing water stress and limited rainfall in the last few years have resulted in a considerable decrease in hydropower production. The production has decreased by 19% from 44,2 TWh in 2006 to 36 TWh in 2007, despite the capacity additions in hydropower. Thus to meet the high demand, in 2007, thermal power plants produced 155 TWh of electricity with 18% increase from the previous year, meeting 81% of the total electricity demand with 67% share of total installed capacity. The emissions from power sector have increased due to increased stress on hydropower production and demand growth by almost 20%. There was no production from Asphaltite, although some capacity of 455 MW existed in 2007.

There was an increase in wind capacity from 59MW's of installed capacity to 355 MW, i.e. almost six folds. Renewables Law which passed in 2005 and incentives provided by the government has started to show some results. This pace is expected to increase in the coming years. The role of voluntary carbon market is important to mention here, as many of the wind projects in the country generate and sell the voluntary carbon credits created.

Renewable waste is burnt at an increasing number of power generation facilities, electricity generation from biofuels and municipal waste has increased by 39% compared to the previous year, reaching to 43 MWs of installed power, generating 214 TWh of power in 2007. Several coal-fired power stations and some large combustion plants also have used biomass to supplement the use of fossil fuels. The emissions of electricity producing waste facilities are reported under 1.a.1 (electricity generation).

In 2007, Total Primary Energy Supply (TPES) in Turkey was 107.625 Mtoe with an increase of 10.2% from the previous year and of 107% from the 1990 levels. Natural gas accounted for the largest share of energy demand with 32%, followed by oil with 31%, other fossil fuels with 29% and hydro and other renewables with 9% in 2007.

Primary energy (domestic) production increased by 3.4% from 26.6 million tons oil equivalent (Mtoe) in 2006 to 27.5 Mtoe in 2007, and provided 25.5% of overall energy supply, increasing import dependency of the country to 74.5% from previous years' 73%. The production of almost all energy sources, excluding animal & vegetal waste, has increased. Local oil and natural gas production is relatively small, and the main domestic energy source is coal, mostly lignite, with a production increased to 72.32 from 63.8 million tons (Mt) in 2006.

The activity rates for fuels are taken directly from the Energy Balance tables. Where pertinent statistical indications or experts' assessments are available, fuel inputs are

additionally divided into two size classes (combustion plants bigger or smaller than 50 MW). In energy balance sheets, the input for electricity sector is presented at the bottom of the table. The columns are divided on the basis of energy sources for electricity and energy production. Emissions were calculated based on the fuel type used for generation, and the EF's were accordingly selected from IPCC Good Practice Guidance. More information on energy balance tables are presented in Annex 8.

Heat content of fuels for source category 1.A.1.a was the weighted average of data collected from electricity generation installations, using real plant values, through questionnaires.

3.1.1.2 Petroleum refining (1.A.1.b)

"Petroleum refining" (1.A.1.b) was a key category in terms of emissions level for CO_2 emissions of residual fuel-oil, natural gas and refinery gas consumption. The contribution to total CO_2 emission from petroleum refining was ranging between 1.90% and 2.76% throughout the years. Fuel inputs in refinery power stations were taken from energy balance tables of MENR. The emission factors were default from the IPCC Methodology. The uncertainty of activity data were estimated by MENR experts.

3.1.1.3 Manufacture of solid fuels and other energy industries (1.A.1.c)

This section was not separated from the Electricity and Heat Production. Therefore it was considered within part 1.A.1.a or 1.B.1.a. Although some parties have considered hard coal and lignite mining within this section, Turkey does not.

3.1.2 Manufacturing industries and construction (1.A.2)

Source Category Description: This source category consists of sub-source categories defined in close harmony with the IPCC categorisations. However, Pulp, Paper and Print (1.A.2.d) and Food Processing, Beverages and Tobacco (1.A.2.e) were considered in part "other (1.A.2.f)". For the years between 1990 and 2004, "Cement Production", "Sugar Production", "Fertilizer Industries" and "Other Industries" was given as aggregated. But, it was separated after 2005. Although the sub-source category head was seen as "Cement Production, Sugar, Fertilizer and Other Industries", it was the other industries for year 2005, 2006 and 2007. After 2005, (1.A.2.f) was separated into 4 sub-source categories as seen below:

- Cement Production
- Sugar
- Fertilizer
- Other Industries

The industries' process combustion and power generation were not separated in the energy balance tables.

Methodological Issues: The fuel consumption data was applied to emission factors (EF) to give estimations of the greenhouse gase emission. The MENR tables were used to obtain relevant activity data. The emission factors were given in annex.

Uncertainties and time-series consistency: The approach to produce quantitative uncertainty estimates was to use expert judgement as described in IPCC Good Practice Guidance and Uncertainty Management (2000) Reference. Sectoral expert calculated the uncertainty and combined with their judgement to minimise the risk of bias. The main judgement of the activity data was depending on mass balance considerations. The combine uncertainties in emission factors and activity data were explained in annex in detail.

Table 3.3. Time series consistency of emission factor for (1.A.2)

Source Category	GHGs	Fuel Type	Comments on time series consistency
1.A.2	CO_2	All Fuels	* All EF were constant over the entire time series.
1.A.2	N_2O, CH_4	All Fuels	* All EF were constant over the entire time series.

Source-specific QA/QC and verification: This source category was covered by the general QA/QC of the greenhouse gas inventory. The fuel supply statistics were available for this group sectors. However, Pulp, Paper and Print (1.A.2.d) and Food Processing, Beverages and Tobacco (1.A.2.e) were considered in part "other (1.A.2.f)", because data for these two sub-group sources were not separable. Except for (1.A.2.e) and (1.A.2.f), the fuel delivery statistics were available by source category. Therefore, GHGs emissions were estimated by using Tier 1 approach by using IPCC Good Practice Guidance (2000).

Recalculation: There wasn't any change in sector 1.A.2 for 1990-2007.

3.1.2.1 Iron and Steel Industries (1.A.2.a)

The source category "Manufacturing industries and construction – iron and steel" was a key category, in terms of CO_2 emissions. The relevant fuel-use amounts, including those for secondary fuel coal in iron and steel industries were taken from energy balance tables of MENR. The emission from the iron and steel industry was very high compared to other sectors. The main reason was the burning of coal during the processing. The emission from the combustion of fuels in iron and steel industry was only the result of burning of fuels in large scale iron and steel production industries. The emission from small and medium scale enterprises were included in other industries since their fuel combustion could not be obtained separately.

3.1.2.2 Non - Ferrous Metal (1.A.2.b)

The source category "Non –Ferrous Metal" was a key category, in terms of CO_2 emission from natural gas burning. The CO_2 emission compared to total CO_2 emission from the combustion of petroleum was ranging between 1.95% and 2.96%.

3.1.2.3 Chemicals (1.A.2.c)

The source category "chemicals" was a key category, in terms of CO_2 emissions from Residual fuel-oil and natural gas burning.

3.1.2.4 Pulp, Paper and Print (1.A.2.d)

The energy consumption for production of pulp, paper and printed products was not separated in the energy balance tables. Therefore emissions from use of regular fuels in process combustion, and emissions generated by plants in own-power generation, were not been listed separately. They were summarised under other (1.A.2.f).

3.1.2.5 Food Processing, Beverages and Tobacco (1.A.2.e)

This section was also summarised under other (1.A.2.f). Because the fuels used in process combustion and power generation was not separated in energy balance tables and aggregated into part "other (1.A.2.f)".

3.1.2.6 Other – Cement Production (1.A.2.f)

Cement production involves considerable fuel substitutions in burning of clinkers. In the process, the fuels as lignite, hard coal, coke and petroleum coke were used. The source category "Cement Production" was a key category in terms of CO_2 emissions.

3.1.2.7 Other – Sugar (1.A.2.f)

The fuel input data for Energy Balance Tables has been taken by MENR from annual progress report of manufacturing industries.

3.1.2.8 Other – Fertilizer (1.A.2.f)

The fuel input data for Energy Balances Tables has been taken by MENR from annual progress report of manufacturing industries.

3.1.2.8 Other (1.A.2.f)

The source category "Other" was a key category in terms of CO_2 emissions from hard coal, natural gas, lignite and residual fuel-oil. The fuel input data for Energy Balance Tables has been taken by MENR from annual progress report of manufacturing industries.

3.1.3 Transport (1.A.3)

Source Category Description: Emissions from civil aviation, road transportation, railways and navigation are included in the transport sector. This sector is a key contributor to CO_2, N_2O emissions.

Transport sector contributed 51.42 Mt CO_2 emissions in 2007. Road transportation is the major source in this sector, contributing 84.2 % (42.93 Mt), of which 34.4 % (14.77 Mt) are from passenger cars. Contribution of the domestic aviation is 11.8 % (6.06 Mt), domestic navigation 3.1 % (1.59 Mt), and railways 0.8 % (0.41 Mt).

International aviation and marine 'bunkers' could not be reported as data was not available for year 2007.

Total transport CO_2 emissions increased by 96.0 % on the 1990 level, and increased by 16.0 % on the 2006 level. Average annual increase of transport emissions over the period 1990-2007 is about 5.6 % (Figure 3.4.).

Increase in emissions from passenger cars is 73.4 % between 1990 and 2007, from 8.17 Mt to 14.77 Mt.

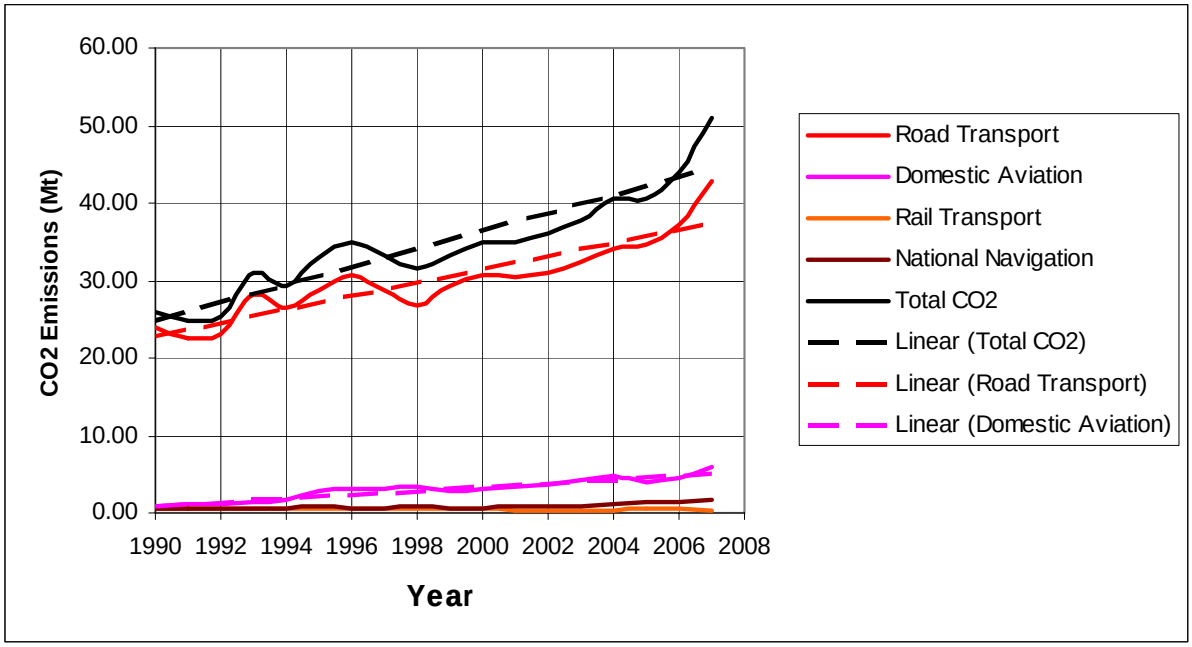


Figure 3.4. Emissions from transport sector, 1990 – 2007 (CO_2)

Emissions of N_2O grow very fast in this sector, primarily due to the increase in civil aviation. Estimates of N_2O emissions resulting from civil aviation is 33.3 % higher in 2007 than 2006 level and 546 % higher than 1990 level. Generally, emissions have grown strongly in civil aviation sector as in the other countries.

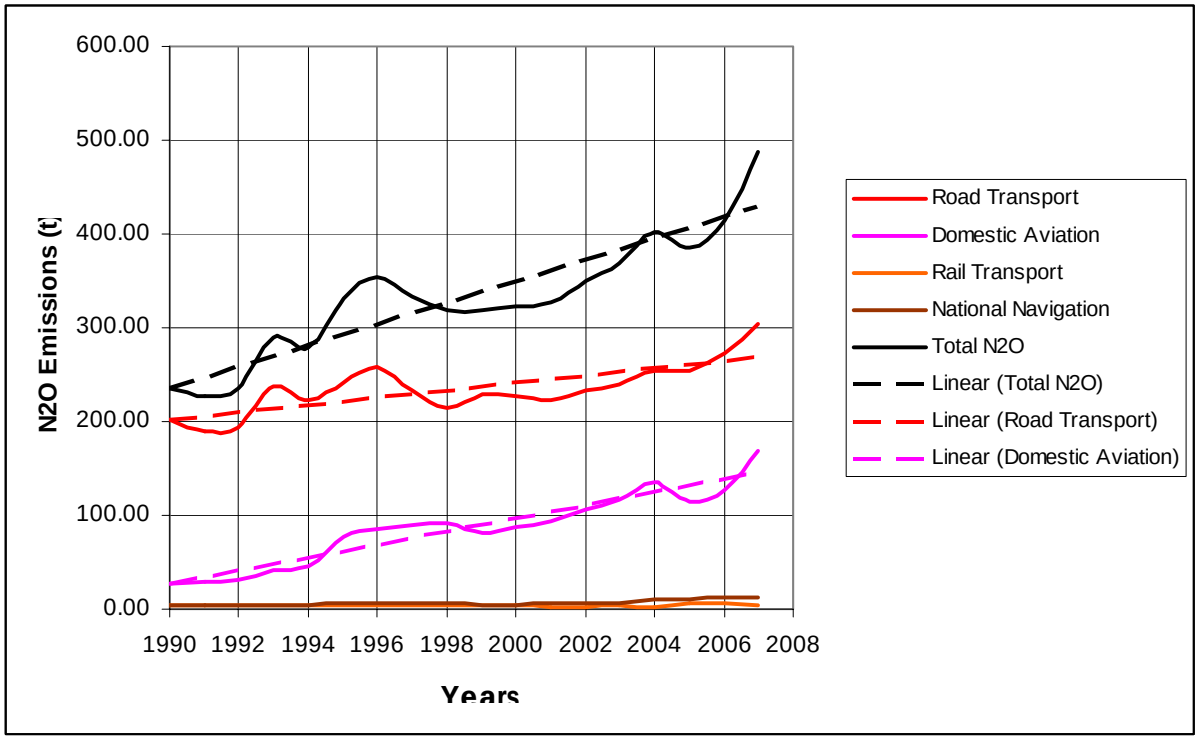


Figure 3.5. Emissions from transport sector, 1990 – 2007 (N_2O)

Methodological Issues: Specific informiaton relating to Mthodologies are given under individual sections.

Uncertainties and time-series consistency: Uncertainties are arising mainly from lack of data related to fuel consumption for vehicle categories, country specific emission factors and basic activities such as vehicle mileage.

The uncertainty associated with CO_2 from road vehicles for 2007 is estimated to be within the range of ± 20 %, mainly due to the lack of data for Diesel oil consumption for various purposes. Some Diesel oil used in heating and electricity generation systems is registered under fuel station consumptions as transport fuel.

Over the border trade of Diesel oil in southern Turkey is not registered and has some noticeable effect on the total fuel consumption.

Source-specific QA/QC and verification: IPCC Tier 1 QC checks are performed on the key categories for CO_2: civil aviation, road transport, railways, navigation and pipelines. No significant anomalies were detected. In addition, certain verification steps are performed using Tier 2 data as described above. Inventory uses official fuel data obtained from the MoE, for each fuel type and transportation sub-sectors. The fuel consumption per vehicle category and hence CO_2 emission quantities are then calculated and verified by the Tier 1 approach.

Planned Improvements: Emissions resulting from international aviation and navigation could not be estimated due to the lack of data. A database is planned to be establised which

will include international and domestic fuel data. After establishment of this database, international emissions resulted from aviation and navigation could be estimated.

The IPCC methodology is used to evaluate emissions associated with the transport sector based on fuel-constrained estimates. The activity data related to traffic flow conditions and country specific emission factors for road transport considerably affects the final results. Therefore future improvements will concentrate on obtaining more detailed activity data.

These will include:

- higher resolution in vehicle population profiles, covering the annual age distribution, the

  technology penetration and larger number of vehicle subcategories,
- country specific emission factors considering traffic flow conditions locally,
- improved vehicle mileages estimates, for calculating fuel consumption with higher accuracy, both regionally and cumulatively,
- more accurate and detailed fuel consumption and emission factor data for marine vehicles.

Recalculation: No recalculations are performed under this category.

3.1.3.1 Civil Aviation (1.A.3.a)

The fuel consumption data related to aviation was provided only for the domestic consumption. Therefore no results were provided in this work for unallocated emissions resulting from international aviation.

Methodological Issues: Emissions from domestic civil aviation are estimated using IPCC Tier 2 methodology explained in IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 2006). The calculation methodology is based on the national energy consumption data and air traffic data for each airport, while default emission factors for the activities are used. Air traffic data consisting of landing and takeoff (LTO) cycles and cruise is processed for all 38 airports in Turkey. All movements below 914 m are included in LTO cycle; movements over 914 m altitude are covered in the cruise phase. Domestic flights for all aircraft types have been accounted considering individual fuel consumption values and emission factors for LTO and cruise.

Activity Data: The data on energy consumption is provided by the Ministry of Environment and Forestry (MoE) and Turkish Statistical Institute (TurkStat) in form of the national energy balance. In the aviation sub-sector only jet fuel is consumed.

Air traffic data is provided by DG of Airports Authority (DHMI) of Ministry of Transport (MoT) for all civil airports in Turkey. The number of LTO values for all airplane types are provided for each airport (Figure 3.6.). In the year 2007 total number of LTO's in domestic travel for all airplane types added up to 335661. The increase in passenger traffic over the years from 1995 to 2007 for both domestic and international travel is also given in Figure 3.6.

Figure 3.6. Operated airports in Turkey (2007)

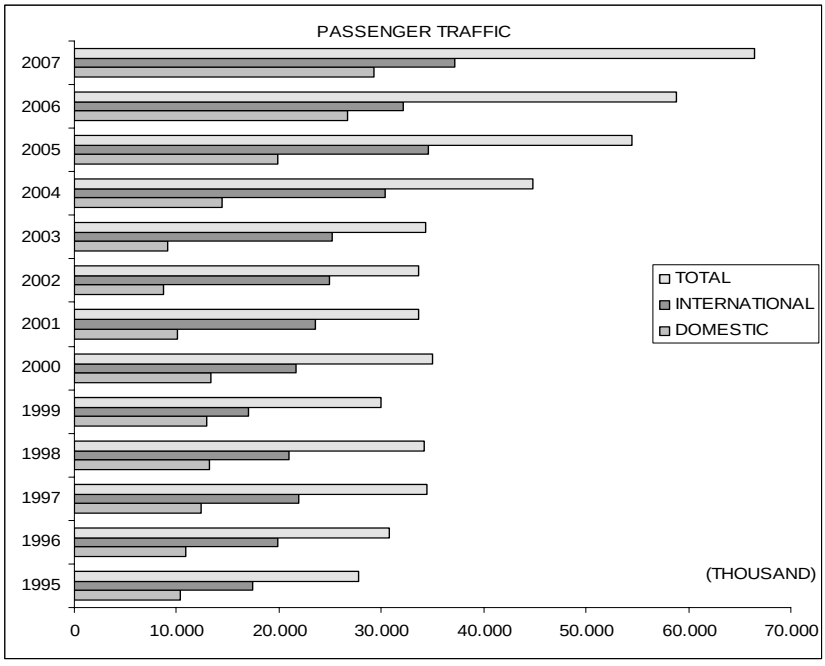


Figure 3.7. Passenger traffic (1995 to 2007)

Table 3.4. Air traffic in turkish airports in 2007

Airport Name	Domestic	International	TOTAL
ATATÜRK	115.820	146.428	262.248
ESENBOĞA	47.578	16.331	63.909
A.MENDERES	37.647	14.127	51.774
ANTALYA	25.410	89.592	115.002
DALAMAN	5.708	15.641	21.349
MİLAS-BODRUM	10.059	10.968	21.027
ADANA	20.754	5.253	26.007
TRABZON	11.592	2.982	14.574
S. DEMIREL	598	345	943
NEVŞEHİR-KAPADOKYA	731	213	944
ERZURUM	5.170	252	5.422
GAZİANTEP	5.824	927	6.751
ADIYAMAN	586	-	586
AĞRI	482	-	482
BALIKESİR	96	-	96
KÖRFEZ	1.830	-	1.830
BURSA-YENİŞEHİR	1.551	234	1.785
ÇANAKKALE	1.826	18	1.844
ÇARDAK	1.500	6	1.506
DİYARBAKIR	7.353	143	7.496
ELAZIĞ	1.404	-	1.404
ERZİNCAN	1.234	-	1.234
HATAY	46	-	46
K.MARAŞ	660	-	660
KARS	866	-	866
KAYSERİ	5.154	1.716	6.870
KONYA	2.014	310	2.324
MALATYA	3.662	116	3.778
MARDİN	1.706	-	1.706
MUŞ	268	-	268
SAMSUN-ÇARŞAMBA	4.236	834	5.070
SİİRT	352	-	352
SİVAS	969	39	1.008
ŞANLIURFA-GAP	1236	14	1250
ÇORLU	2.770	804	3.574
TOKAT	612	-	612
UŞAK	513	-	513
FERİT MELEN	5.844	34	5.878
TOTAL	**335.661**	**307.327**	**642.988**
OVERFLIGHT	**247.099**		

Emission Factors: Emission factors for all aircraft types are obtained from IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 2006). Default values are applied for aircrafts where specific data is not available.

The total domestic fuel consumption for aviation is 5960.4 Gg. The calculated total LTO fuel consumption is 301057.6 tons and cruise fuel consumption is 1590287.4 tons, giving

CO_2 values of 950956.1 Gg and 5009405.2 Gg for LTO and cruise respectively. CO_2, CH_4 and N_2O emission values and average emission factors are given in Table 2. for domestic aviation.

Table 3.5. GHG Emissions and average emission factors for LTO and cruise in aviation (2007)

	CO_2	**CH_4**	**N_2O**
Emissions [ton]			
Total emissions	6060690	81.99	193.7
LTO emissions	950956.1	81.99	34.69
Cruise emissions	5009405.2	-	159.03
Emission Factors [$kg_{emissions}$/ton_{fuel}]			
LTO + Cruise	3204.5	0.043	0.10
LTO	3158.7	0.272	0.12
Cruise	3149.9	-	0.10

Uncertainties: Uncertainties arise from the lack of data concerning various airplane types which are evaluated with default values for fuel consumption and emission production. Some data is also missing for two airports in Turkey.

IPCC default values of 7% for the activities and 7% for the fuel consumption are accepted for civil aviation sector.

3.1.3.2 Road Transportation (1.A.3.b)

Road transportation being the major source within transportation sector contributed 42.93 Mt of CO_2 in 2007, with 84.2 % of the total, while 34.4 % (14.77 Mt) these emissions resulted from passenger cars.

Emissions other than CO_2 from road transport are estimated using Tier 2 approach.

Method: The method for the estimation of emissions from road transportation was developed by Istanbul Technical University (ITU) in 2005 (UNDP Report, 2005). The model is based on COPERT with certain modifications according to country specifications related to the availability of data.

Energy based emission calculations are conducted according to IPCC Tier 1 approach initially to obtain CO_2 emissions for basis of model result comparisons. Then IPCC Tier 2 approach is conducted using the vehicle fleet and traffic activity data to recalculate CO_2 emissions. Both results are compared for consistency in an iterative approach. Then the model is used to calculate other GHG emissions.

As the complete statistical data for the annual mileage of the vehicle classes in Turkey are not available, travelled distance for vehicles are obtained from an algorithm based on total fuel consumed and fuel consumption assumptions per unit distance travelled. In case of

gasoline fuelled passenger cars, total fuel consumed is proportional to the number of vehicles in traffic. As the gasoline is used only by passenger cars, yearly average mileage can be obtained from the consumption and the number of vehicles in traffic for any model year.

The solution algorithm for other vehicle classes (fuelled with Diesel oil) is based on the minimization of differences between energy consumption as reported in the national energy balance account and the estimated energy consumption. This is achieved by appropriately adjusting the mileage covered and the fuel consumption of each category (Table 3.6).

Annual mileages calculated are then used for obtaining greenhouse gas emissions from road traffic. CO_2 emissions reported are obtained by IPCC Tier 1 approach based on energy consumption, whereas emissions other than CO_2 are calculated by IPCC Tier 2 approach. Tier 2 results are compared with Tier 1 results for validation (Figure 3.7).

The predictions for the distance travelled are given in Table 3. for different vehicle categories. Improvements for the predictions of distance travelled for each vehicle category are in progress for future studies.

Emissions from the consumption of biofuels are taken into consideration for components other than CO_2, but CO_2 emissions are only reported separately.

Table 3.6. Yearly Travelled Distances by Vehicle Classes (predictions)

Annual distance covered [km]								
	Passenger Cars			HD Trucks	LDV	Minibuses	Buses	Motorcycles
Year	Diesel	Gasoline	LPG					
2007	7850	7850	17500	19500	14000	14750	53000	1550
2006	8400	8400	16970	15000	13250	14250	52500	1650
2005	8900	8900	18060	14000	13000	14000	52000	1700
2004	9400	9400	19230	18000	11800	12400	51000	1750
2003	9750	9750	24200	25500	17000	17500	55500	1800
2002	10400	10400	24500	25500	14750	15250	55000	1800
2001	10550	10550	28500	24500	12900	13100	54500	2000
2000	12400	12400	28200	22500	11700	12600	53500	2250
1999	14800	14800	23500	21000	10600	11700	51500	3250
1998	16000	16000	23200	18000	8400	9450	43500	3250
1997	16000	16000	23200	25000	11250	12270	58000	3500
1996	15600	15600	-	33000	15100	15930	80000	3700
1995	15250	15250	-	34500	14525	15640	77500	3700
1994	14400	14400	-	33000	14030	14975	76000	3350
1993	15300	15300	-	39200	16400	17535	84000	3350
1992	15200	15200	-	34200	14200	15135	76000	3350
1991	15900	15900	-	36700	17300	18300	85500	3000
1990	18400	18400	-	44000	22500	22500	89000	3000

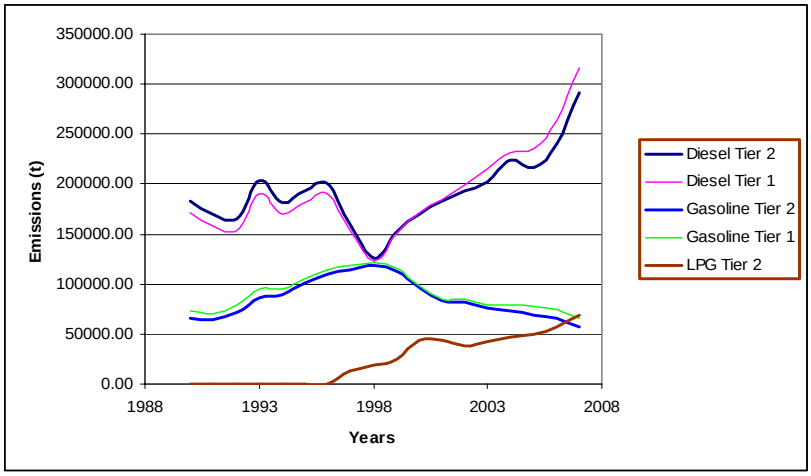


Figure 3.8. NOx emissions calculated by Tier 1 and Tier 2 methods for gasoline, LPG and Diesel fuel consumed

Table 3.7. Fuel consumption values and emission factors for Vehicle Categories

Vehicle Classes								
Emission Factors (g/km)	Passenger Cars			HD Trucks	LDV	Minibuses	Buses	Motorcycles
	Diesel	Gasoline	LPG					
CH_4								
Model year 1990-2001	0,005	0,07	0,06	0,06	0,005	0,005	0,06	0,15
Model year 2002-2007	0,005	0,02	0,06	0,06	0,005	0,005	0,06	0,15
N_2O								
Model year 1990-2001	0,01	0,005	0,0	0,03	0,02	0,02	0,03	0,002
Model year 2002-2007	0,01	0,05	0,0	0,03	0,02	0,02	0,03	0,002
CO								
Model year 1990-1993	-	46,00	7,10	9,00	1,60	1,60	9,00	22,00
Model year 1994-2001	-	19,00	7,10	9,00	1,60	1,60	9,00	22,00
Model year 2002-2007	0,70	2,90	7,10	9,00	1,60	1,60	9,00	22,00
NMVOC								
Model year 1990-1993	0,20	5,30	1,50	1,90	0,40	0,40	1,90	16,00
Model year 1994-2001	0,20	4,50	1,50	1,90	0,40	0,40	1,90	16,00
Model year 2002-2007	0,20	0,50	1,50	1,90	0,40	0,40	1,90	16,00
Fuel Consumptions (l/100 km)								
Model year 1990-1993	7,3	11,2	-	-	-	-	-	-
Model year 1994-2001	7,3	8,3	-	-	-	-	-	-
Model year 2001-2007	7,3	8,5	-	-	-	-	-	-

3.1.3.3 Railways (1.A.3.c)

The transport related data available for railways and navigation is limited. Therefore IPCC Tier 1 approach has been used in these sub-sectors. The energy consumption for the activity and IPCC default emission factors are used to estimate all related emissions. IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 2006) have been applied.

Diesel oil used in railways is taken into consideration here while emissions produced during the production of electricity used by railways are given separately.

National navigation also used Diesel oil and fuel oil as energy source.

3.1.3.4 Navigation (1.A.3.d)

Information related to this section is given under section "3.1.3.3. Railways".

3.1.3.5 Other (1.A.3.e)

No information is reported under this category.

3.1.4 Other Sectors (1.A.4)

Source Category Description: The emissions that were included in this category mainly arise from Residential (emission from fuel combustion in households including institutional) and Agriculture (emissions from fuel combustion in agriculture including forestry and fisheries) sectors. Therefore, (1.A.4.a) was considered with (1.A.4.b) due to the energy balance tables.

Methodological Issues: The methodology used for emissions calculation was identical that used for the combustion of fuels in "Manufacturing Industries and Constructions – 1.A.2" sectors.

Uncertainties and time-series consistency: The approach to produce quantitative uncertainty estimates was to use expert judgement as described in IPCC Good Practice Guidance and Uncertainty Management (2000) Reference.

Table 3.8. Time series consistency of emission factor for (1.A.4)

Source Category	GHGs	Fuel Type	Comments on time series consistency
1.A.4	CO_2	All Fuels	* All EFs were constant over the entire time series.
1.A.4	N_2O, CH_4	All Fuels	* All EFs were constant over the entire time series.

Source-specific QA/QC and verification: This source category was covered by the general QA/QC of the greenhouse gas inventory.

Recalculation: There wasn't any change in sector 1.A.2 for 1990-2007.

3.1.4.1 Commercial/Institutional (1.A.4.a)

The energy consumption of commercial/institutional was not separated in the energy balance tables. Therefore emissions from use of fuels were not been listed separately. They were given under Residential (1.A.4.b).

3.1.4.2 Residential (1.A.4.b)

The source category “Residential” was a key category in terms of CO_2 emissions from natural gas, lignite, LPG and hard coal. The relevant fuel-use amounts were taken from energy balance tables. Although, residential and institutional fuel used amount were not separable in tables, the high percentage of fuel was consumed in households. The residential contribution to total CO_2 emission from the lignite and petroleum consumption was almost the same with a value of 7.3% in 1990. However, these ratios for lignite and petroleum in latest year were considerably decreasing. The main reason is the shifting from lignite to natural gas.

3.1.4.3 Agriculture/Forestry/Fisheries (1.A.4.c)

The source category “Agriculture/Forestry/Fisheries” were not including mobile sources. Such emissions were included instead in transport emissions (1.A.3). This source category was a key category in terms of CO_2 from gas/diesel oil.

3.1.5 Other Sectors (1.A.5)

This source category was not considered owing to lack of occurrence.

3.2 Fugitive Emission from Fuels

During all stages of fuel production and use, from extraction of fossil fuels to their final use, fuel components can be released as fugitive emissions. CH_4 emission was the most important emission within the source category "solid fuels", especially “Coal Mining and Handling (1.B.1.a)”. The other sub-sector was not considered due to not occurring (as 1.B.2) or not having available data (as 1.B.1.b).

Methane (CH_4): In Turkey, the main fugitive emissions were the CH_4 from the coal mining, especially the lignite and hard coal mining from underground and surface mines. The percent of extracted coal from underground mines was approximately 4.3%.

The emission factors of underground and surface mines differ considerably. IPCC Tier 1 approach was used for the emission. The emission from the coal mining was given in Table 3.9 and Figure 3.9. Moreover, the total amount of extracted coal was also given in Figure 3.10.

As shown in Figure 3.4 and Table 3.5, the CH_4 emission from coal mining changed between 58.54 Gg and 87.48 Gg. The highest CH_4 emission was observed in 2007 and the lowest emission was observed in 2004.

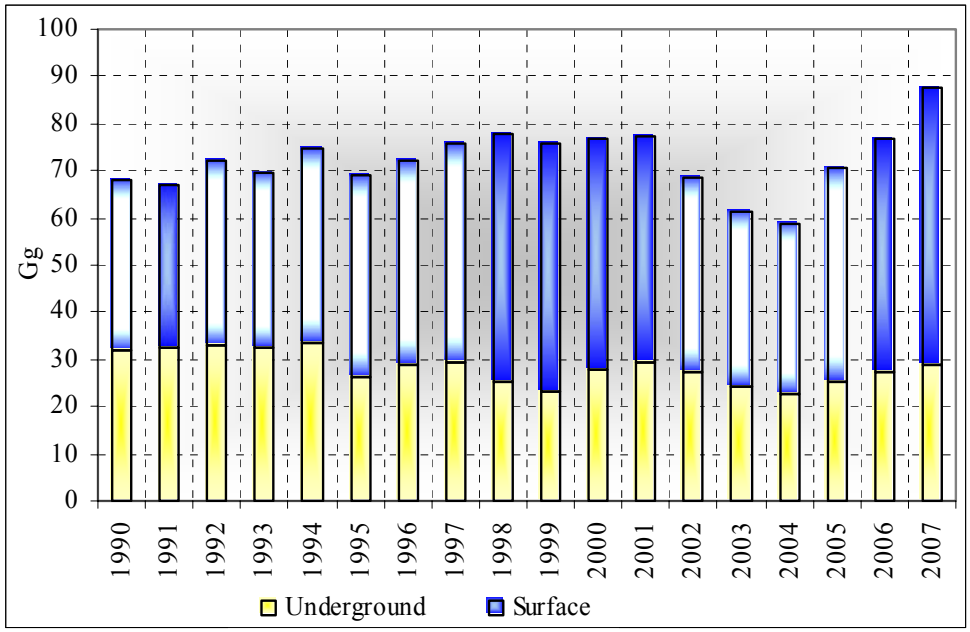


Figure 3.9. CH_4 emissions from coal mining

Table 3.9. CH_4 emissions from coal mining

Unit: Gg	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Underground	32.19	32.38	33.18	32.70	33.29	26.36	28.62	29.46	25.28	23.33	28.05	29.24	27.19	24.14	22.82	25.44	27.19	28.87
Surface	35.93	34.85	39.08	36.80	41.43	42.47	43.35	46.16	52.44	52.30	48.94	47.92	41.54	37.39	35.72	45.16	49.80	58.61

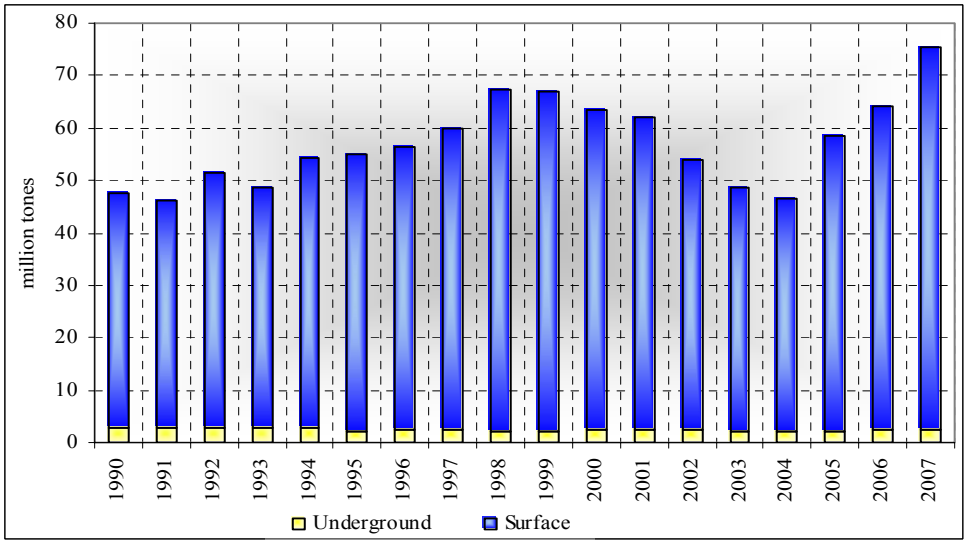


Figure 3.10. Coal mining

The underground coal mining was decreased throughout the years. In 1990, approximately 5.8% of the total extracted coal was obtained from underground mining. However, this ratio in 2007 was only 3.3%. The coal mining has decreased since 1990. The main reason was the shifting of fuel coal to natural gas in residential areas.

During surface and underground mining, methane escaping was not related to any specific conditions. Therefore, default IPCC emission factors were used to calculate methane emissions.

Activity data of the coal extraction was taken from the energy balances of MENR.

3.2.1 Solid Fuels (1.B.1)

Although this source category "Solid fuels" (1.B.1) consists of three sub-source categories "Coal mining and handling" (1.B.1.a), "Solid fuel transformation" (1.B.1.b) and "Other" (1.B.1.c). The most important one is “Coal Mining and Handling (1.B.1.a)”.

Source Category Description: This source category was covering CH_4 emissions which occur during the surface and underground production of solid fuels. The emissions due to combustions of those fuels to support product activities was not included in this section.

Methodological Issues: The methodology used for emissions calculation was IPCC simplest method. Methane emission was estimated by multiplying coal production with methane emission factors. The EFs were given in annex. Turkey couldn’t use Tier 2 or Tier 3 method “Country or Basin Specific Method” due to lack of basin specific information. For that reason the EFs were accepted as (17.5 m^3/tones for underground mining) and (1.2 m^3/tones for surface mining). The underground mining was not significant; therefore Tier 1 methodology was used according to the IPCC Good Practice.

Uncertainties and time-series consistency: The approach to produce quantitative uncertainty estimates was to use expert judgement as described in IPCC Good Practice Guidance and Uncertainty Management Reference.

Table 3.10. Time series consistency of emission factor for (1.B.1)

Source Category	GHGs	Fuel Type	Comments on time series consistency
1.B.1	CH_4	Solid Fuels	* All EFs were constant over the entire time series.

Source-specific QA/QC and verification: This source category was covered by the general QA/QC of the greenhouse gas inventory.

Recalculation: There wasn’t any change in sector 1.B.1 for 1990-2007.

3.2.1.1 Coal Mining and Handling (1.B.1.a)

The data were gathered from MENR. The average percent of extracted coal from underground mines was approximately 4.3% for the years 1990-2007. For year 2007, the percentage was even lower than the average with a value of 3.3%.

Chapter 4

4. Industrial Processes

4.1. Overview

The GHG emissions from Industrial Processes are released as a result of manufacturing processes. It means this category includes only emissions from processes and not from fuel combustion used to supply energy for carrying out the processes. For that reason, emission from industrial processes are referred to as "non - combustion".

The TurkStat was the basic data source for the quantities of materials and goods produced. During the preparation of the inventories, owing to the data confidentiality (i.e., number of related industries which were less than 3), some emissions were given as aggregated into upper IPCC level in CRFR and NIR. Turkish Statistical Law has been published in the Official Gazette on 18 November 2005 related to this issue and it includes the legal private law. It means, the private information cannot be announced as information except for 3 of the same private category being aggregated. Therefore, the information given in the CRF Tables and NIR were not including any confidentiality since it was aggregated to upper IPCC category.

The emissions were calculated according to the following equation 4.1:

Emissions = Production* Emission factor (4.1)

The emission factors given in annex for the current inventories were the default from the IPCC Guidelines emission factors.

According to the IPCC categorization of this source, this section also includes emissions from the use of HFCs and SF_6.

Carbon Dioxide (CO_2): In industrial processes, 89% of the CO_2 emission was coming from the cement production (See Table 4.1), which was also one of the key sources. The main emission source was the clinker production. From the table, it might be concluded that the highest emission ratio was observed in 2007 with an approximate value of 21.2 million tones CO_2.

Table 4.1. CO_2 emission contribution of cement production (%)

1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
80.15	82.31	82.65	81.25	83.07	83.75	82.15	80.81	83.99	86.44	88.18	88.89	86.10	86.12	85.33	91.03	91.62	89,26

In 2007, the other CO_2 emission source in industries was lime production with 3.34%.

The total CO_2 emission from the industrial processes was given in Figure 4.1. According to this figure, the trend involves a steady increase.

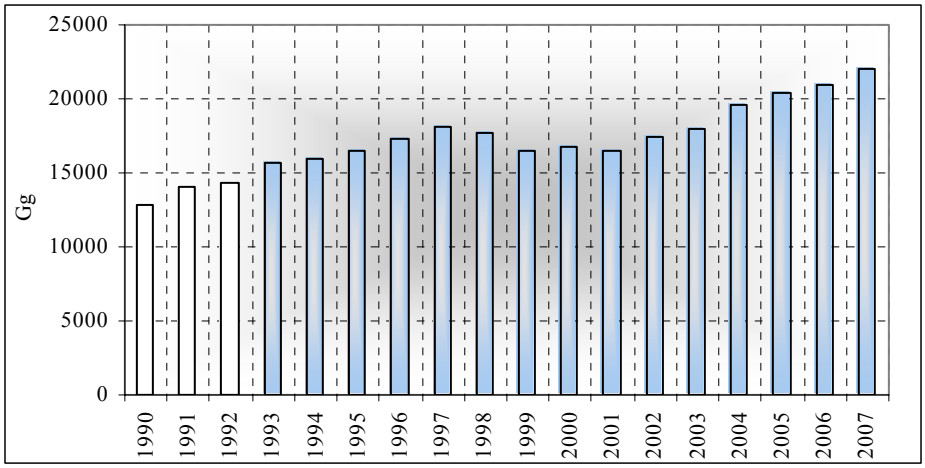


Figure 4.1. CO_2 emissions from industrial processes

Nitrous Oxides (N_2O): The source of N_2O emission was the chemical industry, especially the nitric acid production. Between the years 1990 and 2006, the N_2O emission trend shows a great variety and fluctuations. The main reason was the nitric acid demands changes in domestic markets. This was also affecting the NO_X emissions. The main emission sources for NO_X can be categorized as follows: Glass production, road paving with asphalt, nitric acid production, other chemical productions, iron and steel production, aluminium industry, pulp and paper, petroleum industry. The NO_X emission from glass production and petroleum industry was estimated by the CORINAIR methodology. The IPCC Guidelines don't provide methodology for estimating the emissions for these processes. For the other industrial processes, the emission factors are the default from the IPCC Guidelines. Until the year 1993, the NO_X emission trend shows an increase; afterwards it involves great variations. In Turkey, the highest NO_X emission sources were the pulp and paper and nitric acid production.

Methane (CH_4): In Turkey, the main source of the CH_4 emission was the Chemical Industry. The annual base emissions from the industries were range between 0.71 and 2.56 Gg. As can be seen in Figure 4.2, there was steep change in 2005 compared to 1990.

The other GHGs emissions for this sector were also given in the following Figure 4.2.

The main sources of CO emissions were road paving with asphalt, asphalt roofing, ammonia production, other chemical productions, aluminium industry, iron and steel production, petroleum industry, pulp and paper.

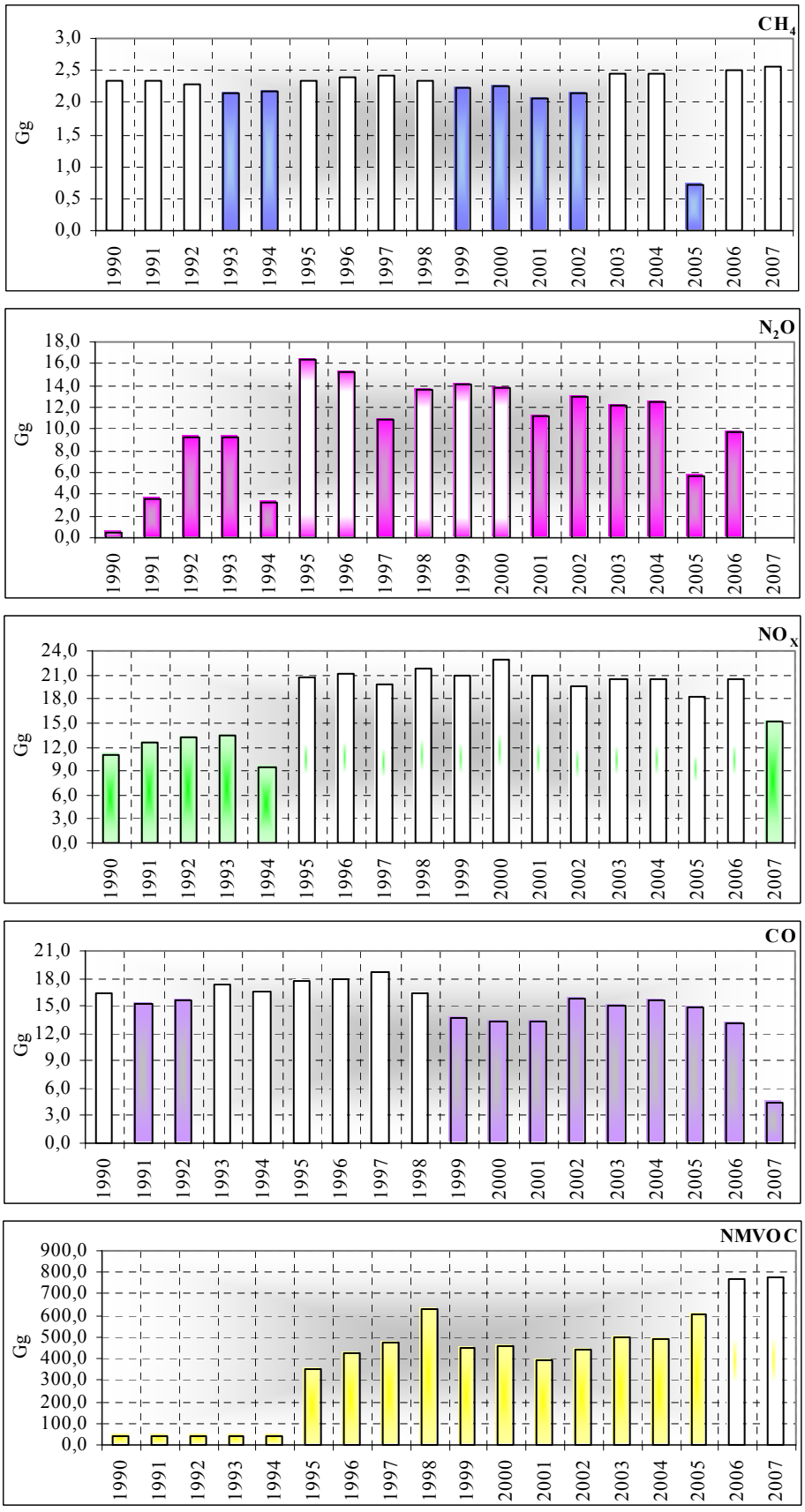


Figure 4.2. CH_4, N_2O, NO_X, CO, NMVOC emissions from industrial processes

The CORINAIR methodology was used for estimating the CO emission from petroleum industry. The IPCC Guidelines don't provide methodology for estimating the emission for this process. For the other industrial processes, the emission factors were the default from the IPCC. The highest CO emission source was the aluminium industry. The total CO emission range was changing between 12.93 Gg (in 2007) to 18.64 Gg (in 1997).

Finally, the main sources of NMVOC emissions were road paving with asphalt, asphalt roofing, ammonia production, other chemical productions, iron and steel production, petroleum industry, pulp and paper, food and drink. The highest NMVOC emission was coming from the food and drink industries. The emission trend involves fluctuations throughout the years. The CORINAIR methodology was used for estimating the NMVOC emission from petroleum industry. The IPCC Guidelines don't provide methodology for estimating the emission for this process.

The CORINAIR emission factors for NO_X, CO and NMVOC were given in the following Table 4.2.

Table 4.2. CORINAIR emission factor

Glass production type	Emission factor (kg NO_X/tones production)
Plain glass	10
Bottle	5
others	6

Gases	Emission factor from petroleum industry
NOX	0.05 kg/m^3 *
CO	0.08 kg/m^3 *
NMVOC	0.25 g/kg

There's no production of PFC, HFC and SF6 in Turkey. All demand is met by import. The methodology has been based on the IPCC Guidelines and the IPCC Good Practice Guidance. Inventory calculations have been based on the raw import data.

4.2. Mineral Products (2.A)

Source Category Description: This source category, mainly, includes the cement production, lime production, soda ash production and use, asphalt roofing, road paving with asphalt and glass production. Emissions of GHG from industrial processes were reported under (2.A). Fuel combustion's emissions were reported under CRF source category (1.A). The industrial processes also gave rise to emissions of NO_X, N_2O, NMVOC, CO and SO_2. The main activity data provider was TurkStat and TCMA (Turkish Cement Manufacturers' Association). In TurkStat, the annual industrial production data were formed by monthly industrial production survey.

Methodological Issues: The production data was applied to emission factors (EF) to give an estimation of the direct and indirect greenhouse gas emissions.

Uncertainties and time-series consistency: The activity data for industrial processes were almost gathered from TurkStat industrial production survey results. The approach to produce quantitative uncertainty estimates was to use expert judgement as described in IPCC Good Practice Guidance and Uncertainty Management (2000) Reference. Sectoral expert calculated the uncertainty and combined with their judgement to minimise the risk of bias. The uncertainties in emission factors and activity data were explained in annex in detail.

Table 4.5. Time series consistency of emission factor for (2.A)

Source Category	GHGs	Comments on time series consistency
2.A	CO_2	* EFs were not vary until 2004 for (2.A). For 2005, EFs were taken as 0.51 instead of 0.51025 for (2.A.1). Others were all constant over the entire time series.
2.A	NO_X, CO, NMVOC, SO_2	* All EFs were constant over the entire time series.

Source-specific QA/QC and verification: This source category was covered by the general QA/QC of the greenhouse gas inventory

Recalculation: There was no main change in sector 2.A per pollutant for 1990-2007.

4.2.1 Cement Production (2.A.1)

Cement is produced by grinding a mixture of calcium carbonate (CaCO3), silica, alumina, iron oxides and then heating the ground material in a kiln. The calcium oxide subsequently reacts with the other raw materials to form clinker. The clinker is cooled after addition of other raw materials. The methodology used for estimating CO_2 emissions from calcinations is the IPCC Tier 1 approach (IPCC, 2000). Although the clinker production data were available, CaO content in clinker from individual plants or companies were not known. Therefore, Country Specific CaO content was not formed for Tier 2 methodology. The EF was consistent for the years between 1990 and 2004. However, EF was taken as 0.51 instead of 0.51025 after the year 2005 CO_2 emission estimations.

This sector was a key category in terms of CO_2 emissions from kiln production. The activity data were gathered from Turkish Cement Manufacturers' Association.

There are 41 integrated cement plants in Turkey, which produce clinker and final product cement. There are also 18 cement plants in Turkey producing only cement from the clinker and final product cement. The clinker production capacity was around 42 million tones in 2007, whereas the actual production was 41.6 million tones. In Turkey, about 90% of the

cement kilns (not the plants) are based on dry systems (with or without pre-calciner). The remaining 10% covers semi-wet (Lepol) or wet systems.

Main fuel for this sector was lignite and petroleum-coke. In Turkey, cement plants can co-incinerate waste via securing a licence from the Turkish Ministry of Environment and Forestry. The licence requires stack gas emissions and analyses according to the regulation prepared in accordance with the "EU incineration of waste directive 2000/76/EC. Wastes co-incinerated by licence are: waste plastics, used tyres, waste oils (Class I and Class II), industrial sludge and tank bottom sludge. Sulphur is not a main emission item in cement sector. However, as given in the 1996 IPCC Revised Guidelines (Section 2.3.3.) SO_2 emission was also estimated according to the processes originated from sulphur in the raw material.

4.2.2 Lime Production (2.A.2)

Lime (CaO) is manufactured by the calcination. The calcination results in the evaluation of carbon dioxide. The use of production data was simpler and more reliable than the consumption data. For that reason the production data from TurkStat was used for the emission calculations. The time series of emission factors were consistent. This section was not a key category. However, there was a high uncertain activity data. The uncertainty for the activity rates used was estimated as 34%. This experts' assessment took account of the following error sources:

- Uncertainty in collecting and transferring data,
- Uncertainties in determination of activity rates, since some of the data can only be estimated, using industrial plant data.

Moreover, there were not country-specific data on CaO and MgO content.

4.2.3 Lime Stone and Dolomite Use (2.A.3)

Basically, limestone and dolomite are added to sinter where they are calcinated. After the year 2005, the CO_2 emission was aggregated to lime production (2.A.2). Because number of related industries was less than 3 and the emission from production value privacy according to the Regulations was summed (2.A.2) up. This source category was not a key category.

4.2.4 Soda Ash Production and Use (2.A.4)

Soda ash use results in CO_2 emissions. TurkStat determines the total amounts of soda ash produced in Turkey. This source category was not a key category since the number of the sector is less than three and the production data is confidential in accordance with law. Emission estimation was based on production of soda-ash.

4.2.5 Asphalt Roofing (2.A.5)

Emissions of CO_2 were not estimated from this source as there was no methodology available. Emissions from this source category were extremely small in relation to national emissions.

4.2.6 Road Paving with Asphalt (2.A.6)

This source category "Road paving with asphalt" produces no direct greenhouse-gas emissions and was thus not a key category.

4.2.7 Other – Glass Production (2.A.7)

Emissions from glass production were reported under (2.A.7). The source category Mineral products: glass production was not a key category. The currently valid IPPC Good Practice Guidance contains no proposals or information relative to calculation of process-related CO_2 emissions for the glass industry.

4.3. Chemical Industry (2.B)

Source Category Description: This source category, mainly, includes the ammonia production, nitric acid production, adipic acid production, carbide production and other chemicals (carbon black, ethylene, dichloroethylene, styrene, methonal) production. The main activity data provider was TurkStat. In TurkStat, the annual industrial production data were formed by monthly industrial production survey.

Methodological Issues: The production data was applied to emission factors (EF) to give an estimation of the direct and indirect greenhouse gas emission.

Uncertainties and time-series consistency: The activity data for industrial processes were almost gathered from TurkStat industrial production survey results. The approach to produce quantitative uncertainty estimates was to use expert judgement as described in IPCC Good Practice Guidance and Uncertainty Management (2000) Reference. Sectoral expert calculated the uncertainty and combined with their judgement to minimise the risk of bias. The uncertainties in emission factors and activity data were explained in annex in detail.

Table 4.6. Time series consistency of emission factor for (2.B)

Source Category	GHGs	Comments on time series consistency
2.B	CO_2, CH_4, N_2O	* All EFs were constant over the entire time series.
2.B	NO_X, CO, NMVOC, SO_2	* All EFs were constant over the entire time series.

Source-specific QA/QC and verification: This source category is covered by the general QA/QC of the greenhouse gas inventory

Recalculation: There was no change in sector 2.B per pollutant for 1990-2007.

4.3.1 Ammonia Production (2.B.1)

The source category was not a key category. Ammonia is produced on the basis of hydrogen and nitrogen. The amount of ammonia produced in Turkey was determined by TurkStat via monthly inventories. And, the emissions were calculated as follows (4.2):

Emission (kt) = Ammonia production quantity (kt) x emission factor (kt/kt) (4.2)

Due to a lack of plant-specific data, an emission factor of 1600 kg CO_2 /t NH_3 – the proposed default factor – was used.

4.3.2 Nitric Acid Production (2.B.2)

The numbers of nitric acid plants were, only, 3 in 2007. At the beginning of 1990s, there was no catalytic reduction. However for the latest year, the plants were equipped with non-selective catalytic reduction. For the consistency and IPCC GPG (2000), section 3.2 for older plants without NSCR, the (EF) was taken as 19 kg/t. Basically, the nitric and ammonium productions were used for artificial fertilizers. The values given below on the figures were intermediate products and were directly used for fertilizer productions (either nitric acid basis fertilizers or ammonia basis fertilizers).

The needs for agricultural activities (domestic markets) have determined the production quantity of fertilizers. Therefore the trends for either ammonia or nitric acid basis fertilizers produced according to the agricultural demand. The regions of these production plants are also different.

The production data for NH_3 and HNO_3 were almost gathered from TurkStat industrial production survey results. This sector (Nitric Acid Production) was a key category in terms of N_2O emissions.

4.3.3 Adipic Acid Production (2.B.3)

The source category was not a key category. The N_2O emission from this sector was considerably small. Therefore it was included in part (2.B.2). This chemical was also used for fertilizer production.

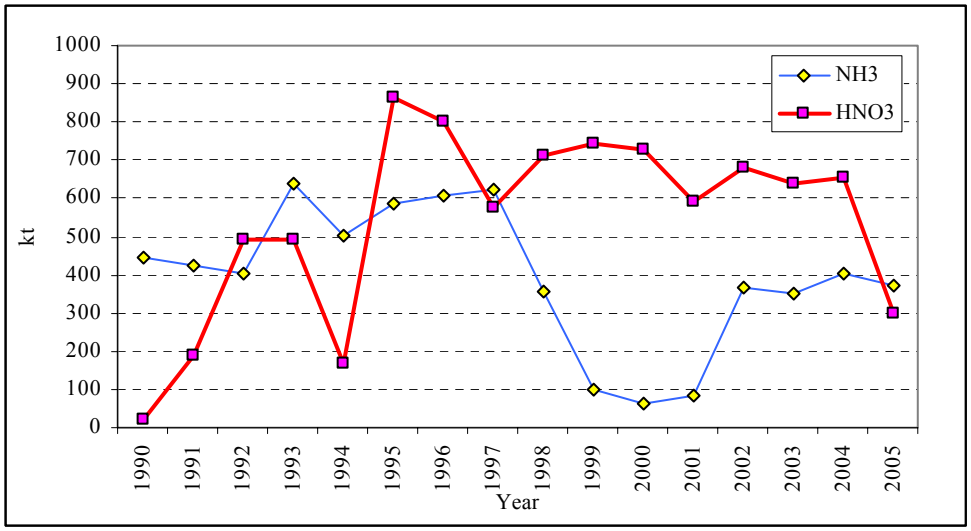


Figure 4.3. NH_3 and HNO_3 production in industries for the years 1990-2005

4.3.4 Carbide Production (2.B.4)

There was no carbide production in 2007 according to the TurkStat industrial production survey results. Therefore, it was not considered for 2007.

4.3.5 Emission from Other Chemical Production (2.B.5)

This section was including carbon black, ethylene, dichloroethylene, styrene and methanol production. The numbers of related industries were less than 3; therefore emissions were not given as separate per each product. This section was not a key category in terms of emissions.

4.4. Metal Production (2.C)

Source Category Description: This source category, mainly, includes iron and steel production, ferroalloys production and aluminium production. The main activity data provider was TurkStat. In TurkStat, the annual industrial production data were formed by monthly industrial production survey.

Methodological Issues: The production data was applied to emission factors (EF) to give an estimation of the direct and indirect greenhouse gas emissions.

Uncertainties and time-series consistency: The activity data for industrial processes were almost gathered from TurkStat industrial production survey results. The approach to produce quantitative uncertainty estimates was to use expert judgement as described in IPCC Good Practice Guidance and Uncertainty Management (2000) Reference. Sectoral expert calculated the uncertainty and combined with their judgement to minimise the risk of bias. The uncertainties in emission factors and activity data were explained in annex in detail.

Table 4.7. Time series consistency of emission factor for (2.C)

Source Category	GHGs	Comments on time series consistency
2.C	CO_2	* All EFs were constant over the entire time series.
2.C	NO_X, CO, NMVOC, SO_2	* All EFs were constant over the entire time series.

Source-specific QA/QC and verification: This source category was covered by the general QA/QC of the greenhouse gas inventory.

Recalculation: There was no change in sector 2.C per pollutant for 1990-2007.

4.4.1 Iron and Steel Production (2.C.1)

The Turkish iron and steel industry produces steel in integrated steel plants with basic oxygen furnaces and by electric arc furnaces. There were three integrated steel plants and 18 electric arc furnaces. There was high energy consumption in this sector. The emissions from energy consumption were reported under CRF category 1.A.2. The emission from production was not a key category.

4.4.2 Ferroalloys Production (2.C.2)

This category was not a key category. The CO_2 emission from this sector was considerably small.

4.4.3 Aluminium Production (2.C.3)

This category was not a key category. The CO_2 emission from this sector was considerably small.

4.4.4 SF6 used in Aluminium and Magnesium Foundries (2.C.4)

This category was not relevant to Turkey.

4.4.5 Other Metal production (2.C.5)

This category was not relevant to Turkey.

4.5. Other Production (2.D)

Source Category Description: This source category, mainly, includes pulp and paper production and food and drink. The main activity data provider was TurkStat. In TurkStat, the annual industrial production data were formed by monthly industrial production survey.

Methodological Issues: The production data was applied to emission factors (EF) to give an estimation of the direct and indirect greenhouse gas emissions.

Uncertainties and time-series consistency: The activity data for industrial processes were almost gathered from TurkStat industrial production survey results. The approach to produce quantitative uncertainty estimates was to use expert judgement as described in IPCC Good Practice Guidance and Uncertainty Management (2000) Reference. Sectoral expert calculated the uncertainty and combined with their judgement to minimise the risk of bias. The uncertainties in emission factors and activity data were explained in annex in detail.

Table 4.8. Time series consistency of emission factor for (2.D)

Source Category	GHGs	Comments on time series consistency
2.D	NO_X, CO, NMVOC, SO_2	* All EFs were constant over the entire time series.

Source-specific QA/QC and verification: This source category was covered by the general QA/QC of the greenhouse gas inventory

Recalculation: There was no change in sector 2.D per pollutant for 1990-2007.

4.5.1 Pulp and Paper Production (2.D.1)

The source category (2.D.1) was not a key source with regard to production of pulp and paper. All emissions of direct GH gases from the pulp and paper industry in Turkey resulted from combustion of fuels; for this reason, they were reported as energy-related emissions in section (1.A.2.f). Production data was taken from TurkStat.

4.5.2 Food and Drink (2.D.2)

A number of food and drink manufacturing processes (such as: whisky, wine, bear, beverage, meal, fish, sugar, margarine, cake, biscuits, bread, animal's feed productions and etc.) gave rise to emissions of NMVOC. This source category was not a key category.

4.5. Production of Halocarbons and SF_6 (2.E)

This category was not relevant to Turkey.

4.6. Consumption of Halocarbons and SF_6 (2.F)

This section was prepared by MoEF

Source Category Description: This section is prepared by the Ministry of Environment and Forestry. There's no production of PFC, HFC and SF_6 in Turkey. All demand is met by import. The methodology has been based on the IPCC Guidelines and the IPCC Good Practice Guidance. Inventory calculations have been based on the raw import data provided by Undersecreteriat of Customs.

Methodological Issues:

HFCs

HFCs are mostly consumed in the production processes. A major portion of HFCs are used in refrigeration sector. HFCs are being used as alternatives to CFCs since 1999 mainly in refrigeration sector. Minor increases over the years are because of this transition. The minor increase in 2005 also depends on this factor.

Import licenses are registered by the Ministry of Environment and Forestry.

PFCs

Data is being collected form the aluminium production plant and metal foundries and it will be reflected to National Inventory on following years. For year 2006, PFC emissions from the aluminium production plant are estimated using Tier 3 methodology. Emissons from this plant could not be included in the inventory due to confidentiality.

In addition to this, there's an ongoing technology renewing project in the plant which will reduce the PFC emissions from electrolytic cell process.

From the data provided by the Undersecreteriat of Customs and TURKSTAT, PFC imports figures are negligible so they are not reflected on the tables. Most of the importers in metal industry are smaller foundries. Amount of emission by metal industry is equal to amount used as stated in guidelines.

SF_6

A major portion of SF_6 is used in electrical instruments. The increase in the import data from 2004 is mainly because of the increasing amount of circuit breakers being installed in Turkey.

Unfortunately there's no reliable data source on SF_6 imports, both for amounts coming as gas and inside electrical equipment. However Ministry of Environment and Forestry have

began working on collection of the data together with related institutions. After a licensing and data collection system is established more reliable data will be obtained and previous years' data will be recalculated if possible.

The only available data for electrical equipments is the imported SF_6 data. There is no information about the number and the capacity of the used, imported or exported equipments and the number of destroyed equipments. The imported amount has been assumed as completely emitted. Since, electrical equipment production is the main consumer of SF_6, this assumption has led to high emission rates which thought to be less in practice.

SF6 data has been classified according to the company's name and the activity. When necessary, companies have been asked (i.e. leather industry) to clarify the emission rates.

Also, use of SF_6 in fire extinguisher is a source of error due to lack of information whether it is used in fixed or portable systems.

Leather industry is a new sector which uses SF_6 and not listed in guidelines. It has been determined that SF_6 is used to prevent wrinkling during processing of leathers. In the same way as metal, all SF_6 used in leather industry has been taken as equal to amount emitted.

SF6 imported by laboratories, universities, medical industries have also been calculated in the same way and it has been assumed that all SF_6 is emitted in two years in equal amounts as suggested in guidelines. Amounts imported by unidentified users have also been calculated in the same way.

SF_6 used in "fire extinguishers" has been calculated by contacting the importing company. Emission factor of fire extinguishers depends on whether they are used is fixed systems or portable systems. Since there is no data about the place, according to the interview with the importer, it has been assumed that 2/3 of the imported amount is used in fixed systems and 1/3 is used in portable systems. Emission factors have been taken as %60 and %35 for portable and fixed systems respectively.

For year 2006 and 2007 emissions from SF_6 are estimated using annual growth rates of Turkey due to lack of data.

Uncertainties and time-series consistency: Uncertaities araising from estimation emissions arising fro HFC, PFC and SF_6 were estimated using expert judgement as described in IPCC Good Practice Guidance and Uncertainty Management (2000) Reference.

Source-specific QA/QC and verification: Import data of HFCs are cross-checked between import data available in TurkStat and import licenses available in MoEF.

Recalculation: Emissons from SF_6 for year 2006 is recalculated. No data is available on imprtos and use of SF_6 for years 2006 and 2007. SF_6 emissons are assumed to increase by the same percentage with overall ecomonic growth in Turkey.

4.7. Other (2.G)

Source Category Description: This source category, mainly, includes petroleum industry. The main activity data provider was TurkStat.

Methodological Issues: The methodology of this source category was the same as industrial processes.

Uncertainties and time-series consistency: The experts provided the uncertainty estimates.

Table 4.9. Time series consistency of emission factor for (2.G)

Source Category	GHGs	Comments on time series consistency
2.G	NO_X, CO, NMVOC	* All EFs were constant over the entire time series.

Source-specific QA/QC and verification: This source category was covered by the general QA/QC of the greenhouse gas inventory

Recalculation: There was no change in sector 2.G per pollutant for 1990-2007.

4.7.1 Petroleum Industry (2.G)

This source category was not a key category in terms of emissions level. All emissions of direct GH gases from this industry in Turkey resulted from combustion of fuels; for this reason, they were reported as energy-related emissions in section (1.A.2.b). However, the industrial processes in this category also emit NO_X, CO and NMVOC during production processes rather than the fugitive emission. Therefore, the emissions were reported under industrial processes.

Chapter 5

5. Solvent and Other Product Use

This category includes particularly emissions of CO_2, N_2O and NMVOC (IPCC Guidelines don't provide methodology for estimating the emissions of NMVOCs) from the use of solvents. It was very difficult to gather the information from the consumption sources of solvent. The lack of data for solvent use hinders to estimate the CO_2, N_2O and NMVOC emissions. Therefore, this section, which contains the following activities

- Paint applications
- Degreasing and dry cleaning
- Chemical products, manufacture and processing
- Other
  - Use of N_2O for anaesthesia
  - N_2O from fire extinguishers
  - N_2O from aerosol cans
  - Other use of N_2O

were skipped by TurkStat.

Chapter 6

6. Agriculture

6.1. Overview

In Turkey, the GHG emissions from agriculture activities are released as a result of the production and processing of agricultural crop, animal population (enteric fermentation, manure management), agricultural soil and field burning of agricultural residue.

The processes and activities of the agricultural activities were mainly sources of CH_4. However, the field burning of agricultural residues emitted N_2O, CO and NO_X.

Most of the activity data was collected and provided by the TurkStat. The parameters and emission factors for estimating the GHG emissions from this sector were from the IPCC guidelines.

Methane (CH_4): In this sector, the highest methane emission was the results of the enteric fermentation. It could be seen from Figure 6.1 that, the CH_4 emission trend is decreasing after the year 1990. The main reason was determined as the decreasing number of livestock (Table 6.1). In 2007, the CH_4 emission reaches to 828.6 Gg due to separation of dairy cattle and using higher EF. Dairy cattle category is also separated into domestic and cultural.

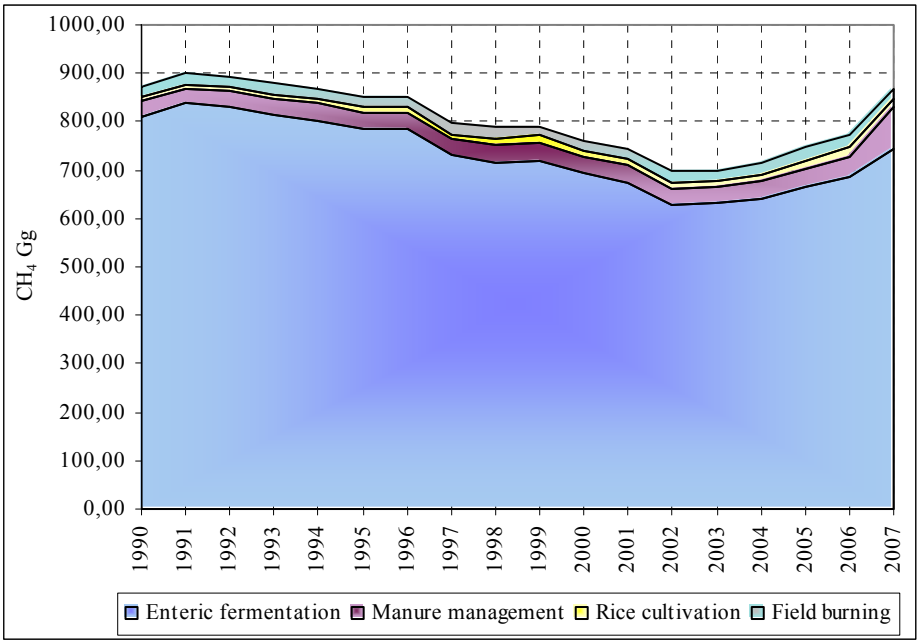


Figure 6.1. CH_4 emission trend from agricultural activities

The Ministry of Environment and Forestry prohibit farmer from burning the agricultural residue. Most of the farmers adapt the regulations, but the total quantity was not known. Therefore, the residue of the agricultural crops was still estimated as burned.

Table 6.1. The number of animals (*1000)

Unit: (*1000)	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Dairy Cattle	1013	1254	1337	1442	1512	1702	1795	1715	1733	1782	1806	1854	1860	1941	2109	2355	2772	4260
Other Cattle	10364	10719	10613	10468	10389	10087	10091	9470	9298	9272	8955	8694	7944	7848	7960	8171	8100	6807
Buffalo	371	366	352	316	305	255	235	194	176	165	146	138	121	113	104	105	101	54
Sheep	40553	40432	39416	37541	35646	33791	33072	30238	29435	30256	28492	26972	25174	25432	25201	25304	25617	25462
Goats	10926	10764	10454	10133	9564	9111	8951	8376	8057	7774	7201	7022	6780	6772	6610	6517	6643	6286
Camels	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1
Horse	513	496	483	450	437	415	391	345	330	309	271	271	249	227	212	208	204	189
Mules&Dankeys	1187	1136	1075	1013	978	900	843	782	736	680	588	559	512	490	452	423	404	364
Swine	12	10	12	9	8	5	5	5	5	3	3	3	4	7	4	2	1	2
Poultry	98848	141918	155437	181120	186591	131960	155693	169896	240108	242714	260769	219887	248009	279680	298897	319220	346175	270873

Table 6.2. The percent of animal according to the climate region and manure management and enteric fermentation emission factors, 2007

Unit of EF (kg CH_4/head/y)	cool (%)	Tempe. (%)	Manure		Enteric
			Cool EF	Tempe. EF	EF
Dairy Cattle	64,7	35,3	7	16	68.5
Other Cattle	66,4	33,6	1	1	44
Buffalo	70,6	29,4	1	2	55
Sheep	70,1	29,9	0.1	0.16	5
Goats	47,5	52,5	0.11	0.17	5
Camels	4,8	95,2	1.3	1.9	46
Horse	57,1	42,9	1.1	1.6	18
Mules&Dankeys	58,7	41,3	0.6	0.9	10
Swine	48,6	51,4	1	4	1
Poultry	49,4	50,6	0.012	0.018	-

Turkey's climate is considerable changing from region to region. As the annual average air temperature is considered, Turkey's provinces are in cool (0 and 14 degrees centigrade) and temperate (15 and 25 degrees centigrade) climatic region. The used emission factor for manure management and enteric fermentation were according to the IPCC guidelines and the percent of the animal distribution were given in Table 6.2.

Direct emissions of nitrous oxide from agricultural soils (including the application of fertilizers and manure), were estimated for 2007.

The emission from the field burning of agricultural residue was determined as one of the important emission sources. The result was seen in Figure 6.2. However, the emission trend shows fluctuations between 1990 and 2007. The highest CO emission from field

burning was seen in 2005 with a value of 561.94 Gg. For N_2O and NO_X, the highest emissions were determined as 0.51 Gg and 12.86 Gg in 2005, respectively.

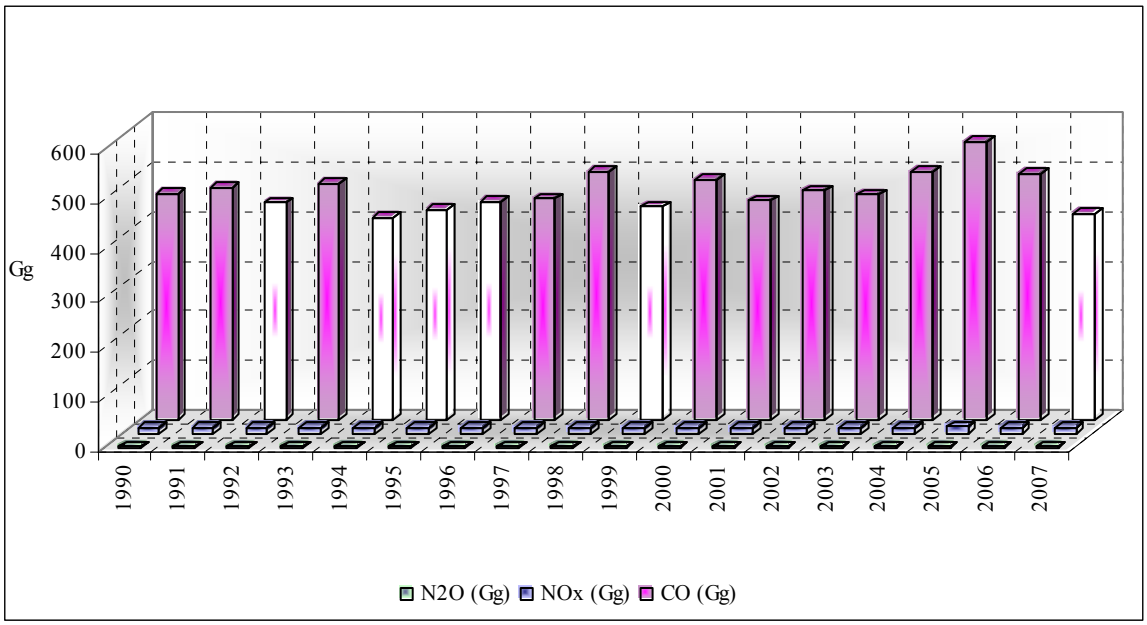


Figure 6.2. N_2O, NO_X and CO emissions from field burning of agricultural residues

6.1. Enteric Fermentation (4.A)

Source Category Description: Enteric fermentation is a digestive process whereby carbohydrates are broken down by micro-organism into simple molecules. The main product is the CH_4 gases. All type of animals produces CH_4 during and/or after feed intake. The highest methane emission in Agricultural sector in Turkey was the results of the enteric fermentation. The CH_4 emission has been decreasing since 1990. The main reason was the decreasing number of livestock. The main activity data (the population of animals) provider was TurkStat (provincial animal statistics).

Methodological Issues: The provincial animal population data collected from TurkStat was categorized according to the climate of province, then applying to appropriate emission factors (EF) to give an estimation of CH_4 emission. The methane emission factors were default IPCC Tier 1 factors. Although IPCC-GPG (2000) calls for the more detailed Tier 2 method to be used in cases in which a country has listed methane emissions from animal husbandry as a key source for its inventories. The cattle and sheep emission factors were not studied according to the IPCC Tier 2 methods. Because the nutrient requirements, feed intake and CH_4 conversion rates for feeding types were showing big differences even in provincial level. The rough CS emission factor estimation by experts almost resulted in IPCC Tier 1 factors.

Uncertainties and time-series consistency: The activity data for this section were almost gathered from TurkStat agricultural statistics. The approach to produce quantitative

uncertainty estimates was to use expert judgement as described in IPCC Good Practice Guidance and Uncertainty Management (2000) Reference. Agricultural expert calculated the uncertainty and combined with their judgement to minimise the risk of bias. The uncertainties in emission factors and activity data were explained in annex in detail.

Table 6.3. Time series consistency of emission factor for (4.A)

Source Category	GHGs	Comments on time series consistency
4.A	CH_4	* All EFs were constant over the entire time series as given in Table 6.2.

Source-specific QA/QC and verification: This source category was covered by the general QA/QC of the greenhouse gas inventory

Recalculation: There was no change in sector 4.A per pollutant for 1990-2007.

6.2. Manure Management (4.B)

Source Category Description: Animal manure is composed of organic materials and it decomposes in an anaerobic environment and methanogenic bacteria produce methane (CH_4). This source category was a key category in terms of N_2O and CH_4 emissions.

Methodological Issues: The provincial animal population data collected from TurkStat was categorized according to the climate of province, then applying to appropriate emission factors (EF) to give an estimation of CH_4 and N_2O emission from manure management. The methane emission factors were default IPCC Tier 1 factors. Since, there were no significant share of emission and detailed information on animal characteristics. The method chosen depended on data availability.

Uncertainties and time-series consistency: The approach to produce quantitative uncertainty estimates was to use expert judgement as described in IPCC Good Practice Guidance and Uncertainty Management (2000) Reference.

Table 6.4. Time series consistency of emission factor for (4.B)

Source Category	GHGs	Comments on time series consistency
4.B	CH_4	* All EFs were constant over the entire time series as given in Table 6.2.

Source-specific QA/QC and verification: This source category was covered by the general QA/QC of the greenhouse gas inventory

Recalculation: There was no change in sector 4.B per pollutant for 1990-2007.

6.3. Rice Cultivation (4.C)

Source Category Description: Anaerobic decomposition of organic material in flooded rice fields produces methane (CH_4), which escapes to the atmosphere primarily by transport through the rice plants. This source category was not a key category in Turkey.

Methodological Issues: The rice harvested area (in Turkey, Water Management Regime was irrigated and flood type was continues) collected from TurkStat and then applied to appropriate emission factors (EF) to give an estimation of CH_4 emission from rice production. The methane emission factors were default IPCC factors.

Uncertainties and time-series consistency: The approach to produce quantitative uncertainty estimates was to use expert judgement as described in IPCC Good Practice Guidance and Uncertainty Management (2000) Reference.

Table 6.5. Time series consistency of emission factor for (4.C)

Source Category	GHGs	Comments on time series consistency
4.C	CH_4, CO, N_2O, NO_x	* All EFs were constant over the entire time series

Source-specific QA/QC and verification: This source category was covered by the general QA/QC of the greenhouse gas inventory

Recalculation: There was no change in sector 4.F per pollutant for 1990-2007.

6.4. Agricultural Soils (4.D)

Source Category Description: This source category was a key category in terms of N_2O and emissions.

Methodological Issues: The manure (synthetic and animal manure applied to soil) management was applied to appropriate emission factors (EF) to give an estimation of N_2O emission from Agricultural soil.

Uncertainties and time-series consistency: The approach to produce quantitative uncertainty estimates was to use expert judgement as described in IPCC Good Practice Guidance and Uncertainty Management (2000) Reference.

Table 6.4. Time series consistency of emission factor for (4.B)

Source Category	GHGs	Comments on time series consistency
4.B	CH_4	* EF aplied to 2007 will be constant over the entire time series for the 1990-2006 in the next year.

Source-specific QA/QC and verification: This source category was covered by the general QA/QC of the greenhouse gas inventory

Recalculation: NE category is now calculated.

6.5. Prescribed Burning of Savannas (4.E)

This category is not relevant to Turkey.

6.6. Field Burning of Agricultural Residues (4.F)

Source Category Description: Although the burning of agricultural residues considered a net source of carbon dioxide because the carbon released to the atmosphere is reabsorbed during the growing season, this burning is a net source of emission of CH_4, CO, N_2O and NO_x. This source category was not a key category in Turkey.

Methodological Issues: The emissions from agricultural residue burning were considered under agriculture. The estimates were derived from IPCC emission factor and from crop production including wheat, barley, maize, oat and rye. The statistical data (activity data) were gathered from TurkStat.

Uncertainties and time-series consistency: The approach to produce quantitative uncertainty estimates was to use expert judgement as described in IPCC Good Practice Guidance and Uncertainty Management (2000) Reference.

Table 6.6. Time series consistency of emission factor for (4.6)

Source Category	GHGs	Comments on time series consistency
4.F	CH_4	* All EFs were constant over the entire time series

Source-specific QA/QC and verification: This source category was covered by the general QA/QC of the greenhouse gas inventory

Recalculation: There was no change in sector 4.C per pollutant for 1990-2007.

6.7. Other (4.G)

This category was not relevant to Turkey.

Chapter 7

7. LULUCF

This section will be submitted to UNFCCC separately.

Chapter 8

8. Waste

8.1 OVERVIEW

Emission from this sector is mainly occurring from the disposal of waste. The most important GHG produced in this sector is CH_4 (methane). In addition to methane, solid waste incineration in this sector could also produce CO_2 and other GHG. Although there was one hazardous waste inceneration plant and 2 medical waste incineration plants in Turkey, emissions from waste incineration was not included in this report since the methodology for hazardous waste inceneration was not clear due to different characteristics of waste. Moreover, wastewater was also not handled within the inventory due to lack of data.

8.2 Solid Waste Disposal on Land (6.A)

Source Category Description: This sector includes emissions from managed waste disposal and unmanaged waste disposal sites landfills. This category is including CH_4 emissions from municipal solid waste disposal on land. This sector was a key category in terms of CH_4 emissions from waste disposal.

Methodological Issues: The disposed of solid waste emits CH_4 as a result of the processes of anaerobic and aerobic decomposition of organic mater contained in the waste. The default methodology recommended in the IPCC Guidelines was used for estimating the volumes of methane emitted in Turkey.

Although, this sector was a key category. Estimation of CH_4 emission using the First Order Decay (FOD) method was not possible. Either individual landfill or group of specific landfills detail were not known as a time series. For some years, it is possible to obtain the results of FOD. However, for consistency, the Tier 1 methodology was selected and used.

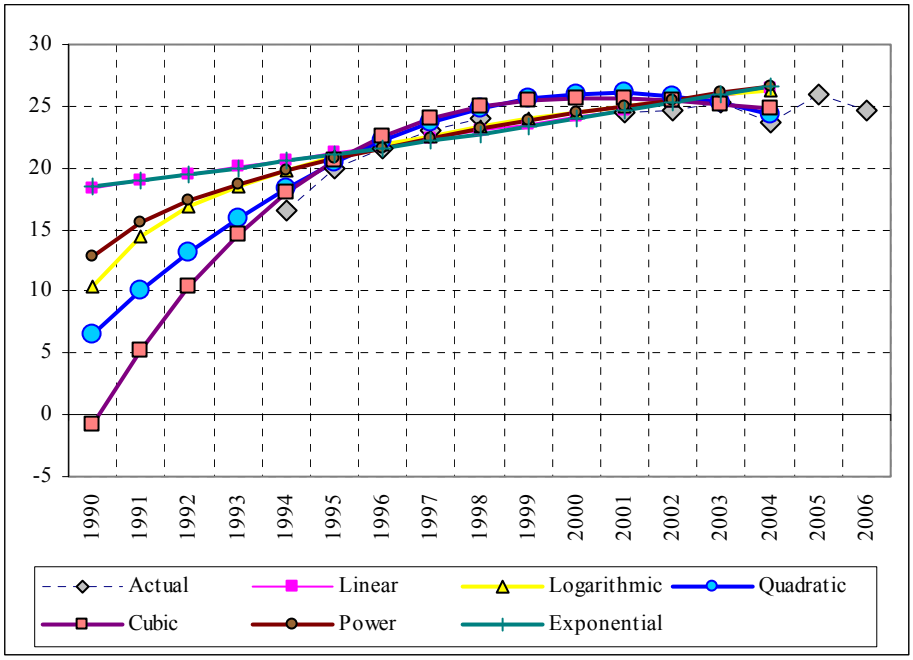
Both managed and unmanaged landfills were considered in the estimations. The annual data on municipal solid waste disposal on landfills were produced by TurkStat via Municipal Solid Waste Statistics Survey. The data were gathered from all municipalities. However, the annual survey has been done discontinuously. Only the data for years 1994, 1995, 1996, 1997, 1998, 2001, 2002, 2003, 2004 and 2006 were available. For 2005 and 2006, only managed landfill activity data was gathered from Waste Disposal and Recovery Facilities Statistisc Survey. Others were estimated by regression analysis. The used regression models were linear, logarithmic, quadratic, cubic, power and exponential. The best fit model is determined as quadratic and cubic models. The R^2 values for each model were given in Table 8.1. As shown in this table, the standard errors for power and exponential regression model were very small. R^2 values were also small. It means, the estimation did not fit for some years. The results could be seen from Figure 8.2. The

missing data were estimated by using the cubic model. In Turkey, there was only one managed landfill site for year 1992 and 1993 but data on waste disposal amount for those years were not available, 1994 waste disposal amount was used for emission estimations for 1992 and 1993. In 1999 and 2000, only one new managed landfill site started to operate. Therefore, the quantity of waste disposal on managed landfill sites was assumed as same as waste disposed on managed landfill sites in 2001. However, the regression model was prefered to estimate the waste disposed in unmanaged landfill in 1999 and 2000.

Table 8.1 Regression model results

	Linear	Logarithmic	Quadratic	Cubic	Power	Exponential
R square	0.64	0.76	0.95	0.97	0.74	0.61
Standard Err.	1722.44	1411.12	673.29	575.07	0.07	0.08

Figure 8.1 Best Fit Regression Model



The recovery of methane and its subsequent utilization was not considered in these calculations due to the lack of data.

As seen in Figure 8.2, CH_4 emissions from solid waste disposal increased from 304 Gg to 1517 Gg during the period 1990 and 2007. Since 2000, the emission was relatively stable.

Uncertainties and time-series consistency: The approach to produce quantitative uncertainty estimates was to use expert judgement as described in IPCC Good Practice Guidance and Uncertainty Management (2000) Reference.

Table 8.2. Time series consistency of emission factor for (6.A)

Source Category	GHGs	Comments on time series consistency
6.A	CH_4	* All EFs were constant over the entire time series

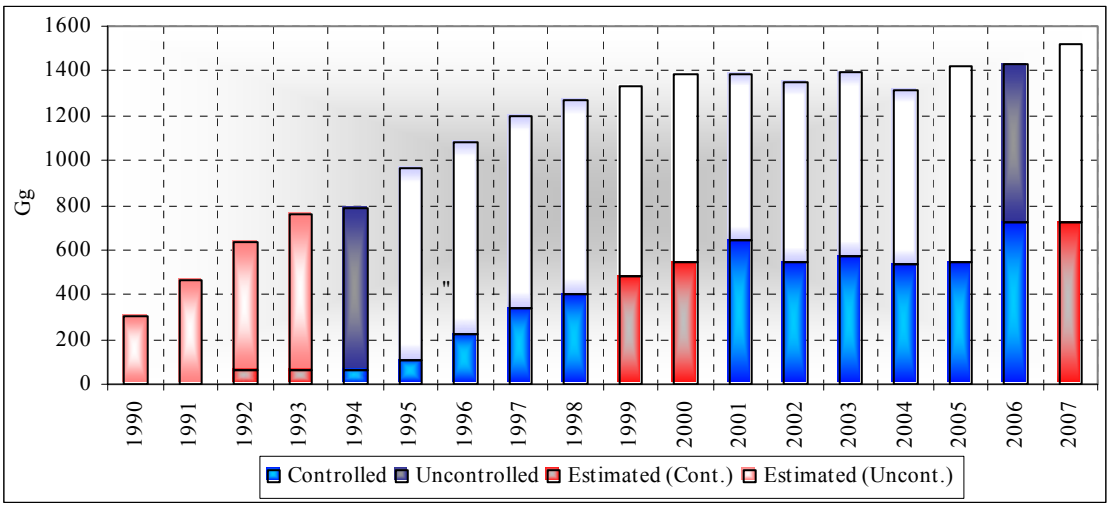


Figure 8.2 CH_4 emission trends from waste disposal

Source-specific QA/QC and verification: This source category was covered by the general QA/QC of the greenhouse gas inventory.

Recalculation: There was no change in sector 6.A per pollutant for 1990-2007.

8.2 Wastewater Handling (6.B)

This sector was not handled in this inventory due to lack of data.

8.3 Waste Incineration (6.C)

Although there was one hazardous waste inceneration plant and 2 medical waste incineration plants in Turkey, emissions from waste incineration was not included in this report and CRFR, since the methodology for hazardous waste inceneration was not clear due to different characteristics of waste.

8.4 Other (6.D)

This category was not relevant to Turkey.

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Annex 1

A1. Key Categories

According to the IPCC Good Practice Guidance, a key source category is one that is prioritised within the national inventory system because its estimate has a significant influence on a country's total inventory of direct greenhouse gases in terms of the absolute level of emissions. The results of this study has shown that

- Land Use, Land-Use Change and Forestry (CO_2)
- Public Electricity and Heat Production (Electricity Production) (CO_2),
- Road Transportation (CO_2),
- Other industries (CO_2),
- Cement Industry (Mineral Products) (CO_2),
- Residential usage of natural gas, lignite, LPG, hard coal (CO_2),
- Solid Waste Disposal (CH_4),
- Non-Ferrous Metal Industry (CO_2),
- Iron and Steel Industry (CO_2),
- Enteric Fermentation (CH_4),
- Agriculture/Forestry/Fisheries (CO_2),
- Civil Aviation (Transport) (CO_2),
- Petroleum refining (CO_2),
- Emission of HFCs (HFC-134a)
- Agricultural Soil (Synthetic Fertilizer) (N_2O)
- Chemical industry (CO_2),
- Manure Management (CH_4, N_2O)

were determined as key sources in 2007 according to the IPCC GPG (2000).

The key source categories were determined by using Tier 1 level and Trend Assessment and it was evaluated according to the qualitative criteria.

The contribution of each source category to the total national inventory level was calculated according to Equation A1.1.

Source Category Level Assessment = Source Category Estimate / Total Estimate

$$\mathbf{L_{x,t} = E_{x,t} / E_t \ * 100} \quad \text{(A1.1)}$$

Where,

$L_{x,t}$: Level assessment for source x in year t
$E_{x,t}$: Emission estimate of source category x in year t
E_t : Total inventory estimate in year t

After the necessary level assessment were computed, key source categories were those that summed together in descending order of magnitude, add up to over %95 of the total

cumulative of level assessment. The following spreadsheet can be used for the key source categories.

Table A1.1 Tier 1 Key Source Categories

A	B	C	D	E	F
Source Category	FUEL	GAS	2005 EMIS.	LEVEL Assessment (contribution)	CUMULATIVE TOTAL (%)
Example (1.A.1.a)	-	-	Input Data		Input Data
	-	-	Gg	%	&
Total			$\sum(E_{x,t})$		**100**

ANNEX 1

Table A1.2 Key Source Categories

2007 KSA						
CATEGORY	**FUEL**	**GAS**	**EMISSION**	**ABS (EMIS**	**CONTRIBUTION (%)**	**COMMUTATIVE CONTRIBUTION**
Land Use, Land-Use Change and Forestry		CO2	-76274,0	76274,0	17,0	17,0
Public Electricity and Heat Production	Lignite	CO2	41662,9	41662,9	9,3	26,3
Public Electricity and Heat Production	Natural Gas	CO2	39823,8	39823,8	8,9	35,1
Road Transportation	Gas / Diesel oil	CO2	29299,3	29299,3	6,5	41,7
Other Industries	Hard Coal	CO2	25312,0	25312,0	5,6	47,3
Cement Production (Mineral Products)		CO2	21208,5	21208,5	4,7	52,0
Residential	Natural Gas	CO2	17891,9	17891,9	4,0	56,0
Waste (landfill)		CH4	16609,5	16609,5	3,7	59,7
Enteric Fermentation		CH4	15631,9	15631,9	3,5	63,2
Waste (control landfill)		CH4	15240,2	15240,2	3,4	66,6
Public Electricity and Heat Production	Hard Coal	CO2	12466,1	12466,1	2,8	69,4
Agriculture/Forestry/Fisheries	Gas / Diesel oil	CO2	10795,4	10795,4	2,4	71,8
Non-Ferrous Metals	Natural Gas	CO2	9297,1	9297,1	2,1	73,8
Iron and Steel	Second Fuel Coal	CO2	9236,9	9236,9	2,1	75,9
Residential	Lignite	CO2	7920,6	7920,6	1,8	77,7
Road Transportation	Gasoline	CO2	7645,5	7645,5	1,7	79,4
Other Industries	Natural Gas	CO2	6599,8	6599,8	1,5	80,8
Public Electricity and Heat Production	Residual Fuel Oil	CO2	6515,5	6515,5	1,5	82,3
Cement Production	Hard Coal	CO2	6222,9	6222,9	1,4	83,7
Civil Aviation	Jet Kerosene	CO2	6063,7	6063,7	1,4	85,0
Road Transportation	LPG	CO2	5989,2	5989,2	1,3	86,4
Cement Production	Petroleum Coke	CO2	4397,6	4397,6	1,0	87,3
Agricultural Soil (Synthetic Fertilizer)		N2O	4202,8	4202,8	0,9	88,3
Other Industries	Lignite	CO2	3994,7	3994,7	0,9	89,2
Residential	LPG	CO2	3847,3	3847,3	0,9	90,0
Other Industries	Residual Fuel Oil	CO2	3727,2	3727,2	0,8	90,9
Emission of HFCs		HFC-134a	3174,3	3174,3	0,7	91,6
Petroleum Refining	Residual Fuel Oil	CO2	2665,1	2665,1	0,6	92,2
Residential	Hard Coal	CO2	2446,5	2446,5	0,5	92,7
Cement Production	Lignite	CO2	2382,7	2382,7	0,5	93,2
Manure Management		N20	2316,0	2316,0	0,5	93,8
Chemicals	Natural Gas	CO2	2287,7	2287,7	0,5	94,3
Petroleum Refining	Refinery Gas	CO2	1968,0	1968,0	0,4	94,7
Manure Management		CH4	1767,8	1767,8	0,4	95,1
Agricultural Soil (Animal Manure Applied)		N2O	1421,5	1421,5	0,3	95,4
Petroleum Refining	Natural Gas	CO2	1291,1	1291,1	0,3	95,7
Navigation	Gas / Diesel oil	CO2	1238,5	1238,5	0,3	96,0
Mining (Surface)		CH4	1230,9	1230,9	0,3	96,2
Other Industries	Gas / Diesel oil	CO2	1136,0	1136,0	0,3	96,5
Other Industries	Petroleum Coke	CO2	1087,0	1087,0	0,2	96,7
Residential	wood	CH4	1008,0	1008,0	0,2	97,0

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Table A1.2 Key Source Categories

2007 KSA						
Emission of SF6		SF6	952,1	952,1	0,2	97,2
Residential	Residual Fuel Oil	CO2	873,7	873,7	0,2	97,4
Residential	Asphalt	CO2	843,4	843,4	0,2	97,6
Sugar	Lignite	CO2	809,0	809,0	0,2	97,7
Lime Production (Mineral Products)		CO2	794,5	794,5	0,2	97,9
Other Industries	Second Fuel Coal	CO2	752,5	752,5	0,2	98,1
Iron and Steel	Hard Coal	CO2	684,0	684,0	0,2	98,2
Mining (underground)		CH4	606,2	606,2	0,1	98,4
Residential	Lignite	CH4	503,1	503,1	0,1	98,5
Road Transportation	Gas / Diesel oil	N20	442,4	442,4	0,1	98,6
Railways	Gas / Diesel oil	CO2	424,1	424,1	0,1	98,7
Residual Burning		CH4	416,4	416,4	0,1	98,8
Rice Cultivation		CH4	394,4	394,4	0,1	98,9
Non-Ferrous Metals	Hard Coal	CO2	381,1	381,1	0,1	98,9
Navigation	Residual Fuel Oil	CO2	350,3	350,3	0,1	99,0
Residential	waste of animal, plant	CH4	294,2	294,2	0,1	99,1
Other Industries	LPG	CO2	262,5	262,5	0,1	99,1
Non-Ferrous Metals	Second Fuel Coal	CO2	211,8	211,8	0,0	99,2
Cement Production	Natural Gas	CO2	211,7	211,7	0,0	99,2
Other Industries	Asphalt	CO2	210,8	210,8	0,0	99,3
Residential	wood	N20	198,4	198,4	0,0	99,3
Public Electricity and Heat Production	Lignite	N20	182,3	182,3	0,0	99,4
Residential	Second Fuel Coal	CO2	178,6	178,6	0,0	99,4
Residential	Hard Coal	CH4	166,3	166,3	0,0	99,4
Sugar	Natural Gas	CO2	165,1	165,1	0,0	99,5
Public Electricity and Heat Production	Gas / Diesel oil	CO2	157,3	157,3	0,0	99,5
Road Transportation	Gasoline	N20	138,0	138,0	0,0	99,6
Residual Burning		N20	126,0	126,0	0,0	99,6
Sugar	Residual Fuel Oil	CO2	125,3	125,3	0,0	99,6
Other Industries	Hard Coal	N20	118,5	118,5	0,0	99,6
Sugar	Second Fuel Coal	CO2	97,0	97,0	0,0	99,7
Chemicals	Residual Fuel Oil	CO2	77,0	77,0	0,0	99,7
Non-Ferrous Metals	Residual Fuel Oil	CO2	67,4	67,4	0,0	99,7
Cement Production	Residual Fuel Oil	CO2	64,7	64,7	0,0	99,7
Sugar	LPG	CO2	60,5	60,5	0,0	99,7
Civil Aviation	Jet Kerosene	N20	60,1	60,1	0,0	99,7
Public Electricity and Heat Production	Hard Coal	N20	58,3	58,3	0,0	99,7
Residential	waste of animal, plant	N20	57,9	57,9	0,0	99,8
Other Industries	Hard Coal	CH4	57,3	57,3	0,0	99,8
Residential	Asphalt	CH4	57,3	57,3	0,0	99,8
Other Chemicals Production (Chemical Industry)		CH4	53,7	53,7	0,0	99,8
Residential	Gas / Diesel oil	CO2	49,0	49,0	0,0	99,8

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Table A1.2 Key Source Categories

2007 KSA						
Road Transportation	Gasoline	CH4	47,9	47,9	0,0	99,8
Chemicals	Lignite	CO2	45,0	45,0	0,0	99,8
Iron and Steel	Second Fuel Coal	N20	43,2	43,2	0,0	99,8
Road Transportation	LPG	CH4	40,3	40,3	0,0	99,8
Public Electricity and Heat Production	Naphta	CO2	35,9	35,9	0,0	99,9
Iron and Steel	Residual Fuel Oil	CO2	34,7	34,7	0,0	99,9
Residential	Lignite	N20	34,7	34,7	0,0	99,9
Road Transportation	Gas / Diesel oil	CH4	34,5	34,5	0,0	99,9
Residential	Natural Gas	CH4	33,9	33,9	0,0	99,9
Sugar	Hard Coal	CO2	30,4	30,4	0,0	99,9
Cement Production	Hard Coal	N20	29,1	29,1	0,0	99,9
Agriculture/Forestry/Fisheries	Gas / Diesel oil	N20	27,4	27,4	0,0	99,9
Public Electricity and Heat Production	Natural Gas	N20	22,0	22,0	0,0	99,9
Iron and Steel	Second Fuel Coal	CH4	20,9	20,9	0,0	99,9
Cement Production	Petroleum Coke	N20	20,6	20,6	0,0	99,9
Iron and Steel	Gas / Diesel oil	CO2	18,1	18,1	0,0	99,9
Non-Ferrous Metals	Natural Gas	CH4	17,5	17,5	0,0	99,9
Other Industries	Lignite	N20	17,5	17,5	0,0	99,9
Public Electricity and Heat Production	Residual Fuel Oil	N20	16,7	16,7	0,0	99,9
Petroleum Refining	Gas / Diesel oil	CO2	16,7	16,7	0,0	99,9
Agriculture/Forestry/Fisheries	Gas / Diesel oil	CH4	15,5	15,5	0,0	99,9
Fertilizer	Residual Fuel Oil	CO2	15,3	15,3	0,0	99,9
Public Electricity and Heat Production	Natural Gas	CH4	15,0	15,0	0,0	99,9
Cement Production	Hard Coal	CH4	14,1	14,1	0,0	99,9
Residential	LPG	CH4	12,9	12,9	0,0	100,0
Other Industries	Natural Gas	CH4	12,4	12,4	0,0	100,0
Residential	Second Fuel Coal	CH4	12,1	12,1	0,0	100,0
Residential	LPG	N20	11,5	11,5	0,0	100,0
Residential	Hard Coal	N20	11,5	11,5	0,0	100,0
Cement Production	Lignite	N20	10,4	10,4	0,0	100,0
Residential	Natural Gas	N20	10,0	10,0	0,0	100,0
Cement Production	Petroleum Coke	CH4	10,0	10,0	0,0	100,0
Other Industries	Residual Fuel Oil	N20	9,1	9,1	0,0	100,0
Public Electricity and Heat Production	Lignite	CH4	8,8	8,8	0,0	100,0
Other Industries	Lignite	CH4	8,5	8,5	0,0	100,0
Railways	Gas / Diesel oil	N20	6,8	6,8	0,0	100,0
Petroleum Refining	Residual Fuel Oil	N20	6,5	6,5	0,0	100,0
Public Electricity and Heat Production	Residual Fuel Oil	CH4	5,6	5,6	0,0	100,0
Non-Ferrous Metals	Natural Gas	N20	5,2	5,2	0,0	100,0
Other Industries	Petroleum Coke	N20	5,1	5,1	0,0	100,0
Cement Production	Lignite	CH4	5,0	5,0	0,0	100,0

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Table A1.2 Key Source Categories

2007 KSA						
Petroleum Refining	Refinery Gas	N20	5,0	5,0	0,0	100,0
Chemicals	Natural Gas	CH4	4,3	4,3	0,0	100,0
Residential	Asphalt	N20	3,9	3,9	0,0	100,0
Other Industries	Natural Gas	N20	3,7	3,7	0,0	100,0
Sugar	Lignite	N20	3,5	3,5	0,0	100,0
Other Industries	Second Fuel Coal	N20	3,5	3,5	0,0	100,0
Cement Production	LPG	CO2	3,4	3,4	0,0	100,0
Iron and Steel	Hard Coal	N20	3,2	3,2	0,0	100,0
Navigation	Gas / Diesel oil	N20	3,1	3,1	0,0	100,0
Other Industries	Gas / Diesel oil	N20	2,9	2,9	0,0	100,0
Public Electricity and Heat Production	Hard Coal	CH4	2,8	2,8	0,0	100,0
Other Industries	Petroleum Coke	CH4	2,5	2,5	0,0	100,0
Residential	Residual Fuel Oil	CH4	2,4	2,4	0,0	100,0
Petroleum Refining	Residual Fuel Oil	CH4	2,2	2,2	0,0	100,0
Residential	Residual Fuel Oil	N20	2,1	2,1	0,0	100,0
Other Industries	Residual Fuel Oil	CH4	2,0	2,0	0,0	100,0
Non-Ferrous Metals	Hard Coal	N20	1,8	1,8	0,0	100,0
Navigation	Gas / Diesel oil	CH4	1,8	1,8	0,0	100,0
Civil Aviation	Jet Kerosene	CH4	1,7	1,7	0,0	100,0
Sugar	Lignite	CH4	1,7	1,7	0,0	100,0
Petroleum Refining	Refinery Gas	CH4	1,7	1,7	0,0	100,0
Other Industries	Second Fuel Coal	CH4	1,7	1,7	0,0	100,0
Iron and Steel	Natural Gas	CO2	1,7	1,7	0,0	100,0
Iron and Steel	Hard Coal	CH4	1,5	1,5	0,0	100,0
Chemicals	Natural Gas	N20	1,3	1,3	0,0	100,0
Non-Ferrous Metals	Second Fuel Coal	N20	1,0	1,0	0,0	100,0
Other Industries	Asphalt	N20	1,0	1,0	0,0	100,0
Navigation	Residual Fuel Oil	N20	0,9	0,9	0,0	100,0
Chemicals	LPG	CO2	0,9	0,9	0,0	100,0
Non-Ferrous Metals	Hard Coal	CH4	0,9	0,9	0,0	100,0
Residential	Second Fuel Coal	N20	0,8	0,8	0,0	100,0
Other Industries	LPG	N20	0,8	0,8	0,0	100,0
Petroleum Refining	Natural Gas	N20	0,7	0,7	0,0	100,0
Other Industries	Gas / Diesel oil	CH4	0,7	0,7	0,0	100,0
Road Transportation	Biofuel	N20	0,6	0,6	0,0	100,0
Petroleum Refining	Natural Gas	CH4	0,5	0,5	0,0	100,0
Navigation	Residual Fuel Oil	CH4	0,5	0,5	0,0	100,0
Non-Ferrous Metals	Second Fuel Coal	CH4	0,5	0,5	0,0	100,0
Other Industries	Asphalt	CH4	0,5	0,5	0,0	100,0
Railways	Gas / Diesel oil	CH4	0,5	0,5	0,0	100,0
Sugar	Second Fuel Coal	N20	0,5	0,5	0,0	100,0
Cement Production	Natural Gas	CH4	0,4	0,4	0,0	100,0

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Table A1.2 Key Source Categories

2007 KSA						
Sugar	Natural Gas	CH4	0,3	0,3	0,0	100,0
Public Electricity and Heat Production	Gas / Diesel oil	N20	0,3	0,3	0,0	100,0
Chemicals	Gas / Diesel oil	CO2	0,3	0,3	0,0	100,0
Sugar	Residual Fuel Oil	N20	0,3	0,3	0,0	100,0
Sugar	Second Fuel Coal	CH4	0,2	0,2	0,0	100,0
Petroleum Refining	LPG	CO2	0,2	0,2	0,0	100,0
Chemicals	Lignite	N20	0,2	0,2	0,0	100,0
Chemicals	Residual Fuel Oil	N20	0,2	0,2	0,0	100,0
Sugar	LPG	N20	0,2	0,2	0,0	100,0
Other Industries	LPG	CH4	0,2	0,2	0,0	100,0
Non-Ferrous Metals	Residual Fuel Oil	N20	0,2	0,2	0,0	100,0
Cement Production	Residual Fuel Oil	N20	0,2	0,2	0,0	100,0
Sugar	Hard Coal	N20	0,1	0,1	0,0	100,0
Residential	Gas / Diesel oil	CH4	0,1	0,1	0,0	100,0
Public Electricity and Heat Production	Gas / Diesel oil	CH4	0,1	0,1	0,0	100,0
Residential	Gas / Diesel oil	N20	0,1	0,1	0,0	100,0
Cement Production	Natural Gas	N20	0,1	0,1	0,0	100,0
Chemicals	Lignite	CH4	0,1	0,1	0,0	100,0
Public Electricity and Heat Production	Naphta	N20	0,1	0,1	0,0	100,0
Sugar	Natural Gas	N20	0,1	0,1	0,0	100,0
Petroleum Refining	Gasoline	CO2	0,1	0,1	0,0	100,0
Iron and Steel	Residual Fuel Oil	N20	0,1	0,1	0,0	100,0
Sugar	Hard Coal	CH4	0,1	0,1	0,0	100,0
Sugar	Residual Fuel Oil	CH4	0,1	0,1	0,0	100,0
Iron and Steel	Gas / Diesel oil	N20	0,0	0,0	0,0	100,0
Petroleum Refining	Gas / Diesel oil	N20	0,0	0,0	0,0	100,0
Chemicals	Residual Fuel Oil	CH4	0,0	0,0	0,0	100,0
Road Transportation	Biofuel	CH4	0,0	0,0	0,0	100,0
Sugar	LPG	CH4	0,0	0,0	0,0	100,0
Fertilizer	Residual Fuel Oil	N20	0,0	0,0	0,0	100,0
Non-Ferrous Metals	Residual Fuel Oil	CH4	0,0	0,0	0,0	100,0
Cement Production	Residual Fuel Oil	CH4	0,0	0,0	0,0	100,0
Public Electricity and Heat Production	Naphta	CH4	0,0	0,0	0,0	100,0
Iron and Steel	Residual Fuel Oil	CH4	0,0	0,0	0,0	100,0
Petroleum Refining	Gas / Diesel oil	CH4	0,0	0,0	0,0	100,0
Iron and Steel	Gas / Diesel oil	CH4	0,0	0,0	0,0	100,0
Cement Production	LPG	N20	0,0	0,0	0,0	100,0
Fertilizer	Gas / Diesel oil	CO2	0,0	0,0	0,0	100,0
Fertilizer	Residual Fuel Oil	CH4	0,0	0,0	0,0	100,0
Iron and Steel	Natural Gas	CH4	0,0	0,0	0,0	100,0
Chemicals	LPG	N20	0,0	0,0	0,0	100,0
Cement Production	LPG	CH4	0,0	0,0	0,0	100,0

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Table A1.2 Key Source Categories

2007 KSA						
Iron and Steel	Natural Gas	N20	0,0	0,0	0,0	100,0
Chemicals	Gas / Diesel oil	N20	0,0	0,0	0,0	100,0
Petroleum Refining	LPG	N20	0,0	0,0	0,0	100,0
Chemicals	LPG	CH4	0,0	0,0	0,0	100,0
Petroleum Refining	Gasoline	N20	0,0	0,0	0,0	100,0
Petroleum Refining	LPG	CH4	0,0	0,0	0,0	100,0
Chemicals	Gas / Diesel oil	CH4	0,0	0,0	0,0	100,0
Petroleum Refining	Gasoline	CH4	0,0	0,0	0,0	100,0
Fertilizer	Gas / Diesel oil	N20	0,0	0,0	0,0	100,0
Fertilizer	Gas / Diesel oil	CH4	0,0	0,0	0,0	100,0
Cement Production	Asphalt	CH4	0,0	0,0	0,0	100,0
Cement Production	Asphalt	CO2	0,0	0,0	0,0	100,0
Cement Production	Asphalt	N20	0,0	0,0	0,0	100,0
Cement Production	Gas / Diesel oil	CH4	0,0	0,0	0,0	100,0
Cement Production	Gas / Diesel oil	CO2	0,0	0,0	0,0	100,0
Cement Production	Gas / Diesel oil	N20	0,0	0,0	0,0	100,0
Non-Ferrous Metals	Gas / Diesel oil	CH4	0,0	0,0	0,0	100,0
Non-Ferrous Metals	Gas / Diesel oil	CO2	0,0	0,0	0,0	100,0
Non-Ferrous Metals	Gas / Diesel oil	N20	0,0	0,0	0,0	100,0
Navigation	Hard Coal	CH4	0,0	0,0	0,0	100,0
Navigation	Hard Coal	CO2	0,0	0,0	0,0	100,0
Navigation	Hard Coal	N20	0,0	0,0	0,0	100,0
Railways	Hard Coal	CH4	0,0	0,0	0,0	100,0
Railways	Hard Coal	CO2	0,0	0,0	0,0	100,0
Railways	Hard Coal	N20	0,0	0,0	0,0	100,0
Fertilizer	Lignite	CH4	0,0	0,0	0,0	100,0
Fertilizer	Lignite	CO2	0,0	0,0	0,0	100,0
Fertilizer	Lignite	N20	0,0	0,0	0,0	100,0
Non-Ferrous Metals	Lignite	CH4	0,0	0,0	0,0	100,0
Non-Ferrous Metals	Lignite	CO2	0,0	0,0	0,0	100,0
Non-Ferrous Metals	Lignite	N20	0,0	0,0	0,0	100,0
Railways	Lignite	CH4	0,0	0,0	0,0	100,0
Railways	Lignite	CO2	0,0	0,0	0,0	100,0
Railways	Lignite	N20	0,0	0,0	0,0	100,0
Fertilizer	Naphta	CH4	0,0	0,0	0,0	100,0
Fertilizer	Naphta	CO2	0,0	0,0	0,0	100,0
Fertilizer	Naphta	N20	0,0	0,0	0,0	100,0
Petroleum Refining	Naphta	CH4	0,0	0,0	0,0	100,0
Petroleum Refining	Naphta	CO2	0,0	0,0	0,0	100,0
Petroleum Refining	Naphta	N20	0,0	0,0	0,0	100,0
Fertilizer	Natural Gas	CH4	0,0	0,0	0,0	100,0
Fertilizer	Natural Gas	CO2	0,0	0,0	0,0	100,0

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Table A1.2 Key Source Categories

2007 KSA						
Fertilizer	Natural Gas	N20	0,0	0,0	0,0	100,0
Non-Ferrous Metals	Petroleum Coke	CH4	0,0	0,0	0,0	100,0
Non-Ferrous Metals	Petroleum Coke	CO2	0,0	0,0	0,0	100,0
Non-Ferrous Metals	Petroleum Coke	N20	0,0	0,0	0,0	100,0
Other Industries	Refinery Gas	CH4	0,0	0,0	0,0	100,0
Other Industries	Refinery Gas	CO2	0,0	0,0	0,0	100,0
Other Industries	Refinery Gas	N20	0,0	0,0	0,0	100,0
Railways	Residual Fuel Oil	CH4	0,0	0,0	0,0	100,0
Railways	Residual Fuel Oil	CO2	0,0	0,0	0,0	100,0
Railways	Residual Fuel Oil	N20	0,0	0,0	0,0	100,0
Cement Production	Second Fuel Coal	CH4	0,0	0,0	0,0	100,0
Cement Production	Second Fuel Coal	CO2	0,0	0,0	0,0	100,0
Cement Production	Second Fuel Coal	N20	0,0	0,0	0,0	100,0
Fertilizer	Second Fuel Coal	CH4	0,0	0,0	0,0	100,0
Fertilizer	Second Fuel Coal	CO2	0,0	0,0	0,0	100,0
Fertilizer	Second Fuel Coal	N20	0,0	0,0	0,0	100,0
Carbide Production (Chemical Industry)		CO2	0,0	0,0	0,0	100,0
Ferroalloys Production (Metal Production)		CO2	-	0,0	0,0	100,0
Iron and Steel Production (Metal Production)		CO2	-	0,0	0,0	100,0
Aluminium Production (Metal Production)		CO2	-	0,0	0,0	100,0
Ammonia Production (Chemical Industry)		CO2	-	0,0	0,0	100,0
Emission of PFCs		PFC	-	0,0	0,0	100,0
Limestone and Dolomite Use (Mineral Products)		CO2	-	0,0	0,0	100,0
Nitric Acid Production (Chemical Industry)		N20	-	0,0	0,0	100,0
Soda Ash Production and Use (Mineral Products)		CO2	-	0,0	0,0	100,0
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Annex 2

A2. Discussion of Methodology

Turkey's greenhouse gas emission inventory is in accordance with the Revised 1996 IPCC Guidelines. Emission factors used for this national inventory were provided in Annex 2. The emission factors as given in the following Table A2.1 were;

ANNEX 2

Table A2.1 Emission Factors used for Turkish National Emission Inventory

Sector	Gas	Unit	Emission Factor
Energy			
Hard Coal	CO_2	tC/TJ	25,8
Lignite	CO_2	tC/TJ	27,6
Asphalt	CO_2	tC/TJ	25,8
Secondary Fuel Coal	CO_2	tC/TJ	25,8
Petroleum Coke	CO_2	tC/TJ	25,8
Petroleum	CO_2	tC/TJ	20,0
Natural Gases	CO_2	tC/TJ	15,3
Jet Kerosene	CO_2	tC/TJ	19,5
Energy - Electricity Production			
Hard Coal	CH_4	KG/TJ	1,0
Lignite	CH_4	KG/TJ	1,0
Asphalt	CH_4	KG/TJ	1,0
Secondary Fuel Coal	CH_4	KG/TJ	1,0
Petroleum Coke	CH_4	KG/TJ	1,0
Petroleum	CH_4	KG/TJ	3,0
Natural Gas	CH_4	KG/TJ	1,0
Energy - Industry			
Hard Coal	CH_4	KG/TJ	10,0
Lignite	CH_4	KG/TJ	10,0
Asphalt	CH_4	KG/TJ	10,0
Secondary Fuel Coal	CH_4	KG/TJ	10,0
Petroleum Coke	CH_4	KG/TJ	10,0
Petroleum	CH_4	KG/TJ	2,0
Natural Gas	CH_4	KG/TJ	5,0
Energy - Other			
Hard Coal	CH_4	KG/TJ	300,0
Lignite	CH_4	KG/TJ	300,0
Asphalt	CH_4	KG/TJ	300,0
Secondary Fuel Coal	CH_4	KG/TJ	300,0
Petroleum Coke	CH_4	KG/TJ	300,0
Petroleum (Residential)	CH_4	KG/TJ	10,0
Petroleum (Agriculture)	CH_4	KG/TJ	5,0
Natural Gas	CH_4	KG/TJ	5,0
Bomass (Residential)	CH_4	KG/TJ	300,0
Energy - Transport			
Hard Coal	CH_4	KG/TJ	10,0
Lignite	CH_4	KG/TJ	10,0
Asphalt	CH_4	KG/TJ	10,0
Secondary Fuel Coal	CH_4	KG/TJ	10,0
Petroleum Coke	CH_4	KG/TJ	10,0
Petroleum	CH_4	KG/TJ	5,0
Natural Gas	CH_4	KG/TJ	50,0
Jet Kerosene	CH_4	KG/TJ	0,5
Fuel-oil	CH_4	KG/TJ	5,0
Diesel	CH_4	KG/TJ	5,0
Gasoline	CH_4	KG/TJ	20,0
Energy - Electricity Production			
Hard Coal	N_20	KG/TJ	1,4
Lignite	N_20	KG/TJ	1,4
Asphalt	N_20	KG/TJ	1,4
Secondary Fuel Coal	N_20	KG/TJ	1,4
Petroleum Coke	N_20	KG/TJ	1,4
Petroleum	N_20	KG/TJ	0,6
Natural Gas	N_20	KG/TJ	0,1
Energy - Industry			
Hard Coal	N_20	KG/TJ	1,4
Lignite	N_20	KG/TJ	1,4
Asphalt	N_20	KG/TJ	1,4
Secondary Fuel Coal	N_20	KG/TJ	1,4
Petroleum Coke	N_20	KG/TJ	1,4
Petroleum	N_20	KG/TJ	0,6
Natural Gas	N_20	KG/TJ	0,1
Energy - Industry			
Natural Gas	N_20	KG/TJ	0,1
Energy - Other			
Hard Coal	N_20	KG/TJ	1,4
Lignite	N_20	KG/TJ	1,4
Asphalt	N_20	KG/TJ	1,4
Secondary Fuel Coal	N_20	KG/TJ	1,4
Petroleum Coke	N_20	KG/TJ	1,4
Petroleum (Residential)	N_20	KG/TJ	0,6
Petroleum (Agriculture)	N_20	KG/TJ	0,6
Natural Gas	N_20	KG/TJ	0,1
Bomass (Residential)	N_20	KG/TJ	4,0
Energy - Transport			
Hard Coal	N_20	KG/TJ	1,4
Lignite	N_20	KG/TJ	1,4
Asphalt	N_20	KG/TJ	1,4
Secondary Fuel Coal	N_20	KG/TJ	1,4
Petroleum Coke	N_20	KG/TJ	1,4
Petroleum	N_20	KG/TJ	0,6
Natural Gas	N_20	KG/TJ	0,1
Jet Kerosene	N_20	KG/TJ	2,0
Fuel-oil	N_20	KG/TJ	0,6
Diesel	N_20	KG/TJ	0,6
Gasoline	N_20	KG/TJ	0,6
Energy - Electricity Production			
Hard Coal	NO_X	KG/TJ	300,0
Lignite	NO_X	KG/TJ	300,0
Asphalt	NO_X	KG/TJ	300,0
Secondary Fuel Coal	NO_X	KG/TJ	300,0
Petroleum Coke	NO_X	KG/TJ	300,0
Petroleum	NO_X	KG/TJ	200,0
Natural Gas	NO_X	KG/TJ	150,0
Energy - Industry			
Hard Coal	NO_X	KG/TJ	300,0
Lignite	NO_X	KG/TJ	300,0
Asphalt	NO_X	KG/TJ	300,0
Secondary Fuel Coal	NO_X	KG/TJ	300,0
Petroleum Coke	NO_X	KG/TJ	300,0
Petroleum	NO_X	KG/TJ	200,0
Natural Gas	NO_X	KG/TJ	150,0
Energy - Other			
Hard Coal	NO_X	KG/TJ	100,0
Lignite	NO_X	KG/TJ	100,0
Asphalt	NO_X	KG/TJ	100,0
Secondary Fuel Coal	NO_X	KG/TJ	100,0
Petroleum Coke	NO_X	KG/TJ	100,0
Petroleum (Residential)	NO_X	KG/TJ	100,0
Petroleum (Agriculture)	NO_X	KG/TJ	1200,0
Natural Gas	NO_X	KG/TJ	50,0
Bomass (Residential)	NO_X	KG/TJ	100,0
Energy - Transport			
Hard Coal	NO_X	KG/TJ	300,0
Lignite	NO_X	KG/TJ	300,0
Asphalt	NO_X	KG/TJ	300,0
Secondary Fuel Coal	NO_X	KG/TJ	300,0
Petroleum Coke	NO_X	KG/TJ	300,0
Natural Gas	NO_X	KG/TJ	600,0
Jet Kerosene	NO_X	KG/TJ	300,0
Fuel-oil (Railway)	NO_X	KG/TJ	1200,0
Diesel (Railway)	NO_X	KG/TJ	1200,0
Gasoline	NO_X	KG/TJ	600,0
Fuel-oil (Navigation)	NO_X	KG/TJ	1500,0

ANNEX 2

Table A2.1 Emission Factors used for Turkish National Emission Inventory

Sector	Gas	Unit	Emission Factor
Energy - Transport			
Diesel (Navigation)	NO_X	KG/TJ	1500,0
Fuel-oil (Road Trans.)	NO_X	KG/TJ	800,0
Diesel (Road Trans.)	NO_X	KG/TJ	800,0
Energy - Electricity Production			
Hard Coal	CO	KG/TJ	20,0
Lignite	CO	KG/TJ	20,0
Asphalt	CO	KG/TJ	20,0
Secondary Fuel Coal	CO	KG/TJ	20,0
Petroleum Coke	CO	KG/TJ	20,0
Petroleum	CO	KG/TJ	15,0
Natural Gas	CO	KG/TJ	20,0
Energy - Industry			
Hard Coal	CO	KG/TJ	150,0
Lignite	CO	KG/TJ	150,0
Asphalt	CO	KG/TJ	150,0
Secondary Fuel Coal	CO	KG/TJ	150,0
Petroleum Coke	CO	KG/TJ	150,0
Petroleum	CO	KG/TJ	10,0
Natural Gas	CO	KG/TJ	30,0
Energy - Other			
Hard Coal	CO	KG/TJ	2000,0
Lignite	CO	KG/TJ	2000,0
Asphalt	CO	KG/TJ	2000,0
Secondary Fuel Coal	CO	KG/TJ	2000,0
Petroleum Coke	CO	KG/TJ	2000,0
Petroleum (Residential)	CO	KG/TJ	20,0
Petroleum (Agriculture)	CO	KG/TJ	1000,0
Natural Gas	CO	KG/TJ	50,0
Bomass (Residential)	CO	KG/TJ	5000,0
Energy - Transport			
Hard Coal	CO	KG/TJ	150,0
Lignite	CO	KG/TJ	150,0
Asphalt	CO	KG/TJ	150,0
Secondary Fuel Coal	CO	KG/TJ	150,0
Petroleum Coke	CO	KG/TJ	150,0
Petroleum	CO	KG/TJ	1000,0
Natural Gas	CO	KG/TJ	400,0
Jet Kerosene	CO	KG/TJ	100,0
Fuel-oil	CO	KG/TJ	1000,0
Diesel	CO	KG/TJ	1000,0
Gasoline	CO	KG/TJ	8000,0
Energy - Electricity Production			
Hard Coal	NMVOC	KG/TJ	5,0
Lignite	NMVOC	KG/TJ	5,0
Asphalt	NMVOC	KG/TJ	5,0
Secondary Fuel Coal	NMVOC	KG/TJ	5,0
Petroleum Coke	NMVOC	KG/TJ	5,0
Petroleum	NMVOC	KG/TJ	5,0
Natural Gas	NMVOC	KG/TJ	5,0
Energy - Industry			
Hard Coal	NMVOC	KG/TJ	20,0
Lignite	NMVOC	KG/TJ	20,0
Asphalt	NMVOC	KG/TJ	20,0
Secondary Fuel Coal	NMVOC	KG/TJ	20,0
Petroleum Coke	NMVOC	KG/TJ	20,0
Petroleum	NMVOC	KG/TJ	5,0
Natural Gas	NMVOC	KG/TJ	5,0
Energy - Other			
Hard Coal	NMVOC	KG/TJ	200,0
Lignite	NMVOC	KG/TJ	200,0
Asphalt	NMVOC	KG/TJ	200,0
Secondary Fuel Coal	NMVOC	KG/TJ	200,0
Petroleum Coke	NMVOC	KG/TJ	200,0
Petroleum (Residential)	NMVOC	KG/TJ	5,0
Petroleum (Agriculture)	NMVOC	KG/TJ	200,0
Natural Gas	NMVOC	KG/TJ	5,0
Bomass (Residential)	NMVOC	KG/TJ	600,0

Sector	Gas	Unit	Emission Factor
Energy - Transport			
Hard Coal	NMVOC	KG/TJ	20,0
Lignite	NMVOC	KG/TJ	20,0
Asphalt	NMVOC	KG/TJ	20,0
Secondary Fuel Coal	NMVOC	KG/TJ	20,0
Petroleum Coke	NMVOC	KG/TJ	20,0
Petroleum	NMVOC	KG/TJ	200,0
Natural Gas	NMVOC	KG/TJ	5,0
Jet Kerosene	NMVOC	KG/TJ	50,0
Fuel-oil	NMVOC	KG/TJ	200,0
Diesel	NMVOC	KG/TJ	200,0
Gasoline	NMVOC	KG/TJ	1500,0
Energy - Fugitive Emission			
Coal Mining			
Underground mining	CH_4	m^3/tones	17,5
Surface mining	CH_4	m^3/tones	1,2
Industrial Processes			
Cement Production			
Clinker	CO_2	tone CO_2/tonne	0,51
Lime Production			
CaO Production	CO_2	Kg CO_2/tonne	0,91
Limestone and Dolomite Use			
limestone	CO_2	Kg CO_2/tonne	440*f
Dolomite	CO_2	Kg CO_2/tonne	477*f
Note: f is the fractional purity, which is taken as 1			
Soda Ash Production and Use			
Soda Ash Use (Na_2CO_3)	CO_2	Kg CO_2/tonne	415,0
Road Paving with Asphalt			
Asphalt plant	NO_X	Kg/tonne	0,084
Asphalt plant	CO_2	Kg/tonne	0,035
Asphalt plant	NMVOC	Kg/tonne	0,023
Road Surface	MNVOC	Kg/tonne	320
Asphalt Roofing Production			
Asphalt Roofing	MNVOC	Kg/tonne	0,16
Asphalt Roofing	CO	Kg/tonne	0,0095
Ammonia Production			
NH_3	CO_2	tonne CO_2/tonne	1,6
Desulphurisation	TOC	Kg/tonne	3,6
Carbondioxide regenerator	TOC	Kg/tonne	0,5
Condensate steam stripper	TOC	Kg/tonne	0,6
Desulphurisation	CO	Kg/tonne	6,9
Carbondioxide regenerator	CO	Kg/tonne	1,0
Nitric Acid Production			
Nitric Acid	N_20	Kg/tonne	19,0
Nitric Acid	NO_X	Kg/tonne	12,0
Calcium Carbid Production			
limestone	CO_2	Kg/tonne	760,0
Reduction	CO_2	Kg/tonne	1090,0
Use of product	CO_2	Kg/tonne	1100,0
Production of Other Chemicals			
Carbon Black	CH_4	g/Kg	11,0
Ethylene	CH_4	g/Kg	1,0
Styrene	CH_4	g/Kg	4,0
Methanol	CH_4	g/Kg	2,0
Coke	CH_4	g/Kg	0,5
Carbon Black	NO_X	Kg/tonne	0,4
Acrylonitrite	NMVOC	Kg/tonne	1,0
Etylene	NMVOC	Kg/tonne	1,4
Propylene	NMVOC	Kg/tonne	1,4
Carbon Black	NMVOC	Kg/tonne	40,0
Formaldehyde	NMVOC	Kg/tonne	5,0
Phtalic anthydride	NMVOC	Kg/tonne	6,0
Polypropylene	NMVOC	Kg/tonne	12,0
Polystyrene	NMVOC	Kg/tonne	5,4
Polyethene-low density	NMVOC	Kg/tonne	3,0
Polyethene-high density	NMVOC	Kg/tonne	6,4
Polyvinylchloride	NMVOC	Kg/tonne	8,5
Styrene	NMVOC	Kg/tonne	18,0

ANNEX 2

Table A2.1 Emission Factors used for Turkish National Emission Inventory

Sector	Gas	Unit	Emission Factor
Production of Other Chemicals			
Styrene butadiene	NMVOC	Kg/tonne	5,8
Carbon Black	CO	Kg/tonne	10,0
Iron and Steel			
Iron Production	CO_2	tonne/tonne	1,6
Steel Production	CO_2	tonne/tonne	1,6
Ferrochromium	CO_2	tonne/tonne	1,3
Ferromanganese	CO_2	tonne/tonne	1,6
Iron production-Pig Iron Tap.	NMVOC	g/tonne	20,0
Iron production-Blast Fur.	NMVOC	g/tonne	100,0
Steel Production	NMVOC	g/tonne	30,0
Iron production-Pig Iron Tap.	CO	g/tonne	112,0
Iron production-Blast Fur.	CO	g/tonne	1330,0
Steel Production	CO	g/tonne	1,0
Iron production	NO_X	g/tonne	76,0
Steel Production	NO_X	g/tonne	40,0
Aluminium			
Aluminium Production	CO_2	tonne/tonne	1,8
Aluminium Production	NO_X	Kg/tonne	2,15
Aluminium Production	CO	Kg/tonne	135,0
Pulp and Paper			
Pulp and Paper Production	NOX	Kg/tonne	1,5
Pulp and Paper Production	VOC	Kg/tonne	3,7
Pulp and Paper Production	CO	Kg/tonne	5,6
Alcoholic Beverages			
Wine	NMVOC	Kg/Liter	0,08
Beer	NMVOC	Kg/Liter	0,035
Spirits (unspecified)	NMVOC	Kg/Liter	15,0
Whiskey	NMVOC	Kg/Liter	15,0
Bread making and other food			
Meat, fish and poultry	NMVOC	Kg/tonne	0,3
Sugar	NMVOC	Kg/tonne	10,0
Margarine-solid cooking fats	NMVOC	Kg/tonne	10,0
Cakes, biscuits, bre.cereals	NMVOC	Kg/tonne	1,0
Bread	NMVOC	Kg/tonne	8,0
Animal feed	NMVOC	Kg/tonne	1,0
Agriculture			
Enteric Fermentation			
Dairy Cattle	CH_4	Kg/head/year	56,0
Other Cattle	CH_4	Kg/head/year	44,0
Buffalo	CH_4	Kg/head/year	55,0
Sheep	CH_4	Kg/head/year	5,0
Goats	CH_4	Kg/head/year	5,0
Camels	CH_4	Kg/head/year	46,0
Horse	CH_4	Kg/head/year	18,0
Swine	CH_4	Kg/head/year	1,0
Mules&Dankeys	CH_4	Kg/head/year	10,0
Manure Mangement			
Dairy Cattle (Clim.R. Temp.)	CH_4	Kg/head/year	16,0
Other Cattle (Clim.R. Temp.)	CH_4	Kg/head/year	1,0
Buffalo (Clim.R. Temp.)	CH_4	Kg/head/year	2,0
Sheep (Clim.R. Temp.)	CH_4	Kg/head/year	0,2
Goats (Clim.R. Temp.)	CH_4	Kg/head/year	0,17
Camels (Clim.R. Temp.)	CH_4	Kg/head/year	1,9
Horse (Clim.R. Temp.)	CH_4	Kg/head/year	1,6
Mules&Dankeys (C.R.Temp.	CH_4	Kg/head/year	0,9
Swine (Clim.R. Temp.)	CH_4	Kg/head/year	4,0
Poultry (Clim.R. Temp.)	CH_4	Kg/head/year	0,018
Rice Cultivation			
Rice	CH_4	g/m^2	20,0
Note: Integrated emission factor (arithmetic mean)			
Agricultural Burning			
Wheat, Barley, Maize, Oat, Rye	CH_4	Emission Ratios*	0,05
Wheat, Barley, Maize, Oat, Rye	CO	Emission Ratios*	0,06
Wheat, Barley, Maize, Oat, Rye	N_20	Emission Ratios*	0,007
Wheat, Barley, Maize, Oat, Rye	NO_X	Emission Ratios*	0,121
Note: Dry Matter fraction (arithmetic mean)			
Waste			
CH_4 emission from waste disposal side			
*= (MSW_T *MSW_F *MCF*DOC*DOC_F *F*16/12-R) x (1-OX)*			
MSW_T	*Collected*	*Gg/year*	-
MSW_F	*Fraction*	-	*1,0*
MCF (Uncont. Landfill)	*Corr. Fact.*	-	*0,6*
MCF (Cont. Landfill)	*Corr. Fact.*	-	*1,0*
DOC	*Deg.Org.C*	-	*0,15*
DOC_F	*Fraction*	-	*0,77*
F	*Fra.in land*	-	*0,5*
R	*Recovered*	*Gg/year*	-
OX	*Oxi. Fact.*	-	*0,0*

Annex 3

A3. Quality Assurance and Quality Control

After the ratification of the United Nations Framework Convention on Climate Change. The political measures and policies in Turkey have increased fairly. Some working groups were formed for the air quality management. One of the working groups was “the GHG Emission Inventory Working Group”. The coordination was under the responsibilities of MOEF and TurkStat. The member of this groups were the Ministry of Energy and Natural Resources, Ministry of Transport, Turkish Electricity Generation Transmission Corporation, universities and other related organizations. The main aim of this working group was to improve the GHG emission inventories.

TurkStat was responsible for preparing the Turkey’s greenhouse gas inventory (GHGI). The inventory was compiled by the related organizations after the study was completed. The critics and their data correction were reflected to the national inventory. The MOEF submitted to the UNFCCC. The Energy Balance tables were also compiled and there were some small corrections. The consistency check and the corrections were reflected to the CRF tables before the submission. The Ministry of Energy and Natural Resources published these tables as officially.

The industrial establishments directly submit their industrial production data to TurkStat by seasonal and annual questionnaires. The necessary production data for the emission inventory was gathered from the related department of TurkStat. Moreover, the biggest establishments which have high GHGs also asked for compilations of these production data such as cement productions industries.

The database system was also computerized. The energy balance tables were only copied to the Excell base programme and the calculations were automatically made by programme at detail level and due to the each fuel type as the requirement of CRF tables. The emission factor and all used data could also be seen within the programme. Except for the energy, the activity data have to be entered the database. It was always checked by a second person.

Control of quality of the inventory by experts was carried out both on the basis of the emission factors and activity data.

There was also internal quality control, these were;

- control of consistency to ensure data integrity, its correctness and completeness;
- determination and correction of errors,
- documentation and archiving of material used for the inventory preparation and QC activities.

Annex 4

A4. Reference and Sectoral Approach

A4.1 Reference Approach

The *Reference Approach* is the method for determining the CO_2 emissions from combustion of total domestic fuels. Therefore, first step in this approach is to calculate the apparent fuel consumption. This is done using the following formula:

extraction + imports - exports - change (increase/decrease) in stocks (A4.1)

The emission factors are related to all type of fuel that enter domestic consumption at the level of sources without regard to specific kinds of fuel burned in the consumer part of the energy balance.

In the equation (A4.1), each fuel emission was presented in units of Gg. The conversion to energy units - TJ was done using conversion factors provided in the IPCC Guidelines. A domestic conversion factor was applied only for lignite, hard coal and petroleum products. For each year average conversion factor were changing according to the quality and/or quantity of these fuels as seen in Table A4.1.

Table A4.1. Conversion Factors for Turkey - (Reference Approach)

(TJ/Gg)	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Hardcoal	31.43	30.85	29.56	28.58	28.17	28.92	28.45	28.23	28.41	28.40	26.79	26.26	26.75	26.75	27.30	26.98	27.03	25.42
Lignite	8.91	9.06	8.88	9.01	8.45	8.47	8.52	8.67	8.20	8.05	8.14	7.84	8.40	8.61	8.83	6.90	7.78	7.78
Petroleum	44.08	44.14	44.00	43.94	43.95	43.98	43.76	43.79	43.78	43.72	43.52	43.67	43.49	43.42	43.44	43.43	43.41	43.49

Country specific emission factors were used for comparative estimation of CO_2 emissions. The differences tend to vary around 7% except for 1990 and 2006, which was around 10%. The main reason was the reference approach uses data on crude oil, lignite and hard coal as the average "calorific values" and "carbon content". However sectoral approach uses the individual "calorific values" and "carbon content" in each sector. The annual differences could be seen from Table A4.2.

Table A4.2. Comparison of CO_2 from Fuel combustion
(Sectoral and Reference Approach difference)

1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
10.54	-4.37	0.18	3.71	4.83	4.70	3.11	1.66	5.08	3.30	2.58	-1.35	3.25	4.42	1.97	6.89	9.65	7,34

The above differences could also be owing to the differences in the methodological approach and activity data.

A4.2 Sectoral Approach

The *Sectoral Approach* is considerably demanding input data and requires information on fuel consumption according to type of sectors. The biggest advantage of this method is the possibility of analyzing the structure of emissions. The calculations by using sectoral approach should be more exact, because the emission factors employed are specific for each type of consumed fuel.

The GHG emissions from fuel combustion derive from two types of sources: stationary and mobile. The stationary sources include the industrial processes, energy production, services, agriculture and residential sector. The mobile sources include transport and other motor vehicles. All these sources grouped according to the IPCC requirements which were reflected in CRF tables. The GHG emissions were estimated by grouping the fuel types into 4 categories - liquid, solid, gaseous and biomass.

The GHGs emissions in the energy sector were the main key sources in the inventory.

Emissions from *International Bunkers* were not included in the emissions owing to the lack of data. Moreover, the transport of fuels was not a part of the energy balance of the country and emissions were not estimated.

Annex 5

A5. Completeness

The following sources were not estimated in 2006 owing to the reasons listed below;

Table A5.1. GHGs and sources were not considered in Turkey's Inventory

GHG	Sector	Source/sink category	Explanation
CH_4	1 Energy	1.B.1.B Solid Fuel Transformation	The methodology is not clear, since mined solid fuels are always transformed from mining area for use purposes.
CH_4	1 Energy	1.B.2.A.1 Exploration	The methodology and the data availability are studied.
CH_4	1 Energy	1.B.2.A.2 Production	The methodology and the data availability are studied.
CH_4	1 Energy	1.B.2.A.3 Transport	The methodology and the data availability are studied.
CH_4	1 Energy	1.B.2.A.4 Refining / Storage	The methodology and the data availability are studied.
CH_4	1 Energy	1.B.2.A.5 Distribution of oil products	The methodology and the data availability are studied.
CH_4	1 Energy	1.B.2.B.1 Exploration	The methodology and the data availability are studied.
CH_4	1 Energy	1.B.2.B.2 Production / Processing	The methodology and the data availability are studied.
CH_4	1 Energy	1.B.2.B.3 Transmission	The methodology and the data availability are studied.
CH_4	1 Energy	1.B.2.B.4 Distribution	The methodology and the data availability are studied.
CH_4	1 Energy	1.B.2.B.5.1 at industrial plants and power stations	The methodology and the data availability are studied.
CH_4	1 Energy	1.B.2.B.5.2 in residential and commercial sectors	The methodology and the data availability are studied.
CH_4	1 Energy	1.B.2.C.1.1 Oil	The methodology and the data availability are studied.
CH_4	1 Energy	1.C1.B 1.C1.B Marine	The international bunkers data in energy balances tables are not seperated.
CH_4	1 Energy	1.C1.B 1.C1.B Marine	The international bunkers data in energy balances tables are not seperated.
CH_4	1 Energy	1.C1.A 1.C1.A Aviation	The international bunkers data in energy balances tables are not seperated.
CH_4	6 Waste	6.B.1 6.B.1 Industrial Wastewater	The methodology and data availability has been considered.
CH_4	6 Waste	6.B.1 6.B.1 Industrial Wastewater	The methodology and data availability has been considered.
CH_4	6 Waste	6.B.2.1 6.B.2.1 Domestic and Commercial (w/o human sewage)	The activity data is not known to calculate
CO_2	1 Energy	1.B.2.A.1 Exploration	The methodology and the data availability are studied.
CO_2	1 Energy	1.B.2.A.2 Production	The methodology and the data availability are studied.
CO_2	1 Energy	1.B.2.A.3 Transport	The methodology and the data availability are studied.
CO_2	1 Energy	1.B.2.A.4 Refining / Storage	The methodology and the data availability are studied.

Table A5.1. GHGs and sources were not considered in Turkey's Inventory (con't)

GHG	Sector	Source/sink category	Explanation
CO_2	1 Energy	1.B.2.A.5 Distribution of oil products	The methodology and the data availability are studied.
CO_2	1 Energy	1.B.2.B.1 Exploration	The methodology and the data availability are studied.
CO_2	1 Energy	1.B.2.B.2 Production / Processing	The methodology and the data availability are studied.
CO_2	1 Energy	1.B.2.B.3 Transmission	The methodology and the data availability are studied.
CO_2	1 Energy	1.B.2.B.4 Distribution	The methodology and the data availability are studied.
CO_2	1 Energy	1.B.2.B.5.1 at industrial plants and power stations	The methodology and the data availability are studied.
CO_2	1 Energy	1.B.2.B.5.2 in residential and commercial sectors	The methodology and the data availability are studied.
CO_2	1 Energy	1.B.2.C.1.1 Oil	The methodology and the data availability are studied.
CO_2	1 Energy	1.C1.B 1.C1.B Marine	The international bunkers data in energy balances tables are not seperated.
CO_2	1 Energy	1.C1.B 1.C1.B Marine	The international bunkers data in energy balances tables are not seperated.
CO_2	1 Energy	1.C1.A 1.C1.A Aviation	The international bunkers data in energy balances tables are not seperated.
CO_2	2 Industrial Processes	2.A.5 Asphalt Roofing	The methodology for CO2 emission is not clear
CO_2	2 Industrial Processes	2.A.6 Road Paving with Asphalt	The methodology for CO2 emission is not clear.
CO_2	2 Industrial Processes	2.B.5.2 Ethylene	Because of confidentiality, the emission from this section was added to 2.B.5 other non-specified.
CO_2	2 Industrial Processes	2.D.2 Food and Drink	The methodology for CO2 emission is not clear.
CO_2	3 Solvent and Other Product Use	3.A Paint Application	The lack of data for solvent use hinder to estiimate the CO2, N20 and NMVOC
CO_2	3 Solvent and Other Product Use	3.B Degreasing and Dry Cleaning	The lack of data for solvent use hinder to estiimate the CO2, N20 and NMVOC
CO_2	3 Solvent and Other Product Use	3.C Chemical Products, Manufacture and Processing	The lack of data for solvent use hinder to estiimate the CO2, N20 and NMVOC
N_2O	1 Energy	1.B.2.A.1 Exploration	The methodology and the data availability are studied.
N_2O	1 Energy	1.B.2.A.4 Refining / Storage	The methodology and the data availability are studied.
N_2O	1 Energy	1.C1.B 1.C1.B Marine	The international bunkers data in energy balances tables are not seperated.
N_2O	1 Energy	1.C1.B 1.C1.B Marine	The international bunkers data in energy balances tables are not seperated.
N_2O	1 Energy	1.C1.A 1.C1.A Aviation	The international bunkers data in energy balances tables are not seperated.
N_2O	3 Solvent and Other Product Use	3.B Degreasing and Dry Cleaning	The lack of data for solvent use hinder to estiimate the CO2, N20 and NMVOC

Table A5.1. GHGs and sources were not considered in Turkey's Inventory (con't)

GHG	Sector	Source/sink category	Explanation
N_2O	3 Solvent and Other Product Use	3.D.1 Use of N2O for Anaesthesia	The lack of data for solvent use hinder to estimate the CO2, N20 and NMVOC
N_2O	3 Solvent and Other Product Use	3.D.2 Fire Extinguishers	The lack of data for solvent use hinder to estimate the CO2, N20 and NMVOC
N_2O	3 Solvent and Other Product Use	3.D.3 N2O from Aerosol Cans	The lack of data for solvent use hinder to estimate the CO2, N20 and NMVOC
N_2O	3 Solvent and Other Product Use	3.D.4 Other Use of N2O	The lack of data for solvent use hinder to estimate the CO2, N20 and NMVOC
N_2O	4 Agriculture	4.D.1.3 N-fixing Crops	The activity data is not known to calculate
N_2O	4 Agriculture	4.D.1.4 Crop Residue	The activity data is not known to calculate
N_2O	4 Agriculture	4.D.2 Pasture ,Range and Paddock Manure	The methodology and the activity data availability has been considered.
N_2O	4 Agriculture	4.D.3.2 Nitrogen Leaching and Run-off	The methodology and the activity data availability has been considered.
N_2O	6 Waste	6.B.1 6.B.1 Industrial Wastewater	The methodology and data availability has been considered.
N_2O	6 Waste	6.B.1 6.B.1 Industrial Wastewater	The methodology and data availability has been considered.
N_2O	6 Waste	6.B.2.1 6.B.2.1 Domestic and Commercial (w/o human sewage)	The activity data is not known to calculate
N_2O	6 Waste	6.B.2.2 Human sewage	The activity data is not known to calculate
SF_6	2 Industrial Processes	2.C.4 Aluminium and Magnesium Foundries	The methodology and the production details of the industry is not well-understood.
SF_6	2 Industrial Processes	2.C.4.1 Aluminium Foundries	The methodology and the production details of the industry is not well-understood.
SF_6	2 Industrial Processes	2.C.4.1 Aluminium Foundries	The methodology and the production details of the industry is not well-understood.
SF_6	2 Industrial Processes	2.F.3 Fire Extinguishers	This element couldn't be included in the inventory for year 2006 due to deficient import data.
SF_6	2 Industrial Processes	2.F.3 Fire Extinguishers	This element couldn't be included in the inventory for year 2006 due to deficient import data.
SF_6	2 Industrial Processes	2.F.3 2.F.3 Fire Extinguishers	This element couldn't be included in the inventory for year 2006 due to deficient import data.
SF_6	2 Industrial Processes	2.F.3 2.F.3 Fire Extinguishers	This element couldn't be included in the inventory for year 2006 due to deficient import data.
SF_6	2 Industrial Processes	2.F.3 2.F.3 Fire Extinguishers	This element couldn't be included in the inventory for year 2006 due to deficient import data.
SF_6	2 Industrial Processes	2.F.P2.1 In bulk	SF6 emissions for year 2006 are not included due to deficient import data.

Annex 6

A6. Trend Analysis

One of the major component part of the inventories is the determination of year to base year differences in national emission.

In the Following Table A6.1., the annual trend analyses compared to year 1990 are given. The aim is to observe the changes in the sectors. The basic formula used for the trend analysis is;

$$T_x^t = L_x^t * [((E_x^t - E_x^o)/ E_x^t) - ((E^t_{tot} – E^o_{tot})/ E^t_{tot})] \qquad (D1)$$

where,

x	: the category
t	: year t
o	: base year
tot	: total emission
T	: trend assessment (%)
L	: emission contribution (%)
E	: emission (unit)

The annual results could be seen in the following Tables A6.1.

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Table A6.2. Trend Analysis

2007 VS. 1990 TREND ANALYSIS									
CATEGORY	**FUEL**	**GAS**	**EMISSION 2007**	**CONTRIBUTION (%)**	**EMISSION 1990**	**TREND ASSESMENT**	**CONTRIBUTION**	**CUMULATIVE TOTAL**	**TREND**
Public Electricity and Heat Production	Lignite	CO2	41662,92	11,2	20662,22	0,4425	1,3%	1,3%	50,4%
Public Electricity and Heat Production	Natural Gas	CO2	39823,84	10,7	5435,89	3,4184	10,3%	11,6%	86,4%
Road Transportation	Gas / Diesel oil	CO2	29299,32	7,9	15742,61	0,6364	1,9%	13,6%	46,3%
Other Industries	Hard Coal	CO2	25312,00	6,8	1266,53	2,7600	8,3%	21,9%	95,0%
Cement Production (Mineral Products)		CO2	21208,47	5,7	10333,37	0,1757	0,5%	22,4%	51,3%
Residential	Natural Gas	CO2	17891,87	4,8	104,21	2,1632	6,5%	28,9%	99,4%
Waste (landfill)		CH4	16609,47	4,5	6386,46	0,3203	1,0%	29,9%	61,5%
Enteric Fermentation		CH4	15631,85	4,2	17046,76	2,6602	8,0%	37,9%	-9,1%
Waste (control landfill)		CH4	15240,23	4,1	0,00	1,8664	5,6%	43,5%	100,0%
Public Electricity and Heat Production	Hard Coal	CO2	12466,12	3,3	851,45	1,2982	3,9%	47,4%	93,2%
Agriculture/Forestry/Fisheries	Gas / Diesel oil	CO2	10795,35	2,9	5795,38	0,2331	0,7%	48,2%	46,3%
Non-Ferrous Metals	Natural Gas	CO2	9297,11	2,5	0,00	1,1386	3,4%	51,6%	100,0%
Iron and Steel	Second Fuel Coal	CO2	9236,90	2,5	7681,10	0,9300	2,8%	54,4%	16,8%
Residential	Lignite	CO2	7920,63	2,1	9276,74	1,5195	4,6%	59,0%	-17,1%
Road Transportation	Gasoline	CO2	7645,55	2,1	8293,32	1,2892	3,9%	62,9%	-8,5%
Other Industries	Natural Gas	CO2	6599,76	1,8	678,42	0,6262	1,9%	64,7%	89,7%
Public Electricity and Heat Production	Residual Fuel Oil	CO2	6515,51	1,7	3311,30	0,0907	0,3%	65,0%	49,2%
Cement Production	Hard Coal	CO2	6222,91	1,7	2653,20	0,0501	0,2%	65,2%	57,4%
Civil Aviation	Jet Kerosene	CO2	6063,69	1,6	904,59	0,4999	1,5%	66,7%	85,1%
Road Transportation	LPG	CO2	5989,22	1,6	0,00	0,7335	2,2%	68,9%	100,0%
Cement Production	Petroleum Coke	CO2	4397,60	1,2	941,03	0,2860	0,9%	69,7%	78,6%
Agricultural Soil (Synthetic Fertilizer)		N2O	4202,84	1,1	NE	0,0000	0,0%	69,7%	0,0%
Other Industries	Lignite	CO2	3994,69	1,1	5086,15	0,8757	2,6%	72,4%	-27,3%
Residential	LPG	CO2	3847,26	1,0	4772,19	0,8095	2,4%	74,8%	-24,0%
Other Industries	Residual Fuel Oil	CO2	3727,25	1,0	4212,15	0,6739	2,0%	76,9%	-13,0%
Emission of HFCs		HFC-134a	3174,30	0,9	0,00	0,3888	1,2%	78,0%	100,0%
Petroleum Refining	Residual Fuel Oil	CO2	2665,11	0,7	2277,75	0,2849	0,9%	78,9%	14,5%
Residential	Hard Coal	CO2	2446,53	0,7	3845,79	0,7324	2,2%	81,1%	-57,2%
Cement Production	Lignite	CO2	2382,65	0,6	2453,05	0,3665	1,1%	82,2%	-3,0%
Manure Management		N20	2316,03	0,6	NE	0,0000	0,0%	82,2%	0,0%
Chemicals	Natural Gas	CO2	2287,67	0,6	0,00	0,2802	0,8%	83,0%	100,0%
Petroleum Refining	Refinery Gas	CO2	1968,02	0,5	1403,84	0,1357	0,4%	83,5%	28,7%
Manure Management		CH4	1767,80	0,5	613,63	0,0518	0,2%	83,6%	65,3%
Agricultural Soil (Animal Manure Applied)		N2O	1421,48	0,4	NE	0,0000	0,0%	83,6%	0,0%
Petroleum Refining	Natural Gas	CO2	1291,12	0,3		0,1581	0,5%	84,1%	100,0%
Navigation	Gas / Diesel oil	CO2	1238,48	0,3	219,01	0,0929	0,3%	84,4%	82,3%
Mining (Surface)		CH4	1230,89	0,3	754,43	0,0517	0,2%	84,5%	38,7%
Other Industries	Gas / Diesel oil	CO2	1136,01	0,3	292,99	0,0605	0,2%	84,7%	74,2%
Other Industries	Petroleum Coke	CO2	1087,02	0,3	0,00	0,1331	0,4%	85,1%	100,0%
Residential	wood	CH4	1008,04	0,3	1414,06	0,2560	0,8%	85,9%	-40,3%
Emission of SF6		SF6	952,11	0,3	0,00	0,1166	0,4%	86,2%	100,0%
Residential	Residual Fuel Oil	CO2	873,69	0,2	3754,89	0,9007	2,7%	88,9%	-329,8%
Residential	Asphalt	CO2	843,43	0,2	390,56	0,0015	0,0%	88,9%	53,7%
Sugar	Lignite	CO2	809,03	0,2	1775,11	0,3773	1,1%	90,1%	-119,4%
Lime Production (Mineral Products)		CO2	794,49	0,2	645,09	0,0758	0,2%	90,3%	18,8%
Other Industries	Second Fuel Coal	CO2	752,48	0,2	527,11	0,0493	0,1%	90,5%	30,0%
Iron and Steel	Hard Coal	CO2	684,05	0,2	0,00	0,0838	0,3%	90,7%	100,0%
Mining (underground)		CH4	606,21	0,2	675,89	0,1071	0,3%	91,0%	-11,5%
Residential	Lignite	CH4	503,15	0,1	589,29	0,0965	0,3%	91,3%	-17,1%
Road Transportation	Gas / Diesel oil	N20	442,37	0,1	157,94	0,0118	0,0%	91,4%	64,3%

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Table A6.2. Trend Analysis

2007 VS. 1990 TREND ANALYSIS									
Railways	Gas / Diesel oil	CO_2	424,12	0,1	404,58	0,0566	0,2%	91,5%	4,6%
Residual Burning		CH_4	416,43	0,1	454,59	0,0710	0,2%	91,7%	-9,2%
Rice Cultivation		CH_4	394,38	0,1	222,60	0,0114	0,0%	91,8%	43,6%
Non-Ferrous Metals	Hard Coal	CO_2	381,15	0,1	0,00	0,0467	0,1%	91,9%	100,0%
Navigation	Residual Fuel Oil	CO_2	350,28	0,1	275,27	0,0310	0,1%	92,0%	21,4%
Residential	waste of animal, plant	CH_4	294,23	0,1	487,15	0,0947	0,3%	92,3%	-65,6%
Other Industries	LPG	CO_2	262,52	0,1	129,70	0,0027	0,0%	92,3%	50,6%
Non-Ferrous Metals	Second Fuel Coal	CO_2	211,78	0,1	73,36	0,0062	0,0%	92,3%	65,4%
Cement Production	Natural Gas	CO_2	211,71	0,1	2,13	0,0254	0,1%	92,4%	99,0%
Other Industries	Asphalt	CO_2	210,82	0,1	25,04	0,0191	0,1%	92,5%	88,1%
Residential	wood	N_2O	198,41	0,1	278,32	0,0504	0,2%	92,6%	-40,3%
Public Electricity and Heat Production	Lignite	N_2O	182,28	0,0	90,42	0,0019	0,0%	92,6%	50,4%
Residential	Second Fuel Coal	CO_2	178,61	0,0	635,01	0,1485	0,4%	93,1%	-255,5%
Residential	Hard Coal	CH_4	166,25	0,0	261,34	0,0498	0,2%	93,2%	-57,2%
Sugar	Natural Gas	CO_2	165,14	0,0	0,00	0,0202	0,1%	93,3%	100,0%
Public Electricity and Heat Production	Gas / Diesel oil	CO_2	157,27	0,0	64,60	0,0019	0,0%	93,3%	58,9%
Road Transportation	Gasoline	N_2O	137,95	0,0	88,93	0,0070	0,0%	93,3%	35,5%
Residual Burning		N_2O	125,99	0,0	135,51	0,0209	0,1%	93,4%	-7,6%
Sugar	Residual Fuel Oil	CO_2	125,31	0,0	400,87	0,0922	0,3%	93,6%	-219,9%
Other Industries	Hard Coal	N_2O	118,49	0,0	5,93	0,0129	0,0%	93,7%	95,0%
Sugar	Second Fuel Coal	CO_2	97,03	0,0	149,44	0,0282	0,1%	93,8%	-54,0%
Chemicals	Residual Fuel Oil	CO_2	76,96	0,0	1984,26	0,5231	1,6%	95,3%	-2478,2%
Non-Ferrous Metals	Residual Fuel Oil	CO_2	67,42	0,0	731,31	0,1880	0,6%	95,9%	-984,7%
Cement Production	Residual Fuel Oil	CO_2	64,66	0,0	1473,79	0,3876	1,2%	97,1%	-2179,2%
Sugar	LPG	CO_2	60,51	0,0	0,00	0,0074	0,0%	97,1%	100,0%
Civil Aviation	Jet Kerosene	N_2O	60,14	0,0	9,08	0,0049	0,0%	97,1%	84,9%
Public Electricity and Heat Production	Hard Coal	N_2O	58,28	0,0	3,99	0,0061	0,0%	97,1%	93,2%
Residential	waste of animal, plant	N_2O	57,91	0,0	95,88	0,0186	0,1%	97,2%	-65,6%
Other Industries	Hard Coal	CH_4	57,34	0,0	2,87	0,0063	0,0%	97,2%	95,0%
Residential	Asphalt	CH_4	57,32	0,0	26,54	0,0001	0,0%	97,2%	53,7%
Other Chemicals Production (Chemical Industry)		CH_4	53,68	0,0	49,39	0,0067	0,0%	97,2%	8,0%
Residential	Gas / Diesel oil	CO_2	49,04	0,0	626,23	0,1620	0,5%	97,7%	-1176,9%
Road Transportation	Gasoline	CH_4	47,90	0,0	47,03	0,0068	0,0%	97,7%	1,8%
Chemicals	Lignite	CO_2	45,01	0,0	529,42	0,1366	0,4%	98,2%	-1076,2%
Iron and Steel	Second Fuel Coal	N_2O	43,24	0,0	35,96	0,0044	0,0%	98,2%	16,8%
Road Transportation	LPG	CH_4	40,26	0,0	0,00	0,0049	0,0%	98,2%	100,0%
Public Electricity and Heat Production	Naphta	CO_2	35,86	0,0	0,00	0,0044	0,0%	98,2%	100,0%
Iron and Steel	Residual Fuel Oil	CO_2	34,69	0,0	1702,29	0,4526	1,4%	99,6%	-4806,5%
Residential	Lignite	N_2O	34,66	0,0	40,60	0,0066	0,0%	99,6%	-17,1%
Road Transportation	Gas / Diesel oil	CH_4	34,52	0,0	20,88	0,0014	0,0%	99,6%	39,5%
Residential	Natural Gas	CH_4	33,87	0,0	0,20	0,0041	0,0%	99,6%	99,4%
Sugar	Hard Coal	CO_2	30,44	0,0	248,42	0,0629	0,2%	99,8%	-716,1%
Cement Production	Hard Coal	N_2O	29,13	0,0	12,42	0,0002	0,0%	99,8%	57,4%
Agriculture/Forestry/Fisheries	Gas / Diesel oil	N_2O	27,38	0,0	14,85	0,0006	0,0%	99,8%	45,8%
Public Electricity and Heat Production	Natural Gas	N_2O	22,01	0,0	3,02	0,0019	0,0%	99,8%	86,3%
Iron and Steel	Second Fuel Coal	CH_4	20,92	0,0	17,40	0,0021	0,0%	99,8%	16,8%
Cement Production	Petroleum Coke	N_2O	20,59	0,0	4,41	0,0013	0,0%	99,8%	78,6%
Iron and Steel	Gas / Diesel oil	CO_2	18,12	0,0	18,63	0,0028	0,0%	99,8%	-2,8%
Non-Ferrous Metals	Natural Gas	CH_4	17,49	0,0	0,00	0,0021	0,0%	99,8%	100,0%
Other Industries	Lignite	N_2O	17,48	0,0	22,26	0,0038	0,0%	99,8%	-27,3%
Public Electricity and Heat Production	Residual Fuel Oil	N_2O	16,74	0,0	8,48	0,0002	0,0%	99,8%	49,4%

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Table A6.2. Trend Analysis

2007 VS. 1990 TREND ANALYSIS									
Petroleum Refining	Gas / Diesel oil	CO_2	16,69	0,0	5,63	0,0005	0,0%	99,8%	66,3%
Agriculture/Forestry/Fisheries	Gas / Diesel oil	CH_4	15,46	0,0	8,38	0,0004	0,0%	99,8%	45,8%
Fertilizer	Residual Fuel Oil	CO_2	15,33	0,0	0,00	0,0019	0,0%	99,8%	100,0%
Public Electricity and Heat Production	Natural Gas	CH_4	14,97	0,0	2,05	0,0013	0,0%	99,8%	86,3%
Cement Production	Hard Coal	CH_4	14,10	0,0	6,01	0,0001	0,0%	99,8%	57,4%
Residential	LPG	CH_4	12,94	0,0	15,10	0,0025	0,0%	99,9%	-16,7%
Other Industries	Natural Gas	CH_4	12,41	0,0	1,28	0,0012	0,0%	99,9%	89,7%
Residential	Second Fuel Coal	CH_4	12,14	0,0	43,15	0,0101	0,0%	99,9%	-255,5%
Residential	LPG	N_2O	11,46	0,0	13,38	0,0022	0,0%	99,9%	-16,7%
Residential	Hard Coal	N_2O	11,45	0,0	18,00	0,0034	0,0%	99,9%	-57,2%
Cement Production	Lignite	N_2O	10,43	0,0	10,73	0,0016	0,0%	99,9%	-3,0%
Residential	Natural Gas	N_2O	10,00	0,0	0,06	0,0012	0,0%	99,9%	99,4%
Cement Production	Petroleum Coke	CH_4	9,96	0,0	2,13	0,0006	0,0%	99,9%	78,6%
Other Industries	Residual Fuel Oil	N_2O	9,05	0,0	10,68	0,0018	0,0%	99,9%	-18,0%
Public Electricity and Heat Production	Lignite	CH_4	8,82	0,0	4,38	0,0001	0,0%	99,9%	50,4%
Other Industries	Lignite	CH_4	8,46	0,0	10,77	0,0019	0,0%	99,9%	-27,3%
Railways	Gas / Diesel oil	N_2O	6,82	0,0	2,94	0,0000	0,0%	99,9%	56,9%
Petroleum Refining	Residual Fuel Oil	N_2O	6,47	0,0	5,71	0,0007	0,0%	99,9%	11,8%
Public Electricity and Heat Production	Residual Fuel Oil	CH_4	5,65	0,0	2,87	0,0001	0,0%	99,9%	49,2%
Non-Ferrous Metals	Natural Gas	N_2O	5,16	0,0	0,00	0,0006	0,0%	99,9%	100,0%
Other Industries	Petroleum Coke	N_2O	5,09	0,0	0,00	0,0006	0,0%	99,9%	100,0%
Cement Production	Lignite	CH_4	5,05	0,0	5,19	0,0008	0,0%	99,9%	-3,0%
Petroleum Refining	Refinery Gas	N_2O	5,04	0,0	3,71	0,0004	0,0%	99,9%	26,3%
Chemicals	Natural Gas	CH_4	4,30	0,0	0,00	0,0005	0,0%	99,9%	100,0%
Residential	Asphalt	N_2O	3,95	0,0	1,83	0,0000	0,0%	99,9%	53,7%
Other Industries	Natural Gas	N_2O	3,67	0,0	0,38	0,0003	0,0%	99,9%	89,7%
Sugar	Lignite	N_2O	3,54	0,0	7,77	0,0017	0,0%	99,9%	-119,4%
Other Industries	Second Fuel Coal	N_2O	3,52	0,0	2,47	0,0002	0,0%	99,9%	30,0%
Cement Production	LPG	CO_2	3,41	0,0	0,00	0,0004	0,0%	99,9%	100,0%
Iron and Steel	Hard Coal	N_2O	3,20	0,0	0,00	0,0004	0,0%	99,9%	100,0%
Navigation	Gas / Diesel oil	N_2O	3,10	0,0	0,56	0,0002	0,0%	99,9%	82,0%
Other Industries	Gas / Diesel oil	N_2O	2,88	0,0	0,78	0,0001	0,0%	99,9%	73,1%
Public Electricity and Heat Production	Hard Coal	CH_4	2,84	0,0	0,19	0,0003	0,0%	99,9%	93,2%
Other Industries	Petroleum Coke	CH_4	2,46	0,0	0,00	0,0003	0,0%	99,9%	100,0%
Residential	Residual Fuel Oil	CH_4	2,40	0,0	9,69	0,0023	0,0%	100,0%	-304,4%
Petroleum Refining	Residual Fuel Oil	CH_4	2,19	0,0	1,93	0,0003	0,0%	100,0%	11,8%
Residential	Residual Fuel Oil	N_2O	2,12	0,0	8,58	0,0020	0,0%	100,0%	-304,4%
Other Industries	Residual Fuel Oil	CH_4	2,04	0,0	2,41	0,0004	0,0%	100,0%	-18,0%
Non-Ferrous Metals	Hard Coal	N_2O	1,78	0,0	0,00	0,0002	0,0%	100,0%	100,0%
Navigation	Gas / Diesel oil	CH_4	1,76	0,0	0,12	0,0002	0,0%	100,0%	93,1%
Civil Aviation	Jet Kerosene	CH_4	1,72	0,0	1,31	0,0001	0,0%	100,0%	24,1%
Sugar	Lignite	CH_4	1,71	0,0	3,76	0,0008	0,0%	100,0%	-119,4%
Petroleum Refining	Refinery Gas	CH_4	1,71	0,0	1,26	0,0001	0,0%	100,0%	26,3%
Other Industries	Second Fuel Coal	CH_4	1,70	0,0	1,19	0,0001	0,0%	100,0%	30,0%
Iron and Steel	Natural Gas	CO_2	1,68	0,0	0,00	0,0002	0,0%	100,0%	100,0%
Iron and Steel	Hard Coal	CH_4	1,55	0,0	0,00	0,0002	0,0%	100,0%	100,0%
Chemicals	Natural Gas	N_2O	1,27	0,0	0,00	0,0002	0,0%	100,0%	100,0%
Non-Ferrous Metals	Second Fuel Coal	N_2O	0,99	0,0	0,34	0,0000	0,0%	100,0%	65,4%
Other Industries	Asphalt	N_2O	0,99	0,0	0,12	0,0001	0,0%	100,0%	88,1%
Navigation	Residual Fuel Oil	N_2O	0,93	0,0	0,67	0,0001	0,0%	100,0%	27,7%
Chemicals	LPG	CO_2	0,89	0,0	0,00	0,0001	0,0%	100,0%	100,0%

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Table A6.2. Trend Analysis

2007 VS. 1990 TREND ANALYSIS									
Non-Ferrous Metals	Hard Coal	CH4	0,86	0,0	0,00	0,0001	0,0%	100,0%	100,0%
Residential	Second Fuel Coal	N20	0,84	0,0	2,97	0,0007	0,0%	100,0%	-255,5%
Other Industries	LPG	N20	0,78	0,0	0,40	0,0000	0,0%	100,0%	48,4%
Petroleum Refining	Natural Gas	N20	0,72	0,0		0,0001	0,0%	100,0%	100,0%
Other Industries	Gas / Diesel oil	CH4	0,65	0,0	0,18	0,0000	0,0%	100,0%	73,1%
Road Transportation	Biofuel	N20	0,62	0,0	0,00	0,0001	0,0%	100,0%	100,0%
Petroleum Refining	Natural Gas	CH4	0,49	0,0		0,0001	0,0%	100,0%	100,0%
Navigation	Residual Fuel Oil	CH4	0,48	0,0	0,15	0,0000	0,0%	100,0%	69,5%
Non-Ferrous Metals	Second Fuel Coal	CH4	0,48	0,0	0,17	0,0000	0,0%	100,0%	65,4%
Other Industries	Asphalt	CH4	0,48	0,0	0,06	0,0000	0,0%	100,0%	88,1%
Railways	Gas / Diesel oil	CH4	0,46	0,0	0,64	0,0001	0,0%	100,0%	-37,8%
Sugar	Second Fuel Coal	N20	0,45	0,0	0,70	0,0001	0,0%	100,0%	-54,0%
Cement Production	Natural Gas	CH4	0,40	0,0	0,00	0,0000	0,0%	100,0%	99,0%
Sugar	Natural Gas	CH4	0,31	0,0	0,00	0,0000	0,0%	100,0%	100,0%
Public Electricity and Heat Production	Gas / Diesel oil	N20	0,31	0,0	0,17	0,0000	0,0%	100,0%	44,3%
Chemicals	Gas / Diesel oil	CO2	0,31	0,0	0,00	0,0000	0,0%	100,0%	100,0%
Sugar	Residual Fuel Oil	N20	0,30	0,0	1,02	0,0002	0,0%	100,0%	-234,1%
Sugar	Second Fuel Coal	CH4	0,22	0,0	0,34	0,0001	0,0%	100,0%	-54,0%
Petroleum Refining	LPG	CO2	0,21	0,0	0,14	0,0000	0,0%	100,0%	34,5%
Chemicals	Lignite	N20	0,20	0,0	2,32	0,0006	0,0%	100,0%	-1076,2%
Chemicals	Residual Fuel Oil	N20	0,19	0,0	5,08	0,0013	0,0%	100,0%	-2620,0%
Sugar	LPG	N20	0,18	0,0	0,00	0,0000	0,0%	100,0%	100,0%
Other Industries	LPG	CH4	0,18	0,0	0,09	0,0000	0,0%	100,0%	48,4%
Non-Ferrous Metals	Residual Fuel Oil	N20	0,16	0,0	1,87	0,0005	0,0%	100,0%	-1041,6%
Cement Production	Residual Fuel Oil	N20	0,16	0,0	3,74	0,0010	0,0%	100,0%	-2280,4%
Sugar	Hard Coal	N20	0,14	0,0	1,16	0,0003	0,0%	100,0%	-716,1%
Residential	Gas / Diesel oil	CH4	0,14	0,0	1,69	0,0004	0,0%	100,0%	-1101,4%
Public Electricity and Heat Production	Gas / Diesel oil	CH4	0,13	0,0	0,06	0,0000	0,0%	100,0%	53,6%
Residential	Gas / Diesel oil	N20	0,12	0,0	1,49	0,0004	0,0%	100,0%	-1101,4%
Cement Production	Natural Gas	N20	0,12	0,0	0,00	0,0000	0,0%	100,0%	99,0%
Chemicals	Lignite	CH4	0,10	0,0	1,12	0,0003	0,0%	100,0%	-1076,2%
Public Electricity and Heat Production	Naphta	N20	0,09	0,0	0,00	0,0000	0,0%	100,0%	100,0%
Sugar	Natural Gas	N20	0,09	0,0	0,00	0,0000	0,0%	100,0%	100,0%
Petroleum Refining	Gasoline	CO2	0,09	0,0	1,88	0,0005	0,0%	100,0%	-2086,1%
Iron and Steel	Residual Fuel Oil	N20	0,08	0,0	4,36	0,0012	0,0%	100,0%	-5073,8%
Sugar	Hard Coal	CH4	0,07	0,0	0,56	0,0001	0,0%	100,0%	-716,1%
Sugar	Residual Fuel Oil	CH4	0,07	0,0	0,23	0,0001	0,0%	100,0%	-234,1%
Iron and Steel	Gas / Diesel oil	N20	0,05	0,0	0,05	0,0000	0,0%	100,0%	-8,4%
Petroleum Refining	Gas / Diesel oil	N20	0,04	0,0	0,01	0,0000	0,0%	100,0%	65,2%
Chemicals	Residual Fuel Oil	CH4	0,04	0,0	1,15	0,0003	0,0%	100,0%	-2620,0%
Road Transportation	Biofuel	CH4	0,04	0,0	0,00	0,0000	0,0%	100,0%	100,0%
Sugar	LPG	CH4	0,04	0,0	0,00	0,0000	0,0%	100,0%	100,0%
Fertilizer	Residual Fuel Oil	N20	0,04	0,0	0,00	0,0000	0,0%	100,0%	100,0%
Non-Ferrous Metals	Residual Fuel Oil	CH4	0,04	0,0	0,42	0,0001	0,0%	100,0%	-1041,6%
Cement Production	Residual Fuel Oil	CH4	0,04	0,0	0,84	0,0002	0,0%	100,0%	-2280,4%
Public Electricity and Heat Production	Naphta	CH4	0,02	0,0	0,00	0,0000	0,0%	100,0%	100,0%
Iron and Steel	Residual Fuel Oil	CH4	0,02	0,0	0,98	0,0003	0,0%	100,0%	-5073,8%
Petroleum Refining	Gas / Diesel oil	CH4	0,01	0,0	0,00	0,0000	0,0%	100,0%	65,2%
Iron and Steel	Gas / Diesel oil	CH4	0,01	0,0	0,01	0,0000	0,0%	100,0%	-8,4%
Cement Production	LPG	N20	0,01	0,0	0,00	0,0000	0,0%	100,0%	100,0%
Fertilizer	Gas / Diesel oil	CO2	0,01	0,0	0,00	0,0000	0,0%	100,0%	100,0%

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Table A6.2. Trend Analysis

2007 VS. 1990 TREND ANALYSIS									
Fertilizer	Residual Fuel Oil	CH4	0,01	0,0	0,00	0,0000	0,0%	100,0%	100,0%
Iron and Steel	Natural Gas	CH4	0,00	0,0	0,00	0,0000	0,0%	100,0%	100,0%
Chemicals	LPG	N20	0,00	0,0	0,00	0,0000	0,0%	100,0%	100,0%
Cement Production	LPG	CH4	0,00	0,0	0,00	0,0000	0,0%	100,0%	100,0%
Iron and Steel	Natural Gas	N20	0,00	0,0	0,00	0,0000	0,0%	100,0%	100,0%
Chemicals	Gas / Diesel oil	N20	0,00	0,0	0,00	0,0000	0,0%	100,0%	100,0%
Petroleum Refining	LPG	N20	0,00	0,0	0,00	0,0000	0,0%	100,0%	32,4%
Chemicals	LPG	CH4	0,00	0,0	0,00	0,0000	0,0%	100,0%	100,0%
Petroleum Refining	Gasoline	N20	0,00	0,0	0,01	0,0000	0,0%	100,0%	-2157,1%
Petroleum Refining	LPG	CH4	0,00	0,0	0,00	0,0000	0,0%	100,0%	32,4%
Chemicals	Gas / Diesel oil	CH4	0,00	0,0	0,00	0,0000	0,0%	100,0%	100,0%
Petroleum Refining	Gasoline	CH4	0,00	0,0	0,00	0,0000	0,0%	100,0%	-2157,1%
Fertilizer	Gas / Diesel oil	N20	0,00	0,0	0,00	0,0000	0,0%	100,0%	100,0%
Fertilizer	Gas / Diesel oil	CH4	0,00	0,0	0,00	0,0000	0,0%	100,0%	100,0%
Cement Production	Asphalt	CH4	0,00	0,0	0,14	-	-	-	-
Cement Production	Asphalt	CO2	0,00	0,0	63,42	-	-	-	-
Cement Production	Asphalt	N20	0,00	0,0	0,30	-	-	-	-
Cement Production	Gas / Diesel oil	CH4	0,00	0,0	0,05	-	-	-	-
Cement Production	Gas / Diesel oil	CO2	0,00	0,0	76,06	-	-	-	-
Cement Production	Gas / Diesel oil	N20	0,00	0,0	0,20	-	-	-	-
Non-Ferrous Metals	Gas / Diesel oil	CH4	0,00	0,0	0,03	-	-	-	-
Non-Ferrous Metals	Gas / Diesel oil	CO2	0,00	0,0	42,91	-	-	-	-
Non-Ferrous Metals	Gas / Diesel oil	N20	0,00	0,0	0,11	-	-	-	-
Navigation	Hard Coal	CH4	0,00	0,0	0,00	-	-	-	-
Navigation	Hard Coal	CO2	0,00	0,0	3,19	-	-	-	-
Navigation	Hard Coal	N20	0,00	0,0	0,01	-	-	-	-
Railways	Hard Coal	CH4	0,00	0,0	0,07	-	-	-	-
Railways	Hard Coal	CO2	0,00	0,0	29,73	-	-	-	-
Railways	Hard Coal	N20	0,00	0,0	0,39	-	-	-	-
Fertilizer	Lignite	CH4	0,00	0,0	1,34	-	-	-	-
Fertilizer	Lignite	CO2	0,00	0,0	634,06	-	-	-	-
Fertilizer	Lignite	N20	0,00	0,0	2,77	-	-	-	-
Non-Ferrous Metals	Lignite	CH4	0,00	0,0	0,13	-	-	-	-
Non-Ferrous Metals	Lignite	CO2	0,00	0,0	59,79	-	-	-	-
Non-Ferrous Metals	Lignite	N20	0,00	0,0	0,26	-	-	-	-
Railways	Lignite	CH4	0,00	0,0	0,05	-	-	-	-
Railways	Lignite	CO2	0,00	0,0	21,87	-	-	-	-
Railways	Lignite	N20	0,00	0,0	0,27	-	-	-	-
Fertilizer	Naphta	CH4	0,00	0,0	0,28	-	-	-	-
Fertilizer	Naphta	CO2	0,00	0,0	463,51	-	-	-	-
Fertilizer	Naphta	N20	0,00	0,0	1,24	-	-	-	-
Petroleum Refining	Naphta	CH4	0,00	0,0		-	-	-	-
Petroleum Refining	Naphta	CO2	0,00	0,0		-	-	-	-
Petroleum Refining	Naphta	N20	0,00	0,0		-	-	-	-
Fertilizer	Natural Gas	CH4	0,00	0,0	1,97	-	-	-	-
Fertilizer	Natural Gas	CO2	0,00	0,0	1048,47	-	-	-	-
Fertilizer	Natural Gas	N20	0,00	0,0	0,58	-	-	-	-
Non-Ferrous Metals	Petroleum Coke	CH4	0,00	0,0	0,23	-	-	-	-
Non-Ferrous Metals	Petroleum Coke	CO2	0,00	0,0	103,25	-	-	-	-
Non-Ferrous Metals	Petroleum Coke	N20	0,00	0,0	0,48	-	-	-	-
Other Industries	Refinery Gas	CH4	0,00	0,0	0,00	-	-	-	-

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Table A6.2. Trend Analysis

2007 VS. 1990 TREND ANALYSIS									
Other Industries	Refinery Gas	CO_2	0,00	0,0	1,05	-	-	-	-
Other Industries	Refinery Gas	N_2O	0,00	0,0	0,00	-	-	-	-
Railways	Residual Fuel Oil	CH_4	0,00	0,0	0,09	-	-	-	-
Railways	Residual Fuel Oil	CO_2	0,00	0,0	60,47	-	-	-	-
Railways	Residual Fuel Oil	N_2O	0,00	0,0	0,42	-	-	-	-
Cement Production	Second Fuel Coal	CH_4	0,00	0,0	0,00	-	-	-	-
Cement Production	Second Fuel Coal	CO_2	0,00	0,0	0,00	-	-	-	-
Cement Production	Second Fuel Coal	N_2O	0,00	0,0	0,00	-	-	-	-
Fertilizer	Second Fuel Coal	CH_4	0,00	0,0	0,01	-	-	-	-
Fertilizer	Second Fuel Coal	CO_2	0,00	0,0	2,72	-	-	-	-
Fertilizer	Second Fuel Coal	N_2O	0,00	0,0	0,01	-	-	-	-
Carbide Production (Chemical Industry)		CO_2	0,00	0,0	112,25	-	-	-	-
Ferroalloys Production (Metal Production)		CO_2	-	0,0	81,17	-	-	-	-
Iron and Steel Production (Metal Production)		CO_2	-	0,0	770,23	-	-	-	-
Aluminium Production (Metal Production)		CO_2	-	0,0	109,62	-	-	-	-
Ammonia Production (Chemical Industry)		CO_2	-	0,0	713,47	-	-	-	-
Emission of PFCs		PFC	-	0,0	0,00	-	-	-	-
Limestone and Dolomite Use (Mineral Products)		CO_2	-	0,0	21,52	-	-	-	-
Nitric Acid Production (Chemical Industry)		N_2O	-	0,0	128,08	-	-	-	-
Soda Ash Production and Use (Mineral Products)		CO_2	-	0,0	106,30	-	-	-	-
TOTAL									

Annex 7

A7. Uncertainties

Quantitative estimates of the uncertainties in the emissions were calculated using direct expert judgement. It can be concluded that the total uncertainty is 10.9% according to the high certain data of LULUCF. The emissions from all sectors were calculated by summing the GWP weighted emissions of CO_2, N_20, CH_4, HFCs, PFCs and SF_6 gases.

The general procedure for uncertainty analysis was:

- Uncertainties of each activity were allocated by using emission factor and activity rate uncertainties.
- A calculation was set up to estimate the emission of each CO_2, CH_4, N_20, HFCs and SF_6 gases.
- The uncertainties used for the industrial processes data were estimated from the statistical difference between entire supply and institutional inventory demand.
- The uncertainties for sectorial energy usage were estimated by MENR experts.
- The uncertainties of agricultural activities were estimated by TurkStat experts.
- The uncertainties of transport sectors were estimated by MOT experts.

The highest combined uncertainties were seen in the industrial processes (especially chemical productions), burning of agricultural residue, solid waste, coal mining and fuel combustion (basically the usage of hard coal in electricity production and residential areas).

The results are given in Table A7.1

Uncertainty estimates are an essential element of a complete emissions inventory. It is not intended dispute the validity of the inventory estimates, but to help prioritise efforts to improve the accuracy of inventories in the future. Uncertainties of the inventories are, mainly derived from measured data. However, it is not practical to measure every energy sources in this way. As in Turkey, experts have enough knowledge about sources to determine their uncertainty. Expert judgement in this way minimise the risk of bias and it discusses how to combine uncertainties in emission factors and activity data to estimate source category and total uncertainties in inventories. Once the uncertainties in the source categories have been determined, they may be combined to provide uncertainty estimates for the entire inventory. Tier 1 method was used for correlation over time. However, it did not account for correlation and dependency between source categories. The following Table A1 was used for calculating Total Tier 1 Uncertainty of Turkish Emission inventory.

Table A7.1 Tier 1 Uncertainty Calculation (IPCC GPG-Table6.1, 2000)

A	B	C	D	E	F	G	H	I
Source Category	FUEL	GAS	1990 EMIS.	2005 EMIS.	Activity data Unc. (%)	Emis fact. Unc. (%)	Combined Unc. (%)	Combined uncertainty as % of total national emissions in year 2005
	-	-	Input Data	Input Data	Input Data	Input Data	$\sqrt{F^2+G^2}$	$\frac{H \bullet E}{\sum E}$
	-	-	Gg CO_2 Equ.	Gg CO_2 Equ.	%	%	%	&
Example (1.A.1.a)	Hard Coal	CO_2						
				$\sum D$	$\sum E$			Total Uncertainty $\sqrt{\sum H^2}$

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Table A7.2 Uncertainties, 2007

CATEGORY	FUEL	GAS	1990 EMIS.	2007 EMIS.	Activity data Unc. (%)	Emıs fact. Unc. (%)	Combıned Unc. (%)	Combined uncertainty as % of total national emissions in year 2007
Public Electricity and Heat Production	Lignite	CO2	20662,22	41662,92	5,30	3,0	6,1	0,9
Public Electricity and Heat Production	Natural Gas	CO2	5435,89	39823,84	0,00	3,0	3,0	0,4
Road Transportation	Gas / Diesel oil	CO2	15742,61	29299,32	0,00	5,0	5,0	0,5
Other Industries	Hard Coal	CO2	1266,53	25312,00	7,00	3,0	7,6	0,7
Cement Production (Mineral Products)		CO2	10333,37	21208,47	0,00	5,0	5,0	0,4
Residential	Natural Gas	CO2	104,21	17891,87	0,00	3,0	3,0	0,2
Waste (landfill)		CH4	6386,46	16609,47	15,00	19,0	24,2	1,4
Enteric Fermentation		CH4	17046,76	15631,85	6,30	1,0	6,4	0,3
Waste (control landfill)		CH4	0,00	15240,23	15,00	19,0	24,2	1,2
Public Electricity and Heat Production	Hard Coal	CO2	851,45	12466,12	7,00	3,0	7,6	0,3
Agriculture/Forestry/Fisheries	Gas / Diesel oil	CO2	5795,38	10795,35	0,00	5,0	5,0	0,2
Non-Ferrous Metals	Natural Gas	CO2	0,00	9297,11	0,00	3,0	3,0	0,1
Iron and Steel	Second Fuel Coal	CO2	7681,10	9236,90	7,00	3,0	7,6	0,2
Residential	Lignite	CO2	9276,74	7920,63	5,30	3,0	6,1	0,2
Road Transportation	Gasoline	CO2	8293,32	7645,55	3,00	3,0	4,2	0,1
Other Industries	Natural Gas	CO2	678,42	6599,76	0,00	3,0	3,0	0,1
Public Electricity and Heat Production	Residual Fuel Oil	CO2	3311,30	6515,51	2,50	3,0	3,9	0,1
Cement Production	Hard Coal	CO2	2653,20	6222,91	7,00	3,0	7,6	0,2
Civil Aviation	Jet Kerosene	CO2	904,59	6063,69	0,00	3,0	3,0	0,1
Road Transportation	LPG	CO2	0,00	5989,22	2,50	5,0	5,6	0,1
Cement Production	Petroleum Coke	CO2	941,03	4397,60	0,00	3,0	3,0	0,0
Agricultural Soil (Synthetic Fertilizer)		N2O	NE	4202,84	1,00	9,0	9,1	0,1
Other Industries	Lignite	CO2	5086,15	3994,69	5,30	3,0	6,1	0,1
Residential	LPG	CO2	4772,19	3847,26	2,50	5,0	5,6	0,1
Other Industries	Residual Fuel Oil	CO2	4212,15	3727,25	2,50	3,0	3,9	0,0
Emission of HFCs		HFC-134a	0,00	3174,30	40,00	20,0	44,7	0,5
Petroleum Refining	Residual Fuel Oil	CO2	2277,75	2665,11	2,50	3,0	3,9	0,0
Residential	Hard Coal	CO2	3845,79	2446,53	7,00	3,0	7,6	0,1
Cement Production	Lignite	CO2	2453,05	2382,65	5,30	3,0	6,1	0,0
Manure Management		N2O	NE	2316,03	1,00	9,0	9,1	0,1
Chemicals	Natural Gas	CO2	0,00	2287,67	0,00	3,0	3,0	0,0
Petroleum Refining	Refinery Gas	CO2	1403,84	1968,02	0,00	3,0	3,0	0,0
Manure Management		CH4	613,63	1767,80	6,30	1,0	6,4	0,0
Agricultural Soil (Animal Manure Applied)		N2O	NE	1421,48	1,00	9,0	9,1	0,0
Petroleum Refining	Natural Gas	CO2		1291,12	0,00	3,0	3,0	0,0

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Table A7.2 Uncertainties, 2007

CATEGORY	FUEL	GAS	1990 EMIS.	2007 EMIS.	Activity data Unc. (%)	Emıs fact. Unc. (%)	Combıned Unc. (%)	Combined uncertainty as % of total national emissions in year 2007
Navigation	Gas / Diesel oil	CO2	219,01	1238,48	0,00	5,0	5,0	0,0
Mining (Surface)		CH4	754,43	1230,89	5,00	20,0	20,6	0,1
Other Industries	Gas / Diesel oil	CO2	292,99	1136,01	0,00	5,0	5,0	0,0
Other Industries	Petroleum Coke	CO2	0,00	1087,02	0,00	3,0	3,0	0,0
Residential	wood	CH4	1414,06	1008,04	0,00	16,0	16,0	0,1
Emission of SF6		SF6	0,00	952,11	40,00	20,0	44,7	0,1
Residential	Residual Fuel Oil	CO2	3754,89	873,69	2,50	3,0	3,9	0,0
Residential	Asphalt	CO2	390,56	843,43	0,00	20,0	20,0	0,1
Sugar	Lignite	CO2	1775,11	809,03	5,30	3,0	6,1	0,0
Lime Production (Mineral Products)		CO2	645,09	794,49	34,00	1,0	34,0	0,1
Other Industries	Second Fuel Coal	CO2	527,11	752,48	7,00	3,0	7,6	0,0
Iron and Steel	Hard Coal	CO2	0,00	684,05	7,00	3,0	7,6	0,0
Mining (underground)		CH4	675,89	606,21	5,00	20,0	20,6	0,0
Residential	Lignite	CH4	589,29	503,15	5,30	16,0	16,9	0,0
Road Transportation	Gas / Diesel oil	N20	157,94	442,37	0,00	10,0	10,0	0,0
Railways	Gas / Diesel oil	CO2	404,58	424,12	0,00	5,0	5,0	0,0
Residual Burning		CH4	454,59	416,43	25,00	14,0	28,7	0,0
Rice Cultivation		CH4	222,60	394,38	10,00	20,0	22,4	0,0
Non-Ferrous Metals	Hard Coal	CO2	0,00	381,15	7,00	3,0	7,6	0,0
Navigation	Residual Fuel Oil	CO2	275,27	350,28	2,50	3,0	3,9	0,0
Residential	waste of animal, p	CH4	487,15	294,23	0,00	16,0	16,0	0,0
Other Industries	LPG	CO2	129,70	262,52	2,50	5,0	5,6	0,0
Non-Ferrous Metals	Second Fuel Coal	CO2	73,36	211,78	7,00	3,0	7,6	0,0
Cement Production	Natural Gas	CO2	2,13	211,71	0,00	3,0	3,0	0,0
Other Industries	Asphalt	CO2	25,04	210,82	0,00	20,0	20,0	0,0
Residential	wood	N20	278,32	198,41	0,00	45,0	45,0	0,0
Public Electricity and Heat Production	Lignite	N20	90,42	182,28	5,30	20,0	20,7	0,0
Residential	Second Fuel Coal	CO2	635,01	178,61	7,00	3,0	7,6	0,0
Residential	Hard Coal	CH4	261,34	166,25	7,00	16,0	17,5	0,0
Sugar	Natural Gas	CO2	0,00	165,14	0,00	3,0	3,0	0,0
Public Electricity and Heat Production	Gas / Diesel oil	CO2	64,60	157,27	0,00	5,0	5,0	0,0
Road Transportation	Gasoline	N20	88,93	137,95	16,00	16,0	22,6	0,0
Residual Burning		N2O	135,51	125,99	25,00	20,0	32,0	0,0
Sugar	Residual Fuel Oil	CO2	400,87	125,31	2,50	3,0	3,9	0,0
Other Industries	Hard Coal	N20	5,93	118,49	7,00	20,0	21,2	0,0

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Table A7.2 Uncertainties, 2007

CATEGORY	FUEL	GAS	1990 EMIS.	2007 EMIS.	Activity data Unc. (%)	Emıs fact. Unc. (%)	Combıned Unc. (%)	Combined uncertainty as % of total national emissions in year 2007
Sugar	Second Fuel Coal	CO2	149,44	97,03	7,00	3,0	7,6	0,0
Chemicals	Residual Fuel Oil	CO2	1984,26	76,96	2,50	3,0	3,9	0,0
Non-Ferrous Metals	Residual Fuel Oil	CO2	731,31	67,42	2,50	3,0	3,9	0,0
Cement Production	Residual Fuel Oil	CO2	1473,79	64,66	2,50	3,0	3,9	0,0
Sugar	LPG	CO2	0,00	60,51	2,50	5,0	5,6	0,0
Civil Aviation	Jet Kerosene	N20	9,08	60,14	0,00	10,0	10,0	0,0
Public Electricity and Heat Production	Hard Coal	N20	3,99	58,28	7,00	20,0	21,2	0,0
Residential	waste of animal, p	N20	95,88	57,91	0,00	45,0	45,0	0,0
Other Industries	Hard Coal	CH4	2,87	57,34	7,00	16,0	17,5	0,0
Residential	Asphalt	CH4	26,54	57,32	0,00	20,0	20,0	0,0
Other Chemicals Production (Chemical Industry)		CH4	49,39	53,68	60,00	1,0	60,0	0,0
Residential	Gas / Diesel oil	CO2	626,23	49,04	0,00	5,0	5,0	0,0
Road Transportation	Gasoline	CH4	47,03	47,90	10,00	10,0	14,1	0,0
Chemicals	Lignite	CO2	529,42	45,01	5,30	3,0	6,1	0,0
Iron and Steel	Second Fuel Coal	N20	35,96	43,24	7,00	20,0	21,2	0,0
Road Transportation	LPG	CH4	0,00	40,26	2,50	10,0	10,3	0,0
Public Electricity and Heat Production	Naphta	CO2	0,00	35,86	2,50	3,0	3,9	0,0
Iron and Steel	Residual Fuel Oil	CO2	1702,29	34,69	2,50	3,0	3,9	0,0
Residential	Lignite	N20	40,60	34,66	5,30	20,0	20,7	0,0
Road Transportation	Gas / Diesel oil	CH4	20,88	34,52	0,00	10,0	10,0	0,0
Residential	Natural Gas	CH4	0,20	33,87	0,00	16,0	16,0	0,0
Sugar	Hard Coal	CO2	248,42	30,44	7,00	3,0	7,6	0,0
Cement Production	Hard Coal	N20	12,42	29,13	7,00	20,0	21,2	0,0
Agriculture/Forestry/Fisheries	Gas / Diesel oil	N20	14,85	27,38	0,00	10,0	10,0	0,0
Public Electricity and Heat Production	Natural Gas	N20	3,02	22,01	0,00	20,0	20,0	0,0
Iron and Steel	Second Fuel Coal	CH4	17,40	20,92	7,00	16,0	17,5	0,0
Cement Production	Petroleum Coke	N20	4,41	20,59	0,00	20,0	20,0	0,0
Iron and Steel	Gas / Diesel oil	CO2	18,63	18,12	0,00	5,0	5,0	0,0
Non-Ferrous Metals	Natural Gas	CH4	0,00	17,49	0,00	16,0	16,0	0,0
Other Industries	Lignite	N20	22,26	17,48	5,30	20,0	20,7	0,0
Public Electricity and Heat Production	Residual Fuel Oil	N20	8,48	16,74	2,50	16,0	16,2	0,0
Petroleum Refining	Gas / Diesel oil	CO2	5,63	16,69	0,00	5,0	5,0	0,0
Agriculture/Forestry/Fisheries	Gas / Diesel oil	CH4	8,38	15,46	0,00	10,0	10,0	0,0
Fertilizer	Residual Fuel Oil	CO2	0,00	15,33	2,50	3,0	3,9	0,0
Public Electricity and Heat Production	Natural Gas	CH4	2,05	14,97	0,00	16,0	16,0	0,0

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Table A7.2 Uncertainties, 2007

CATEGORY	FUEL	GAS	1990 EMIS.	2007 EMIS.	Activity data Unc. (%)	Emıs fact. Unc. (%)	Combıned Unc. (%)	Combined uncertainty as % of total national emissions in year 2007
Cement Production	Hard Coal	CH4	6,01	14,10	7,00	16,0	17,5	0,0
Residential	LPG	CH4	15,10	12,94	2,50	10,0	10,3	0,0
Other Industries	Natural Gas	CH4	1,28	12,41	0,00	16,0	16,0	0,0
Residential	Second Fuel Coal	CH4	43,15	12,14	7,00	16,0	17,5	0,0
Residential	LPG	N20	13,38	11,46	2,50	16,0	16,2	0,0
Residential	Hard Coal	N20	18,00	11,45	7,00	20,0	21,2	0,0
Cement Production	Lignite	N20	10,73	10,43	5,30	20,0	20,7	0,0
Residential	Natural Gas	N20	0,06	10,00	0,00	20,0	20,0	0,0
Cement Production	Petroleum Coke	CH4	2,13	9,96	0,00	16,0	16,0	0,0
Other Industries	Residual Fuel Oil	N20	10,68	9,05	2,50	16,0	16,2	0,0
Public Electricity and Heat Production	Lignite	CH4	4,38	8,82	5,30	16,0	16,9	0,0
Other Industries	Lignite	CH4	10,77	8,46	5,30	16,0	16,9	0,0
Railways	Gas / Diesel oil	N20	2,94	6,82	0,00	10,0	10,0	0,0
Petroleum Refining	Residual Fuel Oil	N20	5,71	6,47	2,50	16,0	16,2	0,0
Public Electricity and Heat Production	Residual Fuel Oil	CH4	2,87	5,65	2,50	10,0	10,3	0,0
Non-Ferrous Metals	Natural Gas	N20	0,00	5,16	0,00	20,0	20,0	0,0
Other Industries	Petroleum Coke	N20	0,00	5,09	0,00	20,0	20,0	0,0
Cement Production	Lignite	CH4	5,19	5,05	5,30	16,0	16,9	0,0
Petroleum Refining	Refinery Gas	N20	3,71	5,04	0,00	16,0	16,0	0,0
Chemicals	Natural Gas	CH4	0,00	4,30	0,00	16,0	16,0	0,0
Residential	Asphalt	N20	1,83	3,95	0,00	20,0	20,0	0,0
Other Industries	Natural Gas	N20	0,38	3,67	0,00	20,0	20,0	0,0
Sugar	Lignite	N20	7,77	3,54	5,30	20,0	20,7	0,0
Other Industries	Second Fuel Coal	N20	2,47	3,52	7,00	20,0	21,2	0,0
Cement Production	LPG	CO2	0,00	3,41	2,50	5,0	5,6	0,0
Iron and Steel	Hard Coal	N20	0,00	3,20	7,00	20,0	21,2	0,0
Navigation	Gas / Diesel oil	N20	0,56	3,10	0,00	10,0	10,0	0,0
Other Industries	Gas / Diesel oil	N20	0,78	2,88	0,00	10,0	10,0	0,0
Public Electricity and Heat Production	Hard Coal	CH4	0,19	2,84	7,00	16,0	17,5	0,0
Other Industries	Petroleum Coke	CH4	0,00	2,46	0,00	16,0	16,0	0,0
Residential	Residual Fuel Oil	CH4	9,69	2,40	2,50	10,0	10,3	0,0
Petroleum Refining	Residual Fuel Oil	CH4	1,93	2,19	2,50	10,0	10,3	0,0
Residential	Residual Fuel Oil	N20	8,58	2,12	2,50	16,0	16,2	0,0
Other Industries	Residual Fuel Oil	CH4	2,41	2,04	2,50	10,0	10,3	0,0
Non-Ferrous Metals	Hard Coal	N20	0,00	1,78	7,00	20,0	21,2	0,0

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Table A7.2 Uncertainties, 2007

CATEGORY	FUEL	GAS	1990 EMIS.	2007 EMIS.	Activity data Unc. (%)	Emıs fact. Unc. (%)	Combıned Unc. (%)	Combined uncertainty as % of total national emissions in year 2007
Navigation	Gas / Diesel oil	CH4	0,12	1,76	0,00	10,0	10,0	0,0
Civil Aviation	Jet Kerosene	CH4	1,31	1,72	0,00	10,0	10,0	0,0
Sugar	Lignite	CH4	3,76	1,71	5,30	16,0	16,9	0,0
Petroleum Refining	Refinery Gas	CH4	1,26	1,71	0,00	10,0	10,0	0,0
Other Industries	Second Fuel Coal	CH4	1,19	1,70	7,00	16,0	17,5	0,0
Iron and Steel	Natural Gas	CO2	0,00	1,68	0,00	3,0	3,0	0,0
Iron and Steel	Hard Coal	CH4	0,00	1,55	7,00	16,0	17,5	0,0
Chemicals	Natural Gas	N20	0,00	1,27	0,00	20,0	20,0	0,0
Non-Ferrous Metals	Second Fuel Coal	N20	0,34	0,99	7,00	20,0	21,2	0,0
Other Industries	Asphalt	N20	0,12	0,99	0,00	20,0	20,0	0,0
Navigation	Residual Fuel Oil	N20	0,67	0,93	2,50	16,0	16,2	0,0
Chemicals	LPG	CO2	0,00	0,89	2,50	5,0	5,6	0,0
Non-Ferrous Metals	Hard Coal	CH4	0,00	0,86	7,00	16,0	17,5	0,0
Residential	Second Fuel Coal	N20	2,97	0,84	7,00	20,0	21,2	0,0
Other Industries	LPG	N20	0,40	0,78	2,50	16,0	16,2	0,0
Petroleum Refining	Natural Gas	N20		0,72	0,00	20,0	20,0	0,0
Other Industries	Gas / Diesel oil	CH4	0,18	0,65	0,00	10,0	10,0	0,0
Road Transportation	Biofuel	N20	0,00	0,62	45,00	45,0	63,6	0,0
Petroleum Refining	Natural Gas	CH4		0,49	0,00	16,0	16,0	0,0
Navigation	Residual Fuel Oil	CH4	0,15	0,48	2,50	10,0	10,3	0,0
Non-Ferrous Metals	Second Fuel Coal	CH4	0,17	0,48	7,00	16,0	17,5	0,0
Other Industries	Asphalt	CH4	0,06	0,48	0,00	20,0	20,0	0,0
Railways	Gas / Diesel oil	CH4	0,64	0,46	0,00	10,0	10,0	0,0
Sugar	Second Fuel Coal	N20	0,70	0,45	7,00	20,0	21,2	0,0
Cement Production	Natural Gas	CH4	0,00	0,40	0,00	16,0	16,0	0,0
Sugar	Natural Gas	CH4	0,00	0,31	0,00	16,0	16,0	0,0
Public Electricity and Heat Production	Gas / Diesel oil	N20	0,17	0,31	0,00	10,0	10,0	0,0
Chemicals	Gas / Diesel oil	CO2	0,00	0,31	0,00	5,0	5,0	0,0
Sugar	Residual Fuel Oil	N20	1,02	0,30	2,50	16,0	16,2	0,0
Sugar	Second Fuel Coal	CH4	0,34	0,22	7,00	16,0	17,5	0,0
Petroleum Refining	LPG	CO2	0,14	0,21	2,50	5,0	5,6	0,0
Chemicals	Lignite	N20	2,32	0,20	5,30	20,0	20,7	0,0
Chemicals	Residual Fuel Oil	N20	5,08	0,19	2,50	16,0	16,2	0,0
Sugar	LPG	N20	0,00	0,18	2,50	16,0	16,2	0,0
Other Industries	LPG	CH4	0,09	0,18	2,50	10,0	10,3	0,0

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Table A7.2 Uncertainties, 2007

CATEGORY	FUEL	GAS	1990 EMIS.	2007 EMIS.	Activity data Unc. (%)	Emıs fact. Unc. (%)	Combıned Unc. (%)	Combined uncertainty as % of total national emissions in year 2007
Non-Ferrous Metals	Residual Fuel Oil	N20	1,87	0,16	2,50	16,0	16,2	0,0
Cement Production	Residual Fuel Oil	N20	3,74	0,16	2,50	16,0	16,2	0,0
Sugar	Hard Coal	N20	1,16	0,14	7,00	20,0	21,2	0,0
Residential	Gas / Diesel oil	CH4	1,69	0,14	0,00	10,0	10,0	0,0
Public Electricity and Heat Production	Gas / Diesel oil	CH4	0,06	0,13	0,00	10,0	10,0	0,0
Residential	Gas / Diesel oil	N20	1,49	0,12	0,00	10,0	10,0	0,0
Cement Production	Natural Gas	N20	0,00	0,12	0,00	20,0	20,0	0,0
Chemicals	Lignite	CH4	1,12	0,10	5,30	16,0	16,9	0,0
Public Electricity and Heat Production	Naphta	N20	0,00	0,09	2,50	16,0	16,2	0,0
Sugar	Natural Gas	N20	0,00	0,09	0,00	20,0	20,0	0,0
Petroleum Refining	Gasoline	CO2	1,88	0,09	3,00	3,0	4,2	0,0
Iron and Steel	Residual Fuel Oil	N20	4,36	0,08	2,50	16,0	16,2	0,0
Sugar	Hard Coal	CH4	0,56	0,07	7,00	16,0	17,5	0,0
Sugar	Residual Fuel Oil	CH4	0,23	0,07	2,50	10,0	10,3	0,0
Iron and Steel	Gas / Diesel oil	N20	0,05	0,05	0,00	10,0	10,0	0,0
Petroleum Refining	Gas / Diesel oil	N20	0,01	0,04	0,00	10,0	10,0	0,0
Chemicals	Residual Fuel Oil	CH4	1,15	0,04	2,50	10,0	10,3	0,0
Road Transportation	Biofuel	CH4	0,00	0,04	16,00	16,0	22,6	0,0
Sugar	LPG	CH4	0,00	0,04	2,50	10,0	10,3	0,0
Fertilizer	Residual Fuel Oil	N20	0,00	0,04	2,50	16,0	16,2	0,0
Non-Ferrous Metals	Residual Fuel Oil	CH4	0,42	0,04	2,50	10,0	10,3	0,0
Cement Production	Residual Fuel Oil	CH4	0,84	0,04	2,50	10,0	10,3	0,0
Public Electricity and Heat Production	Naphta	CH4	0,00	0,02	2,50	10,0	10,3	0,0
Iron and Steel	Residual Fuel Oil	CH4	0,98	0,02	2,50	10,0	10,3	0,0
Petroleum Refining	Gas / Diesel oil	CH4	0,00	0,01	0,00	10,0	10,0	0,0
Iron and Steel	Gas / Diesel oil	CH4	0,01	0,01	0,00	10,0	10,0	0,0
Cement Production	LPG	N20	0,00	0,01	2,50	16,0	16,2	0,0
Fertilizer	Gas / Diesel oil	CO2	0,00	0,01	0,00	5,0	5,0	0,0
Fertilizer	Residual Fuel Oil	CH4	0,00	0,01	2,50	10,0	10,3	0,0
Iron and Steel	Natural Gas	CH4	0,00	0,00	0,00	16,0	16,0	0,0
Chemicals	LPG	N20	0,00	0,00	2,50	16,0	16,2	0,0
Cement Production	LPG	CH4	0,00	0,00	2,50	10,0	10,3	0,0
Iron and Steel	Natural Gas	N20	0,00	0,00	0,00	20,0	20,0	0,0
Chemicals	Gas / Diesel oil	N20	0,00	0,00	0,00	10,0	10,0	0,0
Petroleum Refining	LPG	N20	0,00	0,00	2,50	16,0	16,2	0,0

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Table A7.2 Uncertainties, 2007

CATEGORY	FUEL	GAS	1990 EMIS.	2007 EMIS.	Activity data Unc. (%)	Emıs fact. Unc. (%)	Combıned Unc. (%)	Combined uncertainty as % of total national emissions in year 2007
Chemicals	LPG	CH4	0,00	0,00	2,50	10,0	10,3	0,0
Petroleum Refining	Gasoline	N20	0,01	0,00	16,00	16,0	22,6	0,0
Petroleum Refining	LPG	CH4	0,00	0,00	2,50	10,0	10,3	0,0
Chemicals	Gas / Diesel oil	CH4	0,00	0,00	0,00	10,0	10,0	0,0
Petroleum Refining	Gasoline	CH4	0,00	0,00	10,00	10,0	14,1	0,0
Fertilizer	Gas / Diesel oil	N20	0,00	0,00	0,00	10,0	10,0	0,0
Fertilizer	Gas / Diesel oil	CH4	0,00	0,00	0,00	10,0	10,0	0,0
Cement Production	Asphalt	CH4	0,14	0,00	0,00	20,0	20,0	0,0
Cement Production	Asphalt	CO2	63,42	0,00	0,00	20,0	20,0	0,0
Cement Production	Asphalt	N20	0,30	0,00	0,00	20,0	20,0	0,0
Cement Production	Gas / Diesel oil	CH4	0,05	0,00	0,00	10,0	10,0	0,0
Cement Production	Gas / Diesel oil	CO2	76,06	0,00	0,00	5,0	5,0	0,0
Cement Production	Gas / Diesel oil	N20	0,20	0,00	0,00	10,0	10,0	0,0
Non-Ferrous Metals	Gas / Diesel oil	CH4	0,03	0,00	0,00	10,0	10,0	0,0
Non-Ferrous Metals	Gas / Diesel oil	CO2	42,91	0,00	0,00	5,0	5,0	0,0
Non-Ferrous Metals	Gas / Diesel oil	N20	0,11	0,00	0,00	10,0	10,0	0,0
Navigation	Hard Coal	CH4	0,00	0,00	7,00	16,0	17,5	0,0
Navigation	Hard Coal	CO2	3,19	0,00	7,00	3,0	7,6	0,0
Navigation	Hard Coal	N20	0,01	0,00	7,00	20,0	21,2	0,0
Railways	Hard Coal	CH4	0,07	0,00	7,00	16,0	17,5	0,0
Railways	Hard Coal	CO2	29,73	0,00	7,00	3,0	7,6	0,0
Railways	Hard Coal	N20	0,39	0,00	7,00	20,0	21,2	0,0
Fertilizer	Lignite	CH4	1,34	0,00	5,30	16,0	16,9	0,0
Fertilizer	Lignite	CO2	634,06	0,00	5,30	3,0	6,1	0,0
Fertilizer	Lignite	N20	2,77	0,00	5,30	20,0	20,7	0,0
Non-Ferrous Metals	Lignite	CH4	0,13	0,00	5,30	16,0	16,9	0,0
Non-Ferrous Metals	Lignite	CO2	59,79	0,00	5,30	3,0	6,1	0,0
Non-Ferrous Metals	Lignite	N20	0,26	0,00	5,30	20,0	20,7	0,0
Railways	Lignite	CH4	0,05	0,00	5,30	16,0	16,9	0,0
Railways	Lignite	CO2	21,87	0,00	5,30	3,0	6,1	0,0
Railways	Lignite	N20	0,27	0,00	5,30	20,0	20,7	0,0
Fertilizer	Naphta	CH4	0,28	0,00	2,50	10,0	10,3	0,0
Fertilizer	Naphta	CO2	463,51	0,00	2,50	3,0	3,9	0,0
Fertilizer	Naphta	N20	1,24	0,00	2,50	16,0	16,2	0,0
Petroleum Refining	Naphta	CH4		0,00	2,50	10,0	10,3	0,0

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Table A7.2 Uncertainties, 2007

CATEGORY	FUEL	GAS	1990 EMIS.	2007 EMIS.	Activity data Unc. (%)	Emıs fact. Unc. (%)	Combıned Unc. (%)	Combined uncertainty as % of total national emissions in year 2007
Petroleum Refining	Naphta	CO2		0,00	2,50	3,0	3,9	0,0
Petroleum Refining	Naphta	N20		0,00	2,50	16,0	16,2	0,0
Fertilizer	Natural Gas	CH4	1,97	0,00	0,00	16,0	16,0	0,0
Fertilizer	Natural Gas	CO2	1048,47	0,00	0,00	3,0	3,0	0,0
Fertilizer	Natural Gas	N20	0,58	0,00	0,00	20,0	20,0	0,0
Non-Ferrous Metals	Petroleum Coke	CH4	0,23	0,00	0,00	16,0	16,0	0,0
Non-Ferrous Metals	Petroleum Coke	CO2	103,25	0,00	0,00	3,0	3,0	0,0
Non-Ferrous Metals	Petroleum Coke	N20	0,48	0,00	0,00	20,0	20,0	0,0
Other Industries	Refinery Gas	CH4	0,00	0,00	0,00	10,0	10,0	0,0
Other Industries	Refinery Gas	CO2	1,05	0,00	0,00	3,0	3,0	0,0
Other Industries	Refinery Gas	N20	0,00	0,00	0,00	16,0	16,0	0,0
Railways	Residual Fuel Oil	CH4	0,09	0,00	2,50	10,0	10,3	0,0
Railways	Residual Fuel Oil	CO2	60,47	0,00	2,50	3,0	3,9	0,0
Railways	Residual Fuel Oil	N20	0,42	0,00	2,50	16,0	16,2	0,0
Cement Production	Second Fuel Coal	CH4	0,00	0,00	7,00	16,0	17,5	0,0
Cement Production	Second Fuel Coal	CO2	0,00	0,00	7,00	3,0	7,6	0,0
Cement Production	Second Fuel Coal	N20	0,00	0,00	7,00	20,0	21,2	0,0
Fertilizer	Second Fuel Coal	CH4	0,01	0,00	7,00	16,0	17,5	0,0
Fertilizer	Second Fuel Coal	CO2	2,72	0,00	7,00	3,0	7,6	0,0
Fertilizer	Second Fuel Coal	N20	0,01	0,00	7,00	20,0	21,2	0,0
Carbide Production (Chemical Industry)		CO2	112,25	0,00	45,00	1,0	45,0	0,0
Ferroalloys Production (Metal Production)		CO2	81,17	IE	0,00	1,0	1,0	0,0
Iron and Steel Production (Metal Production)		CO2	770,23	IE	0,00	1,0	1,0	0,0
Aluminium Production (Metal Production)		CO2	109,62	C	0,00	1,0	1,0	0,0
Ammonia Production (Chemical Industry)		CO2	713,47	C	24,00	1,0	24,0	0,0
Emission of PFCs		PFC	0,00	C	40,00	20,0	44,7	0,0
Limestone and Dolomite Use (Mineral Products)		CO2	21,52	C	35,00	1,0	35,0	0,0
Nitric Acid Production (Chemical Industry)		N2O	128,08	C	8,91	1,0	9,0	0,0
Soda Ash Production and Use (Mineral Products)		CO2	106,30	C	45,00	1,0	45,0	0,0
Land Use, Land-Use Change and Forestry		CO2	-44870,57	-76274,05	40,00	10,0	41,2	-10,6
Land Use, Land-Use Change and Forestry		CH4	0,00	0,00	40,00	10,0	41,2	0,0
Land Use, Land-Use Change and Forestry		N2O	0,00	0,00	40,00	10,0	41,2	0,0
Total			125187	296364				10,9

Annex 8

A8.1. Energy Balances Table

Ministry of Energy and Natural Resources is the responsible body for collecting, analysing and publishing the data concerning the overall energy statistics. The Section of Energy Statistics and Planning under the Directorate of Energy Affairs is charged with the above mentioned duty. The data related to energy activities is collected from all existing energy industries which are within access. The sectoral and reference approach calculations are made using these data. Then the spreadsheets are formed and balance sheets, each provided information on a certain fuel type or a main sector, are prepared. Those tables are, then, used to create the main balance sheet which represents the whole energy sector within a table. The balance table is mainly subdivided into three sections, which have sections of primary energy, conversion sector and final energy. The following figure presents a summary of the energy flow. The latest available balance tables are accessible through the internet and can be accessed at the address, http://www.enerji.gov.tr, i.e. the web page of the ministry.

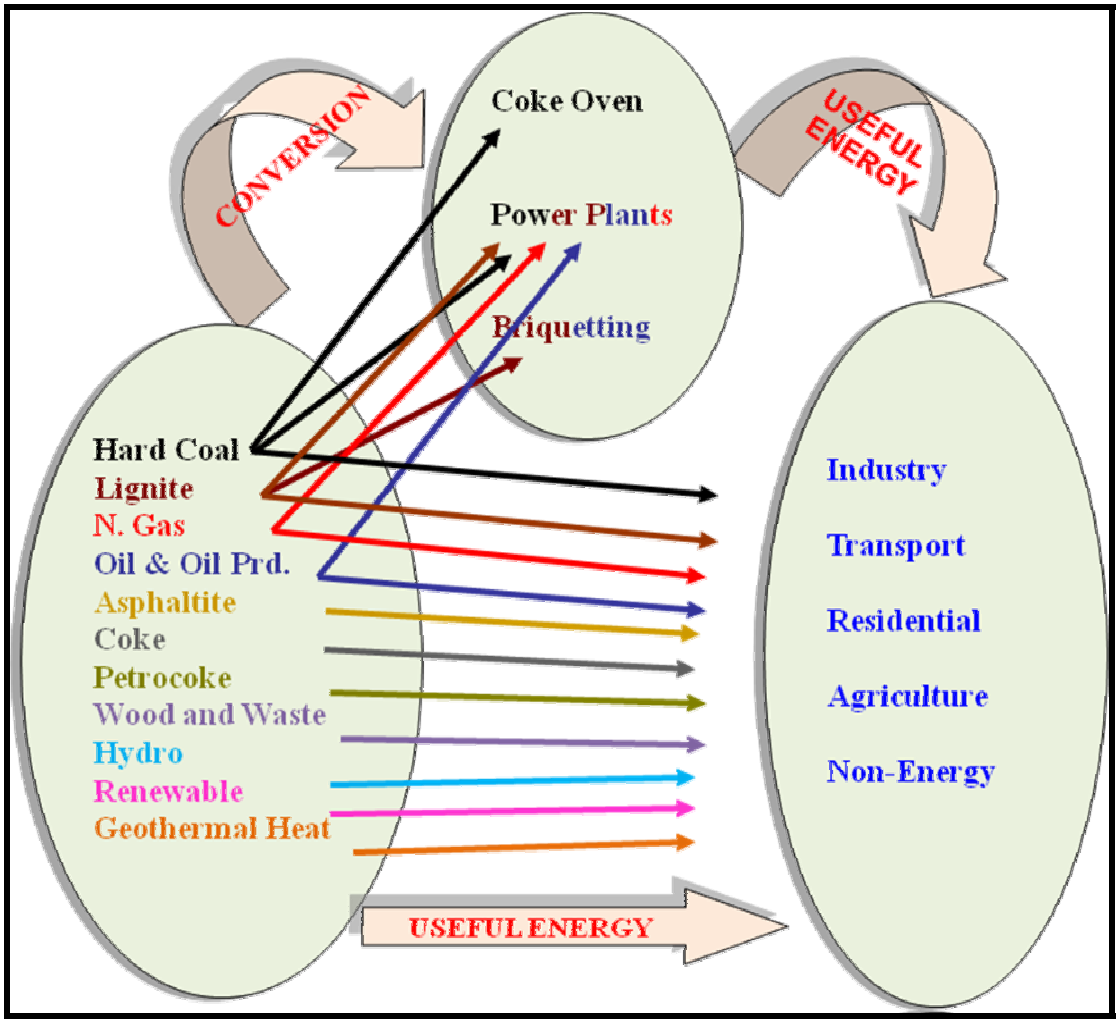

Figure A8.1. Energy Flow

A8.1.1. Reference approach:

Hard Coal, lignite, oil and gas are main sources of fuel combustion. In the procedure of preparation of balance tables as a first step, main indicators by type of fuel are recorded. The data is gathered both from public and private energy industries.

The Energy Balance Table also consists of data on the following fuel types:

- Coke,
- Petroleumcoke,
- Briquette,
- Wood,
- Animal and Vegetal Waste,
- Hydro and Geothermal Electricity,
- Biofuels,
- Wind ,
- Electricity,
- Geothermal Heat,
- Solar

A8.1.1.1. Hard Coal

Hard coal seams are only found in West Black Sea Region called Zonguldak. Turkish Hard Coal Enterprises (TTK) is the unique owner of the coal field and coal is extracted by underground mining methods. However, some private companies are also operating coal mines in the region, via a royalty system or redevans, under the control of TTK.

TTK and private sector sell some part of the coal extracted to the Catalagzi Thermic Power Plant which is operated under state owned Electricity Generation Corporation. Erdemir and Kardemir, two of the three integrated steel industry facilities in Turkey are other customers buying coking coal. The region is not connected to natural gas network and therefore still consumes hard coal for heating during cold seasons.

The coal basin is very young compared to the European basin, many folds and faults exist in the region, which dictate more difficulty in production. The young basin also results in existance of variance in coal produced and limited production of coking coal.

Activity data on production, inner consumption, stock and sales of coking coal and other bituminous coal is collected separately. TTK provides the data on quality of coal, including the heat values to the Ministry.

In addition to this, Catalagzi Thermal Power Plant reports the data on coal burned in the boiler. This data includes hourly analysis of heat value and ash, moisture, sulphur content of coal burned. Beside this, the power plant sends coal samples to EUAS,, which is burned within a certain period of time, to the Central Laboratory of EUAS to make both proximate and ultimate analysis. These data enables us to cross-check some of the incoming data from utilities.

Also Erdemir and Kardemir Iron-Steel Factories keep data on coal used in cooking plants, including the heat contents of the coal and they report to the Ministry..

The data gathered both from TTK and other institutions operating in energy sector are compared for consistency and accuracy by the Ministry. If there is a case of inconsistency or inaccuracy, data is fed back to their sources for re-evaluation.

Imported hard coal is tabled separate from the local hard coal, at the stage of preparation of the balance tables . The data on privately owned power plants and other industry sectors such as iron and steel, cement and sugar are gathered through questionnaires sent by the Ministry on yearly basis. Since there are three main private power plants (Isken, Colakoglu and Icdas), it is easy to get in contact to enhance the quality of the data. This is also true for the integrated iron-steel industry which involves the 2 major companies Erdemir Inc. and Kardemir Inc. located in the West Black Sea region, which has been mentioned above, and also the İsdemir inc. located in the East Mediterranean region.

Prior to preparation of Hard Coal Balance Tables, cross-checking the relevant data and responding back to sources about the inconsistencies or about any exception is essential part of the preliminary process. Finally, once Hard Coal Balance tables are completed, they are rechecked using both the sectoral and reference approaches.

A8.1.1.2. Lignite

Lignite deposits are found almost in every region throughout the country and almost half of the reserves exist in Afsin-Elbistan which is a tiny region of South-east Anatolia.

Two public institutions are responsible for more than 95% of total yearly lignite production of the whole country. One of them is Turkish Coal Enterprises (TKI) and the other is EUAS. Although there are many small sized private companies operating other lignite mines throughout the country, they have limited production capacities compared to large enterprises of TKI, EUAS. The Directorate of Mining Affairs (MIGEM) keeps the yearly record of produced and sold lignite amounts. However these records do not provide data about the coal characteristics, nevertheless they are assumed to have the same coal characteristics with the lignite which is produced by TKI in the same areas.

Addition to TTK, TKI also reports detailed information about, production, inner consumption, stock and consumption (sales) of lignite. Again these reports are compared with the reports of energy industries (power plants cement and sugar producers, residential users etc.). Since all power plants are constructed close to a coal mine for practical purposes, main customer of TKI is EUAS. Some portion of the coal is also consumed through the region by residential sector, mostly for heating purposes. Rest of the production is used by industrial subsectors. As it has been mentioned above all relevant data, including the heat values, are reported by TKI.

In addition to the above mentioned flow of data, thermal power plants in operation report hourly data including heat value, ash, moisture and sulphur content of the coal burned in the boilers. As in the case of hardcoal, consumption power plants send coal samples, which

were consumed within a period of time, to the Central Laboratory of EUAS to make both proximate and ultimate analysis.

In many cases, the cross checking of data coming from TKI and other energy industries show inconsistencies. In those cases, a feed back mechanism between the Ministry and data sources is set up, which sets the final values for data gathered, this mechanism also helps to improve coordination and ensure the accuracy of statistical results.

Afsin-Elbistan coal mining region is the largest mining field of the country and is currently exploited by surface mining methods. EUAS is the only owner of privilege of extraction, whereas preliminary studies about involvement of private companies is still ongoing. nevertheless, two thermal power plants, owned by EUAS, named Afsin-Elbistan A and Afsin Elbistan B are main consumers of the extracted coal in the region. Both EUAS and these power plants keep records of values related to the consumed coal, which is a quit low-rank fuel with low heat value and high moisture content, and present opportunity for comparing values with each regarding the accuracy and consistency. Even after recording all the data into the Lignite Balance Table, again the table is reviewed for accuracy and consistency using both sectoral and reference approaches.

A8.1.1.3. Asphaltite

Asphaltite, a sub-bituminous coal, is found only around Sırnak region, with uniform characteristics. Apart from having pretty restricted deposit fields, the amount of extraction is not too much and mostly consumed by the residential sector. However, a thermal power plant, using asphaltite, will be commissioned in the forthcoming year and it is going to be operated by a private company. Up to now all the relevant data has been obtained from TKI, however after privatization, these data will be received from the private company starting from the year 2008.

A8.1.1.4. Natural Gas

Natural gas records are kept by two state owned institutions, Petroleum Pipeline Corporation (BOTAS) and Turkish Petroleum Corporation (TPAO). TPAO produces limited amount of natural gas and sells it to the energy industry, rest of the gas consumed in the country is imported. Although the Natural Gas Market Law, No. 4646, abolished BOTAŞ's monopoly privileges on natural gas importation, distribution, marketing and pricing which had been granted by the Decree of Natural Gas Utilization, No. 397 dated February 9, 1990, it has still practically a monopoly, except in distribution of natural gas. Therefore, BOTAS has the most accurate available data on overall natural gas transactions, which includes the reports on primary supply and consumption by sectors. Natural gas distribution companies mostly owned by municipalities also records values related to natural gas consumption and publish reports of the prior year. Having both values of the distribution companies and the data set of the natural gas importing company, the data is cross-checked by the Ministry. However, after privatization of distribution companies, records of the private company have to be inspected, for the coming years, observing the consistency of data.

Energy Market Regulatory Authority (EPDK), which publishes annual reports on energy sectors including the natural gas sector, can be considered as another significant source of information about natural gas transaction taking place within a year.

EUAS is recording the data on input and production values of natural gas firing power plants which are owned by itself, while Turkish Electricity Transmission Corporation (TEİAS) has information concerning the rest of the natural gas firing power plants. At the same time; the data set, which includes heat content of natural gas, is assembled by questionnaires periodically sent to both public and private power plants having a capacity over 50 MW, and is treated separately by the Ministry.

As well as having all the required data sets, ensuring accuracy of the data sets is a fundamental part of the procedure. That is why the data received from other energy industries are compared with the ones submitted by the public entities to have reliable and most accurate data.

In the last decade, natural gas started to be consumed also for transportation purposes especially in the public transportation sector. Municipalities of major cities, such as Istanbul and Ankara, have started to replace buses with the ones using compressed natural gas. Metropolitan municipalities, who are major consumers of natural gas for public transportation, are also reliable source of information.

In recent years, beside the values on natural gas transportation obtained from BOTAS, Turkish Petroleum Refineries Corporation (TUPRAS), the only refinery industry exist in Turkey, reports its natural gas consumption data.

To have a consistency with the calculations of International Energy Agency, while mean calorific value is to be used in emission calculations, in the balance tables gross calorific value for power plants is used.

After completing natural gas balance table and testing for consistency of data set both by reference and sectoral approaches, the data is transferred to the main Energy Balance Table.

A8.1.1.5. Oil

A detailed balance sheet of oil and oil products has to be separately prepared. Balance sheet of oil and oil products includes summary of almost all of the activities, starting from production to the consumption of the oil and its derivatives by final users. General Directorate of Petroleum Affairs (PIGM) was the only responsible body for collecting data and publishing annual statistical yearbooks. Since 2008 EPDK has taken this responsibility, but both of the institutions will be working together for several years till EPDK, as a newly established institution, has adequate experience.

PIGM collects data from TUPRAS and TurkStat, then reports it to the MENR to have primary supply calculations. MENR owns a detailed data set on sectoral basis especially on industry and conversion sectors, including power plants, so both of the data sets can be put

against each other and evaluated for consistency and accuracy. Since the data sets of power plants are evaluated and checked separately, this data can also be used in the Oil Balance Sheet.

For sectoral consumption each fuel is considered separately.

Fuel oil is mostly used in industry and the values related to fuel oil consumption are obtained by questionnaires and values about rest of the consumption, corresponding to the consumption of other sectors, are little bit complicated. Gathering data on transportation (marine) and residential sector fuel consumption is quite difficult. Some expert judgement is used in predicting the amount consumed.

Although data on marine consumption is incomplete but it is known that most of the diesel oil in the transport sector is consumed by road vehicles. Turkish State Railways (TDCI) is monopoly in railway operations, except subways in the cities, and provides adequate data on consumption. Another difficulty is finding reliable account on the diesel oil consumed for agricultural purposes. Nevertheless, certain time-series approach can be used with sufficient precision.

In deducing the sectoral consumption, LPG sector report published by EPDK and MENR questionnaires, filled by industry sectors, are used. A portion of LPG is used for agricultural purposes in Turkey, nevertheless it is not possible to get reliable data and the consumption here is included in the residential sector.

Jet fuel is used only in aviation and consumption data can easily be monitored. Very little amount of kerosene is consumed in iron-steel industry and after calculating consumptions of other industries considering the time series, the rest is assumed as the consumption of residential sector.

Nafta is only used in petrochemistry, feedstock industry and the data is obtained from the related facilities.

Other oil products such as asphalt, lube oil and HVGO are mostly used for non-energy purposes.

Completing oil balance sheet enables responding back to PİGM for consistency. After ensuring consistency of data sets both by the sectoral and reference approaches, the data ise transferred to the main balance sheet.

A8.1.1.6. Other Fuels

Major renewable energy sources are wood, animal and vegetal waste, hydro and geothermal electricity, biofuel, wind, geothermal heat and solar.

General Directorate of the Electrical Power Resources Survey and Development Administration (EIE) is responsible for the development of renewable energy resources, particularly solar and wind energy. In Turkey the most common usage of solar power is in water heating.

Upto date, data for wood, animal and vegetal waste, which is indigenously produced and consumed by the residential sector, was obtained from The Ministry of Environment and Forestry.

Biofuels have been included in the balance sheet since 2006 and the Energy Market Regulatory Authority (EPDK) is responsible for collecting this data.

Petroleumcoke is mostly used by the cement sector and imported by sector participants.

A8.1.1.7. Import

TurkStat, Undersecretary of Foreign Trade and sector participants are main sources of the records. All data is required to be sorted by origin in order to ensure consistency between data resources. The very same data set having two different sources are compared with each other and about exceptional points having communication with record keepers is indispensable. After assuring reliability of data, it is posted to a specific balance sheet, then to the main energy balance sheet.

A8.1.1.8. Conversion Sector

This sector consists of power plants which convert fuel into useful energy. Those plants are burning coal, gas and oil in the boilers to produce electricity. Briquette, mixture of little amount of lignite and other oil products, i.e. pitch, is used for heating purposes. In addition, coking coal is converted into coke. Refinery fuel use and inner consumptions are also included in the conversion sector.

The data on fuels which are consumed for production of electricity are derived from the balance sheets which include transaction flow of respective fuel type. As mentioned before, while the fuel balance tables are being concluded, data sets based on records of different power plants and public institutions are tested for consistency and reliability. After responding back about inconsistencies, especially to the TEİAS office of statistics, the completed data set is posted to the main balance table. At this stage, consistency with TEİAS which is the institution filling out the annual and monthly electricity questionnaires of the Internal Energy Agency (IEA) and EUROSTAT, has crucial importance. That is why TEİAS forwards the data to the Ministry to final check for consistency before presenting it to the IEA.

Coking coal and coke data are from their balances.

A8.1.2. Sectoral Approach:

The Balance Tables shows detailed information on sectoral fuel consumption. End users are described as Industrial Sector, Transport Sector, Residential Sector, Agriculture Sector and Non–Energy uses.

Transport Sector includes consumption data on:

- Roadways

- Railways
- Marine Transport
- Aviation
- Pipelines (since 2006)

Residential sector includes household and commercial buildings.

A8.1.2.1. Industrial Sector

Industrial sector is divided into the following sub-sectors:

- Iron-Steel
- Chemistry-Petrochemistry
- Petrochemistry Feedstock
- Fertilizer
- Cement
- Sugar
- Non-Ferrous Metals
- Other Industry

A8.1.2.2. Iron-Steel Sector

About 30% of crude steel is produced by oxygen furnaces, i.e. integrated iron-steel production, while rest of the production relies on electrical arc furnaces (EAFs). In integrated iron-steel industry there are two major corporations with three facilities located in Karabuk (Kardemir), Eregli (Erdemir) and Iskenderun (İsdemir).

Since EAFs use only electricity, their overall consumption is not thoroughly reviewed and values of electricity consumption of EAFs are included into the consumption of other industry.

In contrast to EAFs, activities of integrated iron steel industry have been investigated much more rigorously. The questionnaires prepared by the Ministry are annually sent to the three of integrated iron steel facilities. The questionnaires ask for standard values, including the heat content of input and output, of consumed fuel, especially hard coal, and derivatives of coke, coke oven gas (COG) and blast furnace gas (BFG).

The same data set based on different records, one belonging to the facilities and other to the public entities, are compared for confidence and accuracy. Then, a specific balance sheet of hard coal, coke, COG and BFG are tabulated. Just like other balance sheets, they are summarizing all the activities taking place between the production and the final consumption of the fuels. Finally, after checking the balance sheets, for convenience, using reference and sectoral approach, they are posted to the main balance sheet.

A8.1.2.3. Chemistry-Petrochemistry Sector

Petkim Petrokimya Holding A.Ş., major company of the industry, was established on April 3, 1965, in accordance with policy of establishing a domestic petrochemical industry. On 30.06.2008, 51% of the public shares of PETKIM were privatized through block selling. Petkim, one of the most solvent corporations of the country, is indispensable raw-material producer of the industry market with its product range over 50 chemical derivatives.

Since its an unchallenged leader of the industry as an integrated company, even in national scale, the sectoral data predominantly is based on records of Petkim and the questionnaires filled out by the authorities of Petkim

A8.1.2.4. Petrochemistry Feedstock Sector

The sector uses only naphta and sectoral data is simply calculated extracting the amount used by power plants from gross consumption. The data is directly posted into the main balance sheet.

A8.1.2.5. Cement Sector

Collecting the data concerning the cement industry is not easy task as it was before, when a state owned entity CITOSAN was a monopoly in the sector, prior to 1990. After liberalization of cement market, the players increased in number. Today, the sector is entirely privatized and there is about 16 actors in the sector with almost 50 factories.

Regular questionnaires asking for various values of facilities are annually sent to the each company. Questionnaires hold declarations of consumption, stock accounts of both domestic and import fuel, including the calorific values. Accounts of imported coal is requested to be sorted by origin so that to correlate them with the accounts of Foreign Trade Undersecretary and Turkish Statistical Institute (TurkStat). After controlling the data for accuracy, the weighted average sum is transferred into the main balance sheet.

A8.1.2.6. Sugar Sector

Production and distribution of sugar were under control of the government via state owned Sugar Plants Ltd. (Turkseker), which is now with its 25 sugar beet factories under supervision of Prime Ministry Privatization Administration, until early 1990s. Sugar Beet Producers' Cooperatives, Pankobirlik, which is representative and senior organization of Beet Cooperatives is another producer with 7 cooperative sugar beet factories (Adapazarı, Amasya, Kayseri, Boğazlıyan, Konya, Çumra). In addition to these public institutions private companies is gaining more and more importance. Three sugar beet and six starch based sugar factories are operated by private sector under the supervision of Turkish Sugar Authority.

Since Turkseker is under privatization, the Ministry team has to be careful to follow developments in the sector in order to have more accurate and reliable data.

Annual questionnaires are sent to Turkseker, Pankobirlik and private companies. The questionnaires are asking for data on fuel consumptions, stocks by source, import or export, including the heat values. Turkseker declares accounts of overall consumption while rest of producers also present breakdown of tables. Finally, the data is checked for accuracy and consistency then total values are posted into the main balance sheets.

A8.1.2.7. Fertilizer Sector

Throughout the country there are 10 fertilizer factories producing fertilizer.

As it is in the other sectors, data on fuel consumption of fertilizer industry is assembled via annually distributed questionnaires. Fertilizer industry mostly uses natural gas and electricity and since heat values of natural gas and electricity are explicit, heat values of consumed fuels are not demanded. In addition to this, a warning not to include feedstock consumptions is added to questionnaire forms as a remark. Accounts of stock data are also expected to be tabulated with these questionnaires. The data received from the sector and other sources are controlled for accuracy and reliability. Then summary of data is posted to the main balance sheet.

A8.1.2.8. Non-Ferrous Metal Sector

Due to lack of adequate data, drived schedules of the sector have certain deficiencies. Questionnaires asking for accounts of production are annually distributed to holdings and main producers such as Koc Holding, Sabanci Holding, Toprak Holding, Eti Alluminium. Beside, questionnaires coal imports of the industry also helps in completing the balance sheet. Also time series consistency is applied to some fuel consumption data. The data which could not been collected is included under the heading of other industries sector.

A8.1.2.9. Other Industries Sector

All the other industries are included in this sector. Deficiencies in above mentioned industries such as EAFs iron-steel industries, small scale chemistry-petrochemistry producers and some nonferrous metal industry consumption are also considered in this sector.

A8.1.2.10. Transport Sector

Transportation sector is discussed in the oil report. It is assumed that all the oil products are consumed by sectors. In other words, stocks of retail companies are not considered separately. Heat contents of oil products are obtained from TUPRAS and do not vary considerably from year to year, that is why same values for many years remain to be valid. Following five titles which are Roadway, Railways, Marine Transport, Aviation, Pipe Line Transport are also considered within this same context.

A8.1.2.11. Roadways

Diesel oil, gasoline, LPG and compressed natural gas is used in road transport. All of the supplied gasoline is consumed by motor vehicles. Amount of LPG consumption is obtained from LPG Sector Report of EPDK. Diesel oil is mostly consumed in motor vehicles. Extracting the amount of diesel oil used in navigation and in railway transportation, which is obtained from (TDCI), from total diesel oil consumption roadway transportation is calculated. Ankara and Istanbul are the largest consumers of compressed natural gas and the data is obtained by questionnaires. The remaining amount gas is considered to be consumption of other industries.

A8.1.2.12. Railways

Diesel oil and electricity are main fuels in this sector. TDCI keeps the records of diesel oil and electricity consumption and amount of diesel oil consumption is evaluated in oil balance table. Railway electricity consumptions is recorded by TEIAS as well and since it comprises TDCI consumption plus others (non specified), values of TEIAS is used in the balance table.

Electricity consumption of subways is included under other industries.

A8.1.2.13. Marine Transport

Time series methodology is applied in estimation of consumption of fuel oil and diesel oil. This sector requires more detailed analysis to get reliable and accurate information.

A8.1.2.14. Aviation

All the jet fuel supply is assumed to be the consumption of aviation sector.

A8.1.2.15. Pipeline Transport

Pipeline transportation is relatively new and the data is directly obtained from the only responsible institution operating in the area, which is BOTAS.

A8.1.2.16. Residential Sector

Residential sector includes all households, commercial and official buildings, hospitals and similar places. Above mentioned balance sheets of hard coal, lignite, gas and oil are valid source of data on residential sector. Although Turkish Electricity Distribution Corporation (TEDAS) gives breakdown of electricity consumption of the sector, due to lack of data about breakdowns of other fuels, total amount is used in the balance sheet.

Geothermal heat and solar consumption are simply calculated by extracting other consumption from total amount of consumption.

A8.2. EMISSIONS ARISING FROM ELECTRICITY AND HEAT GENERATION

Collection, evaluation and reporting the activity data, the amount of fuels combusted, and related fuel statistics were responsibility of EUAS till 2008. However, since 2008, Instead of EUAS, MENR was charged with this responsibility.

2006 IPCC Guidelines for National Greenhouse Gas Inventories is the basic source for emission factors. Local emissions (SO_2 and NO_x) are calculated by using country specific emission factors, while IPCC emission factors are used to calculate greenhouse gas emissions (CO_2, CH_4, N_2O, CO and NMVOC).

All emissions are calculated with the following formula:

$$\text{Emissions (ton)} = \frac{\text{Input Activity (GJ)} \times \text{Emission Factor (kg/Gj)}}{1000}$$

A8.2.1. Activity Data

Although transmission is under the state control, via TEIAS, distribution and generation is in the course of privatization. In the dual market of generation and distribution, the share of state is getting lower and lower. Since private companies are gaining larger shares in the market within relatively shorter times, quality of researches has to be improved to monitor the market.

According to the reference approach, main source categories are, hard coal, lignite, natural gas, fuel oil, diesel oil, LPG and naphtha. Hard coal is also divided into two sections as imported and indigenous hard coal

As a principal, all public and the private power plants having a capacity over 50 MW are treated separately for every sequent year.

Public power plants have a well prepared and comprehensive database on consumed fuel and its characteristics including the hourly values. Each power plant prepares monthly reports on process, which is starting from feedstock to the final product, i.e. from buying fuel to producing electricity. Quantity, ash, moisture and sulphur characteristics of fuel

burned are analyzed and reported hourly. In addition to this, the installations with continuous measurement devices are also recording and reporting hourly measurements. Weighted averages of these hourly statistics are converted to daily and then to monthly basis. EUAS publishes a statistical yearbook based on these monthly reports.
For certain times power plants send fuel samples, consumed in a specific time interval, to the

Central Laboratory of EUAS, to have elementary and proximate analysis of fuel burned. Environment Department of EUAS requests a copy of these reports.

TEIAS also publishes another annual statistical yearbook based on data records of EUAS and the private sector. This year book also includes amount and heat content of fuel burned.

In addition to this, results of examination is also sent to MENR by EUAS, MENR examines data records of all public power plants to control and check accuracy and reliability of data. In the case of inconsistency, source of statistics is responsible for clarification.

Private companies, having a capacity over 50 MW, have to declare relevant records asked through MENR questionnaires. The questionnaires cover statistics on operation of the facility. Private companies should also report their emissions recorded by both continuous measurement devices or compulsory measurements conducted by special agencies for each two year.

Since TEIAS is the responsible body for reporting electricity statistics to IEA and other international organizations, a special spreadsheet is prepared and sent by the related division, including total amounts of fuel burned and heat produced. This spreadsheet is expected to be consistent with the summation of data which is collected and evaluated by the Ministry.

Most of the time is should be devoted to examination of accuracy and reliability of statistical records of activity data in the course of calculation of emission factors.

A8.2.2. Methodology of Calculating Emission Factors

The basic source for emission factors for the inventories is the IPCC Guidelines. Local emissions (SO_2 and NO_x) are calculated by using country specific emission factors and greenhouse gas emissions (CO_2, CH_4, N_2O, CO and NMVOC) are calculated using IPCC emission factors.

A8.2.3. Calculating Country Specific Emission Factors

An emission factor is the amount of pollutant released to the atmosphere per unit of energy (kg/Kcal, kg/GJ).

An emission factor is calculated for each power plant using the data available.

Emission factors for the thermal power plants having continuous measurement equipments are computed using measured emission of the following formula;

$$\textbf{EF (kg, } SO_2\textbf{, } NO_x \textbf{ /GJ)} = \frac{\textbf{MEV (mg/Nm}^3\textbf{) x 10}^{-6}\textbf{ (kg/mg) x FGR (Nm}^3\textbf{/h)}}{\textbf{HI (Kcal/h) x 4.187x10}^{-6}\textbf{ (GJ/ Kcal)}}$$

where:

EF : Emission Factor
MEV : Measured Emission Values (at 6% O_2)
FGFR : Flue Gas Flow Rate (on dry base)
HI : Heat input

For other thermal power plants, without continuous measurement equipment, emission factors are calculated using fuel characteristics. To check data confidentiality and accuracy; emission factors, using fuel characteristics, of the thermal power plants having continuous measurement devices are calculated as well.

Uncontrolled SO_2 emission factor is calculated on the basis of sulphur content of the fuel. As a principle, it is assumed that 90% of sulphur is converted to SO_2 and approximately 10 % of SO_2 in flue gases are captured by CaO in combustion chamber, this is because Turkish lignite has comparatively high CaO content. Therefore, a factor of 0.81 is added to the formula. The molar ratio of sulphur to sulphur dioxide, a mass conversion factor of 2.0 is also used.

$$\textbf{EF ((kg } SO_2 \textbf{ /Gj)} = \frac{\textbf{SC (kg S/ kg coal) x 2 (kg } SO_2 \textbf{ / kg S) x 1000 (kg/tonnel)x 0.81}}{\textbf{Heat content (G J/ tonne coal)}}$$

Where:

EF : Emission Factor
SC : Sulfur Content of Coal
HC : Heat Content

If available, particulate capture efficiencies of electrostatic separators and Flue Gas Desulphurization units (FGDs) are used to find controlled emission factor of particulate emissions; while FGDs' S capture efficiencies are used to determine controlled SO_2 emission factors.

An emission factor is determined for each power plant using the data available. Usually, heat value of natural gas and oil products do not change yearly, therefore IPCC emission factors are used most of time. However, characteristics of coal show significant changes from one basin to the other and also from year to year. In addition to these, undergoing rehabilitation studies for some power plants of EUAS and difficulties in running of FGD units make it compulsory to calculate emission factors annually.

A8.2.4. Calculating Greenhouse Gas Emission Factors

The 1996 IPCC Good Practice Tier 1 methodology is used for calculation of emissions of greenhouse gases (CO_2, CH_4, N_2O, CO and NMVOC),

All the emissions are calculated as in the following formula:

Fraction of oxidized carbon values were taken from the IPCC Guidelines for coal, oil and gas.

$$\text{Emissions (ton)} = \frac{\text{Input Activity (GJ) x Emission Factor (kg/Gj)}}{1000}$$

Table A8.1. Energy Balance Table (unit: ktoe)

Prepared by:MENR/RPCB/PFD	Hard Coal	Lignite	Asphaltite	Secondary Coal	Petroleum Coke	Wood	Animal& Vegetal Waste	Total Solid Fuel	Oil	Natural Gas	Hydro+Geo Elec.	Biofuels	Wind	Electricity	Geothermal Heat	Solar	Total
Domestic Production (+)	**1089**	**13372**	**336**	**0**	**0**	**3880**	**1116**	**19793**	**2241**	**827**	**3217**	**11**	**31**	**0**	**914**	**420**	**27453**
Import (+)	14334	0	0	309	1497	0	0	16140	38233	33167	0	0	0	74	0	0	**87614**
Export (-)	0	0	0	0	0	0	0	0	6689	29	0	0	0	208	0	0	**6926**
Bunkers (-)	0	0	0	0	0	0	0	0	92	0	0	0	0	0	0	0	**92**
Stock Changes (+/-)	-12	72	-65	27	-52	0	0	-28	-367	-12	0	0	0	0	0	0	**-408**
Statistical Diff.(+/-)	0	0	0	0	0	0	0	0	-16	0	0	0	0	0	0	0	**-16**
Total Primary Energy Supply	**15411**	**13444**	**272**	**337**	**1445**	**3880**	**1116**	**35904**	**33310**	**33953**	**3217**	**11**	**31**	**-134**	**914**	**420**	**107625**
Conversion Sector	**-6486**	**-9820**	**0**	**2363**	**0**	**-58**	**0**	**-14002**	**-3880**	**-18168**	**-3217**	**0**	**-31**	**13387**	**1032**	**0**	**-24879**
Power Plants	-3137	-9771	0	0	0	-58	0	-12966	-1035	-17567	-3217	0	-31	16474	1032	0	**-17310**
Coke Ovens	-3237	0	0	2335	0	0	0	-903	0	0	0	0	0	0	0	0	**-903**
Briquette Fab.	0	-24	0	28	0	0	0	4	-10	0	0	0	0	0	0	0	**-6**
Petrohum Refinery	0	0	0	0	0	0	0	0	-1485	-552	0	0	0	-89	0	0	**-2126**
Own Use and Losses	-112	-25	0	0	0	0	0	-137	-1351	-48	0	0	0	-2998	0	0	**-4535**
TFC	**8925**	**3624**	**272**	**2699**	**1445**	**3822**	**1116**	**21902**	**29430**	**15784**	**0**	**11**	**0**	**13253**	**1946**	**420**	**82746**
TFC	**8925**	**3624**	**272**	**2699**	**1445**	**3822**	**1116**	**21902**	**29430**	**15784**	**0**	**11**	**0**	**13253**	**1946**	**420**	**82746**
Industry Consumption	**8407**	**1742**	**54**	**2653**	**1445**	**0**	**0**	**14301**	**2718**	**7943**	**0**	**0**	**0**	**6346**	**1032**	**126**	**32466**
Iron and Steel	176	0	0	2380	0	0	0	2556	136	1	0	0	0	1331	174	0	**4197**
Chemical&Petrochemical	0	11	0	0	0	0	0	11	24	979	0	0	0	395	0	0	**1409**
Petrochemical Feedstock	0	0	0	0	0	0	0	0	810	0	0	0	0	0	0	0	**810**
Fertilizer	0	0	0	0	0	0	0	0	5	0	0	0	0	17	0	0	**22**
Cement	1603	574	0	0	1133	0	0	3310	21	91	0	0	0	471	0	0	**3893**
Sugar	8	195	0	25	0	0	0	228	62	71	0	0	0	0	0	0	**361**
Non Ferro Metals	98	0	0	55	0	0	0	153	21	3978	0	0	0	261	0	0	**4413**
Other Industry	6521	962	54	194	280	0	0	8011	1638	2824	0	0	0	3863	858	126	**17322**
Transportation	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**17005**	**186**	**0**	**11**	**0**	**80**	**0**	**0**	**17282**
Railway	0	0	0	0	0	0	0	0	137	0	0	0	0	80	0	0	**217**
Navigation	0	0	0	0	0	0	0	0	507	0	0	0	0	0	0	0	**507**
Airway	0	0	0	0	0	0	0	0	2014	0	0	0	0	0	0	0	**2014**
Roads	0	0	0	0	0	0	0	0	14347	10	0	11	0	0	0	0	**14368**
Other Sectors	**518**	**1883**	**217**	**46**	**0**	**3822**	**1116**	**7601**	**5277**	**7656**	**0**	**0**	**0**	**6826**	**914**	**294**	**28568**
Households&Services	518	1883	217	46	0	3822	1116	7601	1760	7656	0	0	0	6398	914	294	24623
Agriculture	0	0	0	0	0	0	0	0	3516	0	0	0	0	428	0	0	3945
Non-energy	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**4430**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**4430**
Electricity Production (GWh)	**15136**	**38295**	**0**	0	0	0	214	**53645**	**6527**	**95025**	**36007**	**0**	**355**	**191558**	0	0	0
Installed Capacity (MW)	**1986**	**8211**	**455**	0	0	0	43	**10695**	**2000**	**14576**	**13418**	**0**	**146**	**40836**	0	0	0
		Population (Million person)		70,59	**Per Capita Energy Consumption kgoe/p**		1524,73	**Per Capita Electricitynergy Consumption kWh/p**		**Net:**	2197,81			**GNP Growth Rate**			5,00
										Gross:	2691,75			**GDP Growth Rate**			4,50